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Load Rating TxDOT Pre-1980 In-Service Culverts: Model Enhancements, Procedure Improvements, and Results for 1,000 Structures

William D. Lawson, Hoyoung Seo, James G. Surles, Stephen M. Morse, Priyantha W. Jayawickrama, Sang-Wook Bae, Timothy Wood, Suranga Gunerathne, Bolaji Afolabi, Mehdi Mousavi, Amir Javid

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16. Abstract: This report presents research findings associated with performing load-rating calculations and analyses for 1,000 culvert structures which constitute a statistically-representative sample of Texas Department of Transportation (TxDOT) pre-1980, on-system, bridge-class, cast-in-place, reinforced concrete box culvert structures. Work centered around three key themes: (1) the introduction and validation of several enhancements into TxDOT's Level 3 (soil-structure interaction) culvert rating analysis model to improve load rating accuracy and precision, (2) establishing an improved procedure for culvert load rating based on lessons learned from working through the trial set of load ratings for 1,000 culverts at the system level, and (3) performing approved Level 1 and Level 3 load ratings for 1,000 culverts to reflect the enhanced model and improved load rating process. In all cases, the starting place for further work was the initial load rating procedure articulated in TxDOT's *Culvert Rating Guide* developed in research project 0-5849, and the numerical algorithms represented in Version 1.0 of TxDOT's *CULVLR* software created through TxDOT implementation projects 5-5849-01 and 5-5849-3. As a result of this study, both the *Culvert Rating Guide* and the *CULVLR* software are slated for revision. Final load rating results indicate operating ratings greater than or equal to HS-20 for 82% to 92% (±2%) of TxDOT's population of pre-1980 culvert structures.

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William D. Lawson, P.E., Ph.D.
Hoyoung Seo, Ph.D., P.E.
James G. Surles, Ph.D.
Stephen M. Morse, Ph.D.
Priyantha Jayawickrama, Ph.D.
Sang-Wook Bae, Ph.D.
Timothy Wood, Ph.D.
Suranga Gunerathne
Bolaji Afolabi
Mehdi Mousavi
Amir Javid

Performed in cooperation with the Texas Department of Transportation and the Federal Highway Administration

Center for Multidisciplinary Research in Transportation
Texas Tech University

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PUBLICATION NOTE

The authors submitted the DRAFT research report on December 19, 2016. TxDOT accepted the DRAFT report – with administrative revisions only – on June 14, 2018. During the interim period the authors continued their research on other related tasks, and they occasionally identified minor errors and/or inconsistencies in the data – which were corrected. Selected summary charts and figures herein are updated accordingly. The FINAL version of the research report; *i.e.*, this document, was published July 21, 2018. To facilitate clarity and historical continuity, the date of substantial report completion – *December 2016* – is identified as the formal publication date for this document.

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CHAPTER 1
INTRODUCTION

1.1 THE RESEARCH PROBLEM

1.1.1 Overview

This report presents research findings associated with performing load-rating calculations and analyses for 1,000 culvert structures which constitute a statistically-representative sample of Texas Department of Transportation (TxDOT) pre-1980, on-system, bridge-class, cast-in-place, reinforced concrete box culverts. Figure 1.1 shows a representative example of this type of culvert.

Figure 1.1 Structure 25-065-0042-06-007, upstream end, a 4-span, 9'x7' reinforced concrete box culvert, constructed 1934, widened 1978, Donley County, Childress District

The load rating calculations and analyses reported herein support TxDOT efforts to comply with federal regulations for bridge inspection per 23 CFR 650 Subpart C, *National Bridge Inspection Standards* (Code of Federal Regulations 2016). The research has utilized, builds upon and extends the TxDOT *Culvert Rating Guide* (Lawson et al. 2009) developed in research project 0-5849 (Lawson et al. 2010), as well as findings from TxDOT implementation projects 5-5849-01 (Lawson et al. 2013) and 5-5849-3 (Wood et al. 2013a, 2013b, 2013c).

1.1.2 Policy

Load rating is a component of the bridge inspection process and consists of determining the live load carrying capacity of a bridge, defined as "…a structure including supports erected over a depression or an obstruction… and having an opening measured along the center of the roadway of more than 20 feet…" (Code of Federal Regulations 2016). As used in this report, multi-span box culverts are bridge-class structures provided the centerline length of all spans combined is greater than 20 feet. Load rating is used to determine whether specific legal or overweight vehicles can safely cross the bridge-class culvert, and to determine if the bridge-class culvert needs to be restricted and what level of posting is required. As such, many standards, manuals, and technical advisories have been developed for bridge inspection and load rating. Some of the major publications include:

- AASHTO. (2016). *Manual for Bridge Evaluation (MBE), Second Edition., with 2011, 2013, 2014, 2015 and 2016 Interim Revisions*. Washington D.C.: American Association of State Highway and Transportation Officials, Inc. (AASHTO 2016).

- AASHTO. (2014). *LRFD Bridge Design Specifications, U.S.Customary Units, 7th Edition*. Washington, D.C.: American Association of State Highway and Transportation Officials. (AASHTO 2014)

- AASHTO. (2003). *Manual for Condition Evaluation of Bridges (Second Edition)*. Washington, D.C.: American Association of State Highway and Transportation Officials. (AASHTO 2003)

- AASHTO. (2002). *Standard Specifications for Highway Bridges, Seventeenth Edition*. Washington, D.C.: American Association of State Highway and Transportation Officials. (AASHTO 2002)

- FHWA. (2011). "Assigned Load Ratings." Memorandum dated 29 September 2011. (FHWA 2011a)

- FHWA. (2011). "Revisions to the Recording and Coding Guide for the Structure, Inventory and Appraisal of the Nation's Bridges (Coding Guide) Items 63 and 65, Method Used to Determine Operating and Inventory Ratings." Memorandum dated 15 November 2011. (FHWA 2011b)

- FHWA. (2006). "Bridge Load Ratings for the National Bridge Inventory." Memorandum dated 30 October 2006. (FHWA 2006)

- FHWA. (1986). *Culvert Inspection Manual*. Washington, D.C.: U.S. Department of Transportation. (FHWA 1986)

- TxDOT. (2013). *Bridge Inspection Manual*. Austin, TX: Texas Department of Transportation. (TxDOT 2013a)
- TxDOT. (2015). *Bridge Design Manual (LRFD)*. Austin, TX: Texas Department of Transportation. (TxDOT 2015)

The research described herein was informed by and is aligned with such policy and in some cases is specifically responsive to it. However, this report does not attempt to address all aspects of federal and state policy associated with load rating all TxDOT culverts.

1.1.3 Authorization

1.1.3.1 Initial Research Contract

This culvert load rating research was authorized per TxDOT Interagency Contract No. 88-4XXIA001 as executed on 1 August 2014. The initial scope of work focused on TxDOT's *complete* inventory of approximately 11,000 on-system, pre-1980 bridge-class culverts, and included the following tasks:

Task 1.0. Data Capture. The research team was to review a static archive copy of TxDOT's PonTex database and accompanying source documents, identify culvert design identification (index) parameters including the sheet name, height, span, number of spans, haunches, cover soil depth, and other parameters needed to uniquely identify a known standard design used to build the culvert, and perform a check for internal data consistency to finalize the parameters to be used for subsequent load rating work. Data were to be collected from three source documents: bridge inventory records, original construction drawings, and bridge inspection reports.

Task 2.0. Level 1 Culvert Load Rating Activities. The research team would model the culvert structures and calculate demand loads using TxDOT's in-house program, CULV-5 (TxDOT 2003a, TxDOT 2003b, TxDOT 2004), based on TxDOT load rating policy and practice. This is a "direct stiffness" modeling approach. With these data, the researchers were to perform batch processing using TxDOT's *CULVLR* program (TxDOT 2013b) to facilitate Level 1 load rating analyses. The outcome was to be a table of Level 1 load rating data for TxDOT's full population of pre-1980 culvert structures which had design documents in the file.

Task 3.0. Level 3 Culvert Load Rating Calculations. Using soil stiffness parameters obtained from Task 1, the research team would analyze the culvert structures using RISA-3D (RISA Technologies 2012) and generate a table of load rating data for the population of pre-1980 culvert structures. This is a "soil-structure interaction" modeling approach. The outcome was to be a table of Level 3 load rating data for the population of pre-1980 culvert structures having design documents in the file.

Work proceeded according to plan, but by the time load rating effort was completed for the first 1,000 culverts (referred to as ‘Batch 1’) which were selected as a statistically-representative sample of the full population, it had become clear that the scope of work required significant modification.

1.1.3.2 Modification Required

In accordance with the contract, the research team completed Batch 1 load rating results and reported findings to TxDOT management personnel at project status meetings on 17 June 2015 and 23 October 2015. The essence of these conversations was that modification to the scope of work was necessary to achieve an approved load rating process and acceptable load rating results. Key reasons for the modification included:

1. Several of the initial assumptions about TxDOT’s culvert dataset were not supported:
    a. Culvert structures often consisted of multiple segments where the culvert was structurally modified after construction:
        - Nominally, half the culvert structures had more than one segment.
        - Approximately 1,800 segments, ranging from one to thirteen segments per culvert, existed for the 1,000 Batch 1 culverts.
        - Multiple segment culverts frequently had incomplete documents (*almost always*).
        - Resolving the culvert history was highly complex.
        - Many technical assumptions were required to load rate culverts.
    b. Nominally, one-half of the culvert structures contained no drawings or designs.
    c. Nominally, two-thirds of the culvert segments had no designs.
2. Data analyses were performed using field load test data from TxDOT 0-5849 (measured moment demands). This work indicated that the existing culvert load rating models incorporated *excessive over-conservatism* resulting in non-valid load ratings:
    a. The Level 1 (direct stiffness) model over-predicted live load demands by an average of 16 times with *extremely* large scatter.
    b. The existing Level 3 (soil-structure interaction) model over-predicted live load demands by an average of 6+ times with large scatter.
    c. Basic enhancements to the Level 3 (soil-structure interaction) model that increase the accuracy and precision of the model were identified: (a) depth-calibrated live-load attenuation, (b) revised interior wall joint fixity, (c) reduced effective moment of inertia, (d) the addition of nominal pavement stiffness, and (e) refinements to the soil stiffness model.
    d. Collectively, these were termed “second-generation” enhancements to the Level 3 model.

3. The original culvert load rating *procedure* required significant modification and redesign.
    a. The revised procedure must first interpret the structure history in order to identify all culvert segments.
    b. Document capture and data capture are accomplished at the *segment* level, not the structure level.
    c. A “design collective” was created to help address the pervasive problem of missing construction documents and data.
    d. Custom software, under continuous development, was necessary to manage and process the data.
    e. Quality control for all load rating steps was iterative and highly complex.

These factors dictated a shift from Texas Tech University performing all the load rating calculations for TxDOT’s full population of 11,000 pre-1980 culverts to Texas Tech doing the research necessary to facilitate reliable production culvert load rating by others. A series of subsequent conversations established the contract modification in these terms.

1.1.3.3 Continuation Agreement

TxDOT issued a Continuation Agreement and Business Case Memo, dated 8 July 2016, extending the project completion date to 31 August 2016 and effectively accepting the modified scope of work.

1.2 APPROVED CULVERT LOAD RATING RESEARCH

1.2.1 Overview

The scope of work for the modified contract centered around three key themes: (1) introduce and validate several enhancements into the Level 3 culvert rating analysis model to improve load rating accuracy and precision, (2) establish an improved procedure for culvert load rating at the system level based on lessons learned from working through the trial set of load ratings for Batch 1, and (3) update the Level 1 and Level 3 culvert load rating results for Batch 1 to reflect the enhanced model and improved load rating process. In all cases, the starting place for further work was the initial culvert rating procedure articulated in TxDOT’s *Culvert Rating Guide* (Lawson et al. 2009) and the numerical algorithms represented in Version 1.0 of TxDOT’s *CULVLR* software (TxDOT 2013b). This report presents the research findings associated with each of the research themes.

1.2.2 Theme 1: Second-Generation Enhancements to the Culvert Load Rating Model

Approved load rating derives from both the load rating *model* and the load rating *process*. The goal was to improve the validity (accuracy and precision) of the load ratings so as to avoid unnecessary restrictions on commerce which may result from, on the one hand, unfounded (high) load ratings that lead to premature structure deterioration or failure or, on the other hand, unwarranted (low) ratings that lead to unnecessary structure replacements or upgrades (NCHRP 2015).

This study invested extensive effort in order to identify, specify and evaluate enhancements to the Level 3 (soil-structure interaction) load rating model. Basic model enhancements included (a) depth-calibrated live-load attenuation, (b) revised interior wall joint fixity, (c) reduced effective moment of inertia, (d) the addition of nominal pavement stiffness, and (e) refinements to the soil stiffness model. Research effort focused on identifying and specifying the enhancements, testing the impact of each enhancement on load rating by performing a detailed parametric study for a sample of TxDOT's culvert population, and externally validating the results where possible by comparing predicted performance against measured data obtained from field load tests.

1.2.3 Theme 2: Improved Culvert Load Rating Procedure

Over the course of this study, the research team performed load rating calculations for the 1,000 Batch 1 culverts *multiple* times, say, anywhere from a minimum of four times each to over 100 times each depending on how the multiples are defined. The sheer number of culvert structures, coupled with the tremendous quantity of load rating effort, led to practical observations, knowledge, insights, and lessons learned about the load rating process at the *system* level.

The system perspective is significant, because load rating questions are often framed from the desk-level view of the DOT operations engineer or load-rating engineer who is faced with performing load rating calculations for a particular culvert structure. This engineer needs and is actively seeking specific information about policy interpretation, or perhaps has questions about the suitability of a structural software package, or approved values for a certain load-rating parameter. These are important matters. But one of the lessons learned from this research was that viewing the culvert rating problem at the *system* level reveals issues, challenges, and questions not readily apparent – or more correctly, *tractable* – to the engineer who is focused on a specific structure. And ultimately, proper system-level questions not resolved at the system level lead to structure-level assumptions, inconsistencies and variance which coalesce into what has been described as a “disconnect” between observed structure performance and calculated load ratings.

From this effort, the research team established the recommended (improved) procedure for culvert load rating as per the validity-based model enhancements and the many lessons learned from working through the trial set of load ratings for TxDOT’s Batch 1 culverts. Documentation of the load rating process addresses document capture, data capture, segment interpretation, design identification, Level 1 load rating, Level 3 load rating, and reporting.

1.2.4 Theme 3: Revised Level 1 and Level 3 Load Ratings for Batch 1 Culverts

Having established the improved culvert load rating process and updated the culvert rating model, the next step was to re-do all Level 1 and Level 3 load ratings for 1,000 Batch 1 culverts in order to gain the benefit of this work. This revised load rating effort is the third theme of the study. The load rating for each culvert was performed as follows:

<u>*Task 1*</u>*. Document Capture & Classification (by culvert).*
Document capture started with the culvert document file. TxDOT provided digital documents, sometimes from the bridge database and sometimes from the construction drawing archive. If the document file was incomplete, we asked for what was missing. In any case, we opened all files, reviewed them, and classified the available documents.

<u>*Task 2*</u>*. Structure History & Segment Interpretation (by culvert).*
Available documents ideally should provide a cogent account of the structure history, in particular, the construction date and nature of all culvert segments. To keep track of this, it was necessary to create a highly-detailed segment classification and identification system. Usually the structure history was clear and segment identification was non-controversial. Sometimes key data were missing or conflicting. Either way, the load rating process required that we make the best interpretation possible. This was a key decision, and the interpretation was documented by means of a 5-point quality rating.

<u>*Task 3*</u>*. Parameter Interpretation & Data Capture (by segment).*
This step obtained and identified all culvert parameters (except design details) necessary to load-rate a culvert segment. Often data were missing. Frequently data existed in multiple files and were not fully consistent. The research effort focused on doing the work necessary to achieve a complete and un-conflicted dataset. This was a second key

decision in the load rating process, so we also documented this interpretation by means of a 5-point quality rating.

Task 4. Design Selection (by segment).
TxDOT uses engineered design standards for their culvert designs. For efficiency, consistency and quality reasons, we digitized TxDOT's complete set of design standard sheets and placed these in a digital design collective. Further, we catalogued every design in such a way that the design could be associated with basic parameters such as design year, number of spans, span length, box height, etc. as identified in the previous task. If the culvert documents contained the actual design, we selected it (from the collective, as it was already digitized there). If the culvert documents did not specify the design, we used known information about the culvert segment, i.e., its unique set of parameters, to identify plausible designs that "match." This represented the third key decision in the load rating process, and we documented this interpretation by means of a 5-point quality rating.

Task 5. Level 1 (simple/structural frame) Load Rating Calculation (by segment).
In this task, the calculations were performed to load-rate each culvert segment, and we actually load-rated each culvert segment multiple times. The Level 1 load-rating relies on a simple structural frame model, and we coded software to fully automate this rating process. Further, we iterated the load rating over a full range of cover soil depth from 'direct traffic' to 'dead load fail.' We did this in order to identify the critical cover soil depth for the structure, *i.e.*, the thickness of cover soil within the range of actual cover soil depths that yielded the lowest rating factor. We defined this as the controlling cover soil depth and used this parameter to define subsequent load rating analyses.

Task 6. Level 3 (refined/production-simplified) Load Rating Calculations (by segment).
The Level 3 load rating is a more refined load rating analysis, the results from which were usually the version of the load ratings that were placed in the culvert file for record purposes. We used the production-simplified, two-dimensional (2D), finite element model that accounts for soil-structure interaction. This model includes all the enhancements.

Task 7. Reporting (by culvert).
The culvert rating program, CULVLR, offers various reporting options. Typical practice was to include a summary page, culvert segment sketch, individual rating summaries (direct stiffness model) for all segments, individual rating summaries (soil-structure interaction model) for all segments, and a project documentation sheet that identifies all files from which data were obtained to support the rating factor calculations.

In addition to determining all the load ratings, we performed descriptive and predictive analyses based on the Level 1 and Level 3 load rating data. These findings provide a high-level view of the load rating results and trends relative to TxDOT's population of pre-1980 bridge-class culvert structures.

1.3 STRUCTURE OF THE RESEARCH REPORT

1.3.1 Overview

This research report is presented in twelve chapters. This chapter, Chapter 1, provides an introduction to the study and context for the chapters that follow. The rest of the report is built around the three research themes. Work associated with Theme 1, second-generation enhancements to the culvert load rating model, is presented in Chapters 2 through 6. Work associated with Theme 2, the improved culvert load rating procedure and method, is presented in Chapters 7 through 9. Theme 3, consisting of results from the updated Level 1 and Level 3 load ratings for Batch 1 culverts, is presented in Chapters 10 through 12.

1.3.2 Theme 1, Model Enhancements, Chapters 2 through 6

Chapter 2 describes out-of-plane live load attenuation by critical section depth. The effectiveness of depth-calibration was assessed by comparing predicted live load moments obtained from the model to measured live load moments obtained from full-scale culvert load tests. Findings show that depth calibration improves load rating practice by increasing the accuracy and precision of live load demand predictions, particularly in culvert walls and bottom slabs.

Chapter 3 addresses an issue which is idiosyncratic to the Level 3 load rating model, namely, that the bending moment at the top of the interior culvert walls frequently seemed to control the load rating. However, flexural cracking of the interior wall top is not a true *failure mode* for reinforced concrete box culverts and it should not be allowed to control. This chapter provides a critical analysis of this shortcoming and describes enhancements to overcome the limitation.

Chapter 4 discusses the typical practice of modeling concrete members assuming that the effective moment of inertia, I_{eff}, of concrete members is equal to the gross moment of inertia, I_g. The implication in a soil-structure interaction model is that the stiffer structure will attract additional load from the soil resulting in larger demands. However, for culvert load rating, if the reinforced concrete box is cracked, a reduced I_{eff} is reasonable. Guidance on the selection of reduced I_{eff} values is the third model enhancement.

The contribution of the pavement structure to live-load attenuation can usually improve the load rating reinforced concrete box culverts. Chapter 5 of this report discusses this issue and identifies, calibrates, and applies a simplified pavement model for production load rating of culverts to include and account for the influence of pavement structure type on load rating analyses.

Chapter 6 provides an analytical study of stiffness values used for the soil constitutive models associated with the load rating of reinforced concrete box culverts. The responses of the soil-culvert system under dead load and live loads are examined separately, and recommended modulus values are identified for both cases.

1.3.3 Theme 2, Improved Load Rating Process, Chapters 7 through 9

Chapter 7 provides details of the improved culvert load rating process, including document capture, data capture, segment interpretation, design identification, Level 1 load rating, Level 3 load rating, and reporting.

Chapter 8 discusses the creation of the digital design collective, a repository of TxDOT's standard culvert designs, which were digitized and indexed for efficient load rating purposes. This chapter also describes TxDOT's population of culvert standard designs and the process by which these standard designs were digitized.

Chapter 9 presents the research method used to accomplish the Level 1 and Level 3 load ratings for the 1,000 Batch 1 culvert structures.

1.3.4 Theme 3, Load Rating Results, Chapters 10 through 12

Chapter 10 presents statistical summaries and descriptive analyses of Level 1 and Level 3 load rating results for 1,788 culvert *segments* associated with 1,000 Batch 1 culverts. This includes overall load rating results, descriptive results for selected independent variables, and details about segments that failed.

Chapter 11 presents statistical summaries and descriptive analyses of Level 1 and Level 3 load rating results for 1,000 Batch 1 culverts at the culvert *structure* level. This includes overall load rating results, descriptive results for selected independent variables, discussion of results, and recommendations for implementation of the findings.

Chapter 12, summary and conclusions, provides key findings from the study, research and load rating limitations, and a series of recommendations for additional research that will continue to advance TxDOT's knowledge and state of practice for culvert load rating.

1.3.5 Appendixes

The research report contains three appendixes.

Appendix A consists of summary load rating results in tabular form at the culvert *segment* level.

Appendix B consists of summary load rating results in tabular form at the culvert *structure* level.

Appendix C is a Load Rating Technical Declaration that addresses the professional authority of the load rating results determined from this study.

1.3.6 Product Deliverables

In addition to the research report, the deliverables for this research study included five products. These products are separate from this report, are digital in nature, and are not included with the report. The product deliverables include:

Product P1. Summary Load Rating Reports for Level 1, Batch 1 culverts, reflecting updated load rating procedure

Product P2. Summary Load Rating Reports for Level 3, Batch 1 culverts, reflecting updated load rating procedure and model validity enhancements

Product P3. Tables for Batch 1 defining all categories of pre-1980 bridge-class culverts with load ratings as applicable

Product P4. Updated (QC/QA'd) copy of TxDOT PonTex database with documents and data for Batch 1 as available, reflecting the new, improved culvert rating procedure and including:

- Bridge Inventory Record
- Bridge Inspection Report(s) Construction Drawing(s)
- Soil stiffness report correlated from Web Soil Survey

Product P5. CULVLR Input Files for Batch 1 culverts

The reader is referred to the TxDOT Bridge Division for further information about the product deliverables for this study.

CHAPTER 2
MODEL ENHANCEMENT – DEPTH-CALIBRATED LIVE LOAD ATTENUATION

2.1 OVERVIEW

This chapter describes depth-calibrated live load attenuation for the load rating of reinforced concrete box culverts using production-simplified models as a way to improve the accuracy and precision of the models. In-plane depth calibration is accomplished using a production-simplified, two-dimensional, linear-elastic, finite-element, soil-structure interaction model with results compared to those from the direct-stiffness, structural-frame model recommended by AASHTO policy. Out-of-plane live load attenuation considers each potential critical section depth rather than the cover soil depth only. The effectiveness of depth-calibration is assessed by comparing predicted live load moments obtained from the models to measured live load moments obtained from full-scale culvert load tests. A load rating case study illustrates the potential for improved alignment between load rating and observed performance. Findings show that depth calibration improves current load rating practice by increasing the accuracy and precision of live load demand predictions, particularly in culvert walls and bottom slabs. Use of the depth-calibrated soil-structure model helps close the disconnect between calculated load rating and observed structural performance by more accurately predicting both the location of the weakest critical section and the live load magnitude. The depth-calibrated soil-structure model also moves the predicted live load toward more uniform accuracy and precision across all sections. The work presented in this chapter has been published in the ASCE *Journal of Bridge Engineering* (Wood et al. 2016).

2.2 INTRODUCTION AND BACKGROUND

This paper describes a depth-calibrated live load attenuation method that improves the accuracy and precision of demand predictions for culvert load rating by attenuating live load both in-plane and out-of-plane to each potential critical section depth in a culvert. The depth-calibration described here is specific to cast-in-place (CIP), reinforced concrete (RC) box culverts, has been evaluated specifically for multi-barrel culverts, and functions within the following context. First, culvert load rating requires a structural analysis model, and a valid model should predict *both* the form and the magnitude of the structural response. Alignment between predicted and measured performance is a fundamental requirement. Second, engineers typically use *production-simplified* demand models for routine culvert load rating in an attempt to balance work effort with analysis sophistication. Third, the state of practice for culvert load rating with production-simplified models has historically focused on accurately determining live load induced pressures on the top slab, with recent emphasis on structural response in the top slab and top corners. However, load rating of RC box culverts requires evaluation of *all* sections of the culvert structure. Thus, load rating benefits from accurately predicting live load-induced structural response throughout the culvert.

2.2.1 Disconnect Between Field Inspection Observation and Load Rating Calculation

Federal law requires state departments of transportation (DOTs) to conform to the National Bridge Inspection Standards (NBIS) for “the proper safety inspection and evaluation of all highway bridges” (Bridges, Structures, and Hydraulics, 2009). By NBIS definition, “bridges” include RC box culverts with a total span of 20ft or greater, and thousands of bridge-class culverts are in service in the United States. Further, the NBIS incorporates the AASHTO *Manual for Bridge Evaluation* (*MBE*) by reference (AASHTO, 2013). The *MBE* outlines a system of documentation, field inspection, load rating, and field-testing that together satisfy the requirements of the NBIS.

Per the NBIS, typically routine bridge inspections are performed every 24 months (Bridges, Structures, and Hydraulics, 2009). A qualified engineer visits and carefully examines the culvert structure, notes any damage, and assigns condition ratings to the culvert and its elements (AASHTO, 2013). Culvert elements include top slabs, bottom slabs, and walls. Typically, field inspections show that in-service RC box culverts perform very well. For example, the Texas Department of Transportation maintains an inventory of 11,000 pre-1980 bridge-class CIP RC box culverts, and these structures show an average overall condition rating of 7 out of 9, which recognizes “light” to “insignificant” damage “not requiring corrective action” (FHWA, 1995). Structural condition ratings greater than 4 to 5 are typically adequate so as not to require load posting, replacement, or retrofit.

DOTs expect the load rating calculations for their culverts to be consistent with their observations during routine field inspections. However, highway officials at both the state and federal levels have noted a disconnect between field inspection observations and calculated load rating values for culverts (NCHRP, 2013). The typical case is that an older, in-service RC box culvert shows little structural damage, but the calculated load rating indicates that the culvert does not have adequate capacity for an HS20 truck and would require load posting or possibly replacement. The significant problem is that “overly conservative rating procedures result in expensive replacements or upgrades, while unconservative rating procedures could result in future highway load limitations, premature deterioration, and even sudden failures” (NCHRP, 2013). Sponsored research projects (NCHRP 15-54, 2015; Lawson et al., 2010; Han et al., 2013; Orton et al., 2013) have sought to overcome this disconnect within the framework of existing policy. The depth-calibrated live load attenuation introduced in this chapter helps close this disconnect for CIP RC box culverts by improving the accuracy and precision of the live load demand model.

2.2.2 Load Rating with Production-Simplified Demand Models

Culvert load rating as a *component* of the NBIS involves numerical calculations to determine the safe load carrying capacity of a culvert structure, whether specific legal or overweight vehicles can safely cross a culvert, and the level of posting that may be required. The *MBE* provides three methods for load rating: load and resistance factor rating (LRFR), load factor rating (LFR), and allowable stress rating (ASR). For this research, the LFR rating factor equation will suffice to summarize the principles of load rating. Equation 2.1 shows the rating factor equation.

$$RF = \frac{C - A_1 D}{A_2 L(1 + I)} \tag{2.1}$$

The rating factor, RF, is essentially a live load factor of safety for a particular section in a structure calculated from the capacity, C, minus the factored dead load, $A_1 D$, and divided by the factored live load including impact, $A_2 L(1 + I)$. If the rating factor is greater than 1.0, the section can carry the applied live load at that section; if less than 1.0, the section does not have adequate capacity. The LFR rating factor equation accommodates two rating levels, the inventory rating level (IR) associated with the design capacity and operating rating level

(OR) associated with the ultimate capacity. The rating for the section is calculated by multiplying the rating factor by the nominal tonnage of the load rating truck, typically an HS20 truck for the LFR method. The lowest rating from all sections governs the load rating for the structure. (AASHTO, 2013)

Figure 2.1(a) shows an in-service culvert. Figure 2.1(b) illustrates the *MBE*-defined potential critical sections where demand moments, shears, or thrusts would maximize on a unique cross section of a culvert element; *i.e.* corners and midspans. Unique rating factors must be calculated for all sections, demand types, bending directions, and load cases. For example, a typical 4-span RC box culvert can have as many as 468 rating factor calculations; the lowest *one* rating factor will govern the load rating. In this way, the load rating not only indicates the safe carrying live load capacity of the culvert, but also the location of the weakest section. Ideally, calculated load rating results will corroborate field performance in both magnitude and location by predicting if and where damage would occur.

(a)

(b)

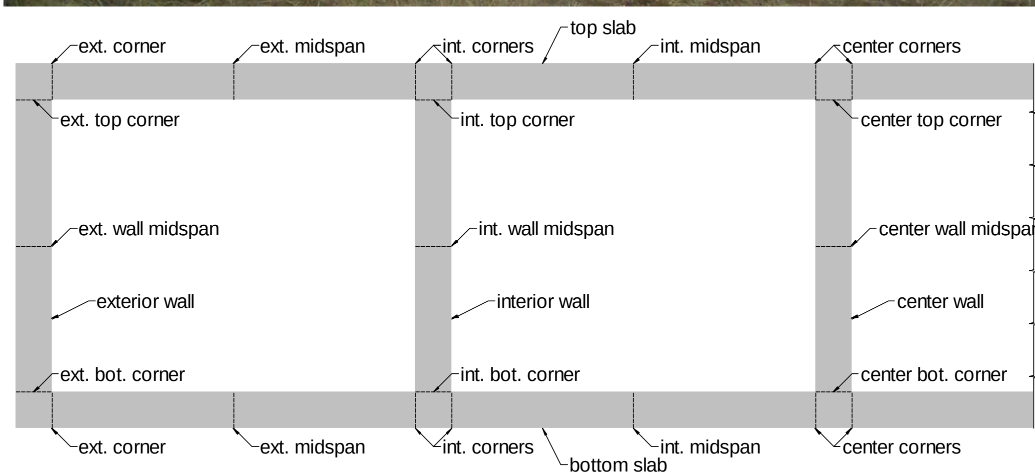


Figure 2.1. (a) A five-span reinforced concrete box culvert in Swisher Co., TX; (b) potential critical section schematic

Additionally, the *MBE* recommends the use of *production-simplified* demand models to achieve “consistent and repeatable” load ratings (AASHTO, 2013). The alternative to production-simplified models is research-intensive models that typically use finite element analysis with non-linear constitutive models for soil and concrete. Research-intensive models promise more accurate and precise demand predictions, but the additional complexity in modeling and constitutive properties makes them onerous for routine load rating.

2.2.3 Live Load Attenuation

The top slabs of RC box culverts have historically been of primary concern for culvert load rating. From the early days of culvert design and analysis, engineers recognized (correctly) that the culvert top slab – especially for structures with shallow cover soil – receives the most direct and intense loading (Spangler et al., 1926). Therefore, good performance in the top slab became an obvious structural requirement. The general approach to culvert design and analysis has been to apply loads from soil and vehicles to a structural model. This has naturally led to a research emphasis on live load induced pressures on the culvert structure, especially the top slab (James & Brown, 1987; Tadros & Benak, 1989).

The most recent research on live loads on buried structures expanded the research approach to include the live load induced pressures *and* live load induced structural response. NCHRP Report 647 addressed the structural response but only at those sections with the largest demands. For RC box culverts, the maximum positive moment occurs in the midspan of the top slab. For negative moment, the top exterior wall corners typically experience the greatest demand (Petersen et al., 2010). An expanded focus on structural response allows for improved analysis at these top sections with conservative demands predicted elsewhere in the structure. Yet per the *MBE*, load rating requires the analysis of all potential critical sections in a culvert structure. For load rating, the ideal live load attenuation method would produce accurate live load demand predictions for every section in the culvert, not just the top slab midspans and top corners.

Consider the illustration of the live load path for a single wheel load shown in Figure 2.2(a) shows a three-dimensional conceptualization of the load path. The load passes from the tire pressure and spreads slightly in the pavement structure (Han et al., 2013). Once through the pavement, the load spreads and attenuates further through the cover soil as evaluated by the historical research. Upon reaching the culvert surface, the load transfers through the top slab. The top slab bends using beam action to distribute the load in the in-plane direction, parallel to the span. In the out-of-plane direction, along the culvert flow length, slab behavior slightly spreads the load along the flow length. This slab-induced out-of-plane distribution is considerable for direct traffic culverts with less than 0.6 m (2 ft) of cover soil (McGrath et al., 2005) and still slightly present in deeply buried culverts (Petersen et al., 2010). From the top slab, the culvert walls carry the load down to the bottom slab, attenuating the load primarily in the out-of-plane direction. The wall-soil interface also spreads some of the load into the surrounding soil. At the bottom slab, additional beam/slab action further attenuates the remaining load into the foundation soils (McGrath et al., 2005). This conceptual behavior is complex, but relatively straightforward to imagine.

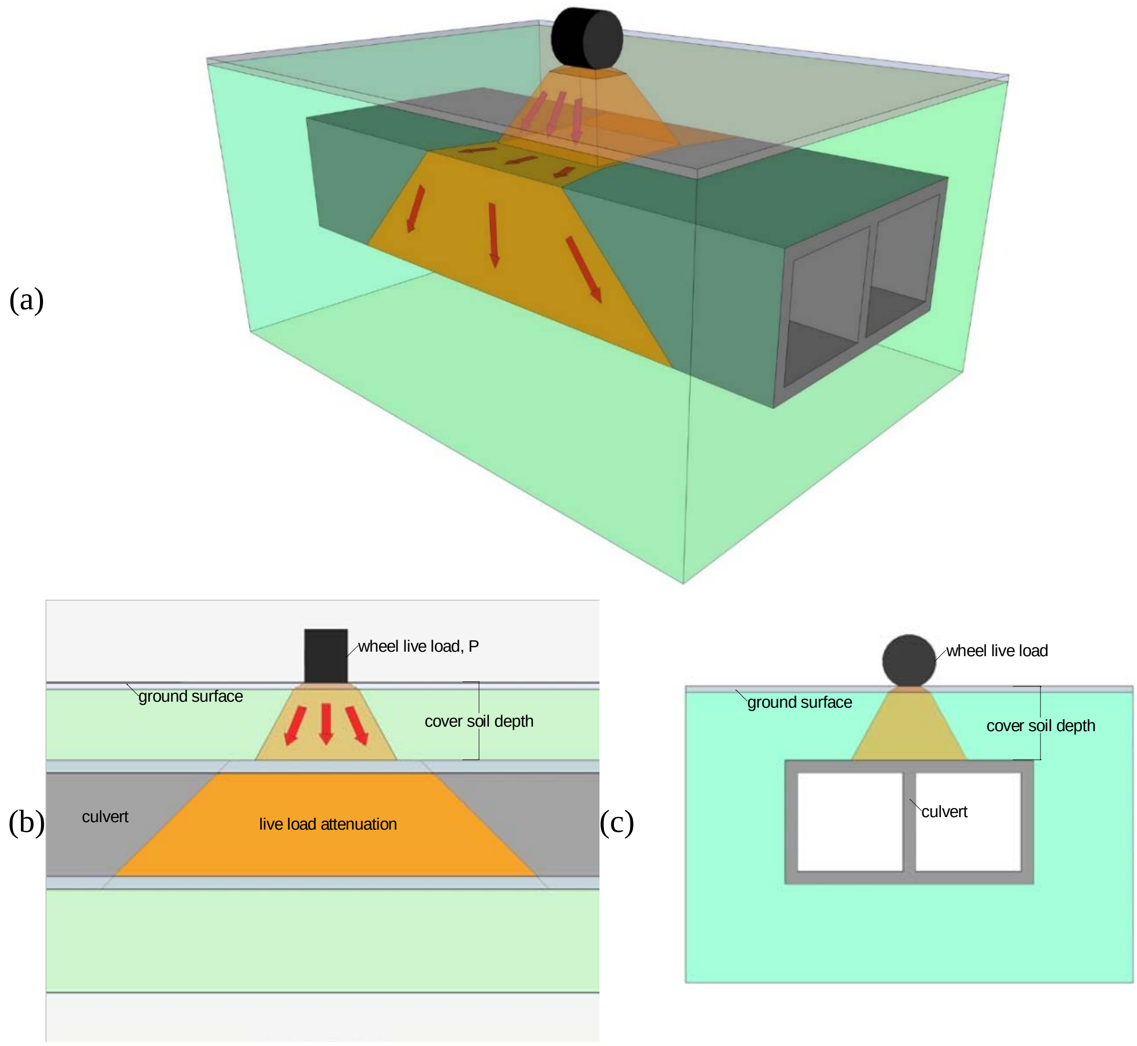


Figure 2.2. Conceptual illustration of live load attenuation (a) in three dimensions, (b) out-of-plane cross section, and (c) in-plane cross section

When modeling such complex behavior in less than a full three-dimensional model, the load path must be considered by viewing cross sections both *in-plane* and *out-of-plane*. Figure 2.2(b) shows a conceptual rendering of out-of-plane distribution through the pavement, soil, slabs and walls. Figure 2.2(c) shows an in-plane cross section from the three-dimensional conceptualization. Attenuation in-plane is clearly visible through the pavement, soil and into the concrete culvert. From this perspective, the culvert has the appearance of a structural frame. These figures are intended to illustrate the conceptual load path, not any particular model of the load path.

2.3 LIVE LOAD ATTENUATION MODELS AND METHODS

The balance of this chapter presents a comparison of three analytical approaches for attenuating live loads effects in a culvert: (1) a structural-frame model where live loads, both in-plane and out-of-plane, are calibrated to the top slab, (2) a soil-structure interaction model that attenuates in-plane live loads with depth and calibrates out-of-plane live loads only to the top slab, and (3) a soil-structure interaction model that attenuates in-plane live loads with depth and calibrates out-of-plane live loads to the depth of each potential critical section in the culvert. The first two approaches represent analytical conditions incorporated in the *Culvert Rating Guide* (Lawson et al. 2009) and in *CULVLR version 1.0.4* (TxDOT 2013b) with the third approach being an enhancement to the model. Descriptions of each model follow. Each description focuses on the distribution of a single wheel load for the sake of clarity; however, actual analysis employs a moving load pattern that considers each truck axle explicitly.

2.3.1 Structural-Frame Model

Figure 2.3 shows the out-of-plane and in-plane live load attenuation applied to a production-simplified, two-dimensional, direct-stiffness, *structural-frame* model as recommended by the *MBE* (AASHTO, 2013). The structural-frame model, as the name indicates, directly models the behavior of the RC box culvert as a concrete structural-frame. Soil is treated as dead load only. Live loads are “distributed to the top slabs” by calculating an equivalent, uniform, live load pressure by dividing the wheel load, P, by the area defined by the out-of-plane effective width, w (Figure 2.3(a)), and the in-plane effective length, l (Figure 2.3(b)) (AASHTO, 2014). This top-slab-calibrated pressure is applied directly to the top slab of the two-dimensional, in-plane model along the effective live load length, l, beneath each wheel load. Uniform pressure of the same magnitude as the top slab pressure acts on the bottom slab to balance vertical loads applied to the top slab (AASHTO, 2013). A lateral stress due to live load surcharge is applied to the exterior box walls to account for loads from approaching vehicles. The live load distribution attenuates the live load-induced pressure, both in-plane and out-of-plane, to create a calibrated culvert response in the top slab. This top-slab-calibrated live load pressure is moved back and forth across the culvert to calculate a live load demand envelope. Though the structural-frame model accounts for live load attenuation to the top slab, the structural-frame model does not model soil-structure interaction.

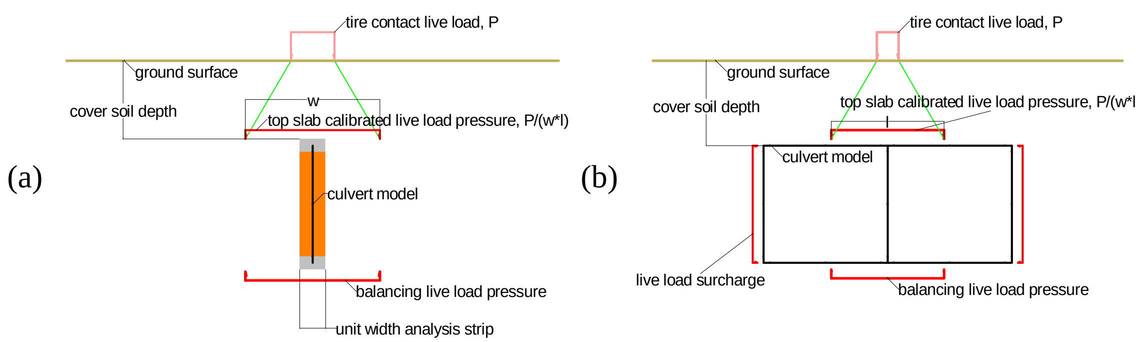


Figure 2.3. Live load attenuation for a structural-frame model: (a) out-of-plane, and (b) in-plane

The structural-frame model is the epitome of a production-simplified model for culvert load rating. The application of loads to a structure is easily understood, and the approach to estimating those loads is reasonable and conservative. However, the structural-frame model yields very conservative moment demands, particularly in the bottom slab (AASHTO, 2013). This excessive conservatism is partially due to the live load attenuation method. In-plane (Figure 2.3(b)), the balanced live load pressures on the bottom slab are more concentrated than conceptually expected (see Figure 2.2). The *MBE* suggests that the bottom slab could be supported using springs rather than a balanced load, resulting in “more natural distributions of the live load across the bottom slab” (AASHTO, 2013). While spring supports might improve the in-plane direction, out-of-plane (Figure 2.3(a)), the two-dimensional nature of the model requires that all load applied to the top of a unit width analysis strip be resisted by only a unit width of the walls and bottom slabs, unlike the actual behavior of the culvert structure (Figure 2.2(b)).

The unit width analysis strip is an issue for all two-dimensional models. In effect, a two-dimensional model predicts the response of the three-dimensional structure of the same cross section extending infinitely in the out-of-plane direction. Any loads applied to the structure are modeled as infinite line or strip loads, not true discrete loads. Live load attenuation focuses on calibrating an equivalent infinite strip or line load which elicits the same structural response as a discrete load on a three-dimensional system.

2.3.2 Top-Slab-Calibrated Soil-Structure Model

In 2007, TxDOT sponsored a research project to incorporate soil-structure interaction into the demand modeling for CIP RC box culvert load rating (Lawson et al., 2010). The result was an improved, production-simplified, two-dimensional, linear-elastic, finite-element, soil-structure interaction model described in the *Culvert Rating Guide* (Lawson et al., 2009). Though the model uses finite-elements to model the soil, thereby increasing the model's sophistication and complexity, this model is in all other respects production-simplified. The soil and concrete use linear-elastic constitutive models, no interface elements are used between the soil and concrete, and the concrete members are conservatively modeled using gross moment of inertia.

Figure 2.4 shows the live load attenuation for the *top-slab-calibrated soil-structure* model. Out-of-plane (Figure 2.4(a)), the live load is attenuated to the top slab depth, same as in the structural-frame model, but is applied as a line load with an intensity of the wheel load divided by the effective live load width, P/w. In-plane (Figure 2.4(b)), the live load is attenuated into and around the culvert by applying the line load to the ground surface and letting the linear-elastic finite-elements transmit the load naturally into the soil-culvert system. This better captures structural response from approaching truck loads (no need for a live load surcharge), and distributes the stress into the bottom slab more naturally. The effect of the live load attenuation is a calibrated live load applied to a two-dimensional model of the culvert that predicts the actual, three-dimensional, live load induced, top section, structural response caused by discrete wheel loads.

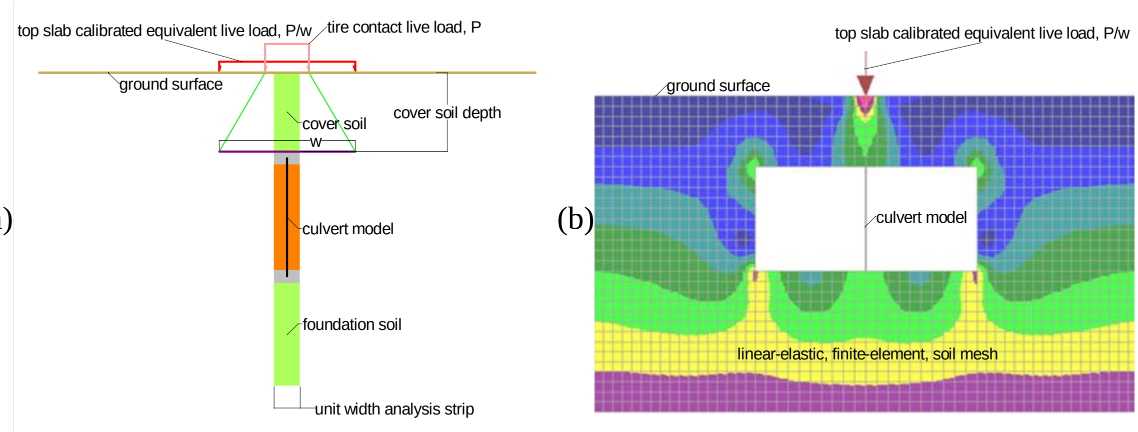
(a) 

Figure 2.4. Live load attenuation for the top-slab-calibrated soil-structure model: (a) out-of-plane, and (b) in-plane

For both the structural-frame and top-slab-calibrated soil-structure models, the goal is to accurately and conservatively predict demands placed on a culvert. Both models adequately predict the response of the top slab, but beyond this, the models diverge. The top-slab-calibrated soil-structure model provides improved response in the bottom slab because this model attenuates the live load with depth, in-plane. Yet, predictions are still significantly over-conservative in the bottom slab and at other locations in the culvert because the *out-of-plane* live load remains top-slab-calibrated (Wood et al., 2015). By policy, culvert load rating evaluates every section in a structure, not just the top slab. Therefore, a model is needed that accurately predicts demands in the top slab, walls, and bottom slab.

2.3.3 Fully Depth-Calibrated Soil-Structure Model

For culvert load rating, the ideal demand model will predict structural response at every potential critical section (Figure 2.1(b)) with the same high degree of accuracy and precision. The structural-frame model does an adequate job of predicting top slab response, but is very conservative in the bottom slab. While suitable for design, such excess conservatism leads to the calculation of low load ratings in the bottom slab of structures that are, in reality, performing well. The top-slab-calibrated soil-structure model seeks to improve the situation by modeling the in-plane live load attenuation using finite-elements. The outcome is that in-plane live load attenuation is depth-calibrated while out-of-plane attenuation continues to be calibrated at the top slab.

To help address these limitations, this chapter introduces a *fully depth-calibrated soil-structure* model as seen in Figure 2.5. Out-of-plane (Figure 2.5(a)), the live load is attenuated using an equivalent line width, w_i, to calculate the calibrated line load, P/w_i, *for each section depth*. In-plane (Figure 2.5(b)), the soil-structure system is modeled using the production-simplified, two-dimensional, linear-elastic, finite-element, soil-structure interaction model, same as the top-slab-calibrated soil-structure model. In other words, this approach calculates a depth-calibrated infinite line live load that more accurately predicts in two dimensions the live load response at each section due to the discrete live load in three dimensions. For the top slab depth, the live load is attenuated to account for live load distribution through the pavement, cover soil and top slab to the depth of the midpoint of the top slab. Additional distribution to the top wall corners requires slightly greater attenuation. The wall midspans experience less loading due to further out-of-plane distribution through the walls and surrounding soil. The wall bottom corners benefit from more distribution, and the bottom slab slightly more distribution. In each case (*i.e.*, for each section), the live load is attenuated as a function of the section depth. Conceptually, models must be evaluated with different attenuated live load for each section depth. Practically, the attenuation factor, $1/w_i$, is scalar value that can be applied before the analysis to the loads *or* after the analysis to the demands. The linear elastic nature of the model, as assumed by the rating equation (Equation 1), means that the model can be evaluated once with the *un-attenuated* wheel loads; then the demands at each potential critical section can be attenuated by the depth-calibrated scalar factor, $1/w_i$.

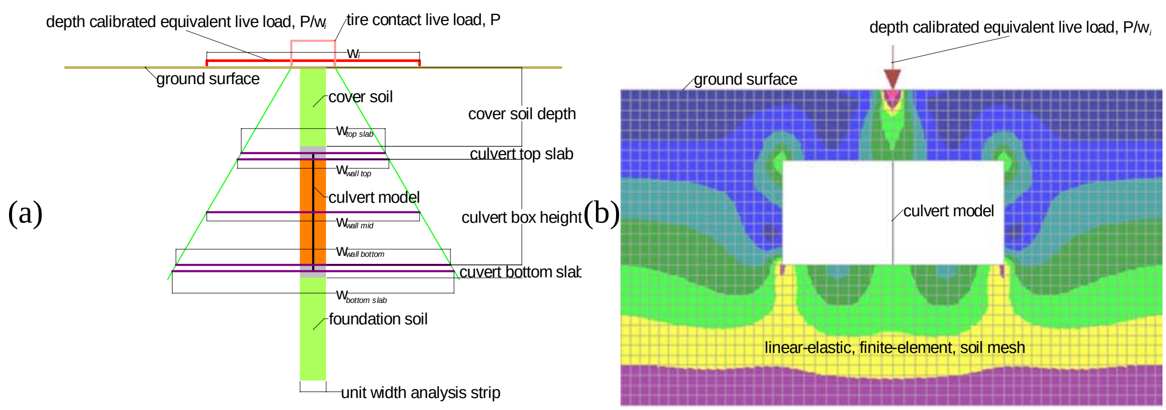


Figure 2.5. Modeled live load attenuation for fully depth-calibrated soil-structure model: (a) out-of-plane, and (b) in-plane

Ideally, the out-of-plane live load distribution used with the fully depth-calibrated model should consider the pavement, cover soil, spread through the top slab, distribution through the culvert walls and surrounding soil, and spread through the bottom slab. This chapter does *not* attempt to develop or define this ideal distribution. Rather, this chapter illustrates the increase in accuracy and precision in live load demand predictions and culvert load ratings that can be achieved using a first-order approximation of the depth-calibration distribution. The first-order assumption is that a CIP RC box culvert is at least as stiff in the out-of-plane direction as the surrounding soil. From this assumption, it follows that any live load distribution equation suitable to calibrate live load to the top slab can be applied at every section depth in the structure.

The distribution equation in the AASHTO *LRFD Bridge Design Specifications, 7th Ed.* has been used for this paper (AASHTO, 2014). The equivalent line widths for this distribution are a function of the tire contact width – either in-plane (10 in.) or out-of-plane (20 in.), plus the distribution through the cover soil (rate of 1.15 times the cover soil depth), plus distribution due to the slab (0.06 times the span length). Special provisions for direct traffic culverts and for moderate-to-large fill culverts account for slab behavior and overlapping wheel influence, respectively. By simply replacing the cover soil depth with the section depth, the same equations are used to depth-calibrate the out-of-plane live load attenuation.

2.4 MEASURED MOMENT DATA

2.4.1 Data Sources

This paper evaluates predicted live load moment response using measured live load moments from a published study of full-scale culvert load tests. Researchers at Texas Tech University instrumented three culverts and load tested them under four cover soil depths (Lawson et al., 2010; Wood et al., 2015). Researchers instrumented each culvert with strain gages at potential critical sections. Static truck loads with reported axle loads and wheel spacings were placed over the top of each culvert to induce worst-case structural responses at the gage line. Three configurations were moved across each culvert at 2ft increments: (1) one truck straddling the gage line, (2) one truck with wheels over the gage line, and (3) two trucks straddling the gage line separated by 4ft. Live load induced moments were back-calculated from measured strains using ACI recommended effective moment of inertia values for cracked members (ACI 318, 2011). Each load test produced a measured moment envelope at each instrumented section. The extreme values from the measured live load envelopes are referred to as measured moments. In total, the four load tests on three physical culverts provided 160 measured moments. Of the 160 measured moments, 110 measured moments were in the dominant direction, that is, the bending direction where the expected moment is significantly different from zero.

The site investigations identified the USCS soil classification and group symbol for the surrounding soil at each culvert location (ASTM Standard D2487-11, 2011). The Texas Tech University study obtained soil stiffness values using a falling-weight deflectometer (ASTM Standard D4694-09, 2009). Table 2.1 summarizes the published project data including test locations, culvert dimensions, cover soil depths, soil types, soil stiffness values, and truck loads.

Table 2.1. Previously published project data for measured live load moments from field-tested culverts in Texas (Lawson, et al., 2010; Wood, et al., 2015)

Location	Swisher County, TX	Lubbock County, TX	Hale County, TX
Culvert Properties			
Cover depth of soil	1.5ft	2ft-4ft	3.5ft
No. of barrels	5	4	4
Barrel span	6ft	10ft	10ft
Height	6ft	8ft	6ft
Constructed year	1951	2007	1991
AASHTO default soil unit weight, γ	120pcf	120pcf	120pcf
Specified reinforcing steel strength, F_y	33ksi	60ksi	60ksi
Measured concrete compressive strength, f'_c	9750psi	6000psi	8000psi
Cover Soil Properties			
USCS soil classification	sandy clay	clayey sand	fat clay
USCS group symbol	CL	SC	CH

Soil modulus of elasticity, E	9.0ksi	12.0ksi	8.0ksi
Assumed soil Poisson's ratio, v	0.3	0.3	0.3
Truck Loads			
Front Axle (single) [c]	12.3kips	14.0kips	11.5kips
Rear Axles (tandem) [d]	38.7kips	40.0kips	35.5kips
Front Wheel [e]	6.2kips	7.0kips	5.8kips
Rear Wheels [e]	9.7kips	10.0kips	8.9kips

Notes: [a] (ASTM Standard D2487-11, 2011); [b] composite soil stiffness from falling weight deflectometer test (ASTM Standard D4694-09, 2009); [c] front axle followed by first rear axle at 14ft; [d] rear tandem axles separated by 4ft; [e] left and right wheels separated by 6ft.

2.4.2 Predicted Moment Calculations

The structural-frame model, top-slab-calibrated soil-structure model, and fully depth-calibrated model were used to predict live load moment envelopes for each load test identified in Table 2.1. All culverts were modeled for demand calculations using concrete stiffness calculated from measured strengths, f'_c. The soil-structure models used soil stiffness values shown in Table 2.1 for the soil mass surrounding each culvert. A moving live load consisting of three wheel loads was applied to calculate the predicted moment envelope. In each case, the *LRFD Bridge Design Specification, 7th Ed.* distribution was used including a multiple presence factor of 1.2 applied to a single truck load. The multiple presence factor adequately captures the response due to multiple vehicles with lower multiple presences factors, *i.e.* simultaneous loading from two trucks (McGrath et al., 2005). All field tests were static; therefore, the dynamic impact factor was excluded. Additional detail on load rating-centric modeling using structural-frame and soil-structure interaction models can be found in the prior discussion of the models in this paper and in policy (Lawson et al., 2009).

2.4.3 Moment Envelopes

The measured moment envelope and predicted moment envelopes for the three models are shown in Figure 2.6. Positive bending induces tensile stress on the inside of the culvert element. Negative bending induces tensile stress on the outside, typically the soil side, of the culvert element.

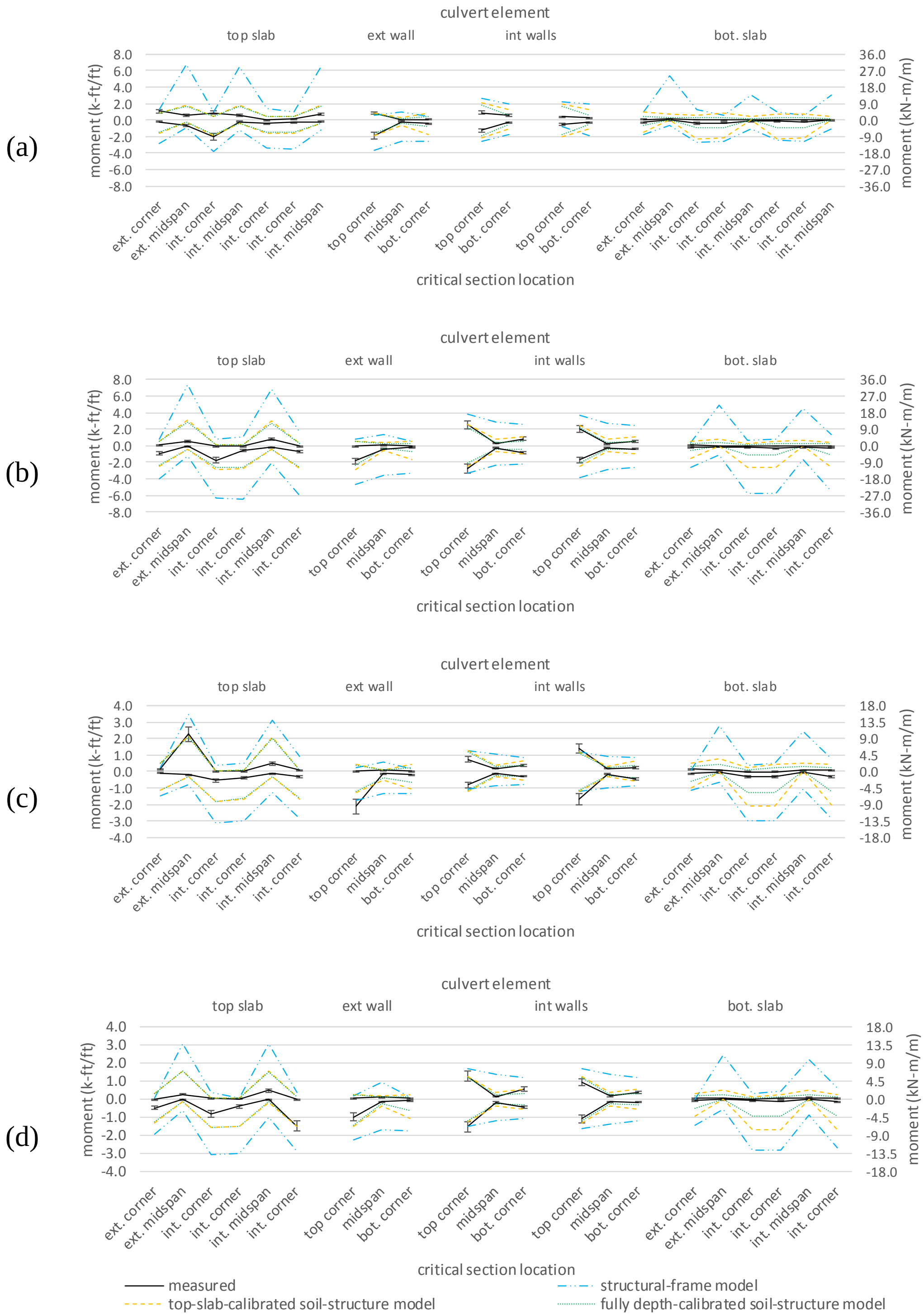


Figure 2.6. Moment envelopes for (a) Swisher County, TX culvert under 1.5ft of cover soil; (b) Lubbock County, TX culvert under 2.0ft of cover soil; (c) Hale County, TX culvert under 3.5ft of cover soil; (d) Lubbock County TX culvert under 4.0ft of cover soil.

Several observations can be made about all three models. First, predicted moment envelopes follow the trend of the measured moments; that is, the predicted moment magnitude is large where the measured moment is large and small where the measured moment is small. Second, the predicted moments appear to be generally conservative, *i.e.* the predicted moment envelopes fall mostly outside the measured envelope. In some few cases, the model under-predicts the moment. This may be due to variability in the test data or a lack of precision in the predictive model. Third, in every case, the structural-frame model is significantly more conservative than the other models. Finally, these plots illustrate that certain bending directions and locations tend to produce very low bending moment. The degree to which the model correctly predicts low live load moments in the negative bending direction in the top and bottom midspans and in the positive direction in the top slab, bottom slab, and exterior wall corners typically will not control the structural load rating. The model accuracy and precision in the remaining dominant bending directions are more important.

The more interesting comparisons are by culvert element. In the top slab (leftmost moment envelopes in Figure 2.6), the top-slab-calibrated soil-structure model and the fully depth-calibrated model generate very similar live load envelopes. This is consistent with the expected behavior and can be illustrated by considering the effective widths based on the cover soil depth (to the surface of the top slab) in Figure 2.4(a) and the critical section depth (to the midpoint of the top slab) in Figure 2.5(a). The fully depth-calibrated effective width, w_{top}, is only marginally longer (slightly greater attenuation) than the top-slab-calibrated effective width, w. Because the equivalent live load widths are so close, the predicted moments in the top slab are very similar for both the top-slab-calibrated soil-structure and fully depth-calibrated models. The inclusion of in-plane depth-calibration by modeling soil-structure interaction causes both of these models to be significantly more accurate than the structural-frame model.

In contrast, the bottom slab (rightmost moment envelopes in Figure 2.6) most clearly illustrates the improvement provided by the depth-calibration both in-plane and out-of-plane. By using in-plane live load attenuation, the top-slab-calibrated soil-structure model is far more accurate than the structural-frame model. By attenuating the live load out-of-plane, the fully depth-calibrated model reduces the over-conservatism by half again. The fully depth-calibrated model comes much closer to the expected behavior; the depth-calibrated effective width, w_{bot}, is much larger (significantly greater attenuation) than the top-slab-calibrated effective width, w. The first-order approximation of the out-of-plane live load attenuation results in a continued over-prediction in the bottom slab; this could be improved by an out-of-plane live load distribution that considers the actual stiffness of all soil-culvert elements. The greatest improvement in predictive accuracy provided by the depth-calibrated model is in the bottom slab.

Each of the walls (the middle three moment envelopes in Figure 2.6) serves as a case study of the difference between the three models. Again, the structural-frame model is the most conservative. At the wall top corners, the difference between the top-slab-calibrated soil-structure model and the fully depth-calibrated model is slight, much like the top slab. The wall midspans show a divergence between the predictive models; the fully depth-calibrated model predicts live load moment about half way between the top-slab-calibrated moments and the measured moments. The wall bottom corners show performance similar to the bottom slab with marked improvement in predicted moments provided by the fully depth-calibrated soil-structure model.

2.5 FINDINGS AND DISCUSSION

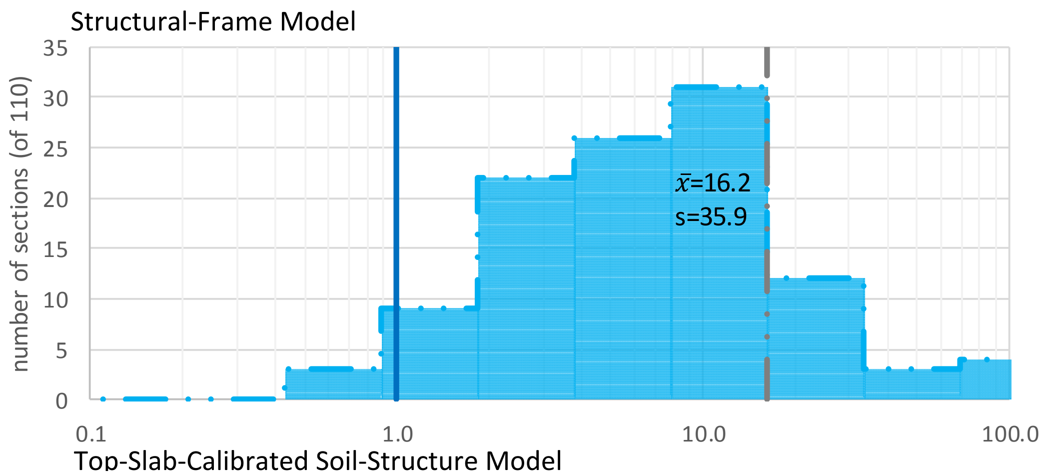
The moment envelopes provide valuable insight into the differences between the structural-frame model, the top-slab-calibrated soil-structure model, and the fully depth-calibrated model. The influence of model choice can be further illustrated by evaluating the accuracy and precision of moment results from all four load tests. The ratio of the predicted vs. measured live load moment, referred to as the *moment bias*, will be evaluated. When moment bias is greater than 1.0, the model over-predicts the live load moment (conservative); when the moment bias is less than 1.0, the model under-predicts (unconservative).

Analysis of the moment bias mean and standard deviation quantifies the concepts of accuracy and precision. Qualitatively, accuracy is the model’s ability to predict the true moment in the culvert, and precision is the scatter in those predictions. Quantitatively, an accurate and precise model produces a moment bias mean close to 1.0, a small standard deviation, and uniform mean and standard deviation at all sections. These definitions provide an interpretive framework for all 110 dominant moment biases from the four load tests.

2.5.1 Observations of Moment Bias

Figure 2.7 shows moment bias histograms on the log-scale for the structural-frame model, the top-slab-calibrated soil-structure model, and the fully depth-calibrated model. In each plot the mean of the moment biases, $\bar{x}$, and standard deviation, s, are shown. Figure 2.7(a) presents a histogram, on the log-scale, of the moment biases for the structural-frame model. The mean value of 16.2 means that on average the model over-predicts the dominant live load bending moment by more than 16 times. This over-conservatism is *before* the application of any load factors. Furthermore, the standard deviation is very large at 35.9. The predicted moments can be as much as 240 times the measured moment, so large that the full range is not conveniently shown on the histogram even in the log scale. The structural-frame model can be much improved.

(a)



(b)

(c)

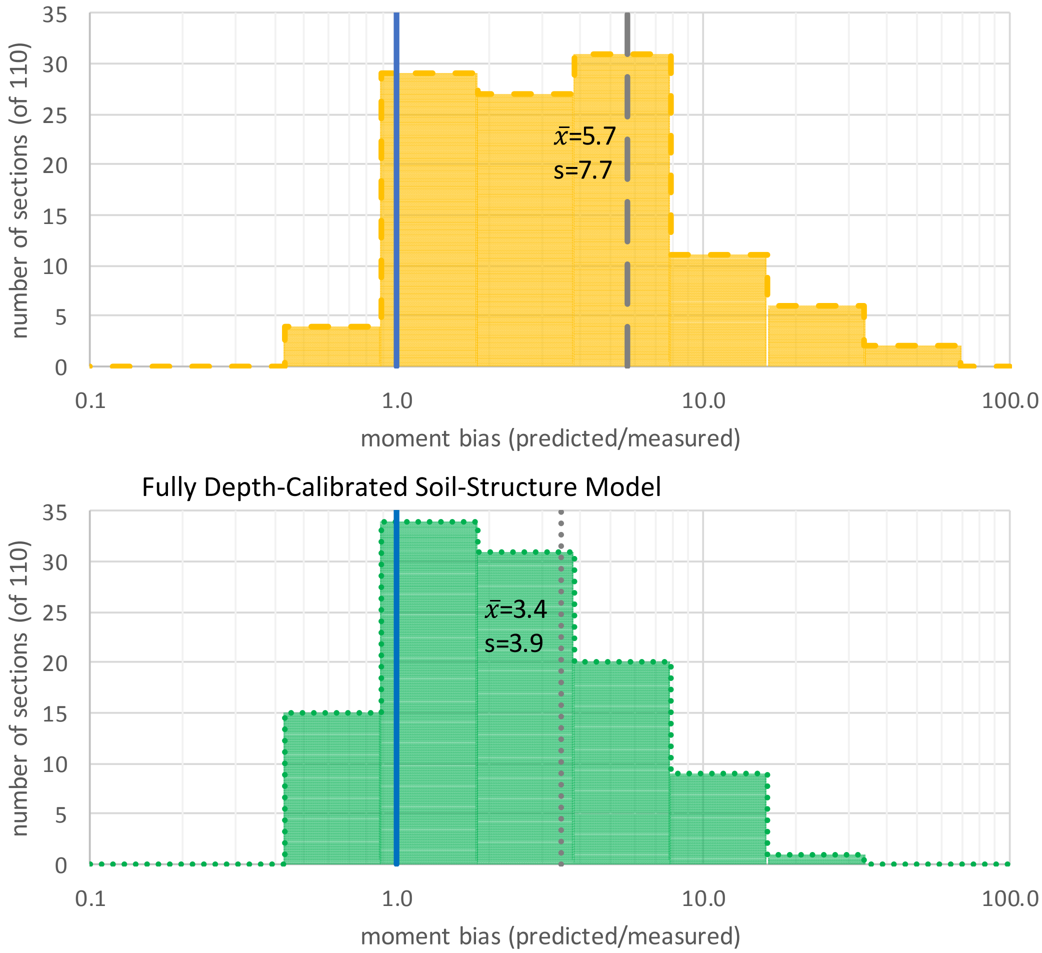


Figure 2.7. Histogram of moment biases from 4 culvert load tests using the (a) structural-frame (SF) model, (b) top-slab-calibrated soil-structure model, and (c) fully depth-calibrated soil-structure model

Figure 2.7(b) shows the moment bias histogram for the top-slab-calibrated soil-structure model. The moment bias mean is 5.7, meaning that on average, the model predicts 5.7 times the live load moment measured in the culvert. The moment bias standard deviation (s=7.7) is still large, but is significantly better than the structural-frame model. Some of the predicted moments are greater than 50 times the measured values. Though a significant improvement over the structural-frame model, the top-slab-calibrated soil-structure model can be further improved.

Figure 2.7(c) shows the moment bias histogram for the fully depth-calibrated soil-structure model. The mean and standard deviation have both improved dramatically ($\bar{x}$=3.4,

s=3.9). The mean reduced by almost half and moved closer to 1.0. The standard deviation also reduced by nearly half. Furthermore, the mode (the peak point on the histogram) is around 1.0 for the fully depth-calibrated model suggesting that many of the moment biases are ideally predicted, *i.e.*, very close to unity. The improvement in mean and standard deviation indicates that the fully depth-calibrated soil-structure model improves the accuracy and precision beyond that of the structural-frame and top-slab-calibrated soil-structure models by attenuating the live load both in-plane and out-of-plane.

The histograms in Figure 2.7 show that each of the three models produces a few moment biases less than 1.0. Of these lower bias values (*i.e.*, bias below 1.0), the average moment bias is around 0.8, or 25% under-predicted. Load rating analysis must be conservative, though not *excessively* conservative. And in this case, these unconservative moment biases are unlikely to lead to unconservative load ratings.

First, the live load moment demands used to calculate bias values are *unfactored*. The LFR load rating equation introduces appropriate conservatism into the process by applying load factors to the predicted live load moment demands, with values of 1.3 for operating ratings and 2.17 for inventory ratings. The conservatism of load rating analyses should be assessed in light of predicted moments (from the model) *and* the application of load factors (per policy).

Relative to the bias data, Figure 2.7(c) is of particular interest as it describes the fully depth-calibrated model. Here, 18 of 110 bias values are less than 1.0, and careful review of these 18 values showed that 12 are from critical sections in interior culvert walls where the major structural function is axial support, not moment. The remaining six critical sections are of practical significance (5% of 110 dominant moment biases), with five sections having bias values ranging from 0.86 to 0.97 and one section having a lower bias value, 0.57. The load factor for the operating rating is 1.3; therefore, any bias value greater than 1/1.3 = 0.78 will directly factor above 1.0, indicating a conservative result. So, notwithstanding the one low bias value which represents less than 1% of the data, the model will result in conservative LFR load ratings.

Further, many RC box culverts, particularly those in this study, when inspected are shown to be structurally serviceable, and as such, may be said to have “stood the test of time.” Therefore, when the load rating analysis for a serviceable culvert shows a disconnect between observed structural performance (good) and the calculated load rating value (low), the problem is likely with excess conservatism in the predictive model, not the structural performance of the culvert. This line of reasoning is consistent with Section 6.1.4 of the *Manual for Bridge Evaluation* that states “a concrete bridge with unknown details need not be posted for restricted loading if it has been carrying normal traffic for an appreciable period and shows no distress” (AASHTO, 2013).

2.5.2 Observations of Moment Bias by Section

Ideally, the demand model will result in uniform moment bias mean and standard deviation between sections. Figure 2.8 plots the mean and standard deviation of the moment bias by section depth. The first columns show the mean and standard deviation for all data as previously presented in Figure 2.7.

(a)

(b)

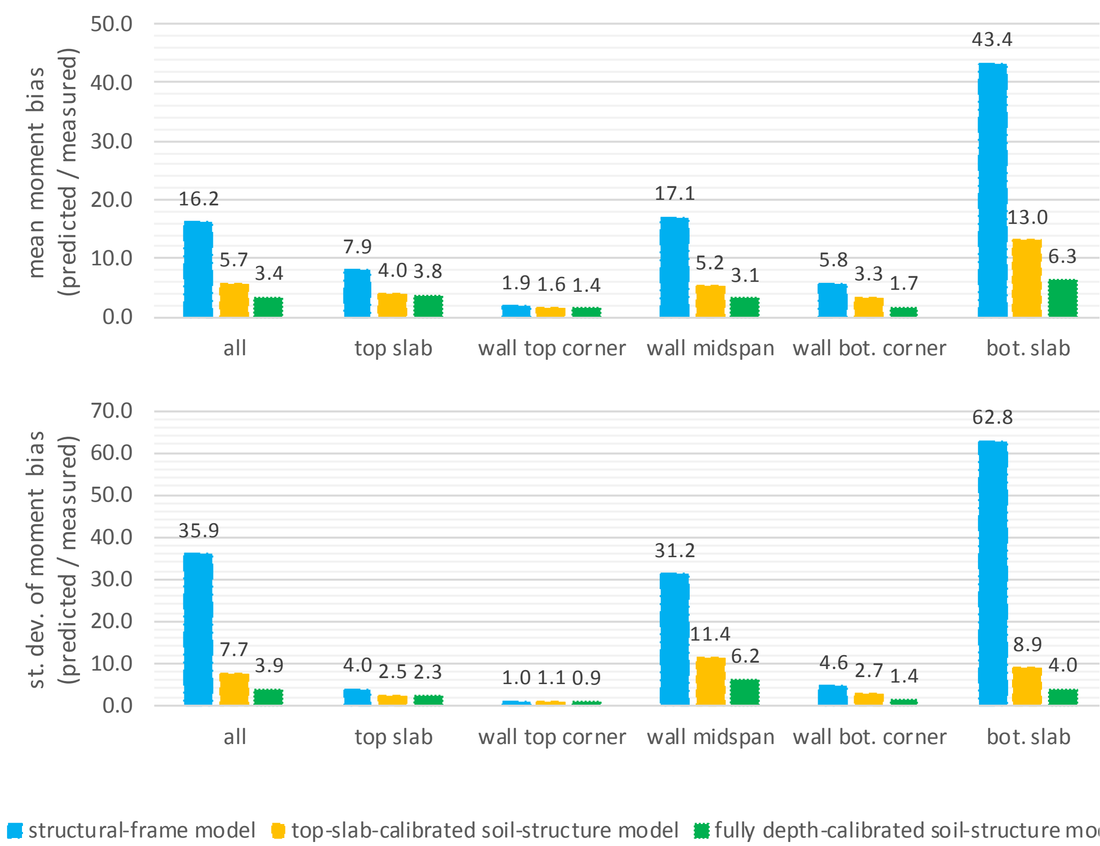


Figure 2.8. (a) mean and (b) standard deviation of moment bias by section depth

In almost every case the top-slab-calibrated soil-structure model and the fully depth-calibrated model significantly improve accuracy (as suggested by the mean) and precision (as suggested by the standard deviation) compared to the structural frame model. The only exception is the top wall corner, where all three models have roughly the same standard deviation.

The top slab is consistent with observations from the moment envelope (Figure 2.6). There is significant improvement in the accuracy and precision in the top slab by depth-calibrating in-plane (*i.e.*, moving from the structural-frame model to the soil-structure models). The top-slab-calibrated model and the fully depth-calibrated soil-structure model show similar moment bias mean and standard deviation. As expected for the top sections, the difference in effective widths between the soil-structure models does not significantly change the predicted moment. In addition, the mean and standard deviation for top sections are lower than the overall mean and standard deviation for all sections. These observations are consistent with the *LRFD Bridge Design Specification, 7th Ed.* live load distribution calibration to the top slab and top wall corners (Petersen et al., 2010).

The bottom slab (far right in Figure 2.8) has a larger mean and standard deviation than the top slab counterparts. For all three models, the moment bias mean and standard deviation are clearly not uniform for the overall culvert structure. However, for the bottom slab, the top-slab-calibrated soil-structure model reduces the moment bias mean to one third of the structural-frame model mean, and the standard deviation to one ninth of the variation in the structural-frame model. The fully depth-calibrated model then reduces the moment bias mean and standard deviation to half the top-slab-calibrated soil-structure values. The moment bias could be further improved by using a more comprehensive out-of-plane live load distribution. Nevertheless, the improvement in accuracy and precision in the bottom slab from the first-order approximation of the distribution is substantial.

The wall midspan and bottom corner bias data are similar to the bottom slab. Though the mean for all three methods is lower for the bottom wall corner sections than for the bottom slab, the mean and standard deviation improves moving from the structural-frame model to the top-slab-calibrated soil-structure model to the fully depth-calibrated model. The wall midspans have larger means and standard deviations. Particularly for the top-slab-calibrated and fully depth-calibrated soil-structure models, the predictions are the least accurate and the least precise at the wall midspans, indicating a potential limitation for production-simplified, soil-structure interaction in-plane live load attenuation.

Nevertheless, the trend is clear: depth calibration in the in-plane direction improves the live load attenuation in the top-slab-calibrated soil-structure model over the structural-frame model, and depth calibration in both the in-plane and out-of-plane directions makes the fully depth-calibrated model even better. No model achieves uniform mean or standard deviation. However, the fully depth-calibrated soil-structure model most closely approaches uniform mean and standard deviation when compared to the structural-frame or top-slab-calibrated soil-structure models.

2.5.3 Load Rating Case Study

Depth-calibrated live load attenuation improves the accuracy and precision of the moment predictions obtained from a production-simplified demand model. However, live load demand is only one component of the rating factor equation (Equation 1), the others being capacity and dead load demand. Therefore, the influence of the live load attenuation method on overall culvert load rating is indirect and varies by structure. A case study will illustrate the potential improvement in overall load rating.

The test culvert in Lubbock Co., TX (Table 2.1) has approximately 2.0ft of cover soil under the traffic lanes. Field inspections show this structure has performed reasonably well with minor cracking and leaching appearing in the top slab and an overall condition rating of 6.

The structural-frame model calculates an IR of HS5 and OR of HS9 using an HS20 truck as the load rating live load. The analysis indicates that the structure load rating is governed by the midspan of the bottom slab. Not only does the structure show no distress in the bottom slab, but also the magnitude of the load rating indicates that the culvert needs retrofit or replacement.

The top-slab-calibrated soil-structure model increases the load rating to an IR of HS10 and OR of HS17 governed by the bottom corner of the exterior wall. Though depth calibration in the in-plane direction increases the load rating, the structure is still controlled by the bottom wall corner where the top-slab-calibrated soil-structure model over-predicts live load demand.

By depth-calibrating the live load attenuation in both the in-plane and out-of-plane directions using the fully depth-calibrated soil-structure model, the IR increases again to HS12 and the OR increases to HS21. This load rating reasonably corresponds with the condition rating; though the culvert can carry the HS20 load, repeated loading at the operating level should cause some damage (AASHTO, 2013). Furthermore, the controlling critical section is now the midspan of the top slab, and this matches the location of the distress recorded in the inspection report. In this example, depth-calibrated live load attenuation yields load rating results that more reasonably correspond with field inspection observations.

As noted, live load is only one part of the load rating equation, so the fully depth-calibrated model will not provide significant load rating improvement in every case. Sometimes capacity will drive the load rating process. If the top slab governs the load rating using the top-slab-calibrated soil-structure or even the structural-frame model, the top slab will still govern when the fully depth-calibrated model is used. In other cases, the predicted dead load may exceed the section capacity, and this behavior will govern the load rating. But, for cases where the structural-frame or top-slab-calibrated soil-structure model shows that a bottom slab, wall midspan, or wall bottom corner section governs the load rating, the fully depth-calibrated model will improve the load rating outcome, in some cases dramatically.

2.5.4 Future Work Necessary

Most published research on live loads to RC box culverts has focused on live load induced pressures on the culvert, particularly *loads* on the top slab. The most recent policy has shifted the discussion to live load induced *response* also in the culvert top slab and corners. However, if the research question were reframed to look at live load induced structural response *at all sections,* a better out-of-plane live load distribution could be developed. This better distribution should consider the many sources of live load attenuation including pavement, cover soil, slab behavior, and soil-culvert interaction. The goal would be an even more accurate and precise out-of-plane live load distribution that achieves uniform moment bias mean and standard deviation between sections.

Though this chapter has illustrated a model that improves live load demand predictions regardless of load rating method, the LRFR method has its own challenges. Current LRFR calibration methods implicitly assume independent measurements with uniform bias mean and variance (related to standard deviation). However, measurements at each section on a single culvert are not statistically independent. Further, the biases at each section for a given culvert do not have uniform bias mean or variance; rather a non-constant relationship exists between bias distribution and section depth. Achieving uniform bias through a better out-of-plane live load distribution would decrease variance and improve calibrated load factors. These issues should be addressed by a robust LRFR load calibration effort for RC box culverts.

2.6 IMPACT ON LOAD RATING OF TXDOT'S POPULATION OF CULVERTS

Fig. 9 shows the improvement in overall load rating performance from *preliminary analysis* of a sample of 400 TxDOT culverts. Those 400 culverts included 552 load rated reinforced concrete box culvert segments. The influence of the in-plane depth calibration using the top-slab-calibrated soil-structure interaction model was significant, resulting in approximately 70% more culverts and segments passing. The improvement due to out-of-plane depth calibration was far less pronounced with only 2% more culverts passing.

(a)
(b)

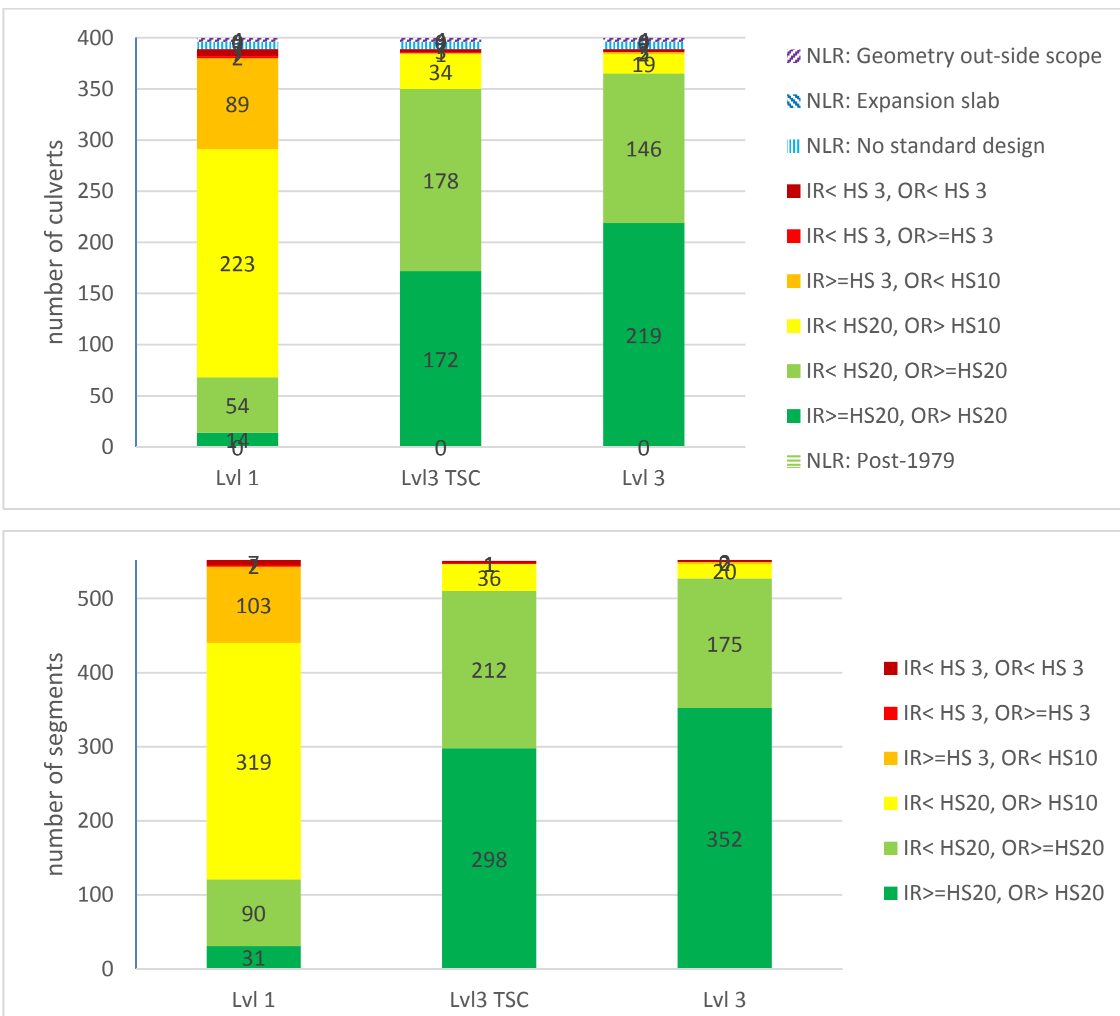
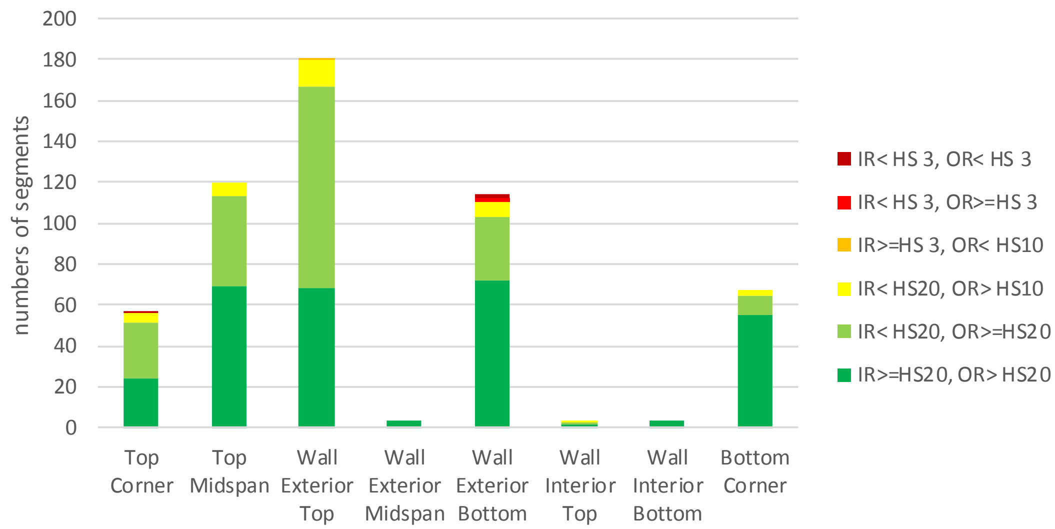


Fig. 2.9. Load rating performance by (a) culvert (400) and (b) load rated segment (552)

The real benefit in load rating performance is shown by the location of the critical section. Fig. 10 shows the controlling critical sections from the top-slab and depth-calibrated soil-structure interaction models. In the top-slab-calibrated case approximately 30% of the load rated segments are governed by the bottom slab or wall bottom corner. However, by depth-calibrating the out-of-plane live load attenuation, most bottom sections no longer control; rather, the fully depth-calibrated load rating is governed by the top slab or top wall corner. From a practical perspective, an analysis that shows that retrofit is needed in the top slab or top corners is more acceptable than repairs to the bottom slab.

(a)



(b)

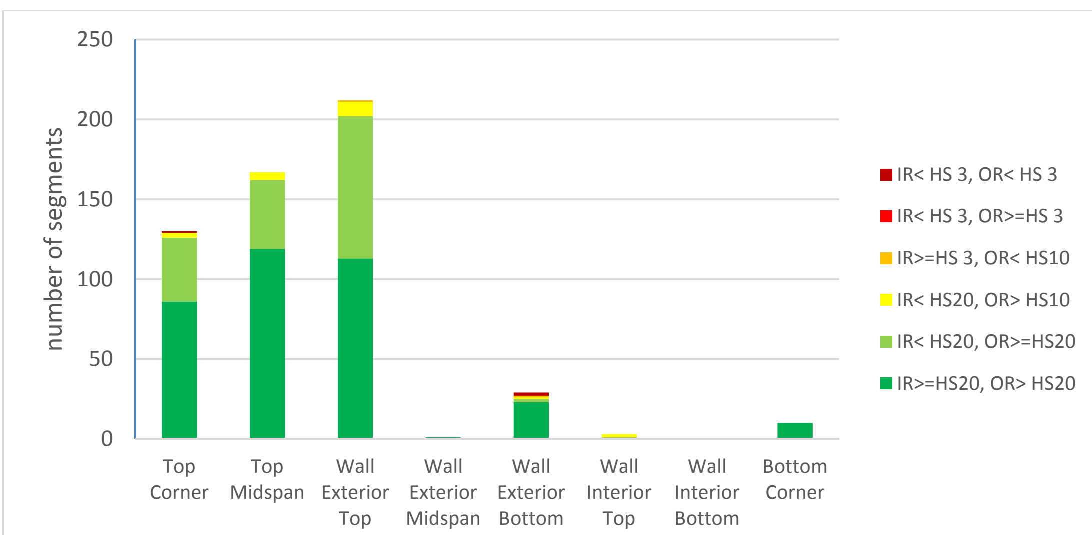


Fig. 2.10. Load rating performance by controlling critical section for load rated segments for (a) top slab calibrated soil-structure interaction model and (b) depth calibrated soil-structure interaction model

2.7 CONCLUSIONS

Careful consideration of depth-calibrated live load attenuation represents a step forward in closing the disconnect between calculated load rating values and field inspection observations for CIP RC box culverts. The calibration of live load attenuation, both in-plane and out-of-plane, to each potential critical section depth in a structure reduces over-prediction of live load demand in the culvert bottom slab and walls. Better out-of-plane live load distribution is achieved by focusing on the accurate determination of live load induced structural response at each section in the culvert. Depth-calibrated live load attenuation helps provide more accurate and precise load ratings for RC box culverts.

CHAPTER 3
MODEL ENHANCEMENT – INTERIOR WALL, TOP CORNER FIXITY

3.1 OVERVIEW

This chapter introduces a second enhancement to the original culvert load rating analytical model, that of filtering out spurious results associated with the common but inaccurate modeling of joint fixity at the tops of interior culvert walls. Typical structural analysis practice is to specify a soil-structure interaction model for multi-span reinforced concrete box culverts using "fixed" joints at all connections, and it is often found that the bending moments at the tops of the interior walls govern the load rating for such culvert models. However, as a matter of practice, if excessive moment cracking occurs at the point where the interior wall of a multi-span culvert meets the top slab, such cracking does not necessarily lead to failure. Instead, the cracks allow a hinge to form at the joint between the interior wall and the top slab, and the interior walls will continue to serve as columns and support the top slab in a safe and serviceable manner. Therefore, it does not seem reasonable to accept flexural cracking at the tops of interior culvert walls as a true *failure mode* and allow this joint to control the culvert load rating. This chapter provides a critical analysis of this shortcoming in the original load rating model and describes enhancements that were implemented to overcome that limitation.

3.2 THEORETICAL BASIS FOR ENHANCEMENT

3.2.1 Structural Analysis of Box Culverts

In multi-span reinforced concrete box culverts, it has long been recognized that the top slab and the connections between the top slab and the supporting walls often experience the highest bending moment demands from live loads (Spangler *et al.*, 1926), a trend that is particularly evident in direct traffic and low fill culverts. This is taken into consideration when designing the culvert structure.

Critical sections of the culvert top slab (as illustrated in Figure 3.1) located at the mid-span (TEM) and at interior and exterior corners (TIC and TEC) are therefore designed to carry higher moment demands. The same is true about the top exterior wall corner (WTEC).

However, culvert designers have recognized that the critical section located at the top of the interior culvert walls (WTIC) need not be designed to carry such high moment demands. This

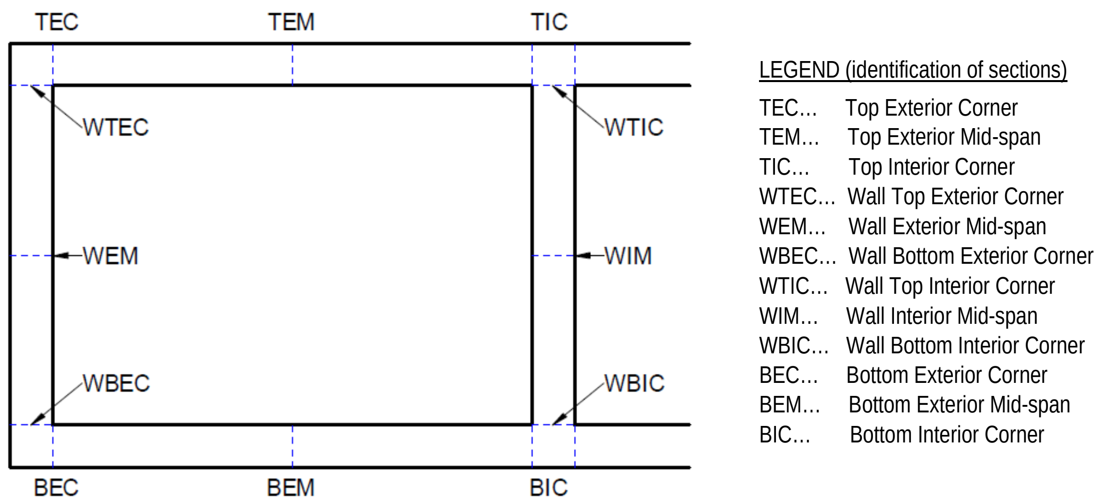


Figure 3.1. Moment Critical Sections in a Reinforced Concrete Box Culvert with no Haunches (Lawson *et al*., 2009)

is because moment cracking at this section does not lead to failure of the culvert structure. Rather, cracking will allow a hinge to form at the joint between the interior wall and the culvert top slab, but the interior wall will continue to support the top slab safely. For this reason, the critical sections corresponding to the tops of interior walls are often found to be lightly reinforced, or perhaps the reinforcement that passes through these sections may not have sufficient development length.

3.2.2 Shortcomings of the Typical Approach to Modeling Culvert Structures

As outlined in the *Culvert Rating Guide* (Lawson *et al*. 2009), TxDOT uses a production-simplified, two-dimensional, soil-structure interaction model to calculate moment demands when load-rating reinforced concrete box culverts. Typical practice for specifying such models assumes full fixity at *all* critical sections of the culvert structure including the tops of interior walls, WTIC. However, the assumption of full fixity yields larger moment demands at the WTIC joint, and has been noted this is a location at which moment reinforcing tends to be light. When an actual in-service culvert experiences these conditions, moment cracks will develop at the WTIC joint. However, the interior wall will continue to fully support the top slab with a connection that is more flexible than the fully-fixed condition. Further, moment redistribution will occur such that the top slab experiences larger rotation about the interior wall joint, and this in turn will generate increased moment demands elsewhere in the culvert structure. Since development of moment cracks at the WTIC critical section does not result in failure of the culvert structure, the calculated load rating corresponding to the "full" joint fixity condition can be viewed as *excessively* conservative.

With this more realistic structural behavior in mind, and recognizing the fully-fixed case is overly conservative, it seems unreasonable to penalize the load rating for multi-span box culverts due to moment failure at the top interior wall. A better approach for when the WTIC section governs the load rating is to specify a second model that treats the connection between the interior wall and top slab as "pinned". In this approach, moment demands directly redistribute into the top slab and throughout the structure. Most importantly, this is still a conservative model for the top slab since the WTIC joint provides no restraint against rotation. In other words, the alternative model will increase moment demands in the top slab, which is a structural element of special concern for any load rating analysis.

3.2.3 Enhanced Approach to Modeling Culvert Structures

The enhanced soil-structure model for load rating multi-span box culverts requires two steps. First, the culvert is analyzed assuming full fixity at the top interior wall joint, WTIC. If the top interior wall joint does *not* govern the load rating, the culvert analysis can be said to be complete. However, if the top interior wall joint *does govern* the load rating, the second step is to reanalyze the culvert assuming pinned joints for those sections where interior walls meet the top slab. This second approach normalizes spurious concerns about cracks which might form at the WTIC joint and it is also more conservative for the top slab. Thus, the larger of the two load ratings (*i.e.*, the fixed vs. pinned condition) is reported as the actual load rating for the culvert structure. Two examples will illustrate the impact of the WTIC joint fixity condition on the load rating of a multi-span box culvert.

3.2.3.1 Joint Fixity Example 1

The first culvert structure example consists of a three-span 10ftx10ft reinforced concrete box culvert built in 1932. The design sheet used is MBC-10-1932. Figure 3.2 provides general information about this culvert, excerpted from the summary load rating report produced from the enhanced culvert rating procedure.

General Information		Culvert Segment Sketch	
Structure Number:	191720008501001		
Culvert Segment:	1 Org 1932 3-10x10 T		
Design Sheet:	MBC-10-1932		
Construction Year:	1932		
Steel Grade:	Pre-1954 (Fy=33ksi)		
Concrete Class:	Class A (f'c=2000psi)		
Number of Spans:	3		
Clear Span:	10.0ft		
Clear Height:	10.0ft		
PMIS Pavement:	10 Seal Coat or Surf. Tmt		
Soil Properties:	Medium Stiffness	Soil Elastic Modulus:	24000psi
Soil Unit Weight:	120pcf	Soil Poisson's Ratio:	0.3
Rating Vehicle:	HS20		

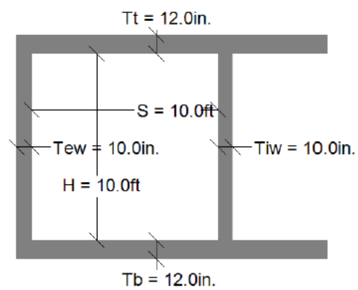


Figure 3.2. Culvert No. 191720008501001; General Information and Segment Sketch

Per the enhanced procedure, this culvert was first analyzed assuming full fixity conditions at the interior wall, top corner. This analysis yielded an inventory rating of HS8 and operating rating of HS14. As shown in Fig. 3.3, the interior wall top corners (yellow dots) govern the load rating for this case.

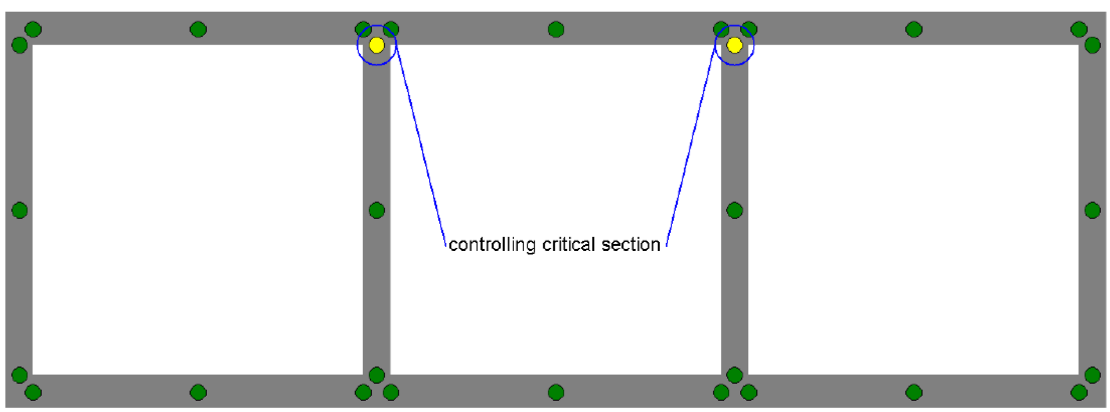


Figure 3.3. Culvert No. 191720008501001; Critical Section for Load Rating Analysis assuming Full-Fixity Conditions at WTIC

Review of the applicable design sheet, MBC-10-1932, confirmed that the interior wall, top corner does in fact have undeveloped reinforcement, and thus this segment will have undergone moment failure under load (see Figure 3.4).

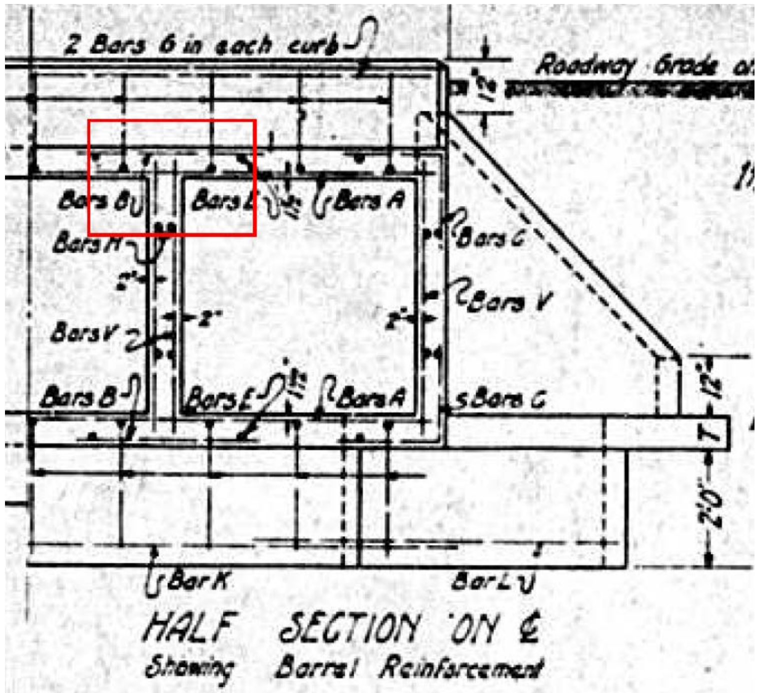


Figure 3.4. MBC-10-1932; Undeveloped Reinforcement at WTIC

Because the WTIC joint controlled the rating, in Step 2, the same structure is reanalyzed assuming pinned conditions at the interior wall, top corner. As anticipated, this second analysis yielded improved structural response, consisting of inventory rating of HS47 and operating rating of HS79. Further, the load rating is governed by the top slab, mid-span (see Figure 3.5), which is a legitimate critical section of interest for this multi-span culvert structure.

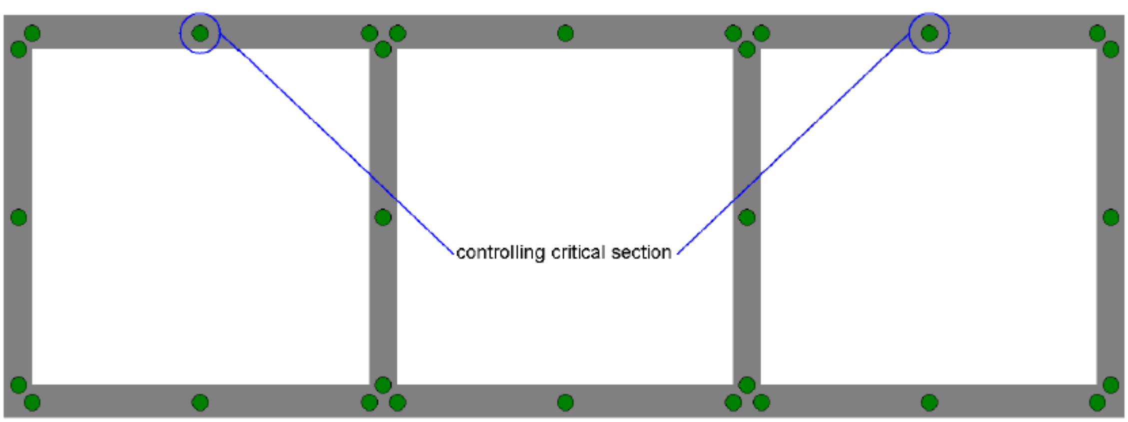


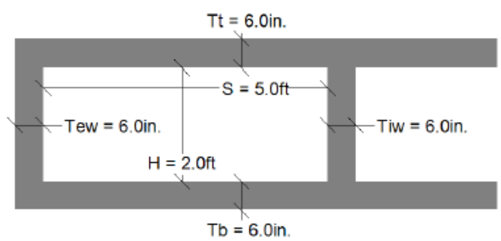
Figure 3.5. Culvert No. 191720008501001; Critical Section for Load Rating Analysis assuming Pinned Conditions at WTIC

3.2.3.2 Joint Fixity Example 2

The second illustrative example is Culvert No. 30390161502005. The structure is a four-span 5ftx2ft reinforced concrete box culvert built in 1958. The design sheet used is MC-5-1-1958. Figure 3.6 shows the summary information for this culvert structure.

General Information	
Structure Number:	30390161502005
Culvert Segment:	1 Org 1958 4-5x2 T
Design Sheet:	MC5-1-1958
Construction Year:	1958
Steel Grade:	Gr. 40 (Fy=40ksi)
Concrete Class:	Class A (f'c=3000psi)
Number of Spans:	4
Clear Span:	5.0ft
Clear Height:	2.0ft
PMIS Pavement:	10 Seal Coat or Surf. Tmt

Culvert Segment Sketch



Soil Properties:	Medium Stiffness	Soil Elastic Modulus:	24000psi
Soil Unit Weight:	120pcf	Soil Poisson's Ratio:	0.3
Rating Vehicle:	HS20		

Figure 3.6. Culvert No. 30390161502005; General Information and Segment Sketch

When analyzed assuming full fixity conditions at the interior wall, top corner (Step 1), the analysis yielded an inventory rating of HS7 and operating rating of HS12. The load rating was governed by the interior wall, top corner (see Figure 3.7).

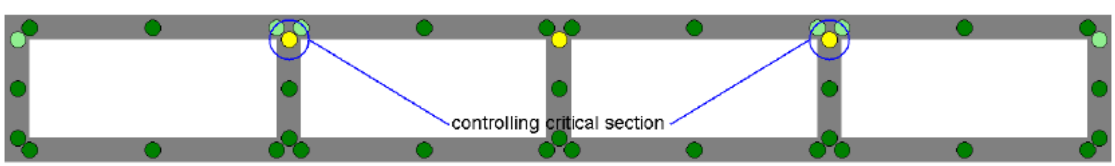


Figure 3.7. Culvert No. 30390161502005; Critical Section for Load Rating Analysis assuming Full-Fixity Conditions at WTIC

Once again, review of the culvert design sheet, MC-1-1958 revealed that the interior wall, top corner had undeveloped reinforcement (see Figure 3.8). Thus the culvert was reanalyzed assuming pinned conditions at the interior wall, top corner (Step 2). Here, the inventory rating of the culvert improved to HS15 and operating rating to HS26. These improved load ratings were governed by the exterior wall, top corner, which is a legitimate critical section of interest for this multi-span culvert structure (see Figure 3.9).

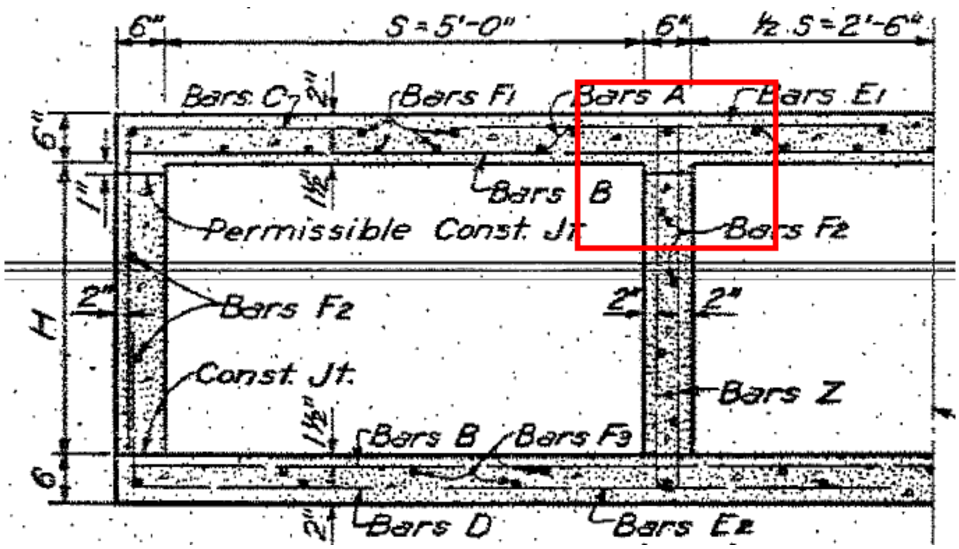


Figure 3.8. MC-5-1-1958; Undeveloped Reinforcement at WTIC

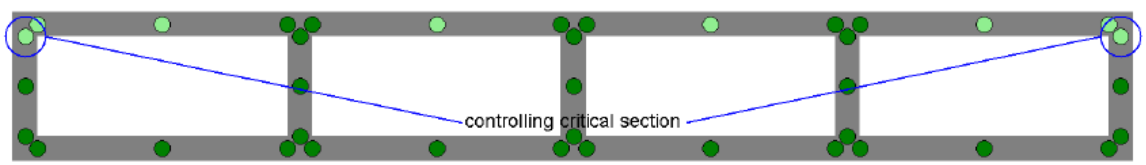


Figure 3.9. Culvert No. 30390161502005; Critical Section for Load Rating Analysis assuming Pinned Conditions at WTIC

3.3 CRITICAL ASSESSMENT AND IMPACT ON LOAD RATING

3.3.1 Direct Comparison of the Original and Enhanced Joint Fixity Models

It is instructive to illustrate the significance of the joint fixity modeling enhancement in terms of its impact on load rating results for TxDOT's population of pre-1980 culvert structures. This was achieved by performing *preliminary* load rating calculations for a sample of 400 in-service culverts (or 552 separate culvert segments), which is statistically representative of the full (11,000) culvert population by a nominal margin of error of +/- 5%. Results were performed using both the original and the enhanced procedures for joint fixity.

3.3.2 Joint Fixity Load Rating Results

3.3.2.1 Original Model

The findings from preliminary load ratings performed for 400 in-service culverts (comprised of 552 culvert segments) using the original soil structure interaction model which assumes full fixity at the top interior wall corner joint are summarized in Figure 3.10. The horizontal axis of this chart identifies the controlling critical section and the vertical axis shows the number of culvert segments corresponding to each controlling critical section. It is quite evident that interior wall top corner was by far the most common among the critical sections that governed the load rating. In fact, interior wall top corner governed the load rating for 477 out of 551 (87%) of all culvert segments. Based on the discussion in the preceding section, it is clear that this finding is not consistent with actual culvert behavior.

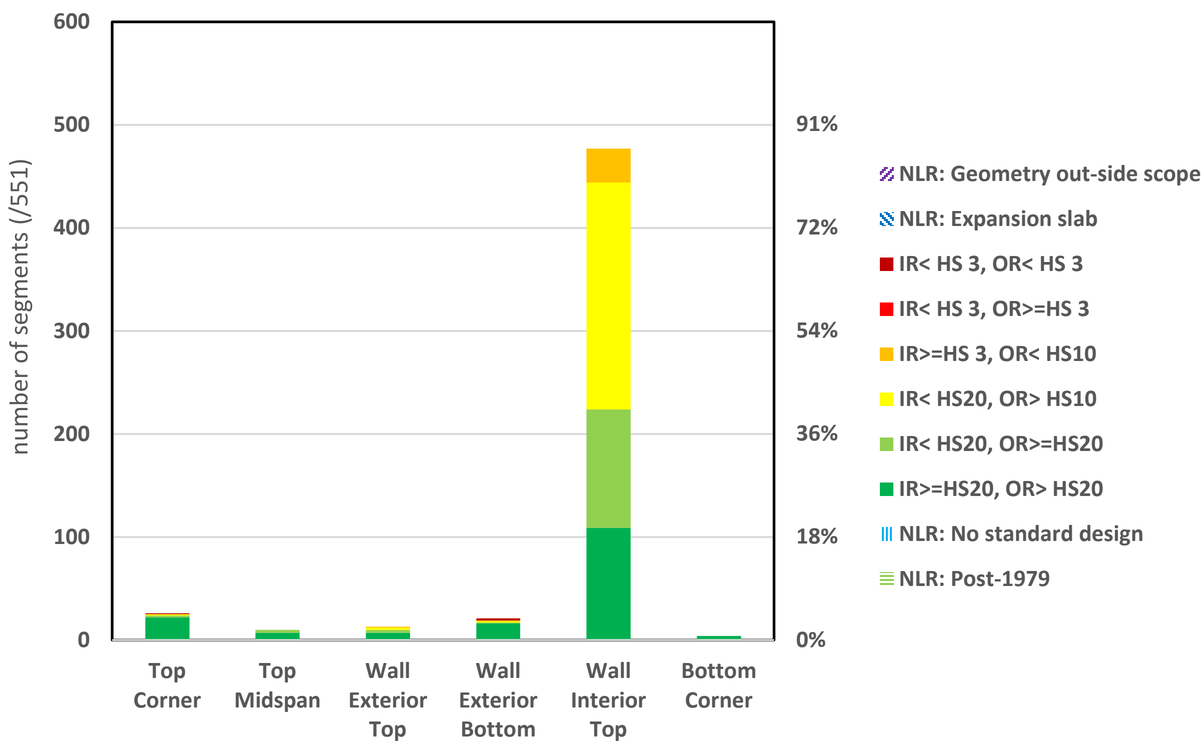


Figure 3.10. Controlling Critical Section; Full-Fixity at Interior Wall Top Corner

3.3.2.2 Enhanced Model

Figure 3.11 summarizes the findings from the preliminary load ratings performed using the enhanced model for joint fixity. As has been explained, the enhanced model requires that load rating analyses are repeated using pinned conditions for the interior wall top corner whenever this section was found to govern the load rating. In contrast to the original model, findings from the enhanced model show that interior wall top corner *rarely* governs the load rating. Instead, other critical sections in the top slab (mid span and corners) and exterior wall (exterior wall top) usually govern the load ratings for the culvert.

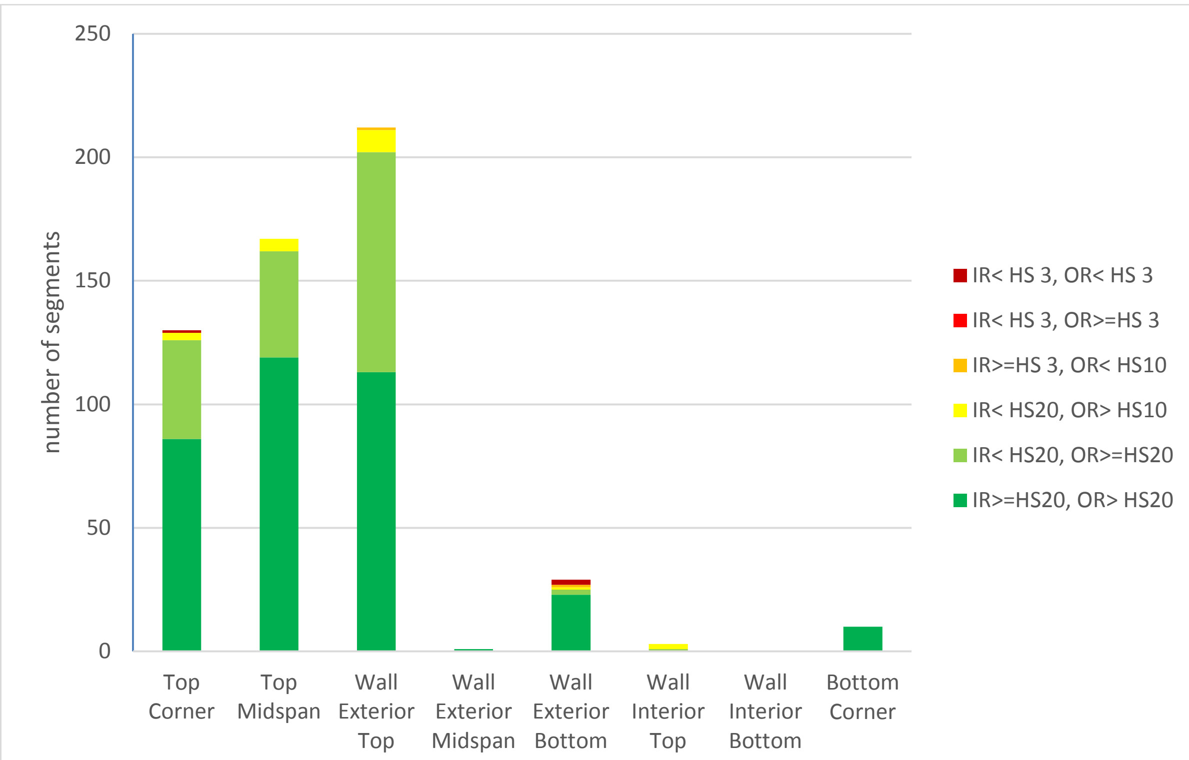


Figure 3.11. Controlling Critical Section; Enhanced Model for Interior Wall, Top Corner Fixity

3.3.2.3 Better Overall Load Rating Results

The enhanced findings are more consistent with expected culvert behavior. Also, it is significant to note that usage of the enhanced model resulted in improved load ratings overall. Whereas the original model showed 53 percent of culvert segments in the passing category (*i.e.*, operating rating ≥ HS20), the enhanced model shows that 95.5 percent of culvert segments will not require load posting. These improved load rating results more closely align with observed culvert performance per NBIS inspection data, and has been noted, the enhanced joint fixity model incorporates less excess conservativism than the original model for all culvert critical sections which are of legitimate interest for load rating.

3.4 SUMMARY

This chapter has described a model enhancement that addresses an apparent disconnect between the critical sections that are expected to govern load ratings and those predicted by the original soil structure interaction model used in load rating analyses. This disconnect resulted from the fixity condition assumed for the interior wall top corner of the culvert during load rating. The soil structure interaction model used in previous phases of this project assumed full fixity at the WTIC critical section, and a detailed review of load ratings obtained from the previous analysis revealed that the interior wall top corner of the culvert governed the load ratings for an inordinately large percentage of culvert structures. This observation was clearly not consistent observed behavior of actual, in-service culverts. Therefore, the model was enhanced to address this deficiency. The improved analysis of the culvert structure requires two separate steps. First, the culvert is analyzed assuming full fixity at the interior wall top corner. Then, if the interior wall top corner governs the load rating, the analysis is repeated assuming pinned conditions at the connection. The results obtained from this enhanced modeling procedure are found to be quite consistent with behavior of actual in-service culverts.

CHAPTER 4

MODEL ENHANCEMENT – EFFECTIVE MOMENT OF INERTIA

4.1 OVERVIEW

This chapter present the results of an analytical study on the influence of different member stiffness EI in determining culvert load rating values using the production-simplified model. As with the previous variables considered thus far, the motivation for this study is that it is frequently reported that actual field inspections show in-service reinforced concrete box culverts are performing well without exhibiting evidence of distress, such as severe cracking at the critical sections; while load ratings per the current AASHTO guidance often suggest the need for load posting or replacement. This could be due in large part to the conservative approaches usually adopted for simplified structural analysis models, such as the production-simplified model used in this project. For this reason, an exploration of member stiffness values is appropriate.

4.2 INTRODUCTION AND BACKGROUND

4.2.1 ACI Policy for Stiffness Analysis of Reinforced Concrete Members

In a structural analysis to determine the response of reinforced concrete members, it is ideal to use the member stiffness values that reflect the degree of cracking and inelastic behavior developed by the applied loads. For example, ACI 313-14 Section R6.7.1.1 states that the stiffness EI used in an analysis for strength design should represent the stiffness of the members immediately prior to failure (ACI 318-14, 2014). It is, however, very complex to obtain realistic stiffness values; thus, it makes the analysis procedure very inefficient. As such, simpler assumptions have been used to define flexural stiffness EI as shown in Tables 4.1 through 4.3.

4.2.2 The Default Approach, $I = I_g$

The simplest approach is to choose the member stiffness EI with the moment of inertia I being equal to the gross moment of inertia, I_g (the moment of inertia of uncracked cross-section) and the modulus of elasticity being equal to the modulus of elasticity of concrete E_c (Orton *et al*. 2014). However, the gross moment of inertia I_g represents the

Table 4.1. ACI specifications pertaining to the stiffness values for elastic analysis

ACI Sections	Specifications
R6.3.1.1	▪ For braced frames, relative values of stiffness are important. A common assumption is to use $0.5I_g$ for beams and I_g for columns. ▪ For sway frames, a realistic estimate of I is desirable and should be used if second-order analyses are performed. Guidance for the choice of I for this case is give in 6.6.3.1
6.6.3.1.1	▪ Moment of inertia and cross-sectional area of members shall be calculated in accordance with Tables 6.6.3.1.1(a) or 6.6.3.3.1.(b), unless a more rigorous analysis is used. If sustained lateral loads are present, I for columns and walls shall be divided by $(1+\beta_{ds})$, where β_{ds} is the ratio of maximum factored sustained shear within a story to the maximum factored shear in that story associated with the same load combination.
6.6.3.1.2	▪ For factored lateral load analysis, it shall be permitted to assume $I=0.5I_g$ for all members or to calculate I by a more detailed analysis, considering the reduced stiffness of all members under the loading conditions.

Table 4.2. ACI Table 6.6.3.1.1(a) - Moment of inertia and cross-sectional area permitted for elastic analysis at factored load level

Member and condition		Moment of Inertia	Cross-sectional area
Columns		$0.7I_g$	$1.0A_g$
Walls	Uncracked	$0.7I_g$	
	Cracked	$0.35I_g$	
Beams		$0.35I_g$	
Flat plates and flat slabs		$0.25I_g$	

Table 4.3. ACI Table 6.6.3.1.1(b) - Moment of inertia and cross-sectional area permitted for elastic analysis at factored load level

Member	Alternative value of I for elastic analysis		
	Minimum	I	Maximum
Columns and walls	$0.35I_g$	$\left(0.80+25\frac{A_{st}}{A_g}\right)\left(1-\frac{M_u}{P_u h}-0.5\frac{P_u}{P_0}\right)I_g$	$0.875I_g$
Beams, flat plates, and flat slabs	$0.25I_g$	$\left(0.10+25\rho\right)\left(1.2-0.2\frac{b_w}{d}\right)I_g$	$0.5I_g$

moment of inertia of uncracked sections. While this is conservative, reinforced concrete members are generally considered to be cracked in service with a moment of inertia value considerably smaller than the gross moment of inertia I_g. For building structures, it could be expected that with this simplest approach, realistic distribution of moment and shear force due to the factored loads can be obtained because the relative difference in member stiffness is the governing factor to determine the moment and shear force distribution over the system. For underground structures, however, soil-structure interaction is another influencing factor. That is, a stiffer structure attracts more load from the soil, resulting in the larger demands (Gardner *et al.*, 1986 and Abdel-Haq, 1987). This implies that the use of gross moment of inertia I_g can be overly conservative and it may be appropriate to use more realistic moment of inertia values for the structural analysis of buried structures.

4.2.3 More Refined Approach, $I = I_{eff}$

For load rating of reinforced concrete box culverts, a *reduced* moment of inertia, also known as the effective moment of inertia I_{eff}, is reasonable. By lowering the value of I_{eff}, more of the load should arch into the soil, decreasing demands and increasing the load rating. Because the focus of this analysis is to illustrate the influence of I_{eff} on the load rating, three I_{eff} / I_g ratios, applied to all culvert members, have been evaluated. I_{eff} = $1.0I_g$ has been evaluated as the typical and conservative case. Additionally, $I_{eff} = 0.7I_g$ and $0.35I_g$ represent the range of values identified in ACI 318 Section 6.6 (ACI 318, 2014).

4.3 ANALYSIS METHOD AND RESULTS

4.3.1 Parametric Study to Explore Member Stiffness

A parametric analysis was used to explore the load rating performance of standard culvert designs with different member stiffness values. This analysis was conducted using the production-simplified, soil-structure interaction model adopted in this project. In this soil-structure interaction model, the culvert itself is modeled as a linear-elastic frame with the surrounding soil modeled using linear-elastic finite-elements. The resulting model allows the soil to arch and carry some of its own self-weight. Furthermore, the soil elements distribute the live load in the in-plane direction and into the culvert structure. This model has been implemented in RISA-3D (RISA Technologies, LLC, 2015). The soil-structure interaction model has been described in the TxDOT's *Culvert Rating Guide* (Lawson, *et al*. 2009) and implemented in TxDOT's analysis program *CULVLR* (TxDOT 2013).

The in-plane live load attenuation implemented by the soil-structure interaction model has been augmented by a depth-calibrated out-of-plane live-load attenuation (see Chapter 2). This out-of-plane live-load attenuation generates marked improvement in the live load modeling accuracy and precision (Wood, *et al*. 2016). The soil-structure interaction model has been implemented within the load factor rating framework using an HS20 load rating vehicle and the out-of-plane live-load distribution recommended by the most recent AASHTO policy (Petersen, *et al*. 2010; AASHTO 2016).

In addition to the different member stiffness values, *i.e.* different effective moment of inertia I_{eff}, five other parameters were considered for specification of the culverts selected for this study: (1) the culvert design, (2) the cover soil depth, (3) the soil stiffness, (4) different pavement types, and (5) top interior wall fixity.

4.3.2 Culvert Standard Designs

Three culvert standard designs were selected for the parametric analysis. One pre-WWII design (MBC-2-34-F) represents smaller, square, haunched culverts. The second design from the Interstate Highway era (MC9-3) is typical of short, long span culverts without haunches. The final design (MC10-3), also from the Interstate Highway era, represents tall long span culverts without haunches. Table 4.4 identifies the reinforced concrete box culvert standard design sheets, geometry and design cover soil depth ranges.

Table 4.4. Culvert designs

Design Sheet	Span Number	Span Length	Box Height	Design Cover Soil Depth Range
MBC-2-34-F	4	5ft	5ft	2ft to 6ft
MC9-3	4	9ft	6ft	4ft-6ft
MC10-3	4	10ft	9ft	4ft-6ft

4.3.3 Cover Soil Depth

Cover soil depth for reinforced concrete box culverts is defined as the in-service, vertical distance from the top surface of the top culvert slab to the surface of overlying pavement. Cover soil depth directly contributes to the load rating by increasing the dead load demand through soil self-weight and decreasing live load demand through live load attenuation. The relationship between load rating and cover soil depth is highly non-linear (Wood, *et al*. 2015). Cover soil depth on culverts can be considered as direct traffic (0-2ft), low fill (2-6ft), and deep fill (>6ft). In this analysis, three different cover soil depths were chosen for this analytical study: (1) direct traffic condition (cover soil depth = 1.0 ft), (2) low fill condition (cover soil depth = 4.0 ft) and (3) high fill condition (cover soil depth = 10.0 ft).

Critically, the relationship between design, cover soil depth, and load rating is very dynamic and one design may perform well under one cover soil depth and not another. In particular, the three culvert designs selected for this parametric study were intended for use in low fill situations. However, because this study explores the *relative* influence of each parameter, the impact of varying the cover soil depth (beyond that of the original design) is appropriate and useful for illustrative purposes.

4.3.4 Soil Stiffness

The next parameter defined by the in-service culvert condition is the soil stiffness. While not a required parameter for the AASHTO-recommended structural-frame demand model, soil stiffness in a linear-elastic soil-structure interaction model directly impacts the culvert load rating. The *Culvert Rating Guide* (Lawson, *et al*. 2009) simplifies the selection of soil stiffness by categorizing USCS group symbols (ASTM D2487-11, 2011) into three levels: low, medium, and high. A single dead load stiffness of 20ksi has been selected, and resilient modulus values of 12ksi, 24ksi, and 36ksi for low, medium, and high stiffness soils have been selected to model live load impacts. The selection and justification of these soil stiffness values are beyond the scope of this chapter and the reader is referred to Chapter 6 for details. Rather, the stiffness values selected for the parametric study represent an appropriate range of live load soil stiffness values necessary to explore the influence of soil stiffness on culvert load rating.

4.3.5 Equivalent Pavement Stiffness

By conservative practice, the contribution of the pavement structure to the live load attenuation and spread is typically ignored when load rating reinforced concrete box culverts. Usually, the cover soil depth is modeled entirely as soil. However, pavement is stiffer than soil and will therefore spread live load faster with depth than soil alone. In a research-intensive culvert model, the pavement structure might be modeled by a series of finite-element layers of measured material properties; however, specifying such a model would be challenging for production load rating. The production-simplified approach investigated in this parametric study models the full cover soil depth using soil finite elements and adds beam elements across the top row of nodes to represent the pavement. The stiffness of this equivalent beam is a function of the pavement profile and supporting soil stiffness. The equivalent beam stiffnesses were calibrated by minimizing the mean standard error of the induced vertical pressure from a point load between the research-intensive layered model and the production-simplified beam model, generally as described in Chapter 5. Four pavement cases were selected for evaluation: (1) without pavement (None), (2) chip seal surface treatment (SC), (3) intermediate asphalt pavement (IA), and (4) continuously reinforced concrete pavement (CRCP). Table 4.5 shows the equivalent pavement beam stiffnesses for each pavement type and soil stiffness evaluated in this parametric analysis.

Table 4.5. Equivalent pavement stiffness assuming a 6in. thick pavement beam

Pavement Type	1. Low Soil Stiffness	2. Medium Soil Stiffness	3. High Soil Stiffness
No pavement (None)	0	0	0
Seal coat (SC)	20ksi	1ksi	1ksi
Asphalt (IA)	500ksi	300ksi	200ksi
CRCP	30000ksi	33000ksi	33000ksi

4.3.6 Fixity of Top Interior Wall/Slab Joint

The last parameter investigated in this parametric analysis is the fixity of the top interior wall joint, that is, the top slab/interior culvert wall connection. As discussed in Chapter 3, when evaluating a reinforced concrete box culvert using a soil-structure interaction model, the bending moment in the interior wall where the wall supports the top slab frequently governs the load rating. This is due in part to excessive bending demands from live load (especially for direct traffic and low fill culverts) and in part from typically light reinforcement passing through this structural section. Yet, for an actual culvert, if excessive moment cracking occurs where the interior wall meets the top slab, the structure will not catastrophically fail. Rather, the interior wall will continue to act as a column and support the top slab with a connection more flexible than fully fixed. The top slab will rotate more about the interior wall joint and experience increased moment demands through continuous beam action redistributing the moment elsewhere in the culvert.

The parametric analysis assumes two cases of top interior wall fixity. The “fixed” model assumes fully fixed connections between all culvert members. The “pinned” model first evaluates the culvert as fully fixed, same as the “fixed” model. If the governing critical section is not in the top interior walls, the rating stands. However, if the top interior wall governs the load rating, a second model is evaluated with pinned joints where the interior walls meet the top slab. The “pinned” model procedure represents an accommodation to account for a peculiarity in the soil-structure interaction model. The parametric analysis considers the influence of this modeling accommodation on the overall load rating.

4.4 PARAMETRIC ANALYSIS RESULTS

4.4.1 Summary of Results

The results for all reinforced concrete box culvert designs, though varying in magnitude, show similar trends. Therefore, the operating rating factors (ORFs) for one culvert are shown for the sake of brevity. Figures 4.1 through 4.3 show the ORFs for the MC 9-3, 4-9×6 culvert arranged by cover soil depth. Each case is represented by two markers indicting the "fixed" top interior wall model and the "pinned" top interior wall model. Where two markers are side by side, the “fixed” model was governed by a critical section other than the "pinned" top interior wall. When the points are shown in blue, the higher ORF is the “pinned” model while the lower ORF is the “fixed” model. Frequently, the differences are very small resulting in what looks like one marker. In the few cases where the “pinned” model was less than the “fixed” model, the markers are shown in red.

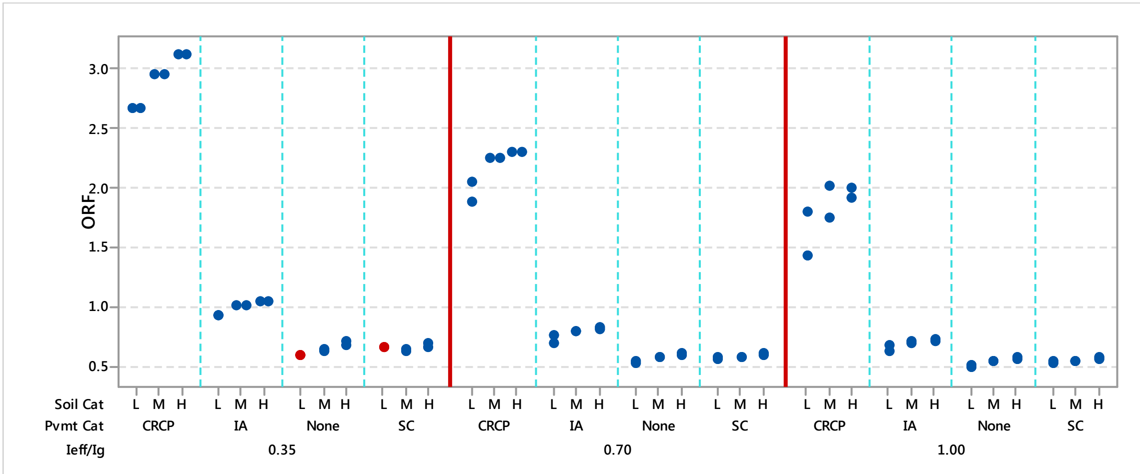


FIGURE 4.1. Load rating for MC 9-3 4-9×6 under 1ft of cover soil.

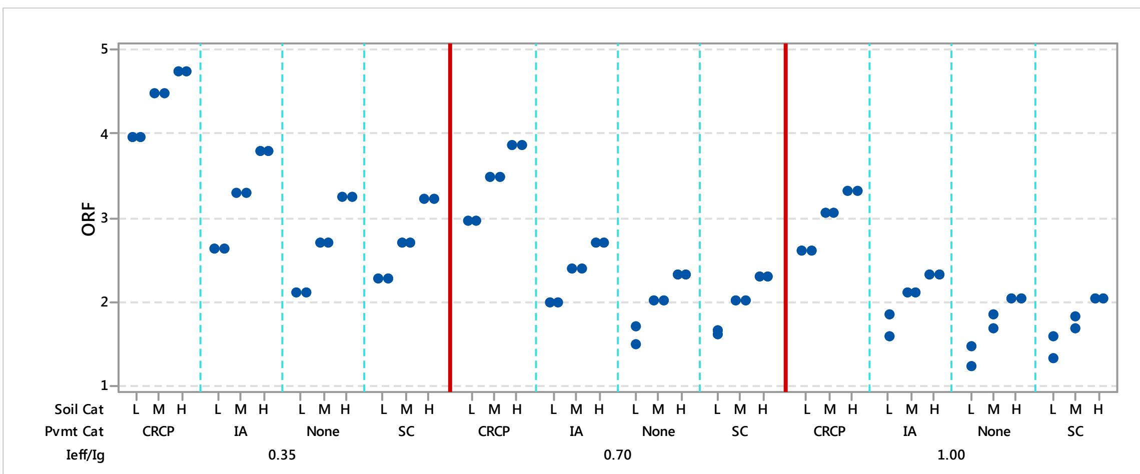


FIGURE 4.2. Load rating for MC 9-3 4-9×6 under 4ft of cover soil.

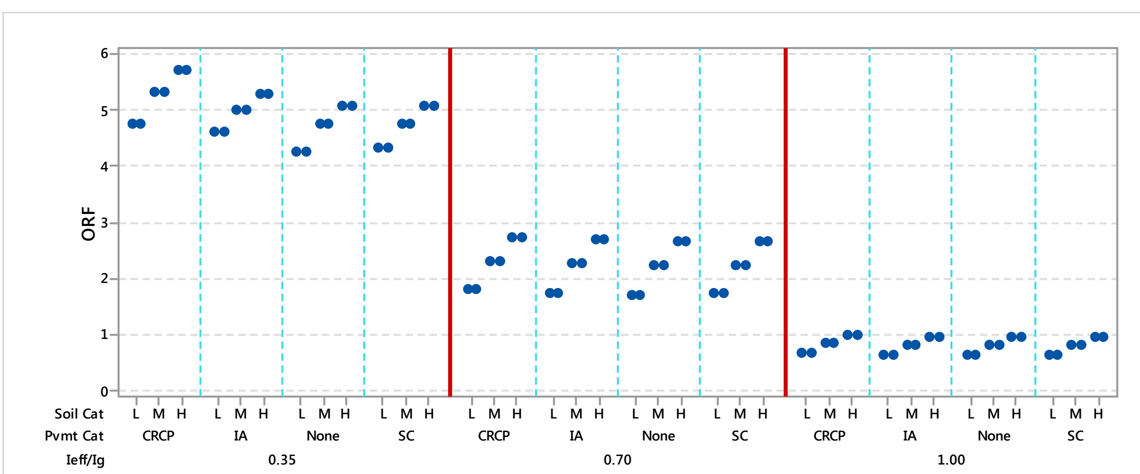


FIGURE 4.3. Load rating for MC 9-3 4-9×6 under 10ft of cover soil.

The ORFs are first grouped by the I_{eff} / I_g ratio. The next sub-grouping is pavement type. The final sub-grouping is soil category. The soil categories are shown as (1) low stiffness, (2) medium stiffness, and (3) high stiffness.

4.4.2 Influence of Cover Soil Depth

Figure 4.1 shows the analysis results for the direct traffic condition, *i.e.* cover soil depth equal to 1 ft. Here the ORF values increase *very slightly* as the I_{eff} / I_g ratios decrease, but the trend is quite muted and relatively flat. The one exception is for the case where the culvert is under CRCP pavement (which will be discussed shortly).

In contrast, consider the low fill condition, *i.e.* cover soil depth equal to 4 ft. Figure 4.2 shows clearly shows a trend of increasing ORF values with decreasing I_{eff} values. This trend is even more pronounced for the deep fill condition, *i.e.* cover soil depth equal to 10 ft as shown in Figure 4.3. Here, decreasing I_{eff} shows a definite step up in ORF values, nominally from 1 to 2 to 5 for I_{eff} / I_g ratios of 1.0, 0.75, and 0.35, respectively. Clearly and as would be expected, larger cover soil depths represent the domain where I_{eff} values most strongly influence operating rating factors from culvert load rating.

4.4.3 Influence of Pavement Type

The four pavement types included in this parametric study cluster into three performance groups relative to their influence on ORF vis-à-vis the I_{eff} / I_g ratio. The low-performing group contains “no pavement” and “seal coat pavement”. ORFs for the culvert under these pavement conditions are the lowest among the pavement types and are essentially identical in every category of cover soil depth and soil type. Varying the I_{eff} / I_g ratio under these pavement types has no impact.

The middle performance group is the intermediate asphalt (IA) pavement. Here, a trend of increasing ORF values with decreasing I_{eff} values exists for all cover soil depths. The trend is more muted (but discernable) for direct traffic culverts, and the trend becomes more pronounced for low fill and deep fill culverts. ORFs for the culvert under intermediate asphalt pavement conditions are typically higher than for seal coat or no pavement, but lower than for concrete pavement. The one exception is the deep fill culvert condition where the relative influence of pavement type is muted for all cases.

The high performance group is the concrete (CRCP) pavement. Here, a clear trend of increasing ORF values with decreasing I_{eff} values exists for all cover soil depths. Further, ORFs for the culvert under concrete pavement conditions are higher than for asphalt, seal coat and no pavement, even for direct traffic culverts. The one exception is the deep fill culvert condition where the relative influence of pavement type is muted for all cases.

4.4.4 Influence of Soil Type

Soil type (or more properly, soil stiffness) shows a positive relationship to ORF for all cover soil depths, pavement types, and I_{eff} / I_g ratios. That is, the ORF values increase with increasing soil stiffness values. The influence is more muted (but exists) for direct traffic culverts, and is more pronounced for low fill and deep fill cover soil conditions.

4.4.5 Other Observations about Member Stiffness Values

In addition, it can be observed that the effects of different I_{eff} / I_g ratios on the deep fill condition are more amplified compared to the low fill and direct traffic conditions. This clearly indicates that the soil-structure interaction plays an important role as the cover soil depth increases. That is, the member stiffness has more influence on the load rating of deep fill culverts than on the low fill or direct traffic culverts.

Further, in the cases of the direct traffic and low-fill conditions, the ORF values remarkably increase if the member stiffness is very low ($I_{eff} = 0.35 I_g$) and the pavement stiffness is high (*i.e.* CRCP) while this trend is not observed in the case of the deep fill condition. This may imply that the selection of member stiffness for direct traffic and low fill conditions should be done more carefully when stiffer pavement such as CRCP is used. However, additional study is required to investigate the interaction between the pavement stiffness and member stiffness to confirm this observation.

4.4.6 Selection of Appropriate Member Stiffness Values for Further Study

ACI policy on member stiffness EI used in an analysis for strength design, coupled with the results from the parametric study, suggest that it is reasonable and appropriate to consider I_{eff} values other than the typical and conservative case of $I_{eff} = 1.0I_g$. Four other observations, all specific to TxDOT's population of pre-1980, cast-in-place, reinforced concrete box culverts, are instructive. The observations reflect data from 1,000 Batch 1 culverts (1,788 segments) which are statistically-representative of TxDOT's full population of pre-1980 culvert structures with a nominal margin of error +/- 3%.

- Over half of the design standards used for pre-1980 TxDOT culverts are from the Interstate Highway era, *i.e.*, they are non-haunched culverts represented by the second and third designs from the parametric study. In fact, in the sample of 1,000 Batch 1 culverts, half (904/1788 segments) explicitly used the MC #-# standard for load rating, and this does not include "one-off" structure-specific designs that also may have been based on the MC #-# standard.
- The soil type for TxDOT's pre-1980 culverts is predominantly "medium" to "low" stiffness (94%, 1684/1788 segments).
- Concrete pavement (CRCP, JRCP, and JPCP) covers only 4% (80/1788 segments) of TxDOT's pre-1980 culverts; whereas, seal coats cover 36% (639/1788) of culvert segments.
- Deep fill culverts comprise only 5% (64 out of 1385 load rated segments) of TxDOT's pre-1980 culvert population; whereas, direct traffic culverts comprise 78% (1075/1385) of the population.

Collectively, these typical characteristics of TxDOT's culvert population serve to focus the broader observations and implications from the parametric study. Because TxDOT culverts are typically under direct traffic with a seal coat, it is fair to say that for most of TxDOT's pre-1980 culverts – perhaps as many as 70% to 90% – the practical influence of member stiffness on the operating rating factor will range from "none" to "slight". This follows from the fact that the conditions which amplify the influence of member stiffness – namely, concrete pavement and deep-fill conditions – are not common.

With this in mind, and with reference to ACI policy, a reasonable approach is to follow ACI specification R6.3.1.1 for braced frames, and assume $0.5I_g$ for flexural members (*i.e.* culvert top slabs, bottom slabs, and exterior walls) and $1.0\,I_g$ for columns (*i.e.* culvert interior walls). This moderate approach will be followed and further evaluated in the remainder of this chapter.

4.5 COMPARISON BASED ON MEASURED MOMENT DATA (LIVE LOAD)

This section presents an evaluation of the effect of member stiffness values on predicted live-load moment response using measured live-load moments from four, previously published, field live-load tests on in-service culverts. The researchers performed load tests on three culverts using static truck loads (Lawson, *et al.* 2010; Wood, *et al.* 2015; Wood, *et al.* 2016). The culverts were instrumented with strain gages at potential critical sections. Table 4.6 shows the configuration of the testing culverts: the Lubbock county culvert, the Swisher county culvert and the Hale county culvert.

Table 4.6. Project Data for Measured Live Load Moments from Field-Tested Culverts in Texas (Lawson *et al*. 2010; Wood *et al*. 2015; Wood *et al*. 2016)

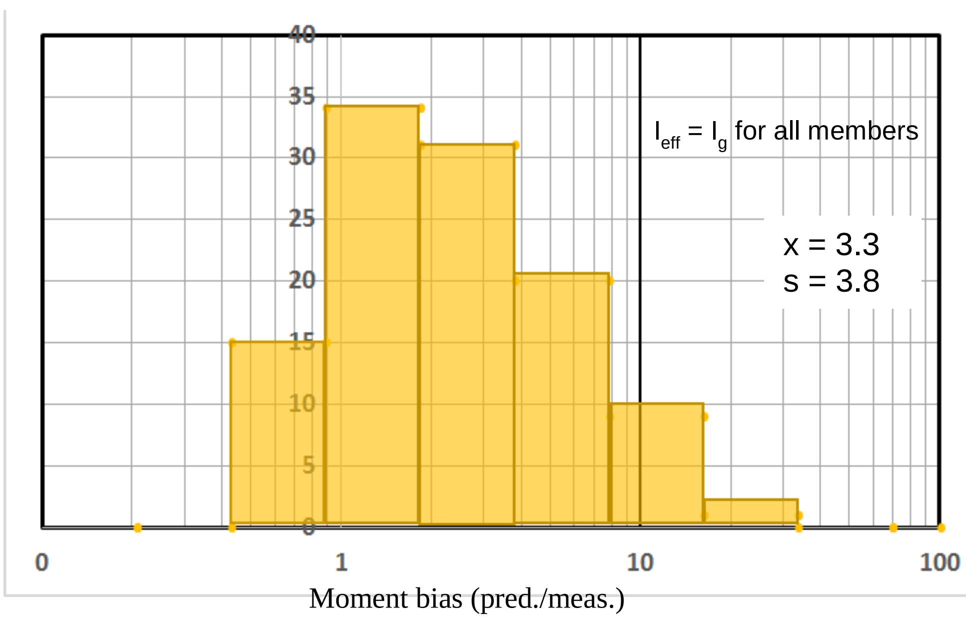
Location	Swisher County, TX	Lubbock County, TX	Hale County, TX
Culvert Properties			
Cover depth of soil	1.5ft	2ft-4ft	3.5ft
No. of barrels	5	4	4
Barrel span	6ft	10ft	10ft
Height	6ft	8ft	6ft
Constructed year	1951	2007	1991
AASHTO default soil unit weight, γ	120pcf	120pcf	120pcf
Specified reinforcing steel strength, F_y	33ksi	60ksi	60ksi
Measured concrete compressive strength, f'_c	9750psi	6000psi	8000psi
Cover Soil Properties			
USCS soil classification	sandy clay	clayey sand	fat clay
USCS group symbol	CL	SC	CH
Soil modulus of elasticity, E	9.0ksi	12.0ksi	8.0ksi
Assumed soil Poisson's ratio, v	0.3	0.3	0.3

Truck Loads			
Front Axle (single) [c]	12.3kips	14.0kips	11.5kips
Rear Axles (tandem) [d]	38.7kips	40.0kips	35.5kips
Front Wheel [e]	6.2kips	7.0kips	5.8kips
Rear Wheels [e]	9.7kips	10.0kips	8.9kips

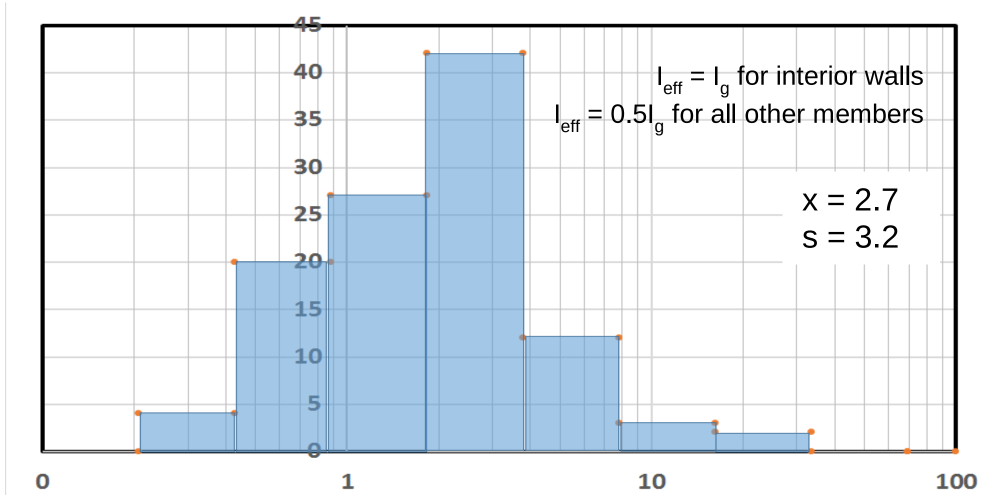
Notes: [a] (ASTM Standard D2487-11, 2011); [b] composite soil stiffness from falling weight deflectometer test (ASTM Standard D4694-09, 2009); [c] front axle followed by first rear axle at 14ft; [d] rear tandem axles separated by 4ft;[e] left and right wheels separated by 6ft.

Figure 4.4 shows two histograms, on the log scale, of the moment biases (defined as predicted moment over measured moment) for dominant bending in the culvert members for the test culverts. The top plot, Figure 4.4(a) represents the conservative case, $I_{eff} = 1.0 I_g$ for all members. Figure 4.4(b) represents the moderate case, $0.5 I_g$ for flexural members (*i.e.*, culvert top slabs, bottom slabs, and exterior walls) and $1.0 I_g$ for columns (*i.e.* culvert interior walls). In each plot, the mean of the moment biases, $\bar{x}$, and standard deviation, *s*, are shown. Ideally, the mean ($\bar{x}$) of these moment biases would be close to 1.0 with low scatter (*s*) indicating high accuracy and precision.

(a)



(b)



Moment bias (pred./meas.)

Figure 4.4. Log-scale histograms of dominant moment bias (predicted/measured) for three culverts using (a) conservative stiffness values, (b) moderate member stiffness values

The predicted moments for the 110 sections represented by the conservative member stiffness model (Figure 4.4(a)) are on average overly conservative by more than three times ($\bar{x}$ = 3.3). The standard deviation shows significant scatter (s = 3.8). By comparison, Figure 4.4(b) identifies some improvement in the moment bias by using the moderate member stiffness model. Here, the accuracy and precision improve as illustrated by a lower mean and standard deviation ($\bar{x}$ = 2.7; s = 3.2). Further, the model comes very close to achieving a log-normal distribution. Collectively, these measured data suggest that the moderate member stiffness model is reasonable for load-rating TxDOT pre-1980 culvert structures.

4.6 MEMBER STIFFNESS EFFECT ON OPERATING RATING

Live-load demand is only one component of the rating factor equation, with the others being capacity and dead-load demand. Therefore, the influence of member stiffness on overall culvert load rating is indirect and will vary by structure. In this section, the effect of member stiffness on overall load rating is illustrated using a sample of the TxDOT's culvert population. This was achieved by performing load rating calculations for 400 in-service culverts (or 715 culvert segments, 552 of which were rated). This sample is statistically representative of TxDOT's full (11,000) pre-1980 culvert population by a nominal margin of error of +/- 5%. Results were obtained using both the conservative and the moderate procedures for member stiffness. Figure 4.5 summarizes the results from these analyses.

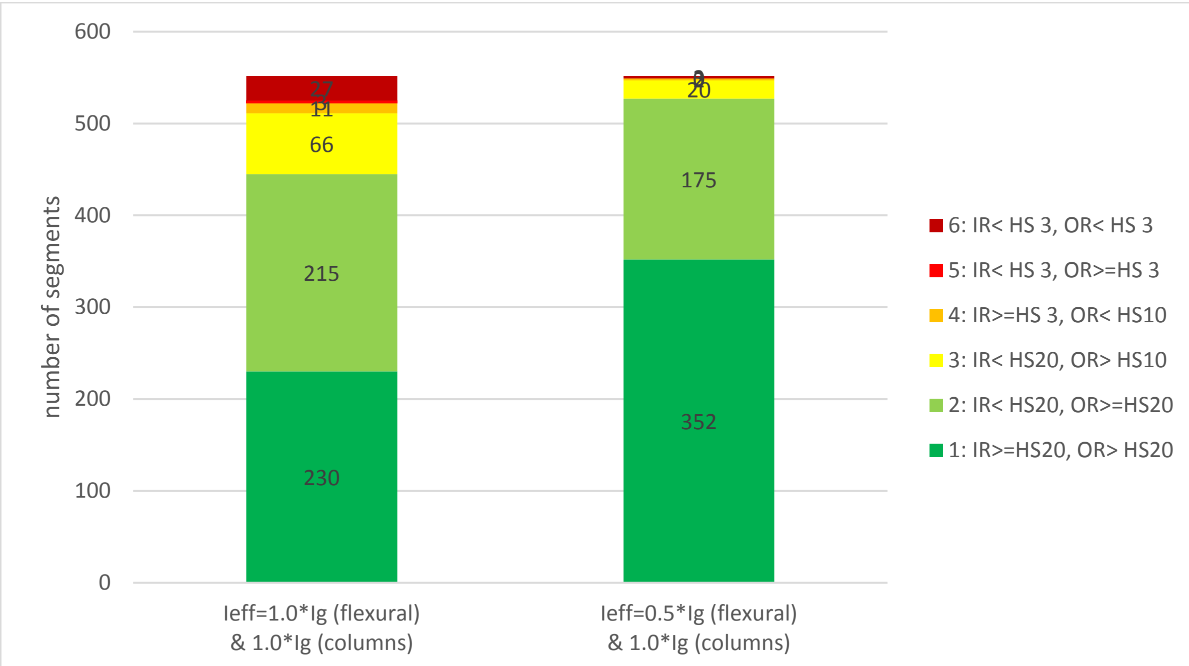


Figure 4.5. Load Rating Results for 400 Culverts (552 rated segments) Comparing Conservative and Moderate Member Stiffness Values

The left bar chart identifies the load rating values using the conservative member stiffness approach, where $I_{eff} = 1.0*I_g$ for all members. Here, it can be seen that 80.6% of rated culvert segments (shaded green) do not require load posting; that is, the OR > HS20. The right bar chart identifies the load rating values where the analysis was performed based on the moderate member stiffness approach, where $I_{eff} = 0.5*I_g$ for all flexural members and $1.0*I_g$ for columns (*i.e.*, interior culvert walls). Here, 95.5% of rated culvert segments (shaded green) will not require load posting; that is, the OR > HS20. This is a difference (increase) in posting category for 14.9% for the culvert population.

It is clear that using the moderate member stiffness approach yields higher load ratings for TxDOT's culvert population. However, the overall effect, while significant, is somewhat muted. This finding is consistent with observations from policy, from the parametric study, from the live load moment analysis, and also from characteristics of TxDOT's culvert population.

4.7 CONCLUSIONS

This chapter summarizes results from a study conducted to investigate the influence of member stiffness on the operating rating factors for TxDOT pre-1980 culvert structures. This included observations from policy, performance of a parametric study, a comparative analysis of live load moment data, and also consideration of the characteristics of TxDOT's culvert population.

ACI policy can be viewed as allowing the use of different member stiffness ratios, I_{eff} / I_g, ranging from 1.0 (which is the typical and conservative case) to as low as 0.35. Analysis results from the parametric study typically showed that the operating rating factors increased as the member stiffness ratio decreased. While this was generally true, the effect was more pronounced for low-fill and deep-fill cover soil conditions and also for cases of more stiff pavement, especially concrete pavement, overlying the culvert structure. Practically, because most TxDOT culverts are typically under direct traffic with a seal coat, the influence of member stiffness on the operating rating factor will range from "none" to "slight" for most cases. With this in mind, and with reference to ACI specification R6.3.1.1 for braced frames, the decision was made to select a moderate approach to member stiffness, $0.5I_g$ for flexural members (*i.e.* culvert top slabs, bottom slabs, and exterior walls) and 1.0 I_g for columns (*i.e.* culvert interior walls). Comparative load rating analyses for a sample of 400 in-service culverts representative of TxDOT's culvert population showed this decision resulted in an improvement in load posting category for about 15% of culvert segments.

The improvement in load rating associated with implementation of the moderate approach for selecting member stiffness ratio is significant but somewhat muted owing to the characteristics of TxDOT's population of pre-1980 culverts. Soil-structure interaction becomes more important as the cover soil depth increases, and the selection of member stiffness warrants further consideration under deep fill conditions.

CHAPTER 5
MODEL ENHANCEMENT – PAVEMENT STIFFNESS

5.1 OVERVIEW

The study presented in this chapter identifies, calibrates, and applies a simplified pavement model for production load rating of culverts to include and account for the influence of pavement structure on load rating analyses. This enhancement to the load rating model employs linear elastic, finite element analysis. Full cover soils are modelled as linear elastic elements and the pavement structures are modelled as beam elements by adding them across the top row of finite element nodes. Equivalent beam modulus values for the simplified model are then calibrated against the results from a research-intensive, full-pavement model for various pavement types. A parametric study shows that the inclusion of pavement increases the load ratings for direct-traffic and low-fill culverts carrying either intermediate-thickness asphalt pavements or concrete pavements. The effects of the simplified pavement beam model on predicted live-load moment response were further evaluated using measured live-load moments from field live-load tests on in-service culverts. From these comparisons, it was shown that the pavement beam model increased the accuracy and precision of the live load demands prediction. Finally, load rating analyses performed for 24 in-service culverts under various pavement types illustrated that the proposed pavement beam model improved rating factors compared to the no-pavement case. This evidence indicates that inclusion of pavement for in-plane live load attenuation should help close the disconnect between calculated load ratings and visually-observed performance of reinforced concrete box culverts. The contents of this chapter have been published by the *ASCE Journal of Bridge Engineering* (Seo *et al*. 2017).

5.2 INTRODUCTION AND BACKGROUND

It has been observed that older, in-service cast-in-place (CIP), reinforced-concrete box culverts typically show little structural damage, but load ratings calculated using the current policies frequently indicate that the culverts do not have adequate capacity. Highway officials, at both the state and federal levels, have sought to resolve this apparent disconnect between field observations and calculated load rating values for culverts (Lawson *et al*.

2010; Han *et al*. 2013; Orton *et al*. 2013; NCHRP 2015; Wood *et al*. 2016). One of the main reasons for such disconnect is that what were reasonably conservative assumptions for the *design* of reinforced concrete box culverts may become obstacles in assessing in-service *performance* of these culverts. The objective of this study is to reduce the excessive conservatism for load rating of reinforced concrete box culverts by introducing the benefit of live-load attenuation through the pavement layer.

The live load from a moving vehicle transmits into an in-service culvert by passing through the tire pressure, spreading slightly in the pavement structure, and attenuating further through the soil beneath the pavement structure until reaching top slab where the load distributes through the structure. Typical load rating practice is for the cover soil depth to subsume the pavement structure such that the combined pavement-soil system is modelled entirely as soil. Therefore, the contribution of the pavement structure to the live-load attenuation is usually ignored for load rating reinforced concrete box culverts (refer to the dashed line in Figure 5.1). However, pavement is stiffer than soil and will therefore spread live load faster with depth than soil alone (refer to solid line in Figure 5.1).

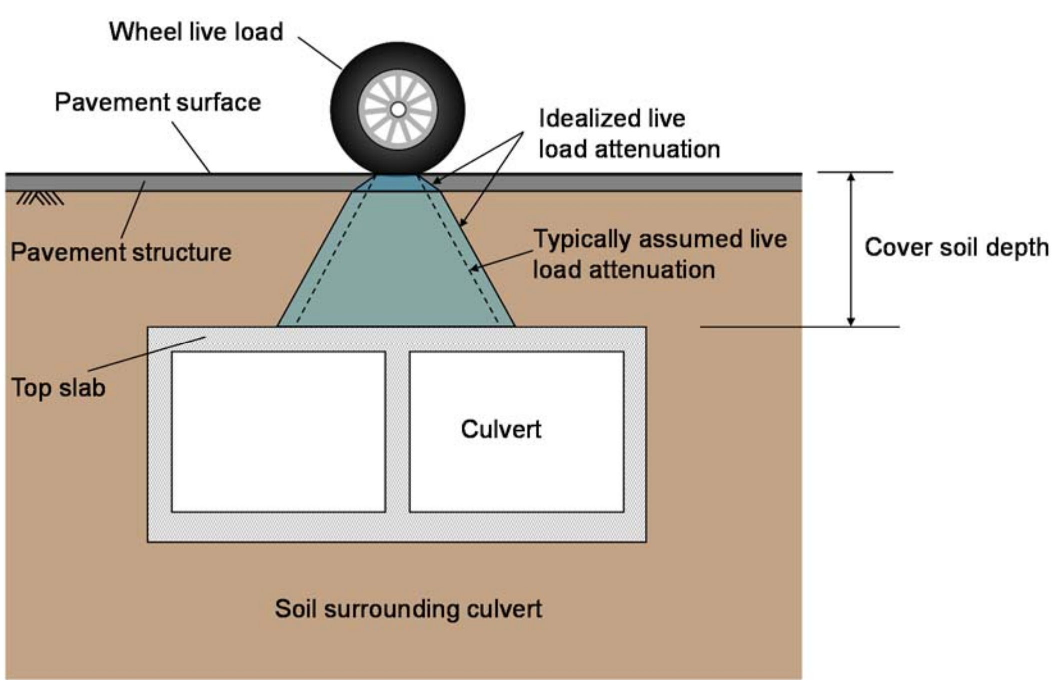


Figure 5.1. Live load attenuation below pavement surface

The contribution of pavement to live-load attenuation has been recognized by many researchers. AASHTO (2013) acknowledges that pavement influences the live load distribution, although it does not provide guidance for it. NCHRP (2015) also specifically identifies accounting for “the effect of pavement” as a requirement for *improved* load rating specifications. Petersen *et al*. (2010) modelled a concrete pavement by adding a single, elastic layer with concrete properties on top of the soil in their three-dimensional (3D) numerical modelling using FLAC3D (Itasca 2005). They reported that the influence of pavement was “greater for shallow culvert cover depth and flexible culverts and smaller for stiffer culverts and deeper burial.”

Han *et al*. (2013) performed two field tests on the concrete box culverts under rigid and flexible pavements. They then developed 3D numerical models of the test culverts and verified the models against the results from the field tests. Using the verified models, Han *et al*. (2013) performed a parametric study to investigate the effect of pavement type, pavement thickness, fill depth, and culvert span on the live load attenuation. Results from their parametric study showed that “the effect of the traffic load on the vertical pressure on the culvert was more significant at the lower fill depth and gradually decreased with the increase of the fill depth”; this supports the observations made by Petersen *et al*. (2010) in their study. Han *et al*. (2013) further reported that the vertical pressure acting on the top slab of the culvert was lower under a rigid pavement than that under a flexible pavement at the same pavement thickness. The intensity of the distributed vertical pressure on the culvert decreased with the increasing pavement thickness. More interestingly, they reported that the effect of the culvert span on live load attenuation was negligible for culverts with properly designed slab thicknesses.

Mlynarski *et al*. (2016) presented preliminary results from their study on influence of in-plane pavement stiffness on the load-rating factor. Pavements were modeled in CANDE (2015) with linear-elastic, beam-column elements laid over soil surface. Three pavement cases (“None”, “Modest”, and “Heavy”, representing no pavement, asphalt, and concrete, respectively) were considered in the study. After performing analyses on various pipe culverts, they concluded that pavement models can significantly improve load rating and further recommended that pavement always be included in load-rating models. This work should be applauded because it was an effort to consider the pavement in *production-*

oriented, routine load rating rather than in research-intensive models.

The study described herein identifies, calibrates, and applies a simplified pavement model to a production-simplified, linear-elastic, finite-element, soil-structure interaction model to include and account for the in-plane influence of pavement structure on reinforced concrete box culvert load ratings. The pavement-soil system is modeled using linear elastic elements for the full cover soil thickness with beam elements across the top row of nodes for pavement. The equivalent beam stiffnesses were calibrated by minimizing the mean standard error of the induced vertical force from a point load between the research-intensive, full-pavement model and the production-simplified beam model. To account for soil-structure interactions, various soil stiffness conditions were also considered in the analysis. The simplified pavement model proposed herein is specific to cast-in-place, reinforced-concrete box culverts, although the same approach could be applied to other types of culverts.

5.3 SIMPLIFIED PAVEMENT MODEL AND CALIBRATION METHOD

TxDOT maintains pavement data through their Pavement Management Information System (PMIS). PMIS contains more than 195,000 data collection sections, each section 0.5 mile in length on average, making up the entire network of State-maintained highways (TxDOT 2014). The PMIS data include visual conditions of the pavement surface, deflection surveys, and pavement types (TxDOT 2011). The pavements used in PMIS are categorized into ten different types and presented in Table 5.1. Types 01 through 03 are rigid pavements, Types 04 through 07 are flexible pavements, Types 08 and 09 are overlay pavements, and Type 10 is a seal coat pavement.

Table 5.1. Pavement Types in Texas DOT's PMIS (Modified after TxDOT 2014)

Code	Description	Abbreviation
01	Continuously Reinforced Concrete Pavement	CRCP
02	Jointed Reinforced Concrete Pavement (JRCP)	JRCP
03	Jointed Plain Concrete Pavement (JPCP)	JPCP
04	Thick Asphaltic Concrete Pavement (greater than 5-1/2")	Thick ACP
05	Intermediate Thickness Asphaltic Concrete Pavement (2-1/2" to 5-1/2")	Int. ACP
06	Thin Surfaced Flexible Base Pavement (less than 2-1/2")	Thin ACP
07	Asphalt Surfacing with Heavily Stabilized Base	ACP w/ Stab. Base
08	Overlaid and/or Widened Old Concrete Pavement	Overlaid Concrete
09	Overlaid and/or Widened Old Flexible Pavement	Overlaid Flexible
10	Thin Surfaced Flexible Base Pavement (Surface Treatment-Seal Coat Combination)	Seal Coat

The ideal approach to properly account for live-load attenuation through the pavement structure is to identify (measure) the thicknesses of pavement surface and base layers. Of course, these may vary from culvert to culvert, even for the same pavement type presented in Table 5.1. Furthermore, determination of in-service moduli values of the pavement layers involves field tests such as falling weight deflectometer (FWD) or core samples and laboratory tests. Likewise, determining stiffness of supporting soil beneath the pavement structure requires either a field test or geotechnical borings and laboratory tests. Therefore, obtaining project-specific data, even for pavement properties alone, may not be a viable option for production-oriented, routine culvert load-rating applications.

In this study, in order to facilitate the use of pavement model for production culvert load rating, a *simplified* approach is proposed. Nominal thicknesses and moduli of pavement structures of each category were determined based on the extensive literature on typical design modulus values and thicknesses of pavement layers in Texas (Won 2001; Walubita and Scullion 2010; TxDOT 2011; Liu and Scullion 2011, Jung *et al*. 2012; and TxDOT 2014). Pavement engineers who have in-depth knowledge of TxDOT's pavement design practices actively participated in this process as well. The nominal properties for each pavement type determined in this manner are presented in Table 5.2. For a rigid pavement (Types 1 through 3), the differences in the nominal properties among the three types were practically negligible and hence the same values are recommended.

Table 5.2. Nominal Properties of Each Pavement Type

Type	Description	Material Type	Properties: $E/\nu/t$ (a)
01 02 03	CRCP JRCP JPCP	Surface: Concrete	5000 ksi/0.15/10 in
		Base: Asphalt	300 ksi/0.35/4 in
04	Thick ACP	Surface: Asphalt	650 ksi/0.35/6 in
		Base: Cement-stabilized base	125 ksi/0.3/5 in
05	Int. ACP	Surface: Asphalt	500 ksi/0.35/4 in
		Base: Cement-stabilized base	125 ksi/0.3/8 in
06	Thin ACP	Surface: Asphalt	500 ksi/0.35/2 in
		Base: Flexible base	50 ksi/0.35/12 in
07	ACP w/ Stab. Base	Surface: Asphalt	200 ksi/0.35/2 in
		Base: Asphalt treated base	350 ksi/0.35/8 in
08	Overlaid Concrete	Surface: Concrete	5000 ksi/0.15/10 in
		Base: Old concrete	500 ksi/0.2/11 in
		SubBase: Asphalt	300 ksi/0.35/4 in
09	Overlaid Flexible	Surface: Asphalt	500 ksi/0.35/4 in
		Base: Old asphalt	100 ksi/0.35/4 in
		SubBase: Cement-stabilized base	125 ksi/0.3/8 in
10	Seal Coat (b)	Surface: Sprayed asphalt seal	No credit
		Base: Flexible base	50 ksi/0.35/12 in

(a) E = Young's modulus; ν = Poisson's ratio; and t = thickness of pavement layer
(b) Type 10 has a thin seal coat over the flexible base, but it was assumed that the thin seal coat has no structural capacity and therefore only the base layer is considered.

It is emphasized that *actual* stiffness values and thicknesses of the pavement layers are likely to be different from the nominal properties presented in Table 5.2, an actual values should be used when available. Further, it is helpful to recall that the nominal stiffnesses and thicknesses are not intended for pavement *design*. Rather, the development of a simplified model to account for live-load attenuation through pavement is focused on production-oriented culvert *load rating*.

The pavement structure can be appropriately modeled by a series of finite-element layers using the nominal properties (hereafter, referred to as a *full pavement model*). However, specifying such a model would be challenging for production load rating. Alternatively, the authors propose a simplified approach (hereafter, referred to as a *simplified* *beam model*) that models the full cover soil depth using linear-elastic, finite elements of soil stiffness and adds a beam across the top row of nodes. The equivalent Young's modulus of the beam is calibrated by minimizing the differences of the induced vertical force between the full pavement model and the simplified beam model below the pavement structure. Although most finite element software packages should work, all analyses for this study were performed using *RISA-3D 14.0* (RISA Technologies, LLC 2015). The soil elements were modeled as quadrilateral plates and the thickness of the beam element was kept constant at 6 in. A convergence study was also performed to determine domain size.

Detailed procedures to calibrate the equivalent beam modulus $E_{eq,beam}$ against results from the full-pavement model are described as follows. Type 5 pavement is used as an example:

1) Generate a finite-element model using nominal properties of full pavement model [i.e., a 4-inch-thick hot mix asphalt surface with E = 500 ksi and ν = 0.35 overlying a 8-inch-thick cement-stabilized base with E = 125 ksi and ν = 0.3 for Type 5] and apply a vertical point load onto the pavement surface [refer to Fig. 5.2(a)]. Note that the top of the soil layer for pavement Type 5 is located at 1 ft below the pavement surface.
2) Obtain a profile of induced vertical force versus depth, represented as the red-dashed curve in Fig. 5.2(a), from the full pavement model.
3) Generate a separate finite-element model, and model the pavement structure with soil elements. Then, add a 6-inch-thick beam element across the top row of finite-element nodes [refer to Fig. 5.2(b)].
4) Assign a trial value of beam modulus ($E_{eq,beam}$).
5) Apply the same magnitude of the vertical load used for full pavement model onto the beam element and obtain a profile of induced vertical force versus depth in the soil, represented as the blue-solid curve in Fig. 5.2(b).
6) Compare the profiles of vertical force versus depth from full-pavement and simplified beam models, and compute the mean standard error (ε_{std}) (using Equation 5-1) between the two models for the zone *below* the pavement structure [i.e., below the dashed horizontal line in Fig. 5.2(b)]:

$$\varepsilon_{std} = \sqrt{\frac{\sum_{i=1}^{N} (F^i_{y,full} - F^i_{y,beam})^2}{N}} \qquad (5\text{-}1)$$

where $F^i_{y,full}$ = induced vertical force at node i from the full-pavement model; $F^i_{y,beam}$ = induced vertical force at node i from the simplified beam model; and N = total number of nodes.

7) Assign different value of $E_{eq,beam}$ and repeat Steps 4 through 6 until the minimum of the mean standard error is identified.

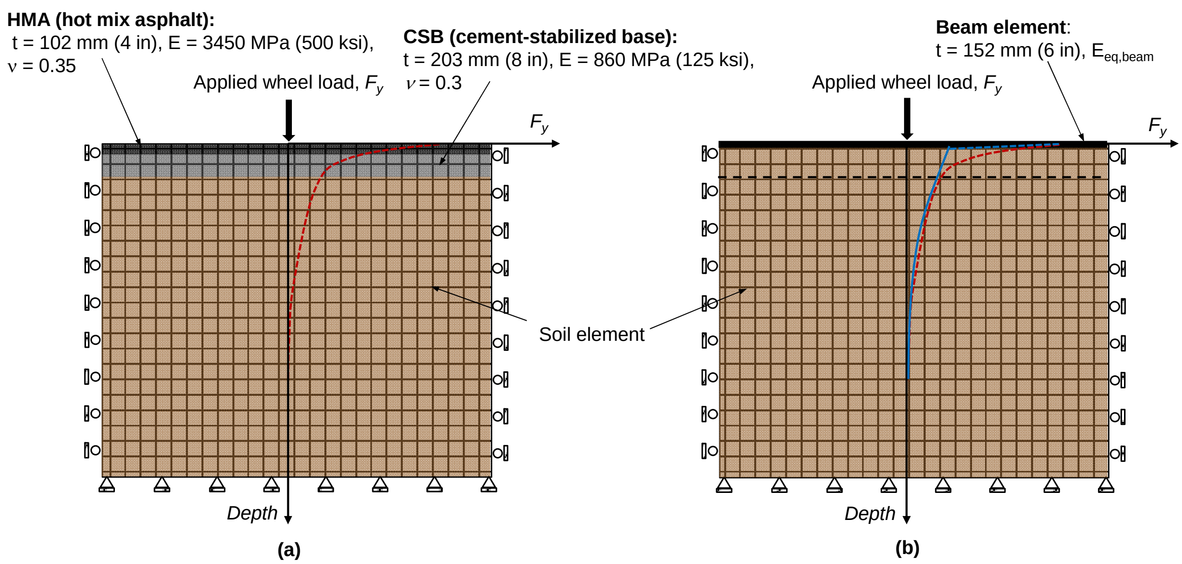


Figure 5.2. Illustration of analysis method for Type 5 pavement: (a) full pavement model and (b) simplified beam model

Because the calibrated equivalent beam modulus is influenced by the stiffness of the surrounding soil due to soil-structure interactions, the calibrations were performed for three different soil modulus values: E_{soil} = 12 ksi, 24 ksi, and 36 ksi, representing resilient moduli of low-, medium-, and high-stiffness soils, respectively. Figs. 5.3(a) and 5.3(b) show the mean standard error and the profiles of the induced vertical force versus depth for Type 5 pavement with E_{soil} = 24 ksi.

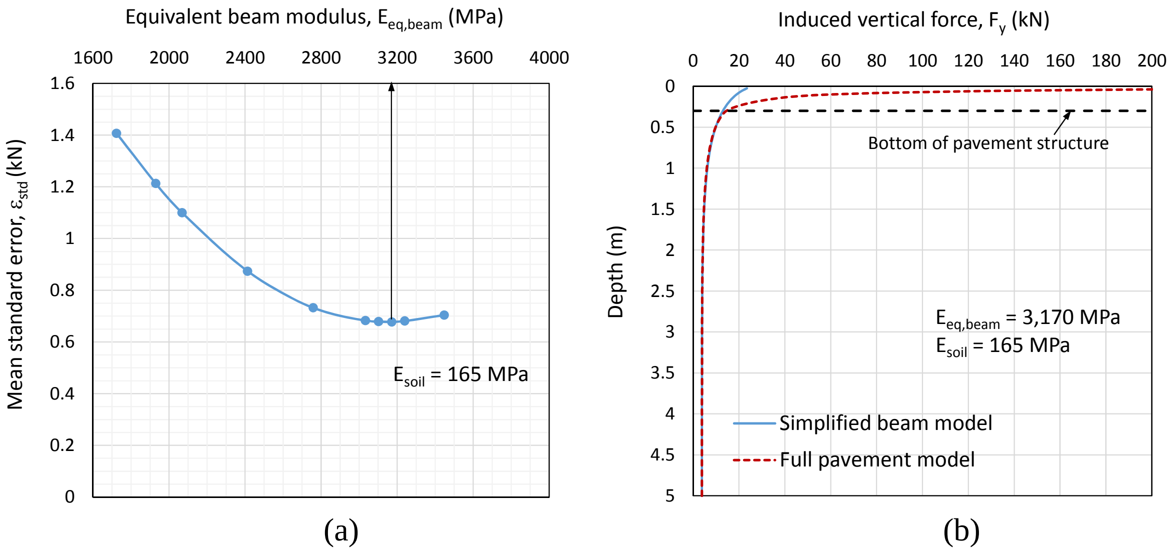


Figure 5.3. Calibration of equivalent beam modulus for Type 5 pavement with E_{soil} = 24 ksi: (a) induced vertical force versus depth from full-pavement and simplified beam models and (b) equivalent beam modulus versus mean standard error

The aforementioned calibration processes were performed for all ten pavement types with three different soil moduli. Final equivalent beam modulus values determined in this study for the simplified beam model are presented in Table 5.3. As expected, pavement types with concrete surfaces (Type 1, 2, 3, and 8) yielded the greatest $E_{eq,beam}$ values. Pavement types with asphalt surfaces (Types 4, 5, 6, 7, and 9) yielded the second greatest $E_{eq,beam}$ values, and the seal coat surface (Type 10) yielded the smallest value. Furthermore, regardless of pavement types, the equivalent beam modulus decreases as the soil modulus increases. This is intuitive because the softer the soil is, the stiffer the beam is required to compensate for slower live-load attenuation in the soft soil layer.

The equivalent beam modulus $E_{eq,beam}$ presented in Table 5.3 should not be interpreted as physical modulus values. For example, the values of $E_{eq,beam}$ for rigid pavements (Types 1, 2, 3, and 8) are an order of magnitude greater than the actual concrete surface and base properties. Rather, the $E_{eq,beam}$ should be viewed as a modulus of a fictitious beam that would induce similar magnitude of live load at the top slab of the culvert to what would have been observed had the actual pavement structure been fully modeled.

TABLE 5.3. Equivalent Modulus ($E_{eq,beam}$) for Simplified Beam Model for Pavement

Type	Description	Equivalent beam modulus, $E_{eq,beam}$ (ksi)		
		E_{soil} = 12 ksi	E_{soil} = 24 ksi	E_{soil} = 36 ksi
1	Continuously Reinforced Concrete Pavement (CRCP)	34,000	32,000	29,500
2	Jointed Reinforced Concrete Pavement (JRCP)			
3	Jointed Plain Concrete Pavement (JPCP)			
4	Thick Asphaltic Concrete Pavement (greater than 5-1/2")	890	630	520
5	Intermediate Thickness Asphaltic Concrete Pavement (2-1/2" to 5-1/2")	720	460	340
6	Thin Surfaced Flexible Base Pavement (less than 2-1/2")	255	130	75
7	Asphalt Surfacing with Heavily Stabilized Base	580	390	310
8	Overlaid and/or Widened Old Concrete Pavement	58,000	55,000	53,000
9	Overlaid and/or Widened Old Flexible Pavement	1250	660	430
10	Thin Surfaced Flexible Base Pavement (Surface Treatment-Seal Coat)	50	21	11

5.4 PARAMETRIC STUDY

In this section, the impact of the proposed simplified pavement model on load rating is evaluated by performing a parametric study. Results from the parametric study are presented in terms of the rating factor computed using Eq. (5-2):

$$RF = \frac{C - A_1 D}{A_2 L(1+I)} \qquad (5\text{-}2)$$

where RF = rating factor; C = structural capacity of the member; D = dead-load effect on the member; L = live-load effect on the member; I = impact factor; A_1 =1.3 [factor for dead loads from *AASHTO Manual for Condition Evaluation of Bridges* (MCEB) 6.5.3 (AASHTO 2003)]; and A_2 = 2.17 for inventory level and 1.3 for operating level (factors for live loads from MCEB 6.5.3). Structural capacities (C) of the culvert members in Eq. (5-2) are determined from a culvert design standard defining configuration and strength of the concrete and reinforcing steel. The dead- and live-load demands (D and L) are obtained from the production-simplified, two-dimensional, linear-elastic, finite-element, soil-structure interaction model. The soil-structure interaction model has been described in the TxDOT's

Culvert Rating Guide (Lawson *et al*. 2009) and implemented in TxDOT's analysis program *CULVLR* (TxDOT 2013).

A culvert standard design selected for the parametric analysis was MBC-2-34-F, one of the pre-WWII standards (c.1920s-1940s), representing small, square, haunched culverts. The culvert geometry is a four-barrel, 5 ft by 5 ft box culvert. In order to assess the effect of the cover soil depth, three cover soil depths were evaluated: 1 ft, 4 ft, and 10 ft, representing direct-traffic (0-2 ft), low-fill (2-6 ft), and deep-fill (> 6 ft) culverts, respectively. Since the soil stiffness directly impacts the culvert load rating in a linear-elastic soil-structure interaction model, three different soil stiffness conditions (low, medium, and high stiffnesses) were also considered in the parametric study. Finally, four pavement cases were evaluated: 1) without pavement (None), 2) Type 10 seal coat treatment (SC), 3) Type 5 intermediate thickness asphalt pavement (IA), and 4) Type 1 continuously reinforced concrete pavement (CRCP).

Results from the parametric study are presented in Fig. 5.4 in terms of operating rating factor (ORF) versus soil stiffness for various pavement types. The seal coat (SC), as seen in Figs. 5.4(a) and **5.4**(b), shows negligible increases in load ratings compared to the model without pavement (shown as None) for direct-traffic and low-fill culverts. This is because the equivalent modulus for the seal coat pavement is very similar in stiffness to the soil and does not greatly attenuate live load. However, the intermediate asphalt (IA) pavements show slight increase in ORF, and the concrete pavement (CRCP) significantly increases the load ratings for all three soil conditions. On the other hand, Fig. 5.4(c) suggests that for deep-fill culverts, none of the pavements contribute much to load rating, regardless of soil conditions. Rather, the soil stiffness conditions play a larger role in load rating when the fill depth is large.

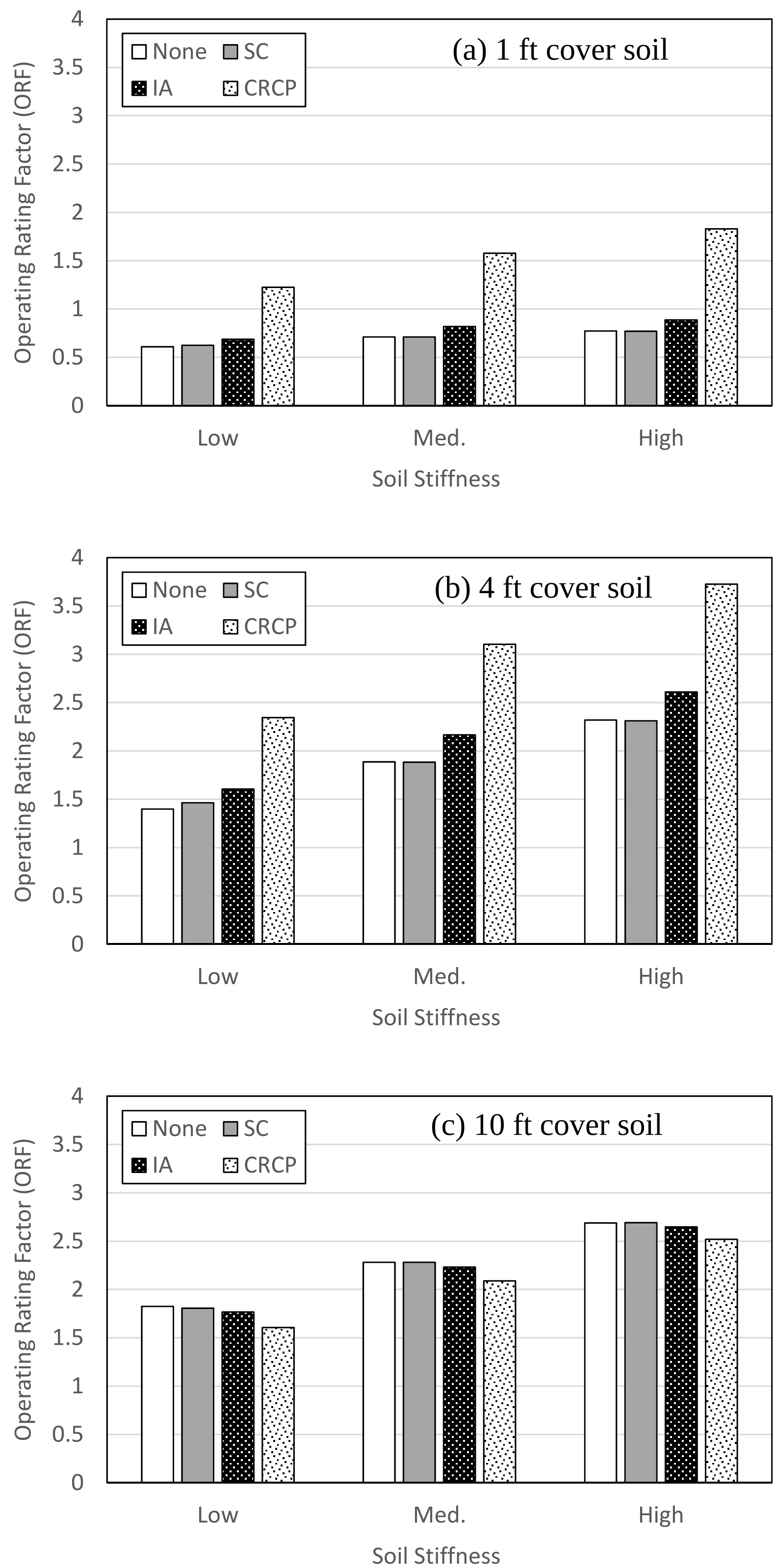


Figure 5.4. Load rating of four-barrel, 5 ft x 5 ft concrete box culvert with MBC-2-34-F design under three cover soil depths

5.5 COMPARISON WITH MEASURED MOMENT DATA

This section presents an evaluation of the effect of the simplified pavement beam model on predicted live-load moment response using measured live-load moments from two, previously published, field live-load tests on in-service culverts. The researchers performed load tests on two culverts with pavement using static truck loads (Lawson, *et al*. 2010; Wood, *et al*. 2015; Wood, *et al*. 2016). The culverts were instrumented with strain gages at potential critical sections. Table 5.4 shows the configuration of the testing culverts. The Swisher county culvert had seal coat surface treatment (pavement Type 10); the Hale county culvert was under intermediate-thickness asphaltic concrete pavement (Type 05).

Table 5.4. Project Data for Measured Live Load Moments from Field-Tested Culverts in Texas (Lawson et al. 2010; Wood et al. 2015; Wood et al. 2016)

	Swisher County, TX	Hale County, TX
Culvert Properties		
Cover soil depth	1.5ft	3.5ft
Pavement Type	Type 10: Seal Coat	Type 5: Int. ACP
No. of barrels	5	4
Barrel span	6ft	10ft
Height	6ft	6ft
Constructed year	1951	1991
AASHTO default soil unit weight, γ	120pcf	120pcf
Specified reinforcing steel strength, f_y	33ksi	60ksi
Measured concrete compressive strength, f'_c	9750psi	8000psi
Cover Soil Properties		
USCS soil classification [(a)]	sandy clay	fat clay
USCS group symbol [(a)]	CL	CH
Soil modulus of elasticity for live load, E [(b)]	9.0ksi	8.0ksi
Assumed soil Poisson's ratio, ν	0.3	0.3
Truck Loads		
Front Axle (single) [(c)]	12.3kips	11.5kips
Rear Axles (tandem) [(d)]	38.7kips	35.5kips
Front Wheel [(e)]	6.2kips	5.8kips
Rear Wheels [(e)]	9.7kips	8.9kips

(a) ASTM Standard D2487-11 (2011)
(b) Composite soil stiffness from falling weight deflectometer test (ASTM Standard D4694-09, 2009)
(c) Front axle followed by first rear axle at 14ft
(d) Rear tandem axles separated by 4ft
(e) Left and right wheels separated by 6ft.

Figure 5.5 shows three histograms, on the log scale, of the moment biases (defined as predicted moment over measured moment) for dominant bending in the exterior members (positive bending in the top and bottom slabs, negative bending in the top slabs, exterior walls, and bottom slabs corners, and positive and negative bending in the exterior walls). In each plot, the mean of the moment biases, $\bar{x}$, and standard deviation, s, are shown. Ideally, the mean ($\bar{x}$) of these moment biases would be close to 1.0 with low scatter (s) indicating high accuracy and precision.

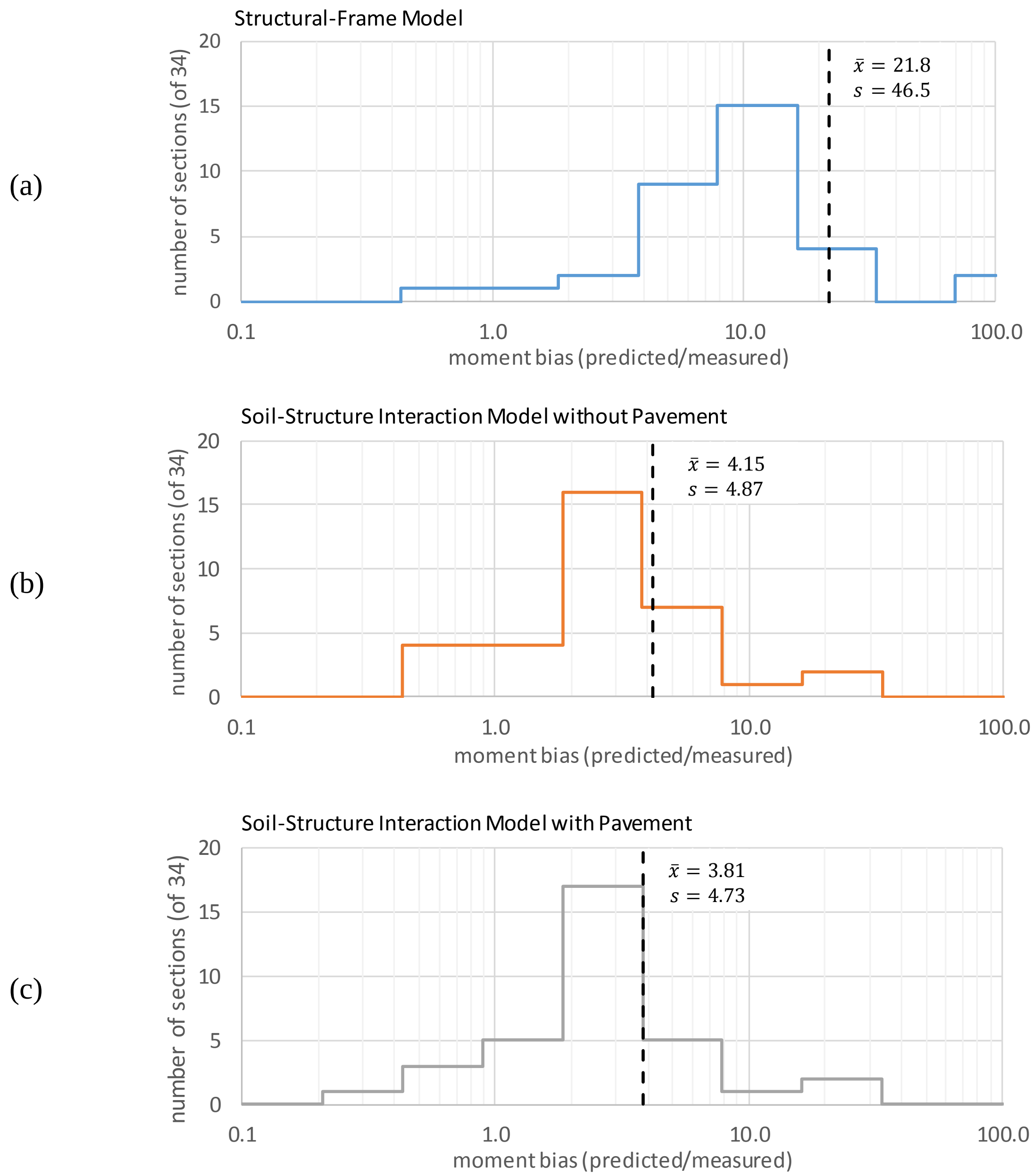


Figure 5.5. Dominant moment bias (predicted/measured) for two load tested culverts using (a) the Structural-Frame model, (b) the Soil-Structure Interaction Model without pavement, and (c) the Soil-Structure Interaction Model with pavement

Figure 5.5(a) shows the histogram of the moment biases from the AASHTO recommended, direct-stiffness, structural frame model. The predicted moments at the 34 sections are on average overly conservative by nearly 22 times ($\bar{x}$ = 21.8). This conservatism is clearly excessive for culvert load rating. Furthermore the standard deviation shows considerable scatter (s = 46.5). Figure 5.5(b) shows the improvement in the moment bias by using the production-simplified, linear-elastic, finite-element, soil-structure interaction model *without* pavement [for more details of the soil-structure interaction model, refer to Lawson *et al*. (2009) and Wood *et al*. (2015)]. Here, the accuracy and precision increase substantially as illustrated by a much lower mean and standard deviation ($\bar{x}$ = 4.15; s = 4.87).

In order to assess the effect of the pavement model, further analyses were performed using the same soil-structure interaction model used for Fig. 5.5(b) but *with* the addition of the simplified pavement beam model; analysis results are presented in Figure 5.5(c). The histogram of the moment biases in Fig. 5.5(c) shows further increase, although not significant, of the accuracy and precision of the model ($\bar{x}$ = 3.81; s = 4.73) and comes very close to achieving a log-normal distribution.

For the Swisher county culvert with the seal coat (Type 10), the operating rating factor increased 10% by including the pavement beam model. Further, as expected, the thicker flexible pavements provide more attenuation. For the Hale county culvert with the intermediate-thickness asphaltic concrete pavement (Type 5), the controlling operating factor increased by 33% with pavement. This trend is consistent with the results from the parametric study.

5.6 PAVEMENT EFFECT ON OPERATING RATING

Live-load demand is only one component of the rating factor equations in Eq. (5-2) with the others being capacity and dead-load demand. Therefore, the influence of the simplified pavement beam model on overall culvert load rating is indirect and may vary by structure. In this section, the effect of pavement on overall load rating is illustrated using a sample of the TxDOT's culvert population.

An *illustrative* sample of 24 in-service culvert segments (ten under Type 10 seal coat, ten under Type 5 intermediate thickness asphalt concrete pavement, and four under Type 1 CRCP) were selected for this analysis. All 24 culverts are direct-traffic or low-fill culverts surrounded by soils with low or medium stiffness. For each culvert, three types of analysis were performed: (a) a production-simplified, two-dimensional (2D), direct-stiffness, *structural-frame model* as recommended by MBE (AASHTO 2013), (b) a production-simplified, 2D, linear elastic, finite-element, *soil-structure interaction model* described in the *Culvert Rating Guide* (Lawson *et al*. 2009) *without pavement*, and (c) the enhanced soil-structure interaction model with *pavement*.

Results from the load rating analysis using the three models are summarized in Table 5.5 and in Figure 5.6. As shown in Fig. 5.6, the soil-structure interaction models (grey and orange areas) yield higher ORF values that those from the structural-frame model (blue area) for all types of pavement. By the inclusion of the pavement beam model in the soil-structure interaction model, the operating rating factor increased for all pavement types. The ORF increased by 7 to 12% with an average of 10% for seal coat and by 46% on average for the intermediate thickness asphalt concrete pavement. This is very consistent with the results from comparison against load-tested field culverts. For the continuously reinforced concrete pavement, the ORF value significantly increased by an average of 147%. This illustrative example indicates that the proposed simplified pavement beam model can improve rating factors and help reduce the gap between load rating calculation and the visually observed performance of reinforced concrete box culverts.

Table 5.5. Summary Load Ratings for 24 In-Service Culverts under Various Pavement Types

Pavement Type	Culvert Segments	Cover soil depth (ft)	Soil stiffness	ORF from structural frame model	ORF soil-structure interaction model w/o pavement	ORF soil-structure interaction model w/ pavement	Percent increase by inclusion of pavement
Seal coat	1 Org 1957 3-8x4 T	0.5	Med.	0.37	0.77	0.83	7%
	1 Org 1961 3-10x10 T	1.0	Med.	0.37	1.08	1.21	12%
	1 Org 1963 4-5x2 T	1.0	Med.	0.56	1.18	1.29	9%
	1 Org 1965 4-8x4 T	1.5	Med.	0.43	1.13	1.25	11%
	1 Org 1963 4-10x6 T	1.5	Med.	0.58	1.22	1.37	12%
	1 Org 1968 4-9x5 T	2.0	Med.	0.57	1.50	1.65	10%
	1 Org 1974 2-10x7 T	2.0	Med.	0.59	1.55	1.71	10%
	1 Org 1961 4-10x10 T	2.0	Med	0.48	2.10	2.30	10%
	1 Org 1954 3-10x10 T	2.5	Med.	0.53	2.54	2.81	10%
	1 Org 1937 4-5x2 T	2.5	Med.	0.92	4.27	4.57	7%
Int. ACP	1 Org 1960 4-10x10 T	0.5	Med	0.33	0.88	1.39	59%
	1 Org 1950 5-6x6 T	1.0	Med.	0.51	0.95	1.54	62%
	1 Org 1944 4-10x10 T	1.0	Med	0.80	1.63	2.43	49%
	1 Org 1955 5-8x7 T	2.0	Med.	0.48	1.37	2.00	46%
	1 Org 1971 2-7x6 T	2.0	Med.	0.64	1.58	2.20	39%
	1 Org 1974 8-10x8 T	2.0	Med.	0.63	1.61	2.47	53%
	1 Org 1964 5-6x5 T	2.0	Med.	0.99	1.96	2.69	38%
	1 Org 1964 6-10x10 T	2.0	Med	0.46	1.78	2.93	64%
	1 Org 1947 2-10x9 T	3.0	Med	0.80	2.45	2.63	7%
	1 Org 1965 4-7x7 T	3.0	Med	1.21	5.23	7.55	44%
CRCP	1 Org 1957 5-6x5 T	1.5	Low	0.74	1.35	3.26	142%
	1 Org 1958 5-9x9 T	2.0	Low	0.76	1.59	2.59	63%
	1 Org 1973 3-6x5 T	2.5	Low	0.76	1.71	4.97	190%
	1 Org 1964 2-10x10 T	2.0	Med.	0.43	2.04	6.01	195%

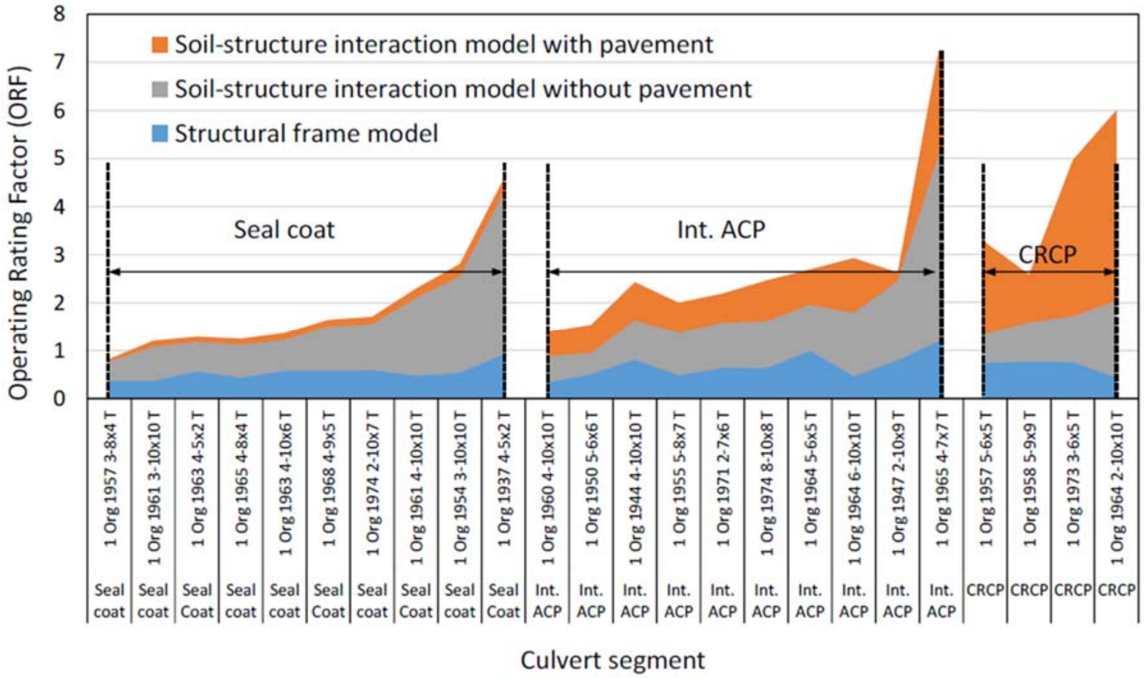


Figure 5.6. Operating rating factors of in-service culverts using structural-frame model, soil-structure interaction model without pavement, and soil-structure interaction model with pavement

5.7 CONCLUSIONS

This chapter has presented a production-simplified soil-structure interaction model for culvert rating that includes the in-plane attenuation of live load due to pavement. The model and its calibration have been described, along with recommended assumptions for the routine production load rating of cast-in-place, reinforced concrete box culverts. The calibrated equivalent beam moduli ($E_{eq,beam}$) were greatest for pavement types with concrete surfaces. Pavement types with asphalt surfaces yielded the second greatest $E_{eq,beam}$ values, and the seal coat pavement type yielded the smallest value. Furthermore, regardless of pavement types, $E_{eq,beam}$ decreases as the soil modulus increases. A parametric study showed that the seat coat pavement provided negligible increase in load ratings. However, it was observed that the proposed simplified pavement beam model could increase the load ratings for asphalt pavements with an intermediate thickness and concrete pavements *for direct-traffic and low-fill culverts*. For deep-fill culverts, the effect of pavement stiffness on load rating was negligible. Furthermore, comparison of measured live-load moment data show the proposed simplified beam model to be significantly more accurate and precise for the prediction of live-load moment response than the AASTHO-recommended structural frame model. Load rating analyses performed for an illustrative sample of 24 in-service culverts under various pavement types indicated that the proposed pavement beam model improved rating factors by an average of 10% for the seal coat, 46% for the intermediate asphalt, and 147% for concrete pavement. These increases should help close the disconnect between calculated load ratings and visually observed structural performance of reinforced concrete box culverts.

CHAPTER 6
MODEL ENHANCEMENT – SOIL STIFFNESS

6.1 OVERVIEW

This chapter presents findings from an analytical study to differentiate dead load soil stiffness and live load soil stiffness values for production-simplified load rating of reinforced concrete box culverts. The focus is on accurately predicting load demands with a soil-structure interaction model which uses a linear elastic constitutive model for both soil and concrete. The responses of the soil-culvert system under dead and live loads were examined separately. First, soil-culvert systems were analyzed to determine dead-load-induced demands in the structure. Predicted results were compared with moments obtained from a structural-frame model which used the simple and accepted Rankine theory for calculation of loads. A calibrated value of static soil modulus, E_s = 10 ksi, was selected as the optimum soil stiffness for dead loads. A comprehensive literature review identified resilient modulus as a reasonable parameter for live load analysis in culvert load rating. Typical resilient moduli, M_R = 12, 24 and 36 ksi for low, medium and high-quality culvert backfill soils, respectively, were identified as suitable for production-simplified live load calculations.

6.2 INTRODUCTION AND BACKGROUND

6.2.1 Types of Models for Calculating Culvert Load Demands

Load rating requires the culvert structure to be analyzed to determine bending moments, shear forces and axial loads induced by both dead loads and live (traffic) loads. Thus, culvert load rating is strongly dependent on how culvert capacity, culvert dead load, and culvert live load are established (Lawson et al. 2009). The AASHTO rating factor equation (Equation 2-1) differentiates between dead load demands which correspond to static load conditions and live load demands which correspond to dynamic loading conditions. The reason for this differentiation is that soil, like many other engineering materials, responds differently to static and dynamic loads. This suggests the need for a differentiated approach toward choosing the soil parameters when modeling the loading conditions associated with load rating. For the production-simplified approach which relies on a linear elastic soil constitutive model, two parameters are used: modulus of elasticity of the soil (Young's modulus) and Poisson's ratio.

This chapter will focus on identifying appropriate values of soil modulus to enhance model accuracy and precision relative to the load rating demands calculation.

6.2.1.1 Structural Frame Model

This project employs two types of production-simplified models as per the TxDOT *Culvert Rating Guide* (Lawson et al. 2009). The first and most commonly used model is the two-dimensional, structural-frame model recommended by AASHTO which uses a direct-stiffness approach to calculate load demands (AASHTO 2003, 2014, 2016). CULV5, an MS-DOS program developed and distributed by TxDOT, implements this structural-frame load rating model and was used in this study (TxDOT 2003a). The structural-frame model simplifies the soil-culvert system by analyzing the culvert as a simply-supported frame subjected to vertical and lateral pressures resulting from the weight of surrounding soil. The structural-frame model generates excessively conservative results for live load (Wood et al. 2015). However, for dead load, the vertical and lateral pressures induced by soil weight and applied by the structural frame model have a long history in soil mechanics and are well understood. Thus the direct stiffness method provides a straightforward and reasonably accurate way to calculate culvert demands under dead load.

The structural frame model ignores the load carrying capabilities of the soil through soil arching. The model does not require soil stiffness as input but instead applies the gravity weight of the soil and relies on a range of active earth pressure coefficients to account for potential differences in soil support. In this way the dead load demand calculations from the direct-stiffness model can then be used to calibrate an equivalent elastic soil modulus that suitably estimates dead load demands for the soil-structure interaction model.

6.2.1.2 Soil-Structure Interaction Model

The second production-simplified model and the focus of this chapter is the production-simplified two-dimensional, linear-elastic, finite-element soil-structure interaction model. This approach uses beam elements to model the concrete structure and trapezoidal finite-elements to model the soil surrounding the culvert. Soil is characterized by its unit weight, modulus of elasticity and Poisson's ratio. The soil-structure interaction model was implemented for this study using RISA-3D software (RISA Technologies, Inc. 2016).

The production-simplified approach represents an overt attempt to balance load rating effort vs. analytical rigor, and nowhere is this expressed more clearly than through the trade-offs associated with implementation of the simplified soil model. Ease of use is achieved by ignoring, among other things, more advanced modeling techniques such as complex soil constitutive relationships and the specification of culvert-soil interface behavior; soil-structure response features such as simulation of construction sequence, soil layering, subsurface drainage and effective stress; and refined material parameters such as soil relative density, confining pressure, and overconsolidation ratio, to name a few. Elastic modulus of course is influenced by these effects, and a research-intensive analysis would measure this influence and implement it through more sophisticated models. But within the context of production load rating, the project-specific data necessary to specify these features are typically not available. Thus the production simplified method calibrates the soil-structure model to the dead load demands obtained from the conservative and widely-implemented direct stiffness model and proceeds from there.

6.2.2 Constitutive Models for Soil-Structure Interaction

6.2.2.1 Overview of Soil Modulus

The linear elastic soil-structure interaction constitutive model used in this study requires two parameters to model stress-deformation behavior of the soil: modulus of elasticity and Poisson's ratio (Putri et al. 2010). The modulus of elasticity is the primary parameter that characterizes the soil material with respect to stiffness. The soil stress-strain relationship is not linear and many different moduli can be identified as shown in Fig. 6.1. Although slope of the stress strain curve is not the modulus of the soil, it is related to the modulus and it is convenient to associate the slope of the stress strain curve to a modulus value. In Fig. 6.1, if the slope is drawn from the origin to a point on the curve (O to A), the secant slope S_s is obtained and the secant modulus E_s (also known as elastic soil modulus) is calculated from it. This modulus can be used for the first application of a load. The next slope is S_t and the tangent modulus E_t calculated from it can be used to calculate the incremental movement due to an incremental load. Next is S_u and the unloading modulus E_u can be used, say, when calculating the heave at the bottom of an excavation or the rebound of a pavement after the loading by a truck tire (also known as resilient modulus). After that the reload slope S_r is obtained and the reload modulus E_r is calculated from it. This parameter may be used, say, to predict the movement at the bottom of an excavation when a building of equal weight is placed back in the excavation. Another application would be to calculate the movement of pavement under reloading by the same truck tire. Cycling $S_{u/c}$ and $E_{u/c}$ are next with applicability as a function of the number of cycles for the movement of a pile foundation subjected to repeated wave loading (Briaud 2001).

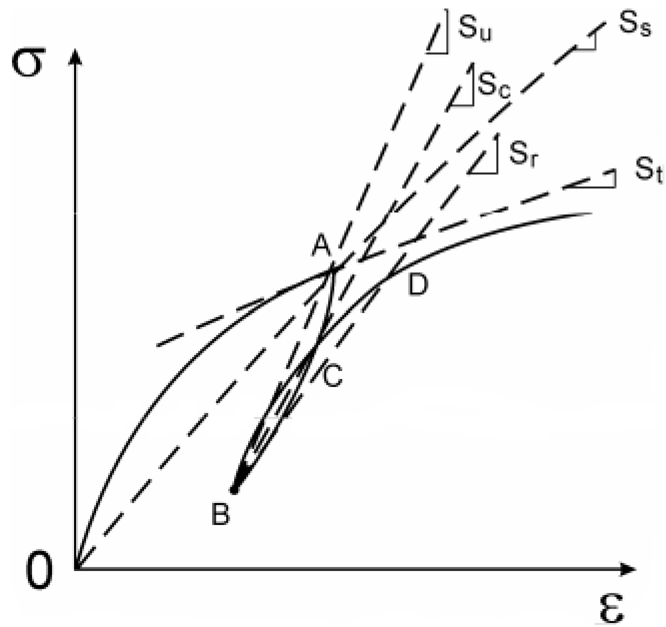


Figure 6.1 Different definitions of soil modulus depending on loading condition (Briaud 2001)

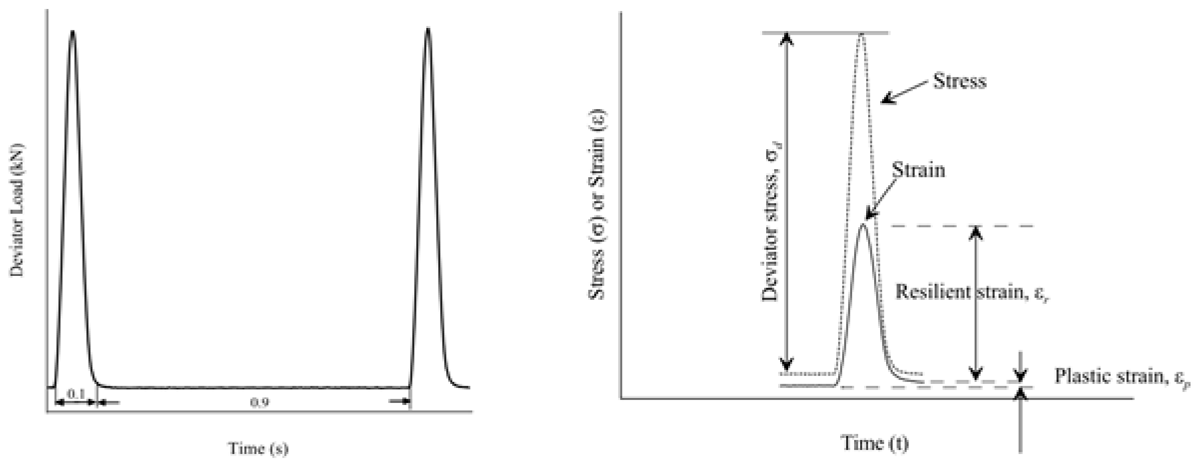
Whichever one of these moduli is defined and considered, the state of the soil at a given time will affect that modulus. For example, modulus depends on material parameters such as the type of soil (*i.e.* sand, silt, clay), its relative density or over-consolidation ratio, confining stress, water content, and more.

6.2.2.2 Dead Load, Elastic Modulus

Elastic soil modulus E_s is used for static loads, where the soil is loaded once and remains in that stress state for all purposes of design. For culverts, where soil backfill represents the first application of dead load on and around the culvert structure, the elastic soil modulus is a reasonable choice. For load rating calculations, elastic soil modulus is used as the soil stiffness for dead load analysis.

6.2.2.3 Live Load, Resilient Modulus

Soil materials show a nonlinear and time-dependent elasto-plastic response under traffic (live) loading. This response is well matched when modeling live load response for pavement applications, and Figure 6.2 is a graphical representation of the definition of resilient modulus from a repeated load triaxial test as specified by AASHTO T 294. The repeated load triaxial test consists of applying a cyclic load on a cylindrical specimen under constant confining pressure and measuring the axial recoverable strain. Fig. 6.2(a) shows the shape and waiting period of a cyclic load. The wait period gives the soil a chance to recover its strain. Fig. 6.2(b) depicts the applied deviator stress and its generated strain on the soil sample. The resilient modulus determined from the repeated load triaxial test is defined as the ratio of the repeated axial deviator stress to the recoverable or resilient axial strain.



(a) Shape and duration of repeated load (b) Stresses and strains of one load cycle

Figure 6.2: Definition of the resilient modulus in a repeated load triaxial test (Titi et al. 2006)

Thus resilient modulus is a reasonable choice when modeling live load response for culvert backfill soil materials. M_R is the elastic modulus based on recoverable strains under repeated loads and has been used for characterizing the stress-strain behavior of subgrade soils subjected to traffic loadings (Kim and Siddiki 2006). M_R is used where there is any wave form with a given rest period, as opposed to dynamic modulus which is used when sinusoidal wave forms occur without a rest period such as for a machine foundation (Putri et al. 2010).

6.2.2.4 Poisson's Ratio

Poisson's ratio is an important constant for retrieving information about stress and deformation of the soil. Static Poisson's ratio is defined as the ratio of axial strain to radial strain. Like soil modulus, Poisson's ratio also can be categorized as static and dynamic Poisson's ratios. But, for linear-elastic materials, dynamic Poisson's ratio is equal to static Poisson's ratio. Thus geomechanists rely on the static Poisson's ratio for stress analysis, in particular to assess lateral stresses (Gretener 2003).

Poisson's ratio usually varies between 0.25 to 0.49 for saturated soils and from 0.25 to 0.4 for unsaturated soils (Warrington 2007). Table 6.1 shows typical representative values for static Poisson's ratio which are between 0.15-0.5.

Table 6.1 Representative Values of Poisson's Ratio (Das 2010)

Type of Soil	Poisson's Ratio
Loose Sand	0.2-0.4
Medium Sand	0.25–0.4
Dense Sand	0.3–0.45
Silty Sand	0.2–0.4
Soft Clay	0.15–0.25
Medium Clay	0.2–0.5

There is no standard procedure for evaluation of Poisson's ratio. Based on early parametric analyses (Lawson et al 2010), for the purpose of this study and the linear-elastic soil model, a constant static Poisson's ratio, $v = 0.3$, has been chosen for this project.

6.3 SOIL STIFFNESS FOR CULVERT DEAD LOAD DEMANDS

6.3.1 Static Soil Modulus Values from Published Literature

It is reasonable to say that the soil modulus to be used when analyzing the soil-culvert system to determine dead load demands should be the static soil modulus E_s since the soil is loaded once under its self weight and remains in that stress state for the life of the structure. Typical values for static soil modulus can be found in literature for different types of soil based on results obtained from oedometric and triaxial testing.

Table 6.2 shows that elastic soil modulus varies by soil type and consistency or relative density. As a general statement, fine-grained soils tend to have lower modulus values compared to coarse-grained soils. For fine-grained soils, the consistency matters such that soft clays tend to have lower modulus values (nominally, 0.5-2.0 ksi) compared to hard clays (nominally, 2.0-8.0 ksi). For granular soils the modulus is stress dependent (as would be expected), with both relative density and overburden pressure having an important influence on soil modulus. Loose coarse-grained soils tend to have lower modulus values (nominally, 2.0-4.0 ksi) compared to dense sands (nominally, 5-10 ksi) and dense gravels (nominally, 12-24 ksi).

Table 6.2. Typical published values of elastic (static) soil modulus, E_s (ksi)

Soil Type	Consistency/ Relative Density	Das (2010)	Bowles (1996)	Lambe and Whitman (1969)			
				Overburden pressure (9-15 psi)		Overburden pressure (29-74 psi)	
				$D_r = 0$	$D_r = 100$	$D_r = 0$	$D_r = 100$
Clay	Very soft		0.3-2.2				
	Soft	0.25-0.5	0.7-3.6				
	Medium		2.2-7.3				
	Hard	0.85-2.0	7.3-14.5				
Silt			0.3-3	0.4	5.1	2.5	11
Loess			2.2-8.7				
Sand	Silty		0.7-2.9				
	Loose	1.5-4.0	1.5-3.6				
	Dense	5-10	7.3-11.7				
	Uniform fine			2.1	7.4	5.1	17.4
	Well-graded			2.0	7.5	3.7	17.6
Sand & Gravel	Loose		7.3-21.8				
	Dense		14.5-29				
Gravel	Uniform			4.4	17	8.7	26

Literature specifically focused on culverts also provided some typical values for soil elastic modulus to be used for buried structures. Kim and Yoo (2002) cited extensive research focused on buried culverts and their backfill soils which showed that the best estimate for a representative Young's modulus for culvert backfill was in the range of 3 to 7 ksi. These values were based on a synthesis of the results of plate load field tests, one dimensional compression tests, and triaxial compression laboratory tests (Kim and Yoo 2002).

6.3.2 Static Soil Modulus Values from Geotechnical Software

Geotechnical engineering software programs that model soil and soil-structure interaction identify a set of typical values for soil modulus of elasticity. Illustrative examples of such software (not an exhaustive list) include FLAC, CANDE, and PLAXIS. Table 6.3 shows selected typical values of elastic soil modulus for soils recommended in these software packages.

FLAC (Fast Lagrangian Analysis of Continua) is a two-dimensional, explicit finite difference numerical program for advanced geotechnical analysis of soil, rock, groundwater, and ground support (Itasca Consultants, Inc. 2015). The nominal values of Young’s modulus recommended in FLAC's *User's Manual* were adapted from Das (2014) and appear in FLAC's built-in material properties database.

Table 6.3. Nominal values of elastic soil modulus, E_s (ksi), selected geotechnical software

Soil Type	Consistency/ Relative Density	FLAC (2016)	CANDE (2015)	PLAXIS (2016)
Clay (cohesive)	Soft (fair compaction)	0.3-0.4	0.15-0.25	0.5-0.7
	Stiff (good compaction)	0.9-2.0	0.25-0.4	1.3-1.5
Mixed Soils	Soft/Loose (fair compaction)		0.4-0.9	
	Stiff/Dense (good compaction)		0.6-1.45	
Sand (Granular)	Loose (fair compaction)	1.5-3.8	0.55-1.4	4.3-5.6
	Dense (good compaction)	4.9-10	1.1-2.25	5-7

CANDE is a special-purpose, finite element computer program developed for the structural design and analysis of buried culverts and structures of all shapes (Mlynarski et al. 2008). CANDE relies on a two-dimensional slice of the culvert installation such that both the culvert structure and soil mass are modeled as a combined soil-structure system. For the isotropic linear-elastic soil model, the *CANDE User's Manual* provides a series of conservative overburden-dependent values for elastic soil modulus (Katona 2015). These values source to research by Selig (1990) and the *CANDE User's Manual* notes that "all the canned and tabularized soil parameters" are "conservative approximations of the actual soil being represented" and that further reduction through the use of LRFD resistance factors is not recommended.

PLAXIS 2D is a finite element program developed for the analysis of deformation, stability and groundwater flow in geotechnical engineering (PLAXIS 2016a). One of the motivations for PLAXIS is its stated intent to serve as a tool for practical analysis of geotechnical problems by engineers who are not necessarily numerical specialists. The PLAXIS *Material Models Manual* (PLAXIS 2016b) identifies several constitutive models for the mechanical behavior of soil, ranging from "crude" and not recommended – *e.g.*, Linear Elastic model, to first-order – *e.g.*, Mohr-Coulomb model, to more sophisticated models – *e.g.*, Hardening model. Relative to the culvert dead load application, Young's modulus is considered the basic stiffness modulus for the Mohr-Coulomb model, and the secant modulus at 50% strength, E_{50} would be used for loading of soils. The PLAXIS software includes a Tutorial Manual showing examples with default property values for selected applications, and this library is the source for property data summarized in the fifth column of Table 6.3.

6.3.3 Summary of Static Modulus Values

Published values for Young's modulus for soil vary from 0.2 to 29 ksi, with nominal values typically in the range of 2 to 12 ksi, and actual values influenced by soil type, consistency/relative density, overburden depth, and other factors. Ideally, the production-simplified soil-structure model used in this study would be calibrated against soil moduli measured from full-scale tests of actual culvert behavior under the influence of dead loads. However such data are not available for the reinforced box culverts in this project. Further, most field research studies or large-scale laboratory tests on culverts have focused on the effect of the method of installation on the induced earth pressure around the culverts (Oshati et al. 2012) and live load effect response of culverts (Orton et al. 2015). Even less information on field instrumentation of box culverts is available (Oshati et al. 2012).

6.4 CALIBRATION OF DEAD LOAD STATIC SOIL MODULUS VALUES

6.4.1 Overview of Calibration Procedure

In the absence of project-specific soil properties and full-scale culvert test data for dead load effects, this study calibrated the dead load response from soil-structure interaction model against the dead load response from the structural frame model. The objective was to determine soil stiffness values suitable for culvert load rating applications that would yield the most reasonable estimates of dead load-induced moments in the culvert structure. The outcome of the calibration was the elastic soil modulus value that provided the best agreement in structural response between the structural-frame model and the soil-structure model.

6.4.2 Independent Variables for Dead Load Soil Stiffness Calibration

Variables which influence the magnitude of load demands on culverts and which were manipulated for this study included the culvert designs selected for analysis, the cover soil depth range, and the range of soil stiffness values. Several other variables were held constant for the analysis.

Culvert Designs: Three culvert designs were selected for analysis of culvert dead load demands. These culverts were: (1) a small, haunched, 4-barrel culvert with a box span of 5ft and height of 5ft, (2) a mid-sized 4-barrel culvert with a box span of 9ft and height of 5ft and (3) a large 4-barrel culvert with a box span of 10ft and height of 9ft. As used in this study, the design included the culvert geometry, reinforcing steel layout, and concrete and steel properties. These three designs are typical among those used to construct TxDOT's pre-1980 culvert structures.

Cover Soil Depth: Cover soil depths for TxDOT culverts range from direct traffic (0-2 ft) to low fill (2 to 6ft) to deep fill (greater than 6 ft). To capture the influence of thickness of soil above the top slab of the culvert, depths for analysis were selected as 1 ft, 4 ft and 10 ft. Of course, the culvert designs selected for the study were not necessarily intended for this full range of overburden soil, but because the analysis focused on the accuracy of load demands and not load ratings, it was possible to apply the cover soil depth range as noted.

Elastic Soil Modulus: Elastic soil moduli chosen for the study represented the typical range of values recommended by the literature. The specific values selected for calculation and analysis purposes were 2, 5, 10, 15, 20, 25, 30 and 35 ksi.

Non-Manipulated Variables. Several variables, important to the analysis, were either "fixed" or held constant for this study. First among these was the type of production-simplified model used to calculate moment demands. The basic (comparator) model was the two-dimensional structural frame (direct stiffness) model implemented via TxDOT's CULV5 software. The calibration model (*i.e.*, the model being calibrated) was the two-dimensional, linear elastic finite element model as implemented through RISA-3D.

Further, and consistent with the production-simplified load rating approach, this study relied on the Linear Elastic (LE) constitutive model for soil. As has been noted, the LE model requires the specification of two parameters: Young's modulus and Poisson's ratio. We did not explore other constitutive soil models for this study.

Other non-manipulated variables included the unit weight of soil (γ = 120 pcf), Poisson's ratio (v = 0.3), lateral earth pressure coefficient (K_o = 0.5), and all aspects of the finite element mesh (domain size, mesh density, boundary conditions). Since this study focused on dead load only, no live load was applied. Further, the analysis did not include the attenuating effects of overlying pavement.

6.4.3 Dependent Variables for Dead Load Soil Stiffness Calibration

The key dependent variable for this study is the coefficient of variation (COV) which is a standardized measure of dispersion of a probability distribution. COV was determined by culvert critical section and provides a way to compare moment demands calculated using the soil-structure interaction model vs. moment demands calculated using the structural frame model. The basic procedure for this calibration study was:

1. Create the structural frame (CULV5) analytical model for each culvert design, apply gravity load (weight of soil), and calculate dead load demands for all critical sections of the culvert structure. These moment demands, by critical section, are the comparator values.

2. Create the soil-structure interaction (RISA) analytical model for each culvert design.

    a. Specify the manipulated independent variables (culvert design, cover soil depth, soil modulus)

    b. Apply gravity load (weight of soil), and calculate dead load demands for all critical sections of the culvert structure

    c. Repeat for the analysis for the full matrix of all independent variables (3 designs x 3 cover soil depths x 8 soil modulus values = 72 “runs”). These moment demands, by critical section, are the calibration values.

3. Identify the moment demand pairs, by critical section, from this analysis.

4. Calculate the standard error for each moment demand pair using Equation 6.1, as follows:

$$\text{Standard Error} = \sqrt{\frac{\Sigma[(M_{ssi} - M_{sf})^2]}{N}} \tag{6.1}$$

where,

M_{ssi} = Induced dead load moment, by critical section, per the soil-structure interaction model

M_{sf} = Induced dead load moment, by critical section, per the structural frame model

N = Total number of the critical sections for the culvert structure (typically 39 sections for a 4-span culvert)

5. Calculate the coefficient of variation (COV) for each moment demand pair using Equation 6.2, as follows:

$$\text{Coefficient of Variation} = \frac{\text{Standard Error}}{\frac{\sqrt{\Sigma[M_{sf}{}^{2}]}}{N}} \tag{6.2}$$

where:

Standard Error = Determined by critical section as per Eq. 6.1

M_{sf} = Induced dead load moment, by critical section, as per the structural frame model

N = Total number of the critical sections for the culvert structure (typically 39 sections for a 4-span culvert)

The COV defined in Eq. 6.2 does not represent inherent soil variability. Instead, the COV quantifies how closely the soil structure interaction model and the structural frame model agree. Large COV values suggest that the moment demands calculated by two models do not agree very well; whereas, small COV values indicate good agreement between two models. Ultimately, the interpretation of a representative soil modulus to be used for dead load demand modeling as per the production-simplified soil-structure model was made based on evaluation of the COV values calculated herein.

6.5 STATIC MODULUS RESULTS

6.5.1 Calculated Soil Pressures

The calibration procedure offered three ways to evaluate the efficacy of the dead load response of the soil structure interaction model compared to the structural frame model. These were: (1) calculated soil pressures, (2) calculated moment demands, and (3) coefficient of variation values. The large (10x9) culvert is suitable for illustration purposes, Figure 6.3. This figure shows basic layout of the culvert and most importantly, the locations of all culvert critical sections where analyses were performed. Figure 6.4(a) shows the calculated soil pressures for the top slab, and Figure 6.4 (b) shows the calculated soil pressures for the right exterior wall.

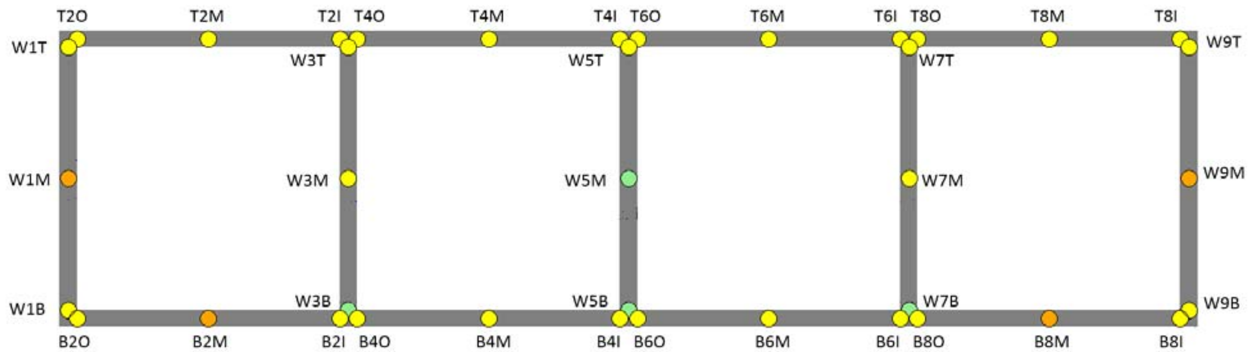
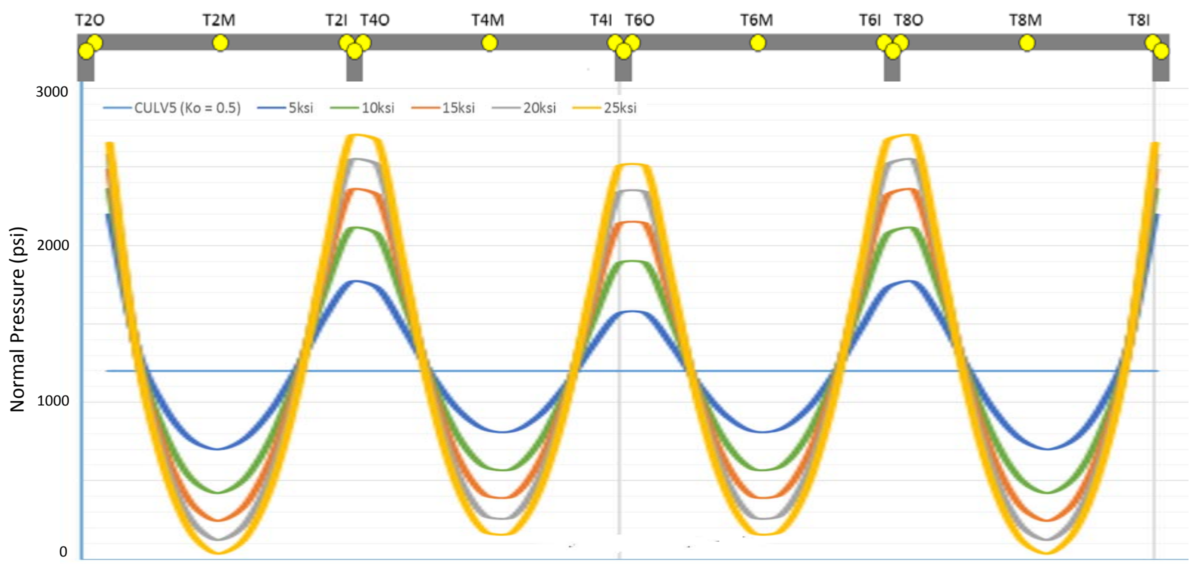
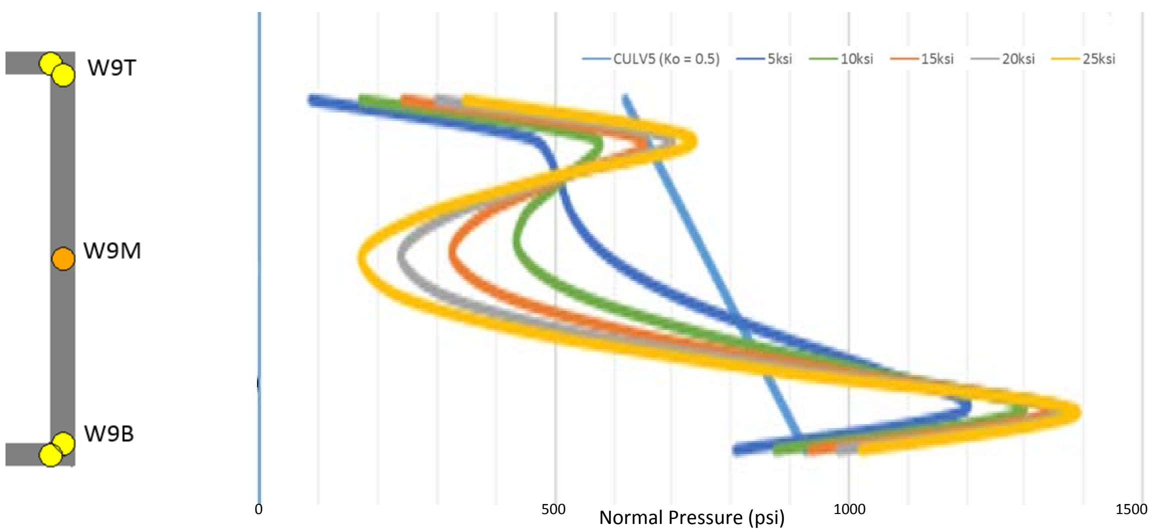


Figure 6.3 Test culvert: 4-span, 10ft x 9ft culvert (MC10-3 design) w/ critical sections identified



(a) Dead load-induced overburden pressure, top slab



b) Dead load-induced lateral pressure, exterior wall

Figure 6.4 Dead Load Induced Pressures on 10ft x 9ft culvert under 10ft of fill (MC10-3)

Results from the structural frame model basically follow Rankine earth pressure theory to calculate the normal pressures. Results for the soil-structure interaction model illustrate the range of pressures from different soil moduli used for the linear elastic soil constitutive model. Calculated pressures from the linear elastic model typically show lower induced pressures at culvert midspans and higher induced pressure at the culvert joints where slabs and walls connect. Conceptually, lower pressure at element midspans is consistent with soil arching effects, and the higher pressures at connections are consistent with the idea that stiffer portions of the structure will attract more load. Further, the higher pressures at connections follow from how the soil-structure interaction model simulates deformation of the entire soil mass (which includes foundation soil, soil on either side of the culvert, and soil above the culvert) under self weight. Figure 6.5, in which the displacements have been magnified, illustrates this behavior.

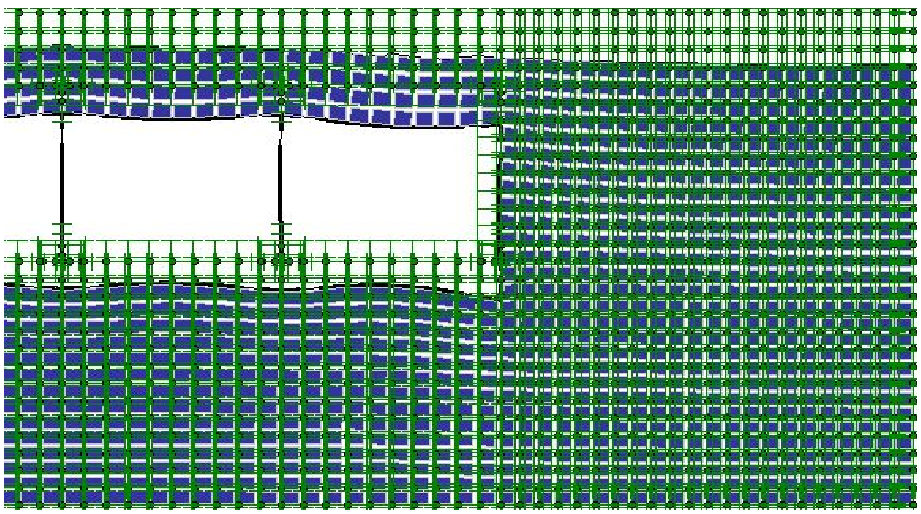


Figure 6.5. Deformation of Soil around the Culvert Structure (Magnification Factor=200)

These large soil deformations in Fig. 6.5 are not consistent with actual structural behavior. The figure illustrates a shortcoming of the production-simplified soil-structure interaction model, namely, how soil surrounding the culvert behaves like a "saddlebag" mounted on the structure. Such loading results in larger moment demands within the culvert. This behavior is more pronounced when the soil modulus is lower and less significant when the soil modulus is higher. This is one of the limitations of the linear elastic soil structure interaction model in that the model does not attempt to simulate the actual construction sequence or associated time-dependent stresses because such information is generally not available for in-service culverts.

6.5.2 Calculated Moment Demands

Dead load-induced moments (not pressures) were the focus of this analysis, since these are the direct values by which the soil structure interaction model was calibrated. Figure 6.6 is an illustrative case, namely, the 4-span 10ft x 9ft culvert design, this time under 4ft of soil cover, and showing moments calculated at all critical sections of the culvert structure.

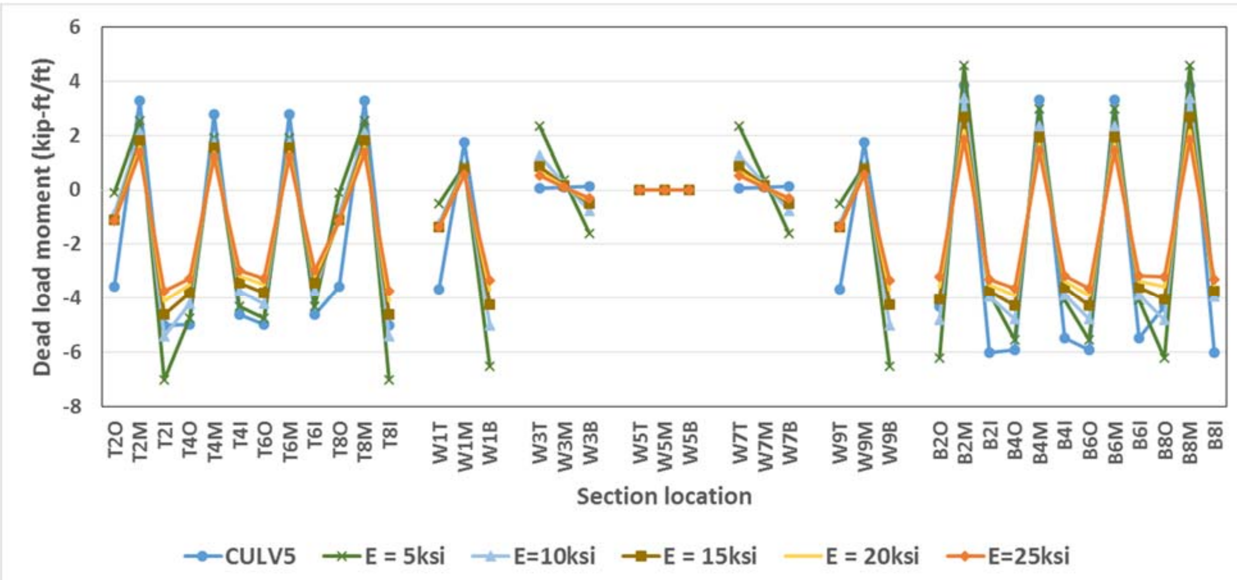


Figure 6.6 Dead load induced moments by critical section, 4-span 10ft x 9ft culvert, 4ft of fill

The critical section identifiers use the convention shown in Figure 6.3. This chart illustrates that dead load-induced moment demands from the structural frame analysis, which are the values deemed "approved" for purposes this study, are often among the higher (absolute) values and thus more conservative. For comparison, results from the soil-structure interaction model are shown based on different soil moduli used for the linear elastic constitutive model. As a general rule (but not always), higher soil modulus values yield lower moment demands, but this is not true for all sections and certainly not consistent across the board.

More significantly, it is not the actual magnitude of the moment demands but the closeness of correspondence of moment demands between the structural frame and soil-structure interaction models that are of interest. Here, dead load demands calculated by the soil structure interaction models tend to show larger differences at element corners as opposed to mid-spans, when compared to the structural frame model. We see these differences regardless of the elastic soil modulus chosen. This is consistent with the "saddle-bag" phenomenon noted previously.

6.5.3 Coefficient of Variation for Dead Load Moments

Figures 6.7 through 6.9 show the coefficient of variation for dead load-induced moments between the structural-frame and soil-structure interaction models, one figure for each culvert structure. Each data point in each figure represents the average COV calculated for 39 critical sections. These results were used to calibrate the static dead load soil modulus for use in the production-simplified, soil-structure interaction model.

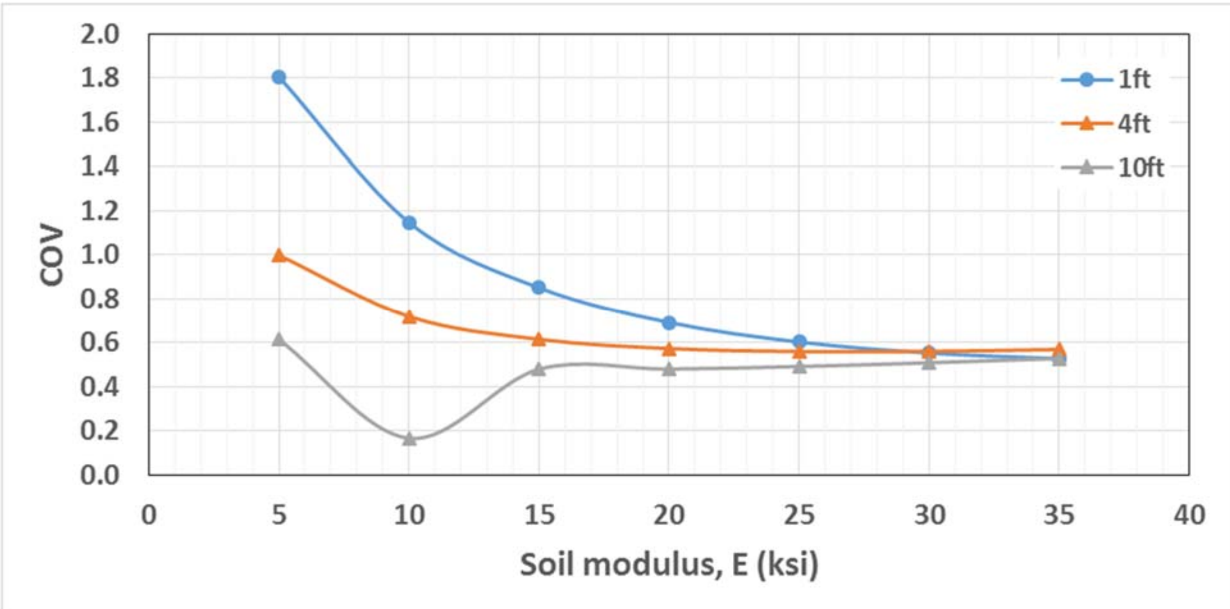


Figure 6.7 Coefficient of variation, dead load moments, small culvert (4-span 5ft x 5ft)

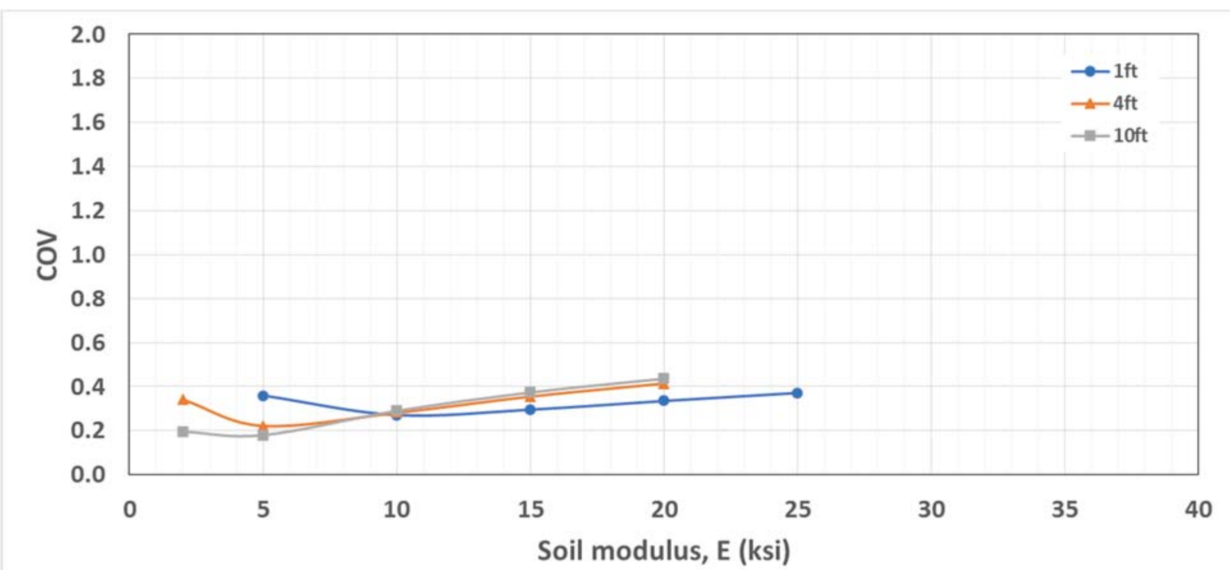


Figure 6.8 Coefficient of variation, dead load moments, medium culvert (4-span 9ft x 5ft)

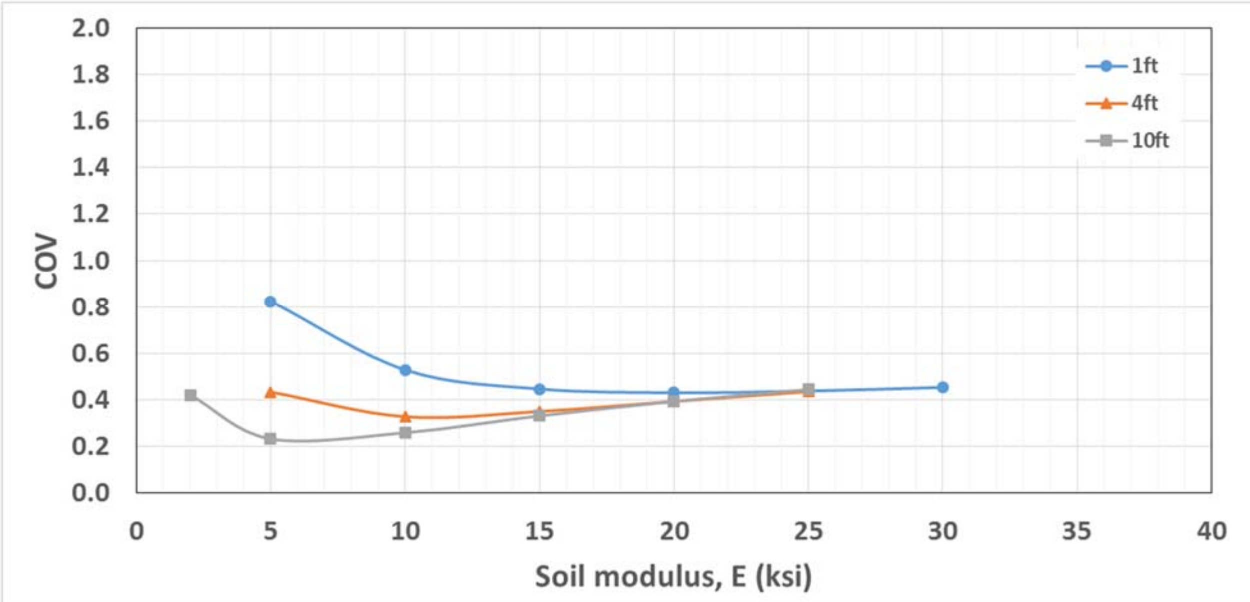


Figure 6.9 Coefficient of variation, dead load moments, large culvert (4-span 10ft x 9ft)

COV data for the small, haunched culvert (Figure 6.7) show larger COV values for soil modulus values less than 15 ksi, especially the low fill and direct traffic conditions. The values tend to converge at COV ≈ 0.5 for modulus values of 20 ksi and larger. This particular family of culvert design dates to the pre-WWII era (1935-1940) and is representative of about 13% of TxDOT's pre-1980 culvert segments.

COV data for the medium, non-haunched culvert (Figure 6.8) show a convergence for soil modulus values at 10 ksi (COV ≈ 0.3), with larger moduli yielding higher COV values and smaller moduli yielding variable COV. For deep fill and low-fill cover soil conditions, the smallest COV values converge at a modulus value of 5 ksi. This particular family of culvert designs, which includes both the medium and large culverts for this analysis, dates to the post-WWII era (1945-1977) and is representative of about 58% of TxDOT's pre-1980 culverts.

COV data for the large, non-haunched culvert (Figure 6.9) show larger COV values for soil modulus values less than 10 ksi, especially the low fill and direct traffic conditions. The values tend to converge at COV ≈ 0.4 for modulus values of 15 ksi and larger.

6.5.4 Recommended Static Modulus for Calculation of Dead Load Demands

Interpretation of the COV data presented in Figures 6.7 through 6.9 considered the culvert design family, the cover soil condition, and the typical range of soil modulus values observed in literature. Relative to culvert design, the medium and large-sized culverts are more representative of TxDOT's population and were given priority. Relative to cover soil depth, direct traffic culverts (0 to 2 ft of fill) comprise about 77% of TxDOT's rated culvert segments. Low-fill culvert segments (2 ft to 6 ft) comprise 18%, and culvert segments with greater than 6 ft of fill (*i.e*. deep fill) comprise 5% of rated segments. Thus, the low-fill and direct traffic conditions also warranted priority in this analysis. Relative to published values for soil modulus, lower values are prominent, nominally in the range of 2 to 12 ksi with actual values influenced by soil type, consistency/relative density, overburden depth, and other factors.

From the calibration study, soil modulus values corresponding to the lowest COVs range from 5 ksi to 15 ksi, average 10 ksi, and these values are specific to the medium and large culverts for direct traffic and low-fill conditions. All things considered, a calibrated elastic modulus of 10 ksi seems a reasonable choice for dead load calculations per the linear elastic soil-structure interaction model. The data do not support differentiation, so this dead load soil stiffness value is recommended without regard to soil type, overburden depth, or other factors.

6.6 SOIL STIFFNESS FOR LIVE LOAD ANALYSIS

6.6.1 Resilient Modulus for Live Load Analysis

The resilient modulus, M_R is the elastic modulus based on the recoverable strain under repeated loads. Repeated loading causes progressive plastic strain accumulation, which results in increasing deformation. Repeated loading also compacts the soils, which is beneficial, except when it results in pore water pressure increase. Resilient modulus is calculated as the ratio of repeated deviator stress to elastic strain (Selig 2014). Due to similarities between loading frequency and soil strains associated with pavement response and culvert response, resilient modulus is an appropriate choice for analyzing live loads on reinforced concrete box culverts under traffic.

6.6.2 Determining Resilient Modulus

Resilient modulus can be measured through laboratory tests or field tests. Several test methods are recognized for determining the resilient modulus of subgrade soils such as developed by Seed and Lee, Bowles, Florida testing sequence, Illinois testing sequence, Washington testing sequence, and New York testing sequence (Putri et al. 2010). One established procedure for laboratory determination of M_R is AASHTO T307: Standard Test Method for Determining the Resilient Modulus of Soils and Aggregate Materials (AASHTO, 2014). This test is also known as the repeated load triaxial compression test or RLT test.

Due to complexity of the laboratory tests, many agencies use simpler field tests. The falling weight deflectometer (FWD) test is a widely-used test for measuring resilient modulus in the field. In this test, the resilient modulus is measured by inducing an impulse load on the surface and measuring deflections with geophones and iterative back-calculating the stiffness (Puppala 2008). The modulus calculated using FWD is referred as "backcalculated modulus," E_{back}, in contrast to resilient modulus, M_R, which is obtained from the AASHTO-specified laboratory test. The *Mechanistic-Empirical Pavement Design Guide* (*MEPDG*) (AASHTO 2008) allows the use of both laboratory and *in situ* back-calculated moduli, but recognizes that the moduli determined by both procedures are not equal. The MEPDG, therefore, suggests that the subgrade modulus determined from deflection measurements on the pavement surface, E_{back}, be decreased by a correction factor of 0.33. However, other correlation equations and ratios have been documented (Rahim and George 2003).

Correlation equations can be used to estimate M_R based on empirical relationships with different soil properties. The technical literature offers a variety of correlation equations for estimating the resilient modulus using soil strength and index properties. More than 30 equations were identified and summarized (Kim and Siddiki 2006). Seed, et.al proposed that the resilient modulus could be related only to the deviator stress. The Asphalt Institute design method recommends that resilient modulus laboratory tests be performed to characterize the subgrade soil for pavement design. However, because many state DOTs do not have the necessary equipment to perform laboratory resilient modulus tests, the Asphalt Institute also provides two correlation equations. Colorado Department of Transportation developed a two-part correlation equation that converts soil support value to an R-value then R-value to an approximation of M_R (Kim and Siddiki 2006).

CBR test values have been used to estimate M_R. For example, Heukelom and Klomp developed a commonly-referenced CBR correlation based on dynamic modulus measurements and in-situ CBR tests. The US Army Corps of Engineers developed a M_R-CBR relationship. The Ohio Department of Transportation also uses a correlation that relates M_R to CBR (Kim and Siddiki 2006).

6.6.3 Published Values of Resilient Modulus

The AASHTO *MEPDG* (2008) provides typical representative M_R values covering a wide range of soil types. The *MEPDG* considers these as "very approximate" and advises caution in their use. Approximate M_R values range from about 5 ksi for clayey soils to about 40 ksi for granular soils. Table 6.4 shows typical resilient modulus values for various soil types based on both the AASHTO Classification System and the Unified Soil Classification System (AASHTO 2008). Figure 6.10 shows a synthesis of the Unified Soil Classification System data in chart form (Mokwa and Akin 2009).

Table 6.4. Typical resilient modulus values for unbound granular and subgrade materials (modulus at optimum moisture content) *Source:* Table 2.2.51, AASHTO (2008)

AASHTO Classification					Unified Soil Classification		
Group Class.	M_R Range (ksi)	Typ. M_R (ksi) Base/ Subbase, Flexible/ Rigid Pvmt	Typ. M_R (ksi) Embankment/ Subgrade, Flexible Pvmt	Typ. M_R (ksi) Embankment/ Subgrade, Rigid Pvmt	Group Symbol	M_R Range (ksi)	Typ. M_R (ksi)
A-7-6	5-13.5	8	11.5	13	CH	5-13.5	8
A-7-5	8-17.5	12	13	10	MH	8-17.5	11.5
A-6	13.5-24	17	14.5	14	CL	13.5-24	17
A-5	17-25.5	20	15.5	15	ML	17-25.5	20
A-4	21.5-29	24	16.5	16	SW	28-37.5	32
A-3	24.5-35.5	29	16.5	16	SP	24-33	28
A-2-7	21.5-28	24	20.5	16	SW-SC	21.5-31	25.5
A-2-6	21.5-31	26	21.5	16	SW-SM	24-33	28
A-2-5	24-33	28	21.5	16	SP-SC	21.5-33	25.5
A-2-4	28-37.5	32	24.5	16.5	SP-SM	24-33	28
A-1-b	35.5-40	38	26.5	18	SC	21.5-28	24
A-1-a	38.5-42	40	29.5	18	SM	28-37.5	32
					GW	39.5-42	41
					GP	35.5-40	38
					GW-GC	28-40	34.5
					GW-GM	35.5-40.5	38.5
					GP-GC	28-39	34
					GP-GM	31-40	36
					GC	24-37.5	31
					GM	33-42	38.5

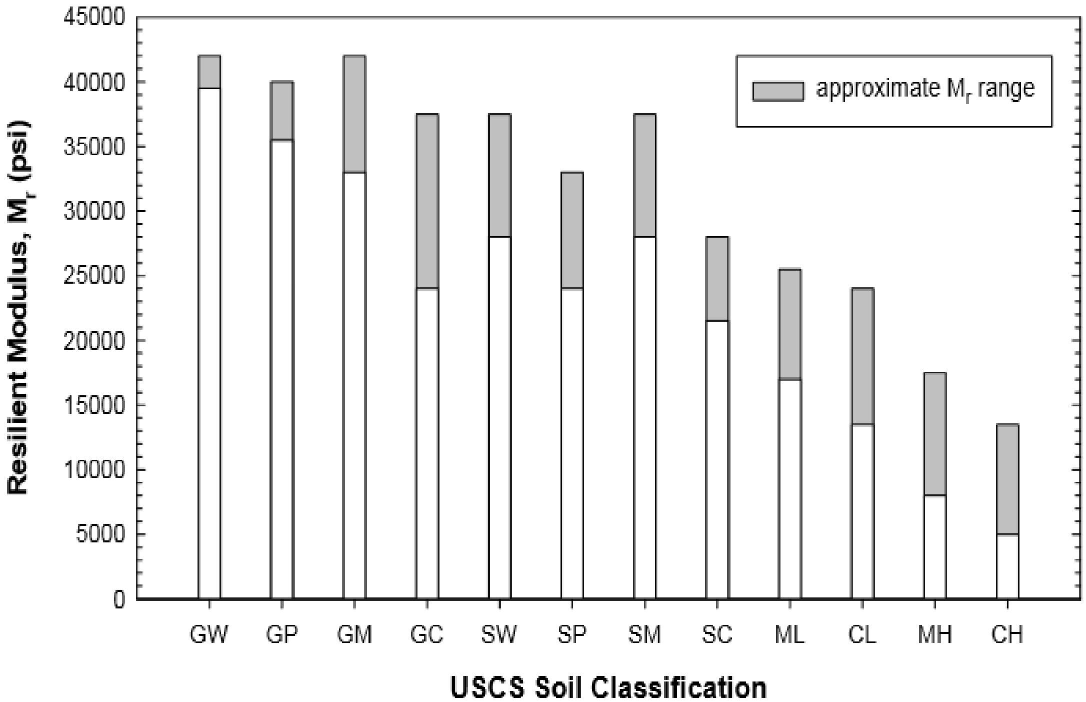


Figure 6.10 Typical M_R distribution for soil per USCS Group Symbol (Mokwa and Akin 2009)

6.6.4 Recommended Values of Resilient Modulus for Live Load Analysis

The linear-elastic soil structure interaction model for this study requires the input of soil stiffness to represent the behavior of soil under live loads. As described, M_R is an appropriate stiffness parameter for this application. But how does one determine M_R for culvert load rating?

The *MEPDG* (AASHTO 2008) recommends a three-level, hierarchical approach for identifying resilient moduli:

Level 1: Conduct specific tests to measure M_R directly. These (laboratory or field) tests are discussed in previous sections.

Level 2: General correlation equations that include soil index properties and strength properties can be used to estimate M_R.

Level 3: Estimate M_R from experience or historical records. This is the approach associated with the data from Table 6.4 and Figure 6.10.

The Level 3 approach is consistent with the production-simplified culvert rating method used for this study, which by necessity often relies on estimated or correlated model parameters rather than culvert-specific data. The *Culvert Rating Guide* (Lawson et al. 2009) acknowledges this approach and further simplifies culvert subgrade soils into three stiffness categories: low, medium, and high. However, the *Culvert Rating Guide* does not (currently) differentiate soil modulus for both dead load and live load as is being done here. Therefore, Table 6-5 presents an updated version of the soil support data table from the *Culvert Rating Guide*, focused on presentation of typical M_R values for the modeling live load-induced moment demands.

Table 6.5 Recommended resilient modulus, M_R for culvert subgrade materials, suitable for calculation of live load moment demands using the linear elastic soil-structure interaction model

Culvert Backfill Soil Description	Resilient Modulus M_R	Unified Soil Classification (ASTM D2487)	AASHTO Group Classification (AASHTO M 145)	Texas Triaxial Classification (TEX-117-E)
Low: Fine-grained soils in which highly-plastic silt and clay-sized particles predominate	*Range*: 5 - 25.5 *ksi* *Typical:* 12 *ksi*	CH, OH, MH, OL	A5, A6, A7, A8	> 5.0
Medium: Sands and sand-gravel mixtures with moderate amounts of silts and clay	*Range*: 13.5 -37.5 *ksi* *Typical:* 24 *ksi*	CL, ML, SC, SP, SM	A3, A4	3.5 to 5.0
High: Gravels and sand-gravel mixtures relatively free of plastic fines	*Range*: 24 -42 *ksi* *Typical*: 36 *ksi*	GW, GP, GM, GC, SW	A1, A2	< 3.5
Lawson et al. 2009, AASHTO 2008				

In the absence of culvert-specific data, the M_R values in Table 6.5 may be correlated from the USCS or AASHTO soil classifications. The practical necessity of categorizing culvert soils into low, medium, and high stiffness materials is a major simplification. Further, the modulus values in Table 6.5 are reasonable choices for live load demand predictions for culvert load rating and are not inconsistent with the production-simplified soil-structure interaction model.

6.7 CONCLUSION

Load rating for reinforced concrete box culverts requires the prediction of dead and live load demands upon the structure using analytical models. Soil-structure interaction models require soil modulus values to predict dead and live load response. Dead load and live load responses are conceptually different, and therefore it is appropriate to consider different soil stiffnesses for each application. For the production-simplified soil-structure interaction model recommended in this paper, a calibrated static modulus value of E_s=10 ksi reasonably models dead load demand.

Live load demands on reinforced concrete box culverts closely resemble live load demands on pavement structures. Therefore, the resilient modulus, M_R has been identified as being appropriate for modeling live load. A literature review indicated that resilient moduli of 12ksi, 24ksi and 36 ksi are reasonable estimates for low, medium and high stiffness soils, respectively. These values may be used for production-simplified load rating of reinforced concrete box culverts specific to the linear-elastic constitutive model used in this project.

The production-specific model with its calibrated static soil modulus and correlated resilient modulus is suitable for load rating applications where culvert-specific material properties are not available. In cases where culvert-specific data exist, more sophisticated demand models can be used. But it should be noted that acquiring the data and specifying advanced models require additional effort and resources.

CHAPTER 7
CULVERT LOAD RATING PROCESS

7.1 OVERVIEW

This chapter provides an overview of the culvert load rating process used for this research study. Included herein is a chronicle of practical observations and lessons learned from performing thousands of load ratings for TxDOT's older, reinforced concrete box culvert structures. Our focus was on the system-level load rating approach which we found was necessary in order to consistently, uniformly and systematically accomplish reliable data which will lead to more accurate and precise culvert rating results.

7.2 INTRODUCTION

This chapter presents practical observations, knowledge, insights, and lessons learned from performing thousands of load ratings for older, cast-in-place, reinforced concrete box culvert structures. Although this chapter will discuss load rating policy, it is not about policy. Likewise, this chapter is not limited to the load-rating process or load rating methods although those topics will be discussed. Fundamentally, this chapter is about achieving an acceptable level of load rating accuracy and precision that avoids unnecessary restrictions on commerce which may result from, on the one hand, unfounded (high) load ratings that lead to premature structure deterioration or failure or, on the other hand, unwarranted (low) ratings that lead to unnecessary structure replacements or upgrades (NCHRP 2015).

The knowledge and lessons learned described herein were mostly obtained from the series of culvert load rating research studies performed over the past ten years which were sponsored by TxDOT. TxDOT is solidly invested in this issue as can be seen from National Bridge Inventory (NBI) data (FHWA 2016a) which show that Texas possesses an inventory of 19,594 bridge-class culverts – by far the largest of any state (Tennessee ranks second with 8,893 culverts) – accounting for 14 percent of the 136,971 bridge-class culverts in the U.S. While much has been learned from this research and this chapter will describe some of that, this chapter will also describe several approaches that did *not* work. These were the experiences which came from ideas, observations, or analytical approaches that appeared fully reasonable but simply did not hold up when tested against facts on the ground.

The primary motivation for this chapter is the plight of the State Load Rating Engineer, that is, the public official who shoulders the responsibility for complying with federal, state and local policy on bridge load rating. While load rating engineers, consultants, researchers, vendors, and others will likely find this chapter of interest, the State Load Rating Engineer is specifically in mind because he or she is responsible for not just the rating of one culvert, or ten, but for an entire system. This difference in perspective is significant because in our experience, most load rating questions are framed from the desk-level view of the DOT operations engineer or load-rating engineer who is faced with performing load rating calculations for a particular culvert structure. This engineer needs and is actively seeking specific information about policy interpretation, or perhaps has questions about the suitability of a structural software package, or approved values for a certain load-rating parameter. These are important matters. But one of the lessons learned from our research is that viewing the culvert rating problem at the *system* level reveals issues, challenges, and questions not readily apparent – or more correctly, *tractable* – to the engineer who is focused on a specific structure. And ultimately, proper system-level questions not resolved at the system level lead to structure-level assumptions, inconsistencies and variance which coalesce into what has been described as a “disconnect” between observed structure performance and calculated load ratings.

7.3 LESSONS LEARNED

7.3.1 Lesson #1. Bridge-class culverts are complex engineered structures, they are not simple.

Federal policy classifies bridge-class culverts – those with spans greater than 20 feet – as part of the larger family of highway bridges (AASHTO 2011). Without regard to their association with bridges, or perhaps because of it, culverts are often described as “simple.” However, to characterize culverts in this way is unhelpful, especially at the system level, and such a view can lead to misdirected attempts at over-simplification when it comes to culvert load rating. If as a general statement, culverts *are* less complex than bridges, it is nevertheless reasonable to regard bridge-class culverts as complex buried structures (Figure 7.1). Some contributing factors to this complexity are as follows:

Figure 7.1 Complex 7-span reinforced concrete culvert: structure #161780010202005.

- *Policy, Procedure and Practice.* A significant body of national-level policy, commentary, and training materials is available for culvert load rating (FHWA 2016b). Some state DOTs have taken this further and published internal manuals, guidance documents and load rating procedures. While these resources are certainly a strength, one of our first major mistakes in culvert load rating was to assume that qualified load-rating engineers – all of whom were given access to published load rating resources – would interpret and apply this guidance consistently such that they would achieve repeatable culvert load-rating results. In other words, we believed that if ten load rating engineers were tasked with load-rating one culvert, they would all get the same (or at least, close) rating factor values. This was definitely *not* the case, and TxDOT's *Culvert Rating Guide* (Lawson, *et al*. 2009) and CULVLR load rating program (Lawson, *et al*. 2013) – both currently slated for update/revision – were created in an effort to help address this issue. Our experience has been that load rating policy is sufficiently complex and the pathways to implementation are sufficiently broad such that the first step to achieving accuracy and precision in culvert load rating is to make sure that personnel can consistently produce repeatable results. This is not a simple task.

- *Quantity.* The number of in-service culvert structures is large. NBI 2015 data identify 136,971 bridge-class culverts out of a total of 611,845 highway bridges in the U.S., or 22 percent of the total inventory. Further, 32 states record more than 1,000 culverts in their bridge inventory, with the proportion of culverts ranging from 3 to 55 percent (*2*). Given the size of the inventory, achieving reliable culvert load ratings is not a simple problem.

- *Diversity*. The makeup of a state DOT culvert inventory can be quite diverse, encompassing various structure geometries and both flexible and rigid material types. NBI identifies ten types of materials for bridge-class culverts, with the primary types being concrete (67%) or continuous concrete (21%). While the load-rating factor equations per AASHTO are the same for all bridges, the calculation of load demands and section capacities used in these equations require that different material types and different culvert geometries be analyzed differently. Texas would actually claim to have a very consistent inventory, with 97 percent of Texas' bridge-class culverts being cast-in-place reinforced concrete boxes. But that still means that more than 500 Texas culverts are made of material other than concrete and may have other than a box shape. Further, alternative culvert materials – *e.g.*, thermoplastic profile pipe – exist but are under-represented in the NBI data, even though state DOTs are using these and other materials for culverts that support highways.

- *Long life*. Culverts have a long service life, with NBI data identifying in-service culverts in the U.S. dating to 1900. In Texas, of 13,409 on-system bridge-class concrete culverts, 10,846 (81 percent) were built prior to 1980 (Figure 7.2). This was about the time that all Texas culvert design standards were uniformly updated to handle HS-20 loading. Roughly one-third of Texas' culverts were constructed in years leading up to and following World War II under an initiative to expand Texas' farm-to-market road system entitled, "Get the farmer out of the mud" (Hagan 1991). About half of Texas' culverts were constructed during the interstate highway era. The implications of long culvert service life are many and include changing construction specifications (for the same materials!), changing design loads, changing design philosophy, and changing load-rating policy, to name a few. An approved load-rating process must be able to systematically identify and account for all these factors.

- *Complex Construction*. While the typical mental image of a culvert is a simple (one-span) box, the construction of actual bridge-class culverts gets quite complicated. Failure to recognize structure complexity was perhaps the second major mistake we made in attempting to load rate Texas' culvert inventory. Culvert construction complexity will be addressed more fully in a later section of this chapter, but it is appropriate to note that during their long service lives, culverts are regularly upgraded to improve hydraulic capacity, traffic capacity, or both. Thus, culvert structures are widened (normal to the centerline) and in some cases lengthened (spans

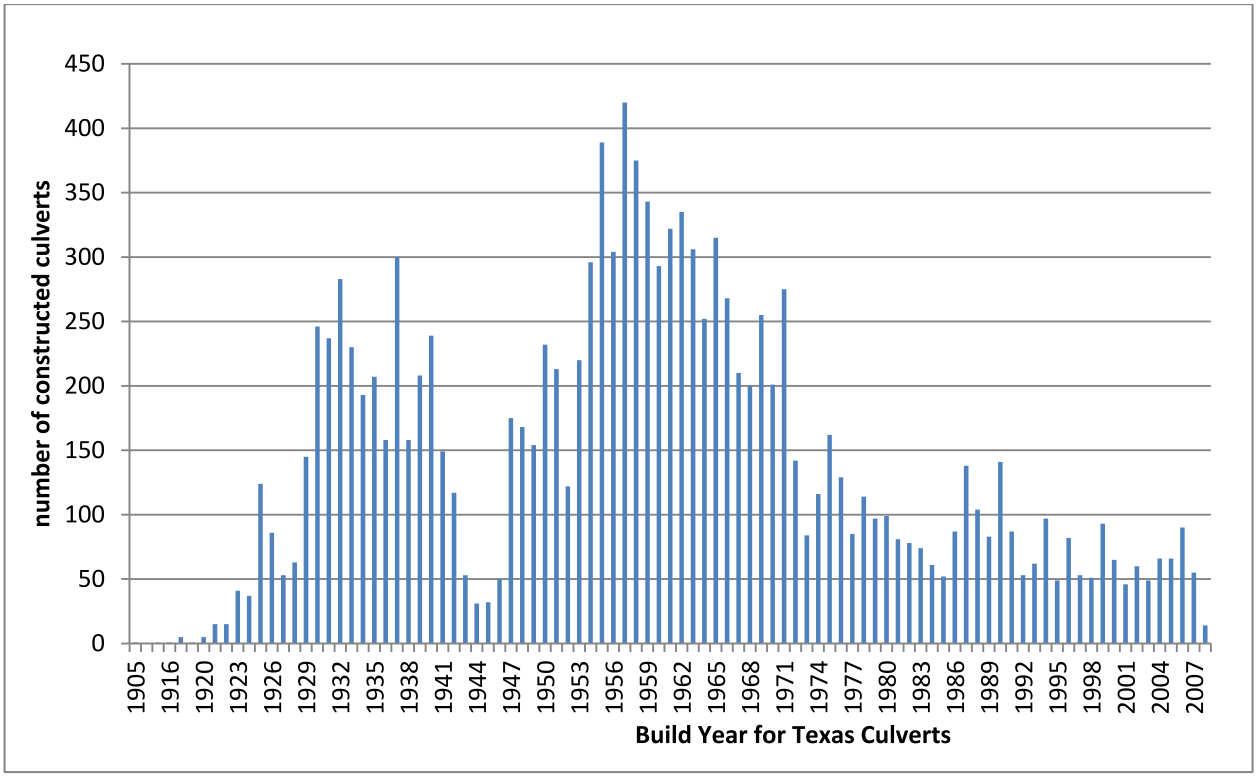


Figure 7.2 Build years for Texas culverts, with 81 percent constructed prior to 1980.

added), years or decades after the original culvert is built. This is true in Texas where detailed culvert documentation shows that 49 percent of Texas culverts have multiple design segments. Nationally, data suggest that 10 to 15 percent of culverts have experienced a significant reconstruction event. These major culvert modifications are usually done under designs and specifications which differ from the original structure. This means that an approved load rating process must identify, define, and account for all unique segments of the culvert structure, and the principle of superposition requires that load rating calculations be performed for each and every culvert segment.

- *Complex Behavior*. Structural analysis is used to determine moment, shear and thrust demands for a culvert under load, and in turn these demands are used to calculate load rating factors. The choice of structural analysis approach varies from empirical formulas to simple/traditional analysis methods to sophisticated/refined analysis methods (Gao 2011). The decision about which structural analysis approach to use is left to the load rater and depends to some extent on the type of culvert material and culvert geometry, but is also subject to trade-offs between computational effort and desired accuracy. A complex analysis model or method does not always produce more accurate or precise results but can significantly impact the load rating. Figure 7.3 presents preliminary load rating results for a sample of 400 culverts that are statistically-representative (+/- 5 percent) of Texas' population of approximately 11,000 pre-1980, on-system, bridge-class, concrete box culvert structures.

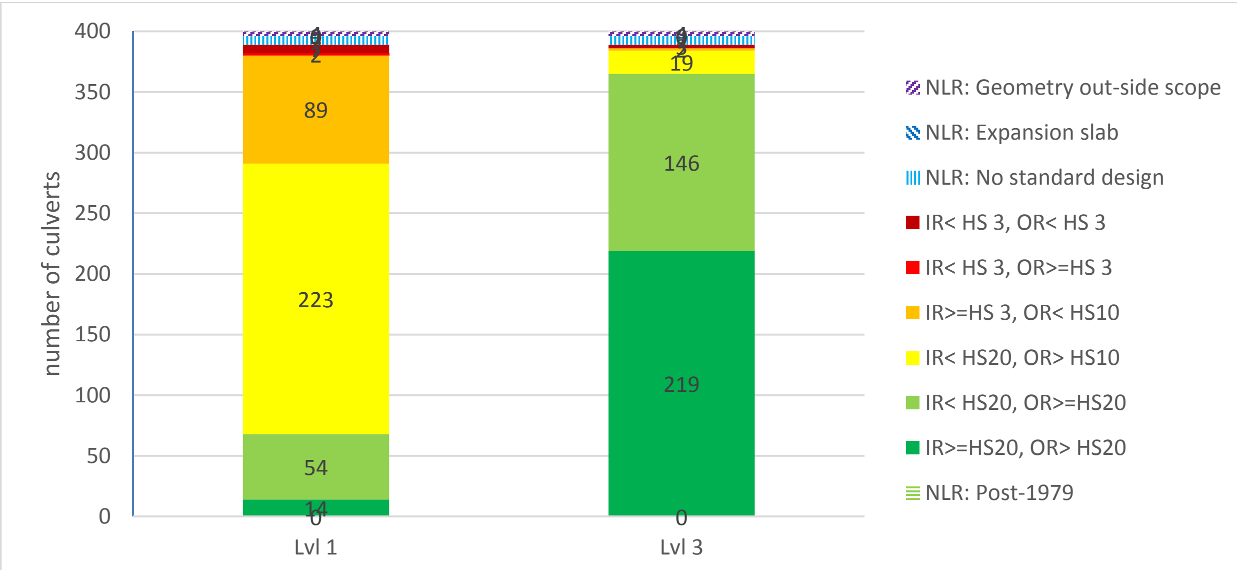


Figure 7.3. Load rating results for *n*=400 Texas culverts.

The left bar shows results obtained when demands were calculated using a simple/traditional 2D structural frame analysis method. Here, 17 percent of the culvert structures rate at a level such that they would not require load posting, *i.e.*, the operating rating is greater than or equal to HS-20. In contrast, the right bar shows results obtained when demands were calculated using a more sophisticated, but production-simplified, 2D linear-elastic, finite-element soil-structure interaction model. Using this approach, *91 percent* of the same set of Texas culvert structures would not require load posting, *i.e.*, the operating rating is greater than or equal to HS-20. The lesson learned is that while simple analysis approaches may be available, sometimes they are not adequate for the task, and this is yet another factor that drives the complexity of culvert structures.

It is true that culverts are often viewed as not-so-glorified pipes, mostly out of sight and out of mind. Further, culverts – individual spans, anyway – tend to be small compared to bridges, and most culverts are indeed less complex than most bridges. Nevertheless, our observation is that culverts are, for many reasons, quite complex buried structures, especially from the perspective of the system level.

7.3.2 Lesson #2. Conservative load ratings are *required*, but *overly-conservative* load ratings tend toward unaffordable.

The comparison of load-rating results obtained using a simple/traditional structural frame model versus results obtained when moment demands were calculated using a more sophisticated, production-simplified, soil-structure interaction model (Figure 3) dramatically illustrates the significance of the modeling decision for reinforced concrete box culverts. But the issue is more fundamental than that.

One of our research inquiries (Wood, *et al*. 2016) focused on using measured moment data from full-scale load tests to explore the influence of depth-calibration for out-of-plane live loads. Figure 7.4 shows moment bias histograms on the log-scale for the structural-frame model and the finite-element model. As used here, moment bias refers to the ratio of predicted vs. measured moment. In each plot, the mean of the moment biases, $\bar{x}$, and standard deviation, s, are shown. The mean value of 16.2 for the structural-frame model means that on average the model overpredicts the dominant live load bending moment by more than 16 times. In contrast, the moment bias histogram for the soil-structure interaction model shows the mean and standard deviation have improved dramatically ($\bar{x}$=3.4, s=3.9). The data indicate that the fully depth-calibrated soil-structure interaction model improves the accuracy and precision beyond that of the structural-frame by attenuating the live load both in-plane and out-of-plane.

However, the histograms in Figure 7.4 also show that each model produces a few moment biases *less than 1.0*. Of these lower bias values (*i.e*., bias below 1.0), the average moment bias is around 0.8, or 25% under-predicted. An important practical question is whether a predictive model that determines bias values less than 1.0 will result in an unconservative load rating analysis. Here the LFR load rating equation introduces appropriate conservatism into the process by applying load factors to the predicted live load moment demands. It is from this broader context of not only predicted moments (from the model) but also the application of load factors (per policy) that the conservatism of load rating analyses should be assessed (Wood, *et al*. 2016). Load rating analyses must be conservative, just not *excessively* conservative, and a fully-calibrated load rating process will seek to trim *excess* conservatism from calculated rating factor values.

(a)

(b)

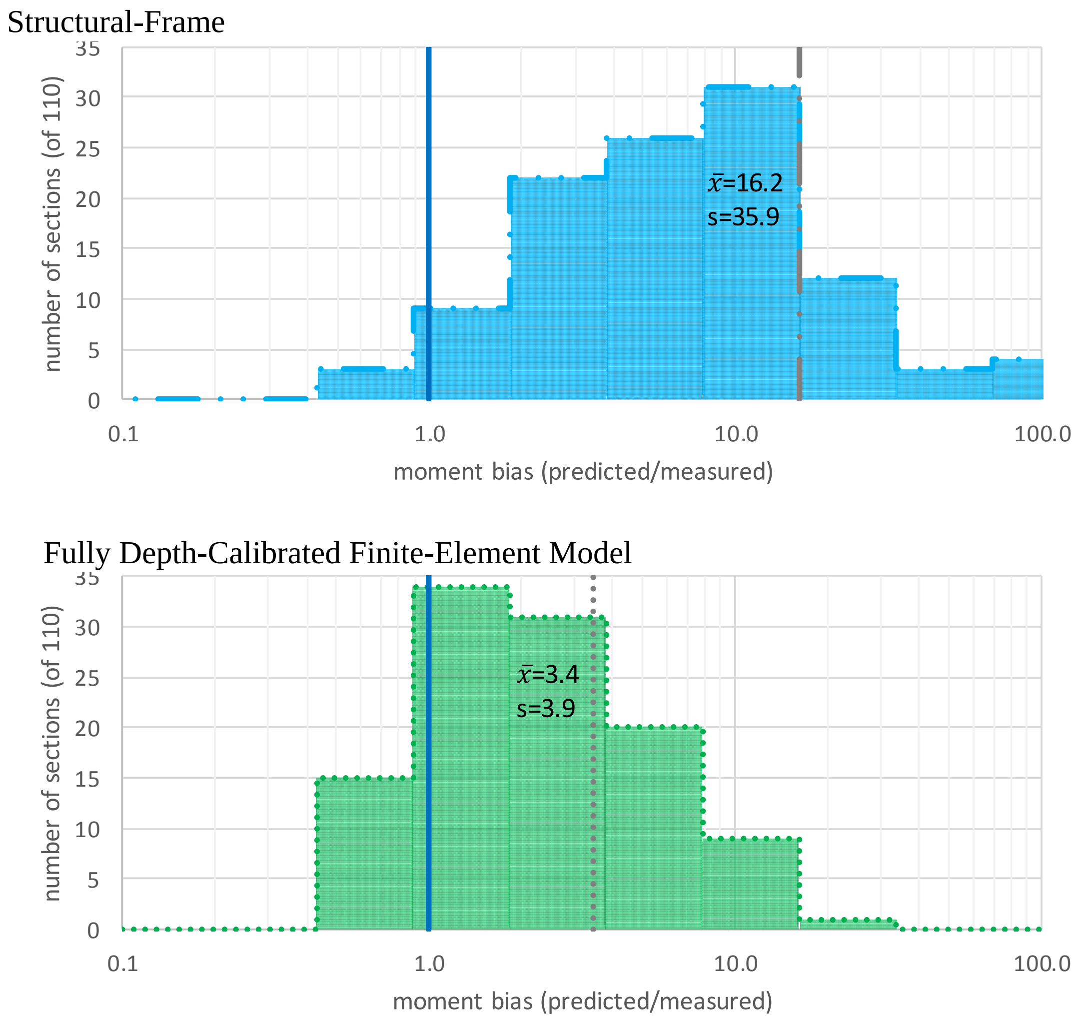


Figure 7.4 Histogram of moment biases from culvert load tests using (a) structural-frame model and (b) fully depth-calibrated soil-structure interaction model.

7.3.3 Lesson #3. One does not load rate culverts, but rather, culvert *segments*.

One of the myths of culvert load rating is that the process is about load-rating culverts. But this is misleading, because as was noted in the preceding discussion of culvert complexity, the load-rating engineer actually analyzes and load-rates individual design *segments* of culverts, and it is from the collective segment ratings that the overall load rating for the culvert structure is determined.

Figure 7.5 illustrates the distinction. The top image (Figure 7.5a) is a culvert structure which was built entirely at one time using a single design, and not subsequently modified. This culvert structure is comprised of one culvert segment, and about half of TxDOT's inventory of pre-1980, on-system, bridge-class culverts fall in this category. The other half of TxDOT's culverts contain *more than one* segment, illustrated by the structure in Figure 7.5b which is comprised of three segments. Each culvert segment has a different design, so each segment must be analyzed and load-rated independently. The segment with the lowest rating controls and sets the load rating for the culvert structure.

(a)

(b)

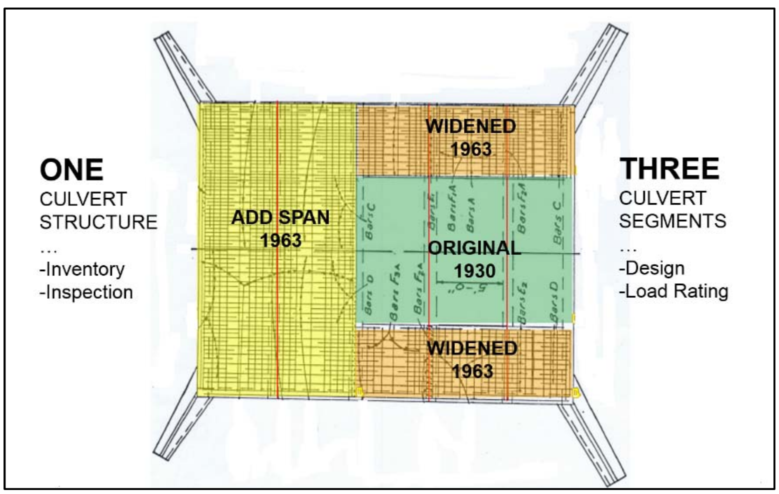


Figure 7.5 The concept of culvert segments: (a) one-segment culvert and (b) three-segment culvert.

That data for culvert segments are usually not identified or captured limits the fidelity of the dataset. The *source* of this oversight is partially based in the vernacular of the NBI. In NBI terms, the inventory is for bridge-class culvert *structures*, and inspections are made for bridge-class culvert *structures*. Direct provision is not made for capturing data on individual segments of a structure other than Item 75 which records the type of work proposed to improve a structure, or Item 106, which records the year of most recent reconstruction of the structure (FHWA 1995). This is in contrast to data for bridges proper where separate fields exist to capture information about components such as the bridge deck, etc.

The *cost* of not capturing the segment data becomes evident when one recognizes, as is the case for Texas, that culverts can have as many as eight or more (in one case 13!) segments. Overall, the Texas inventory comprises an average of about 1.8 segments per culvert, all of which have to be load-rated. Another drawback to not identifying segments is the missed opportunity to sensitize bridge (culvert) inspectors to potential areas of different structure performance.

7.3.4 Lesson #4. Culvert load rating requires data, but required data are often not available.

The data required to perform production-simplified load rating calculations using the load factor rating (LFR) approach for a reinforced concrete box culvert are summarized as follows. Parameters are identified specific to each segment in the culvert structure:

- Structure history – segment identification, build year, overall layout
- Culvert geometry parameters – span number, span length, box height, haunches, skew
- Culvert design parameters – design sheet/design standard name, design year, steel grade, concrete class, condition rating/localized defects
- Load parameters – highway load, lane load, live load distribution out-of-plane
- Environmental parameters – cover soil depth, soil type, soil stiffness, pavement type, pavement layer thicknesses, and pavement layer stiffnesses

Ideally of course, the load rating engineer would be provided (or obtain) a complete, accurate, and non-conflicting set of *as-built* data for each and every parameter, for each culvert segment. We have never seen this definitive case in practice, but it is important to mark where one starts making interpretations and assumptions. In load rating, this starts when the load rating engineer chooses to interpret parameters from best data source available, namely, the culvert document file. This practice is reasonable and widely-accepted, and while most data obtained from documents are usually reliable, the document files are nevertheless a surrogate for actual, as-built, measured parameters and properties. One example will illustrate how data obtained from documents might differ from actual measured data. Early in our research when we were performing field load tests for three older culvert structures, as part of the activity we obtained cores from the culvert concrete (Lawson, *et al*. 2010). Tested compressive strengths ranged from 6,000psi to 9,750psi, whereas the specifications identified the compressive strength for this class of concrete as 2,500psi to 3,000psi. This strength difference impacts structural capacity calculations, and thus the rating factor values. The same can be said for reinforcing steel yield strength, soil stiffness, pavement stiffness, and so on. It will be rare for culvert documentation to include actual measured data, but it is important to recognize the potential impact of the decision to rely only on readily-available data.

In our experience, a reasonably-complete document file will consist of an Inventory Record (the culvert is identified in the NBI database), one or more structural Inspection Reports (which usually include some photos and coded assessments of the various structure components), and the original construction drawings or at least the design standard or design standard name for the culvert. Happily, many (but not all) load rating parameters can be obtained from these culvert documents or they are specified by policy.

What is the *typical* condition of the culvert dataset? To start, even when the culvert documents are reasonably-complete, it is exceedingly rare that the file contains *any* geotechnical borings, soil test data, or pavement data. Further, information is not collected or provided at the segment level, even though load rating calculations (*i.e.*, a full set of parameters) must be performed for each culvert segment. Only occasionally does the file include multiple sets of construction drawings which depict most of the major reconstruction events over the culvert service life.

The construction drawing set, in particular the culvert design sheet, deserves specific mention since the drawings/design are the most significant source of data needed for specification of the culvert model. Our review of a statistically-representative sample (1,000 culverts/1,385 load-rated segments) of TxDOT’s population of pre-1980, on-system bridge-class culverts (~11,000 culverts) showed that the design sheet was provided for 44% of culvert segments, and the design was specified by name for an additional 10% of segments. TxDOT widely uses design standards for their culverts, so specification of the design is usually sufficient to identify the design. The point is that for about half of the culvert segments in the TxDOT inventory, designs were not available in the culvert document file. How does one respond to this finding? In our case, we were working with the *digital* document file and this was deemed "all that is available." But perhaps old, tattered, original designs might exist in archive storage somewhere in the midst of thousands of other files plus dust, spiders, and back-breaking labor. How much effort and expense in searching for documents is enough?

The implication of document availability for culvert load rating is this. The ideal case of complete, culvert-specific, as-built data will likely never happen. The typical case of a complete document file – which still does not fully identify all parameters necessary for a culvert load rating model – will only occur part of the time. Faced with the situation of incomplete or conflicting data, responsible load rating engineers will either obtain more data or they will start making documented interpretations and assumptions. Our experience is that load rating of culvert structures represents a domain of engineering work that is rife with such data assumptions and interpretations. For this reason, desk-level efforts by individual load-raters however skilled, can lead to inconsistences and compounded conservatism that, when multiplied by thousands of structures in the inventory, widen the disconnect between observed structure performance and calculated load-rating values. A system-level approach is necessary in order to consistently, uniformly and systematically accomplish reliable data which will lead to more accurate and precise culvert rating results.

7.3.5 Lesson #5. Engineered design standards for culverts yield both benefits and limitations for culvert load rating.

Limited anecdotal evidence and extensive experience in Texas suggest that design standards are commonly used for culvert structures. TxDOT has, since the earliest days of the agency (chartered in 1916) created and relied on standard designs for their culverts. Our search of TxDOT culvert files revealed design standards dating to 1916, and multiple generations of these design standards exist.

Individual design standard sheets are typically associated with a specific era, design philosophy, material specification, allowable cover soil depth range, design load, and culvert span length. Within this context, the design standard will present a representative cross section identifying culvert member dimensions and the reinforcing steel layout, along with multiple tables (20 to 30, typical) defining specific design options for a range of culvert wall heights and number of spans. Much is good about culvert design standards, and it would be fair to say such standards are an elegant expression of engineering efficiency, repeatability and utility.

As part of our load rating research, we actually digitized the complete set of TxDOT's standard culvert design sheets and placed them in a design collective (about 400 sheets representing over 9,000 individual culvert designs— *see* Chapter 8), so we have looked at these standards very carefully. During this work we noted that when one gets into reviewing multiple generations of standard designs, the details are sometimes very difficult to interpret. Further, even with extensive training, the sheer volume of data which must be identified, extracted and cataloged from a design sheet – even for just one culvert segment – is such that it is easy to make mistakes. Yet, it is to be noted that at both the desk level (one culvert) or system level (thousands of culverts), evaluation of the design is *absolutely required* for each and every culvert segment, as the design conveys the information needed to calculate load demands and capacities necessary for determination of load rating factors.

One concern about culvert design standards is that they seem to invite misuse. The logic goes something like this: (1) All culverts are constructed based on design standards [*mostly true*], (2) All design standard sheets are available [*somewhat true*], (3) It is possible to reliably digitize the design standard sheets [*a lot of work, but yes, it can be done to within reasonable tolerances*], (4) Our inventory contains thousands of culverts [*true*], (5) We can identify the designs for these culverts [*not true about half the time, but let's not quibble*], so (6) We can "load-rate" the designs and use the approved design-load-rating results to back-populate all the individual culvert files in the inventory [*"oops"*]. This appears to be a great idea, but we tried and it did not work. One of the key problems has to do with an interaction between the culvert load rating factor and the depth (*i.e.*, thickness) of cover soil above the structure. We explored this phenomenon (Wood et al. 2015) and determined that the rating factor vs. soil depth relationship for TxDOT culvert design standards takes three typical forms: increasing (61%), decreasing

(29%) and constant (10%). Figure 7.6 shows the increasing relationship which is the most common case.

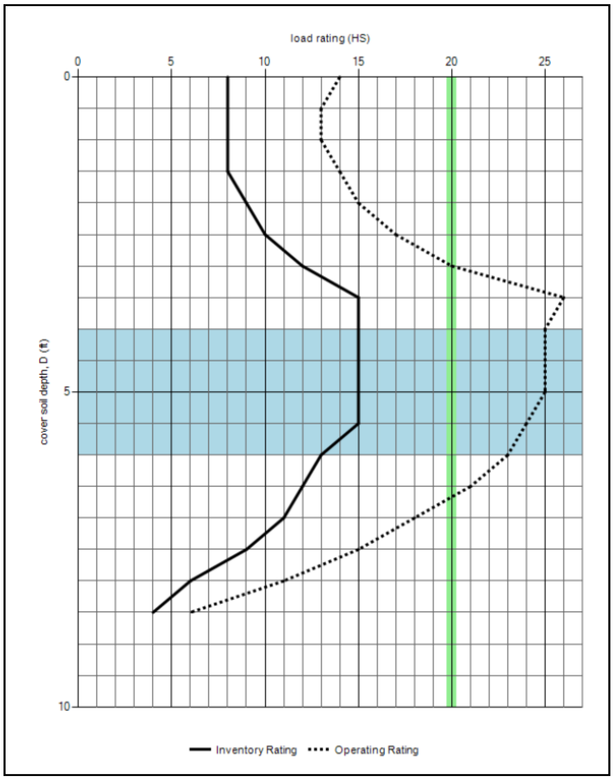


Figure 7.6 Representative load rating vs. cover soil depth relationship, “increasing” case.

The rating vs. depth relationship was established by performing load rating calculations for a full range of assumed cover soil depths, and the curves in Figure 7.6 (both operating rating and inventory rating) are nonlinear and non-constant, with the “design” cover soil range identified by the shaded region of the figure. The dynamic imbalance in the rating factor is associated with changing distributions of live load and dead load with cover soil depth. For the purposes of this discussion, the point is that one must know the actual cover soil depth in order to determine the rating factor. But unfortunately, NBI data do not identify culvert cover soil depth, and only with significant effort can this parameter be reliably extracted from documents in a typical culvert file. This one fact makes it very difficult to reliably associate rating values for a design standard with a particular culvert, and there are other problems as well. The lesson learned is that even when a load rating “short-cut” seems highly plausible, the practical complexities of the culvert rating process may render such approaches unreliable.

7.3.6 Lesson #6. Load rating efficiency must be balanced with rating factor accuracy.

A good way to think about culvert load rating is that an approved (accurate and precise) load rating factor sources to and requires both a valid load rating *process* (for identification of culvert data) and a valid load rating *model* (for calculation of load demands). However, our experience has been that most of the time – and especially from the desk-level perspective where a single culvert needs rating – when the conversation turns to balancing load rating efficiency vs. rating factor accuracy, it is the rating model/ structural analysis procedure which is specifically in mind. But this is not the only efficiency of interest. Where is the bulk of work performed in culvert load rating? Where are hours spent, issues identified, and questions asked? Where are key assumptions and interpretations made? Where are the likely sources of inconsistency and error? When viewed from the *system* level, unquestionably these challenges are greater for the rating *process* than for the rating *model*.

An apt analogy is the painting of an old house. If the project takes a week, the paint crew will spend three days prepping, one day painting, and one day cleaning up. This is not to say that the quality of the paint will not affect the final outcome. But the prep has to be right, and in fact, the finish coat can rarely overcome sloppy prep work. As in paint contracting, so in load rating, the prep (process) must be solid and thorough. Further, only from the perspective of good prep can the quality of different finishes be fully appreciated.

The lesson learned is that approved load rating begins with a sound process that enables the load rating engineer to systematically achieve a quality set of reliable load rating parameters, *by culvert segment*. Only then can the important – even *critical* – questions of rating model selection, calibration and application be approached with insight and confidence. If the rating factors obtained from such a process are still questionable – *i.e.*, they do not match observed structure performance, a sound place exists from which to diagnose potential causes of the disconnect. At a minimum, the load rater will know "the problem's not with the data."

7.4 HOW WE LOAD RATE CULVERTS IN TEXAS (NOW)

The procedure currently used to load rate bridge-class culverts in Texas – all of which are cast-in-place, reinforced concrete, box culvert structures – is as follows:

Task 1. Document Capture & Classification (by culvert).

The place to start is with the culvert document file. Texas provides digital documents, sometimes from their bridge database and sometimes from their construction drawing archive. If the document file is incomplete, we always ask for what is missing. In any event, we open, review, and classify all available documents.

Task 2. Structure History & Segment Interpretation (by culvert).

Available documents should provide a cogent account of the structure history, in particular, the construction date and nature of all culvert segments. We created a highly-detailed segment classification and identification system. Usually the structure history is clear and segment identification is non-controversial. Sometimes key data are missing or conflicting. Either way, we make the best interpretation we can. This is a key decision, so we document the interpretation by means of a 5-point quality rating (see Chapter 9).

Task 3. Parameter Interpretation & Data Capture (by segment).

This step is where we obtain and identify all culvert parameters (except design details) necessary to load-rate a culvert segment. Often data are missing. Frequently data exist in multiple files and are not fully consistent. We do the work necessary to achieve a complete and un-conflicted dataset. This is our second key decision in the load rating process, so we also document this interpretation by means of a 5-point quality rating.

Task 4. Design Selection (by segment).

As has been noted, Texas uses engineered design standards for their culvert designs. For efficiency, consistency and quality reasons, we digitized TxDOT's complete set of design standard sheets and placed these in a digital design collective. Further, we catalogued every design in such a way that the design can be associated with basic parameters such as design year, number of spans, span length, box height, etc. as identified in the previous task. If the culvert documents contain the actual design, we select it (from the collective, as it is already digitized there). If the culvert documents do not specify the design, we use known information about the culvert segment, *i.e.*, its unique set of parameters, to identify plausible designs that "match." This represents our third key decision in the load rating process, and we document this interpretation by means of a 5-point quality rating.

<u>Task 5</u>. Level 1 (simple/structural frame) Load Rating Calculation (by segment).

Now, we load-rate the segment, and we actually load-rate each culvert segment multiple times. The first level of load-rating (Level 1) relies on a simple structural frame model, and we coded software to fully automate this rating process. Further, we iterate the load rating over a full range of cover soil depth from ‘direct traffic’ to ‘dead load fail.’ We do this in order to identify the critical cover soil depth for the structure, *i.e.*, the thickness of cover soil within the range of actual cover soil depths that yields the lowest rating factor. We define this as the controlling cover soil depth and use this parameter to define subsequent load rating analyses.

<u>Task 6</u>. Level 3 (refined/production-simplified) Load Rating Calculations (by segment).

This second, more refined load rating analysis (Level 3) is usually the version the load rating that goes in the culvert file for record purposes. We use a production-simplified, 2D, finite element model that accounts for soil-structure interaction. Our current model accounts for different types of soil, pavement, and a host of other variables.

<u>Task 7</u>. Reporting (by culvert).

TxDOT’s culvert rating program, CULVLR, offers various reporting options. We typically include a summary page, culvert segment sketch, individual rating summaries (direct stiffness model) for all segments, individual rating summaries (finite element model) for all segments, and a project documentation sheet that identifies all files from which data were obtained to support the rating factor calculations. Detailed reports of program input, capacity, demand, and rating factor calculations can be provided upon request.

7.5 SUMMARY AND CONCLUSIONS

This chapter identifies practical observations, knowledge, insights, and lessons learned that are intended to help culvert load-raters achieve an acceptable level of accuracy and precision in their work. In particular, we are sensitive to the burden of State Load Rating Engineers who are tasked with the huge responsibility of actually determining load ratings for the thousands of bridge-class culverts in service today. Our experiences have caused us to give priority attention to the *process* by which load-rating engineers identify and assemble parameters which various analytical models then use to calculate load demands and ultimately, load rating factors. Rating factor calculations must be based on reliable parameters. After this, it is critically important to identify, select, and calibrate load rating models such that these models are finely-tuned to avoid the twin perils of excess conservatism and non-conservatism, neither of which is acceptable. This effort will help close the “disconnect” between observed structure performance and calculated load rating factors.

CHAPTER 8
DIGITAL DESIGN COLLECTIVE

8.1 OVERVIEW

Since the earliest days of the Texas Highway Department (chartered 1916), TxDOT created and has relied on standard designs for their multi-span, bridge-class culvert structures. TxDOT's archive files revealed design standards dating to the 1920s, and multiple generations of these design standards exist. Implementation of the standard designs allowed TxDOT bridge engineers to rapidly specify repeated culvert designs rather than invest the intensive effort and expense needed to create custom designs for each specific structure, one culvert at a time. These culvert design standards are an elegant expression of engineering efficiency, repeatability and utility.

TxDOT's population of culvert designs focus on multiple-span culvert structures, sometimes referred to as multiple box culverts (MBCs), all of which are (for the purposes of this research) cast-in-place reinforced concrete. An individual design standard sheet defines the configuration for various geometries of culverts under different cover soil depths, along with details of reinforcing steel and concrete strength. As such, the design standard fully prescribes the structural *capacity* of the culvert.

As part of this research study, practical considerations associated with load rating efficiency, repeatability, and accuracy required that the design parameters for TxDOT's collection of design standards be digitized electronically to facilitate reliable computation of the capacity and load rating at each critical section of a culvert structure. This chapter describes TxDOT's population of culvert standard designs and the process by which these standard designs were digitized to form what we refer to as the "digital design collective."

8.2 TXDOT'S POPULATION OF CULVERT DESIGN STANDARDS

Individual design standard sheets are typically associated with a specific era, design philosophy, material specification, allowable cover soil depth range, design load, and culvert span length. Within this context, the design standard will present a representative cross section identifying culvert member dimensions and the reinforcing steel layout, along with multiple tables (20 to 30, typical) defining specific design options for a range of culvert wall heights and number of spans. As culvert needs and policy requirements developed, the standard designs changed, evolved, and were replaced. The result was several eras of culvert standard designs.

8.2.1 Culvert Design Eras

TxDOT culvert standards developed over six fairly distinct *eras*: 1) early standards, 2) pre-WWII standards, 3) Interstate Highway standards, 4) modernized Interstate Highway standards, 5) 2003 design standards, and 6) 2014 LRFD standards. Table 8.1 shows a summary of TxDOT design standards identified in this study.

Table 8-1. Classification of TxDOT design standards by era

Design Era	TxDOT Culvert Design Standards	No. of design sheets
1. Early standards	MBC-## (oldest… 1920s-30s)	30
2.a pre-WWII standards (direct traffic)	MBC-##-## (haunched 1930s-40s)	41
2.b pre-WWII standards (fill)	MBC-##-##-F (haunched 1930s-40s)	85
2.c Single box designs	BC-## (haunched… 1930s)	7
3. Interstate Highway standards	MC##-# (newest… 1949-1977)	68
4. Updated Interstate Highway	MC##-# (reissued… 1977 onward)	68
5. 2003 Release	Redesigned standards	25
6. 2014 Release	Updated for LRFD	n.p.

The early standards (c.1900-1920s) tended to be unhaunched, and some few culverts built this era are still in service. The pre-WWII standards (c.1920s-1940s) were smaller (typical spans less than 8ft) and employed haunched corners. The Interstate Highway standards (c.1949-1977) were unhaunched with thinner slabs and longer spans (9-10ft). These design features were intended to reduce construction material and labor cost. The Interstate Highway designs were “modernized” and reissued in 1977 by increasing the designed steel strength from Grade 40 (f_y = 40ksi) to Grade 60 (f_y = 60ksi). These modernized Interstate Highway standards (1977-2002) were the first to be evaluated using current load factor design procedures requiring HS20 loading conditions. In 2003, TxDOT redesigned, expanded, and issued a complete set of culvert construction drawings. The 2003 set includes new designs for deep fill culverts with fill heights up to 23 feet. Our understanding is that TxDOT again updated their culvert design standards for LRFD, resulting in a sixth era (c. 2014), but information was not provided about this set of designs.

Because the emphasis of this research study is pre-1980 culverts not specifically designed for HS-20 loading, most of the discussions which follow focus on the first three eras of TxDOT's culvert standards. Also, Table 8.1 includes a category for single-span culverts. These single-span designs are part of the second era of TxDOT's design standards and are of interest for this research since single-span designs, while not bridge-class culverts by themselves, were sometimes lengthened or used to lengthen in-service multi-span culverts.

8.2.2 Culvert Design Standard Categories

In addition to era, TxDOT culvert design standards can be categorized depending on degree of deviation of their design details from the original standard designs. These categories are: 1) original design standards, 2) modified design standards, and 3) structure-specific designs. Table 8.2 identifies original, modified, and structure-specific design standard sheets identified and digitized for this study.

Table 8.2. Classification of TxDOT design standards encountered in Batch 1

TxDOT Design Standard Categories	**No. of design sheets**
Original Design Standard Sheets	231
Modified Design Standard Sheets	36
Structure-Specific Design Sheets	149
TOTAL Culvert Design Standard Sheets	**416**

The first category, the original design standards, represents the aforementioned families (or eras) of standardized designs for various culvert geometries. Figure 8.1 provides an example of this type of design standard sheet from the Interstate Highway era, MC8-3. It should be noted that original design standards digitized for this study include all culvert design standards from the first three eras, plus the single box designs.

The second category, modified design standards, are standards which were slightly revised from the original design standards. These modified standards were created to account for design situations where very few parameters, such as cover soil depth or skew angle, deviated from the parameters of the original design standards while all other parameters remained the same. Figure 8.2 provides an example of a design standard from this category. Note this is simply a modification of the original MC8-3 design (Figure 8.1).

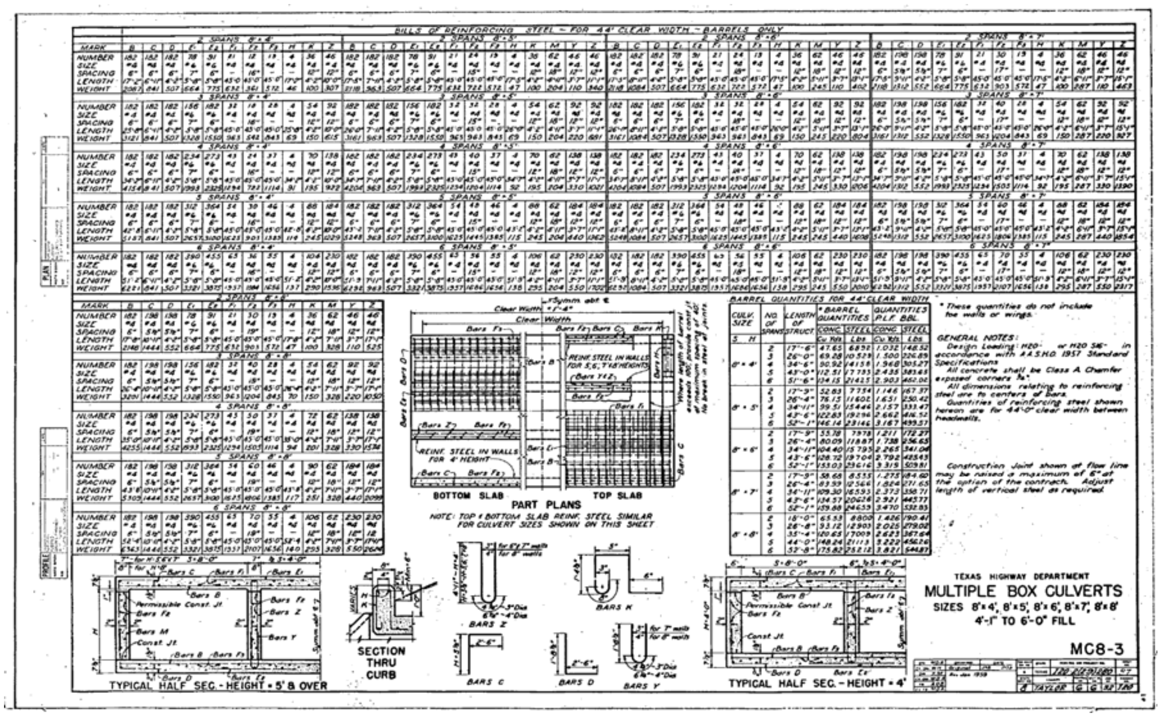


Figure 8.1. TxDOT Standard Category: Original design ('MC8-3')

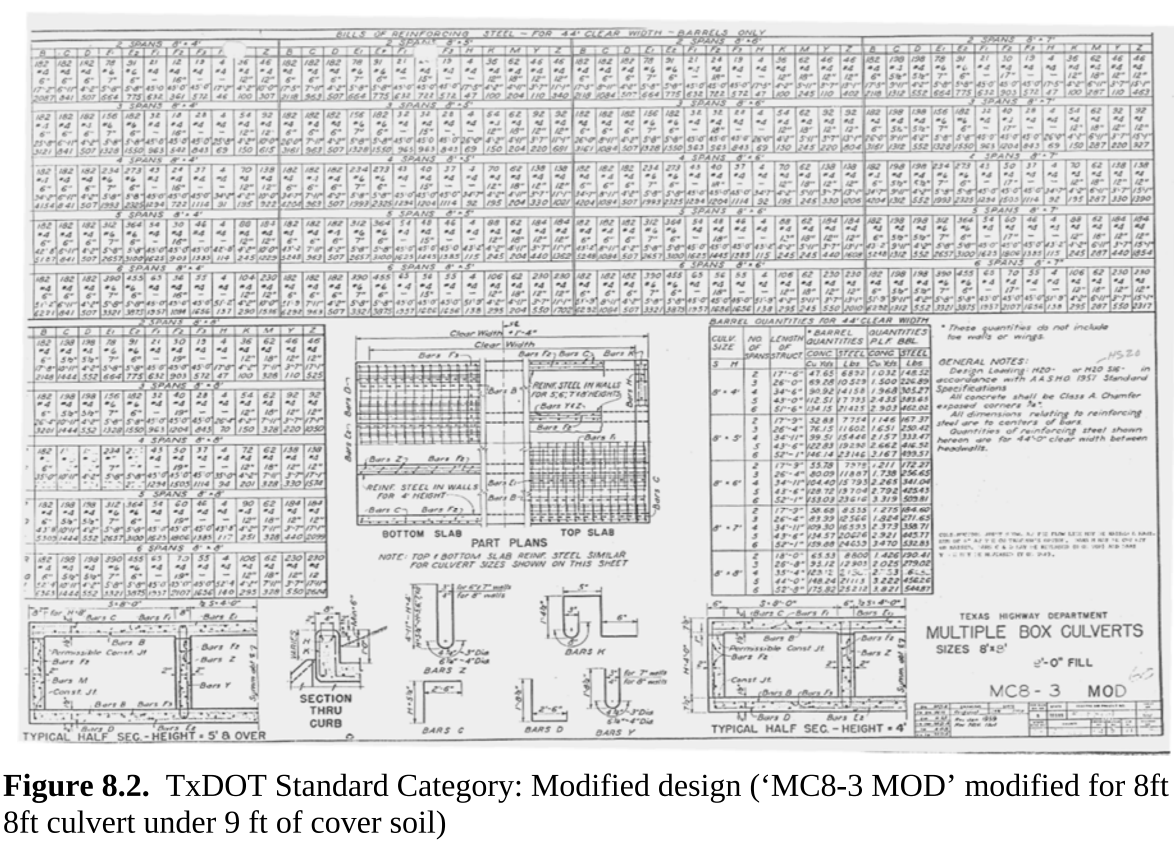


Figure 8.2. TxDOT Standard Category: Modified design ('MC8-3 MOD' modified for 8ft x 8ft culvert under 9 ft of cover soil)

The third category of TxDOT design standards – structure-specific designs – are customized designs that deal with unique aspects of culvert design such as non-typical skew angles, exceedingly deep fills, transitions, lengthening details, and others. Figure 8.3 provides an example of a unique design standard from this category.

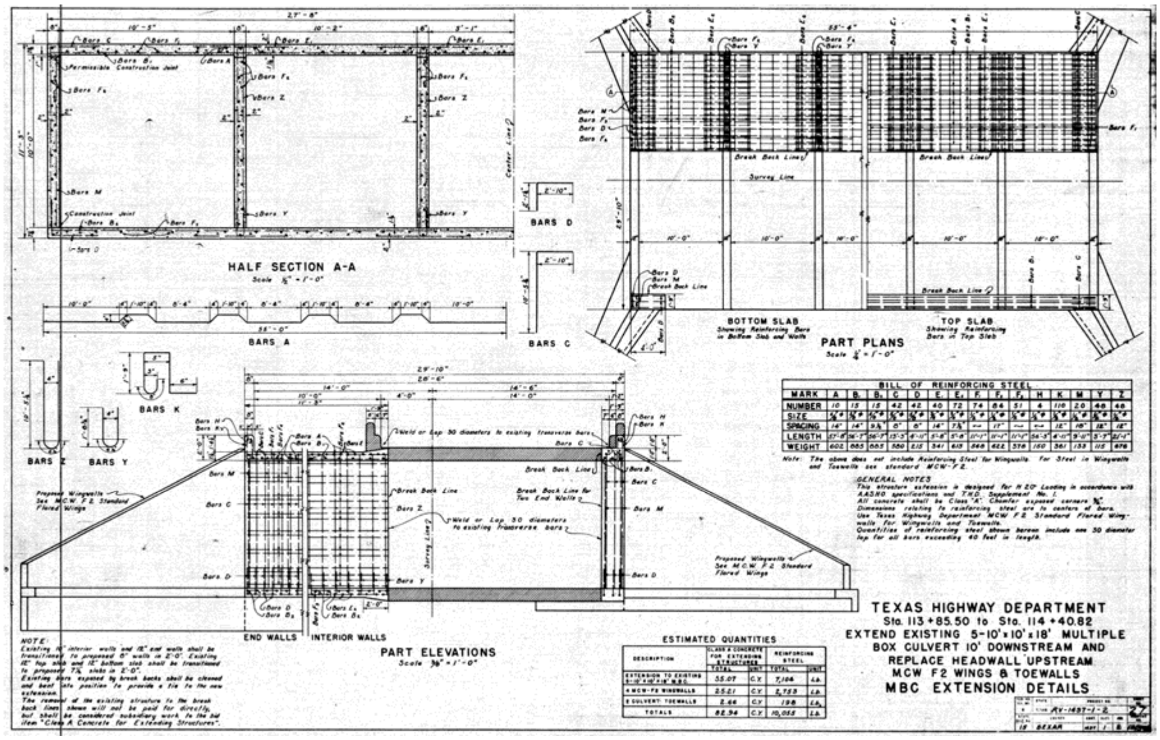


Figure 8.3. TxDOT Standard Category: Structure-specific design ('MBC Extension Details' for widening of 5 barrel, 10ft x10 ft)

8.3 CHARACTERISTICS OF TXDOT'S CULVERT DESIGN STANDARD FAMILIES

The different TxDOT design eras resulted in design standards having similar characteristics including a specific design philosophy and unique design distinctions. For this reason, it is natural to think of the designs for a specific era as a "family" of standard designs. This section describes characteristics of each design standard family.

8.3.1 MBC-# Sheets

MBC-# sheets belong to pre-WWII era with span length ranging between 3 and 10 ft. MBC-# sheets are the oldest design from Batch 1, issued 7 to 16 years earlier than the subsequent MBC-#-# and MBC-#-#-F sheets. All MBC-# design sheets are for low-fill, unhaunched culverts with original design year ranging from 1924 to 1928. Details of expansion slabs and concrete strength classes are also included in design sheets. Total of 30 MBC-# sheets were encountered in Batch 1 culverts. MBC-3 design sheet is presented in Figure 8.4 as an example of MBC-# sheets.

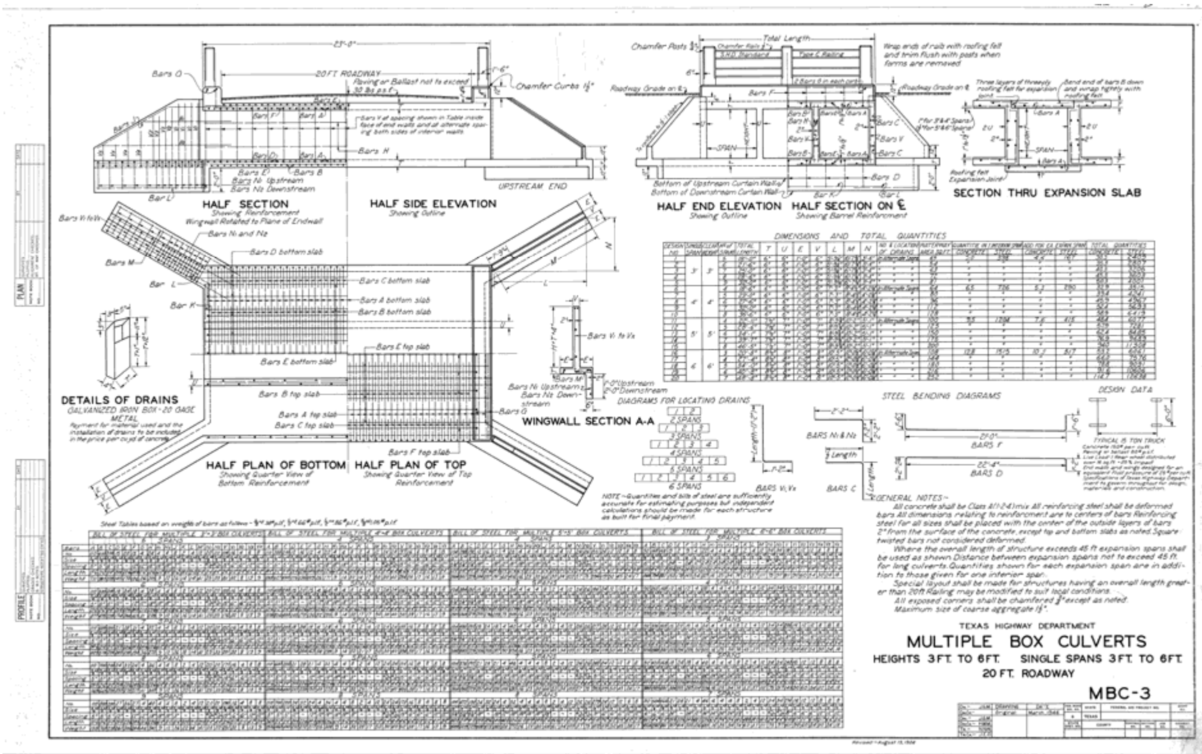


Figure 8-4. Example of MBC-# design standards family: MBC-3

8.3.2 MBC-#-# Sheets

MBC-#-# design sheets belong to pre-WWII era with span lengths ranging between 5 and 10 ft. All MBC-#-# design sheets show haunched culverts with expansion slabs. The first number represents the sub-family and the second number represents roadway width. A particular sub-family might have one-digit number (1 to 7) or two-digit number (11 to 17) depending on the type of wing walls. As long as the roadway widths are the same, there are no differences in structural designs of main body of culverts in this family, except for wing walls. More specifically, for purposes of culvert load rating based on a production-simplified, two-dimensional, unit-width cross section of the culvert, the culverts show exactly the same structural design. For example, MBC-1-34 and MBC-12-34 design sheets have flared wing walls and straight wing walls, respectively, both for 34 ft of roadway width, but these designs are structurally equivalent for load rating. Original design years for MBC-#-# sheets range from 1935 to 1940 and are for direct traffic culverts. Details of expansion slabs and concrete strength classes are also included in design sheets. Total of 41 MBC-#-# sheets were encountered in Batch 1 culverts. As an example, MBC-1-34 design sheet is presented in Figure 8.5.

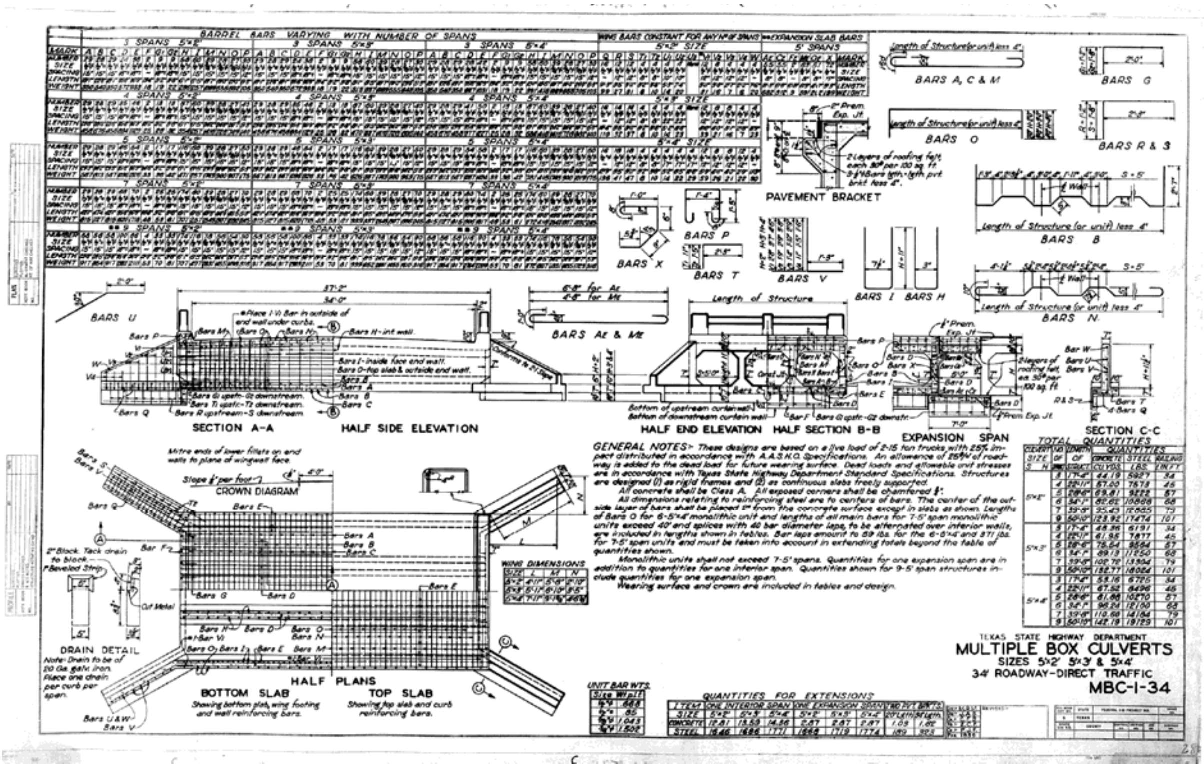


Figure 8.5. Examples of MBC-#-# design standards family: MBC-1-34

8.3.3 MBC-#-#-F Sheets

MBC-#-#-F sheets belong to pre-WWII era with span lengths ranging between 5 and 10 ft. Similar to MBC-#-# sheets, MBC-#-#-F sheets show haunched culverts but no expansion slabs. The sub-family might have one-digit number (1 to 7) or two-digit number (11 to 17) depending on the type of wing walls. As long as the roadway widths are the same, there are no differences in structural designs of main body of culverts, except for wing walls, as was the case for MBC-#-# design sheets. All designs in MBC-#-#-F family are for low-fill type culverts (maximum cover soil depths ranging between 3 and 6 ft). Original design years for MBC-#-#-F sheets range from 1935 to 1940 and concrete strength classes are listed in design sheets. Total of 85 MBC-#-#-F sheets were encountered in Batch 1 culverts. As an example, MBC-1-30-F design sheet is presented in Figure 8.6.

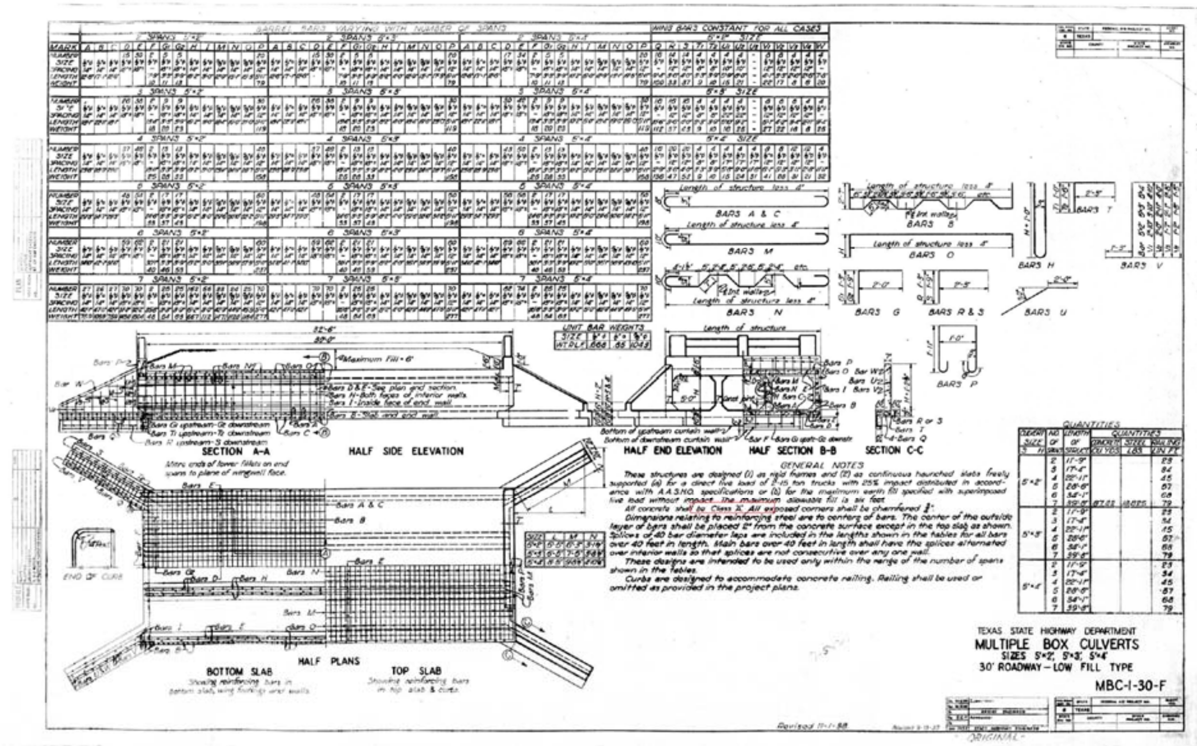


Figure 8.6. Examples of MBC-#-#-F design standards family: MBC-1-30-F

8.3.4 BC-# Sheets

BC-# design sheets typically belong to pre-WWII era and are single-barrel culverts with span lengths ranging from 2ft to 10ft. BC sheets show haunched culvert designs with original design years ranging from 1934 to 1936. All BC-# sheets are for deep-fill culverts with cover soil depths ranging from 4 to 30 ft. Concrete strength classes are listed in each design sheets. Total of seven BC sheets were encountered in Batch 1 culverts. As an example, BC-4 design sheet is shown in Figure 8.7.

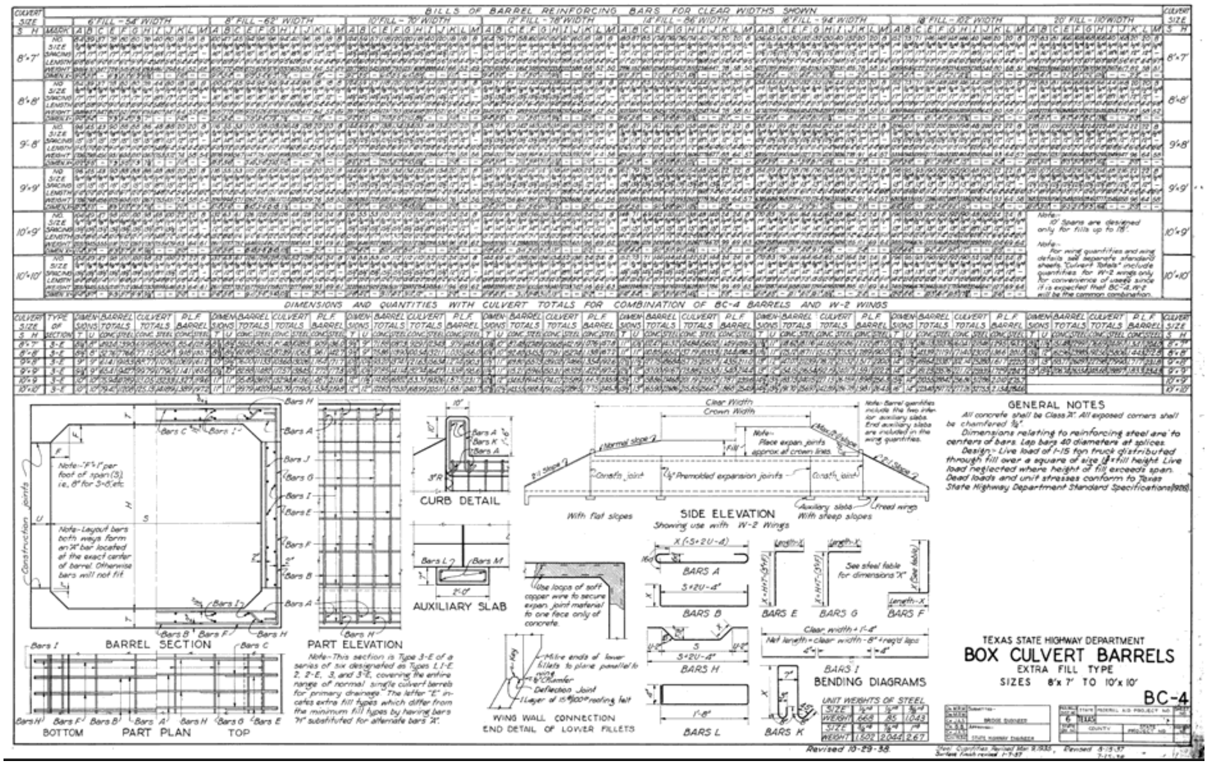


Figure 8.7. Examples of BC-# design standards family: BC-4

8.3.5 MC#-# Sheets

MC sheets have names of MC#-# and belong to Interstate Highway era. The first number (#) represents the span length of a culvert. For example, all designs in MC5-1 and MC10-1 sheets have 5ft and 10ft span lengths, respectively. The second number is associated with the cover soil depth. For 7-, 8-, 9-, and 10-ft-span design sheets (*i.e.*, MC7-#, MC8-#, MC9-#, and MC10-#), the numbers “1”, “2”, and “3” represent 0 – 2ft, 2 – 4ft, and 4 – 6ft of design (allowable) cover soil, respectively,. On the other hand, for 5- and 6-ft-span design sheets (*i.e.*, MC5-# and MC6-#), the numbers “1” and “2” represent 0 – 4ft and 4 – 6ft of cover soil depths, respectively. All MC sheets show unhaunched culverts with original design year ranging from 1949 to 1958 and concrete strength classes are listed in each design sheet. In this study, total of 68 MC sheets were encountered in Batch 1 culverts. As an example, MC10-1 design sheet is presented in Figure 8.8. About half of TxDOT’s population of ~11,000 pre-1980 in-service culverts were constructed using this family of design standards, making MC#-# standards the most-commonly used set of designs.

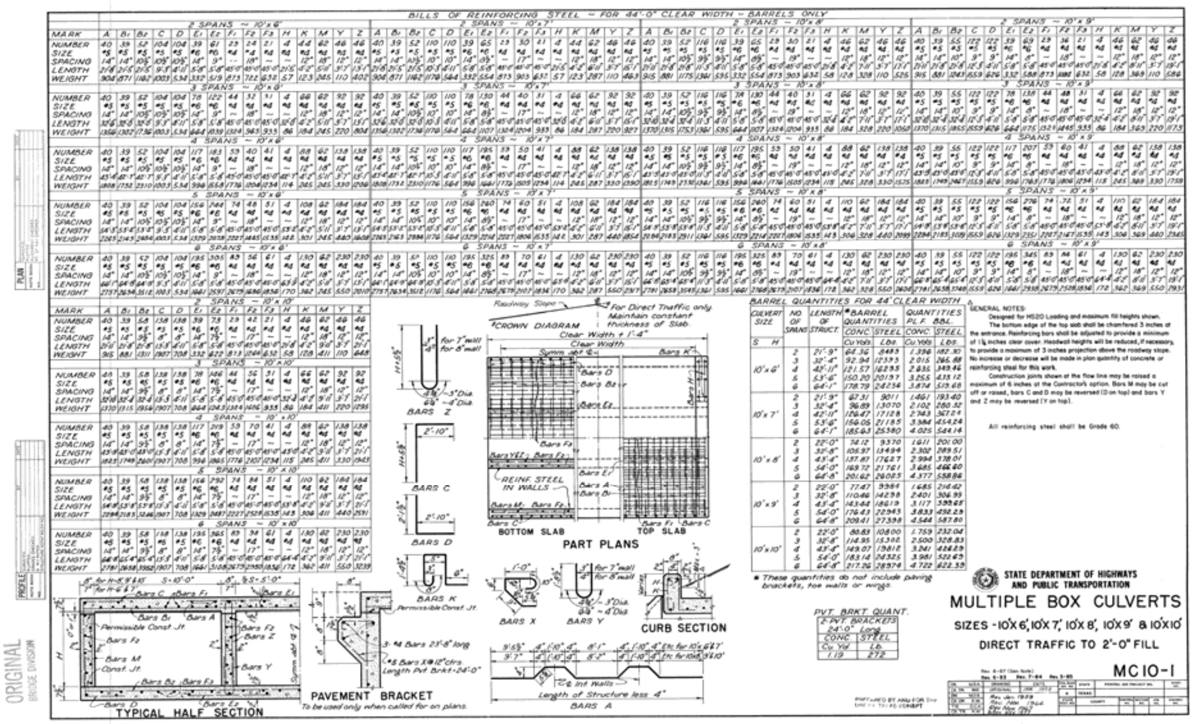


Figure 8.8. Examples of MC#-# design standards family: MC10-1

8.3.6 Summary of TxDOT's Families of Standard Culvert Designs

Table 8.3 presents a summary of the identifying characteristics of the original design standards families for TxDOT culverts. In addition to the family name, the typical span length, box height, number of spans, and cover soil depth are identified. These data provide a comprehensive picture of the diversity of TxDOT's population of available culvert designs.

Figure 8.9 provides an idea of the degree to which these culvert design standards are currently in use. Recall that TxDOT's population of pre-1980, in-service culverts totals approximately 11,000 structures. A statistically-representative sample (1,000 culverts) were identified, and these "Batch 1" culverts comprise 1,788 total/ 1,385 ratable culvert design segments. Because culvert load rating is done at the *segment* level, usage of the design standards also happens at the segment level. Per Figure 8.9, approximately 65.3 percent (±2.8%) of TxDOT's pre-1980 in-service culvert segments use MC designs (Interstate Highway era). The next closest group is the early MBC-#, at 17.5 percent (±2.2%). The remaining pre-WWII standards (BC-#, MBC-#-#, MBC-#-#(-F)), while still in use, are represented less prominently among the in-service culvert segments, at 15.0% (±2.8%) percent of the population.

Table 8.3. Summary of TxDOT original design standards families

Design Family	Span Length (ft.)	Box Height (ft.)	No. of Spans	Cover soil depth	Characteristics
MBC-#	3 – 10	3 – 10	2 - 7	0 – 8 ft.	• Unhaunched • Expansion slab • Design year ranging from 1924 to 1928
MBC-#-#	5 - 10	2 – 12	2 - 9	0-2 ft. (Direct traffic)	• Haunched • Expansion slab • Design year ranging from 1935 to 1940
MBC-#-#-F	5 – 10	2 – 12	2 - 9	2-6 ft. (Low fill type)	• Haunched • No expansion slab • Design year ranging from 1935 to 1940
BC-#	2 - 10	1.5 – 10	1	4 – 30 ft.	• Haunched • Single barrel • Design year ranging from 1934 to 1936
MC#-#	5 – 10	5 – 10	2 - 6	• MC5/6-1: 0-4 ft. • MC5/6-2: 4-6 ft. • MC7/8/9/10-1: 0-2ft • MC7/8/9/10-2: 2-4ft • MC7/8/9/10-3: 4-6ft	• Unhaunched • Design year ranging from 1949 to 1977

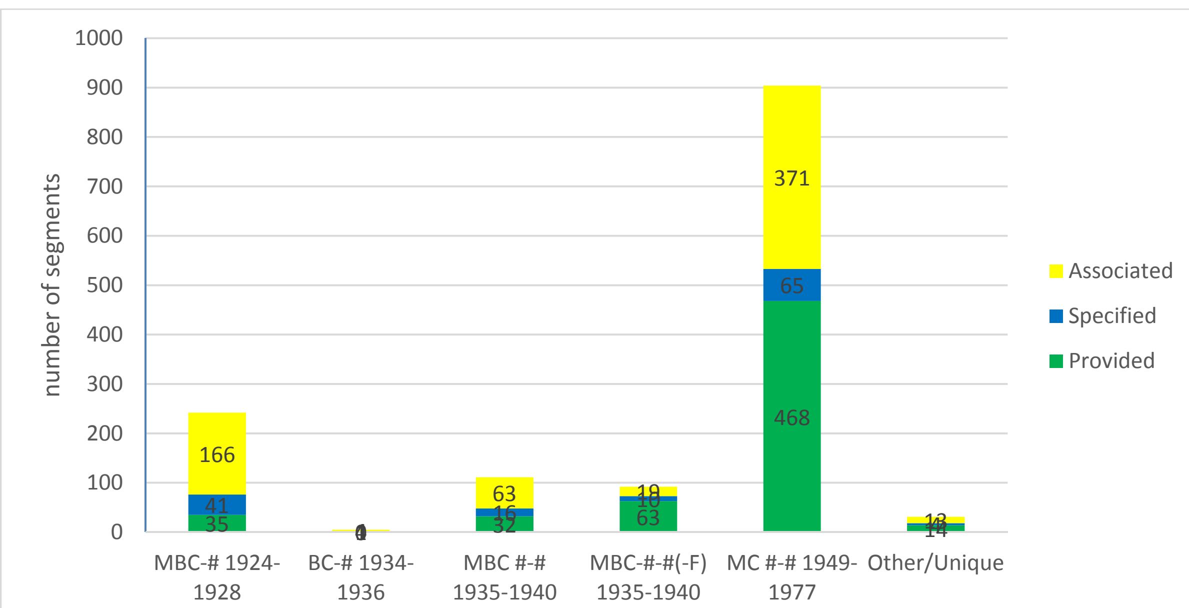


Figure 8.9. Typical usage of standard design families for TxDOT's in-service, pre-1980 culvert segments (data from 1,000 Batch 1 culverts/1,385 rated segments), represent population +/- 3%)

8.4 DIGITIZATION OF THE CULVERT DESIGN STANDARDS

As mentioned previously, TxDOT culvert design standard sheets typically include information such as the culvert geometry, dimensions, reinforcing steel schedule, depth of fill, design loading, concrete properties, issue date, identification and other information. One standard sheet may provide data for as many as 6 to 56 different culvert designs. The culvert load rating process articulated in TxDOT's *Culvert Rating Guide* (Lawson et al. 2009) requires that all these parameters be captured so that culvert capacity and demand calculations can be performed. As part of this project, the complete set of TxDOT's pre-1980 standard culvert design sheets from Batch 1 were digitized and placed in a digital design collective. This consisted 416 design sheets representing 9,362 individual culvert designs.

To accomplish the culvert parameter take-offs necessary to digitize the designs, the research team initiated a systematic training regimen wherein senior faculty guided research assistants (graduate students and senior undergraduate students) to show how to correctly perform the parameter take-offs. These students were observed doing this task, and their work was checked by senior team members (research associates and faculty). After the research assistants demonstrated competency in performing material take-offs, they commenced parameter take-offs for all of TxDOT's culvert design standards. Because every design was catalogued in this way, each design could be associated with its basic parameters such as design year, number of spans, span length, box height, etc. This not only facilitated capture of available parameters, but also systematic extrapolation of design information when the design for a particular segment was not available from source documents.

The research team used a three-tier process to capture all required parameters from the culvert design standards and to assemble this information into culvert-specific data files. The first tier of data entry, performed at the individual culvert design level, consisted of identifying the geometry, dimensions, and material properties for each culvert design. The second tier of data entry, also performed at the individual culvert design level, consisted of capturing the reinforcing steel schedule (bar marks) for each culvert design. This process closely followed the bar mark summaries on the TxDOT design sheets, thus minimizing error and facilitating a check for accuracy. The third tier of data entry, performed at the design sheet level, consisted of mapping reinforcing steel bar marks and concrete cover thicknesses to each culvert critical section based on cross-section drawings presented on the culvert standard sheets.

Upon completion of second tier data entry and quality control, senior members of the research team (engineering faculty or senior graduate students) performed a quality assurance review of a limited sample of the culvert standard population. In addition to the quality control/quality assurance plan described above, as a final quality check, senior members of the research team reviewed the load rating results for all Batch 1 culvert segments. Any erratic or unexpected load rating results (output) led to an independent confirmatory check of the culvert parameters as per the data files (input), with corrections to the data files made as necessary.

8.5 SUMMARY

Archive files of the TxDOT Bridge Division identified five different families of culvert design standards which were used during various eras of TxDOT's history. Careful review of Batch 1 structure data identified that the design standards exist in three categories: original designs, modified designs, and structure-specific designs. This knowledge of the makeup of TxDOT's culvert design standards resulted in the idea to digitize all the culvert design standards for purposes of load rating efficiency, accuracy, and usability.

Collectively, TxDOT's pre-1980 culverts represented a total of 416 design sheets, representing 9,362 individual culvert designs. Among the 416 design standard sheets, 231 sheets were original design standards and 36 were modified design standards. The remaining 149 design sheets were structure-specific designs.

Parameter take-offs for all culvert design standards were performed, and data entry of the reinforcing steel schedule, mapping reinforcing steel bar marks, and concrete cover thicknesses followed. Because of the digitization efforts, these culvert designs can be associated with basic culvert index parameters such as design year, number of spans, span length, box height, etc. This allows the systematic identification of an "associated" culvert design when the original design is not available from source documents. Further, the digitized design data directly facilitated computations of the capacity and load rating at each critical section of the culvert.

CHAPTER 9
CULVERT LOAD RATING RESEARCH METHOD

9.1 OVERVIEW

The culvert load-rating work associated with this study focused on a sample of 1,000 pre-1980, on-system, cast-in-place, reinforced concrete box culverts, identified as 'Batch 1' culverts. These culverts were selected to be statistically representative of TxDOT's full population of approximately 11,000 such structures. The procedure used to load rate these bridge-class culverts is briefly summarized as follows:

Task 1. Document Capture & Classification (by *culvert*).

Task 2. Structure History & Segment Interpretation (by *culvert*).

Task 3. Parameter Interpretation & Data Capture (by *segment*).

Task 4. Design Selection (by *segment*).

Task 5. Level 1 (simple/structural frame) Load Rating Calculation (by *segment*).

Task 6. Level 3 (refined/production-simplified) Load Rating Calculations (by *segment*).

Task 7. Reporting (by *culvert*).

As noted in Section 7.4 of this report, some of these load-rating tasks involved collection of surrogate data when the document file did not contain any information at all, for example, geotechnical information. Other tasks involved significant interpretations relative to conflicting, incomplete, or in some cases missing data. Resolution of these and other issues are properly considerations of the overall research method for the entire project, and while they apply to documents for individual culverts, they are not limited to any one culvert structure. Therefore, it is appropriate to provide details about these key decisions.

9.2 DOCUMENT CAPTURE & CLASSIFICATION [Task 1]

9.2.1 Available Documentation

The culvert load rating work for this research study was accomplished using data obtained from reviewing *available* culvert documentation in *digital* format. Our scope of work was defined such that in no case were we to travel into the field to measure or obtain culvert-specific data. Further, we did not obtain or review any printed (hard copy) culvert documents. While we requested all documents of every type for each culvert, the load rating effort described herein was solely limited to the body of digital documents available from the culvert document file, some from the Bridge Division database, and some from TxDOT's construction drawing archive. Document capture involved searching for documents directly associated with the structure, and also by cross-referencing control and section numbers to identify additional documents associated with the structure which were filed under other construction jobs.

Documents available from these sources often included but were not limited to:

- PonTex database (NBIS data)
- Bridge Inventory Record
- Structural Inspection Report(s)
- Inspection Photo(s)
- Construction Documents (partial or complete set)
- Culvert Design Standard(s)
- Load Rating Statement(s)
- Sketch(es)

In addition to documents from the file, other culvert documents/ data needed for load rating were obtained from both TxDOT and non-TxDOT sources. These included geotechnical data, pavement data, culvert structure properties, and culvert condition rating data.

9.2.2 Geotechnical Documentation

Geotechnical documents were not available for any of the culvert structures reviewed for this study. Occasionally when the project file included a full set of construction drawings, in such cases the plan/profile sheets might show a geotechnical boring in the vicinity of a structure, but this was quite rare. To address this void in the documentation, the research team adopted an "approximate" procedure for characterizing the subsurface materials surrounding and supporting all in-service culverts, consistent with the production-simplified load rating approach. This procedure was based on two underlying assumptions: (1) the excavations associated with culvert construction were typically backfilled with *native soil* obtained from the site where the culvert was built, and (2) such native soils therefore uniformly surround the base, sides and surface of the culvert structure. In effect, the "soil" surrounding the culvert was simplified as a homogenous, isotropic geomaterial having properties typical for the native soils at the culvert construction site. The research team used the following steps to operationalize this procedure:

1) The culvert location was carefully identified in terms of longitude and latitude, as per available NBIS data.

2) The culvert was geo-located relative to the soil association maps in the USDA/NRCS Web Soil Survey (Soil Survey Staff 2016) to identify the soil map unit(s) for the area of interest.

3) With the predominant soil map unit(s) identified, the Web Soil Survey database was used to identify engineering properties of the typical soil profile(s) by layer, in particular, the soil classification (Unified Soil Classification group symbol).

4) The "average" soil classification for the profile(s) was established using a simple calculation, and normally the outcome was a straightforward interpretation. A set of pre-determined decision rules was used to resolve non-typical cases however.

5) Finally, the average soil classification representative of the culvert site was correlated to nominal dead load and live load soil stiffness values as described in the TxDOT *Culvert Rating Guide*, and more particularly in Chapter 6 of this report.

Of course, questions can be voiced about this arguably-simple procedure. In addition to concerns imposed by its basic underlying assumptions, this approach is also subject to limitations associated with the reliability of the Web Soil Survey data. Ideally, project-specific geotechnical data would be available for every culvert site, and reliable material properties specific to culvert load rating would also be available. But when site-specific data are not available or are prohibitively expensive to obtain, the procedure described herein provides a rational approach to identify approximate soil properties that facilitate production-simplified soil-structure demand modeling.

9.2.3 Pavement Documentation

Detailed, project-specific pavement data were not available for any of the culvert structures reviewed for this study. However, unlike the case for geotechnical information, the project file always included a Bridge Inventory Record and site photos, and usually these documents provided a statement or some indication about the pavement type. But in no case did the culvert project file include records identifying the pavement system, pavement layers, pavement thickness, material properties, etc. To address this void, the research team adopted a rational "approximate" procedure for more definitively characterizing the pavement structure overlying the culvert, consistent with the production-simplified load rating approach. The process included the following steps.

1) The location of each culvert was carefully identified in terms of its Texas reference marker and displacement data, as per available TxDOT/NBIS records.
2) TxDOT pavement engineers used the culvert location to cross-link to TxDOT's Pavement Management Information System (PMIS) database (TxDOT 2014).
3) The PMIS database characterizes TxDOT's entire on-system roadway network in terms of 0.5-mile data collection sections. Thus, the pavement type overlying each culvert structure could be identified to this degree of resolution.
4) The PMIS database does not provide pavement core records, layer thickness, or material property data. For the purposes of this load rating study, the best PMIS data available was the "detailed pavement type" of which there are ten – see Chapter 5 of this report.
5) The detailed pavement type was established from the PMIS data, and normally the outcome was a straightforward interpretation. Results were checked against the Bridge Inventory Record and photos. A set of pre-determined decision rules was used to resolve non-typical cases.

Per Chapter 5 of this report, the nominal pavement type can be associated with equivalent pavement structure properties necessary for culvert load rating purposes. As with the geotechnical data, questions can be voiced about the reliability of pavement data obtained using approximate methods. But when project-specific data are not available or are prohibitively expensive to obtain, the procedure described herein provides a rational approach to facilitate the inclusion of the beneficial aspects of the pavement structure in the production-simplified soil-structure demand model.

9.2.4 Culvert Structural Properties

Detailed, project-specific, as-built or contemporaneous structural properties were not available for any of the culvert structures reviewed for this study. Therefore, nominal concrete compressive strengths, reinforcing steel yield strengths, and related structural information had to be obtained from construction documents in the project file. Rather than accept material property information that might appear in the design standards (where available), the material properties were typically correlated by build year for each segment of the culvert structure. The structural properties were then obtained from the appropriate edition of TxDOT's historical archive of *Standard Construction Specifications.*

9.2.5 Structure Condition Rating Data

The quadrennial NBIS Bridge Inspection Records contain numerical ratings that may be used to categorize the condition (performance) for each component of a culvert structure. Report item 62 provides fields where structural engineers rate the "top slabs", "bottom slabs or footings", "abutments & intermediate supports", "headwalls & wingwalls", and "other." The lowest value from these individual ratings is the overall "component" rating for the structure. It was desirable to capture these structural condition ratings as an independent measure of the performance of the structure in order to facilitate comparison with calculated load ratings. For these data, we relied on the condition ratings identified in the most recent Bridge Inspection Record available in the culvert project file. The researchers digitized the data published in the report, excluding the "headwalls and wingwalls." These data were captured for each culvert structure.

9.2.6 The "Production-Simplified" Dataset

Collectively, the document review resulted in nominal data for most of the culvert parameters necessary for load rating. This is not to say that in many cases, more definitive, project-specific data would not refine or "tighten up" the data. But the systematic procedures for document collection and review employed for this study ensured a defined and well-specified dataset, consistent with *production-simplified* load rating work.

9.3 STRUCTURE HISTORY & SEGMENT INTERPRETATION [Task 2]

9.3.1 The Need for Segment Identification

During their service lives, culverts sometimes require upgrading to improve hydraulic capacity, traffic capacity, or both. Thus it is not unusual for culvert structures to be widened (normal to the centerline) or lengthened (spans added) years or decades after the original culvert is built. This is true in Texas where detailed culvert documentation shows that 49 percent of Texas culverts have multiple design segments, and it is also true nationally where NBIS data suggest that 10 to 15 percent of culverts have experienced a significant reconstruction event.

These major culvert modifications are usually done under designs and specifications which *differ* from the original structure. This means that an approved load rating process must identify, define, and account for all unique segments of the culvert structure, and the principle of superposition requires that load rating calculations be performed for each and every culvert segment. Thus, it is necessary for available documents to provide a cogent account of the structure history, in particular, the construction date and nature of all culvert segments.

9.3.2 Segment Identification Process

The first step in segment identification and structure history interpretation was to create a highly-detailed segment classification system as shown in Figure 9.1. The segment key shows five identifying features. First is the segment number, which is assigned chronologically, with the oldest segment being 1, the next segment being 2, etc. In this way, the load rater can quickly identify how many segments exist for a culvert structure.

The next identifier is segment type, for which we defined five specific cases typical for TxDOT's population of cast-in-place, reinforced concrete boxes. Every culvert will have an original segment which sometimes is the *only* segment. Some culverts were initially constructed with multiple segments using multiple designs, so it is also possible for a culvert to contain multiple original segments. Reconstruction events after original construction typically involve culvert widening, and in some cases lengthening, so these are also identified. Another type of segment is the expansion slab. This segment type is not a reinforced concrete box but rather a heavy slab supported by bracket bearing surfaces and used to join adjacent culvert segments. "Other" is used to describe all other non-box culvert segment types that may be part of the structure including pipes, three-sided shapes, etc. While these other types are rare in TxDOT's bridge-class culvert inventory, they do exist.

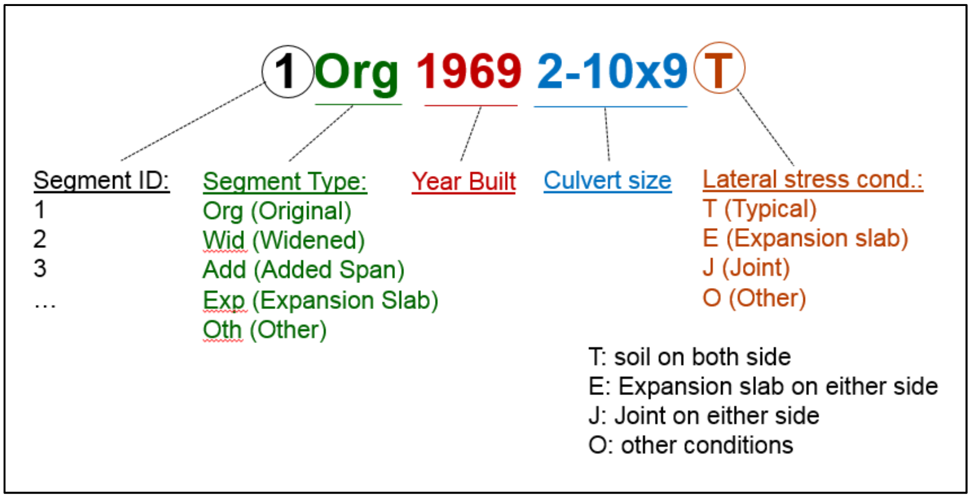


Figure 9.1. Syntax and Interpretive Key for Segment Identification

The 'year built' refers to the year the culvert segment was constructed. NBIS data identify the 'year built' for only the original culvert structure, but it should be apparent that segments can and often are constructed in different years, and this field captures that information.

The 'culvert size' is a short-hand way to define the reinforced concrete box geometry for the segment. The typical syntax is: number of spans, span length, and box height. Thus the segment identified in Figure 9.1 is comprised of two identical spans (also termed boxes or barrels) with dimensions of 10ft wide by 9ft high.

The final identifier refers to the lateral stress condition for the exterior culvert walls. Typically a reinforced concrete box culvert is buried with soil not only above and below the structure, but also with soil bearing against the outside of both exterior culvert walls. That is the *typical* case, and the analytical models used to calculate load demands on a box culvert assume this typical case for load rating (*i.e.*, soil all around). But when the culvert consists of multiple segments, the typical case does not always exist. For example, sometimes the exterior wall of a culvert segment will *not* bear against soil but instead will support an expansion slab. Or, when two segments are constructed side by side (as when culverts are lengthened), only a joint exists between the segments. The culvert modeling software does not identify or analyze these differential lateral stress conditions, but it is appropriate to note the deviation from the typical case.

Having established the segment identification key, interpretation of the structure history and segment identification became an *inductive* process of characterizing the culvert based upon review of all available digital data. The typical case was that the assembled documents from the culvert file would "tell" a straightforward, non-conflicted story and the structure history and segment identification were clearly apparent. However, sometimes – especially for older and complex structures – multiple alternative interpretations were possible. Either way, established practice for this project was for the researchers to identify the best possible interpretation using the available data, to document that decision, and to move on to load rating from there. Concurrent with this goal, resolution of missing or conflicting data sometimes resulted in uncertainty associated with the interpretation. This was a key decision, so we documented the interpretation by means of a 5-point quality rating.

9.3.3 Quality Score for Structure History and Segment Identification

Table 9.1 presents the quality score rubric for interpretation of the structure history and segment identification. Usually the structure history for a culvert was clear and segment identification was non-controversial as has been noted. But sometimes key documents for a culvert were missing or data from multiple sources were in conflict.

Table 9.1. Quality Score Rubric for Structure History and Segment Identification

Quality Score	Concern Score	Descriptive Assessment
(a)	(b)	(c)
5	0	Very high reliability: clear and unambiguous data
4	1 - 2	High reliability: reasonably complete and unconflicted data
3	3 - 4	Average reliability: minor/ limited conflicts or missing data
2	5 - 6	Low reliability: significant missing or conflicted data
1	≥ 7	Very low reliability: incomplete or heavily conflicted data

The first column (Column a) of Table 9.1 identifies the numerical quality score. As would be expected, high scores (4 to 5) represent high quality culvert data characterized by high reliability and few to no conflicts in the document record. The interpretation of such data was essentially clear and unambiguous. On the other end of the spectrum, low quality scores (1 to 2) represent culvert data characterized by questionable reliability and a document record fraught with holes or conflicts. Interpretation of such data was questionable.

Because the interpretation of structure history and segment identification was established inductively relative to the available culvert documents, the assessment primarily focused around the existence (or absence) of conflicts, irregularities, and missing data in the culvert file. These were captured by a “concern score” and this appears in Column (b) of Table 9.1. Conflicts in the document record were assessed as either “minor” or “major” concerns, with minor concerns assigned a score of 1 and major concerns assigned a score of 3, and the sum of the concern scores associated with interpretation quality.

Classification of the concerns was accomplished using a detailed project guidance document established by senior members of the research team. Minor concerns, for example, included conflicts in the file without a clear resolution but which would have little effect on the segment interpretation or load rating, or questionable duplications such as a drawing which was likely misfiled or added in error. By contrast, major concerns included but were not limited to culvert records with a sizeable gap in the documentation where the nature of any segment(s) during that gap was not clear, or cases where documents did not indicate widening or added spans but the inspection photos did indicate such modification, or cases where odd features existed in the culvert structure but were not explained or were undocumented.

Three peculiar cases were deemed neither minor nor major. These cases included (1) scenarios where the only sources of information were primary documents – namely, the inventory record, inspection photos and the PONTEX database, (2) scenarios where the data conflicted but the conflict was clearly resolved based on indisputable evidence in source documents, and (3) scenarios where information about a structure was ambiguous but this had no effect on load rating. These peculiar cases were regarded as non-consequential to load rating and resulted in no discount to the quality score for interpretation of structure history and segment identification.

This basic interpretive approach is rational in that *more* concerns and *more severe* concerns about the culvert documentation rightly imply questions about the quality of the assessment, and the relative quality score captures this effect. Figure 9.2 summarizes the quality score for interpretation of structure history and segment identification for all 1,000 Batch 1 culverts.

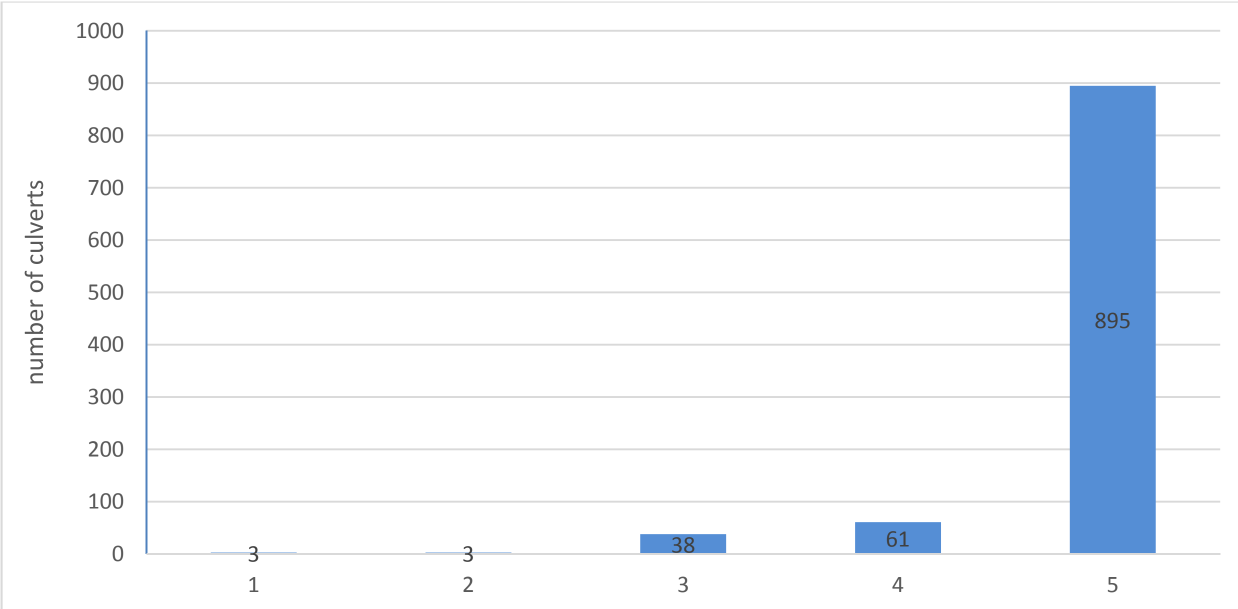


Figure 9.2 Interpretation Quality Score for Structure History and Segment Identification, all Batch 1 Culverts

This figure reveals generally high confidence in the interpretation of structure history and segment identification, with 95.6 percent of Batch 1 culverts having a score of 4 or better. Only 0.6 percent had quality scores less than or equal to 2. As a practical matter, the researchers always identified the best possible interpretation using the available data, realizing that lower quality data might be of questionable benefit. The quality score documents this, but the decision of whether and how to use such results has been left to the sponsor.

9.4 PARAMETER INTERPRETATION & DATA CAPTURE [Task 3]

9.4.1 Parameters for Culvert Load Rating

This load rating task was where the research team reviewed the project file and identified all parameters (except design details – see next section) necessary to load-rate a culvert. Solution of the rating factor equation (Eq 2-1) is based on primary structural analyses associated with the calculation of culvert capacity, dead load demands, and live load demands, and this is done for every critical section in the culvert structure. This means the rating factor solution is obtained for each *segment* of a culvert as interpreted above. In turn, the structural analyses are achieved through production-simplified computational models, and it is these models which dictate the parameters needed to specify each and every segment.

As used in this study, nine parameters were identified to adequately specify a culvert segment. These include: (1) structure design, (2) design standard (sheet) name, (3) year built, (4) number of spans, (5) span length, (6) box height, (7) skew, (8) presence or absence of haunches, and (9) cover soil depth range. Several other culvert parameters exist of course, such as dates, number of traffic lanes, etc. – but these nine were deemed the most significant parameters for this study.

The structure design refers to the *actual drawing* (design standard) used to construct the culvert segment. Sometimes the file contained this drawing, and this is in contrast to other cases where the file only referenced a design (sheet) *name*, this name being a shorthand reference to the design standard. Sometimes a file would contain both the design and appropriate references to it. Either way, owing to the importance of the design relative to load rating, we always looked for the most complete and definitive design information available.

The year built refers to the construction year. The most definitive statement of the build year was the case where the file contained rectified as-built construction drawings explicitly identifying the year of construction. The build year is important because it strongly associates with construction material specifications such as steel grade and concrete class, and these important details were often not directly available otherwise.

Culvert geometry parameters included the number of spans, span length, box height, skew, and the presence or absence of structural haunches. The significance of these parameters to structural analysis is obvious, and again, the ideal case was where the file contained rectified as-built construction drawings explicitly identifying such information. Better yet, sometimes the file contained both as-built construction drawings *and* recent inspection photographs that confirmed these parameters.

The minimum and maximum cover soil depths, that is, the thickness range of cover soil above the top surface of the top slab of the culvert, represents the final parameter. As demonstrated in Chapter 7, the relationship between cover soil depth and load rating is highly non-linear and highly significant, and culvert designs are typically classified by this variable, *i.e.*, direct traffic, low fill, or deep fill. Cover soil thickness data were sometimes available from the construction drawings or from notes in the inventory record, or sometimes the cover soil depth could be reasonably estimated from inspection photographs.

9.4.2 Parameter Identification Process

All available files for a culvert structure were identified by the structure history and segment identification interpretation process. From these documents, capture of the required parameters/ data amounted to carefully reviewing each file and accurately documenting the values present from each file. Our work revealed that oftentimes some of the parameters were missing, and frequently data existed in multiple files but were not fully consistent. However, load rating necessitates a unique, complete and unconflicted dataset, and achieving such data represented our second key decision in the culvert load rating process. Therefore we documented our interpretation of the key parameters for each culvert segment by means of a 5-point quality rating.

9.4.3 Quality Score for Parameter Identification

Table 9.2 presents the rubric and calculation algorithm used to establish the quality score for interpretation of the key segment parameters. The table features six columns. The first column, Column (a), identifies the nine key parameters. Column (b) is a presence factor. Values are assigned 1.0 when a parameter is identified in the file but is assigned a value of 0.0 when missing. This emphasizes that each of these parameters is necessary for load rating. Column (c) assigns weighting factors to the parameters. While all parameters are important, two parameters – the design standard sheet and the presence or absence of haunches – are especially significant for load rating. Column (d) addresses the case where multiple documents identify a parameter but the values are in conflict. Usually the file is clear and parameter identification is non-controversial, but sometimes the parameter values from multiple documents conflict in such a way that resolution is not possible. Column (e) is a scaling factor applied so that the overall quality rating will be in the range of 0 to 5. The final column is the quality rating for each parameter calculated as the product of columns (b) through (3). The sum of the parameter scores is the interpreted parameter quality rating for the segment.

Table 9-2. Quality Score Rubric and Calculation Algorithm for Interpreted Parameters

Parameter	Presence Factor[a]	Weighting Factor	Conflict Resolution Factor[b]	Scaling Factor	Quality Rating
(a)	(b)	(c)	(d)	(e)	=b*c*d*e
Structure design	note a	1.5	note b	0.5	
Design sheet name	note a	1.0	note b	0.5	
Build year	note a	1.0	note b	0.5	
Number of spans	note a	1.0	note b	0.5	
Span length	note a	1.0	note b	0.5	
Box height	note a	1.0	note b	0.5	
Skew	note a	1.0	note b	0.5	
Haunches	note a	1.5	note b	0.5	
Cover soil depth	note a	1.0	note b	0.5	
Interpreted Parameter Quality Score (segment)					∑ **ABOVE**

[a]Note: The presence factor is assigned based on the presence the parameter in the document file, as follows:
= 1.0… present
= 0.0… not present

[b]Note: The conflict resolution factor is assigned based on the degree of confidence in the resolution, as follows:
= 1.0… no conflict or high confidence in resolution
= 0.5… moderate confidence in resolution
= 0.0… little to no confidence in resolution

The basic interpretive approach is rational in that *complete* and *unconflicted* parameter data corresponds to increased confidence in the quality of the assessment, and the relative quality score captures this effect. High scores (4 to 5) represent high quality data characterized by a generally complete set of segment parameters and few to no conflicts in the document record. The interpretation of such data was essentially clear and unambiguous. On the other end of the spectrum, low quality scores (0 to 2) represent segment data obtained from a document record fraught with holes or conflicts. Interpretation of such data was questionable.

Figure 9.3 summarizes the quality score for the interpreted parameter for all segments from the 1,000 Batch 1 culverts. Note that while Batch 1 culverts contained 1,788 segments, only 1,385 were ratable, and the percentages shown are based on ratable segments.

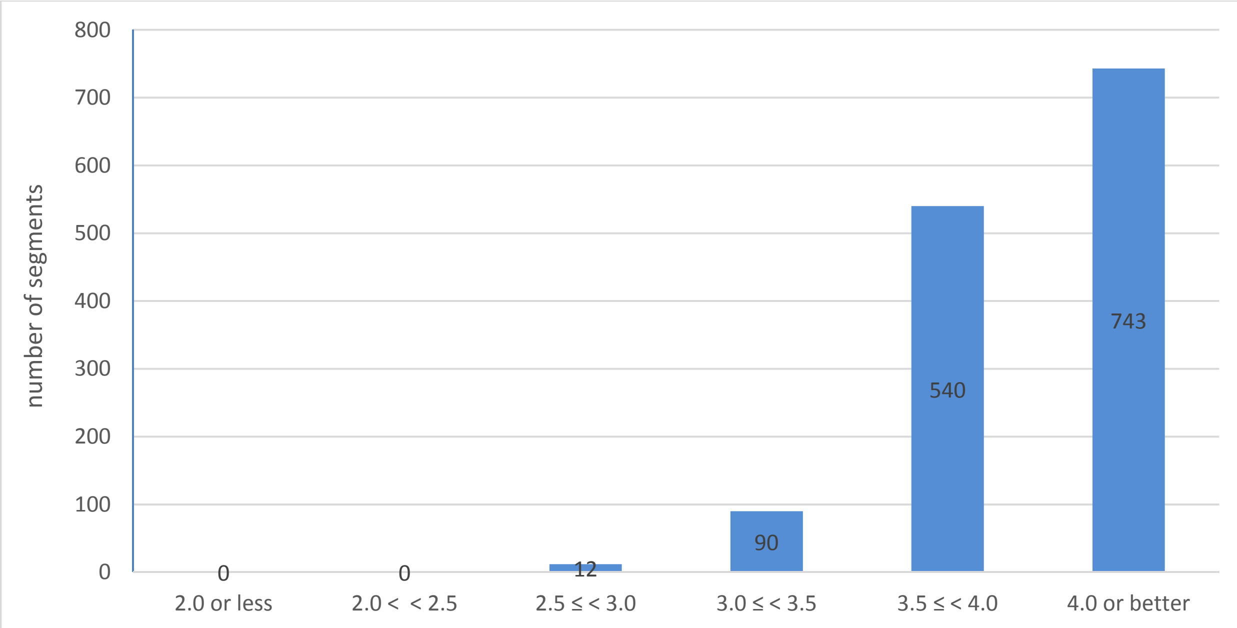


Figure 9.3 Quality Score for Interpretation Parameters, all Ratable Segments for Batch 1 Culverts

This figure reveals generally high confidence in the segment interpreted parameters, with 53.6 percent of Batch 1 ratable culvert segments having a score of 4.0 or better and 92.6 percent of Batch 1 ratable culvert segments having a score of 3.5 or better. No ratable segment had quality scores less than or equal to 2.0. The researchers always identified the best possible interpretation using the available data, realizing that lower quality data might be of questionable benefit. The interpreted parameter quality score documents this, but the decision of whether and how to use such results has been left to the sponsor.

9.5 DESIGN SELECTION [Task 4]

9.5.1 Use of Design Standards for Culvert Load Rating

Culvert load rating is accomplished at the segment level, and the interpreted parameters task emphasizes the importance and priority associated with identifying the actual design drawings used to construct a culvert segment. As discussed in Chapter 8, TxDOT relies on engineered design standards for their culvert designs. For efficiency, consistency and quality reasons, the research team digitized TxDOT's complete set of design standard sheets and placed these in a digital design collective. Further, we catalogued every design in such a way that the design could be associated with basic parameters such as design year, number of spans, span length, box height, etc. When the culvert document file contained the actual design, the research team selected it (from the collective, as it is already digitized there). But when the culvert documents did not specify the design, known information about the culvert segment, *i.e.*, its unique set of parameters, were used to identify plausible designs that "match." This design selection approach represents our third key decision in the culvert load rating process, and we documented the interpretation of segment design selection by means of a 5-point quality rating.

9.5.2 Segment Design Identification Quality Rating Process

A design is necessary for each and every culvert segment to be load rated. As would be expected, when the culvert file provides the actual design sheet with no conflicting information, this "provided" sheet is simply identified for the segment. However, per Figure 9.4, for about 54% of 1,385 ratable segments in Batch 1, the culvert file does not contain the design sheet and when this occurs, the design sheet must be "associated" based on a parameter matching process. The "associated" design can then be identified to facilitate load rating the segment, but some associations are stronger than others. It is this associative process that gives rise to the need for a quality rating for the design selection.

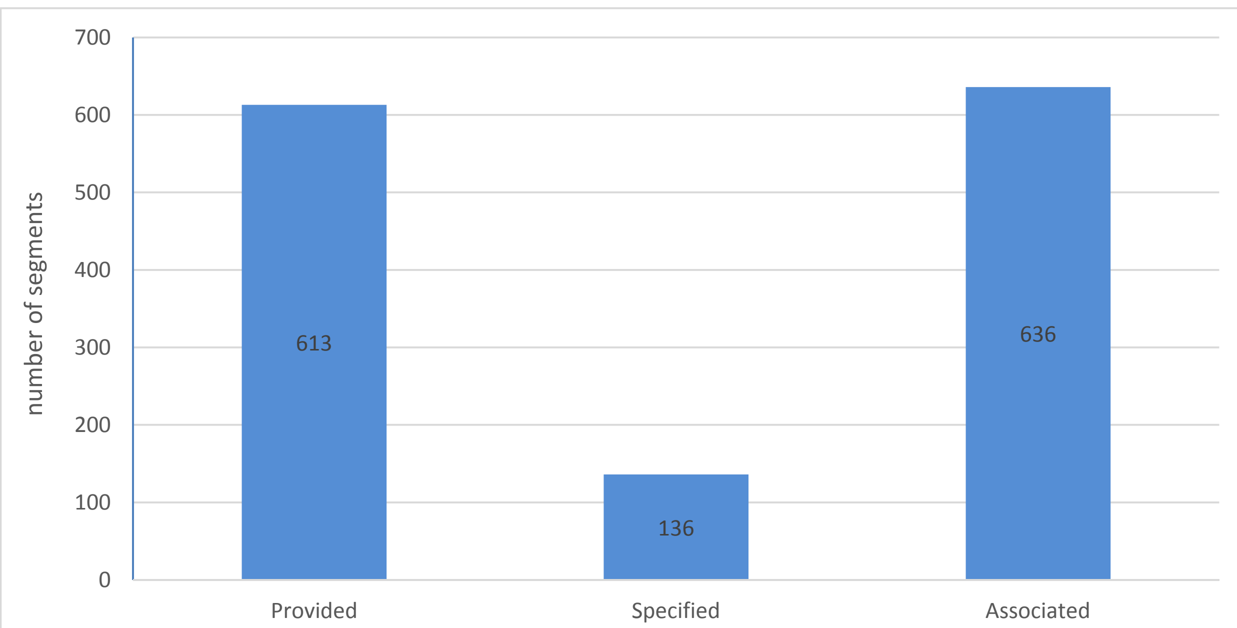


Figure 9.4 Number of Batch 1 Culvert Ratable Segments (1,385) with Provided, Specified, or Associated Designs

The segment design identification quality rating provides a way to assess the reliability of the design assigned to each segment of a culvert structure. The quality rating is based on the completeness of the key segment parameters, employs weighting factors, and systematically quantifies and scales the design match. Possible matches of design sheets for a segment are assessed and awarded a score, and the scores are weighted and summed for an aggregated quality score. Table 9.3 presents the rubric and calculation algorithm used to establish the quality score which is performed in three stages. The first stage is a quantity assessment. The second stage is a scaling assessment. The third stage is design match assessment.

Table 9-3. Quality Score Rubric and Calculation Algorithm for Segment Design Selection

Quality Rating	Completeness of the design match (50%)	Importance of any non-matching data (25%)	Number of possible design matches (25%)
(a)	(b)	(c)	(d)
5	Design <OR> 9/12	Design <OR> No Missing Data	Design <OR> 1
4	7 – 8/12	Skew, Cover Soil Depth	2 - 3
3	6 /12	Name, Design Year, Revision Year	4 – 6
2	5/12	Build Year	7 – 10
1	≤ 4/12	Number, Height and Length of Span, Haunch	>12

The first stage of the design selection quality assessment (Column b) assesses the completeness of the available segment data. This stages uses twelve segment parameters as follows: (1) the presence of a design document for the segment, (2) the name of the design used for the segment, (3) the original year of the design, (4) the revised year of the design, (5) the build year for the segment, (6) the number of spans of the segment, (7) span length of the segment, (8) box height of the segment, (9) the skew of the segment, (10) haunches for the segment- if present, and (11) the minimum and (12) maximum cover soil depth for the segment. Each parameter is given a score of 1 and the sum of the scores is weighted at 50% of the total quality score for segment level design selection.

The second stage scales the information derived from the design selected. The scale quantifies the importance of non-matching design and segment interpreted parameter data. When there are no non-matching data, a score of 5 is assigned. When the skew or cover soil depth of the segment do not match the design selected, a score of 4 is assigned. When the name or design year of the design selected do not match the information provided by the segment source documents, a score of 3 is assigned. When the design year precedes the year the segment was constructed, a score of 2 is assigned. When the number of spans, span length, box height, or presence or absence of haunches are not indicated, a score of 1 is assigned. This assigned score is weighted at 25%.

The third stage assess the possible number of designs matching the segment. The larger the number of possible of designs, the lower the quality score. If there is only one possible design match, a score of 5 assigned. Possible matches are sorted using information provided, specified or interpreted for the segment source documents. For 2 – 3 possible matches, a score of 4 is assigned. For 4 – 6 possible matches, a score of 3 is assigned. If 7 – 10 possible matches exist, a score of 2 is assigned. If there are 11 or more possible matches, a score of 1 is assigned. This assigned score is weighted at 25% percent.

9.5.3 Quality Score for Segment Design Identification

The weighted scores from all three assessment stages were combined to calculate the overall quality score for segment level design selection. The basic interpretive approach is rational in that a *complete* and *unique* parameter set corresponds to increased confidence in the quality of the design selection, and the relative quality score captures this effect. High scores (4 to 5) – especially the case where the actual design is provided – represent high confidence in the design selection process. The interpretation of such data was essentially clear and unambiguous. On the other end of the spectrum, low quality scores (1 to 2) represent design selections obtained from a document record with significant missing data and thus many potentially-viable design options. The segment design selection in this case was questionable.

Figure 9.5 summarizes the quality score for design selection for all segments from the 1,000 Batch 1 culverts. Recall that while Batch 1 culverts contained 1,788 segments, only 1,385 were ratable, and the percentages shown are based on ratable segments.

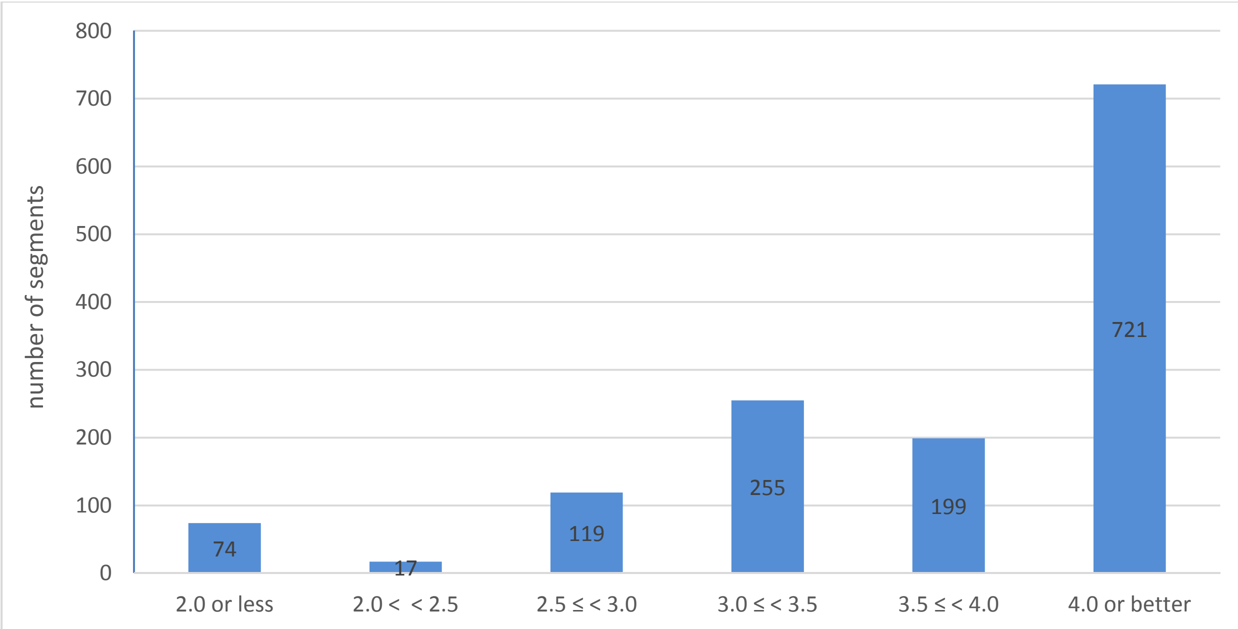


Figure 9.5 Quality Score for Design Selection, all Ratable Segments for Batch 1 Culverts

This figure reveals generally high confidence in the segment design selection, with 52.1 percent of Batch 1 ratable culvert segments having a score of 4.0 or better and 84.9 percent of Batch 1 ratable culvert segments having a score of 3.0 or better. Only 5.3 percent had quality scores less than or equal to 2.0. The researchers always identified the best possible interpretation using the available data, realizing that lower quality data might be of questionable benefit. The interpreted parameter quality score documents this, but the decision of whether and how to use such results has been left to the sponsor.

9.6 LEVEL 1 LOAD RATING [Task 5]

With the culvert data files complete (research tasks 1 through 4), the next step was to load-rate each culvert segment. The place to start was "Level 1" load rating computations which rely on a simple structural frame model. The research team used this model to determine the culvert load rating as a function of soil cover thickness. To accomplish this, we calculated load rating factors at 0.5-foot intervals of soil cover for each culvert segment. The range of soil cover thickness varied from 0 feet (direct traffic) to a maximum cover thickness where dead load demand exceeded the culvert's structural capacity (dead load fail). This work facilitated creation of an interaction chart for each segment which presents load rating (horizontal axis) versus soil cover thickness (vertical axis). We did this in order to identify the critical cover soil depth for the structure, *i.e.*, the thickness of cover soil within the range of actual cover soil depths that yields the lowest rating factor. We defined this as the controlling cover soil depth and used this parameter to define subsequent load rating analyses.

The research team performed all load rating calculations using TxDOT's CULVLR software program, Version 1.0.0 as updated (TxDOT 2013), which is an implementation of the load rating procedures presented in the TxDOT *Culvert Rating Guide* (Lawson, *et al.* 2009). Level 1 load ratings used CULV5 (TxDOT 2003a) for the demand modeling, with the data input file prepared as has been described. We created a utility program to facilitate batch calculations of load ratings over a range of soil cover depths.

9.7 LEVEL 3 LOAD RATING [Task 6]

Upon completion of Level 1 load rating, the researchers performed a second, more refined load rating analysis (Level 3) for each culvert segment. Level 3 relies on a production-simplified, 2D, finite element model that accounts for soil-structure interaction. While the basic Level 3 modeling approach follows the load rating procedures presented in the TxDOT *Culvert Rating Guide* (Lawson, et al. 2009), the updated Level 3 model used for this project accounts for differentiated soil loads, the influence of pavement, and a host of other variables.

For the Level 3 analyses reported herein, we used the critical soil cover thickness value for each culvert as established from the series of Level 1 load rating computations. The basic sequence for Level 3 load rating was as follows:

1. Use the input features of TxDOT's CULVLR software program, Version 1.0.0 as updated (TxDOT 2013), to create the two-dimensional model for the culvert standard.
2. From CULVLR, interface with RISA-3D (RISA Technologies 2012) to create the RISA soil-structural model. CULVLR auto-generates the RISA model from input data with the exception of the moving load pattern for live load. This must be added separately.
3. Use RISA to calculate the dead load and live load demands based on the selected depth of cover soil and soil modulus values. This yields two "flat files" of RISA output, one for dead load and one for live load.

4. Use CULVLR to establish culvert capacity, interpret dead load and live load demands, and calculate load rating factors by critical section.

With this information, we determined the Level 3 inventory rating and operating rating values for each culvert segment.

9.8 REPORTING [Task 7]

9.8.1 Project-Level Reporting

The research project reports load rating results for 1,000 Batch 1 culverts which were selected to be statistically representative of TxDOT's full population of approximately 11,000 such structures. At the project level, these findings are presented in the three appendixes of this report.

- Appendix A consists of summary load rating results in tabular form at the culvert *structure* level.
- Appendix B consists of summary load rating results in tabular form at the culvert *segment* level.
- Appendix C is a Load Rating Technical Declaration that addresses the professional authority of the load rating results determined from this study.

In addition to these appendixes, the deliverables for this research study included five <u>products</u>. These products are digital in nature and include:

- <u>Product P1</u>. Summary Load Rating Reports for Level 1, Batch 1 culverts, reflecting updated load rating procedure
- <u>Product P2</u>. Summary Load Rating Reports for Level 3, Batch 1 culverts, reflecting updated load rating procedure and model validity enhancements
- <u>Product P3</u>. Tables for Batch 1 defining all categories of pre-1980 bridge-class culverts with load ratings as applicable
- <u>Product P4</u>. Updated (QC/QA'd) copy of TxDOT PonTex database with documents and data for Batch 1 as available, reflecting the new, improved culvert rating procedure
- <u>Product P5</u>. CULVLR Input Files for Batch 1 culverts

The reader is referred to the TxDOT Bridge Division for details of the product deliverables for this study.

9.8.2 Culvert-Level Load Rating Report

Notwithstanding that the individual culvert load rating reports for Batch 1 culverts are provided as product deliverables P1 and P2 and are not directly included with this report, it is appropriate to describe reporting of results at the individual culvert structure level. The culvert rating program, CULVLR, offers various reporting options. The practice implemented for this project was for the report to consist of a summary page, culvert segment sketch, individual rating summaries (Level 1- direct stiffness model) for all segments, individual rating summaries (Level 3 - soil-structure interaction model) for all segments, and a project documentation sheet that identifies all files from which data were obtained to support the rating factor calculations. Thus individual culvert summary reports range from 5 pages to over 50 pages in length, with the total report file for all Batch 1 culverts numbering approximately 7,600 pages.

9.9 SUMMARY

This chapter describes the method by which the research team calculated load ratings for 1,000 Batch 1 culverts. Rating factor calculations must be based on reliable parameters, and the research method gives priority attention to the *process* by which we identified and assembled parameters which were then used to calculate load demands and ultimately, load rating factors. Further, the research team selected and calibrated the load rating models such that these models were finely-tuned to avoid the twin perils of excess conservatism and non-conservatism, neither of which is acceptable. This effort was done to help achieve reliable and valid load rating results.

CHAPTER 10
CULVERT SEGMENT LOAD RATING RESULTS

10.1 OVERVIEW

TxDOT's bridge-class culvert structures are comprised of one or more *segments*, and it is these individual segments for which load rating values are determined. Stated another way, load rating computations are performed at the *segment* level, and the lowest rating from all segments that make up a culvert is the *controlling* load rating for the structure. This chapter presents summary results and analysis of Level 1 and Level 3 load rating computations for the 1,788 segments associated with the 1,000 Batch 1 culvert structures evaluated in this study. The data upon which the results in this chapter are based appear in tabular form in Appendix A. This data table in turn sources to the individual culvert load rating reports presented as research Product P1 and Product P2.

The structure of this chapter is as follows. After the introduction, the chapter discusses basic information necessary for interpreting and generalizing the load rating results. The chapter then presents an analytical summary of load rating results for Batch 1 culvert segments, followed by a detailed presentation of the influence of selected independent variables on load rating values. After that, the chapter closes by focusing on the characteristics of culvert segments that do not rate well. This sets the stage for Chapter 11 which presents aggregated results at the culvert *structure* level along with appropriate recommendations and guidance for implementation. But this chapter focuses on segment-level data as that is where the load rating calculations are actually performed.

10.2 INTERPRETATION AND GENERALIZATION OF LOAD RATING RESULTS

10.2.1 Interpretation of Load Rating Values

The outcome of load rating calculations is a rating factor which, for the purposes of this report, is expressed at both the inventory and operating levels for HS20 truck loading. The Inventory Rating (IR) is the maximum truck load that can safely utilize a bridge-class culvert for an indefinite period of time (AASHTO 2016, TxDOT 2013a). The Operating Rating (OR) is the absolute maximum permissible truck load that may use the bridge-class culvert.

It is helpful to characterize the overall performance of a culvert segment by taking a broad view of the efficacy of IR and OR values. This can be achieved by viewing the load rating from the perspective of whether the segment would require load posting as per guidance from TxDOT's *Bridge Inspection Manual* (TxDOT 2013a). Figure 10.1 is a reproduction of the on-system load posting guidelines presented in Chapter 5 of the *Bridge Inspection Manual*. The figure has been color-coded for convenience.

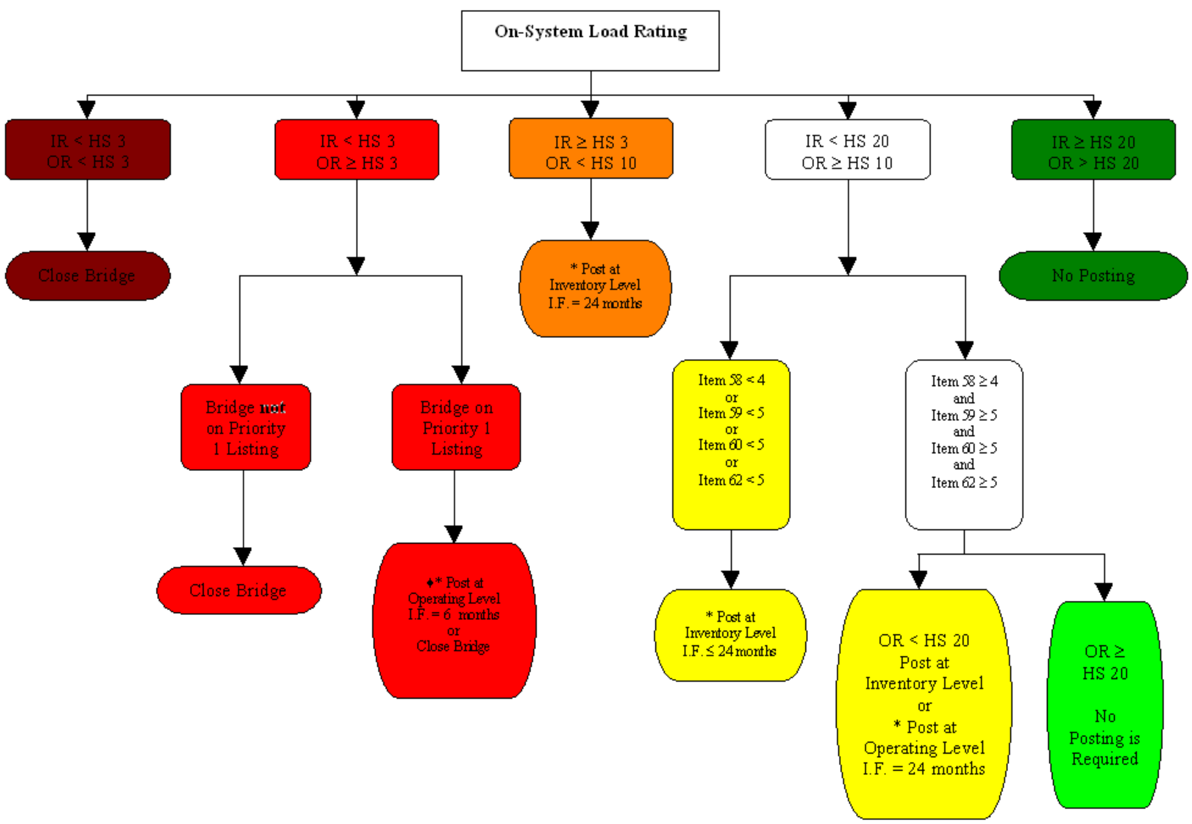


Figure 10.1. Load posting guidelines (source: TxDOT *Bridge Inspection Manual*, Figure 5-3)

Review of Figure 10.1 shows that culvert segments with an IR greater than or equal to HS20 and an OR greater than HS20 do not require load posting. This performance class is depicted by dark green color. Culvert segments where the IR < HS20 and the OR ≥ HS20 will not require load posting either, provided the condition rating of the structure meets or exceeds specified requirements. This performance class is depicted in light green color. Culvert segments where the IR and OR combinations score in the yellow or orange portions require load posting below HS20 and an increased inspection frequency. IR and OR combinations which correspond to the red and maroon categories indicate that the culvert segment will likely require rehabilitation or replacement due to higher risk of failure.

The color codes from Figure 10.1, correlated to the six load posting categories, can be used to provide a visual, high-level indication of the structural health of TxDOT's culvert segments. This approach has been uniformly applied both to the critical sections identified on the load rating reports for individual culvert segments (Product P1, Product P2) as well as to the aggregated data summaries presented in this chapter.

10.2.2 Generalizing the Load Rating Results

TxDOT's population of on-system, bridge-class, pre-1980, cast-in-place, reinforced concrete box culverts numbered 10,829 structures when this project was authorized in 2014. From this, the researchers selected a simple random sample of 1,000 culvert structures for analysis which we have termed 'Batch 1.' This was done to provide a statistically-representative sample from which valid inferences about the entire population could be drawn. In particular, of primary interest are the performance rates. Every performance rate that is calculated has a *margin of error* associated with it that is given by a 95% confidence interval that can be calculated for it.

The standard formula used for a 95% confidence interval margin of error in this case is given by

$$\pm 1.96\sqrt{\frac{\hat{p}(1-\hat{p})}{n}}, \tag{10.1}$$

where $\hat{p}$ is the rate, expressed as a proportion between 0 and 1, and n is the sample size (in this case 1,000).

Equation 10.1 is used when the population is infinite or when the sample makes up a very small fraction of the overall population. In this research study, however, the culvert sample makes up a little over 9% of the total culvert population. Because of this, it is worthwhile to include the *finite population correction factor (fpc)*. The margin of error, with the fpc included, is given by

$$\pm 1.96\sqrt{\frac{\hat{p}(1-\hat{p})}{n}}\sqrt{\frac{N-n}{N-1}}, \tag{10.2}$$

where N is the population size. Since $n = 1{,}000$, and $N = 10{,}829$ this allows us to further reduce the margin of error by a factor of $\sqrt{\frac{N-n}{N-1}} = \sqrt{\frac{10{,}829-1000}{10{,}829-1}} = 0.953$. Table 10-1 presents the margin of error that can be associated with a range of performance rates for the 1,000 culvert structures. Note that the same margin of error will be used for the segments. This is because the random sampling procedure did not produce a random sample of segments, only of structures. Thus, the conservative approach is to assume a sample size of 1,000.

Table 10-1. Performance Rates and Associated Margin of Error

Rate ($\hat{p}$)	Culvert *Structure* Data (n = 1,000) Margin of Error
0.5	$\pm 0.0295 \approx \pm 3.0\%$
0.6 or 0.4	$\pm 0.0289 \approx \pm 2.9\%$
0.7 or 0.3	$\pm 0.0271 \approx \pm 2.7\%$
0.8 or 0.2	$\pm 0.0236 \approx \pm 2.4\%$
0.9 or 0.1	$\pm 0.0177 \approx \pm 1.8\%$

Note that the margin of error is at a maximum of when $\hat{p} = 0.5$ but narrows when the performance rates become either higher or lower. For example, 93.2% (1,291 out of 1,385 ratable segments) of ratable culvert segments have a Level 3 OR ≥ HS20, and the margin of error for this performance rate when generalized to the full population is ±1.5%. Further, the pavement surface over 35.7% of culvert segments is a seal coat/ surface treatment, and the margin of error for this statistic relative to the full culvert population is ±2.8%. Generalizations of the performance data for the 1,000 rated culverts relative to TxDOT's full population of pre-1980 culverts must therefore consider the margin of error.

10.3 OVERALL LOAD RATING RESULTS BY SEGMENT

10.3.1. Ratings for All Segments

For the 1,000 Batch 1 culverts, a total of 1,788 segments were identified for an average of 1.8 segments per culvert. Figure 10-2 presents the overall load rating results for all segments. These results can be grouped into three categories:

- Rated segments with OR ≥ HS20… segment *does not* require load posting
- Rated segments with OR < HS20… *possible* candidate for posting, rehab, or replacement
- Non-rated segments… load rating calculations *not performed*

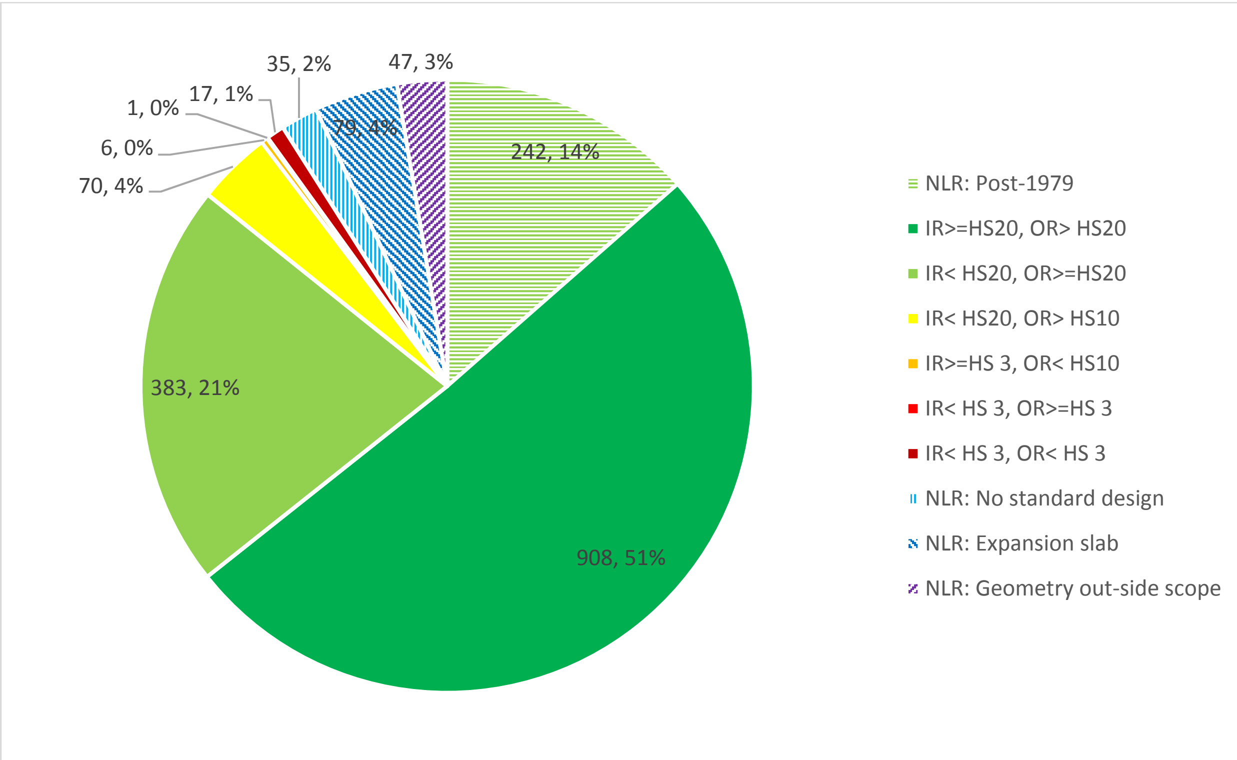


Figure 10.2. Load Rating Results for All Segments (n = 1,788)

Figure 10-2 shows that 85.7% (±2.1%) of culvert segments rate sufficiently high such that they *do not* require load posting. This category includes rated culvert segments having a Level 3 IR ≥ HS20 (dark green color per Figure 10.1) or a Level 3 OR ≥ HS20 (light green color), plus segments that were designed for HS20 loading and constructed post-1979 such that an HS20 rating can be *assigned* per FHWA policy (FHWA 2011a) – identified in the chart by the light green striped pattern.

The second category totals 5.3% (±1.3%) and consists of culvert segments having Level 3 ratings (OR) at varying degrees *below* HS20, represented by the other colors in Figure 10.1, *i.e.*, yellow, orange, red and maroon. If these ratings were deemed "final", such segments would require some type of action such as repair, rehabilitation, load posting, or replacement.

The third category totals 9.0% (±1.7%) and is comprised of segments which were not load rated (NLR) for various reasons. Most of these non-rated segments are expansions slabs (4.4%±1.2%) which were not amenable to load rating with the box-culvert-specific CULVLR software employed for this study. Likewise, other segments (2.6%±0.8%) consisted of geometric designs such as circular pipes, three-sided structures, etc., which also could not be rated using the CULVLR software. The remaining segments in this non-rated category (2.0%±0.8%) did not have designs provided, specified, nor associated.

10.3.2. Ratings for Rated Segments

Figure 10-3 focuses only on those segments for which load-rating calculations were performed, a total of 1,385/1,788 segments. This figure excludes all the NLR categories, even those that are post-1979. Among these rated culvert segments, 93.2% (±1.5%) have a Level 3 IR ≥ HS20 (dark green color per Figure 10.1) or a Level 3 OR ≥ HS20 (light green color).

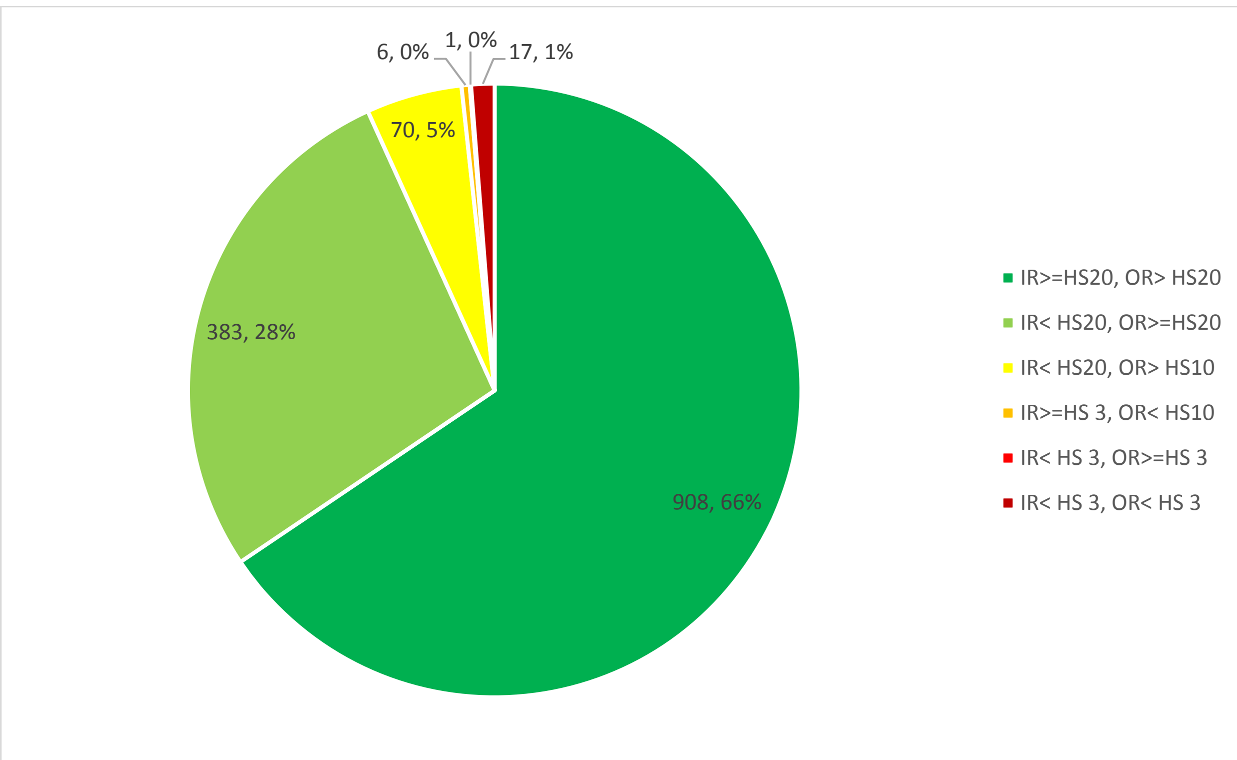


Figure 10.3. Load Rating Results for Load Rated Segments (n = 1,385)

The remaining culvert segments total 6.8% (±1.5%) and consist of culvert segments with Level 3 ratings (OR) at varying degrees *below* HS20, represented by the other colors in Figure 10.1, *i.e.*, yellow, orange, red and maroon. Here it is significant to note that most segments in this group (5.1% ±1.3%) rate "in the yellow" and thus are relatively close to achieving a Level 3 OR ≥ HS20 such that posting would not be required. Given that the structural condition ratings for TxDOT's culverts indicate good performance, such segments are reasonable candidates for further analysis using more sophisticated demand models and with project-specific structural and soil properties, the goal being to determine whether such segments actually rate more in line with their performance, *i.e*. possess an OR ≥ HS20.

It is important to note that only 1.7% (±0.8%) of rated culvert segments show Level 3 ratings (OR) *below* HS10, represented by the orange, red and maroon colors in Figure 10.1. These would be the group most subject to consideration for load posting, rehabilitation, or other action.

One way to further interpret load rating performance is to evaluate the location of the controlling critical section – *i.e*., where the lowest rating factor occurred – for the rated culvert segments, as this provides insight into the reasonableness of the findings. Figure 10-4 presents a histogram that identifies the location of controlling critical sections for all rated segments, where these sections are defined as in Figure 2.1.

By far, the top region of the culvert is where most critical sections occurred, consisting of both the top slab corners and midspan (51.8% ±3.0%) and the top exterior wall (37.5% ±2.9%). This modeled behavior is consistent with the observation that since live load enters the culvert from the ground surface, the top region of the structure will experience the greatest live load intensities, and thus demands will be higher in this region so it is reasonable that this area should most often control the rating. Likewise, the lowest percentage of critical sections occurs in the bottom culvert slab (2.0% ±0.8%) which was expected. The exterior walls show a significant portion of controlling sections in the top (37.5%, as already noted) and at the bottom (7.7% ±1.6%). Interior walls show 0.6% ±0.5% controlling sections at the top which was expected given that the load rating procedure did not require moment resistance at these locations.

Digging deeper, it is of interest to know whether the Level 3 load rating performance is associated with any of several independent variables of interest. The statistical analysis technique used is Pearson's Chi-squared test of independence. Details can be found in any number of basic statistical texts, Ott and Longnecker (2015) is one such reference. The null hypothesis is that the load rating performance and the independent variable are not associated (*i.e*. independent of one another), and a small *p*-value (less than 0.05 is the typical cutoff) indicates that the null hypothesis can be rejected and it can be concluded that the variables *are* associated.

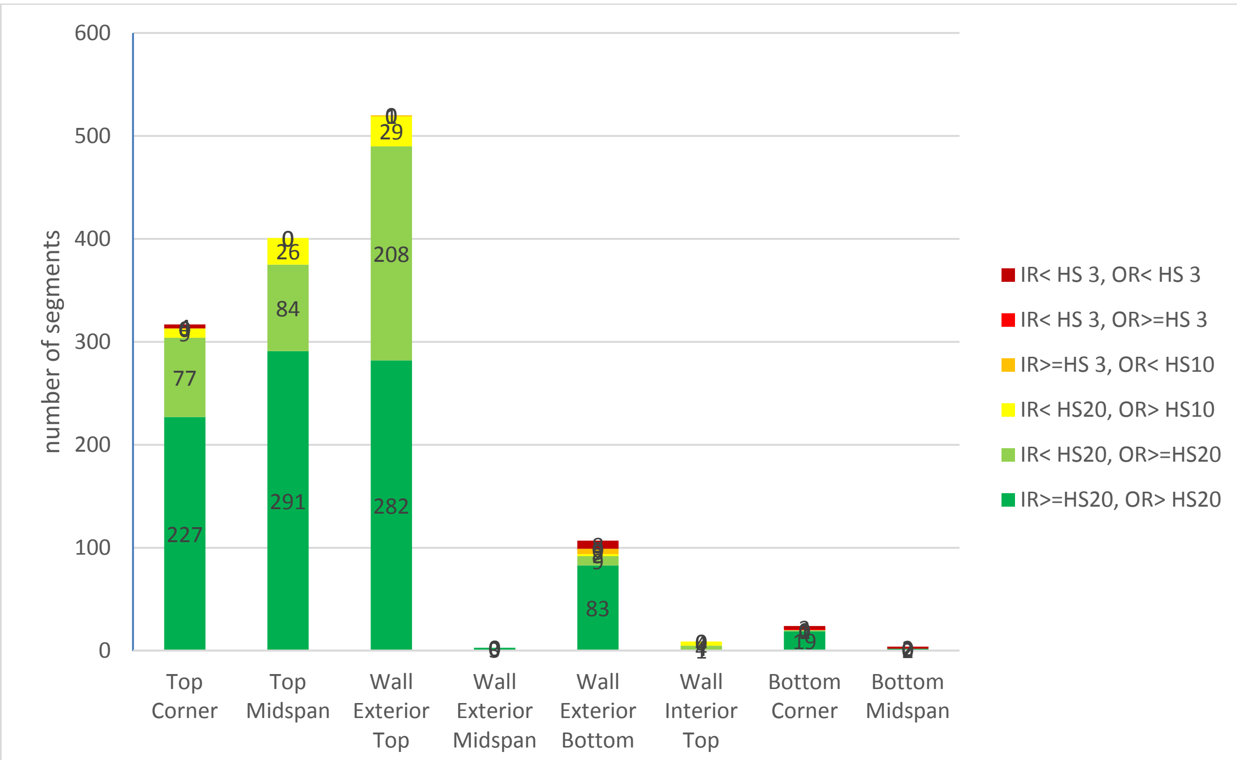


Figure 10.4. Segment Load Rating Performance by Controlling Critical Section (n = 1,385)

Relative to critical section, the *p*-value to test for an association between load rating performance and controlling critical section is 0.000. This was determined by identifying the number of expected non-passing segments at a location (calculated under an assumption of no relationship) and comparing that number with actual observed performance. The strong association identified is largely due to the Wall Interior Top which had 4 observed non-passing segments, but 0-1 were expected, Wall Exterior Bottom (15 observed, 7 expected), and Bottom Midspan (2 observed, 0 expected). On the other hand, Top Corner had fewer non-passing segments than expected (13 observed, 21-22 expected).

10.3.3. Comparison of Level 3 and Level 1 Segment Ratings

Much of the research effort performed for this study (Chapters 2 through 6) has indicated that Level 3 load ratings based on a soil structure interaction demand model incorporate less *excess* conservatism than Level 1 ratings based on a direct stiffness structural frame model. In other words, the Level 3 ratings are more accurate and precise than the Level 1 ratings, other things being equal. But how different are the load ratings from these methods, based on the segment load rating data obtained from this study? Figures 10-5 and 10-6 display segment load rating results in terms of the load-posting categories, and these provide a means to compare Level 1 versus Level 3 load ratings.

Focusing on all Batch 1 segments, the left column of Figure 10-5 indicates that 30.2% (±2.7%) of culvert segments show Level 1 OR ≥ HS20 such that the segment *would not* require load posting. In contrast, the right column shows that 85.7% (±2.1%) of segments have Level 3 OR ≥ HS20. When we focus only on those 1385 segments for which load rating calculations were performed (Figure 10-6), 22.0% (±2.4%) of rated segments show Level 1 OR ≥ HS20 whereas 93.2% (±1.5%) show Level 3 OR ≥ HS20.

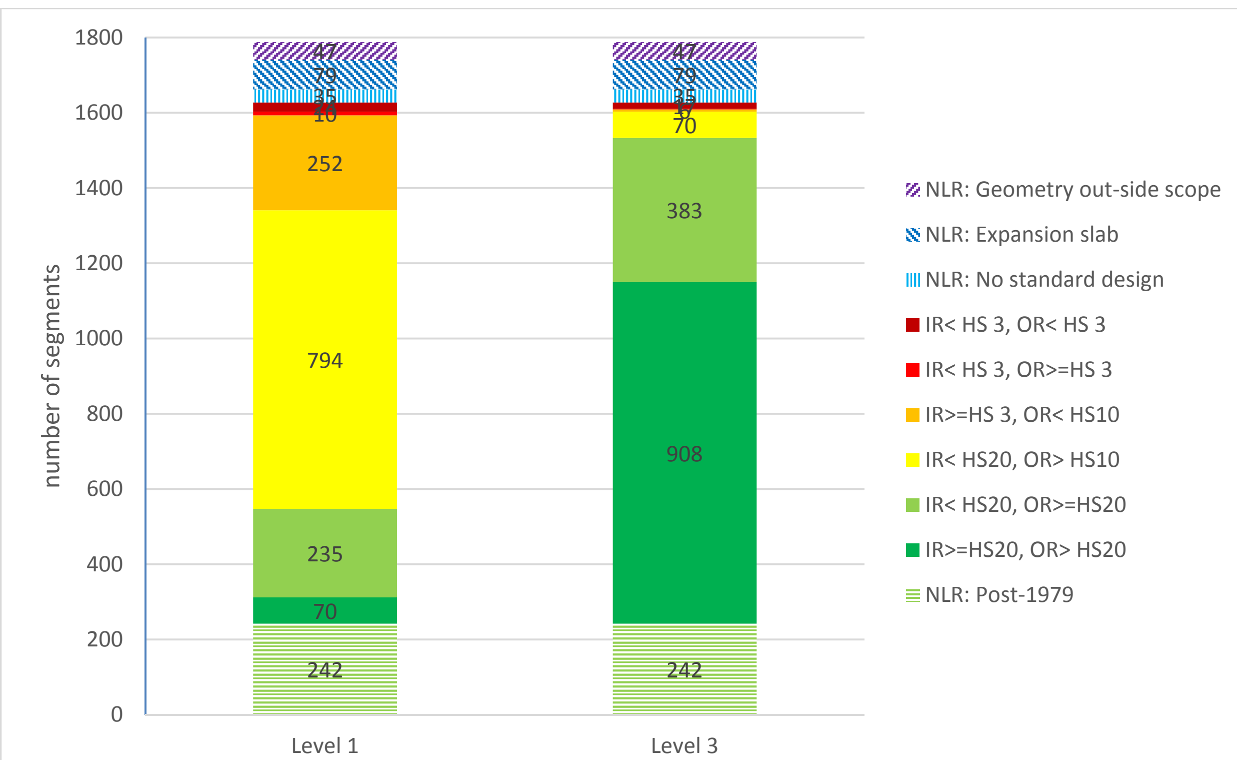


Figure 10.5. Level 1 versus Level 3 Load Rating for All Segments (n = 1,788)

Figure 10.6. Level 1 versus Level 3 Load Rating for Load Rated Segments (*n* = 1,385)

These results emphasize one of the basic premises of this research study, namely, the benefit that may be realized by using more sophisticated demand models for load rating. Current AASHTO policy for load factor rating specifically identifies the use of a production-simplified, direct stiffness (structural frame) model for calculating moment demands (AASHTO 2016). AASHTO appropriately identifies this approach as "conservative," and in fact this is the Level 1 modeling approach identified in this report. But what this study shows – clearly illustrated in Figures 10-5 and 10-6 – is that a soil-structure interaction model, *also* production-simplified, can be calibrated to yield more accurate and reliable but still conservative load rating results, with dramatic effect.

10.4 DESCRIPTIVE RESULTS FOR SELECTED INDEPENEDENT VARIABLES

10.4.1. Overview

Beyond the summary load rating results, associations between selected independent variables and load rating performance for culvert segments provide further insight into the nature and performance of TxDOT's culvert population. This section of the report groups the independent variables into four categories: (1) geometry, (2) design, (3) soil and pavement, and (4) geographic location. Similar to the structure level analysis for controlling critical section, Pearson's chi-squared test of independence will be used here as well, and the format of the analysis will be the same. All segment data are included, and the performance variable is defined by the three groups described previously, namely, Group 1 (rated segments, OR ≥ HS20), Group 2 (rated segments, OR < HS20), and Group 3 (not rated segments).

10.4.2. Influence of Culvert Geometry Variables

The independent variables examined for culvert segment geometry include number of spans, span length, and box height. Figures 10.7, 10.8 and 10.9 present the findings.

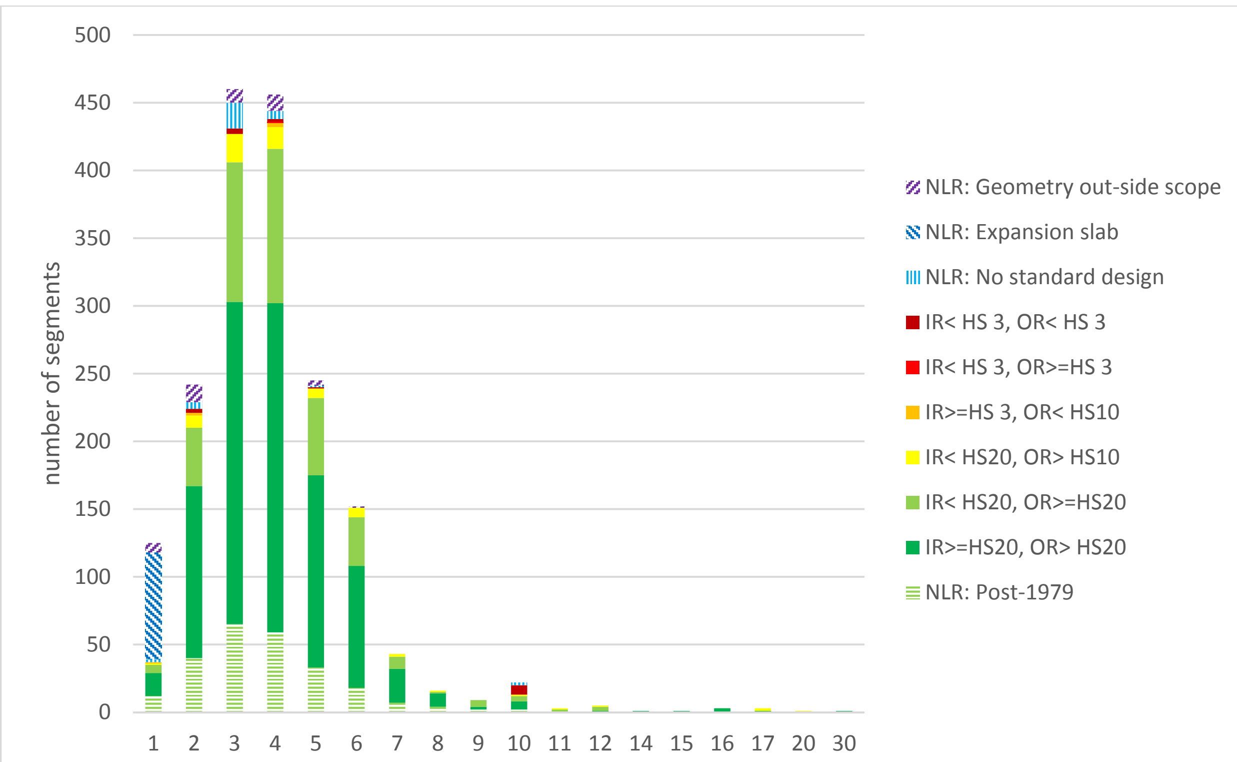


Figure 10.7. Segment Load Rating Performance by Number of Spans (n = 1,788)

Recall that a culvert segment refers to a unique ratable portion of a culvert structure; thus, culvert segments can (and do) contain multiple spans. Per Figure 10.7, the typical number of spans for TxDOT culvert segments is three or four (51.2% ± 3%), while 94% of all segments have 6 or fewer spans (±1.4%), with the total number of spans per segment ranging from 1 to 30.

The *p*-value is 0.000 indicating a significant relationship between load rating performance and number of spans. The difference largely appears to be due to the segments with 10 spans, where there were 8 non-passing segments while 1-2 were expected.

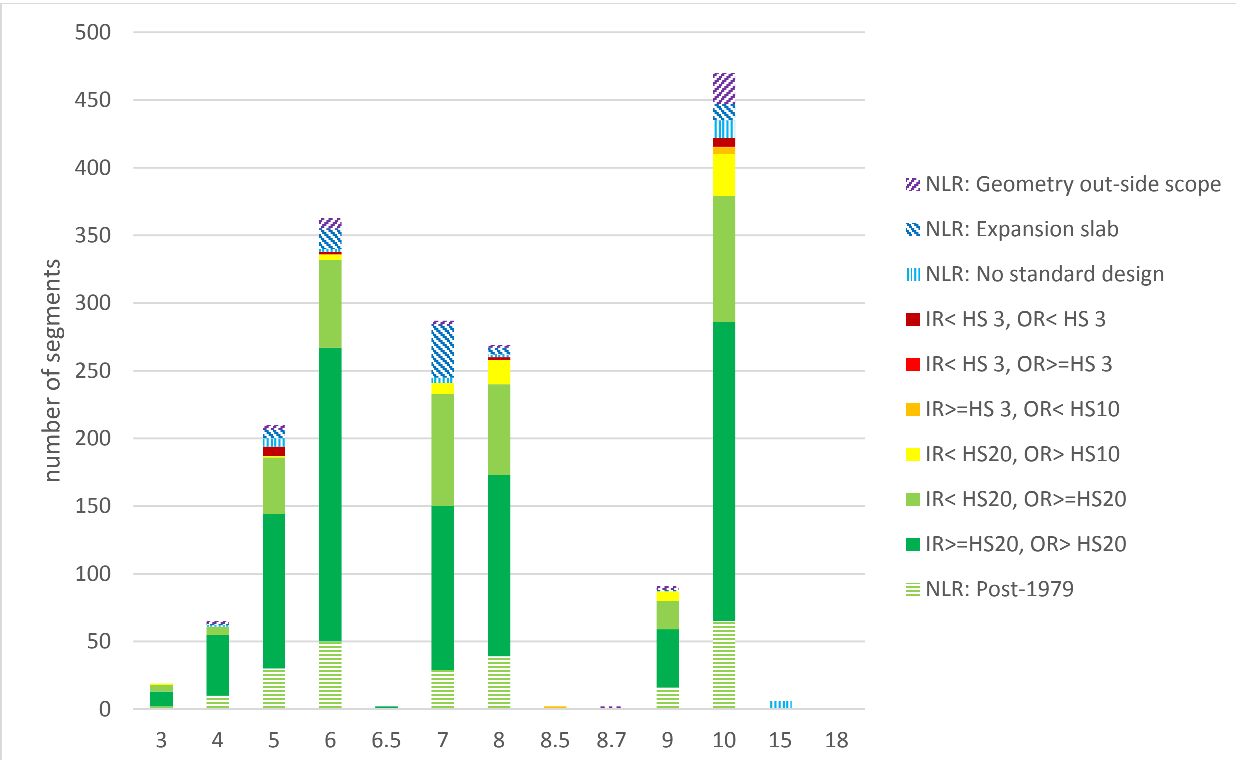


Figure 10.8. Segment Load Rating Performance by Span Length (*n* = 1,787)

Figure 10.8 shows the median span length for TxDOT culvert segments is 7 ft (52.9% ± 2.9% have span lengths 7 ft or less), but there is a very high fraction with 10 ft span lengths (26.3% ± 2.6%), with the actual span length segment ranging from 3 ft to 18 ft. To investigate the relationship between load rating performance and span length, any segment that had a span length that was not a whole number was removed from the analysis. The *p*-value is 0.000 indicating a relationship. Span lengths of 4 through 7 ft all had fewer non-passing segments than expected (4 ft: 0 observed, 3-4 expected, 5 ft: 8 observed, 11 expected, 6 ft: 6 observed, 19-20 expected, 7 ft: 8 observed, 14-15 expected), while span lengths of 8 and 10 ft all had more non-passing segments than expected (8 ft: 20 observed, 15 expected, 10 ft: 43 observed, 24 expected).

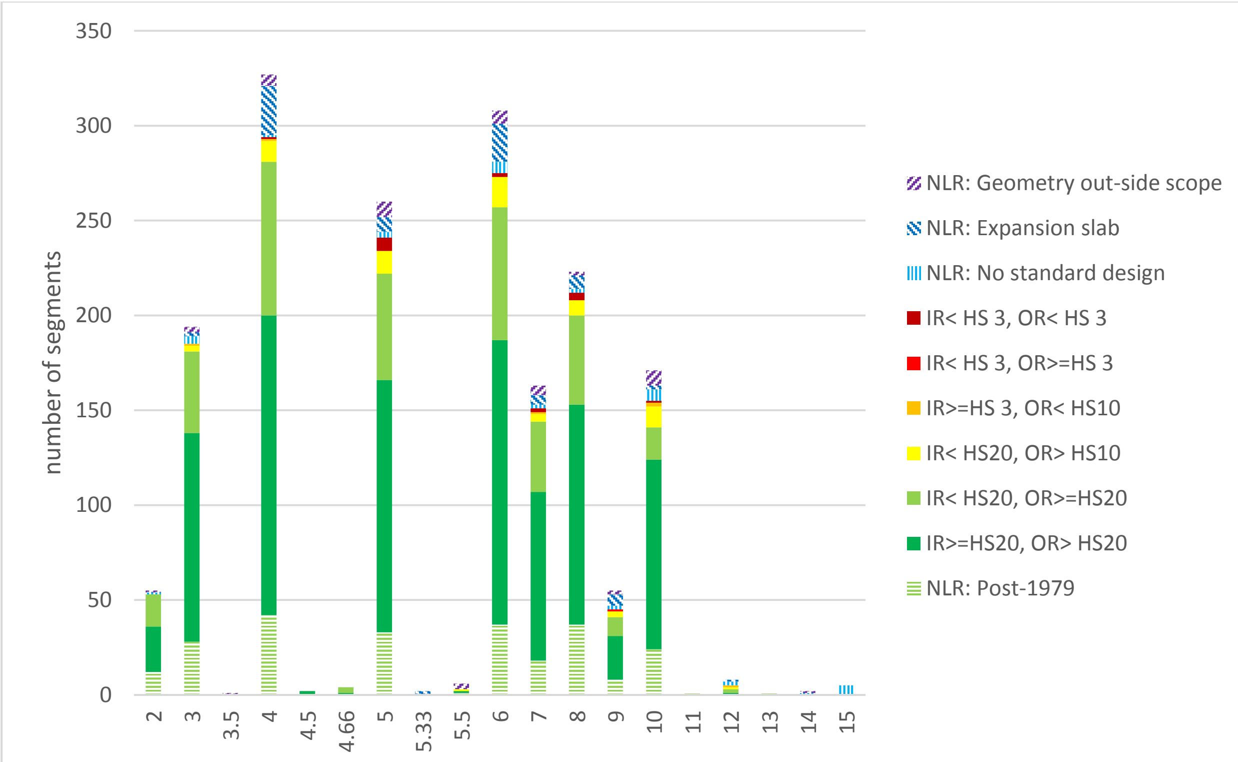


Figure 10.9. Segment Load Rating Performance by Box Height (*n* = 1,788)

The median box height for TxDOT culvert segments, per Figure 10.9, is 6 ft (64.9% ± 2.8% have box heights 6 ft or less), while 89.5% ± 1.8% have a box height of 9 ft or less, with the actual box height per segment ranging from 2 ft to 15 ft. Similar to the analysis for span length, any segment with an odd box height was removed. The *p*-value is 0.001 indicating a relationship between load rating performance and box height. The association was largely due to the 2 ft, 3 ft, 10 ft, and 12 ft box heights. The 10 ft and 12 ft box heights had more non-passing segments than expected (10 ft: 14 observed, 9 expected, 12 ft: 2 observed, 0 expected). Additionally, the 2 ft and 3 ft box heights had fewer non-passing segments than expected (2 ft: 0 observed, 3 expected, 3 ft: 4 observed, 10-11 expected).

10.4.3. Influence of Culvert Design Variables

The independent variables examined for culvert segment design included year built, design family, and design selection (design provided, specified in drawings, or associated). Figures 10.10, 10.11, 10.12 and 10.13 present the findings.

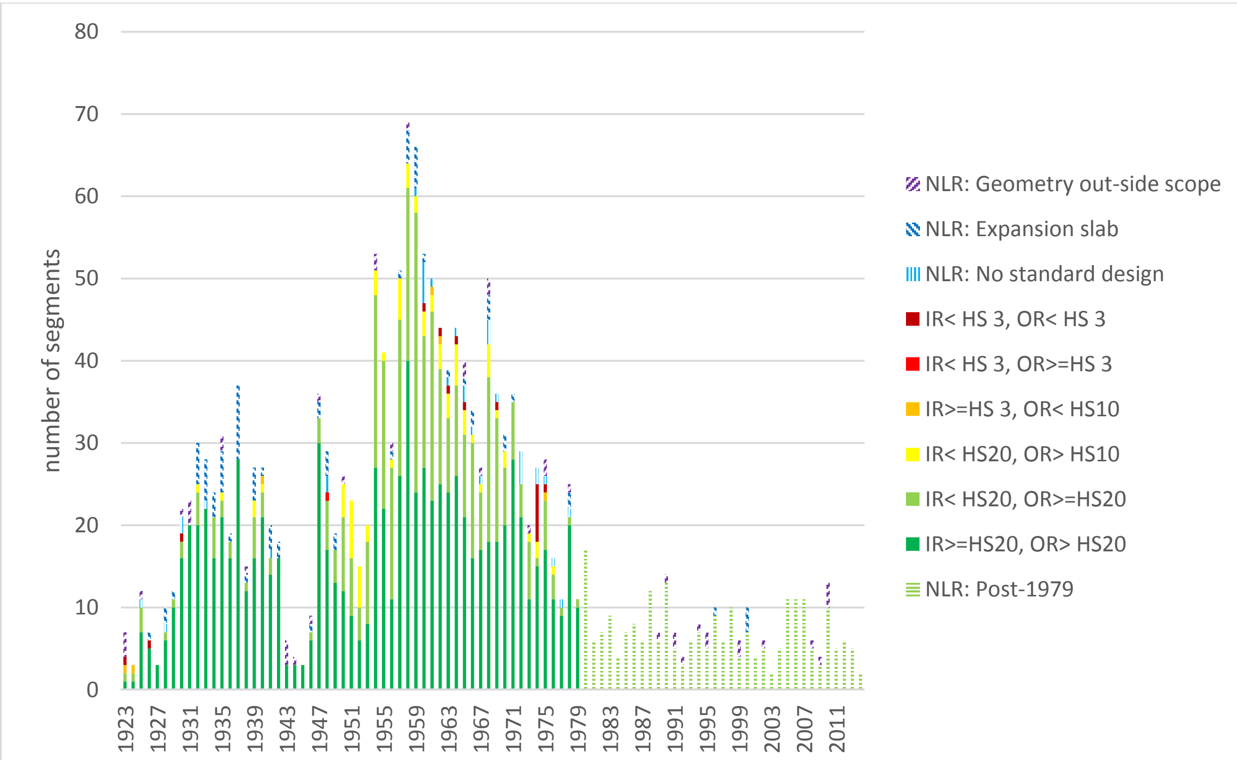


Figure 10.10. Segment Load Rating Performance by Year Built (*n* = 1,788)

This study focuses on Texas culverts constructed prior to 1980, and this totals 10,829 structures which represent 81% of TxDOT's current population of on-system bridge-class concrete culverts. Per Figure 10.10, roughly one-third of Texas' culverts were constructed in years leading up to and following World War II, and about half of Texas' culverts were constructed during the interstate highway era. The implications of such long culvert service life include changing construction specifications, changing design loads, changing design philosophy, and changing load-rating policy, among others. Apart from year built, these factors typically are expressed in terms of the design family as described in Figure 10.11.

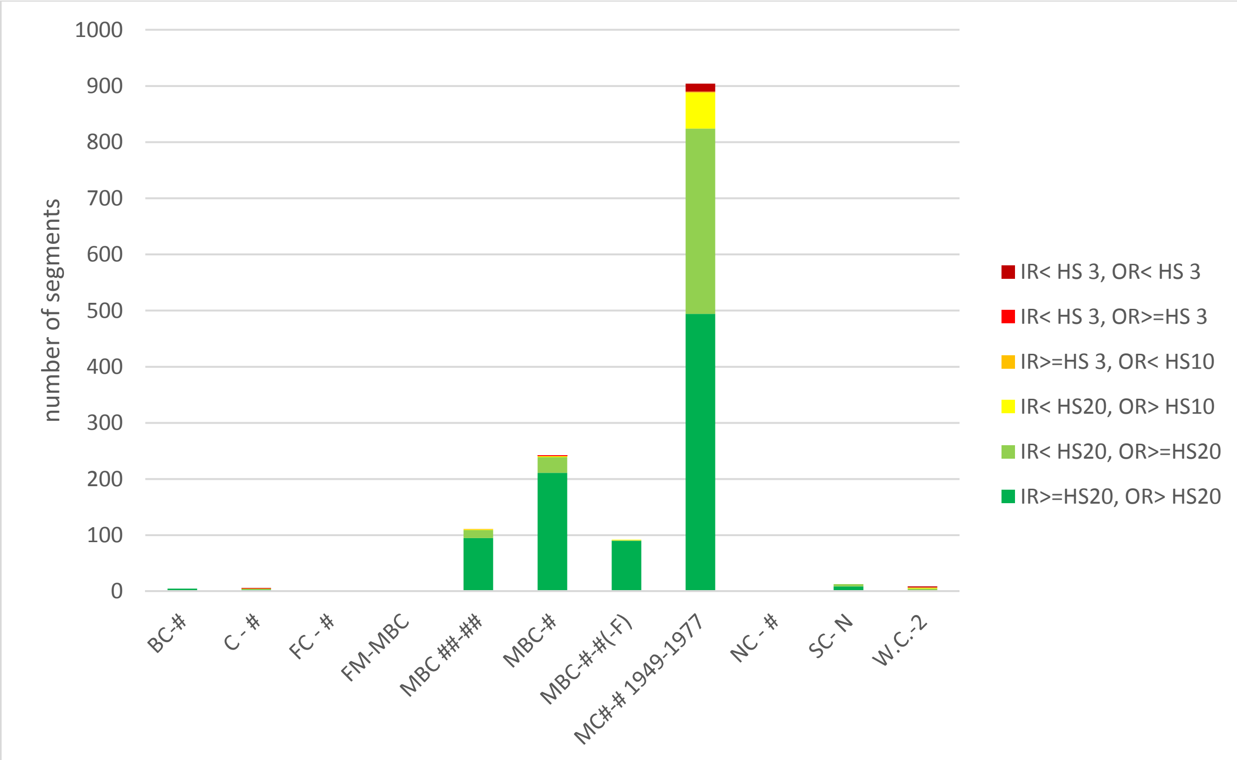


Figure 10.11. Segment Load Rating Performance by Design Family (Era) (n = 1,385)

As described in Chapter 8, the Texas Highway Department issued a full set of culvert standards associated with the interstate highway era – the MC#-# design family – in 1949. Per Figure 10.11, 65.3% (±2.8%) of the pre-1980 (n = 1,385) Batch 1 load rated culvert segments were constructed under this family of standards. The remainder are mostly the early non-haunched standards (17.5% ±2.2%) and the pre-WWII haunched standards (14.7% ±2.1%).

The analysis for an association between load rating performance and design family was limited to only the early (MBC-#), pre-WWII (MBC #-#, MBC-#-#-F), and the interstate highway era (MC #-#) families, totaling 1,349 segments. There were only 36 segments load rated that used other design families (such as BC-#, C-#, etc.). The p-value is 0.000. The MBC-# family had fewer non-passing segments than expected (3 observed, 15-16 expected), as did the MBC-#-#-F family (1 observed, 6 expected) and the MBC-#-# family (2 observed, 7 expected). The MC #-# family had far more non-passing segments than expected (80 observed, 57-58 expected).

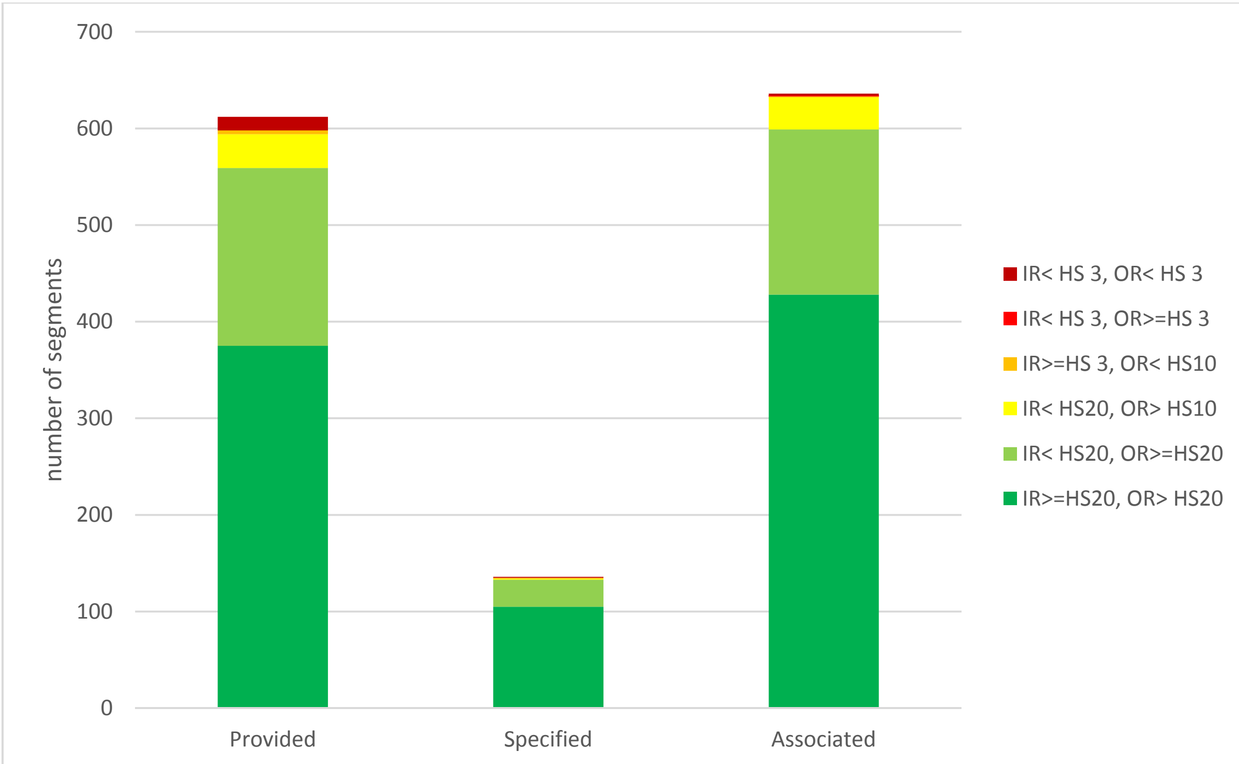


Figure 10.12. Segment Load Rating Performance by Design Selection (*n* = 1,385)

Available culvert documentation did not always include the actual design standard. In fact, per Figure 10.12, the design was provided for only 44.2% (±2.9%) of *n* = 1,385 pre-1980 load-rated segments and was identified or "called" by name (*i.e*. "specified") for an additional 9.7% (±1.7%) of segments. As described in Chapter 8, the designs for the remaining segments were assigned by "association" based on a parameter matching algorithm (45.9% ±2.9%). Outside the load-rated segments, for 35 segments a design standard could not be identified or associated with confidence (*i.e*. "NLR: No standard design"). Thus it was of interest to this study to explore whether the "associated" designs performed similarly to those designs which were provided and/or specified, as this goes to the validity of the design association process.

The analysis testing for a relationship between the Level 3 segment load rating performance and the design selection was limited to only those segments that were actually load rated (a total of 1,385 segments). The *p*-value was 0.009 indicating a relationship between Level 3 load rating performance and design selection. There were more non-passing segments than expected (54 observed, 41-42 expected) for provided designs, and fewer non-passing segments than expected (3 observed, 9 expected) for specified designs. For associated designs, the number of non-passing segments was only slightly lower than expected (37 observed, 43 expected).

Digging deeper, the relationship between design selection and rating factor was explored by a Tukey pairwise comparison (Minitab 2016) as shown in the boxplot, Figure 10.13. This analysis only evaluated direct traffic (0 to 2 ft) and low-fill (2 to 6 ft) culvert segments (n = 1,318), as these cover soil conditions represent over 90% of TxDOT culvert segments. The blue boxes in Figure 10.13 represent the 1st and 3rd quartiles and the horizontal line is the median for each case. The circle-cross denotes the mean (value given). Means that do not share a letter are significantly different. Thus, we have that the mean Level 3 ORF for the "specified" design group is significantly higher than for the "provided" design group.

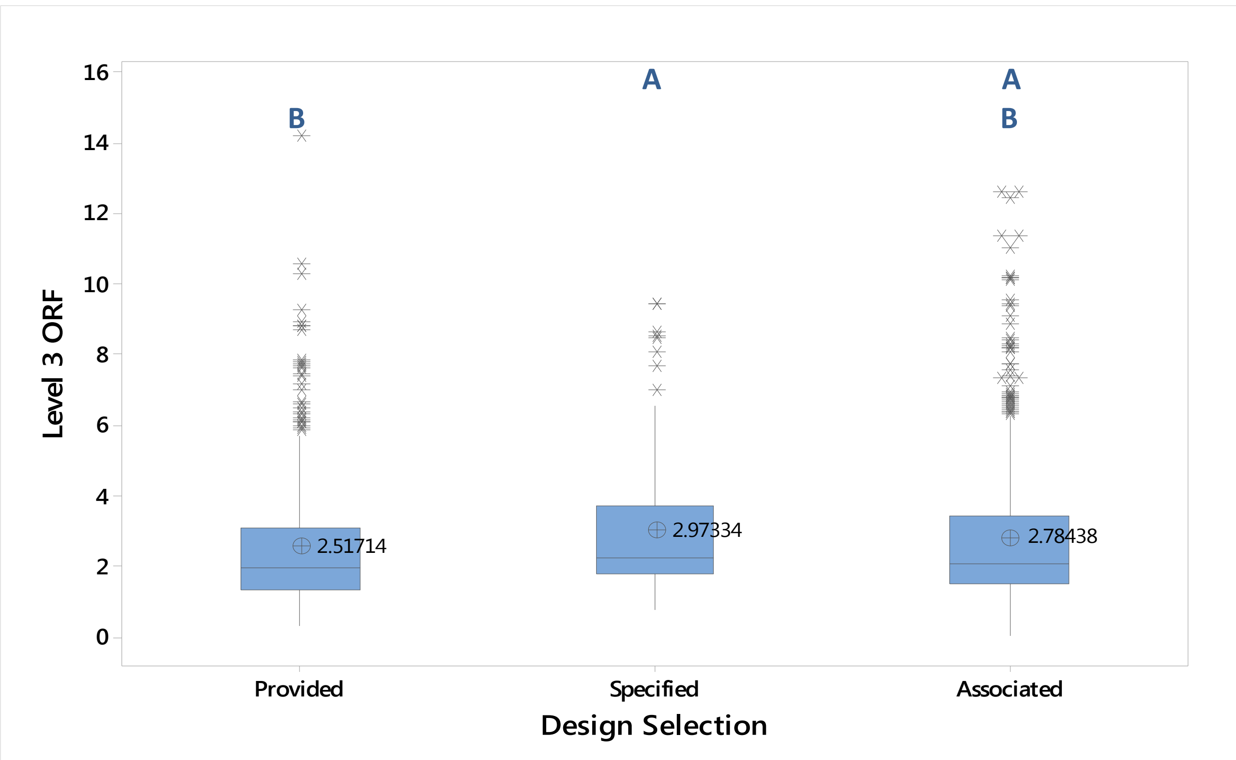


Figure 10.13. Segment Rating Factor vs. Design Selection (n = 1,318)

Recall that "provided" designs (*i.e.* the culvert documentation includes the design sheet) and "specified" designs (*i.e.*, the culvert documentation calls out the design by name) ought to be functionally equivalent, since the same (TxDOT) engineers who provide designs also specify them. However, the analysis shows that the specified designs tend to rate about 18% higher than the provided designs. In contrast, the "associated" designs perform somewhat comparably with the specified designs (6% low) but are about 11% higher than provided designs. Given the values, the use of the design selection algorithm to identify associated designs falls within the range of those designs that TxDOT engineers either specified or provided.

10.4.4. Influence of Culvert Soil and Pavement Variables

The independent variables examined for culvert soil and pavement include cover soil depth (see Figure 10.14), soil type (see Figures 10.15 and 10.16), and pavement type (Figure 10.17).

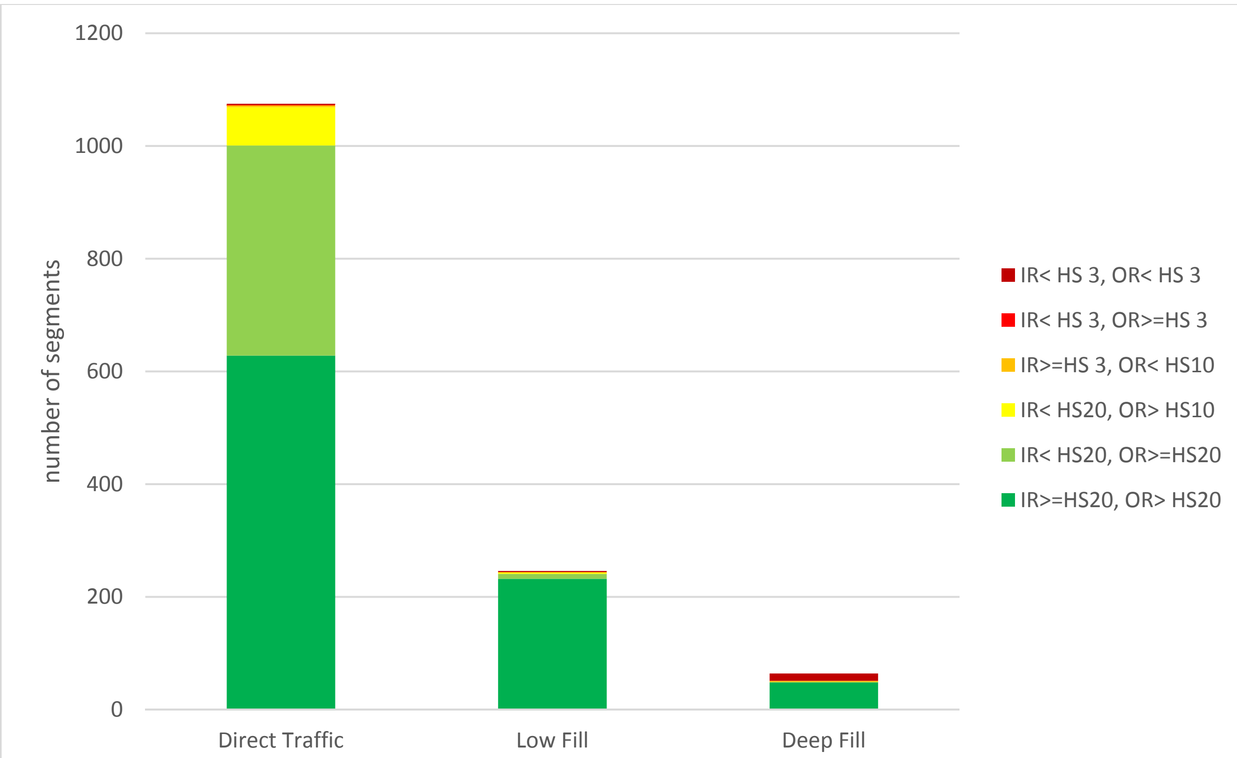


Figure 10.14. Segment Load Rating Performance by Cover Soil Depth (n = 1,385)

Per Figure 10.14 (which is limited to only the n = 1,385 load rated segments), direct traffic culverts having 0 ft to 2.0 ft of cover soil comprise 77.6% (±2.5%) of the Batch 1 rated culvert segments. Low-fill culvert segments having 2.1 ft to 6.0 ft of cover soil comprise 17.8% (±2.3%), and culvert segments with greater than 6.0 ft of fill (i.e. deep fill) comprise 4.6% (±1.2%) of rated segments.

The *p*-value to test for an association between the load rating performance and depth of fill is 0.000 indicating a significant relationship. The number of non-passing segments under direct traffic culverts (74 observed, 73 expected) matches closely. However, there are more non-passing segments than expected under deep fill (15 observed, 4 expected), and fewer non-passing segments than expected under low fill (5 observed, 16-17 expected).

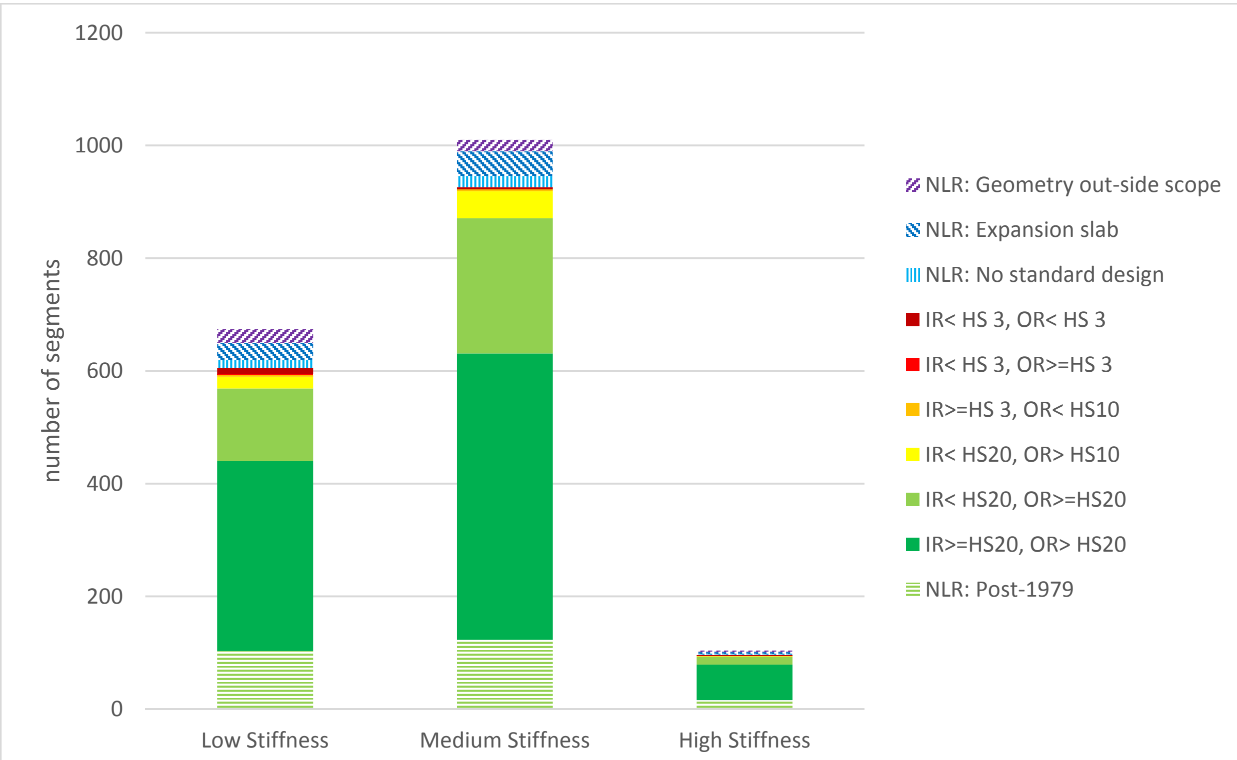


Figure 10.15. Segment Load Rating Performance by Soil Type (n = 1,788)

Geotechnical data were not provided for any of the culverts considered in this study, and as explained in Chapter 9, the process for characterizing the subsurface materials surrounding the culvert consisted of correlating soil type from GIS-based USNRCS soil survey records. Among the several assumptions incorporated in this production-simplified approach was the not unreasonable view that native soils were used to backfill the culvert excavations at the time of construction, and the highly-generalized notion that all soils surrounding the culvert (above, beside and below) were uniform homogenous materials (*i.e*. not layered or variable strength) of this type.

Per Figure 10.15, this process resulted in low-stiffness soils being identified for support of 37.7% (±2.9%) of Batch 1 rated culvert segments, whereas medium-stiffness soils support 56.5% (±2.9%) of rated segments, and high-stiffness soils support 5.8% (±1.4%) of rated segments.

The relationship between soil stiffness and rating factor also depends on cover soil depth (per ANOVA, $p = 0.000$). Note that this analysis excludes any segments with dead load failure as a natural logarithm transformation of the Level 3 ORF was necessary so that the usual ANOVA assumptions of a constant variance and normal distribution were satisfied ($n = 1{,}366$). This can be explored by a Tukey pairwise comparison as shown in the boxplot of soil type/cover soil depth vs. operating rating factor, Figure 10-16. As before, the blue boxes represent the 2nd and 3rd quartiles and the horizontal line is the mean for each case. Means that do not share a letter are significantly different.

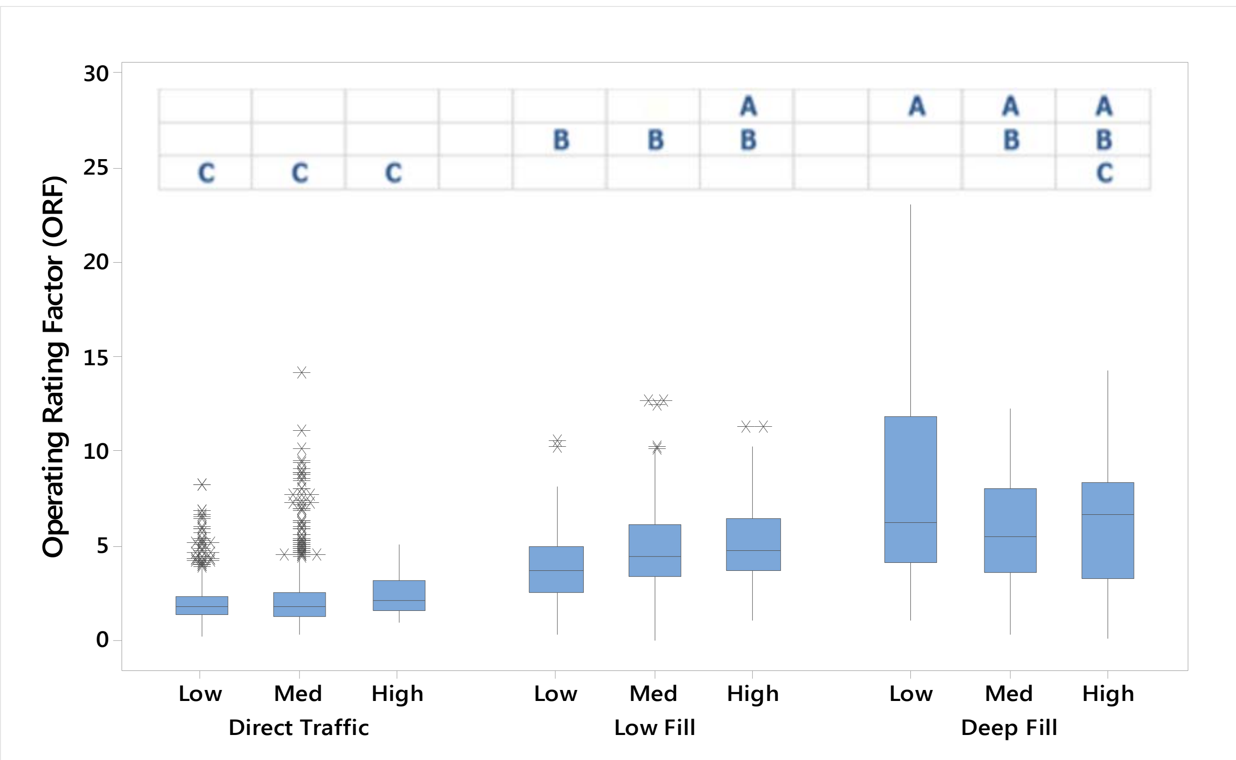


Figure 10.16. Segment Load Rating by Soil Type/Cover Soil Thickness ($n = 1{,}370$)

Figure 10.16 shows that the means for the "direct traffic" group are typically lower than the means for "low fill" and "deep fill" segments, which – because of the load-attenuating benefit of cover soil – is intuitively not surprising. Within the "direct traffic" group, there is no significant difference between the soil stiffness types (they are all in the "C" group). Similarly, within the "low fill" group, there is no significant difference between the soil stiffness type (they are all in the "B" group), as well as there being no significant difference within the "deep fill" group (they are all in the "C" group). The "high" stiffness soil within the deep fill group represents a very small sample (7 segments only) which is why this case aligns with all three culvert fill groups.

One of the second-generation enhancements to the soil-structure demand model (Level 3) used for this study was the introduction of the load-attenuating benefit of the surface pavement material. As demonstrated in Chapter 5 the thinner pavement structures (*i.e*. seal coat) had limited effect; whereas, the thicker and more robust pavement structures (*i.e*. concrete) did significantly impact (increase) the load rating. Figure 10-17 shows the range of pavement types associated with the Batch 1 culvert segments (4 segments had no pavement type associated with them, while 1 had no pavement of any type on the structure).

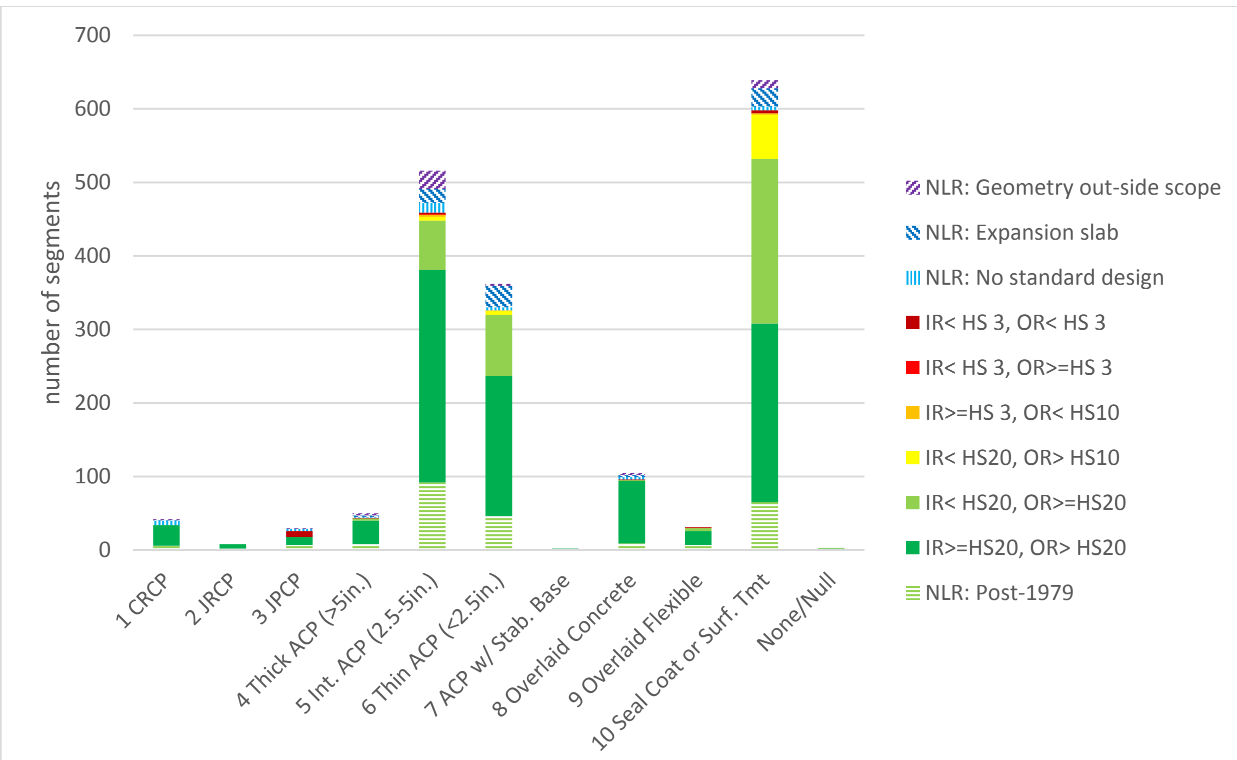


FIGURE 10.17. Segment Load Rating Performance by Pavement Type (n = 1,788)

The analysis testing showed a *p*-value of 0.000 indicating a significant relationship between load rating performance and pavement type. Limiting the discussion to the most common pavement types, there were more non-passing segments than expected for Seal Coat (66 observed, 36 expected) and JPCP (8 observed, 1 expected), while there were fewer non-passing segments than expected for Thin ACP (6 observed, 19 expected), Int ACP (11 observed, 25 expected), and Overlaid Concrete (1 observed, 6 expected).

10.4.5. Influence of Culvert Geographic Location

The culvert structures analyzed in this study are geographically distributed throughout the state of Texas. Figure 10.18 shows segment performance by District.

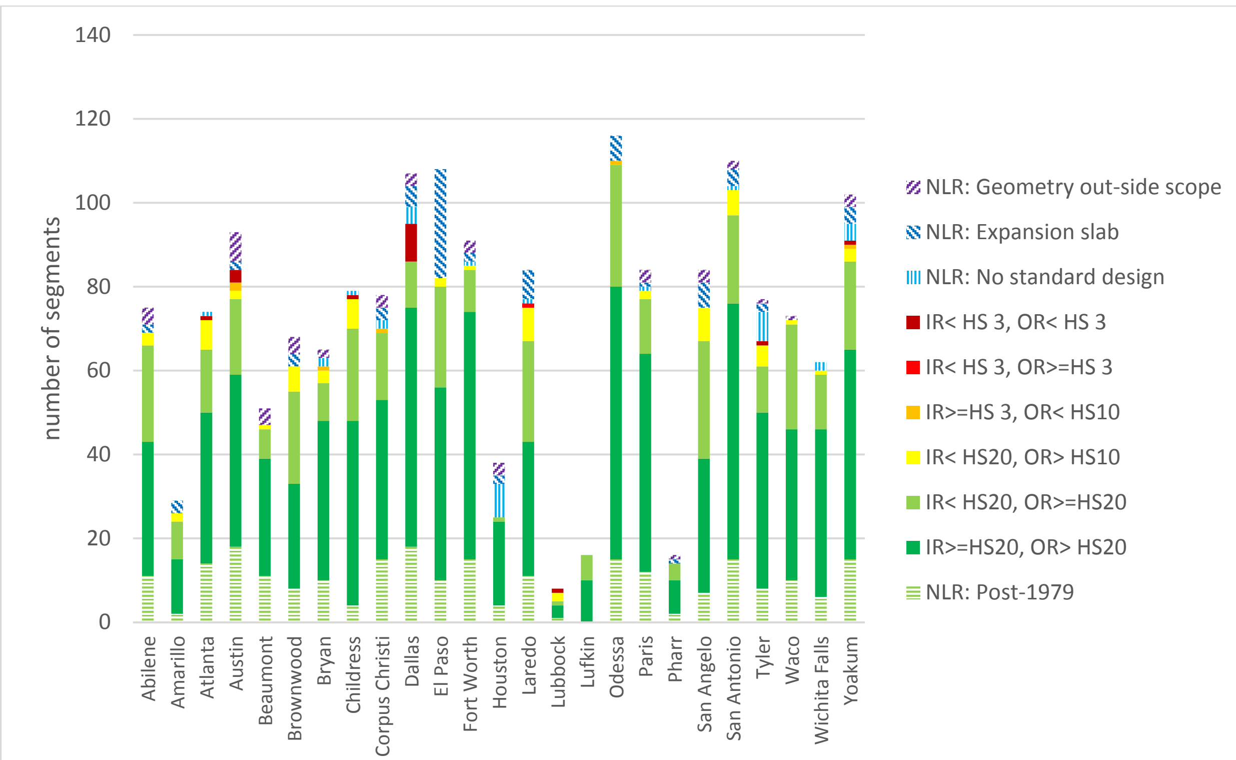


Figure 10.18. Segment Load Rating Performance by District (n = 1,788)

The presentation is descriptive and representative of the numbers of culverts throughout the state. While it might be possible to glean relationships about culvert performance relative to geographic location, such data are confounded by factors including, but not limited to, soil type, traffic, pavement type, and many other variables. It was beyond the scope of this study to explore these factors at the District level.

10.5 ANALYSIS OF VARIANCE FOR OPERATING RATING FACTOR

10.5.1 Overview

The presentation of load rating results up to this point has been descriptive and has illustrated the nature and characteristics of the Batch 1 culvert segments. We now seek to answer the question, “What independent variables significantly influence the OR? This was accomplished by means of an analysis of variance (ANOVA) performed using SAS® 14.1 software (SAS Institute, Inc. 2016).

10.5.2 ANOVA for Level 3 ORF

ANOVA was performed for all ratable culvert segments. The dataset was filtered to remove idiosyncrasies such as segments with span lengths that were odd (6.5 ft), box heights that were odd, non-common design families, etc. This reduced the dataset from 1385 rated segments to 1190 segments for ANOVA purposes. Further, to achieve a tractable problem, only selected factors were considered and these factors were aggregated as follows:

- Span Number (aggregated to 2, 3, 4, 5, 6+ spans)
- Span Length (spans greater than 10ft not included)
- Box Height (heights greater than 10ft not included)
- Design Family (MBC-#, MBC-#-#(-F), MBC ##-##, and MC #-# families only)
- Cover Soil Depth Category (Direct Traffic, Low Fill, Deep Fill)
- Soil Type (Low, Medium, High stiffness)

Table 10.2 presents the results for the “unbalanced ANOVA for two-way design with interaction” as performed relative to the natural log of ORF. The data in this table show that every factor (*i.e.*, independent variable category) identified is involved in at least one highly-significant interaction (*i.e.*, p-value < 0.05). Thus, every factor is significant. Because there are factors not included in the model, and because no terms higher than 2nd order interactions are included, the model shows a lack of fit.

Table 10.2. Analysis of Variance for Batch 1 Culvert Segments

Source[a]	DF[b]	Type III SS[c]	Mean Square[d]	F Value[e]	Pr > F[f]
BoxHeight*DesignFami	23	16.097	0.6999	3.49	<.0001
BoxHeight*CoverSoilD	14	15.590	1.1136	5.55	<.0001
SpanLengt*DesignFami	16	9.774	0.6109	3.04	<.0001
DesignFam*CoverSoilD	6	5.987	0.9978	4.97	<.0001
SpanNo*SoilType	8	5.025	0.6282	3.13	0.0017
SpanLengt*CoverSoilD	11	5.113	0.4648	2.32	0.0083
SpanNo*CoverSoilDept	8	3.889	0.4862	2.42	0.0136
SpanNo*SpanLength	25	8.129	0.3252	1.62	0.028
CoverSoilDe*SoilType	4	1.899	0.4747	2.37	0.0513
SpanLength*SoilType	13	3.637	0.2798	1.39	0.1553
BoxHeight*SoilType	14	3.384	0.2417	1.2	0.2658
SpanLength*BoxHeight	19	4.073	0.2144	1.07	0.379
SpanNo*BoxHeight	30	4.982	0.1661	0.83	0.732
DesignFamil*SoilType	6	0.623	0.1039	0.52	0.7954
SpanNo*DesignFamily	12	1.477	0.1231	0.61	0.8322
CoverSoilDepthCatago	2	18.640	9.3201	46.43	<.0001
DesignFamily	3	2.981	0.9937	4.95	0.002
BoxHeight	8	3.472	0.4340	2.16	0.028
SpanNo	4	1.688	0.4221	2.1	0.0784
SoilType	2	0.336	0.1681	0.84	0.4331
SpanLength	7	1.180	0.1686	0.84	0.5543

[a]Source… This column identifies the source of the variability in the specified dependent variable.

[b]DF… Degrees of freedom. This is the number of “observations” in the data that are free to vary when estimating statistical parameters.

[c]Type III SS… Type III sum of squares measures the differences between predicted factor means over a balanced interaction population.

[d]Mean Squares… represent an estimate of population variance. This is the sum of squares divided by the degrees of freedom.

[e]F Value… is a ratio of two variances. Variances indicate how far the data are scattered from the mean. Larger values represent greater dispersion.

[f]Pr > F… This is the ***p*-value** associated with the F statistic of a given source. The null hypothesis that the predictor has no effect on the outcome variable is evaluated with regard to this *p*-value. For a given alpha level (typically 0.05), if the *p*-value is less than alpha, the null hypothesis is rejected. If not, then we fail to reject the null hypothesis.

The results from Table 10.2 give some idea about the low and high performing factors. All factors where the p-value < 0.05 are statistically significant. Among these, the interactions with the largest sum of squares – *i.e.*, Box Height × Design Family, Box Height × Cover Soil Depth, and Span Length × Design Family – are the most influential, as these explain the largest amount of variance.

10.5.3 Significant Interactions for Level 3 ORF

The most significant interactions are explored via interaction plots in Figure 10.19, 10.20 and 10.21. Here the abscissa (x-axis) is identified and the ordinate (y-axis) is the arithmetic mean of operating rating factor for the subsample of culvert segments of interest. Finer details of the data have been excluded for clarity. For example, consider Figure 10.19, and the MBC-# design family where for a box height of 4 ft, the mean ORF = 4.0. This particular subgroup (data point) represents 49 culvert segments where the ORF values range from 1.2 to 12.6, and the standard deviation of ORF for this subgroup is 3.0. While the range and variance for the segment data representing each data point vary, each point on these charts is representative of a subgroup of culvert segments, with the proviso that clusters with fewer than 4 points are not shown.

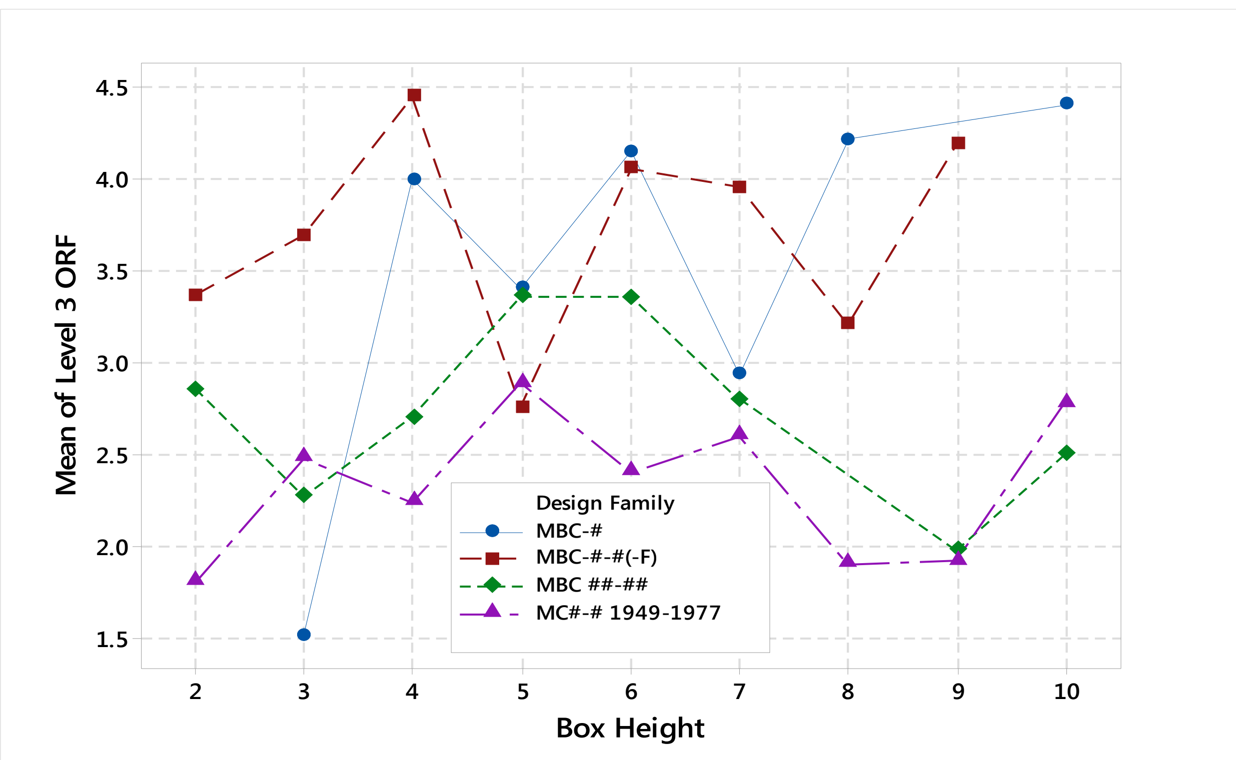


Figure 10.19. Segment Interaction Plot, Box Height × Design Family vs. Mean Level 3 ORF

This chart (Fig. 10.19) indicates a rough hierarchy in structure performance as a function of design family, although the relationships are quite erratic. For example, haunched culverts under fill (MBC-#-#(-F)) generally show the highest operating factors of all the design families for low box heights (4 ft or less). Among the taller culverts (box height 8 ft or more), the oldest of the culvert families, MBC-#, performs the best. The culvert design family that tends to perform the lowest is the post-WWII family, the MC#-# designs. These more modern designs lack the haunches and the very thick slab sections that generally made the older culverts so stout.

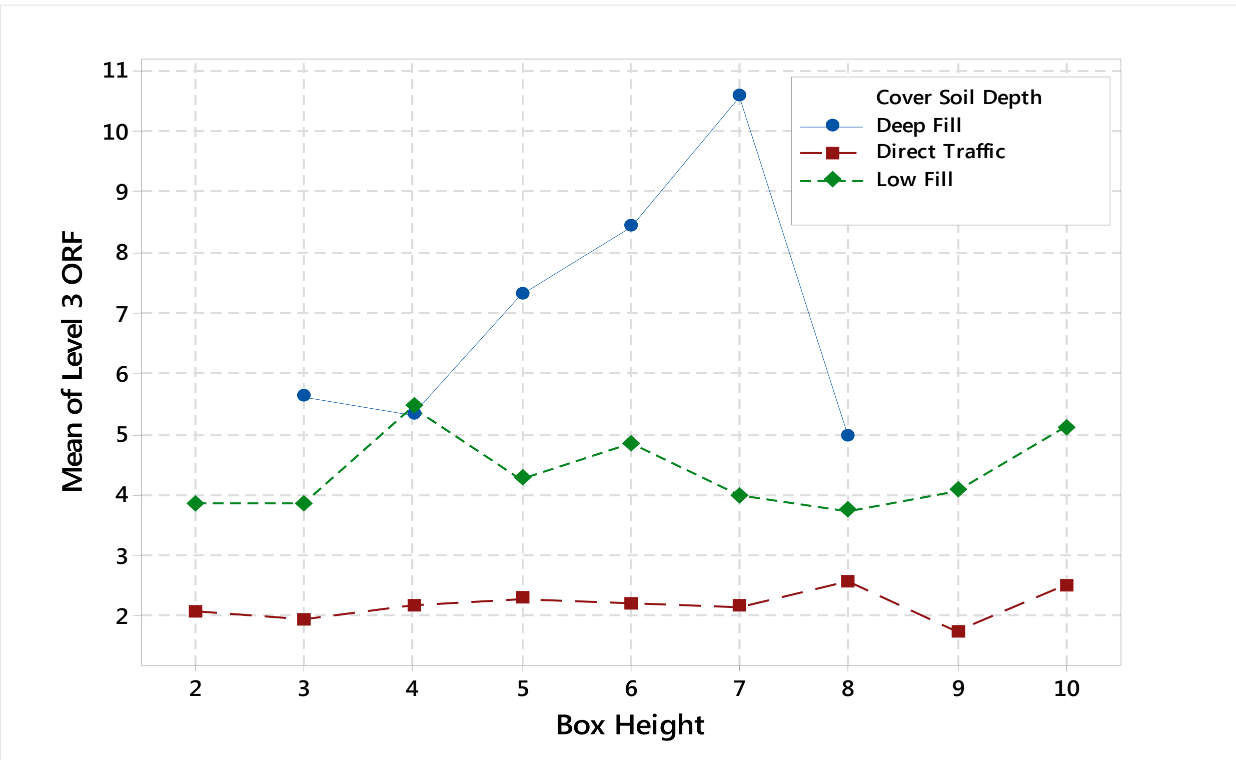


Figure 10.20. Segment Interaction Plot, Box Height × Cover Soil Depth vs. Mean Level 3 ORF

Figure 10.20 identifies structure performance as a function of cover soil depth, relative to box height. This chart shows that culverts under deep fill (cover soil > 6 ft) generally have the highest operating factors, but the influence of box height is erratic. Direct traffic culverts (cover soil ≤ 2ft), which comprise almost 80% of TxDOT's population of pre-1980 culvert structures, consistently show the lowest operating rating factors for all box heights. Low fill culverts (2 ft < cover soil ≤6 ft) fall in the middle.

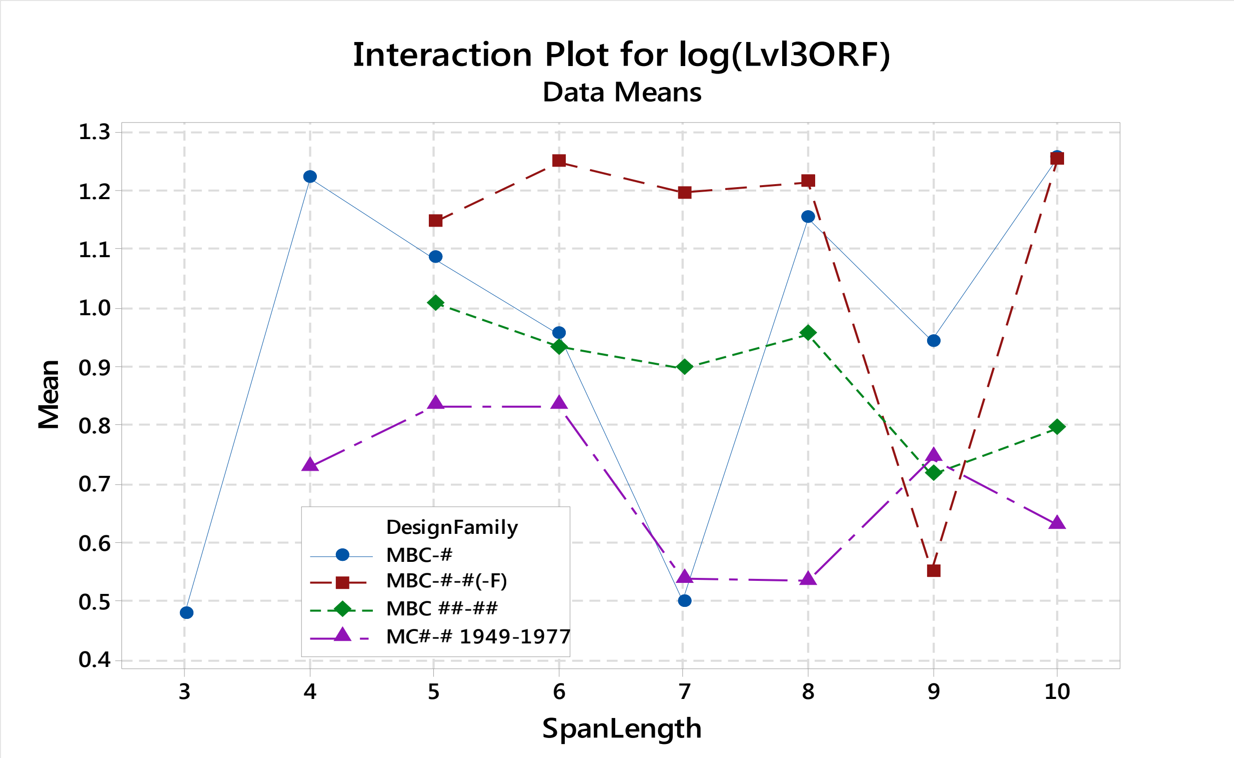


Figure 10.21. Segment Interaction Plot, Span Length × Design Family vs. Mean Level 3 ORF

Figure 10.21 identifies structure performance as a function of design family, relative to span length. Haunched culverts under fill (MBC-#-#(-F)) generally show the highest operating factors of all the design families for span lengths from 5 to 8 ft, and for 10 ft. The oldest of the culvert families, MBC-#, performs the best for span lengths of 4 ft and 10 ft. Three of the four design families show lower performance for culverts with a span of 9 ft. The culvert design family that tends to perform the lowest is the post-WWII family, the MC#-# designs. Again, these more modern designs lack the haunches and the very thick slab sections that generally made the older culverts so stout.

This brief review highlights the performance of Batch 1 culvert segments relative to key independent variables. As has been noted, this is not an exhaustive discussion as the first nine rows of Table 10.2 all show statistically-significant interactions, and we have mentioned only the first three. But this discussion does give some idea of the complexity and diversity of the variable sets that influence the culvert load rating.

10.5.4 ANOVA of Low-performing Culvert Segments

The focus of the discussion thus far has been on those segments that have Level 3 OR values greater than or equal to HS20 and thus do not require posting or other corrective action. However, from an asset management perspective, it is equally if not *more* important to characterize the low-performing sector of the culvert population as this is potentially where most of the repair and rehabilitation resources and attention will be directed. The question that must be asked is: "Among those culvert segments that did not achieve OR ≥ HS20, are there any defining characteristics that they have in common?"

The population of culvert segments of interest for this portion of the study is the 104 *rated* segments where OR < HS20, comprising 7.5% (±1.1%) of the Batch 1 *rated* segments. As was done for the full population, we performed an exploratory ANOVA relative to the operating rating factor for failing segments, evaluating all independent variables of interest for this group. Table 10.3 presents the results, only showing those factors and interactions which provided meaningful data. Due to the small sample size the "full ANOVA" including all of the two-way interactions was not possible, as many terms were not estimable.

Table 10.3. Analysis of Variance for Low-Performing Culvert Segments

Source	DF	Type III SS	Mean Square	F Value	Pr > F
CoverSoilDepthCatago	1	0.5124	0.5124	34.73	<.0001
SpanNo*BoxHeight	10	0.3991	0.0399	2.7	0.0178
SoilType	2	0.0334	0.0167	1.13	0.3363
SpanNo*SoilType	3	0.0388	0.0129	0.88	0.4643
SpanLength	5	0.0673	0.0135	0.91	0.4867
SpanNo*DesignFamily	2	0.0156	0.0078	0.53	0.5953
SpanLength*BoxHeight	4	0.0367	0.0092	0.62	0.6510
SpanNo	4	0.0300	0.0075	0.51	0.7300
SpanLength*SoilType	1	0.0017	0.0017	0.11	0.7383
BoxHeight*SoilType	2	0.0038	0.0019	0.13	0.8791
BoxHeight	7	0.0302	0.0043	0.29	0.9513
DesignFamily	1	0.0000	0.0000	0	0.9838
SpanNo*SpanLength	3	0.0018	0.0006	0.04	0.9884

Per Table 10.3, cover soil depth does emerge as a statistically-significant factor. The vast majority of failing segments (100/ 104) are direct traffic, and there are only 2 deep fill and 2 low fill segments in this group. Further, among the 1284 segments included in the filtered data for the ANOVA, 1002 are direct traffic, 233 are low fill, and 49 are deep fill. Thus, 78% of segments in the (filtered) population are direct traffic (not surprising), but 96% of failing segments are direct traffic. While this is of note, it is nevertheless unsurprising given that most culverts in Batch 1 are direct traffic segments.

In summary, the finding of the ANOVA is that no variables, and no combinations of variables, stand out as strongly influencing the operating rating for this group of low-performing segments. That is, there is no obvious factor (or set of factors) that produces the lower rating. This goes against intuitions about culvert performance such as the idea that older culverts, or deep-fill culverts, or maybe culverts in weaker soil, or perhaps some combination of design family/build year are more likely to have lower ratings. The finding of this study is that there is no “smoking gun” among independent variables for low-performing culvert segments.

10.6 CULVERT SEGMENT RESULTS SUMMARY

This chapter presents summary results and analysis of load rating work for 1,788 total segments/ 1,385 ratable segments which comprise 1,000 culverts which are statistically representative of TxDOT’s population of on-system, bridge-class, pre-1980, cast-in-place, reinforced concrete box culvert structures. The outcome of load rating effort can be viewed from the perspective of whether a segment would require load posting as per guidance from TxDOT’s *Bridge Inspection Manual*.

By this standard and focusing on Level 3 load rating results, 85.7% (±2.1%) of culvert segments *do not* require load posting, either because they rate sufficiently high by calculation or because an HS20 rating can be assigned per FHWA policy. A total of 5.3% (±1.3%) of culvert segments have Level 3 ratings at varying degrees *below* HS20 and may require some type of action such as repair, rehabilitation, load posting, or replacement. A third category of segments (9.0% ±1.7%) were not load rated either because they were not amenable to analysis using the software employed for this study or because designs were not available.

This chapter focuses on load rating computations performed at the *segment* level, because it is the individual segments for which load rating values are determined. Stated another way, the segment-level data provide the most clear picture of the performance of TxDOT's culverts. However, it is also of interest to consider aggregated load rating data at the culvert structure level where the lowest rating from all segments that make up a culvert is the *controlling* load rating for the structure. Chapter 11 will present those findings.

CHAPTER 11
LOAD RATING RESULTS FOR 1,000 CULVERT STRUCTURES

11.1 OVERVIEW

This chapter presents summary results and analysis of Level 1 and Level 3 load rating computations for the 1,000 Batch 1 culvert structures evaluated in this study. These structure-level results are aggregated from segment-level data (Chapter 10) where the lowest rating from all segments that make up a culvert is identified as the *controlling* load rating for the structure. The data summarized in this chapter appear in tabular form in Appendix B. This data table in turn derives from the segment-level data (Appendix A) and from the individual culvert load rating reports presented as research Product P1 and Product P2.

About half of TxDOT's culvert structures are comprised of more than one segment, and rating data for individual segments most clearly tell the story of culvert performance. However, it is also important to present load rating results at the *structure* level. This is primarily because the National Bridge Inventory (NBI) identifies and classifies bridge-class culverts as *structures.* Further, the NBI's required quadrennial condition inspections are made for bridge-class culvert *structures,* and direct provision is not made for capturing data on individual culvert segments. Therefore it is consistent with national policy to think about culverts as structures and to present load rating results accordingly. A second reason for focusing on culverts as structures is this is the level where TxDOT makes administrative decisions about culverts, and where actions are taken – *e.g.*, load posting is done for culvert *structures*, as are repairs and rehabilitation, etc.

The layout of this chapter is as follows. After the introduction, the chapter presents an analytical summary of load rating results for Batch 1 culvert structures. This is followed by a detailed presentation of the influence of selected independent variables on load rating values at the structure level. After that, the chapter presents recommendations and guidance for implementation at the culvert structure level.

11.2 OVERALL LOAD RATING RESULTS BY CULVERT STRUCTURE

11.2.1 Interpretation and Generalization of Load Rating Values

It is helpful to characterize the overall performance of a culvert structure by viewing the load rating from the perspective of whether the culvert would require load posting. As for the segment data, Figure 10.1 provides the key to interpretation. This figure is a reproduction of load posting guidelines presented in TxDOT's *Bridge Inspection Manual.* The chart has been color-coded to the six load posting categories, and the color codes serve to provide a visual, high-level indication of the structural health of TxDOT's culvert structures.

The results presented herein are for a simple random sample of 1,000 culvert structures (termed 'Batch 1') which were selected to provide a statistically-representative sample from which valid inferences could be drawn about TxDOT's entire population of 10,829 on-system, bridge-class, pre-1980, cast-in-place, reinforced concrete box culverts. As with the segment data, of primary interest are the performance rates. Every performance rate has a *margin of error* associated with it that is given by a 95% confidence interval, as per Table 10.1. Therefore, generalizations of the performance data for the 1,000 rated culverts relative to TxDOT's full population of pre-1980 culverts must consider the margin of error.

11.2.2. Load Rating Categories for 1,000 Culverts

Figure 11.1 displays a pie chart that summarizes the load rating results for the 1,000 Batch 1 culvert structures. This figure characterizes culverts as being in one of three categories. The first category consists of those culverts with load ratings that are considered *"passing."* By this we mean that the structure does not require load-posting, *i.e.*, the culvert "rates in the green" because all segments have a Level 1/ Level 3 OR greater than or equal to HS20. The second category indicates culvert load ratings that may be considered *"failing"* and by this we only mean that the culvert does not "rate in the green." Thus this culvert would be subject to load posting or other action because one or more segments indicates a Level 3 OR less than HS20. The third group is comprised of culverts with non-rated segments. Here, because load rating calculations have not been performed for all segments, the culvert structure load rating is as yet "undetermined."

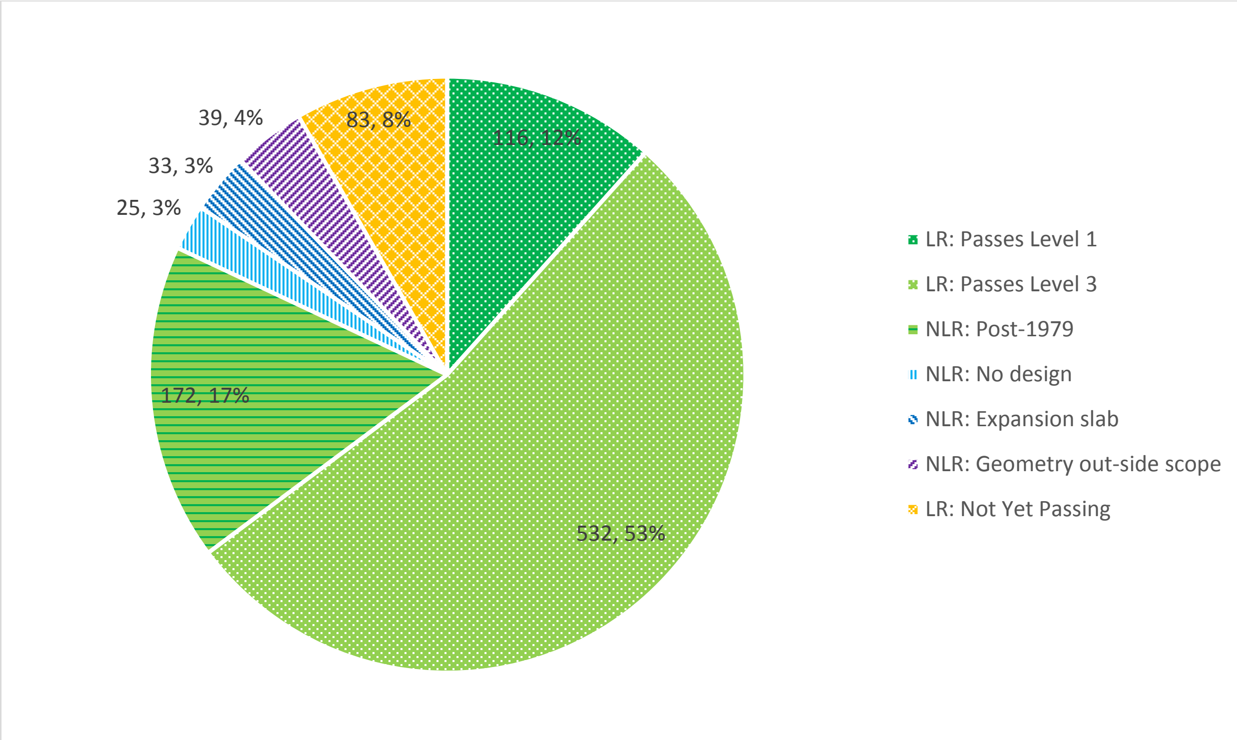


Figure 11.1. Summary Load Rating Results for 1,000 Culverts

The first category –indicated by varying shades of green (*not* in reference to Figure 10.1) – accounts for 82.0% (±2.3%) of culverts, and is comprised of three subcategories:

- LR: Passes Level 1 – All segments "pass" Level 3 *and* Level 1. (116/1000 = 11.6%)
- LR: Passes Level 3 – All segments "pass" Level 3. (532/1000 = 53.2%)
- NLR: Post-1979 – All segments "pass" Level 3 or are assigned "passing" as post-1979 structures designed for HS20 loading. (172/1000 = 17.2%)

This category can be considered the "passing" culverts, structures which require no further action relative to load rating analysis, load posting, or repair/ rehabilitation. This represents the lower bound percentage (82.0% ±2.3%) of culvert structures which pass (*i.e.*, do not require load posting) under this study.

The second category – indicated by yellow (also *not* in reference to Figure 10.1) – accounts for 8.3% (±1.6%) of culverts, and is comprised of one subcategory:

- LR: Not Yet Passing – At least one load-rated segment in the culvert structure "fails" Level 1 and Level 3. (83/1000 = 8.3%)

This category can be considered as the "failing" culverts in that these structures will require further administrative attention. This might take the form of more intensive load rating analysis work to explore whether the “failing” segments actually possess rating values below HS20. As discussed in Chapter 10, most segments (roughly 8 out of every 10) having operating ratings below HS20 are still relatively close to passing, and such segments might “rate in the green” if evaluated using culvert-specific data or more rigorous demand modeling. Some segments likely will not pass – even with careful evaluation – and when the load ratings are finally judged to be below HS20, such structures would be subject to corrective repair or rehabilitation, load posting, or replacement.

The third category –indicated by varying shades of blue – accounts for 9.7% (±1.7%) of culverts, and is comprised of three subcategories:

- NLR: No design – One or more culvert segments has no identified or associated design; other segments pass Level 3 and/or are post-1979 (assigned). Note that this also includes a single structure that also has an expansion slab segment. (25/1000 = 2.5%)
- NLR: Expansion slab – One or more culvert segments is a non-rated expansion slab; other segments pass Level 3, are post-1979 (assigned), or have no identified or associated design. (33/1000 = 3.3%)
- NLR: Geometry out-side scope – One or more culvert segments has a non-box geometry not amenable to rating using CULVLR (e.g., round or three-sided shape); other segments pass Level 3, are post-1979 (assigned), have no identified or associated design, are an expansion slab. (39/1000 = 3.9%)

The load ratings for this third category can be considered “undetermined” and these structures will require further administrative attention. For those culvert segments without designs, perhaps the design can be located? Alternatively, if the design is not available, the rating can be assigned based on policy and condition inspection, similar to the post-1979 segments. For those segments with expansion slabs, the moment demands associated with this ‘simple beam’ configuration can be evaluated and load ratings calculated accordingly. Likewise, culvert segments with non-box geometry can be individually modeled to determine the moment demands. This would require segment-specific, geometry-specific modeling, but the load ratings could be calculated.

11.2.3. Load Rating Performance for 1,000 Culverts

Figure 11.2 displays the load rating results for the 1,000 culverts, not in terms of “pass/fail” category as was done in Figure 11.1, but rather by their calculated load rating (OR/IR) value relative to load-posting. Here, the OR/IR identified is the minimum for all segments that were able to be load rated. The non-load rated segments that might exist in the culvert structure were ignored, and this implicitly presumes such segments would not control the load rating. Rarely did a culvert consist only of segments that could not be load rated (2.4%), and the "NLR" categories represent these structures. The overall load rating results for the 1,000 culverts as per Figure 11-2 can also be grouped into three categories:

- Culverts with OR ≥ HS20… structure *does not* require load posting
- Culverts with OR < HS20… *possible* candidate for posting, rehab, or replacement
- Non-rated culverts… load rating calculations *not performed*

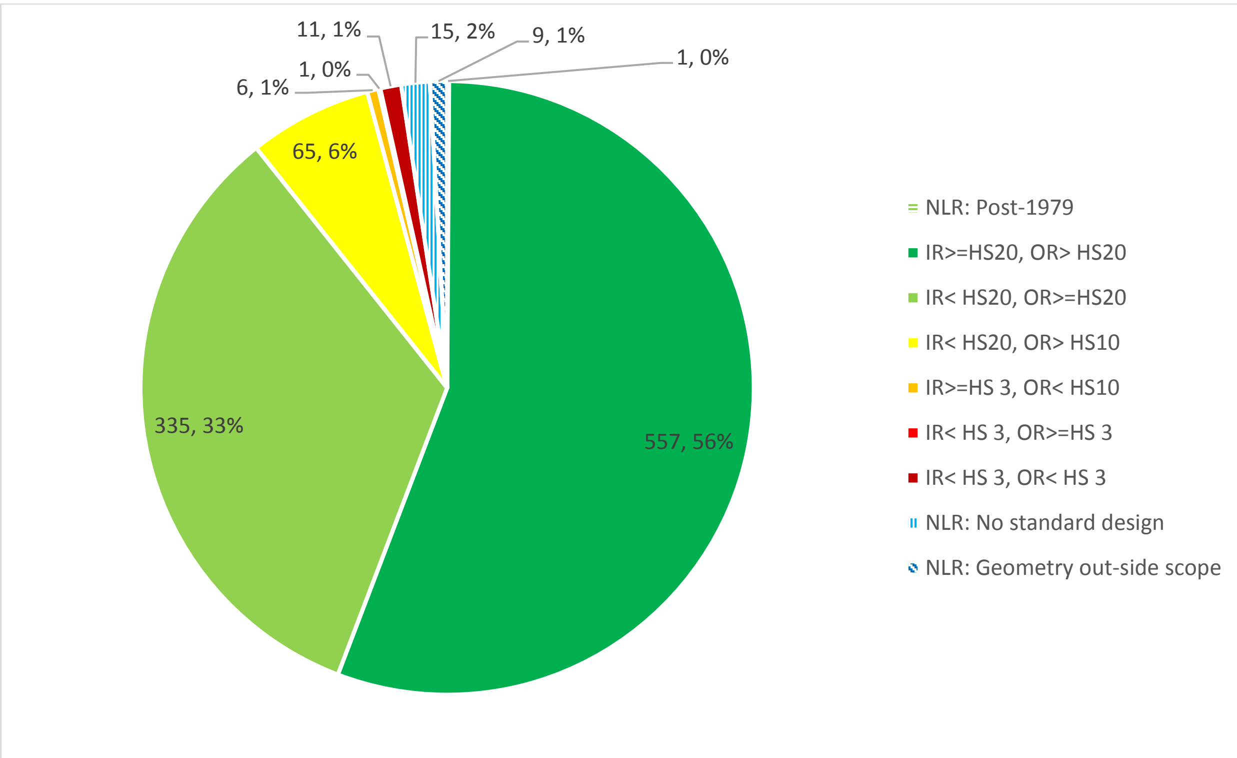


Figure 11.2. Culvert Results by Rated Performance

Figure 11.2 shows that 89.3% (±1.8%) of culverts rate sufficiently high such that they *do not* require load posting. This category includes rated culverts having a Level 3 IR ≥ HS20 (dark green color per Figure 10.1) or a Level 3 OR ≥ HS20 (light green color), plus culverts that were designed for HS20 loading and constructed post-1979 such that an HS20 rating can be *assigned* per FHWA policy (FHWA 2011a) – identified in the chart by the light green striped pattern (only one such structure was encountered).

The second category totals 8.3% (±1.6%) and consists of culverts having Level 3 ratings (OR) at varying degrees *below* HS20, represented by the other colors in Figure 10.1, *i.e.*, yellow, orange, red and maroon. If these ratings were deemed “final”, such culverts would require some type of action such as repair, rehabilitation, load posting, or replacement.

The third category totals 2.4% (±0.9%) and is comprised of culverts which were not load rated (NLR) for various reasons. Some culverts (0.9%±0.5%) contained segments consisting of geometric designs such as circular pipes, three-sided structures, etc., which also could not be rated using the CULVLR software. The remaining culverts in this non-rated category (1.5%±0.7%) were comprised of segments which did not have designs provided, specified, nor associated.

11.2.4. Passing vs. Failing Culverts

Implicit in the discussion of the Figure 11.1 results is the “worst case scenario” notion that “passing” culverts are only those structures where this study has demonstrated that no further action is needed relative to load rating analysis, load posting, or repair/ rehabilitation for any segment. This identifies the *lower bound* percentage (82.0% ±2.3%) of culvert structures which can be said to pass under this study. But what about the other end of the spectrum?

Implicit in the Figure 11.2 results is the “best case scenario” notion that the load rating values for culverts having both ratable and non-ratable segments will not be controlled by the non-rated segments. If this assumption is correct, this is tantamount to assuming that non-ratable segments can be adjudicated to “pass.” And if that is correct, the first and third category culverts can be combined on the view that non-rated segments “pass,” and this combining of results presents an *upper bound* percentage (91.7% ±1.6%) of culvert structures which *could* pass (*i.e.*, not require load posting) under this study. Adding to this, consider the “yellow” culverts in the second category – those with segments having operating ratings close to but not quite HS20. As has been noted in the segment-level data, under more refined analysis many (perhaps most) of these culverts would be candidates for passing. If so, adding these promising culverts from the second category to those from the first and third categories, the *idealized* upper bound percentage of culvert structures which *might* pass load rating might be as high as 98.2% ±0.8%.

To sum up, the culvert-level results presented herein are aggregated, segment-level data. Depending on the assumptions (or follow-on analyses) made for various classes of non-rated segments, the percentage of TxDOT's population of 10,829 on-system, bridge-class, pre-1980, cast-in-place, reinforced concrete box culverts which *do not* require load posting (*i.e.*, can be said to "pass") ranges from 82.0% ±2.3% to 91.7% ±1.6%. Through additional effort, the upper bound percentage might increase to as much as 98.2% ±0.8%. Of course the idealized upper-bound values incorporate multiple assumptions, all of which must be verified.

11.2.5. Comparison of Level 1 and Level 3 Results for 1,000 Culverts

Figure 11.3 directly compares the Level 1 and Level 3 load rating results at the culvert structure level. As was the case with the segment-level data, the difference is dramatic.

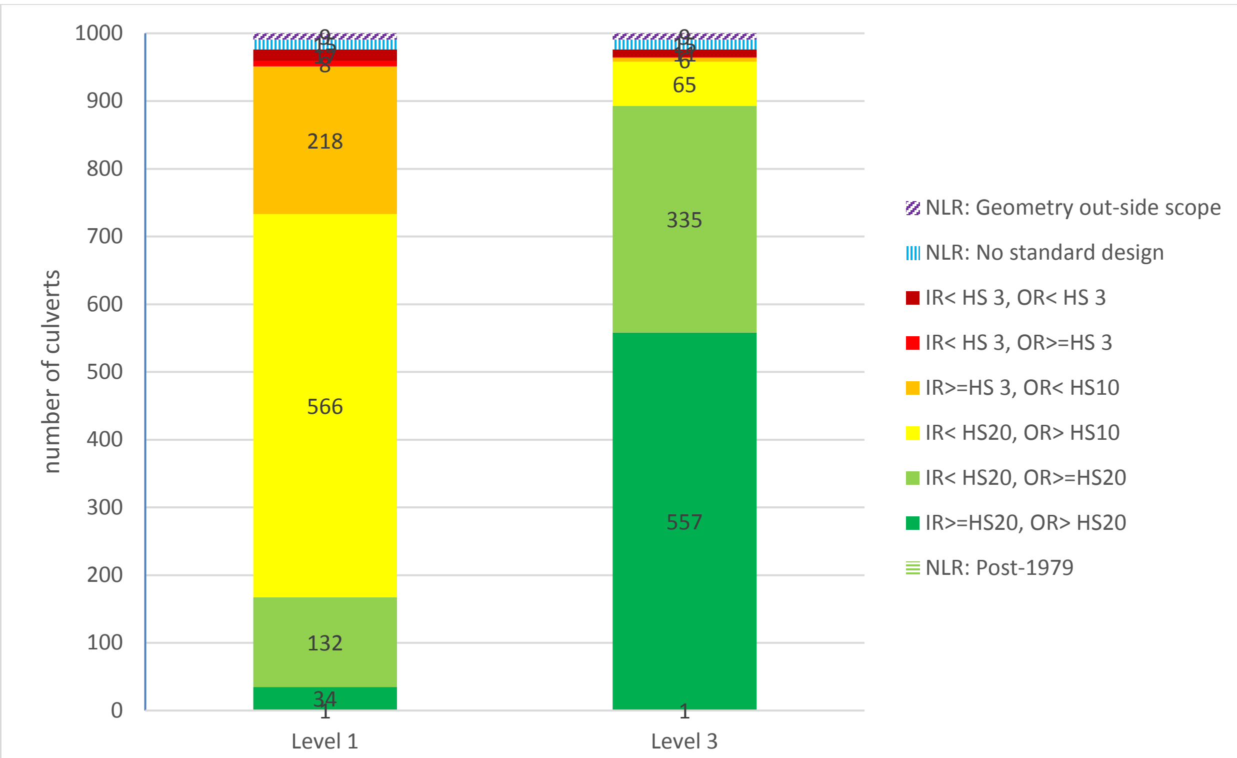


Figure 11.3. Level 1 versus Level 3 Load Rating for 1,000 Culverts

The left column of Figure 11.3 indicates that 16.7% (±2.2%) of culvert structures show Level 1 OR ≥ HS20 such that the culvert *would not* require load posting. In contrast, the right column shows that 89.3% (±1.8%) of structures have Level 3 OR ≥ HS20. This analysis is synonymous with the lower-bound data presented in Figure 11.1. If the idealized assumptions associated with non-rated segments are applied, the percentages increase but the gap remains.

11.3 DESCRIPTIVE RESULTS BY CULVERT STRUCTURE

11.3.1. Overview

Beyond the summary load rating results, associations between selected independent variables and load rating performance for culvert structures provide further insight into the nature and performance of TxDOT's culvert population. This section of the report groups the independent variables into four categories: (1) geometry, (2) soil and pavement, (3) condition rating, and (4) geographic location. Pearson's chi-squared test of independence will be used, and the performance variable is defined by the three categories described for Figure 11.1, namely, category 1 (passing, OR ≥ HS20), category 2 (failing, OR < HS20), and category 3 (undetermined).

11.3.2. Influence of Culvert Geometry Variables

The independent variable examined for culvert geometry is the number of segments, as other geometry variables such as the number of spans, span length and box height are properly segment-level parameters. Figure 11.4 presents the findings. The median number of segments for TxDOT culvert structures is <u>one</u> (52.5% ±2.9%), and the 90th percentile is <u>three</u> segments (92.9% ±1.5%), with the total number of segments per culvert ranging from 1 to 11.

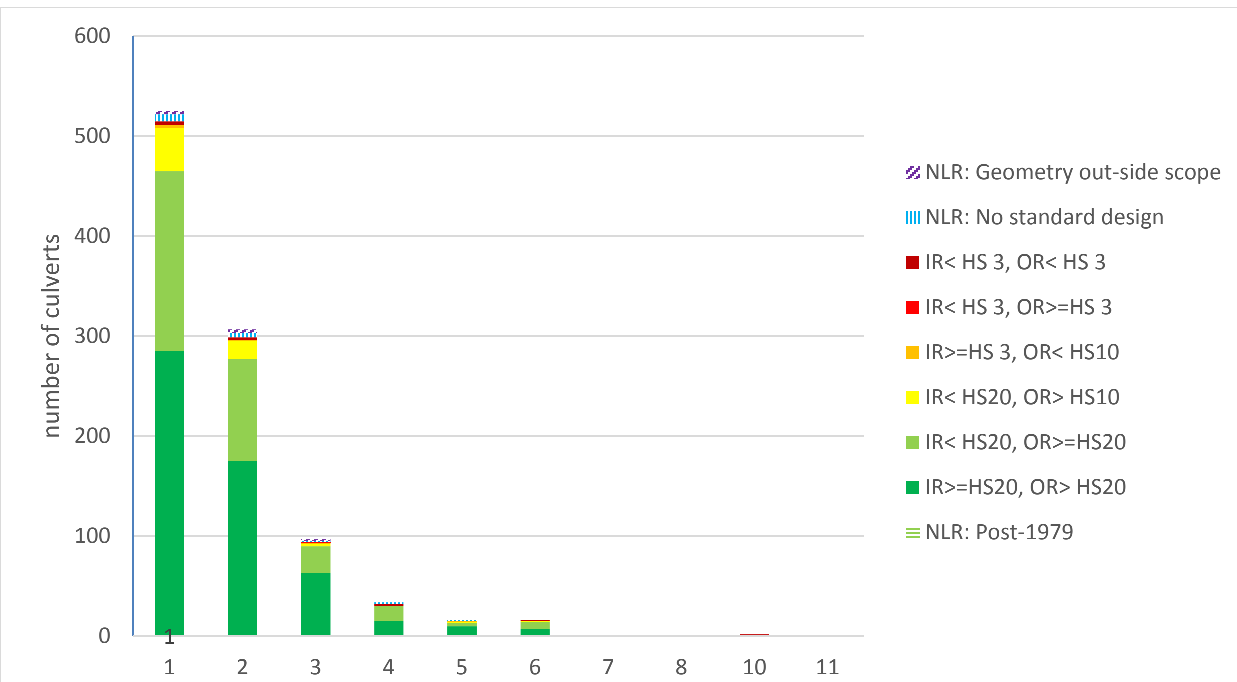


Figure 11.4. Culvert Load Rating Performance by Number of Segments

For the test of association between Level 3 load rating performance and number of segments, because there are only 6 structures with 7 or more segments, these were all combined into a "7+" category. The *p*-value for the test of association is 0.654 indicating there is no conclusive evidence of a relationship between load rating performance and the number of segments a structure has.

11.3.3 Influence of Culvert Soil and Pavement Variables

The independent variables examined for culvert soil and pavement include cover soil depth (see Figure 11.5), soil type (see Figure 11.6), and pavement type (Figure 11.7). These variables were determined for culvert structures but were applied for culvert segments, thus, the findings may be considered at both levels. Relative to culvert structures, the findings are descriptive only.

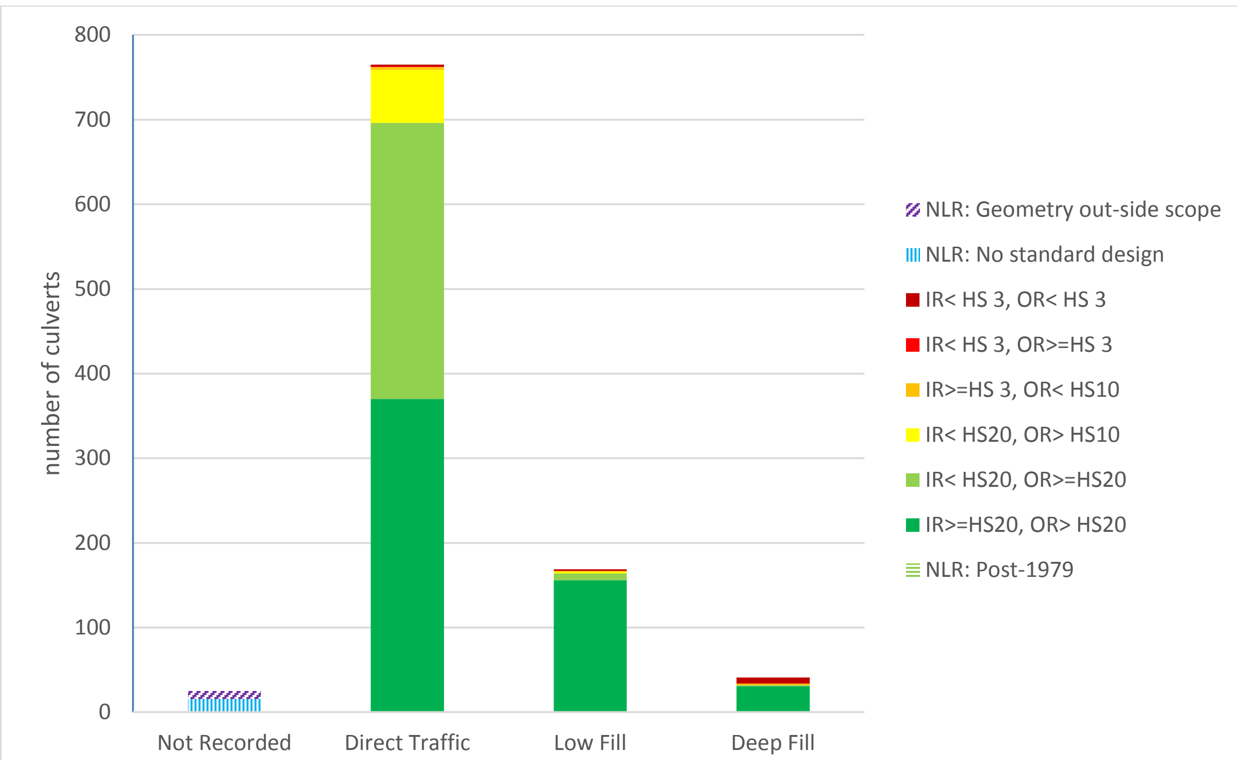


Figure 11.5. Culvert Load Rating Performance by Cover Soil Depth (*n* = 1,000)

Per Figure 11.5, direct traffic culverts having 0 ft to 2.0 ft of cover soil comprise 78.5% (±2.4%) of the Batch 1 culverts (among the 975 with calculated load ratings). Low-fill culverts having 2.1 ft to 6.0 ft of cover soil comprise 17.3% (±2.2%), and culverts with greater than 6.0 ft of fill (i.e. deep fill) comprise 4.2% (±1.2%) of the sample. The *p*-value for the test of association between Level 3 load rating performance and cover soil depth is 0.000, a significant association between the load rating and cover soil depth. There are significantly more non-passing culverts for deep fill (9 not passing, 3-4 expected), and significantly fewer non-passing culverts for low fill (5 not passing, 14-15 expected).

Geotechnical data were not provided for any of the culverts considered in this study, and as explained in Chapter 9, the process for characterizing the subsurface materials surrounding the culvert consisted of correlating soil type from GIS-based USNRCS soil survey records.

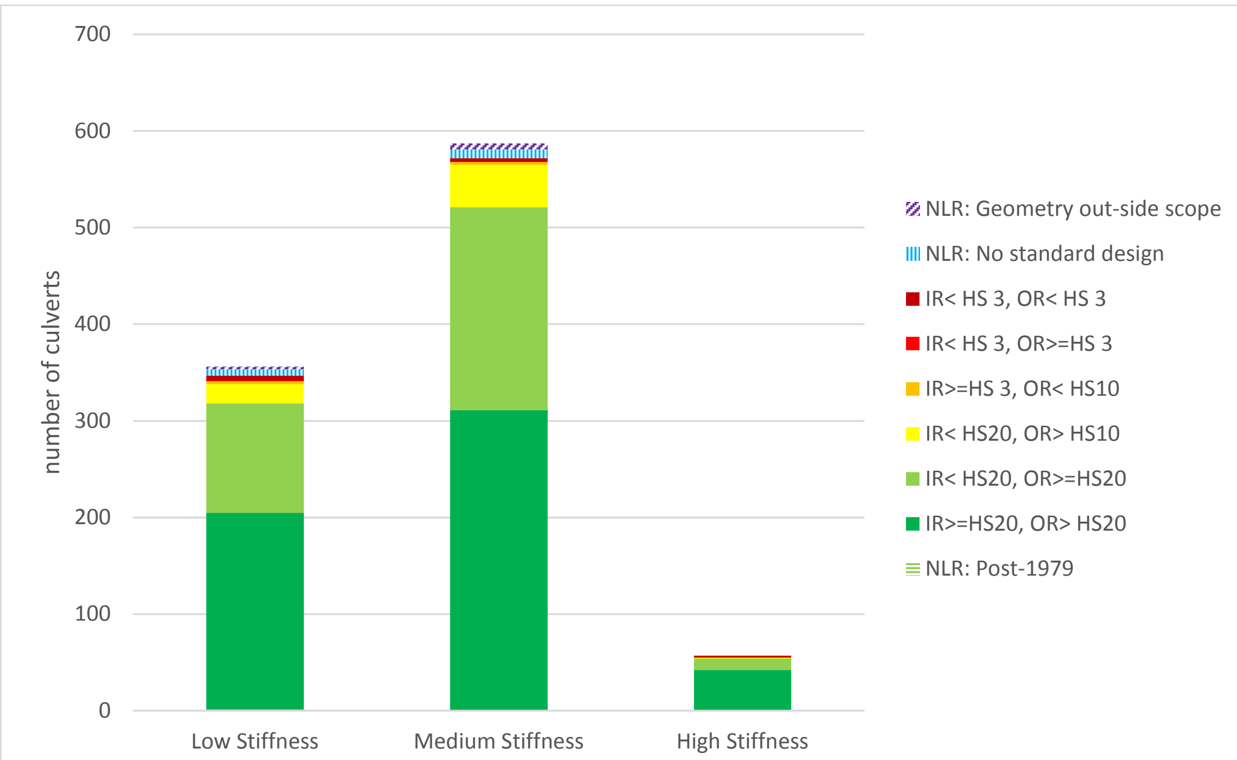


Figure 11.6. Culvert Load Rating Performance by Soil Type (*n* = 1,000)

Per Figure 11.6, this process resulted in low-stiffness soils being identified for support of 35.6% (±2.8%) of Batch 1 culverts, whereas medium-stiffness soils support 58.7% (±2.9%) of culverts, and high-stiffness soils support 5.7% (±1.4%) of culverts. The *p*-value for the test of association between Level 3 load rating performance and soil type is 0.638 indicating no significant association between the load rating and soil type.

One of the second-generation enhancements to the soil-structure demand model (Level 3) used for this study was the introduction of the load-attenuating benefit of the surface pavement material. Figure 11.7 shows the range of pavement types associated with the Batch 1 culverts.

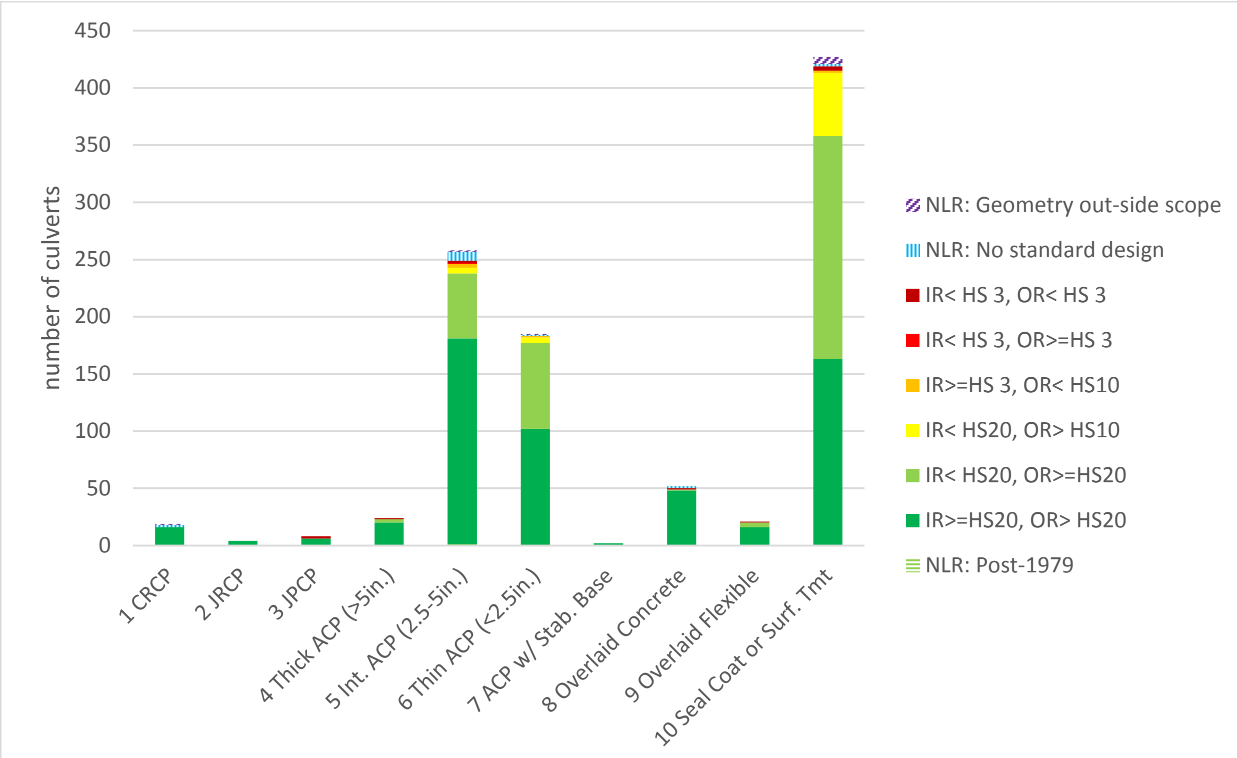


Figure 11.7. Culvert Load Rating Performance by Pavement Type (n = 1,000)

As demonstrated in Chapter 5, the thinner pavement structures (*i.e.* seal coat) had limited effect; whereas, the thicker and more robust pavement structures (*i.e.* concrete) did significantly impact (increase) the load rating. Asphalt concrete pavements (PMIS category 4, 5, 6, 7) cover 46.8% (±2.9%) of culverts, and this is the largest of any category. Seal coat or surface treatment pavements (PMIS category 10) cover 42.7% (±2.9%) of culverts, and is a close second; whereas, Portland cement concrete pavements (PMIS category 1, 2, 3) cover 3.1% (±1.0%) of culverts. Overlaid pavements (PMIS category 8, 9) cover 7.3% (±1.5%) of culverts.

11.3.4. Influence of Culvert Condition Rating

The culvert condition rating is an independent variable specific to the culvert structure, because condition rating data are captured and reported *only* for culvert structures, not segments.

Figure 11.8, 11.9 and 11.10 present the findings. The reported condition rating for TxDOT culvert structures ranges from 4/9 to 8/9, with most culverts (62.5% ±2.9%) scoring 7/9 or better.

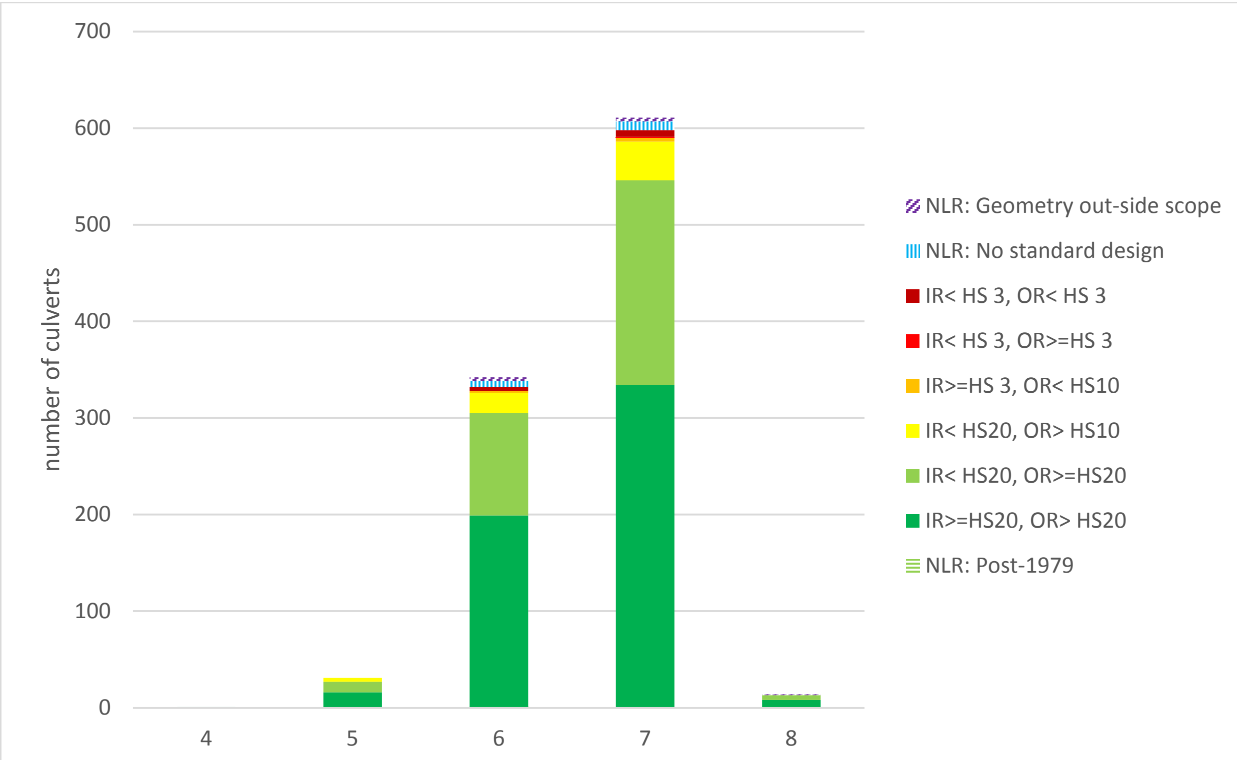


Figure 11.8. Culvert Load Rating Performance by Condition Rating (*n* = 999)

Condition ratings, like load ratings, represent a way to characterize the structural performance of the culvert structure. Low condition ratings (0 to 4) indicate failed to poor condition, middle ratings (5 to 6) indicate fair to satisfactory condition, and high ratings (7 to 9) indicate good to excellent condition. Therefore it is natural to assume that condition ratings and load ratings would be correlated. However, the *p*-value for the test of association between Level 3 operating rating factor and condition rating is 0.562 indicating no significant association between the load rating and condition rating.

Digging deeper, we explored possible interactions that might influence the rating factor/ condition rating relationship including culvert design family and age. Figure 11.9 is a box plot of condition rating vs. rating factor, by major design family, where the boxes represent the 2nd and 3rd quartiles and the horizontal line is the median. The dataset for this analysis excluded dead load failures and anything other than the four primary design families. It also excluded the single structure with a condition rating of 4, which has a Level 3 ORF equal to 2.4 ("1: IR >= HS20, OR> HS20").

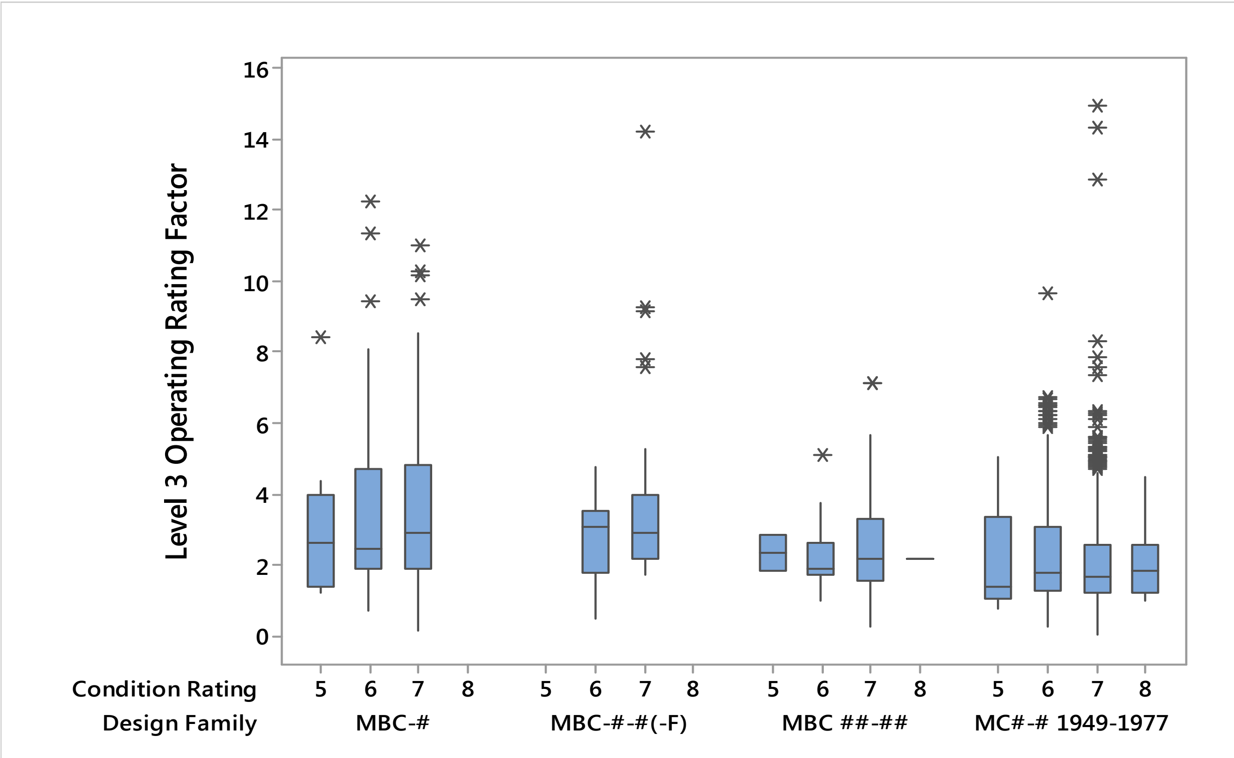


Figure 11.9. Condition Rating vs. Operating Rating Factor, by Design Family (*n* = 947)

Figure 11.9 shows that a significant relationship exists between design family and Level 3 operating rating factor, but <u>no significant relationship</u> exists between condition rating and Level 3 operating rating factor. That is, the Level 3 operating rating varies by design family, but within each of the design families, the Level 3 operating rating factor remains flat relative to the condition rating.

Figure 11.10 presents a bubble plot of condition rating vs. original year built (a surrogate for age), where the size of the bubble is proportional to the sample size for each year. The dataset for this analysis excluded the one culvert with no condition rating assigned, and the one structure that was entirely post-1979.

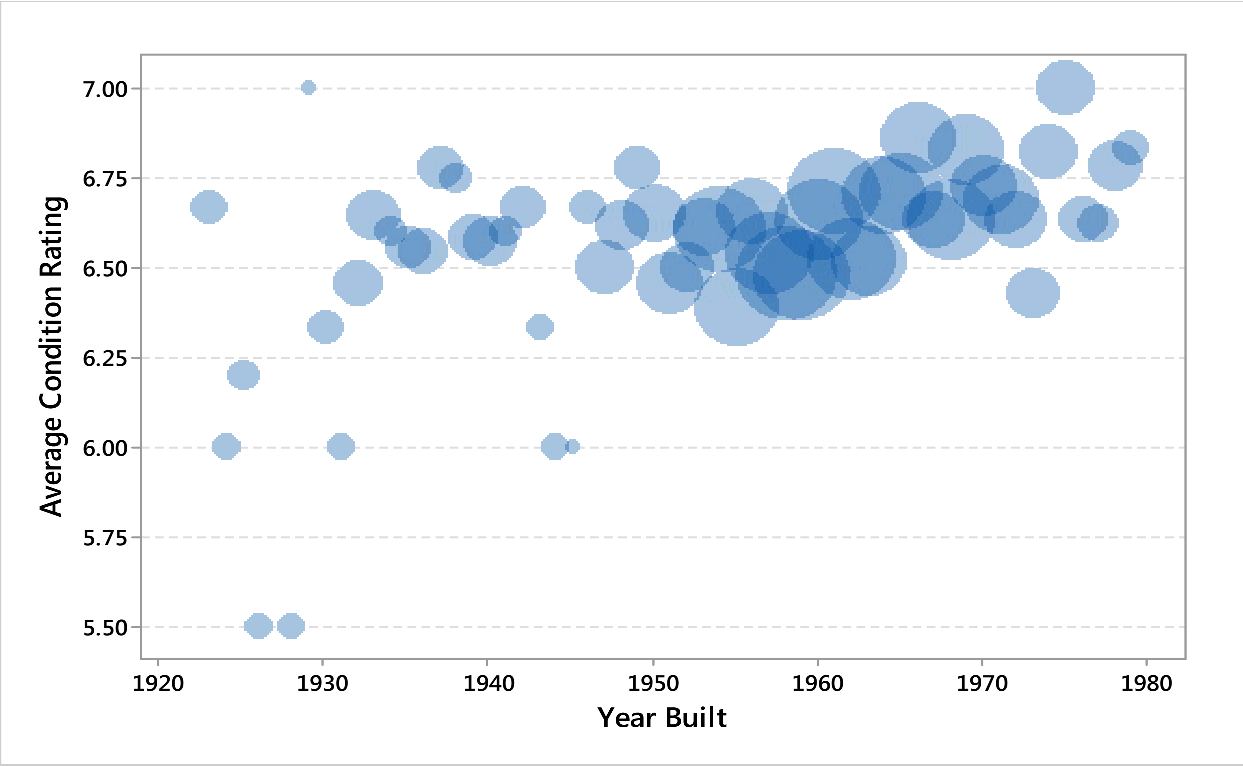


Figure 11.10. Culvert Condition Rating vs. Original Year Built (*n* = 998)

This chart suggests a relationship between age and condition rating for the oldest culverts, but the trend is essentially flat for culverts built after the mid-1930s.

11.3.5. Influence of Culvert Geographic Location

The culvert structures analyzed in this study are geographically distributed throughout the state of Texas. Figure 11.11 shows culvert performance by District.

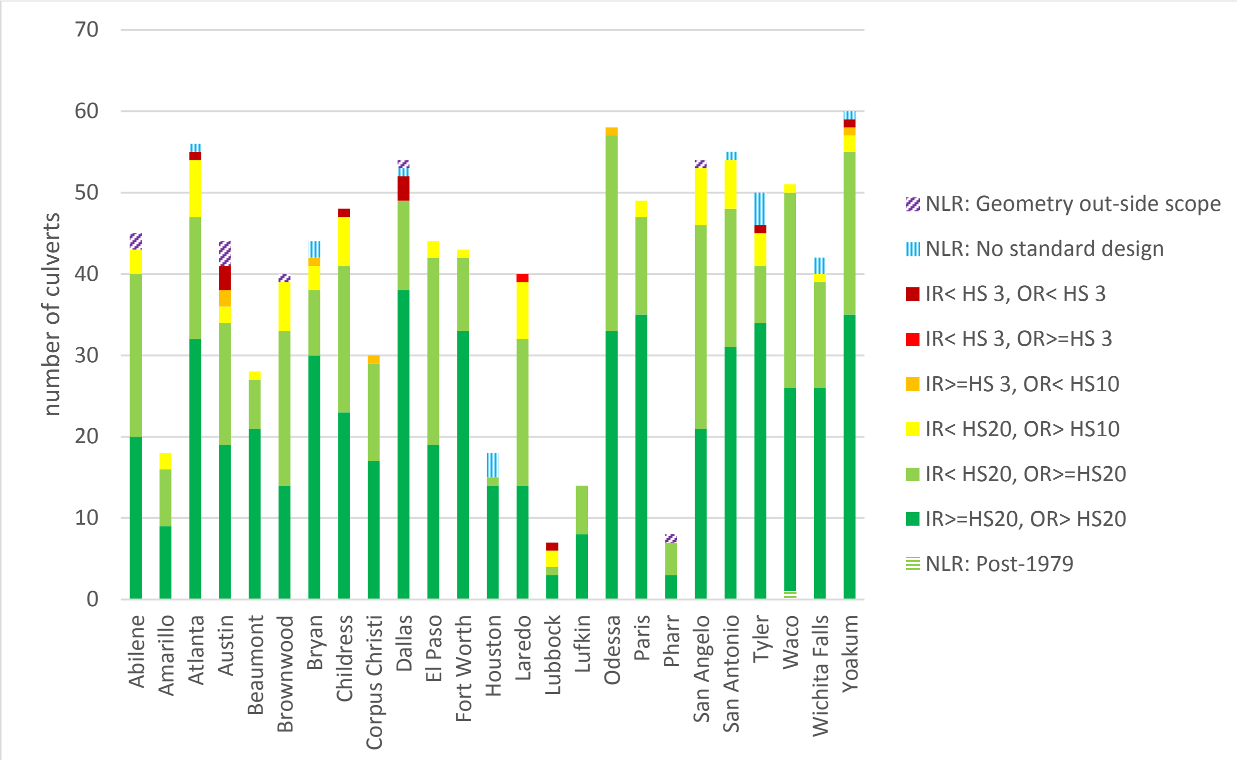


Figure 11.11. Culvert Load Rating Performance by District (n = 1,000)

The presentation is descriptive and representative of the numbers of culverts throughout the state. While it might be possible to glean relationships about culvert performance relative to geographic location, such data are confounded by factors including but not limited to soil type, traffic, pavement type, and many other variables. It was beyond the scope of this study to explore these factors at the District level.

11.4 DISCUSSION AND RECOMMENDATIONS

11.4.1 Overview

The presentation of load rating results up to this point illustrates the nature and characteristics of the Batch 1 culvert structures. As has been noted, the percentage of TxDOT's population of 10,829 on-system, bridge-class, pre-1980, cast-in-place, reinforced concrete box culverts which *do not* require load posting (*i.e.*, can be said to "pass") ranges from 82.0% ±2.3% to 91.7% ±1.6%, depending on the assumptions (or follow-on analyses) made for various classes of non-rated segments. This section of the report presents recommendations and actions for each category of culvert – those that pass, those that fail, and those that are as yet undetermined.

11.4.2 Category 1 – "Passing" Culverts

This group of culverts –indicated by varying shades of green in Figure 11.1 – accounts for 82.0% (±2.3%) of culverts. These "passing" culvert structures essentially require no further action relative to load rating analysis, load posting, or repair/ rehabilitation. Recommendations by subgroup are as noted.

- Subgroup 1.1 (LR: Passes Level 1): The recommendation is to accept Level 3 results *** repeat Level 3*** and place load rating documentation in the file.
- Subgroup 1.2 (LR: Passes Level 3): The recommendation is to accept Level 3 results and place load rating documentation in the file.
- Subgroup 1.3 (NLR: Post-1979): The recommendation is to assign HS20 load ratings to post-1979 segments as these segments were designed for HS20 loading. Accept assigned rating results and place documentation in the file.

The recommended actions should formally resolve the load rating requirements for all structures within this category.

11.4.3 Category 3 – "Undetermined" Culverts

The next category to be addressed is Category 3 –indicated by varying shades of blue in Figure 11.1 – and which accounts for 9.7% (±1.7%) of culverts. This category is comprised of three subgroups of culverts having one or more non-rated segments, but where all rated segments pass. Recommendations are as noted.

- Subgroup 3.1 (NLR: No design): These are culverts having one or more segments with no identified or associated design. The recommendation is to resolve the missing design issue:
    - Option A. Locate design documents, possibly in hard copy from District design files. Load rate segments using procedures as described herein. Accept "passing" Level 3 results and place documentation in the file. Otherwise, see Category 2.
    - Option B. Adjudicate missing design documents as "missing." Assign load ratings commensurate with structure performance as per quadrennial condition inspections. Accept "passing" assigned rating results and place documentation in the file. Otherwise, see Category 2.

- Subgroup 3.2 (NLR: Expansion slab): These are culverts having one or more segments which is a non-rated expansion slab. The recommendation is to perform load rating calculations for the expansion slab segments:
    - Option A. Load rate expansion slab segments using the *direct stiffness* structural analysis method to determine moment demands. Accept "passing" results and place documentation in the file. Otherwise, see Option 3.2.B.
    - Option B. Load rate expansion slab segments using the soil-structure interaction analysis method to determine moment demands. Accept "passing" results and place documentation in the file. Otherwise, see Category 2.
- Subgroup 3.3 (NLR: Geometry out-side scope): These are culverts having one or more segments with a non-box geometry not amenable to rating using CULVLR (e.g., round or three-sided shape). The recommendation is to perform load rating calculations for non-box segments:
    - Option A. Load rate non-box segments using the *direct stiffness* structural analysis method and a culvert-specific model to determine moment demands. Accept "passing" results and place documentation in the file. Otherwise, see Option 3.3.B.
    - Option B. Load rate non-box segments using the soil-structure interaction analysis method and a culvert-specific model to determine moment demands. Accept "passing" results and place documentation in the file. Otherwise, see Category 2.

The recommended actions should formally resolve the "undetermined" status for the all structures within this category. The actual load rating levels will guide whether further administrative attention is necessary for these segments

11.4.4 Category 2 – "Failing" Culverts

The final category to be addressed is Category 2 –indicated by yellow shading in Figure 11.1 – and which accounts for 8.3% (±1.6%) of culverts. These are culverts where at least one load-rated segment in the culvert structure "fails" Level 1 and Level 3. The recommendation is to stratify the failing segments by OR group and proceed with further evaluation as follows.

- Subgroup 2.1 (Level 3 IR < HS20, HS10 ≤ Level 3 OR < HS20): –The recommendation is to pursue further culvert segment-specific load rating efforts as appropriate:
    - Option A. Obtain culvert-specific soil, structure and pavement properties and re-run Level 3 analysis based on these "better" data. Accept "passing" results and place documentation in the file. Otherwise, see Option 2.1.B.

- Option B. Use culvert-specific soil, structure and pavement properties from Option A and re-run analysis using more sophisticated (3D) demand modeling approaches. Accept “passing” results and place documentation in the file. Otherwise, see Category 2.1.C.

- Option C. Accept “failing” results from prior analyses and place documentation in the file. Load post structure. Otherwise, see Category 2.2.

- Subgroup 2.2 (Level 3 IR/OR < HS10): –The recommendation is to pursue further culvert segment-specific load rating efforts as appropriate:

  - Option A. Perform field load test to establish approved load rating. Accept “passing” results and place documentation in the file. Otherwise, see Option 2.2.B.

  - Option B. Accept “failing” results from prior analyses. Design corrective measures (repair, rehabilitation) and implement to achieve “passing” results. Place documentation in the file. Otherwise, see Category 2.2.C.

  - Option C. Accept “failing” results from prior analyses and place documentation in the file. Load post structure if allowed. Otherwise, see Category 2.2D.

  - Option D. Accept “failing” results from prior analyses and place documentation in the file. Close bridge or replace.

The recommended actions should formally resolve the load rating requirements for all structures within this category.

11.4.5 Comments on the Results and Recommendations

The load rating results and recommendations presented herein apply directly to Batch 1 culverts which are a sample of TxDOT’s larger population of pre-1980 culvert structures. The margin of error for all performance rates provides an indication of the extent to which findings for the sample generalize to the population.

One of the basic premises upon which this research study was performed is that TxDOT’s culvert population is *performing* satisfactorily, and the structural condition rating data for TxDOT’s culvert population (Figure 11.8) attest to the validity of this statement. Stated more emphatically, TxDOT has not apprised the research team of any in-service culvert (*not* one) that is performing poorly such that it failed. However, during the history of this project we have been informed of roadway rehabilitation projects where original culvert segments that did not rate well had to be fully replaced, even though the existing culvert segments appeared – in the words of the load rating engineer – in “pristine” condition.

A second premise of this research study is that culvert load ratings *must* be conservative; however, ratings should not be *excessively* conservative as this can lead to costly and unwarranted load posting, repair or replacement. Further, measured culvert performance data show an inverse relationship between the sophistication of demand modeling and the level of conservatism in the calculated rating values – that is, more sophisticated modeling (e.g., Level 3) yields less conservative (yet more accurate and precise) ratings than the basic approaches (e.g. Level 1). Taken together (as noted in Chapter 2), when the load rating analysis for a serviceable culvert shows a disconnect between observed structural performance (good) and the calculated load rating value (low), the problem is likely with excess conservatism in the predictive model, not the structural performance of the culvert, other things being equal. This provides the analytical basis for the load rating and load posting recommendations presented herein. The goal is not simply for the load rating engineer to keep trying different approaches until s/he gets an answer s/he wants. It does no one any good to mislabel poor culverts with high load ratings. Rather, the engineer is admonished not to accept *excessively* conservative (low) load ratings when more valid – that is, more accurate and precise – ratings may be obtained based on further, rational load rating effort. That is the approach advocated in this report.

11.5 CULVERT RESULTS SUMMARY

This chapter presents summary results and analysis of load rating work for 1,000 culverts which are statistically representative of TxDOT’s population of on-system, bridge-class, pre-1980, cast-in-place, reinforced concrete box culvert structures. These are aggregated load rating data at the culvert structure level where the lowest rating from all segments that make up a culvert is the *controlling* load rating for the structure.

The outcome of load rating effort can be viewed from the perspective of whether a culvert would require load posting as per guidance from TxDOT’s *Bridge Inspection Manual*. By this standard, 82.0% (±2.3%) of culverts *do not* require load posting, either because all segments rate sufficiently high by calculation or because an HS20 rating can be assigned per FHWA policy. A total of 8.3% (±1.6%) of culverts have one or more segments with Level 3 ratings at varying degrees *below* HS20 (plus the possibility of undetermined segments), and this category will require some type of administrative action such as further analysis, repair, rehabilitation, load posting, or replacement. A third category which accounts for 9.7% (±1.7%) of culverts is comprised of structures having one or more non-rated segments but where all rated segments pass. These structures also will require some type of administrative action such as further analysis, repair, rehabilitation, load posting, or replacement.

CHAPTER 12
SUMMARY AND CONCLUSIONS

12.1 OVERVIEW

This report has presented research findings associated with performing load-rating calculations and analyses for 1,000 culvert structures (Batch 1) which constitute a statistically-representative sample of Texas Department of Transportation (TxDOT) pre-1980, on-system, bridge-class, cast-in-place, reinforced concrete box culverts. The findings are centered around three key themes: (1) the introduction and validation of several enhancements to the Level 3 culvert rating analysis model in order to improve load rating accuracy and precision, (2) establishing an improved procedure for culvert load rating based on lessons learned from working through the trial set of load ratings for Batch 1, and (3) publishing Level 1 and Level 3 culvert load rating results for the 1,000 Batch 1 culverts to reflect the enhanced model and improved load rating process.

12.2 KEY FINDINGS

12.2.1 Enhancements to the Level 3 Culvert Rating Analysis Model

This study invested extensive effort in order to identify, specify and evaluate enhancements to the Level 3 (*i.e*., soil-structure interaction) model used to calculate moment demands for load rating purposes. Model enhancements included (a) the introduction of depth-calibrated live-load attenuation, (b) revised interior wall joint fixity, (c) use of a reduced effective moment of inertia, (d) the addition of nominal pavement stiffness, and (e) refinements to the soil stiffness model. Research effort focused on identifying and specifying the enhancements, testing the impact of each enhancement on load rating by performing a detailed parametric study for a sample of TxDOT's culvert population, and externally validating the results where possible by comparing predicted performance against measured data obtained from field load tests. The outcome was an appropriately-calibrated – that is to say, "tuned up" – model with improved validity (*i.e*., accuracy and precision) that avoids both unfounded *high* load ratings that might lead to premature structure deterioration/ failure and unwarranted *low* ratings that might lead to unnecessary structure replacements/ upgrades.

12.2.2 Improved Procedure for Culvert Load Rating

Approved load rating outcomes derive not only from the load rating *model* but also from the load rating *process*. Therefore, research effort was directed at improving the validity of the load rating process as well. Because the scope of this research study considered TxDOT's full population of thousands of culvert structures, this project viewed the load rating problem at the *system level* as opposed to typical practice which focuses on a specific structure. The system-level approach revealed issues, challenges, and questions which were otherwise not readily apparent. From this effort, the research team established an improved procedure for culvert load rating informed by the many lessons learned from working through the trial set of load ratings for TxDOT's Batch 1 culverts. Documentation of the improved load rating process addressed document capture, data capture, segment interpretation, design identification, Level 1 load rating, Level 3 load rating, and reporting.

12.2.3 Load Rating Results for Segments

Having tuned up the culvert rating model and updated the culvert rating process, the next step was to perform load rating calculations for 1,000 Batch 1 culverts, by segment, in order to determine the load ratings. Load rating computations were performed at the *segment* level, and the lowest rating from all segments that make up a culvert was the *controlling* load rating for the structure. Because rating data for individual segments most clearly tell the story of culvert performance, the segment-level results are presented first.

For the 1,000 Batch 1 culverts, a total of 1,788 segments were identified for an average of 1.8 segments per culvert. These results can be grouped into three categories. The first category, comprising 85.7% (±2.1%) of culvert segments, rated sufficiently high such that they *do not* require load posting. This category includes segments having a Level 3 IR ≥ HS20 or a Level 3 OR ≥ HS20, plus segments that were designed for HS20 loading and constructed post-1979 such that an HS20 rating can be *assigned* per FHWA policy. The second category totals 5.3% (±1.3%) and consisted of culvert segments having Level 3 ratings *below* HS20. If these ratings were deemed "final," such segments would require some type of action such as more refined analysis, or possibly repair, rehabilitation, load posting, or replacement. The third category totals 9.0% (±1.7%) and is comprised of segments which were not load rated for various reasons. Most of these non-rated segments were expansions slabs which were not amenable to load rating with the box-culvert-specific CULVLR software employed for this study. Likewise, other segments consisted of geometric designs such as circular pipes, three-sided structures, etc., which also could not be rated using the CULVLR software. The remaining segments in this non-rated category (2.0%±0.8%) did not have designs provided, specified, or associated.

The research effort indicated that Level 3 load ratings based on the tuned up soil structure interaction model incorporated less *excess* conservatism than Level 1 ratings based on a direct stiffness structural frame model. In other words, the Level 3 ratings were more accurate and precise than the Level 1 ratings, other things being equal. Of the 1,385 segments for which load rating calculations were performed, 22.0% (±2.4%) of rated segments showed Level 1 OR ≥ HS20 whereas 93.2% (±1.5%) showed Level 3 OR ≥ HS20. These results emphasize the benefit that may be realized by using the appropriately-calibrated, production-simplified, soil structure interaction (Level 3) demand model for load rating.

12.2.4 Load Rating Results for Culverts

It is consistent with national policy to think about culverts as structures and to present load rating results accordingly. Another reason for focusing on culverts as structures is this is the level where TxDOT makes administrative decisions about culverts, and where actions are taken – *e.g.*, load posting is done for culvert *structures*, as are repairs and rehabilitation, etc. So, even though structure-level results are aggregated from segment-level data, it is important to present load rating results at the *structure* level.

The structure-level load rating results for the 1,000 Batch 1 culverts can be characterized as being in one of three categories. The first category accounts for 82.0% (±2.3%) of culverts and consists of those structures with load ratings that are considered *"passing"* because all segments have a Level 1/ Level 3 OR greater than or equal to HS20 such that the structure does not require load-posting. The second category accounts for 8.3% (±1.6%) of culverts and indicates culvert load ratings that may be considered *"failing"* because all segments *do not* have a Level 3 OR greater than or equal to HS20. Thus this culvert would be subject to load posting or other administrative action. The third group accounts for 9.7% (±1.7%) of culverts and is comprised of culverts with non-rated segments. Here, because load rating calculations have not been performed for all segments, the culvert structure load rating is as yet "undetermined."

Viewed from a high-level perspective, the percentage of TxDOT's population of 10,829 on-system, bridge-class, pre-1980, cast-in-place, reinforced concrete box culverts which *do not* require load posting (*i.e.*, can be said to "pass") ranges from a lower bound 82.0% ±2.3% to an upper bound 91.7% ±1.6%, depending on the assumptions made for various classes of non-rated segments. The first category of culverts – *i.e.*, the "passing" culvert structures – essentially require no further action relative to load rating analysis, load posting, or repair/ rehabilitation. The second category of culverts – *i.e.*, culvert structures where at least one load-rated segment in the culvert structure "failed" Level 1 and Level 3 – will require that the failing segments be stratified by operating rating group and further evaluated. Additional culvert segment-specific load rating efforts might include strategies such as obtaining culvert-specific soil, structure and pavement properties and re-running the Level 3 analysis, performing more sophisticated (3D) demand modeling, performing field load tests, designing corrective measures (repair, rehabilitation), load-posting the structure, or closing or replacing the bridge. The third category of culverts – *i.e.*, culvert structures having non-rated segments but where all rated segments pass – will require action to resolve the missing ratings. Strategies might include locating missing design documents, adjudicating segments with missing design documents as "passing" based on FHWA policy for assigned ratings, performing load rating calculations for expansion slab segments, and performing load rating calculations for segments with a non-box geometry not amenable to rating using CULVLR. These actions should formally resolve the "undetermined" status for the all structures within this category.

12.3 LIMITATIONS

12.3.1 Research Limitations

The load-rating philosophy advocated and implemented in this study has been for the engineer not to accept *excessively* conservative (low) or *unusually* optimistic (high) load ratings when more valid – that is, more accurate and precise – ratings may be obtained based on further, rational load rating effort. This philosophy guided the extensive efforts reported herein to calibrate the Level 3 load rating model and to improve the load-rating process. The following limitations are noted:

1) This research study was authorized with the goal to specifically focus on load rating for TxDOT's population of on-system, bridge-class, pre-1980, culverts, over 97% of which are cast-in-place reinforced concrete boxes. This study does not directly consider alternative culvert geometries such as pipes, arches, ellipses, etc. nor does it consider alternative culvert materials such as pre-cast concrete, metal, or plastic.

2) The load ratings reported herein are based on the Load Factor Rating (LFR) approach. This is as opposed to the Allowable Stress Rating (ASR) and the Load and Resistance Factor Rating (LRFR) approaches, both of which are also mentioned in AASHTO policy. This study does not address the ASR or LRFR approaches.

3) All load ratings reported herein were determined based on the standard HS20 truck load as per AASHTO policy. Load ratings do not reflect the breadth of axle load or loading patterns possible with the HL93 live load model, specialized hauling vehicles, or other types of truck loads.

4) This research study gives priority to production-simplified approaches to culvert load rating, namely, the Level 1 approach (simply-supported structural frame model) and the Level 3 approach (linear-elastic finite element soil-structure interaction model). This study recognizes that simpler approaches such as empirical formulas exist which can quickly produce load ratings. Likewise, more sophisticated, research-intensive approaches exist which may provide more accurate and precise results. But the focus on the Level 1 and Level 3 production-simplified approaches represented an overt attempt to balance the sophistication of analysis and the required computational effort.

5) Much research effort was focused on calibrating – *i.e.*, "tuning up" – the Level 3 soil-structure interaction model for culvert load rating. This not only included literature reviews and parametric studies, but where possible, the researchers externally validated findings based on comparison of predicted and measured demands using data collected from four field load tests performed on three TxDOT culverts in 2009-2010. While these load test data are appropriate for such purposes, they are limited to the three, in-service box culverts identified.

6) TxDOT's culvert inventory has been constructed using design standards which cover six fairly distinct eras: 1) early standards, 2) pre-WWII standards, 3) Interstate Highway standards, 4) modernized Interstate Highway standards, 5) 2003 design standards, and 6) 2014 design standards. While the findings of this study can be generalized to other states having an inventory of reinforced concrete box culverts, the specific findings of this study are integrally associated with the TxDOT culvert design standards.

7) The 1,000 'Batch 1' culvert structures were selected to provide a statistically-representative sample from which valid inferences could be drawn relative to TxDOT's entire population of on-system, bridge-class, pre-1980, cast-in-place, reinforced concrete box culverts. Every performance rate that was calculated for Batch 1 has a *margin of error* associated with it that is given by a 95% confidence interval when applied to the population.

12.3.2 Limitations of Published Load Rating Values

One of the outcomes of this study was to publish Level 1 and Level 3 load ratings for 1,000 Batch 1 culvert structures. The following limitations associated with these load ratings are noted:

1) The load rating summary reports for Batch 1 culverts, totaling approximately 7,600 pages, were submitted digitally as Product P1 and Product P2. These summary reports comprise the load rating results for this study. Calculations in support of the load rating summary reports are maintained in the research project file. Appendix A and Appendix B, included in this report, provide tabulated load rating values extracted from the summary reports.

2) Level 1 load rating values reflect structural analysis and demand modeling using TxDOT's CULV5 program, which uses a simply-supported structural frame model. Level 1 load ratings were performed generally as described in the TxDOT *Culvert Rating Guide (2009)* and were implemented using TxDOT's culvert load rating program, CULVLR (2013). Program and procedural updates are as noted in this report.

3) Level 3 load rating values reflect structural analysis and demand modeling using RISA 3D software, which uses a linear-elastic finite element soil-structure model. Level 3 load ratings were performed generally as described in the TxDOT *Culvert Rating Guide (2009)* and were implemented using TxDOT's culvert load rating program, CULVLR (2013). Program and procedural updates are as noted in *this* report, and it is emphasized that the Level 3 demand model was <u>extensively</u> updated and revised for this study.

4) Each load rating summary report reflects the review, classification and interpretation of culvert documents provided in the *digital* culvert file or from other *digital* databases such TxDOT's Pavement Management Information System or the USNRCS web soil survey. In no case was the research team provided with project-specific, hard-copy culvert documents. In no case did the research team obtain contemporary, project-specific field data for soil, pavement, structural materials or other culvert properties.

5) The reported load rating values are based on parameters obtained from TxDOT's design standards – either provided, specified or associated –so the results incorporate and reflect the default assumptions associated with the designs. Design data were not modified to reflect structure-specific flaws or defects that may have been noted in structural inspection reports.

6) The load rating calculations assumed fully-drained backfill soils, and did not directly account for the hydrostatic loads associated with undrained or partially-drained backfill.

7) Reported load ratings are subject to the limitations of the analytical methods and are not intended to supersede the independent professional judgment of load rating engineers who perform physical inspection of in-service culvert structures.

8) The work associated with this study was performed over a 25-month period by a team of approximately seven to nine faculty, one to two research associates, four to twelve graduate students, ten to sixty undergraduate students, plus other support personnel. Given the scope of the project – including 10,829 culvert structures which were the focus of this study and the millions of parameters associated with the culvert data files – the potential for variance in the form of errors, missed data, and inconsistent interpretation was recognized. Steps to achieve repeatable, reliable, high-quality data and results included project orientation, documentation, development of specifications and procedures, ongoing training and instruction, data review, formal quality control checks, and periodic quality assurance review.

Collectively, these limitations provide a context for interpreting the research results and generalizing the results to other states and to other culvert inventories.

12.4 RECOMENDATIONS FOR FURTHER STUDY

This study has significantly advanced the load rating model, the load rating process and the load rating evaluation of TxDOT's inventory of pre-1980 bridge-class culvert structures. While much has been learned, much remains that can be done. Areas for further research include the following.

1) <u>Update TxDOT's culvert rating tools</u>. This study started with the *Culvert Rating Guide* (2009) and CULVLR version 1.0 (2013). Viewed in terms of the findings of this study, both the *Culvert Rating Guide* and the CULVLR software now require significant updating to document and incorporate the improvements and enhancements.

2) <u>Explore the influence of alternative truck loads</u>. This study presents load ratings based on standard HS20 truck loads. However, in-service culverts may experience alternative truck loads such as specialized hauling vehicles or HL93 loads which are permitted by the federal bridge formula but are more intense than HS20 loading. The influence of such loads represents an appropriate follow-on study, both analytically and experimentally.

3) <u>Strengthen TxDOT's culvert load test dataset</u>. Current validation of measured vs. predicted models sources to four full-scale field load tests on three in-service culvert structures. While these data are invaluable, the present study has dramatically increased our knowledge and understanding of TxDOT's culvert inventory as well as highlighted the key issues associated with culvert performance. Additional full-scale load tests would be beneficial toward more robustly representing TxDOT's culvert inventory. Such studies can help address detailed modeling questions for out-of-plane live-load attenuation, dead load soil stiffness, and effective moment of inertia, to name a few.

Further, such a study can be used to develop guidelines, procedures, and protocol for performing field live load tests to load-rate culverts.

4) Refine culvert rating parameters. Incremental improvement in culvert load rating values can possibly be realized based on detailed study of key rating parameters including reinforcing steel yield strength, concrete compressive strength, soil stiffness, and others. Field and analytical studies can help define and quantify the range and variation of such parameters, as well as their likely influence.

5) Investigate broader culvert rating questions. Advances in geotechnical/ structural software are such that the specification, calibration and use of more sophisticated culvert soil-structure models can be explored. Further, it is appropriate to study the policy, application, specification and possible calibration of the LRFR approach currently required by AASHTO. The field load test experimental work identified above (item 3) could be designed to support this effort.

6) Establish best practices for strengthening the capacity of culverts that do not rate. Some culvert structures will not rate, and these must be load-posted, repaired, or possibly replaced. Technical guidance, approved methods, procedures, and recommendations for strengthening or repairing a culvert segment to achieve the desired level of structural capacity should be developed. The place to start is with best practices per the literature, and this information can be augmented with tailored field and experimental research as necessary.

7) Improve TxDOT's structural inspection process. One practical application of the findings of this study would be to develop policy that requires quadrennial structural inspections of bridge-class culverts to begin with an interpretation of the culvert history and segment identification. Inspection should then proceed within the context of the identified segments. The inspection process can possibly be further enhanced by the use of drones to capture detailed 360-degree video of the entire culvert interior. Research can help develop such improved inspection procedures.

One observation supported by the ten-year process of performing culvert load rating research for TxDOT is that load rating policy, procedure, methods and tools continually develop, grow and change. Further, TxDOT's sizable inventory of reinforced concrete box culverts suggests that broader, national-level research studies about culvert load rating will not necessarily address the specific questions that TxDOT faces. The recommendations for further research have been developed with these thoughts in mind, as these represent some of the present and not-so-distant future issues about culvert load rating in Texas.

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APPENDIX A

Summary of

CULVERT SEGMENT

Load Rating Results

TABLE A
Summary Load Rating Results
for
1,788 Segments/ 1,000 Batch 1 Culverts

TABLE A: Column identification and data dictionary

Column No.	Column Label	Column Description
1	No	Record locator for load-rated culvert segment (1,000 culvert sample)
2	Structure No	National Bridge Inventory structure number for load- rated culvert
3	Segment ID	Segment identification for load-rated culvert segment
4	District	TxDOT District in which culvert segment is located
5	County	Texas County in which culvert segment is located
6	Interpreted Parameter Score	Relative data quality score assigned to the load rating parameters for the culvert segment: 5 = excellent, 4 = very good, 3 = fair, 2 = poor, 1 = very poor
7	Design Selection Score	Relative data quality score assigned to the design selected for the culvert segment: 5 = excellent, 4 = very good, 3 = fair, 2 = poor, 1 = very poor
8	Design Class	Design classification category for the culvert segment: Provided = design provided in the culvert documentation; Specified = design identified in the culvert documentation; Associated = design associated based on culvert parameters
9	Design Name	Name of the TxDOT culvert design standard used to construct the culvert segment
10	Critical Cover Soil Depth	Thickness of cover soil above the top slab of the culvert segment, inclusive of both soil and pavement; the critical value is the specific thickness of cover soil within the range of cover soil that yields the lowest load rating based on a structural frame (Level 1) demand analysis
11	Soil Type	The resilient modulus of soil used for live load demand analysis based on a linear-elastic constitutive soil model: Low = 12,000psi; Medium = 24,000psi; High – 36,000 psi
12	Pavement	Type of pavement as determined by the TxDOT Pavement Management Information Systerm (PMIS)
13	HS20 Lvl1 ORF	Operating rating factor associated with HS20 vehicle load for the approved analysis condition, calculated using a structural frame (Level 1) demand model
14	HS20 Lvl3 ORF	Operating rating factor associated with HS20 vehicle load for the approved analysis condition, calculated using a soil-structure interaction (Level 3) demand model
15	Lvl3 Controlling Critical Section	Cross-section of the culvert segment having the lowest operating rating factor associated with HS20 vehicle load for the approved analysis condition, determined per a soil-structure interaction (Level 3) demand model
16	Lvl3 Failure Mode	Failure mode associated with the HS20 operating rating factor for the approved analysis condition, determined per a soil-structure interaction (Level 3) demand model: M= moment, V = shear, P = axial thrust
17	Lvl3 Fixity	Joint fixity condition of the controlling critical section for the approved analysis condition, determined per a soil-structure interaction (Level 3) demand model: FIX = member fully fixed against rotation, PIN = member allowed to freely rotate
18	Lvl3 Load Posting Class	Load posting classification per TxDOT Bridge Inspection policy; calculated based on Level 3 (soil structure interaction) operating rating and inventory rating: RT = RF * 20 tons (specific to HS-20 truck load)

TABLE A: Summary Load Rating Results for 1,788 Segments/ 1,000 Culverts

No	Structure No	Segment ID	District	County	Interpreted Parameter Score	Design Selection Score	Design Class	Design Name	Critical Cover Soil Depth	Soil Type	Pavement	HS20 Lvl1 ORF	HS20 Lvl3 ORF	Lvl3 Controlling Critical Section	Lvl3 Failure Mode	Lvl3 Fixity	Lvl3 Load Posting Class
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
1	10600073501016	1 Org 1954 2-10x8 T	Paris	Delta	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.562	1.191	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
2	10600073501016	2 Wid 1959 2-10x8 T	Paris	Delta	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.562	1.191	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
3	10750004505032	1 Org 1933 6-5x5 T	Paris	Fannin	3.8	3.5	Associated	MBC-#	4.0	Low Stiffness	5 Int. ACP (2.5-5in.)	3.278	6.743	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
4	10750004505032	2 Wid 1974 6-5x5 T	Paris	Fannin	3.8	3.3	Associated	MC#-# 1949-1977	4.0	Low Stiffness	5 Int. ACP (2.5-5in.)	2.532	4.976	Bottom Corner	M	PIN	1: IR>=HS20, OR> HS20
5	10750017404023	1 Org 1952 5-8x4 T	Paris	Fannin	3.8	3.5	Associated	MC#-# 1949-1977	1.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.376	0.795	Wall Exterior Top	M	PIN	3: IR< HS20, OR> HS10
6	10750017404023	2 Wid 1994 5-8x4 T	Paris	Fannin	--	--	--	--	--	Low Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Post-1979
7	10750020203039	1 Org 1943 3-5x3 T	Paris	Fannin	3.0	2.5	Associated	MBC-#-#(-F)	2.0	Low Stiffness	9 Overlaid Flexible	0.785	3.942	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
8	10750020203039	2 Wid 1997 3-5x3 T	Paris	Fannin	--	--	--	--	--	Low Stiffness	9 Overlaid Flexible	--	--	--	--	--	NLR: Post-1979
9	10750027904013	1 Org 1936 3-5x4 T	Paris	Fannin	3.8	1.0	Associated	MBC-#	1.5	Low Stiffness	5 Int. ACP (2.5-5in.)	0.832	2.966	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
10	10750051005011	1 Org 1960 7-9x5 T	Paris	Fannin	3.8	2.5	Associated	MC#-# 1949-1977	0.5	Low Stiffness	10 Seal Coat or Surf. Tmt	0.530	0.883	Wall Exterior Top	M	PIN	3: IR< HS20, OR> HS10
11	10750054902017	1 Org 1962 5-6x6 T	Paris	Fannin	3.0	2.8	Associated	MC#-# 1949-1977	3.0	Low Stiffness	9 Overlaid Flexible	1.471	3.601	Bottom Corner	M	PIN	1: IR>=HS20, OR> HS20
12	10750054902017	2 Wid 2002 5-6x6 T	Paris	Fannin	--	--	--	--	--	Low Stiffness	9 Overlaid Flexible	--	--	--	--	--	NLR: Post-1979
13	10750170802005	1 Org 1954 2-10x10 T	Paris	Fannin	3.8	3.0	Associated	MBC-#	2.0	Low Stiffness	10 Seal Coat or Surf. Tmt	1.599	4.384	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
14	10750197901001	1 Org 1956 4-10x6 E	Paris	Fannin	4.3	4.5	Specified	MC#-# 1949-1977	2.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.507	1.410	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
15	10750197901001	2 Exp 1956 1-10x6 E	Paris	Fannin	--	--	--	--	--	Low Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Expansion slab
16	10810001004084	1 Org 1942 4-10x7 T	Paris	Franklin	5.0	5.0	Provided	MBC-#-#(-F)	1.0	Medium Stiffness	8 Overlaid Concrete	0.805	14.196	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
17	10810001005066	1 Org 1936 4-6x4 T	Paris	Franklin	5.0	5.0	Provided	MBC ##-##	1.0	Medium Stiffness	8 Overlaid Concrete	0.575	8.808	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
18	10810001005066	2 Wid 1954 4-6x4 T	Paris	Franklin	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	8 Overlaid Concrete	0.569	5.279	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
19	10810273102001	1 Org 1977 3-10x10 T	Paris	Franklin	5.0	5.0	Provided	MC#-# 1949-1977	3.0	Medium Stiffness	6 Thin ACP (<2.5in.)	1.412	4.910	Top Corner	V	PIN	1: IR>=HS20, OR> HS20
20	10920004504018	1 Org 1930 2-10x14 T	Paris	Grayson	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: No standard design
21	10920004504018	2 Wid 1955 2-10x10 T	Paris	Grayson	3.8	4.0	Associated	MC#-# 1949-1977	5.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.660	4.654	Wall Exterior Bottom	M	PIN	1: IR>=HS20, OR> HS20
22	10920004701008	1 Org 1930 4-6x6 T	Paris	Grayson	3.8	3.8	Associated	MBC-#	4.0	High Stiffness	5 Int. ACP (2.5-5in.)	2.883	11.337	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
23	10920004701008	2 Wid 1943 4-6x6 T	Paris	Grayson	3.8	3.5	Associated	MBC-#	4.0	High Stiffness	5 Int. ACP (2.5-5in.)	2.883	11.337	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
24	10920008107089	1 Org 1966 3-7x3 T	Paris	Grayson	3.8	3.5	Associated	MC#-# 1949-1977	1.0	Low Stiffness	9 Overlaid Flexible	0.422	1.398	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
25	10920031602004	1 Org 1930 4-10x10 T	Paris	Grayson	3.8	3.5	Associated	MBC-#	3.0	Medium Stiffness	8 Overlaid Concrete	1.817	10.123	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
26	10920031602004	2 Org 1960 4-10x10 T	Paris	Grayson	3.8	3.0	Associated	MC#-# 1949-1977	3.0	Medium Stiffness	8 Overlaid Concrete	0.616	5.414	Wall Exterior Bottom	M	PIN	1: IR>=HS20, OR> HS20
27	10920041002007	1 Oth 1930 3-10x14 T	Paris	Grayson	--	--	--	--	--	Low Stiffness	8 Overlaid Concrete	--	--	--	--	--	NLR: Geometry outside sc
28	10920041002007	2 Wid 1967 3-10x10 T	Paris	Grayson	3.0	1.8	Associated	MC#-# 1949-1977	4.0	Low Stiffness	8 Overlaid Concrete	0.887	3.100	Wall Exterior Bottom	M	PIN	1: IR>=HS20, OR> HS20
29	10920041002007	3 Wid 1967 3-10x10 T	Paris	Grayson	3.3	3.0	Associated	MC#-# 1949-1977	4.0	Low Stiffness	8 Overlaid Concrete	0.887	3.100	Wall Exterior Bottom	M	PIN	1: IR>=HS20, OR> HS20
30	10920051001005	1 Org 1954 3-9x9 T	Paris	Grayson	3.8	3.3	Associated	MC#-# 1949-1977	2.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.749	1.914	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
31	10920072803004	1 Org 1954 2-10x9 T	Paris	Grayson	3.8	3.5	Associated	MC#-# 1949-1977	4.5	Low Stiffness	6 Thin ACP (<2.5in.)	1.112	2.221	Wall Exterior Bottom	M	FIX	1: IR>=HS20, OR> HS20
32	10920072803004	2 Wid 2002 2-10x9 T	Paris	Grayson	--	--	--	--	--	Low Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Post-1979
33	11130001003013	1 Org 1925 2-10x8 T	Paris	Hopkins	5.0	5.0	Provided	MBC-#	1.0	Medium Stiffness	8 Overlaid Concrete	0.952	7.700	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
34	11130001003013	2 Wid 1952 2-10x8 T	Paris	Hopkins	3.8	3.0	Associated	MBC-#	1.0	Medium Stiffness	8 Overlaid Concrete	1.175	7.110	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
35	11130008302041	1 Org 1954 2-10x8 J	Paris	Hopkins	3.8	3.3	Associated	MC#-# 1949-1977	3.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.859	4.173	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
36	11130008302041	2 Oth 1954 2-10x10 J	Paris	Hopkins	--	--	--	--	--	Medium Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Geometry outside sc
37	11130008302041	3 Org 1954 1-10x8 J	Paris	Hopkins	3.8	2.5	Associated	MC#-# 1949-1977	3.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.859	4.173	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
38	11130008302041	4 Wid 2010 2-10x8 J	Paris	Hopkins	--	--	--	--	--	Medium Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
39	11130008302041	5 Oth 2010 2-10x10 J	Paris	Hopkins	--	--	--	--	--	Medium Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Geometry outside sc
40	11130008302041	6 Wid 2010 1-10x8 J	Paris	Hopkins	--	--	--	--	--	Medium Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
41	11130008303013	1 Org 1934 7-9x7 T	Paris	Hopkins	3.8	2.8	Associated	MBC-#	0.5	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.490	1.954	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
42	11130008303013	2 Wid 1957 7-9x7 T	Paris	Hopkins	3.8	2.5	Associated	MBC-#	0.5	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.622	2.328	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
43	11130008303013	3 Wid 2007 7-9x7 T	Paris	Hopkins	--	--	--	--	--	Medium Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
44	11130010809039	1 Org 1942 3-6x6 T	Paris	Hopkins	3.0	2.5	Associated	MBC-#-#(-F)	6.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	2.698	6.741	Wall Interior Bottom	M	PIN	1: IR>=HS20, OR> HS20
45	11130010809039	2 Wid 1969 3-6x6 T	Paris	Hopkins	3.8	3.0	Associated	MC#-# 1949-1977	6.5	Medium Stiffness	5 Int. ACP (2.5-5in.)	1.506	4.704	Bottom Corner	M	FIX	1: IR>=HS20, OR> HS20
46	11130040002024	1 Org 1964 10-10x8 T	Paris	Hopkins	3.8	2.5	Associated	MC#-# 1949-1977	0.5	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.590	1.292	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
47	11130054604005	1 Org 1950 4-6x6 T	Paris	Hopkins	3.8	3.0	Associated	MBC ##-##	5.0	Low Stiffness	5 Int. ACP (2.5-5in.)	2.157	5.349	Wall Exterior Bottom	M	PIN	1: IR>=HS20, OR> HS20
48	11130061001001	1 Org 1962 3-6x6 T	Paris	Hopkins	3.8	2.8	Associated	MC#-# 1949-1977	5.5	Medium Stiffness	6 Thin ACP (<2.5in.)	1.585	4.893	Top Corner	V	FIX	1: IR>=HS20, OR> HS20
49	11130061001030	1 Org 1963 3-6x4 T	Paris	Hopkins	5.0	5.0	Provided	MC#-# 1949-1977	3.0	Low Stiffness	5 Int. ACP (2.5-5in.)	1.165	3.376	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
50	11130064104015	1 Org 1955 4-10x10 T	Paris	Hopkins	3.8	3.0	Associated	MBC-#	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	1.605	4.682	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
51	11130253801002	1 Org 1963 3-9x9 T	Paris	Hopkins	3.5	3.5	Associated	MC#-# 1949-1977	1.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.631	1.569	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
52	11130314403001	1 Org 1969 3-8x6 T	Paris	Hopkins	3.8	3.0	Associated	MC#-# 1949-1977	2.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.683	2.543	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
53	11170000913105	1 Org 1950 2-10x9 T	Paris	Hunt	3.8	3.0	Associated	MBC-#-#(-F)	2.0	Low Stiffness	6 Thin ACP (<2.5in.)	0.958	3.047	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
54	11170000913222	1 Org 1960 2-8x6 T	Paris	Hunt	3.8	2.5	Associated	MC#-# 1949-1977	2.0	Low Stiffness	6 Thin ACP (<2.5in.)	0.713	1.973	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
55	11170013601075	1 Org 1957 2-10x5 J	Paris	Hunt	3.0	2.0	Associated	MC#-# 1949-1977	2.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.534	1.766	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
56	11170013601075	2 Wid 1976 2-10x5 J	Paris	Hunt	3.8	2.0	Associated	MC#-# 1949-1977	2.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.534	1.766	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
57	11170013601075	3 Add 1976 1-10x7 J	Paris	Hunt	3.8	3.0	Associated	SC- N	2.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.630	2.489	Wall Exterior Top	M	FIX	1: IR>=HS20, OR> HS20

TABLE A: Summary Load Rating Results for 1,788 Segments/ 1,000 Culverts

No	Structure No	Segment ID	District	County	Interpreted Parameter Score	Design Selection Score	Design Class	Design Name	Critical Cover Soil Depth	Soil Type	Pavement	HS20 Lvl1 ORF	HS20 Lvl3 ORF	Lvl3 Controlling Critical Section	Lvl3 Failure Mode	Lvl3 Fixity	Lvl3 Load Posting Class
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
58	11170020210031	1 Org 1966 2-8x8 T	Paris	Hunt	3.8	2.5	Associated	MC#-# 1949-1977	2.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.833	2.396	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
59	11170172501004	1 Org 1954 4-8x8 T	Paris	Hunt	3.8	3.0	Associated	MBC-#	2.0	Low Stiffness	6 Thin ACP (<2.5in.)	1.579	4.674	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
60	11170265801001	1 Org 1963 3-6x3 T	Paris	Hunt	3.8	4.0	Associated	MC#-# 1949-1977	2.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.688	2.118	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
61	11390022101006	1 Org 1934 3-10x10 T	Paris	Lamar	3.8	3.0	Associated	MBC-#	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.472	2.094	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
62	11390022101006	2 Wid 1959 3-10x10 T	Paris	Lamar	3.8	3.0	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.367	1.561	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
63	11390043501019	1 Org 1962 2-10x10 T	Paris	Lamar	5.0	5.0	Provided	MC#-# 1949-1977	2.5	Low Stiffness	6 Thin ACP (<2.5in.)	0.523	2.838	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
64	11390073002016	1 Org 1954 4-6x6 T	Paris	Lamar	3.8	2.8	Associated	MC#-# 1949-1977	4.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	1.795	4.010	Bottom Corner	M	FIX	1: IR>=HS20, OR> HS20
65	11390073002016	2 Wid 1980 4-6x6 T	Paris	Lamar	--	--	--	--	--	Medium Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
66	11390073002016	3 Wid 1998 4-6x6 T	Paris	Lamar	--	--	--	--	--	Medium Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
67	11390074902024	1 Org 1949 4-6x4 T	Paris	Lamar	3.0	1.8	Associated	MC#-# 1949-1977	3.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.944	2.390	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
68	11390074902024	2 Wid 1963 4-6x4 T	Paris	Lamar	3.8	3.3	Associated	MC#-# 1949-1977	3.0	Low Stiffness	10 Seal Coat or Surf. Tmt	1.177	2.984	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
69	11390076901005	1 Org 1953 3-8x7 T	Paris	Lamar	3.8	4.0	Associated	MC#-# 1949-1977	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.475	1.523	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
70	11390076901005	2 Wid 2010 3-8x7 T	Paris	Lamar	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Post-1979
71	11390169001002	1 Org 1959 3-9x9 T	Paris	Lamar	3.8	3.0	Associated	MC#-# 1949-1977	3.0	Low Stiffness	2 JRCP	0.807	2.132	Wall Exterior Bottom	M	FIX	1: IR>=HS20, OR> HS20
72	11390169001002	2 Wid 1978 3-9x9 T	Paris	Lamar	3.8	2.8	Associated	MC#-# 1949-1977	3.0	Low Stiffness	2 JRCP	1.454	6.380	Top Corner	V	PIN	1: IR>=HS20, OR> HS20
73	11900020304029	1 Org 1962 2-10x9 T	Paris	Rains	3.8	3.5	Associated	MC#-# 1949-1977	1.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.612	1.592	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
74	11900184903002	1 Org 1955 5-8x5 T	Paris	Rains	3.0	2.3	Associated	MC#-# 1949-1977	5.0	Medium Stiffness	6 Thin ACP (<2.5in.)	1.431	6.340	Top Corner	V	PIN	1: IR>=HS20, OR> HS20
75	11900184903002	2 Wid 1963 5-8x5 T	Paris	Rains	3.0	2.0	Associated	MC#-# 1949-1977	5.5	Medium Stiffness	6 Thin ACP (<2.5in.)	1.363	6.605	Top Corner	V	PIN	1: IR>=HS20, OR> HS20
76	11900184903002	3 Wid 2005 5-8x5 T	Paris	Rains	--	--	--	--	--	Medium Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Post-1979
77	11940004510064	1 Org 1925 2-10x6 T	Paris	Red River	3.8	4.0	Associated	W.C.-2	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.459	1.580	Wall Exterior Bottom	M	FIX	2: IR< HS20, OR>=HS20
78	11940004510064	2 Wid 1993 2-10x6 T	Paris	Red River	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Post-1979
79	11940004601021	1 Org 1936 5-10x10 T	Paris	Red River	3.8	3.5	Associated	MBC ##-##	3.0	Low Stiffness	8 Overlaid Concrete	0.322	1.916	Wall Exterior Bottom	M	FIX	1: IR>=HS20, OR> HS20
80	11940004601021	2 Wid 1960 5-10x10 T	Paris	Red River	3.8	3.0	Associated	MBC ##-##	2.5	Low Stiffness	8 Overlaid Concrete	0.624	3.419	Wall Exterior Bottom	M	FIX	1: IR>=HS20, OR> HS20
81	11940018902025	1 Org 1940 5-6x5 T	Paris	Red River	3.8	3.8	Associated	MBC-#	0.5	Medium Stiffness	9 Overlaid Flexible	0.539	2.058	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
82	11940018902025	2 Wid 1967 5-6x5 T	Paris	Red River	3.8	3.3	Associated	MC#-# 1949-1977	0.5	Medium Stiffness	9 Overlaid Flexible	0.684	1.502	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
83	11940018903038	1 Org 1956 4-8x7 T	Paris	Red River	3.8	4.0	Associated	MC#-# 1949-1977	1.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.605	1.173	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
84	11940215501001	1 Org 1956 2-10x9 T	Paris	Red River	3.8	3.5	Associated	MC#-# 1949-1977	2.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.663	1.222	Wall Interior Top	M	FIX	2: IR< HS20, OR>=HS20
85	20730034303025	1 Org 1947 2-10x10 T	Fort Worth	Erath	4.3	4.3	Specified	MBC ##-##	0.5	Medium Stiffness	6 Thin ACP (<2.5in.)	0.473	1.750	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
86	20730034303025	2 Oth 1978 2-10x10 O	Fort Worth	Erath	--	--	--	--	--	Medium Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Geometry outside sc
87	20730257802002	1 Org 1961 2-10x6 T	Fort Worth	Erath	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.546	1.010	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
88	21120008003042	1 Org 1942 3-7x6 T	Fort Worth	Hood	5.0	5.0	Provided	MBC-#-#(-F)	5.0	Medium Stiffness	4 Thick ACP (>5in.)	1.790	9.236	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
89	21120008003043	1 Org 1942 4-6x3 T	Fort Worth	Hood	5.0	5.0	Provided	MBC-#-#(-F)	1.5	Medium Stiffness	4 Thick ACP (>5in.)	0.498	3.532	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
90	21120008003044	1 Org 1942 4-6x5 E	Fort Worth	Hood	5.0	5.0	Provided	MBC-#-#(-F)	1.0	Medium Stiffness	4 Thick ACP (>5in.)	0.861	2.861	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
91	21120008003044	2 Exp 1942 1-6x5 E	Fort Worth	Hood	--	--	--	--	--	Medium Stiffness	4 Thick ACP (>5in.)	--	--	--	--	--	NLR: Expansion slab
92	21120008004041	1 Org 1941 4-6x4 J	Fort Worth	Hood	5.0	5.0	Provided	MBC-#-#(-F)	2.0	Medium Stiffness	4 Thick ACP (>5in.)	1.026	4.641	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
93	21120008004041	2 Add 1974 1-6x4 J	Fort Worth	Hood	4.8	5.0	Provided	SC- N	2.0	Medium Stiffness	4 Thick ACP (>5in.)	1.099	2.849	Top Corner	V	FIX	1: IR>=HS20, OR> HS20
94	21120008004041	3 Wid 1974 5-6x4 T	Fort Worth	Hood	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Medium Stiffness	4 Thick ACP (>5in.)	0.861	2.593	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
95	21120038504001	1 Org 1938 3-6x6 T	Fort Worth	Hood	3.5	3.8	Specified	MBC-#-#(-F)	2.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	1.178	4.605	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
96	21120038504001	2 Wid 2005 3-6x6 T	Fort Worth	Hood	--	--	--	--	--	Medium Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
97	21120246301002	1 Org 1960 3-7x4 T	Fort Worth	Hood	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.596	2.058	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
98	21120246301002	2 Wid 1991 3-7x4 T	Fort Worth	Hood	--	--	--	--	--	Medium Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Post-1979
99	21200013405018	1 Org 1926 3-10x8 T	Fort Worth	Jack	4.3	3.8	Specified	MBC-#	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.944	2.786	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
100	21200039106025	1 Org 1942 5-7x6 T	Fort Worth	Jack	5.0	5.0	Provided	MBC-#-#(-F)	3.0	Medium Stiffness	6 Thin ACP (<2.5in.)	1.111	5.475	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
101	21200039106025	2 Wid 1944 5-7x6 T	Fort Worth	Jack	5.0	5.0	Provided	MBC ##-##	3.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.596	5.367	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
102	21270001404277	1 Org 1966 2-7x4 T	Fort Worth	Johnson	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.582	1.089	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
103	21270159901002	1 Org 1952 5-5x3 T	Fort Worth	Johnson	5.0	5.0	Provided	MC#-# 1949-1977	2.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	1.009	2.451	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
104	21270159901002	2 Wid 1992 5-5x3 T	Fort Worth	Johnson	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Post-1979
105	21270159901003	1 Org 1952 5-5x3 T	Fort Worth	Johnson	4.3	5.0	Provided	MC#-# 1949-1977	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.881	1.867	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
106	21270159901003	2 Wid 1992 5-5x3 T	Fort Worth	Johnson	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Post-1979
107	21270221301004	1 Org 1970 2-7x4 T	Fort Worth	Johnson	5.0	5.0	Provided	MC#-# 1949-1977	2.5	Low Stiffness	6 Thin ACP (<2.5in.)	0.689	2.316	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
108	21820024908030	1 Oth 1925 3-10x7 T	Fort Worth	Palo Pinto	--	--	--	--	--	Medium Stiffness	4 Thick ACP (>5in.)	--	--	--	--	--	NLR: Geometry outside sc
109	21820024908030	2 Wid 1949 3-10x7 T	Fort Worth	Palo Pinto	5.0	5.0	Provided	MBC-#-#(-F)	1.0	Medium Stiffness	4 Thick ACP (>5in.)	0.618	2.570	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
110	21820024908041	1 Org 1949 2-10x9 T	Fort Worth	Palo Pinto	5.0	5.0	Provided	MBC-#-#(-F)	3.0	Medium Stiffness	4 Thick ACP (>5in.)	1.214	7.774	Top Midspan	M	FIX	1: IR>=HS20, OR> HS20
111	21820031402105	1 Org 1971 3-9x9 T	Fort Worth	Palo Pinto	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.615	1.818	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
112	21820031403158	1 Org 1935 1-10x10 J	Fort Worth	Palo Pinto	5.0	5.0	Provided	C - #	2.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.743	4.483	Top Midspan	M	FIX	1: IR>=HS20, OR> HS20
113	21820031403158	2 Wid 1952 1-10x10 J	Fort Worth	Palo Pinto	3.8	3.0	Associated	BC-#	2.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.752	3.326	Top Midspan	M	FIX	1: IR>=HS20, OR> HS20
114	21820031403158	3 Add 1972 1-10x10 J	Fort Worth	Palo Pinto	5.0	5.0	Provided	SC- N	1.5	Medium Stiffness	6 Thin ACP (<2.5in.)	0.687	1.760	Top Corner	M	FIX	1: IR>=HS20, OR> HS20

No	Structure No	Segment ID	District	County	Interpreted Parameter Score	Design Selection Score	Design Class	Design Name	Critical Cover Soil Depth	Soil Type	Pavement	HS20 Lvl1 ORF	HS20 Lvl3 ORF	Lvl3 Controlling Critical Section	Lvl3 Failure Mode	Lvl3 Fixity	Lvl3 Load Posting Class
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
115	21820039108046	1 Org 1949 4-7x4 T	Fort Worth	Palo Pinto	5.0	5.0	Provided	MBC ##-##	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.439	1.492	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
116	21820039108046	2 Wid 1964 4-7x4 T	Fort Worth	Palo Pinto	3.8	3.5	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.479	1.067	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
117	21820053904022	1 Org 1968 5-10x6 T	Fort Worth	Palo Pinto	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.542	1.129	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
118	21820073601002	1 Org 1950 3-8x8 T	Fort Worth	Palo Pinto	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.506	1.081	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
119	21820073602013	1 Org 1961 3-7x5 T	Fort Worth	Palo Pinto	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.613	1.189	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
120	21820152502001	1 Org 1961 2-10x7 T	Fort Worth	Palo Pinto	4.3	4.3	Specified	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.552	1.052	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
121	21820228901001	1 Org 1959 4-5x3 T	Fort Worth	Palo Pinto	4.3	4.5	Specified	MC#-# 1949-1977	1.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.730	1.766	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
122	21840031401001	1 Org 1933 3-8x8 E	Fort Worth	Parker	4.3	3.8	Specified	MBC-#	1.0	Medium Stiffness	8 Overlaid Concrete	1.114	9.409	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
123	21840031401001	2 Org 1933 2-8x8 E	Fort Worth	Parker	4.3	3.8	Specified	MBC-#	1.0	Medium Stiffness	8 Overlaid Concrete	1.114	8.532	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
124	21840031401001	3 Exp 1933 1-8x8 E	Fort Worth	Parker	--	--	--	--	--	Medium Stiffness	8 Overlaid Concrete	--	--	--	--	--	NLR: Expansion slab
125	21840316301001	1 Org 1970 4-8x4 T	Fort Worth	Parker	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.376	1.010	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
126	22130025902008	1 Org 1925 3-8x8 T	Fort Worth	Somervell	3.8	3.8	Associated	MBC-#	4.0	Medium Stiffness	4 Thick ACP (>5in.)	2.907	9.350	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
127	22130025902008	2 Wid 1953 3-8x6 T	Fort Worth	Somervell	5.0	5.0	Provided	MC#-# 1949-1977	4.5	Medium Stiffness	4 Thick ACP (>5in.)	0.437	1.750	Wall Exterior Bottom	M	FIX	1: IR>=HS20, OR> HS20
128	22200000812073	1 Org 1957 5-8x8 O	Fort Worth	Tarrant	5.0	5.0	Provided	MC#-# 1949-1977	3.5	Low Stiffness	4 Thick ACP (>5in.)	1.350	4.262	Wall Exterior Bottom	M	PIN	1: IR>=HS20, OR> HS20
129	22200000812073	2 Oth 1968 1-10x10 O	Fort Worth	Tarrant	--	--	--	--	--	Low Stiffness	4 Thick ACP (>5in.)	--	--	--	--	--	NLR: Geometry outside sc
130	22200000812073	3 Wid 2000 5-15x13 T	Fort Worth	Tarrant	--	--	--	--	--	Low Stiffness	4 Thick ACP (>5in.)	--	--	--	--	--	NLR: Post-1979
131	22200001415337	1 Org 1970 6-7x4 T	Fort Worth	Tarrant	5.0	5.0	Provided	MC#-# 1949-1977	3.5	Low Stiffness	8 Overlaid Concrete	1.280	6.080	Top Corner	V	PIN	1: IR>=HS20, OR> HS20
132	22200001415337	2 Wid 1976 6-7x4 T	Fort Worth	Tarrant	5.0	5.0	Provided	MC#-# 1949-1977	4.0	Low Stiffness	5 Int. ACP (2.5-5in.)	1.490	3.776	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
133	22200008112080	1 Org 1967 6-10x6 T	Fort Worth	Tarrant	5.0	5.0	Provided	MC#-# 1949-1977	15.0	Low Stiffness	5 Int. ACP (2.5-5in.)	5.441	12.856	Wall Exterior Bottom	M	PIN	1: IR>=HS20, OR> HS20
134	22200008112080	2 Org 1967 6-10x6 T	Fort Worth	Tarrant	5.0	5.0	Provided	MC#-# 1949-1977	7.5	Low Stiffness	5 Int. ACP (2.5-5in.)	1.531	12.953	Top Midspan	M	FIX	1: IR>=HS20, OR> HS20
135	22200008112080	3 Wid 1991 2-10x6 T	Fort Worth	Tarrant	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
136	22200008112080	4 Wid 1991 2-10x6 T	Fort Worth	Tarrant	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
137	22200009402012	1 Org 1925 4-8x7 J	Fort Worth	Tarrant	3.5	2.8	Associated	MBC-#-#(-F)	3.0	Medium Stiffness	4 Thick ACP (>5in.)	1.061	6.273	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
138	22200009402012	2 Wid 1939 4-8x7 J	Fort Worth	Tarrant	4.0	3.8	Specified	MBC-#-#(-F)	3.0	Medium Stiffness	4 Thick ACP (>5in.)	1.061	6.273	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
139	22200009402012	3 Wid 1950 4-8x7 J	Fort Worth	Tarrant	4.8	5.0	Provided	MBC-#-#(-F)	3.0	Medium Stiffness	4 Thick ACP (>5in.)	1.087	5.654	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
140	22200009402012	4 Add 1964 2-8x7 J	Fort Worth	Tarrant	4.8	5.0	Provided	MC#-# 1949-1977	3.0	Medium Stiffness	4 Thick ACP (>5in.)	1.017	4.890	Top Corner	V	PIN	1: IR>=HS20, OR> HS20
141	22200009402012	5 Add 1989 4-8x7 J	Fort Worth	Tarrant	--	--	--	--	--	Medium Stiffness	4 Thick ACP (>5in.)	--	--	--	--	--	NLR: Post-1979
142	22200009402012	6 Wid 1998 10-8x7 T	Fort Worth	Tarrant	--	--	--	--	--	Medium Stiffness	4 Thick ACP (>5in.)	--	--	--	--	--	NLR: Post-1979
143	22200017209132	1 Org 1973 4-10x7 T	Fort Worth	Tarrant	5.0	5.0	Provided	MC#-# 1949-1977	1.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.574	1.334	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
144	22200017209138	1 Org 1973 6-10x7 T	Fort Worth	Tarrant	5.0	5.0	Provided	MC#-# 1949-1977	24.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	4.019	27.961	Top Corner	V	PIN	1: IR>=HS20, OR> HS20
145	22200017209138	2 Org 1973 6-10x7 T	Fort Worth	Tarrant	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.628	1.867	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
146	22200017209144	1 Org 1973 6-8x7 T	Fort Worth	Tarrant	5.0	5.0	Provided	MC#-# 1949-1977	18.0	Low Stiffness	1 CRCP	1.675	11.556	Wall Exterior Midspan	M	PIN	1: IR>=HS20, OR> HS20
147	22200017209144	2 Org 1973 6-8x7 T	Fort Worth	Tarrant	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.705	1.679	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
148	22200071802010	1 Org 1935 3-10x5.5 T	Fort Worth	Tarrant	3.8	1.5	Associated	W.C.-2	3.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.432	0.688	Wall Exterior Bottom	M	FIX	3: IR< HS20, OR> HS10
149	22200071802010	2 Wid 1959 3-10x5.5 T	Fort Worth	Tarrant	5.0	5.0	Provided	MC#-# 1949-1977	2.5	Low Stiffness	5 Int. ACP (2.5-5in.)	0.624	2.247	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
150	22200109802003	1 Org 1939 4-7x6 T	Fort Worth	Tarrant	3.8	3.0	Associated	MBC-#	1.5	Low Stiffness	5 Int. ACP (2.5-5in.)	0.572	2.008	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
151	22200109802003	2 Wid 1980 4-7x6 T	Fort Worth	Tarrant	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
152	22200220801015	1 Org 1975 2-7x6 J	Fort Worth	Tarrant	3.8	3.0	Associated	MC#-# 1949-1977	6.0	Medium Stiffness	1 CRCP	1.665	3.040	Wall Exterior Bottom	M	FIX	1: IR>=HS20, OR> HS20
153	22200220801015	2 Wid 1997 2-7x6 J	Fort Worth	Tarrant	--	--	--	--	--	Medium Stiffness	1 CRCP	--	--	--	--	--	NLR: Post-1979
154	22200220801015	3 Wid 1997 3-7x6 T	Fort Worth	Tarrant	--	--	--	--	--	Medium Stiffness	1 CRCP	--	--	--	--	--	NLR: Post-1979
155	22200220801015	4 Add 1997 1-7x6 J	Fort Worth	Tarrant	--	--	--	--	--	Medium Stiffness	1 CRCP	--	--	--	--	--	NLR: Post-1979
156	22200220801015	5 Add 1995 1-6x5 J	Fort Worth	Tarrant	--	--	--	--	--	Medium Stiffness	1 CRCP	--	--	--	--	--	NLR: Post-1979
157	22200226602013	1 Org 1967 1-10x5 T	Fort Worth	Tarrant	4.8	5.0	Provided	SC- N	5.0	Low Stiffness	1 CRCP	0.482	7.378	Wall Exterior Top	M	FIX	1: IR>=HS20, OR> HS20
158	22200226602013	10 Wid 1976 4-5x7 T	Fort Worth	Tarrant	--	--	--	--	--	Low Stiffness	1 CRCP	--	--	--	--	--	NLR: No standard design
159	22200226602013	11 Wid 1976 2-5x7 T	Fort Worth	Tarrant	5.0	5.0	Provided	MC#-# 1949-1977	4.5	Low Stiffness	1 CRCP	1.358	3.769	Top Corner	M	FIX	1: IR>=HS20, OR> HS20
160	22200226602013	2 Org 1967 1-10x5 J	Fort Worth	Tarrant	4.8	5.0	Provided	SC- N	1.0	Low Stiffness	1 CRCP	0.599	5.155	Wall Exterior Top	M	FIX	1: IR>=HS20, OR> HS20
161	22200226602013	3 Wid 1972 4-5x7 T	Fort Worth	Tarrant	5.0	5.0	Provided	MC#-# 1949-1977	3.5	Low Stiffness	1 CRCP	1.144	3.915	Bottom Corner	M	PIN	1: IR>=HS20, OR> HS20
162	22200226602013	4 Wid 1972 4-5x7 T	Fort Worth	Tarrant	5.0	5.0	Provided	MC#-# 1949-1977	15.5	Low Stiffness	1 CRCP	0.247	6.699	Wall Exterior Midspan	M	FIX	1: IR>=HS20, OR> HS20
163	22200226602013	5 Add 1972 2-5x7 T	Fort Worth	Tarrant	5.0	5.0	Provided	MC#-# 1949-1977	4.0	Low Stiffness	1 CRCP	1.276	3.838	Top Corner	M	FIX	1: IR>=HS20, OR> HS20
164	22200226602013	6 Add 1972 2-5x7 J	Fort Worth	Tarrant	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Low Stiffness	1 CRCP	0.294	3.561	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
165	22200226602013	7 Wid 1972 1-10x5 J	Fort Worth	Tarrant	5.0	5.0	Provided	SC- N	1.0	Low Stiffness	1 CRCP	0.599	5.155	Wall Exterior Top	M	FIX	1: IR>=HS20, OR> HS20
166	22200226602013	8 Wid 1972 2-5x8 J	Fort Worth	Tarrant	5.0	5.0	Provided	MC#-# 1949-1977	4.0	Low Stiffness	1 CRCP	0.898	3.975	Top Corner	M	FIX	1: IR>=HS20, OR> HS20
167	22200226602013	9 Add 1972 2-5x10 J	Fort Worth	Tarrant	5.0	5.0	Provided	MC#-# 1949-1977	3.5	Low Stiffness	1 CRCP	-5.922	3.109	Top Corner	M	FIX	1: IR>=HS20, OR> HS20
168	22200237405198	1 Org 1972 4-7x5 T	Fort Worth	Tarrant	5.0	5.0	Provided	MC#-# 1949-1977	11.0	Low Stiffness	1 CRCP	3.873	6.507	Wall Exterior Bottom	M	FIX	1: IR>=HS20, OR> HS20
169	22200237405301	1 Org 1973 3-6x5 T	Fort Worth	Tarrant	4.5	5.0	Provided	MC#-# 1949-1977	2.5	Low Stiffness	1 CRCP	0.758	4.970	Top Corner	V	PIN	1: IR>=HS20, OR> HS20
170	22490031204035	1 Org 1958 3-7x6 T	Fort Worth	Wise	5.0	5.0	Provided	MC#-# 1949-1977	4.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	1.423	4.305	Wall Exterior Bottom	M	FIX	1: IR>=HS20, OR> HS20
171	22490031204035	2 Wid 1978 3-7x6 T	Fort Worth	Wise	5.0	5.0	Provided	MC#-# 1949-1977	4.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	2.636	5.193	Top Corner	V	FIX	1: IR>=HS20, OR> HS20

TABLE A: Summary Load Rating Results for 1,788 Segments/ 1,000 Culverts

No	Structure No	Segment ID	District	County	Interpreted Parameter Score	Design Selection Score	Design Class	Design Name	Critical Cover Soil Depth	Soil Type	Pavement	HS20 Lvl1 ORF	HS20 Lvl3 ORF	Lvl3 Controlling Critical Section	Lvl3 Failure Mode	Lvl3 Fixity	Lvl3 Load Posting Class
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
172	22490031301025	1 Org 1940 3-5x4 T	Fort Worth	Wise	4.8	2.8	Associated	MBC ##-##	1.5	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.783	3.642	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
173	22490031301025	2 Wid 1965 3-5x4 T	Fort Worth	Wise	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.344	1.738	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
174	22490241801002	1 Org 1961 2-10x10 T	Fort Worth	Wise	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.433	2.741	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
175	22490241801002	2 Wid 2004 2-10x10 T	Fort Worth	Wise	--	--	--	--	--	Medium Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Post-1979
176	30050013707015	1 Org 1929 4-5x5 T	Wichita Falls	Archer	3.8	3.5	Associated	MBC-#	2.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	1.306	3.643	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
177	30050013707015	2 Wid 1967 4-5x5 T	Wichita Falls	Archer	3.8	3.0	Associated	MC#-# 1949-1977	2.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	1.275	3.222	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
178	30050015605013	1 Org 1928 6-6x6 T	Wichita Falls	Archer	4.3	4.3	Specified	MBC-#	1.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.982	2.747	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
179	30050015605013	2 Wid 1941 6-6x6 T	Wichita Falls	Archer	5.0	5.0	Provided	MBC ##-##	1.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.737	1.423	Wall Interior Top	M	FIX	2: IR< HS20, OR>=HS20
180	30050015605013	3 Wid 1965 6-6x6 T	Wichita Falls	Archer	3.5	3.0	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.642	1.859	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
181	30050028303006	1 Org 1928 5-10x8 T	Wichita Falls	Archer	3.8	3.3	Associated	MBC-#	2.0	Medium Stiffness	8 Overlaid Concrete	1.017	8.440	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
182	30050028303006	2 Wid 1955 5-10x8 T	Wichita Falls	Archer	3.8	3.0	Associated	MBC-#	2.0	Medium Stiffness	8 Overlaid Concrete	1.275	10.073	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
183	30050028304013	1 Org 1928 4-5x5 T	Wichita Falls	Archer	3.8	3.5	Associated	MBC-#	0.5	Medium Stiffness	8 Overlaid Concrete	0.757	8.837	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
184	30050028304013	2 Wid 1954 4-5x5 T	Wichita Falls	Archer	3.8	3.3	Associated	MC#-# 1949-1977	0.5	Medium Stiffness	8 Overlaid Concrete	0.665	6.203	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
185	30050080403006	1 Org 1951 3-7x4 T	Wichita Falls	Archer	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.470	1.000	Wall Exterior Top	M	FIX	2: IR< HS20, OR>=HS20
186	30050211301002	1 Org 1961 4-10x10 T	Wichita Falls	Archer	3.8	2.5	Associated	MC#-# 1949-1977	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.478	2.299	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
187	30120012405018	1 Org 1933 3-8x8 T	Wichita Falls	Baylor	3.8	3.3	Associated	MBC-#	2.0	Low Stiffness	6 Thin ACP (<2.5in.)	1.274	3.918	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
188	30120012405018	2 Wid 1996 3-8x8 T	Wichita Falls	Baylor	--	--	--	--	--	Low Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Post-1979
189	30390004402007	1 Org 1925 4-5x5 T	Wichita Falls	Clay	5.0	4.3	Specified	MBC-#	2.0	Medium Stiffness	8 Overlaid Concrete	1.306	6.969	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
190	30390004402007	2 Wid 1938 4-5x5 T	Wichita Falls	Clay	5.0	5.0	Provided	MBC ##-##	2.0	Medium Stiffness	8 Overlaid Concrete	1.141	8.877	Wall Exterior Bottom	M	PIN	1: IR>=HS20, OR> HS20
191	30390004402007	3 Wid 1986 4-5x5 T	Wichita Falls	Clay	--	--	--	--	--	Medium Stiffness	8 Overlaid Concrete	--	--	--	--	--	NLR: Post-1979
192	30390004402076	1 Org 1963 4-5x5 T	Wichita Falls	Clay	3.8	3.0	Associated	MC#-# 1949-1977	2.0	Medium Stiffness	8 Overlaid Concrete	1.275	6.320	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
193	30390004402076	2 Wid 1986 4-5x5 T	Wichita Falls	Clay	--	--	--	--	--	Medium Stiffness	8 Overlaid Concrete	--	--	--	--	--	NLR: Post-1979
194	30390013708043	1 Org 1956 3-8x8 T	Wichita Falls	Clay	3.8	2.5	Associated	MBC-#	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	1.569	4.547	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
195	30390022401044	1 Org 1972 5-6x6 T	Wichita Falls	Clay	3.8	3.0	Associated	MC#-# 1949-1977	2.0	Medium Stiffness	1 CRCP	1.036	4.965	Top Corner	V	PIN	1: IR>=HS20, OR> HS20
196	30390023906016	1 Org 1940 2-10x10 T	Wichita Falls	Clay	3.8	3.5	Associated	MBC ##-##	2.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.315	3.023	Wall Exterior Bottom	M	PIN	1: IR>=HS20, OR> HS20
197	30390023906016	2 Wid 1950 2-10x10 T	Wichita Falls	Clay	3.8	3.0	Associated	MC#-# 1949-1977	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.263	1.420	Wall Exterior Bottom	M	PIN	2: IR< HS20, OR>=HS20
198	30390023906016	3 Wid 2009 2-10x10 T	Wichita Falls	Clay	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Post-1979
199	30390039105044	1 Org 1947 4-8x8 T	Wichita Falls	Clay	3.8	3.3	Associated	MBC ##-##	2.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.360	3.784	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
200	30390068105022	1 Org 1960 4-6x4 T	Wichita Falls	Clay	3.8	3.3	Associated	MC#-# 1949-1977	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.782	2.088	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
201	30390161502005	1 Org 1958 4-5x2 T	Wichita Falls	Clay	3.8	3.8	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.564	1.290	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
202	30490004408112	1 Org 1968 3-8x6 T	Wichita Falls	Cooke	3.8	2.5	Associated	MC#-# 1949-1977	2.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.683	2.179	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
203	30490019501026	1 Org 1948 3-7x6 T	Wichita Falls	Cooke	5.0	5.0	Provided	MBC-#-#(-F)	1.5	Low Stiffness	10 Seal Coat or Surf. Tmt	0.722	2.354	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
204	30490019501026	2 Wid 1963 3-7x6 T	Wichita Falls	Cooke	5.0	5.0	Provided	MC#-# 1949-1977	1.5	Low Stiffness	10 Seal Coat or Surf. Tmt	0.675	1.427	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
205	31690001305045	1 Org 1972 3-10x6 T	Wichita Falls	Montague	4.3	4.3	Specified	MC#-# 1949-1977	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.773	2.117	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
206	31690001305045	2 Org 1972 3-10x6 T	Wichita Falls	Montague	4.3	3.8	Specified	MC#-# 1949-1977	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.773	2.117	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
207	31690001305047	1 Org 1972 3-8x6 T	Wichita Falls	Montague	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: No standard design
208	31690001313038	1 Org 1972 3-7x5 T	Wichita Falls	Montague	--	--	--	--	--	Medium Stiffness	8 Overlaid Concrete	--	--	--	--	--	NLR: No standard design
209	32240012503015	1 Org 1929 4-5x5 T	Wichita Falls	Throckmorton	3.8	3.5	Associated	MBC-#	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.739	1.875	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
210	32240012503015	2 Wid 1961 4-5x5 T	Wichita Falls	Throckmorton	3.8	3.0	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.647	1.789	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
211	32240012503016	1 Org 1929 4-6x6 T	Wichita Falls	Throckmorton	3.8	3.5	Associated	MBC-#	0.5	Medium Stiffness	8 Overlaid Concrete	1.003	11.027	Top Corner	M	FIX	1: IR>=HS20, OR> HS20
212	32240012503016	2 Wid 1961 4-6x6 T	Wichita Falls	Throckmorton	3.8	3.0	Associated	MC#-# 1949-1977	0.5	Medium Stiffness	8 Overlaid Concrete	0.650	6.196	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
213	32240161201001	1 Org 1954 3-9x5 T	Wichita Falls	Throckmorton	3.8	4.0	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.501	1.210	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
214	32240161301001	1 Org 1954 3-7x6 T	Wichita Falls	Throckmorton	3.8	3.5	Associated	MC#-# 1949-1977	0.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.626	0.934	Top Corner	M	PIN	3: IR< HS20, OR> HS10
215	32430004309074	1 Org 1960 4-9x7 T	Wichita Falls	Wichita	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Low Stiffness	3 JPCP	0.598	4.016	Wall Exterior Bottom	M	PIN	1: IR>=HS20, OR> HS20
216	32430004309074	2 Wid 1990 4-9x7 T	Wichita Falls	Wichita	--	--	--	--	--	Low Stiffness	3 JPCP	--	--	--	--	--	NLR: Post-1979
217	32430004309085	1 Org 1961 6-10x6 T	Wichita Falls	Wichita	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Medium Stiffness	8 Overlaid Concrete	0.912	6.955	Top Corner	V	PIN	1: IR>=HS20, OR> HS20
218	32430004309085	2 Org 1961 6-10x6 T	Wichita Falls	Wichita	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Medium Stiffness	8 Overlaid Concrete	0.781	6.309	Top Corner	V	PIN	1: IR>=HS20, OR> HS20
219	32430004317045	1 Org 1936 5-7x7 T	Wichita Falls	Wichita	5.0	5.0	Provided	MBC-#-#(-F)	1.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.497	2.039	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
220	32430004317045	2 Wid 1939 5-7x7 T	Wichita Falls	Wichita	3.8	3.0	Associated	MBC ##-##	1.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.480	2.535	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
221	32430024901053	1 Org 1968 6-6x4 T	Wichita Falls	Wichita	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Low Stiffness	6 Thin ACP (<2.5in.)	0.782	2.495	Top Corner	V	PIN	1: IR>=HS20, OR> HS20
222	32430068104018	1 Org 1956 3-10x8 T	Wichita Falls	Wichita	5.0	5.0	Provided	MC#-# 1949-1977	1.5	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.602	1.979	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
223	32430080201007	1 Org 1960 4-10x10 T	Wichita Falls	Wichita	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.478	2.959	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
224	32430080201007	2 Wid 2004 4-10x10 T	Wichita Falls	Wichita	--	--	--	--	--	Medium Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
225	32430135301002	1 Org 1961 4-10x10 T	Wichita Falls	Wichita	3.8	3.0	Associated	MC#-# 1949-1977	2.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.478	1.967	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
226	32430232301002	1 Org 1960 4-10x10 T	Wichita Falls	Wichita	5.0	5.0	Provided	MC#-# 1949-1977	0.5	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.329	1.394	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
227	32440082102010	1 Org 1959 5-8x4 T	Wichita Falls	Wilbarger	4.8	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.376	1.420	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
228	32440083202004	1 Org 1950 6-5x3 T	Wichita Falls	Wilbarger	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.524	1.437	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20

No (1)	Structure No (2)	Segment ID (3)	District (4)	County (5)	Interpreted Parameter Score (6)	Design Selection Score (7)	Design Class (8)	Design Name (9)	Critical Cover Soil Depth (10)	Soil Type (11)	Pavement (12)	HS20 Lvl1 ORF (13)	HS20 Lvl3 ORF (14)	Lvl3 Controlling Critical Section (15)	Lvl3 Failure Mode (16)	Lvl3 Fixity (17)	Lvl3 Load Posting Class (18)
229	32440083202005	1 Org 1940 4-8x7 T	Wichita Falls	Wilbarger	3.8	3.0	Associated	MBC ##-##	2.5	Medium Stiffness	6 Thin ACP (<2.5in.)	0.338	2.861	Wall Exterior Bottom	M	FIX	1: IR>=HS20, OR> HS20
230	32440116201002	1 Org 1949 4-6x3 T	Wichita Falls	Wilbarger	5.0	5.0	Provided	FM-MBC	0.5	Medium Stiffness	6 Thin ACP (<2.5in.)	0.411	1.221	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
231	32440116202004	1 Org 1965 4-8x4 T	Wichita Falls	Wilbarger	5.0	5.0	Provided	MC#-# 1949-1977	1.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.432	1.250	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
232	32440161601002	1 Org 1955 3-8x6 T	Wichita Falls	Wilbarger	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.515	1.698	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
233	32440177001002	1 Org 1956 4-6x4 T	Wichita Falls	Wilbarger	5.0	5.0	Provided	MC#-# 1949-1977	1.5	Low Stiffness	6 Thin ACP (<2.5in.)	0.660	1.568	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
234	32520028401011	1 Org 1957 8-10x10 T	Wichita Falls	Young	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.451	3.036	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
235	32520036102008	1 Org 1934 4-8x8 T	Wichita Falls	Young	3.8	3.0	Associated	MBC-#	2.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.703	3.688	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
236	32520036102008	2 Wid 1973 4-8x8 T	Wichita Falls	Young	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.649	1.591	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
237	32520036201024	1 Org 1966 5-6x6 T	Wichita Falls	Young	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	9 Overlaid Flexible	0.642	1.966	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
238	40060078902001	1 Org 1946 4-6x4 T	Amarillo	Armstrong	5.0	5.0	Provided	MBC-#-#(-F)	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.765	1.933	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
239	40590124301001	1 Org 1950 4-5x2 T	Amarillo	Deaf Smith	4.3	3.8	Specified	MBC ##-##	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.393	1.275	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
240	40590149101001	1 Org 1951 4-9x5 T	Amarillo	Deaf Smith	5.0	5.0	Provided	MC#-# 1949-1977	1.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.379	0.935	Wall Exterior Top	M	PIN	3: IR< HS20, OR> HS10
241	40910049001005	1 Org 1952 6-8x6 T	Amarillo	Gray	4.8	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.298	0.869	Top Midspan	M	PIN	3: IR< HS20, OR> HS10
242	40910049001005	2 Wid 1982 6-8x6 T	Amarillo	Gray	--	--	--	--	--	Medium Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Post-1979
243	40910079705011	1 Org 1947 3-8x8 T	Amarillo	Gray	3.8	3.0	Associated	MBC-#	0.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.542	1.373	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
244	40990272401001	1 Org 1962 5-5x2 T	Amarillo	Hansford	3.8	3.8	Associated	MC#-# 1949-1977	0.5	Low Stiffness	10 Seal Coat or Surf. Tmt	0.570	1.070	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
245	41040004101014	1 Org 1934 7-4x4 T	Amarillo	Hartley	4.3	3.8	Specified	MBC-#	1.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.725	2.686	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
246	41040004101014	2 Wid 1953 7-4x4 T	Amarillo	Hartley	4.8	5.0	Provided	MBC-#	1.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.748	2.518	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
247	41040004101014	3 Wid 2005 7-4x4 T	Amarillo	Hartley	--	--	--	--	--	Medium Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
248	41070233001001	1 Org 1958 4-5x3 T	Amarillo	Hemphill	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	1.038	2.922	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
249	41180151503001	1 Org 1951 5-6x5 T	Amarillo	Hutchinson	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.773	1.753	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
250	41480035502007	1 Org 1933 3-8x8 T	Amarillo	Lipscomb	3.8	2.5	Associated	MBC-#	7.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	4.761	12.252	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
251	41790035503012	1 Org 1934 3-7x6 E	Amarillo	Ochiltree	3.8	3.8	Associated	MBC-#	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.470	1.272	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
252	41790035503012	2 Org 1934 2-7x6 E	Amarillo	Ochiltree	3.8	2.5	Associated	MBC-#	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.470	1.272	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
253	41790035503012	3 Exp 1934 1-7x6 E	Amarillo	Ochiltree	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Expansion slab
254	41790035503012	4 Wid 1973 6-7x6 T	Amarillo	Ochiltree	4.8	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.597	1.180	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
255	41800009003049	1 Org 1969 3-7x3 T	Amarillo	Oldham	4.3	4.0	Specified	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.422	1.008	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
256	41880004105007	1 Org 1931 6-5x5 T	Amarillo	Potter	4.3	4.0	Specified	MBC-#	1.5	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.846	2.789	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
257	41880004105007	2 Wid 1962 6-5x5 T	Amarillo	Potter	5.0	5.0	Provided	MC#-# 1949-1977	6.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	1.336	4.411	Wall Exterior Bottom	M	FIX	1: IR>=HS20, OR> HS20
258	41880009006023	1 Org 1959 4-5x3 T	Amarillo	Potter	5.0	5.0	Provided	MC#-# 1949-1977	1.5	Medium Stiffness	6 Thin ACP (<2.5in.)	0.730	2.047	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
259	41880016902023	1 Org 1962 4-6x3 T	Amarillo	Potter	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.506	1.617	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
260	41970016908006	1 Org 1931 3-8x8 T	Amarillo	Roberts	4.3	3.8	Specified	MBC-#	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	1.114	1.966	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
261	41970016908006	2 Wid 1962 3-8x8 T	Amarillo	Roberts	3.8	3.0	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.624	1.288	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
262	41970079801002	1 Org 1947 3-10x12 T	Amarillo	Roberts	5.0	5.0	Provided	MBC-#-#(-F)	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.753	2.202	Wall Exterior Bottom	M	PIN	1: IR>=HS20, OR> HS20
263	42110023806012	1 Org 1946 3-7x4 E	Amarillo	Sherman	4.3	3.8	Specified	MBC-#-#(-F)	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.656	3.444	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
264	42110023806012	2 Wid 1970 3-7x4 E	Amarillo	Sherman	4.3	3.0	Associated	MBC-#-#(-F)	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.823	3.998	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
265	42110023806012	3 Exp 1946 1-7x4 E	Amarillo	Sherman	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Expansion slab
266	42110023806012	4 Exp 1970 1-7x4 E	Amarillo	Sherman	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Expansion slab
267	50090005202024	1 Org 1968 4-9x5 T	Lubbock	Bailey	3.8	3.0	Associated	MC#-# 1949-1977	2.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.574	1.967	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
268	50350241901001	1 Org 1962 6-9x7 T	Lubbock	Castro	3.5	3.8	Associated	MC#-# 1949-1977	1.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.545	1.058	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
269	50780045307003	1 Org 1936 4-6x4 T	Lubbock	Floyd	3.8	3.5	Associated	MBC-#	1.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.825	2.013	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
270	50860055801025	1 Org 1960 2-10x8 T	Lubbock	Garza	5.0	5.0	Provided	MC#-# 1949-1977	8.5	High Stiffness	10 Seal Coat or Surf. Tmt	1.104	0.072	Wall Exterior Bottom	M	FIX	6: IR< HS 3, OR< HS 3
271	50960104101005	1 Org 1960 10-7x5 T	Lubbock	Hale	3.8	2.5	Associated	MC#-# 1949-1977	0.5	Low Stiffness	10 Seal Coat or Surf. Tmt	0.640	0.968	Top Midspan	M	PIN	3: IR< HS20, OR> HS10
272	51850163404004	1 Org 1974 3-10x6 T	Lubbock	Parmer	3.8	3.5	Associated	MC#-# 1949-1977	0.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.521	0.810	Wall Exterior Top	M	PIN	3: IR< HS20, OR> HS10
273	52190035704001	1 Org 1946 4-5x3 T	Lubbock	Swisher	5.0	5.0	Provided	MBC-#-#(-F)	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.638	1.943	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
274	52190035704001	2 Wid 2006 4-5x3 T	Lubbock	Swisher	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Post-1979
275	60520022903005	1 Org 1931 6-4x4 T	Odessa	Crane	3.0	2.3	Associated	MBC-#	2.0	High Stiffness	6 Thin ACP (<2.5in.)	1.151	3.828	Top Corner	V	PIN	1: IR>=HS20, OR> HS20
276	60520022903005	2 Wid 1966 6-4x4 T	Odessa	Crane	5.0	5.0	Provided	MC#-# 1949-1977	2.0	High Stiffness	6 Thin ACP (<2.5in.)	1.843	3.653	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
277	60520022903005	3 Wid 1996 6-4x4 T	Odessa	Crane	--	--	--	--	--	High Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Post-1979
278	60520022903006	1 Org 1931 6-4x4 T	Odessa	Crane	3.5	4.3	Specified	MBC-#	2.0	High Stiffness	6 Thin ACP (<2.5in.)	1.151	3.828	Top Corner	V	PIN	1: IR>=HS20, OR> HS20
279	60520022903006	2 Wid 1966 6-4x4 T	Odessa	Crane	5.0	5.0	Provided	MC#-# 1949-1977	2.0	High Stiffness	6 Thin ACP (<2.5in.)	1.843	3.653	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
280	60520022903006	3 Wid 1998 6-4x4 T	Odessa	Crane	--	--	--	--	--	High Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Post-1979
281	60520022903033	1 Org 1931 3-4x4 J	Odessa	Crane	3.5	4.3	Specified	MBC-#	2.0	Medium Stiffness	6 Thin ACP (<2.5in.)	1.146	3.507	Top Corner	V	PIN	1: IR>=HS20, OR> HS20
282	60520022903033	2 Add 1964 2-6x4 J	Odessa	Crane	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.868	2.448	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
283	60520022903033	3 Wid 1964 3-4x4 J	Odessa	Crane	4.6	5.0	Provided	MC#-# 1949-1977	2.0	Medium Stiffness	6 Thin ACP (<2.5in.)	1.846	3.469	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
284	60520022903033	4 Wid 1994 3-4x4 J	Odessa	Crane	--	--	--	--	--	Medium Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Post-1979
285	60520022903033	5 Wid 1994 2-6x4 J	Odessa	Crane	--	--	--	--	--	Medium Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Post-1979

No	Structure No	Segment ID	District	County	Interpreted Parameter Score	Design Selection Score	Design Class	Design Name	Critical Cover Soil Depth	Soil Type	Pavement	HS20 Lvl1 ORF	HS20 Lvl3 ORF	Lvl3 Controlling Critical Section	Lvl3 Failure Mode	Lvl3 Fixity	Lvl3 Load Posting Class
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
286	60690022901017	1 Org 1941 5-7x7 E	Odessa	Ector	5.0	5.0	Provided	MBC ##-##	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.480	2.224	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
287	60690022901017	2 Exp 1941 1-7x7 E	Odessa	Ector	--	--	--	--	--	Medium Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Expansion slab
288	60690022901017	3 Wid 1957 12-7x7 J	Odessa	Ector	3.0	2.5	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.594	1.462	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
289	60690022901017	4 Wid 1957 11-7x7 J	Odessa	Ector	3.0	2.5	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.594	1.462	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
290	60690022901017	5 Wid 1969 12-7x7 J	Odessa	Ector	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.589	1.417	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
291	60690022901017	6 Wid 1969 11-7x7 J	Odessa	Ector	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.589	1.418	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
292	60690022901019	1 Org 1941 5-6x3 T	Odessa	Ector	3.0	1.8	Associated	MBC-#-#(-F)	3.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.639	7.687	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
293	60690022901019	2 Wid 1969 5-6x3 T	Odessa	Ector	5.0	5.0	Provided	MC#-# 1949-1977	3.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	1.141	3.852	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
294	60690022901019	3 Wid 2005 5-6x3 T	Odessa	Ector	--	--	--	--	--	Medium Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
295	60690187001002	1 Org 1969 6-6x4 T	Odessa	Ector	5.0	5.0	Provided	MC#-# 1949-1977	3.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	1.299	3.944	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
296	60690187001002	2 Wid 1986 6-6x4 T	Odessa	Ector	--	--	--	--	--	Medium Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
297	61650000515189	1 Org 1966 4-6x3 J	Odessa	Midland	2.8	2.8	Associated	MC#-# 1949-1977	3.0	Medium Stiffness	6 Thin ACP (<2.5in.)	1.033	3.740	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
298	61650000515189	2 Org 1966 4-6x3 J	Odessa	Midland	2.8	2.8	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.506	1.435	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
299	61650000515189	3 Wid 1983 4-6x3 J	Odessa	Midland	--	--	--	--	--	Medium Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Post-1979
300	61650000515189	4 Add 1983 1-6x3 J	Odessa	Midland	--	--	--	--	--	Medium Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Post-1979
301	61860002106020	1 Org 1931 4-5x5 T	Odessa	Pecos	3.0	2.3	Associated	MBC-#	3.0	High Stiffness	6 Thin ACP (<2.5in.)	1.963	6.678	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
302	61860002106020	2 Wid 1960 4-5x5 T	Odessa	Pecos	3.0	3.3	Associated	MC#-# 1949-1977	3.0	High Stiffness	6 Thin ACP (<2.5in.)	1.836	5.216	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
303	61860007503049	1 Org 1947 4-6x3 T	Odessa	Pecos	3.0	1.8	Associated	MBC ##-##	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.404	2.357	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
304	61860007503049	2 Wid 1971 4-6x3 T	Odessa	Pecos	3.8	3.3	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.556	1.413	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
305	61860007503051	1 Org 1947 7-5x2 T	Odessa	Pecos	3.0	1.8	Associated	MBC ##-##	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.565	2.248	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
306	61860007503051	2 Wid 1966 7-5x2 T	Odessa	Pecos	3.8	2.5	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.564	1.501	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
307	61860007503053	1 Org 1947 4-5x2 T	Odessa	Pecos	3.0	1.8	Associated	MBC ##-##	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.565	2.211	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
308	61860007503053	2 Wid 1966 4-5x2 T	Odessa	Pecos	3.8	3.5	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.564	1.516	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
309	61860007503056	1 Org 1947 6-5x2 T	Odessa	Pecos	3.0	1.3	Associated	MBC-#-#(-F)	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.633	2.279	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
310	61860007503056	2 Wid 1966 6-5x2 T	Odessa	Pecos	3.0	2.3	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.564	1.501	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
311	61860007503056	3 Wid 2010 6-5x2 T	Odessa	Pecos	--	--	--	--	--	Medium Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Post-1979
312	61860007503057	1 Org 1947 4-5x2 T	Odessa	Pecos	3.0	1.8	Associated	MBC ##-##	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.565	2.211	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
313	61860007503057	2 Wid 1966 4-5x2 T	Odessa	Pecos	3.8	3.5	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.564	1.516	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
314	61860013908064	1 Org 1962 6-7x3 T	Odessa	Pecos	3.0	2.5	Associated	MC#-# 1949-1977	3.0	Low Stiffness	6 Thin ACP (<2.5in.)	0.791	2.633	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
315	61860013908064	2 Wid 1968 6-7x3 T	Odessa	Pecos	3.8	3.5	Associated	MC#-# 1949-1977	3.0	Low Stiffness	6 Thin ACP (<2.5in.)	0.859	2.574	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
316	61860014001120	1 Org 1974 4-7x4 T	Odessa	Pecos	3.8	3.5	Associated	MC#-# 1949-1977	3.0	High Stiffness	6 Thin ACP (<2.5in.)	0.807	3.561	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
317	61860014002018	1 Org 1932 6-5x5 E	Odessa	Pecos	3.8	3.3	Associated	MBC-#	0.5	Medium Stiffness	6 Thin ACP (<2.5in.)	0.757	1.359	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
318	61860014002018	2 Exp 1932 1-5x5 E	Odessa	Pecos	--	--	--	--	--	Medium Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Expansion slab
319	61860014002105	1 Org 1975 5-7x3 T	Odessa	Pecos	3.8	3.5	Associated	MC#-# 1949-1977	2.0	High Stiffness	6 Thin ACP (<2.5in.)	0.597	2.119	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
320	61860014002136	1 Org 1975 5-10x8 T	Odessa	Pecos	3.8	3.0	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.553	1.401	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
321	61860014002141	1 Org 1975 5-6x3 T	Odessa	Pecos	3.8	2.0	Associated	MC#-# 1949-1977	3.0	High Stiffness	6 Thin ACP (<2.5in.)	0.135	2.798	Wall Interior Top	M	FIX	1: IR>=HS20, OR> HS20
322	61860014003162	1 Org 1975 3-7x3 T	Odessa	Pecos	3.8	3.5	Associated	MC#-# 1949-1977	4.0	High Stiffness	6 Thin ACP (<2.5in.)	1.205	4.622	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
323	61860014004183	1 Org 1978 15-9x5 T	Odessa	Pecos	3.8	2.5	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.785	1.883	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
324	61860014004230	1 Org 1977 5-8x4 T	Odessa	Pecos	3.8	4.0	Associated	MC#-# 1949-1977	2.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.452	2.731	Top Corner	V	PIN	1: IR>=HS20, OR> HS20
325	61860014005208	1 Org 1978 8-8x6 T	Odessa	Pecos	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.889	2.086	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
326	61860014005248	1 Org 1978 3-7x3 T	Odessa	Pecos	3.8	3.0	Associated	MC#-# 1949-1977	2.0	High Stiffness	6 Thin ACP (<2.5in.)	0.581	3.142	Top Corner	V	PIN	1: IR>=HS20, OR> HS20
327	61860014005251	1 Org 1978 6-7x3 T	Odessa	Pecos	3.8	3.0	Associated	MC#-# 1949-1977	2.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.597	3.039	Top Corner	V	PIN	1: IR>=HS20, OR> HS20
328	61860014007047	1 Org 1932 3-6x3 E	Odessa	Pecos	3.8	3.5	Associated	MBC-#	1.0	High Stiffness	6 Thin ACP (<2.5in.)	0.638	2.894	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
329	61860014007047	2 Exp 1932 1-6x3 E	Odessa	Pecos	--	--	--	--	--	High Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Expansion slab
330	61860014007047	3 Wid 1972 7-6x3 T	Odessa	Pecos	3.8	2.5	Associated	MC#-# 1949-1977	1.0	High Stiffness	6 Thin ACP (<2.5in.)	0.556	1.456	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
331	61860014012090	1 Org 1936 5-4x4 T	Odessa	Pecos	3.0	2.0	Associated	MBC-#	0.5	High Stiffness	6 Thin ACP (<2.5in.)	0.739	1.510	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
332	61860014012090	2 Wid 1990 5-4x4 T	Odessa	Pecos	--	--	--	--	--	High Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Post-1979
333	61860014015077	1 Org 1937 5-7x4 E	Odessa	Pecos	3.8	3.0	Associated	MBC ##-##	0.5	Medium Stiffness	6 Thin ACP (<2.5in.)	0.413	1.691	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
334	61860014015077	2 Exp 1937 1-7x4 E	Odessa	Pecos	--	--	--	--	--	Medium Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Expansion slab
335	61860014015077	3 Org 1937 4-7x4 E	Odessa	Pecos	3.8	3.0	Associated	MBC ##-##	0.5	Medium Stiffness	6 Thin ACP (<2.5in.)	0.413	1.727	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
336	61860022906023	1 Org 1940 4-5x5 T	Odessa	Pecos	3.8	3.3	Associated	MBC-#	1.0	High Stiffness	6 Thin ACP (<2.5in.)	0.739	1.917	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
337	61860022906023	2 Wid 1963 4-5x5 T	Odessa	Pecos	3.8	3.0	Associated	MC#-# 1949-1977	1.0	High Stiffness	6 Thin ACP (<2.5in.)	0.647	1.804	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
338	61860029205011	1 Org 1948 3-6x3 E	Odessa	Pecos	3.3	3.8	Specified	MBC ##-##	0.5	Medium Stiffness	6 Thin ACP (<2.5in.)	0.434	1.852	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
339	61860029205011	2 Exp 1948 1-6x3 E	Odessa	Pecos	--	--	--	--	--	Medium Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Expansion slab
340	61860029205011	3 Wid 1962 7-6x3 T	Odessa	Pecos	5.0	5.0	Provided	MC#-# 1949-1977	0.5	Medium Stiffness	6 Thin ACP (<2.5in.)	0.512	1.086	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
341	61860029301026	1 Org 1963 4-7x3 J	Odessa	Pecos	3.8	4.0	Associated	MC#-# 1949-1977	2.0	High Stiffness	6 Thin ACP (<2.5in.)	0.541	2.173	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
342	61860029301026	2 Org 1963 6-6x3 J	Odessa	Pecos	3.8	4.0	Associated	MC#-# 1949-1977	2.0	High Stiffness	6 Thin ACP (<2.5in.)	0.691	2.551	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20

TABLE A: Summary Load Rating Results for 1,788 Segments/ 1,000 Culverts

No	Structure No	Segment ID	District	County	Interpreted Parameter Score	Design Selection Score	Design Class	Design Name	Critical Cover Soil Depth	Soil Type	Pavement	HS20 Lvl1 ORF	HS20 Lvl3 ORF	Lvl3 Controlling Critical Section	Lvl3 Failure Mode	Lvl3 Fixity	Lvl3 Load Posting Class
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
343	61860029301026	3 Wid 1975 4-7x3 J	Odessa	Pecos	3.8	4.0	Associated	MC#-# 1949-1977	2.0	High Stiffness	6 Thin ACP (<2.5in.)	0.541	2.173	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
344	61860029301026	4 Wid 1975 6-6x3 J	Odessa	Pecos	3.5	4.0	Associated	MC#-# 1949-1977	2.0	High Stiffness	6 Thin ACP (<2.5in.)	0.691	2.551	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
345	61860029301029	1 Org 1963 3-6x3 T	Odessa	Pecos	3.0	2.8	Associated	MC#-# 1949-1977	2.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.688	2.297	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
346	61860029301029	2 Wid 1975 3-6x3 T	Odessa	Pecos	3.8	4.0	Associated	MC#-# 1949-1977	2.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.688	2.297	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
347	61860044107025	1 Org 1931 4-6x6 J	Odessa	Pecos	3.8	3.5	Associated	MBC-#	0.5	Low Stiffness	6 Thin ACP (<2.5in.)	1.003	1.717	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
348	61860044107025	2 Add 1959 2-8x6 J	Odessa	Pecos	3.8	3.0	Associated	MC#-# 1949-1977	0.5	Low Stiffness	6 Thin ACP (<2.5in.)	0.672	1.160	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
349	61860044107025	3 Wid 1959 4-6x6 J	Odessa	Pecos	3.8	3.0	Associated	MC#-# 1949-1977	0.5	Low Stiffness	6 Thin ACP (<2.5in.)	0.650	1.326	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
350	61860044107169	1 Org 1964 3-7x3 T	Odessa	Pecos	3.8	4.0	Associated	MC#-# 1949-1977	2.0	High Stiffness	6 Thin ACP (<2.5in.)	0.525	2.173	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
351	61860044107169	2 Wid 1982 3-7x3 T	Odessa	Pecos	--	--	--	--	--	High Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Post-1979
352	61860044108029	1 Org 1931 4-6x6 T	Odessa	Pecos	5.0	5.0	Provided	MBC-#	1.5	Low Stiffness	6 Thin ACP (<2.5in.)	1.127	2.682	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
353	61860044108029	2 Wid 1959 4-6x6 T	Odessa	Pecos	5.0	5.0	Provided	MC#-# 1949-1977	1.5	Low Stiffness	6 Thin ACP (<2.5in.)	0.713	1.864	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
354	61860044108097	1 Org 1971 3-7x3 T	Odessa	Pecos	3.8	3.5	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.465	1.204	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
355	61860055603007	1 Org 1958 6-6x5 T	Odessa	Pecos	3.8	3.5	Associated	MC#-# 1949-1977	1.5	High Stiffness	6 Thin ACP (<2.5in.)	0.742	2.047	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
356	61860055603008	1 Org 1958 5-8x8 T	Odessa	Pecos	3.8	3.0	Associated	MC#-# 1949-1977	3.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.726	4.063	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
357	61860086605009	1 Org 1968 4-5x2 T	Odessa	Pecos	3.8	3.5	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.564	1.516	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
358	61860086605012	1 Org 1968 3-7x4 T	Odessa	Pecos	3.8	4.0	Associated	MC#-# 1949-1977	1.0	Low Stiffness	6 Thin ACP (<2.5in.)	0.470	1.196	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
359	61950000305042	1 Org 1941 4-6x5 T	Odessa	Reeves	3.8	2.5	Associated	MBC ##-##	0.5	High Stiffness	6 Thin ACP (<2.5in.)	0.727	1.808	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
360	61950000306046	1 Org 1955 4-6x3 T	Odessa	Reeves	3.8	3.3	Associated	MC#-# 1949-1977	0.5	Medium Stiffness	6 Thin ACP (<2.5in.)	0.512	1.113	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
361	61950013902034	1 Org 1932 6-6x4 T	Odessa	Reeves	3.8	3.5	Associated	MBC-#	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.825	2.202	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
362	61950013902034	2 Wid 1960 6-6x4 T	Odessa	Reeves	3.8	3.3	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.569	1.475	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
363	61950013903018	1 Org 1932 3-8x8 T	Odessa	Reeves	3.8	2.5	Associated	MBC-#	1.0	High Stiffness	6 Thin ACP (<2.5in.)	0.529	2.191	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
364	61950013903018	2 Wid 1959 3-8x8 T	Odessa	Reeves	3.8	2.5	Associated	MC#-# 1949-1977	1.0	High Stiffness	6 Thin ACP (<2.5in.)	0.624	1.583	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
365	61950013903018	3 Wid 2000 3-8x8 T	Odessa	Reeves	--	--	--	--	--	High Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Post-1979
366	61950013903056	1 Org 1959 6-7x7 T	Odessa	Reeves	3.8	3.8	Associated	MC#-# 1949-1977	1.0	High Stiffness	6 Thin ACP (<2.5in.)	0.594	1.471	Wall Exterior Top	M	FIX	2: IR< HS20, OR>=HS20
367	61950013905069	1 Org 1977 5-5x2 T	Odessa	Reeves	3.8	3.5	Associated	MC#-# 1949-1977	0.5	Medium Stiffness	6 Thin ACP (<2.5in.)	0.570	1.791	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
368	61950044106051	1 Org 1964 9-5x2 E	Odessa	Reeves	3.0	2.5	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.564	1.501	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
369	61950044106051	2 Wid 1982 9-5x2 T	Odessa	Reeves	--	--	--	--	--	Medium Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Post-1979
370	61950044109062	1 Org 1971 2-5x5 T	Odessa	Reeves	3.8	2.0	Associated	MC#-# 1949-1977	8.0	High Stiffness	6 Thin ACP (<2.5in.)	0.947	3.539	Wall Exterior Bottom	M	FIX	1: IR>=HS20, OR> HS20
371	61950044109062	2 Org 1971 3-5x5 T	Odessa	Reeves	3.8	2.0	Associated	MC#-# 1949-1977	8.0	High Stiffness	6 Thin ACP (<2.5in.)	0.724	3.298	Wall Exterior Bottom	M	FIX	1: IR>=HS20, OR> HS20
372	61950044109105	1 Org 1974 5-6x4 T	Odessa	Reeves	3.8	3.3	Associated	MC#-# 1949-1977	4.0	High Stiffness	6 Thin ACP (<2.5in.)	1.457	5.055	Top Corner	V	FIX	1: IR>=HS20, OR> HS20
373	61950044109111	1 Org 1974 4-7x3 T	Odessa	Reeves	3.8	3.5	Associated	MC#-# 1949-1977	4.0	Medium Stiffness	6 Thin ACP (<2.5in.)	1.430	4.454	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
374	61950296802005	1 Org 1966 5-5x4 T	Odessa	Reeves	3.8	3.5	Associated	MC#-# 1949-1977	1.0	High Stiffness	6 Thin ACP (<2.5in.)	0.635	1.679	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
375	62220002107110	1 Org 1939 2-4x3 J	Odessa	Terrell	3.0	2.0	Associated	BC-#	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.963	2.549	Top Midspan	M	FIX	1: IR>=HS20, OR> HS20
376	62220002107110	2 Wid 1961 1-8.5x3 J	Odessa	Terrell	3.8	2.0	Associated	FC - #	1.5	Medium Stiffness	6 Thin ACP (<2.5in.)	0.032	0.277	Wall Exterior Top	M	FIX	4: IR>=HS 3, OR< HS10
377	62220002107110	3 Add 1961 3-7x3 J	Odessa	Terrell	3.8	3.8	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.422	1.222	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
378	62220002202062	1 Org 1954 4-5x2 T	Odessa	Terrell	3.8	4.0	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.564	1.516	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
379	62220002202062	2 Wid 1985 4-5x2 T	Odessa	Terrell	--	--	--	--	--	Medium Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Post-1979
380	62310007605016	1 Org 1930 9-6x4 T	Odessa	Upton	3.8	2.5	Associated	MBC-#	0.5	Medium Stiffness	6 Thin ACP (<2.5in.)	1.338	2.240	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
381	62310007605016	2 Wid 1955 9-6x4 T	Odessa	Upton	3.8	2.5	Associated	MC#-# 1949-1977	0.5	Medium Stiffness	6 Thin ACP (<2.5in.)	0.576	1.142	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
382	62310022904026	1 Org 1934 6-4x4 E	Odessa	Upton	3.8	3.3	Associated	MBC-#	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.725	2.175	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
383	62310022904026	2 Org 1934 7-4x4 E	Odessa	Upton	3.8	3.8	Associated	MBC-#	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.725	2.174	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
384	62310022904026	3 Exp 1934 1-4x4 E	Odessa	Upton	--	--	--	--	--	Medium Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Expansion slab
385	62310022904026	4 Wid 1964 30-4x4 T	Odessa	Upton	3.8	2.5	Associated	MBC-#	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.905	2.542	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
386	62310022904026	5 Add 1964 9-4x4 J	Odessa	Upton	3.8	2.5	Associated	MBC-#	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.905	2.542	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
387	62310055601033	1 Org 1969 4-7x3 T	Odessa	Upton	3.8	3.0	Associated	MC#-# 1949-1977	2.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.597	1.949	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
388	62380000402066	1 Org 1968 5-6x4 T	Odessa	Ward	5.0	5.0	Provided	MC#-# 1949-1977	1.0	High Stiffness	6 Thin ACP (<2.5in.)	0.625	1.456	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
389	62380000402066	2 Wid 1985 5-6x4 T	Odessa	Ward	--	--	--	--	--	High Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Post-1979
390	62380100101002	1 Org 1947 4-6x5 T	Odessa	Ward	5.0	5.0	Provided	MBC ##-##	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.550	1.880	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
391	70410040604007	1 Org 1941 4-6x4 T	San Angelo	Coke	5.0	5.0	Provided	MBC-#-#(-F)	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.765	2.308	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
392	70410040604007	2 Wid 1969 4-6x4 T	San Angelo	Coke	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.380	1.147	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
393	70410040701010	1 Org 1935 7-6x3 T	San Angelo	Coke	3.0	2.3	Associated	MBC ##-##	1.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.404	2.550	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
394	70410040701010	2 Wid 1957 7-6x3 T	San Angelo	Coke	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.506	1.615	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
395	70410045404031	1 Org 1946 3-7x6 T	San Angelo	Coke	5.0	5.0	Provided	MBC-#-#(-F)	2.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.554	3.095	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
396	70410045404041	1 Org 1956 3-7x5 T	San Angelo	Coke	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.600	1.368	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
397	70480007004063	1 Org 1973 4-5x3 J	San Angelo	Concho	5.0	5.0	Provided	MC#-# 1949-1977	2.5	Medium Stiffness	5 Int. ACP (2.5-5in.)	1.230	3.774	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
398	70480007004063	2 Wid 2006 4-5x3 J	San Angelo	Concho	--	--	--	--	--	Medium Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
399	70480007004063	3 Add 2006 1-5x3 J	San Angelo	Concho	--	--	--	--	--	Medium Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979

TABLE A: Summary Load Rating Results for 1,788 Segments/ 1,000 Culverts

No (1)	Structure No (2)	Segment ID (3)	District (4)	County (5)	Interpreted Parameter Score (6)	Design Selection Score (7)	Design Class (8)	Design Name (9)	Critical Cover Soil Depth (10)	Soil Type (11)	Pavement (12)	HS20 Lvl1 ORF (13)	HS20 Lvl3 ORF (14)	Lvl3 Controlling Critical Section (15)	Lvl3 Failure Mode (16)	Lvl3 Fixity (17)	Lvl3 Load Posting Class (18)
400	70480007005019	1 Org 1935 6-6x5 E	San Angelo	Concho	4.3	4.5	Specified	MBC-#	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.531	1.844	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
401	70480007005019	2 Exp 1935 1-6x5 E	San Angelo	Concho	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Expansion slab
402	70480007005019	3 Wid 1968 6-6x5 E	San Angelo	Concho	4.3	3.8	Specified	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.663	1.312	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
403	70480007005019	4 Exp 1968 1-6x5 E	San Angelo	Concho	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Expansion slab
404	70480087004015	1 Org 1959 6-10x8 T	San Angelo	Concho	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.553	1.202	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
405	70480087004016	1 Org 1959 4-9x6 T	San Angelo	Concho	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.566	1.021	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
406	70480087004031	1 Org 1970 4-8x6 T	San Angelo	Concho	3.8	3.0	Associated	MC#-# 1949-1977	2.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.703	1.763	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
407	70480227801001	1 Org 1958 5-8x4 T	San Angelo	Concho	5.0	5.0	Provided	MC#-# 1949-1977	1.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.417	1.178	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
408	70530014010269	1 Org 1979 6-9x7 T	San Angelo	Crockett	3.8	3.0	Associated	MC#-# 1949-1977	2.0	High Stiffness	5 Int. ACP (2.5-5in.)	1.071	2.852	Top Corner	V	FIX	1: IR>=HS20, OR> HS20
409	70530014010274	1 Org 1979 4-7x3 T	San Angelo	Crockett	3.8	2.5	Associated	MC#-# 1949-1977	6.5	High Stiffness	5 Int. ACP (2.5-5in.)	2.466	7.369	Top Corner	V	FIX	1: IR>=HS20, OR> HS20
410	70530014014087	1 Org 1937 5-5x3 T	San Angelo	Crockett	3.8	3.5	Associated	MBC ##-##	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.602	2.167	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
411	70530014113003	1 Org 1933 5-6x3 T	San Angelo	Crockett	3.8	3.5	Associated	MBC-#	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.643	1.924	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
412	70530041204021	1 Org 1967 5-7x3 T	San Angelo	Crockett	3.8	3.5	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.467	1.020	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
413	70530055810039	1 Org 1965 6-10x10 T	San Angelo	Crockett	3.8	3.0	Associated	MC#-# 1949-1977	0.5	Low Stiffness	10 Seal Coat or Surf. Tmt	0.329	0.968	Top Midspan	M	PIN	3: IR< HS20, OR> HS10
414	70530164502002	1 Org 1935 4-6x4 T	San Angelo	Crockett	3.8	4.0	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.461	1.019	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
415	70530164502002	2 Wid 1996 4-6x4 T	San Angelo	Crockett	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Post-1979
416	70880040501009	1 Org 1954 4-9x5 T	San Angelo	Glasscock	5.0	5.0	Provided	MC#-# 1949-1977	4.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.759	3.442	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
417	70880040501009	2 Wid 1960 4-9x5 T	San Angelo	Glasscock	4.3	4.3	Specified	MC#-# 1949-1977	4.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.759	3.442	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
418	70880040501009	3 Wid 2013 4-9x5 T	San Angelo	Glasscock	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Post-1979
419	71190007705007	1 Org 1933 4-6x5 E	San Angelo	Irion	3.8	3.8	Associated	MBC-#	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.531	1.886	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
420	71190007705007	2 Exp 1933 1-6x5 E	San Angelo	Irion	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Expansion slab
421	71190007705007	3 Org 1933 5-6x5 E	San Angelo	Irion	3.8	3.8	Associated	MBC-#	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.531	1.839	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
422	71190007705007	4 Wid 1958 10-6x5 T	San Angelo	Irion	3.8	2.5	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.654	1.306	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
423	71190164804011	1 Org 1957 4-10x8 J	San Angelo	Irion	5.0	5.0	Provided	MC#-# 1949-1977	0.5	Low Stiffness	10 Seal Coat or Surf. Tmt	0.590	0.967	Top Midspan	M	PIN	3: IR< HS20, OR> HS10
424	71190164804011	2 Org 1957 5-10x8 J	San Angelo	Irion	5.0	5.0	Provided	MC#-# 1949-1977	0.5	Low Stiffness	10 Seal Coat or Surf. Tmt	0.590	0.940	Top Midspan	M	PIN	3: IR< HS20, OR> HS10
425	71640003505046	1 Org 1935 7-8x8 T	San Angelo	Menard	3.8	2.5	Associated	MBC-#-#(-F)	3.0	High Stiffness	6 Thin ACP (<2.5in.)	1.064	6.488	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
426	71640003505046	2 Wid 1957 7-8x8 T	San Angelo	Menard	3.8	2.5	Associated	MC#-# 1949-1977	3.0	High Stiffness	6 Thin ACP (<2.5in.)	0.726	4.564	Top Corner	V	PIN	1: IR>=HS20, OR> HS20
427	71640003506038	1 Org 1941 3-7x6 E	San Angelo	Menard	5.0	5.0	Provided	MBC ##-##	0.5	Low Stiffness	10 Seal Coat or Surf. Tmt	0.489	1.501	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
428	71640003506038	2 Exp 1941 1-7x6 E	San Angelo	Menard	--	--	--	--	--	Low Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Expansion slab
429	71640003506038	3 Wid 1960 3-7x6 E	San Angelo	Menard	5.0	5.0	Provided	MC#-# 1949-1977	0.5	Low Stiffness	10 Seal Coat or Surf. Tmt	0.626	1.032	Top Midspan	M	FIX	2: IR< HS20, OR>=HS20
430	71640003506038	4 Exp 1960 1-7x6 E	San Angelo	Menard	--	--	--	--	--	Low Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Expansion slab
431	71640039601015	1 Org 1939 6-6x4 T	San Angelo	Menard	3.0	1.8	Associated	MBC-#-#(-F)	6.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	2.560	12.441	Wall Exterior Bottom	M	PIN	1: IR>=HS20, OR> HS20
432	71640039601015	2 Wid 1957 6-6x4 T	San Angelo	Menard	3.8	3.5	Associated	MC#-# 1949-1977	6.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	1.476	5.490	Top Corner	V	FIX	1: IR>=HS20, OR> HS20
433	71640039605034	1 Org 1963 5-8x4 T	San Angelo	Menard	3.8	3.3	Associated	MC#-# 1949-1977	2.0	High Stiffness	10 Seal Coat or Surf. Tmt	0.452	0.939	Wall Interior Top	M	FIX	3: IR< HS20, OR> HS10
434	71920055808033	1 Org 1961 8-10x8 T	San Angelo	Reagan	3.8	2.5	Associated	MC#-# 1949-1977	0.5	Low Stiffness	10 Seal Coat or Surf. Tmt	0.590	0.973	Top Midspan	M	PIN	3: IR< HS20, OR> HS10
435	71920055809028	1 Org 1960 3-8x4 T	San Angelo	Reagan	3.8	3.3	Associated	MC#-# 1949-1977	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.428	1.719	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
436	71920055809031	1 Org 1960 3-8x4 T	San Angelo	Reagan	3.8	3.3	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.360	1.010	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
437	71920055809032	1 Org 1960 3-8x4 T	San Angelo	Reagan	3.0	2.0	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.360	1.010	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
438	71920055809032	2 Wid 1993 3-8x4 T	San Angelo	Reagan	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Post-1979
439	71930020106008	1 Oth 1935 4-6x5 J	San Angelo	Real	--	--	--	--	--	High Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Geometry outside sc
440	71930020106008	2 Oth 1935 1-5x5 J	San Angelo	Real	--	--	--	--	--	High Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Geometry outside sc
441	71930020106008	3 Wid 1948 4-6x5 J	San Angelo	Real	3.5	3.8	Associated	MBC-#	1.0	High Stiffness	10 Seal Coat or Surf. Tmt	0.531	1.834	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
442	71930020106008	4 Wid 1948 1-5x5 J	San Angelo	Real	3.5	3.3	Associated	SC- N	1.0	High Stiffness	10 Seal Coat or Surf. Tmt	0.545	1.321	Top Corner	M	FIX	2: IR< HS20, OR>=HS20
443	71930020106008	5 Wid 1960 4-6x5 J	San Angelo	Real	3.5	3.3	Associated	MC#-# 1949-1977	1.0	High Stiffness	10 Seal Coat or Surf. Tmt	0.640	1.310	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
444	71930020106008	6 Wid 1960 1-5x5 J	San Angelo	Real	3.5	3.0	Associated	SC- N	1.0	High Stiffness	10 Seal Coat or Surf. Tmt	0.696	1.633	Top Corner	M	FIX	2: IR< HS20, OR>=HS20
445	71930023503019	1 Org 1957 2-10x10 T	San Angelo	Real	3.8	3.0	Associated	MBC-#	2.0	High Stiffness	10 Seal Coat or Surf. Tmt	1.599	5.004	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
446	72000003403052	1 Org 1972 6-10x8 T	San Angelo	Runnels	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Low Stiffness	6 Thin ACP (<2.5in.)	0.553	1.375	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
447	72000003501005	1 Org 1930 5-4x4 T	San Angelo	Runnels	4.3	4.3	Specified	MBC-#	1.5	Medium Stiffness	6 Thin ACP (<2.5in.)	0.834	2.898	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
448	72000003501005	2 Wid 1956 5-4x4 T	San Angelo	Runnels	3.8	3.3	Associated	MBC-#	1.5	Medium Stiffness	6 Thin ACP (<2.5in.)	1.045	3.297	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
449	72000015801040	1 Org 1961 5-8x4 T	San Angelo	Runnels	3.0	2.8	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.376	1.011	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
450	72000015801040	2 Wid 2002 5-8x4 T	San Angelo	Runnels	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Post-1979
451	72000107003007	1 Org 1959 5-6x4 T	San Angelo	Runnels	4.3	3.8	Specified	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.569	1.233	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
452	72000164102001	1 Org 1957 4-7x5 T	San Angelo	Runnels	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.831	1.965	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
453	72000228001002	1 Org 1965 4-7x3 T	San Angelo	Runnels	3.8	3.5	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.425	1.031	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
454	72000228002001	1 Org 1958 4-8x4 T	San Angelo	Runnels	3.8	3.5	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.376	1.010	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
455	72000247001001	1 Org 1960 3-9x5 T	San Angelo	Runnels	3.8	3.8	Associated	MC#-# 1949-1977	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.574	1.644	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
456	72070015903032	1 Org 1965 7-10x6 T	San Angelo	Schleicher	3.8	2.5	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.542	0.935	Wall Exterior Top	M	PIN	3: IR< HS20, OR> HS10

TABLE A: Summary Load Rating Results for 1,788 Segments/ 1,000 Culverts

No	Structure No	Segment ID	District	County	Interpreted Parameter Score	Design Selection Score	Design Class	Design Name	Critical Cover Soil Depth	Soil Type	Pavement	HS20 Lvl1 ORF	HS20 Lvl3 ORF	Lvl3 Controlling Critical Section	Lvl3 Failure Mode	Lvl3 Fixity	Lvl3 Load Posting Class
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
457	72070039603039	1 Org 1965 5-5x3 T	San Angelo	Schleicher	3.8	3.0	Associated	MC#-# 1949-1977	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	1.038	2.347	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
458	72070039603045	1 Org 1967 5-9x5 T	San Angelo	Schleicher	3.8	3.5	Associated	MC#-# 1949-1977	2.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.574	1.520	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
459	72160040502011	1 Org 1956 2-10x6 T	San Angelo	Sterling	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.546	0.965	Wall Exterior Top	M	PIN	3: IR< HS20, OR> HS10
460	72160040502013	1 Org 1956 5-10x10 T	San Angelo	Sterling	4.3	3.8	Specified	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.343	1.165	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
461	72180014103013	1 Org 1933 6-6x6 E	San Angelo	Sutton	5.0	5.0	Provided	MBC-#	1.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	1.127	2.493	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
462	72180014103013	2 Org 1933 5-6x6 E	San Angelo	Sutton	5.0	5.0	Provided	MBC-#	1.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	1.127	2.491	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
463	72180014103013	3 Exp 1933 1-6x6 E	San Angelo	Sutton	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Expansion slab
464	72180014103082	1 Org 1969 5-6x5 T	San Angelo	Sutton	3.8	2.5	Associated	MC#-# 1949-1977	10.5	Low Stiffness	10 Seal Coat or Surf. Tmt	-0.270	3.138	Top Corner	V	FIX	1: IR>=HS20, OR> HS20
465	72180014116042	1 Org 1948 4-6x5 T	San Angelo	Sutton	3.8	3.0	Associated	MBC ##-##	1.5	Low Stiffness	10 Seal Coat or Surf. Tmt	0.772	2.425	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
466	72260006906128	1 Org 1974 7-10x8 T	San Angelo	Tom Green	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.652	2.895	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
467	72260006907102	1 Org 1968 4-5x2 T	San Angelo	Tom Green	5.0	5.0	Provided	MC#-# 1949-1977	1.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.656	1.612	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
468	72260006907104	1 Oth 1968 2-10x3.5 T	San Angelo	Tom Green	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Geometry outside sc
469	72260007002048	1 Org 1969 6-5x3 T	San Angelo	Tom Green	5.0	5.0	Provided	MC#-# 1949-1977	0.5	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.653	1.506	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
470	72260007706058	1 Org 1968 2-10x8 T	San Angelo	Tom Green	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.647	2.224	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
471	72260007706058	2 Wid 1980 2-10x8 T	San Angelo	Tom Green	--	--	--	--	--	Medium Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Post-1979
472	72260015802019	1 Org 1958 4-8x6 T	San Angelo	Tom Green	3.8	3.0	Associated	MC#-# 1949-1977	0.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.582	0.911	Top Corner	M	PIN	3: IR< HS20, OR> HS10
473	72260015902038	1 Org 1975 2-10x8 T	San Angelo	Tom Green	5.0	5.0	Provided	MC#-# 1949-1977	4.5	Low Stiffness	10 Seal Coat or Surf. Tmt	1.167	1.947	Wall Exterior Bottom	M	FIX	1: IR>=HS20, OR> HS20
474	72260087003029	1 Org 1970 10-10x8 T	San Angelo	Tom Green	3.8	2.5	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.553	1.157	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
475	80170029502023	1 Org 1939 3-10x10 T	Abilene	Borden	3.8	3.0	Associated	MBC-#	0.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.472	1.515	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
476	80170029502024	1 Org 1939 5-8x7 T	Abilene	Borden	3.8	2.0	Associated	MBC-#	2.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	1.463	5.287	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
477	80170029502024	2 Wid 1969 5-8x7 T	Abilene	Borden	3.8	3.5	Associated	MC#-# 1949-1977	2.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.575	2.516	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
478	80170029503039	1 Org 1970 5-6x5 T	Abilene	Borden	3.8	3.3	Associated	MC#-# 1949-1977	1.5	Medium Stiffness	4 Thick ACP (>5in.)	0.753	2.223	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
479	80300018102003	1 Org 1939 5-8x7 T	Abilene	Callahan	5.0	5.0	Provided	MBC-#-#(-F)	1.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.773	1.940	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
480	80300018102003	2 Wid 1959 5-8x7 T	Abilene	Callahan	4.3	4.5	Specified	MC#-# 1949-1977	1.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.605	1.530	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
481	80300043703025	1 Org 1940 3-7x4 T	Abilene	Callahan	5.0	5.0	Provided	MBC-#-#(-F)	7.5	Low Stiffness	10 Seal Coat or Surf. Tmt	1.400	9.129	Wall Exterior Bottom	M	PIN	1: IR>=HS20, OR> HS20
482	80300043703025	2 Wid 2006 3-7x4 T	Abilene	Callahan	--	--	--	--	--	Low Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Post-1979
483	80300210801006	1 Org 1958 2-10x8 T	Abilene	Callahan	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.562	1.197	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
484	80300210801006	2 Wid 2003 2-10x10 T	Abilene	Callahan	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Post-1979
485	80770031701009	1 Org 1955 5-7x4 T	Abilene	Fisher	3.8	4.0	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.479	1.040	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
486	80770237901004	1 Org 1964 2-7x6 T	Abilene	Fisher	3.8	4.0	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.618	1.247	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
487	81050009807021	1 Org 1932 3-8x8 T	Abilene	Haskell	3.8	1.8	Associated	MBC-#	2.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.671	2.775	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
488	81050009807021	2 Wid 1970 3-8x8 T	Abilene	Haskell	3.8	3.0	Associated	MC#-# 1949-1977	2.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.780	1.963	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
489	81050036004019	1 Org 1939 5-6x6 T	Abilene	Haskell	3.8	3.3	Associated	MBC-#	0.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.596	1.606	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
490	81050036004020	1 Org 1939 4-5x5 T	Abilene	Haskell	3.8	3.3	Associated	MBC-#	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.739	1.547	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
491	81050124701001	1 Org 1954 4-6x3 T	Abilene	Haskell	3.8	3.3	Associated	MC#-# 1949-1977	0.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.512	0.961	Wall Exterior Top	M	PIN	3: IR< HS20, OR> HS10
492	81050151202002	1 Org 1957 3-8x4 T	Abilene	Haskell	3.8	3.5	Associated	MC#-# 1949-1977	0.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.369	0.826	Wall Exterior Top	M	PIN	3: IR< HS20, OR> HS10
493	81150000505025	1 Org 1938 5-6x6 T	Abilene	Howard	3.8	3.5	Associated	MBC-#	3.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	2.566	8.164	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
494	81150000505025	2 Wid 1954 5-6x6 T	Abilene	Howard	3.8	2.5	Associated	MC#-# 1949-1977	3.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	1.312	4.227	Top Corner	V	PIN	1: IR>=HS20, OR> HS20
495	81150000505142	1 Org 1964 3-8x4 T	Abilene	Howard	3.8	2.5	Associated	MC#-# 1949-1977	2.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.558	2.351	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
496	81150000505142	2 Wid 1981 3-8x4 T	Abilene	Howard	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Post-1979
497	81150000510158	1 Org 1963 3-5x4 T	Abilene	Howard	3.8	3.0	Associated	MC#-# 1949-1977	2.0	High Stiffness	5 Int. ACP (2.5-5in.)	1.215	3.113	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
498	81150006901076	1 Org 1940 4-6x3 T	Abilene	Howard	5.0	5.0	Provided	MBC-#-#(-F)	1.0	Medium Stiffness	4 Thick ACP (>5in.)	0.458	2.845	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
499	81150006901076	2 Wid 1969 4-6x3 T	Abilene	Howard	3.0	1.8	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	4 Thick ACP (>5in.)	0.556	1.641	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
500	81150006901076	3 Wid 1989 4-6x3 T	Abilene	Howard	--	--	--	--	--	Medium Stiffness	4 Thick ACP (>5in.)	--	--	--	--	--	NLR: Post-1979
501	81150069301021	1 Org 1969 5-7x3 T	Abilene	Howard	3.8	3.0	Associated	MC#-# 1949-1977	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.597	1.662	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
502	81280029604043	1 Org 1947 6-5x2 T	Abilene	Jones	3.0	1.8	Associated	MBC-#-#(-F)	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.807	3.352	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
503	81280029604043	2 Wid 1970 6-5x2 T	Abilene	Jones	3.8	3.5	Associated	MC#-# 1949-1977	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.886	2.219	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
504	81280029605031	1 Org 1927 5-8x8 T	Abilene	Jones	3.8	3.5	Associated	MBC-#	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	1.284	3.871	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
505	81280029605031	2 Wid 1949 5-8x8 T	Abilene	Jones	3.8	3.0	Associated	MC#-# 1949-1977	1.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.540	1.329	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
506	81280097207012	1 Org 1962 3-8x4 T	Abilene	Jones	3.8	3.3	Associated	MC#-# 1949-1977	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.488	1.698	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
507	81320201102002	1 Org 1955 2-10x10 T	Abilene	Kent	3.8	2.8	Associated	MC#-# 1949-1977	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.452	2.046	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
508	81680051802003	1 Org 1955 3-6x6 T	Abilene	Mitchell	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.627	1.235	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
509	81680096603005	1 Org 1955 4-5x4 T	Abilene	Mitchell	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.622	1.425	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
510	81770000603272	1 Org 1962 2-8x5 T	Abilene	Nolan	3.8	2.8	Associated	MC#-# 1949-1977	0.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.641	0.880	Top Corner	M	PIN	3: IR< HS20, OR> HS10
511	82080005308014	1 Org 1978 3-9x9 T	Abilene	Scurry	3.5	3.3	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	4 Thick ACP (>5in.)	0.875	2.807	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
512	82080152603004	1 Org 1953 5-6x6 T	Abilene	Scurry	3.8	3.5	Associated	MC#-# 1949-1977	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.780	1.813	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
513	82090001104010	1 Org 1929 5-4x4 T	Abilene	Shackelford	3.8	2.5	Associated	MBC-#	6.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	4.664	10.148	Top Corner	V	PIN	1: IR>=HS20, OR> HS20

No (1)	Structure No (2)	Segment ID (3)	District (4)	County (5)	Interpreted Parameter Score (6)	Design Selection Score (7)	Design Class (8)	Design Name (9)	Critical Cover Soil Depth (10)	Soil Type (11)	Pavement (12)	HS20 Lvl1 ORF (13)	HS20 Lvl3 ORF (14)	Lvl3 Controlling Critical Section (15)	Lvl3 Failure Mode (16)	Lvl3 Fixity (17)	Lvl3 Load Posting Class (18)
514	82090001104010	2 Wid 1954 5-4x4 T	Abilene	Shackelford	3.5	3.5	Associated	MBC-#	6.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	6.047	12.610	Top Corner	V	PIN	1: IR>=HS20, OR> HS20
515	82090001104010	3 Wid 1962 5-4x4 T	Abilene	Shackelford	3.8	3.5	Associated	MBC-#	6.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	6.047	12.610	Top Corner	V	PIN	1: IR>=HS20, OR> HS20
516	82170003301001	1 Org 1932 2-10x10 T	Abilene	Stonewall	3.8	3.0	Associated	MBC-#	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.698	1.922	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
517	82170003301001	2 Wid 1957 2-10x10 T	Abilene	Stonewall	3.8	3.0	Associated	MBC-#	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	1.439	3.527	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
518	82170010606038	1 Org 1934 3-8x8 T	Abilene	Stonewall	3.8	3.0	Associated	MBC-#	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.529	1.836	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
519	82170010606038	2 Wid 2002 3-8x8 T	Abilene	Stonewall	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Post-1979
520	82170036001023	1 Org 1941 4-5x2 T	Abilene	Stonewall	2.8	2.0	Associated	MBC ##-##	2.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.698	2.927	Wall Exterior Top	M	FIX	1: IR>=HS20, OR> HS20
521	82170036001023	2 Wid 1997 4-5x2 T	Abilene	Stonewall	--	--	--	--	--	Low Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Post-1979
522	82210000604085	1 Org 1927 3-8x8 T	Abilene	Taylor	3.8	2.3	Associated	MBC-#	2.0	Low Stiffness	10 Seal Coat or Surf. Tmt	1.274	3.487	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
523	82210000604085	2 Wid 1977 3-8x8 T	Abilene	Taylor	3.8	3.0	Associated	MC#-# 1949-1977	2.0	Low Stiffness	10 Seal Coat or Surf. Tmt	1.197	2.224	Top Corner	V	PIN	1: IR>=HS20, OR> HS20
524	82210000605222	1 Org 1961 17-7x3 T	Abilene	Taylor	5.0	5.0	Provided	MC#-# 1949-1977	3.0	Medium Stiffness	4 Thick ACP (>5in.)	0.791	3.491	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
525	82210000606226	1 Org 1961 6-9x5 T	Abilene	Taylor	5.0	5.0	Provided	MC#-# 1949-1977	1.0	High Stiffness	10 Seal Coat or Surf. Tmt	0.522	1.001	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
526	82210000606252	1 Org 1961 6-8x6 T	Abilene	Taylor	5.0	5.0	Provided	MC#-# 1949-1977	6.5	Low Stiffness	10 Seal Coat or Surf. Tmt	1.345	4.259	Wall Exterior Bottom	M	FIX	1: IR>=HS20, OR> HS20
527	82210000618032	1 Org 1928 4-5x4.66 E	Abilene	Taylor	3.5	2.5	Associated	MBC-#	0.5	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.757	1.704	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
528	82210000618032	2 Org 1928 5-5x4.66 E	Abilene	Taylor	3.3	2.5	Associated	MBC-#	0.5	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.757	1.653	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
529	82210000618032	3 Exp 1928 1-5x5.33 E	Abilene	Taylor	--	--	--	--	--	Medium Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Expansion slab
530	82210000618032	4 Wid 1959 4-5x4.66 E	Abilene	Taylor	3.3	2.0	Associated	MC#-# 1949-1977	0.5	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.665	1.634	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
531	82210000618032	5 Wid 1959 5-5x4.66 E	Abilene	Taylor	3.3	2.0	Associated	MC#-# 1949-1977	0.5	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.651	1.588	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
532	82210000618032	6 Exp 1959 1-5x5.33 E	Abilene	Taylor	--	--	--	--	--	Medium Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Expansion slab
533	82210003306062	1 Org 1959 5-8x5 T	Abilene	Taylor	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.550	1.111	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
534	82210003306062	2 Wid 1981 5-8x5 T	Abilene	Taylor	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Post-1979
535	82210003306064	1 Org 1959 5-8x4 T	Abilene	Taylor	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.376	1.011	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
536	82210003306064	2 Wid 1981 5-8x4 T	Abilene	Taylor	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Post-1979
537	82210005401003	1 Oth 1923 4-10x7 T	Abilene	Taylor	--	--	--	--	--	Medium Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Geometry outside sc
538	82210005401003	2 Oth 1946 4-10x7 T	Abilene	Taylor	--	--	--	--	--	Medium Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Geometry outside sc
539	82210005401003	3 Oth 2008 4-10x7 T	Abilene	Taylor	--	--	--	--	--	Medium Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Geometry outside sc
540	82210065002005	1 Org 1946 4-5x2 T	Abilene	Taylor	5.0	5.0	Provided	MBC-#-#(-F)	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.633	1.954	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
541	82210065002005	2 Wid 1983 4-5x2 T	Abilene	Taylor	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Post-1979
542	82210066303018	1 Org 1957 6-8x4 T	Abilene	Taylor	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.376	1.010	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
543	82210067701003	1 Oth 1943 3-6x2 T	Abilene	Taylor	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Geometry outside sc
544	82210067701003	2 Wid 2005 3-6x2 T	Abilene	Taylor	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Post-1979
545	82210067702008	1 Org 1960 4-6x3 T	Abilene	Taylor	4.8	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.506	1.216	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
546	82210067702008	2 Wid 2001 4-6x3 T	Abilene	Taylor	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Post-1979
547	82210073303014	1 Org 1954 3-7x4 T	Abilene	Taylor	4.8	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.470	1.024	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
548	82210203204007	1 Org 1959 4-5x2 T	Abilene	Taylor	2.8	1.8	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.564	1.516	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
549	82210203204007	2 Wid 1975 4-5x2 T	Abilene	Taylor	4.5	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.564	1.516	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
550	90140018402004	1 Org 1940 3-6x6 T	Waco	Bell	4.0	5.0	Provided	MBC-#-#(-F)	1.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.874	2.651	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
551	90140083603014	1 Org 1965 5-10x8 T	Waco	Bell	4.8	5.0	Provided	MC#-# 1949-1977	1.5	Low Stiffness	5 Int. ACP (2.5-5in.)	0.606	1.757	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
552	90140083603014	2 Wid 1988 5-10x8 T	Waco	Bell	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
553	90140156501006	1 Org 1968 4-8x4 T	Waco	Bell	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.452	1.580	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
554	90140203801002	1 Org 1955 4-8x6 T	Waco	Bell	4.8	5.0	Provided	MC#-# 1949-1977	1.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.582	1.147	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
555	90140213601001	1 Org 1957 3-10x10 T	Waco	Bell	4.8	5.0	Provided	MC#-# 1949-1977	2.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.489	1.988	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
556	90140260202004	1 Org 1961 6-7x7 T	Waco	Bell	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.594	1.255	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
557	90180025805014	1 Org 1934 3-10x10 T	Waco	Bosque	5.0	5.0	Provided	MBC-#	2.0	Low Stiffness	5 Int. ACP (2.5-5in.)	1.302	4.183	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
558	90180025805014	2 Wid 1968 3-10x10 T	Waco	Bosque	5.0	5.0	Provided	MC#-# 1949-1977	1.5	Low Stiffness	5 Int. ACP (2.5-5in.)	0.454	2.062	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
559	90180025805048	1 Org 1935 3-5x5 T	Waco	Bosque	5.0	4.5	Specified	MBC-#	1.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.740	2.079	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
560	90180025805048	2 Wid 1968 3-5x5 T	Waco	Bosque	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.647	1.076	Wall Interior Top	M	FIX	2: IR< HS20, OR>=HS20
561	90180072402017	1 Org 1950 5-6x5 T	Waco	Bosque	5.0	5.0	Provided	MBC ##-##	1.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.560	1.773	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
562	90180072402017	2 Wid 1961 5-6x5 T	Waco	Bosque	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.654	1.734	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
563	90180072402017	3 Wid 1982 5-6x5 T	Waco	Bosque	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
564	90500005505022	1 Org 1934 3-10x10 T	Waco	Coryell	4.3	3.8	Specified	MBC-#	2.0	Low Stiffness	5 Int. ACP (2.5-5in.)	1.302	4.183	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
565	90500005505022	2 Wid 1964 3-10x10 T	Waco	Coryell	3.8	1.8	Associated	MC#-# 1949-1977	2.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.489	2.327	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
566	90500005505022	3 Wid 1996 3-10x10 T	Waco	Coryell	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
567	90500018401020	1 Org 1950 3-9x9 T	Waco	Coryell	5.0	5.0	Provided	MBC-#-#(-F)	2.5	Low Stiffness	5 Int. ACP (2.5-5in.)	0.490	0.517	Wall Exterior Bottom	M	FIX	3: IR< HS20, OR> HS10
568	90500023102029	1 Oth 1943 3-6x6 T	Waco	Coryell	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Geometry outside sc
569	90500023102029	2 Wid 1960 3-6x6 T	Waco	Coryell	3.8	3.3	Associated	MC#-# 1949-1977	2.0	Low Stiffness	5 Int. ACP (2.5-5in.)	1.018	2.417	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
570	90500086703015	1 Org 1958 3-9x5 T	Waco	Coryell	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.501	1.011	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20

TABLE A: Summary Load Rating Results for 1,788 Segments/ 1,000 Culverts

No (1)	Structure No (2)	Segment ID (3)	District (4)	County (5)	Interpreted Parameter Score (6)	Design Selection Score (7)	Design Class (8)	Design Name (9)	Critical Cover Soil Depth (10)	Soil Type (11)	Pavement (12)	HS20 Lvl1 ORF (13)	HS20 Lvl3 ORF (14)	Lvl3 Controlling Critical Section (15)	Lvl3 Failure Mode (16)	Lvl3 Fixity (17)	Lvl3 Load Posting Class (18)
571	90500192601004	1 Org 1946 4-5x5 T	Waco	Coryell	3.8	3.3	Associated	MBC-#	0.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.757	1.184	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
572	90500192601004	2 Wid 1956 4-5x5 T	Waco	Coryell	3.8	4.0	Associated	MC#-# 1949-1977	0.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.665	1.003	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
573	90500213801002	1 Org 1930 6-3x3 T	Waco	Coryell	3.0	2.3	Associated	MBC-#	2.0	Low Stiffness	10 Seal Coat or Surf. Tmt	1.604	1.980	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
574	90500213801002	2 Wid 1957 6-3x3 T	Waco	Coryell	3.8	2.0	Associated	MBC-#	2.0	Low Stiffness	10 Seal Coat or Surf. Tmt	1.962	2.295	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
575	90740038201022	1 Org 1957 3-9x8 T	Waco	Falls	3.8	3.3	Associated	MC#-# 1949-1977	2.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.621	2.086	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
576	90740081902004	1 Org 1966 2-10x6 T	Waco	Falls	5.0	5.0	Provided	MC#-# 1949-1977	3.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.585	2.089	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
577	90740217101002	1 Org 1957 3-10x6 T	Waco	Falls	5.0	5.0	Provided	MC#-# 1949-1977	1.5	Low Stiffness	5 Int. ACP (2.5-5in.)	0.509	1.404	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
578	90740302801002	1 Org 1967 3-10x9 T	Waco	Falls	5.0	5.0	Provided	MC#-# 1949-1977	1.5	Low Stiffness	10 Seal Coat or Surf. Tmt	0.596	1.505	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
579	90980012001014	1 Org 1947 3-6x5 T	Waco	Hamilton	5.0	5.0	Provided	MBC-#-#(-F)	1.0	High Stiffness	5 Int. ACP (2.5-5in.)	0.847	2.920	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
580	90980025101053	1 Org 1958 2-10x10 T	Waco	Hamilton	5.0	5.0	Provided	MC#-# 1949-1977	2.5	High Stiffness	5 Int. ACP (2.5-5in.)	0.523	4.573	Top Corner	V	PIN	1: IR>=HS20, OR> HS20
581	90980025102046	1 Org 1942 3-6x4 T	Waco	Hamilton	5.0	5.0	Provided	MBC-#-#(-F)	1.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.752	2.602	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
582	90980025102047	1 Org 1942 4-8x7 T	Waco	Hamilton	5.0	5.0	Provided	MBC-#-#(-F)	1.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.773	1.969	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
583	90980077405004	1 Org 1954 4-6x4 T	Waco	Hamilton	5.0	5.0	Provided	MC#-# 1949-1977	1.0	High Stiffness	10 Seal Coat or Surf. Tmt	0.569	1.255	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
584	90980077405005	1 Org 1954 6-8x4 T	Waco	Hamilton	5.0	5.0	Provided	MC#-# 1949-1977	1.0	High Stiffness	10 Seal Coat or Surf. Tmt	0.376	1.002	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
585	90980178003004	1 Org 1965 3-10x7 T	Waco	Hamilton	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.530	1.005	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
586	91100001424222	1 Org 2007 3-10x6 T	Waco	Hill	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
587	91100004806029	1 Org 1945 3-8x7 T	Waco	Hill	5.0	5.0	Provided	MBC-#-#(-F)	3.5	Low Stiffness	5 Int. ACP (2.5-5in.)	1.343	5.054	Wall Exterior Bottom	M	PIN	1: IR>=HS20, OR> HS20
588	91100004806029	2 Wid 1964 3-8x7 T	Waco	Hill	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.690	2.318	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
589	91100004806029	3 Wid 2002 3-8x7 T	Waco	Hill	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
590	91100020906056	1 Org 1957 4-9x5 T	Waco	Hill	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.522	1.022	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
591	91100166103007	1 Org 1958 4-6x5 T	Waco	Hill	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.985	1.998	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
592	91100230502003	1 Org 1964 4-7x6 T	Waco	Hill	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.603	1.179	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
593	91470005602044	1 Org 1941 3-7x7 T	Waco	Limestone	4.6	4.3	Specified	MBC-#-#(-F)	4.0	Low Stiffness	5 Int. ACP (2.5-5in.)	1.523	5.456	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
594	91470005602044	2 Wid 1968 3-7x7 T	Waco	Limestone	5.0	3.5	Associated	MC#-# 1949-1977	4.0	Low Stiffness	5 Int. ACP (2.5-5in.)	1.074	1.250	Wall Exterior Bottom	M	FIX	2: IR< HS20, OR>=HS20
595	91470005701012	1 Org 1958 3-10x10 T	Waco	Limestone	4.6	5.0	Provided	MC#-# 1949-1977	5.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.761	6.198	Wall Exterior Bottom	M	PIN	1: IR>=HS20, OR> HS20
596	91470009305065	1 Org 1960 4-7x4 T	Waco	Limestone	5.0	5.0	Provided	MC#-# 1949-1977	1.5	Low Stiffness	5 Int. ACP (2.5-5in.)	0.417	1.543	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
597	91470041902008	1 Org 1930 3-8x6 T	Waco	Limestone	4.6	5.0	Provided	MBC-#	1.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.861	3.123	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
598	91470041902008	2 Wid 1966 3-8x6 T	Waco	Limestone	3.8	3.0	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.560	1.603	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
599	91470083102015	1 Org 1961 4-6x6 T	Waco	Limestone	4.6	5.0	Provided	MC#-# 1949-1977	1.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.628	1.405	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
600	91470089803008	1 Org 1957 3-10x7 T	Waco	Limestone	4.6	5.0	Provided	MC#-# 1949-1977	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.615	1.894	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
601	91610001408087	1 Org 1950 3-6x6 T	Waco	McLennan	3.8	2.5	Associated	MBC ##-##	5.0	Low Stiffness	1 CRCP	2.109	5.538	Wall Exterior Bottom	M	PIN	1: IR>=HS20, OR> HS20
602	91610001408087	2 Wid 1959 3-6x6 T	Waco	McLennan	5.0	5.0	Provided	MC#-# 1949-1977	1.5	Low Stiffness	5 Int. ACP (2.5-5in.)	0.726	2.030	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
603	91610001408087	3 Wid 2012 3-6x6 T	Waco	McLennan	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
604	91610001410321	1 Org 1960 12-3x3 T	Waco	McLennan	3.8	2.5	Associated	MBC-#	1.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.661	2.085	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
605	91610001502161	1 Org 1960 2-6x6 T	Waco	McLennan	3.5	2.5	Associated	MC#-# 1949-1977	1.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.652	1.859	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
606	91610001502161	2 Wid 2013 2-6x6 T	Waco	McLennan	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
607	91610016201001	1 Org 1932 7-3x3 T	Waco	McLennan	4.3	3.8	Specified	MBC-#	1.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.534	1.841	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
608	91610016201001	2 Wid 1955 7-3x3 T	Waco	McLennan	3.8	3.5	Associated	MBC-#	0.5	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.672	1.628	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
609	91610020907054	1 Org 1957 3-10x10 T	Waco	McLennan	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.367	1.206	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
610	91610020907054	2 Wid 2006 3-10x10 T	Waco	McLennan	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Post-1979
611	91610041301001	1 Org 1935 3-8x8 T	Waco	McLennan	4.8	5.0	Provided	MBC-#	2.0	Low Stiffness	5 Int. ACP (2.5-5in.)	1.274	4.323	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
612	91610041301001	2 Wid 1964 3-8x8 T	Waco	McLennan	3.8	3.8	Specified	MC#-# 1949-1977	1.5	Low Stiffness	5 Int. ACP (2.5-5in.)	0.698	1.975	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
613	91610041301001	3 Wid 2001 3-8x8 T	Waco	McLennan	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
614	91610083103010	1 Org 1956 3-10x6 T	Waco	McLennan	4.3	4.5	Specified	MC#-# 1949-1977	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.507	1.486	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
615	91610118702003	1 Org 1951 3-8x8 T	Waco	McLennan	5.0	5.0	Provided	MC#-# 1949-1977	1.5	Low Stiffness	10 Seal Coat or Surf. Tmt	0.560	1.276	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
616	91610230503005	1 Org 1964 4-9x5 T	Waco	McLennan	4.8	5.0	Provided	MC#-# 1949-1977	2.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.543	1.386	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
617	91610250601002	1 Org 1961 2-8x5 T	Waco	McLennan	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.700	2.165	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
618	91610250601002	2 Wid 1984 2-8x5 T	Waco	McLennan	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
619	91610267402002	1 Org 1963 3-7x4 T	Waco	McLennan	3.8	3.3	Associated	MC#-# 1949-1977	3.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.787	2.532	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
620	91610303201001	1 Org 1969 3-10x7 T	Waco	McLennan	3.8	3.5	Associated	MC#-# 1949-1977	1.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.530	1.316	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
621	91610323401002	1 Org 1972 3-7x5 T	Waco	McLennan	5.0	5.0	Provided	MC#-# 1949-1977	1.5	Low Stiffness	10 Seal Coat or Surf. Tmt	0.674	1.388	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
622	91610323401005	1 Org 1972 3-10x10 T	Waco	McLennan	4.3	3.8	Specified	MC#-# 1949-1977	2.5	Low Stiffness	5 Int. ACP (2.5-5in.)	0.560	3.020	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
623	100010089102004	1 Org 1954 2-10x8 T	Tyler	Anderson	3.8	3.0	Associated	MBC-#	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	1.175	1.145	Wall Interior Top	M	FIX	2: IR< HS20, OR>=HS20
624	100370011805065	1 Org 1958 3-10x10 T	Tyler	Cherokee	3.8	3.0	Associated	MC#-# 1949-1977	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.489	2.334	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
625	100370020604010	1 Org 1930 2-8x8 T	Tyler	Cherokee	3.0	2.8	Associated	MBC-#	2.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	1.282	5.284	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
626	100370020604010	2 Wid 1953 2-8x8 T	Tyler	Cherokee	3.8	2.5	Associated	MBC-#	1.5	Medium Stiffness	5 Int. ACP (2.5-5in.)	1.524	3.769	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
627	100370037808024	1 Org 1970 4-7x3 T	Tyler	Cherokee	3.8	3.5	Associated	MC#-# 1949-1977	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.597	1.682	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20

No	Structure No	Segment ID	District	County	Interpreted Parameter Score	Design Selection Score	Design Class	Design Name	Critical Cover Soil Depth	Soil Type	Pavement	HS20 Lvl1 ORF	HS20 Lvl3 ORF	Lvl3 Controlling Critical Section	Lvl3 Failure Mode	Lvl3 Fixity	Lvl3 Load Posting Class
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
628	100370045001021	1 Org 1947 2-10x9 T	Tyler	Cherokee	3.8	3.5	Associated	MBC-#-#(-F)	3.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	1.214	7.554	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
629	100370192901001	1 Org 1954 3-10x10 T	Tyler	Cherokee	3.8	3.0	Associated	MBC-#	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	1.440	2.972	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
630	100370274201001	1 Org 1964 5-10x10 T	Tyler	Cherokee	3.8	2.5	Associated	MC#-# 1949-1977	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.455	2.311	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
631	100930264201001	1 Org 1964 2-10x6 T	Tyler	Gregg	3.8	2.5	Associated	MC#-# 1949-1977	6.5	Medium Stiffness	5 Int. ACP (2.5-5in.)	1.542	5.612	Wall Exterior Bottom	M	FIX	1: IR>=HS20, OR> HS20
632	100930308201002	1 Org 1968 3-10x10 T	Tyler	Gregg	3.8	3.0	Associated	MC#-# 1949-1977	4.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.716	6.746	Top Corner	V	PIN	1: IR>=HS20, OR> HS20
633	101080010803008	1 Org 1933 2-10x8 T	Tyler	Henderson	3.8	2.5	Associated	MBC-#	5.0	Medium Stiffness	6 Thin ACP (<2.5in.)	2.323	7.383	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
634	101080010803008	2 Wid 1968 2-10x8 T	Tyler	Henderson	3.8	3.5	Associated	MC#-# 1949-1977	5.0	Medium Stiffness	6 Thin ACP (<2.5in.)	1.625	4.878	Wall Exterior Bottom	M	FIX	1: IR>=HS20, OR> HS20
635	101080010803009	1 Org 1933 4-10x12 T	Tyler	Henderson	--	--	--	--	--	Medium Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: No standard design
636	101080010803009	2 Wid 1968 4-10x12 T	Tyler	Henderson	--	--	--	--	--	Medium Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: No standard design
637	101080016402006	1 Org 1930 4-10x10 T	Tyler	Henderson	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: No standard design
638	101080016402006	2 Wid 1976 4-8x6 T	Tyler	Henderson	3.8	3.0	Associated	MC#-# 1949-1977	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.703	1.891	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
639	101080016402006	3 Wid 1976 4-10x10 T	Tyler	Henderson	3.8	3.0	Associated	MC#-# 1949-1977	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.478	2.299	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
640	101080016402009	1 Org 1930 4-8x4 T	Tyler	Henderson	3.8	3.8	Associated	MBC-#	0.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.663	1.723	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
641	101080016402009	2 Wid 1965 4-8x4 T	Tyler	Henderson	3.8	3.3	Associated	MC#-# 1949-1977	0.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.385	0.834	Wall Exterior Top	M	PIN	3: IR< HS20, OR> HS10
642	101080016403033	1 Org 1965 5-8x6 T	Tyler	Henderson	3.8	2.5	Associated	MC#-# 1949-1977	4.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	1.348	5.286	Top Corner	V	PIN	1: IR>=HS20, OR> HS20
643	101080089001003	1 Org 1948 3-8x7 T	Tyler	Henderson	3.8	2.0	Associated	MBC-#	1.5	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.605	3.119	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
644	102010012305014	1 Org 1932 3-10x10 T	Tyler	Rusk	3.8	2.5	Associated	MBC-#	7.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	3.991	10.982	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
645	102010013802011	1 Org 1968 3-10x9 T	Tyler	Rusk	--	--	--	--	--	Medium Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: No standard design
646	102010013802011	2 Wid 2006 3-10x9 T	Tyler	Rusk	--	--	--	--	--	Medium Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
647	102010013809090	1 Org 1930 3-10x7 T	Tyler	Rusk	3.8	3.5	Associated	W.C.-2	2.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.435	0.041	Wall Exterior Bottom	M	FIX	6: IR< HS 3, OR< HS 3
648	102010013809090	2 Wid 1950 3-10x7 T	Tyler	Rusk	3.8	3.3	Associated	MC#-# 1949-1977	2.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.075	1.593	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
649	102010020702016	1 Org 1936 4-6x5 T	Tyler	Rusk	3.8	3.3	Associated	MBC ##-##	1.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.693	2.557	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
650	102010020702016	2 Wid 1992 4-6x5 T	Tyler	Rusk	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
651	102010020703015	1 Org 1935 5-9x9 T	Tyler	Rusk	3.8	3.8	Associated	MBC ##-##	1.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.433	1.999	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
652	102010020703015	2 Wid 1988 5-9x9 T	Tyler	Rusk	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
653	102010042405023	1 Org 1966 2-10x8 T	Tyler	Rusk	3.8	2.5	Associated	MC#-# 1949-1977	1.5	Low Stiffness	10 Seal Coat or Surf. Tmt	0.618	1.469	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
654	102010059202007	1 Org 1961 3-8x8 T	Tyler	Rusk	3.8	3.0	Associated	MC#-# 1949-1977	2.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.780	1.963	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
655	102010059402015	1 Org 1959 3-10x10 T	Tyler	Rusk	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: No standard design
656	102010059402015	2 Wid 1972 3-10x10 T	Tyler	Rusk	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: No standard design
657	102010070602019	1 Org 1940 5-4x4 T	Tyler	Rusk	3.8	3.5	Associated	MBC-#	2.0	Low Stiffness	10 Seal Coat or Surf. Tmt	1.151	2.794	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
658	102010193302001	1 Org 1963 2-10x8 T	Tyler	Rusk	3.8	3.0	Associated	MC#-# 1949-1977	2.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.647	2.224	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
659	102010194001002	1 Org 1959 4-8x6 T	Tyler	Rusk	3.8	2.5	Associated	MC#-# 1949-1977	2.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.535	1.433	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
660	102010215902013	1 Org 1958 3-8x8 T	Tyler	Rusk	3.8	3.8	Associated	MC#-# 1949-1977	6.0	Low Stiffness	10 Seal Coat or Surf. Tmt	1.439	3.096	Wall Exterior Bottom	M	FIX	1: IR>=HS20, OR> HS20
661	102010215903015	1 Org 1955 3-10x7 T	Tyler	Rusk	3.8	3.8	Associated	MC#-# 1949-1977	1.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.530	1.043	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
662	102010215903015	2 Wid 1970 3-10x7 T	Tyler	Rusk	3.8	3.5	Associated	MC#-# 1949-1977	1.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.530	1.043	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
663	102010323901001	1 Org 1976 3-8x7 T	Tyler	Rusk	3.8	3.0	Associated	MC#-# 1949-1977	1.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.381	0.660	Wall Interior Top	M	FIX	3: IR< HS20, OR> HS10
664	102120024507022	1 Org 1925 2-10x10 T	Tyler	Smith	4.3	4.0	Specified	MBC-#	4.5	Medium Stiffness	8 Overlaid Concrete	2.939	9.441	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
665	102120024507022	2 Wid 1938 2-10x10 T	Tyler	Smith	3.8	2.5	Associated	MBC-#	4.5	Medium Stiffness	8 Overlaid Concrete	2.939	9.441	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
666	102120034501022	1 Org 1959 4-10x6 T	Tyler	Smith	3.9	4.3	Specified	MC#-# 1949-1977	2.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.507	2.056	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
667	102120034501022	2 Wid 1981 4-10x6 T	Tyler	Smith	--	--	--	--	--	Medium Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
668	102120042401029	1 Org 1960 2-10x7 T	Tyler	Smith	3.8	3.3	Associated	MC#-# 1949-1977	2.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.783	3.084	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
669	102120049505147	1 Org 1964 6-10x10 T	Tyler	Smith	4.3	3.8	Specified	MC#-# 1949-1977	2.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.464	2.933	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
670	102120049505168	1 Org 1964 2-10x10 T	Tyler	Smith	--	--	--	--	--	Medium Stiffness	1 CRCP	--	--	--	--	--	NLR: No standard design
671	102120049505168	2 Wid 2007 2-10x10 T	Tyler	Smith	--	--	--	--	--	Medium Stiffness	1 CRCP	--	--	--	--	--	NLR: Post-1979
672	102120049505170	1 Org 1964 2-10x10 T	Tyler	Smith	4.3	4.3	Specified	MC#-# 1949-1977	2.0	Medium Stiffness	1 CRCP	0.433	6.009	Top Corner	V	PIN	1: IR>=HS20, OR> HS20
673	102120049506237	1 Org 1966 2-10x8 T	Tyler	Smith	4.3	3.8	Specified	MC#-# 1949-1977	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.664	2.028	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
674	102120052204015	1 Org 1941 6-6x5 T	Tyler	Smith	5.0	5.0	Provided	MBC-#-#(-F)	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.861	1.916	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
675	102120052204015	2 Wid 2008 6-6x5 T	Tyler	Smith	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Post-1979
676	102120207502005	1 Org 1957 5-10x10 J	Tyler	Smith	3.0	1.8	Associated	MBC-#	2.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	1.605	5.866	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
677	102120207502005	2 Wid 1967 5-10x10 J	Tyler	Smith	4.3	3.8	Specified	MC#-# 1949-1977	2.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.455	2.978	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
678	102120207502005	3 Oth 1991 1-10x10 J	Tyler	Smith	--	--	--	--	--	Medium Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Geometry outside sc
679	102120295601001	1 Org 1966 4-7x6 T	Tyler	Smith	3.8	3.5	Associated	MC#-# 1949-1977	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.603	1.767	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
680	102340010802005	1 Org 1934 3-10x10 T	Tyler	Van Zandt	3.0	2.5	Associated	MBC-#	1.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.472	2.396	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
681	102340010802005	2 Wid 1993 3-10x10 T	Tyler	Van Zandt	--	--	--	--	--	Medium Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
682	102340010802007	1 Org 1934 3-10x10 E	Tyler	Van Zandt	3.8	3.0	Associated	MBC-#	0.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.490	1.515	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
683	102340010802007	2 Org 1934 2-10x10 E	Tyler	Van Zandt	3.8	3.0	Associated	MBC-#	0.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.698	1.468	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
684	102340010802007	3 Exp 1934 1-10x10 E	Tyler	Van Zandt	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Expansion slab

TABLE A: Summary Load Rating Results for 1,788 Segments/ 1,000 Culverts

No (1)	Structure No (2)	Segment ID (3)	District (4)	County (5)	Interpreted Parameter Score (6)	Design Selection Score (7)	Design Class (8)	Design Name (9)	Critical Cover Soil Depth (10)	Soil Type (11)	Pavement (12)	HS20 Lvl1 ORF (13)	HS20 Lvl3 ORF (14)	Lvl3 Controlling Critical Section (15)	Lvl3 Failure Mode (16)	Lvl3 Fixity (17)	Lvl3 Load Posting Class (18)
685	102340010802007	4 Wid 1970 3-10x10 E	Tyler	Van Zandt	3.8	3.0	Associated	MC#-# 1949-1977	0.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.296	0.844	Top Midspan	M	PIN	3: IR< HS20, OR> HS10
686	102340010802007	5 Wid 1970 2-10x10 E	Tyler	Van Zandt	3.8	3.0	Associated	MC#-# 1949-1977	0.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.312	0.840	Top Midspan	M	PIN	3: IR< HS20, OR> HS10
687	102340010802007	6 Exp 1970 1-10x10 E	Tyler	Van Zandt	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Expansion slab
688	102340044303019	1 Org 1971 3-8x7 T	Tyler	Van Zandt	3.8	3.0	Associated	MC#-# 1949-1977	5.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	1.388	5.104	Wall Exterior Bottom	M	PIN	1: IR>=HS20, OR> HS20
689	102340049503074	1 Org 1962 5-10x10 T	Tyler	Van Zandt	3.8	3.0	Associated	MC#-# 1949-1977	3.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.616	3.831	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
690	102340049503075	1 Org 1962 5-10x7 T	Tyler	Van Zandt	3.8	3.8	Associated	MC#-# 1949-1977	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.568	1.619	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
691	102340049503085	1 Org 1962 2-10x8 T	Tyler	Van Zandt	5.0	5.0	Provided	MC#-# 1949-1977	2.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.733	2.894	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
692	102340049503085	2 Org 1962 2-10x8 T	Tyler	Van Zandt	5.0	5.0	Provided	MC#-# 1949-1977	2.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.733	2.894	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
693	102340049503085	3 Wid 1996 2-10x8 T	Tyler	Van Zandt	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Post-1979
694	102340167101004	1 Org 1965 5-10x6 T	Tyler	Van Zandt	3.8	3.5	Associated	MC#-# 1949-1977	4.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	1.015	4.029	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
695	102500008306049	1 Org 1955 5-8x7 T	Tyler	Wood	5.0	5.0	Provided	MC#-# 1949-1977	1.5	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.677	1.910	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
696	102500020305043	1 Org 1952 3-6x6 T	Tyler	Wood	3.0	1.8	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.513	1.496	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
697	102500020305043	2 Wid 1969 3-6x6 T	Tyler	Wood	3.8	2.5	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.649	1.819	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
698	102500064702008	1 Org 1957 3-7x4 T	Tyler	Wood	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.470	1.024	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
699	102500139003006	1 Org 1951 4-5x5 T	Tyler	Wood	5.0	5.0	Provided	MC#-# 1949-1977	0.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.537	0.832	Top Midspan	M	FIX	3: IR< HS20, OR> HS10
700	110030017602063	1 Org 1949 4-7x7 T	Lufkin	Angelina	3.8	2.5	Associated	MBC ##-##	2.0	Medium Stiffness	8 Overlaid Concrete	0.504	8.035	Wall Exterior Bottom	M	PIN	1: IR>=HS20, OR> HS20
701	110030017602063	2 Wid 1956 4-7x7 T	Lufkin	Angelina	3.8	2.3	Associated	MC#-# 1949-1977	2.0	Medium Stiffness	8 Overlaid Concrete	0.819	3.566	Wall Exterior Bottom	M	FIX	1: IR>=HS20, OR> HS20
702	110030211501001	1 Org 1957 4-7x4 T	Lufkin	Angelina	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.479	1.067	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
703	111740070605014	1 Org 1959 3-10x8 T	Lufkin	Nacogdoches	5.0	5.0	Provided	MC#-# 1949-1977	1.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.602	1.412	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
704	111740230001003	1 Org 1959 4-10x10 T	Lufkin	Nacogdoches	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.464	1.985	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
705	111870017701088	1 Org 1963 5-5x3 T	Lufkin	Polk	3.8	3.3	Associated	MC#-# 1949-1977	2.0	Low Stiffness	9 Overlaid Flexible	1.038	2.686	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
706	111870034103025	1 Org 1958 3-7x7 T	Lufkin	Polk	3.8	3.3	Associated	MC#-# 1949-1977	2.5	Medium Stiffness	9 Overlaid Flexible	0.625	2.744	Wall Exterior Bottom	M	PIN	1: IR>=HS20, OR> HS20
707	112030033607028	1 Org 1956 2-10x7 T	Lufkin	San Augustine	4.3	4.5	Specified	MC#-# 1949-1977	1.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.552	1.467	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
708	112030168001005	1 Org 1956 2-10x8 T	Lufkin	San Augustine	4.3	4.0	Specified	MC#-# 1949-1977	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.664	2.028	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
709	112040017702046	1 Org 1948 6-5x5 T	Lufkin	San Jacinto	3.0	1.8	Associated	MBC-#	1.0	Medium Stiffness	8 Overlaid Concrete	0.739	7.292	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
710	112040017702046	2 Wid 1979 6-5x5 T	Lufkin	San Jacinto	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	8 Overlaid Concrete	0.966	8.696	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
711	112100030401079	1 Org 1978 3-10x10 T	Lufkin	Shelby	5.0	5.0	Provided	MC#-# 1949-1977	6.0	Low Stiffness	5 Int. ACP (2.5-5in.)	2.025	7.584	Top Corner	V	PIN	1: IR>=HS20, OR> HS20
712	112100074203016	1 Org 1975 4-8x4 T	Lufkin	Shelby	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.376	1.014	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
713	112100074302004	1 Org 1947 3-8x7 T	Lufkin	Shelby	5.0	5.0	Provided	MBC ##-##	0.5	Low Stiffness	10 Seal Coat or Surf. Tmt	0.430	1.389	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
714	112280207103002	1 Org 1957 4-7x6 T	Lufkin	Trinity	3.8	4.0	Associated	MC#-# 1949-1977	1.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.678	1.485	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
715	112280211701005	1 Org 1961 2-10x10 T	Lufkin	Trinity	3.8	3.0	Associated	MC#-# 1949-1977	1.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.449	1.669	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
716	120200018806013	1 Org 1931 3-6x4 J	Houston	Brazoria	2.8	2.3	Associated	MBC-#	2.0	Medium Stiffness	9 Overlaid Flexible	0.977	3.918	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
717	120200018806013	2 Wid 1958 3-6x4 J	Houston	Brazoria	3.8	3.3	Associated	MC#-# 1949-1977	2.0	Medium Stiffness	9 Overlaid Flexible	0.779	2.658	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
718	120200018806014	1 Org 1931 6-6x4 T	Houston	Brazoria	3.0	2.3	Associated	MBC-#	2.0	Low Stiffness	1 CRCP	0.994	6.570	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
719	120200018806014	2 Wid 1958 6-6x4 T	Houston	Brazoria	3.0	1.8	Associated	MC#-# 1949-1977	2.0	Low Stiffness	1 CRCP	0.782	4.438	Top Corner	V	PIN	1: IR>=HS20, OR> HS20
720	120200018806014	3 Wid 1984 6-6x4 T	Houston	Brazoria	--	--	--	--	--	Low Stiffness	1 CRCP	--	--	--	--	--	NLR: Post-1979
721	120800002708053	1 Org 1943 4-6x5 T	Houston	Fort Bend	3.0	1.8	Associated	MBC ##-##	1.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.693	2.557	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
722	120800002708053	2 Wid 1957 4-6x5 T	Houston	Fort Bend	3.8	3.5	Associated	MC#-# 1949-1977	1.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.640	1.743	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
723	120800052708010	1 Org 1958 2-8x8 T	Houston	Fort Bend	3.8	2.5	Associated	MC#-# 1949-1977	1.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.652	1.779	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
724	120800052708011	1 Org 1958 4-8x5 T	Houston	Fort Bend	3.8	3.5	Associated	MC#-# 1949-1977	2.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.672	2.120	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
725	120800304801001	1 Org 1968 3-8x7 T	Houston	Fort Bend	3.8	3.0	Associated	MC#-# 1949-1977	2.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.703	2.193	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
726	120850019204015	1 Oth 1931 2-10x8 T	Houston	Galveston	--	--	--	--	--	Medium Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Geometry outside sc
727	120850019204015	2 Wid 1964 2-10x8 T	Houston	Galveston	3.8	2.5	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.562	1.715	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
728	120850019204017	1 Oth 1931 3-10x10 T	Houston	Galveston	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Geometry outside sc
729	120850019204017	2 Wid 1964 3-10x10 T	Houston	Galveston	3.8	3.0	Associated	MC#-# 1949-1977	1.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.367	1.733	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
730	120850019204021	1 Oth 1931 3-10x8 T	Houston	Galveston	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Geometry outside sc
731	120850019204021	2 Wid 1961 3-10x8 T	Houston	Galveston	3.8	3.0	Associated	MC#-# 1949-1977	1.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.550	1.522	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
732	120850050004322	1 Org 1948 3-5x3 T	Houston	Galveston	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: No standard design
733	120850050004322	2 Org 1948 3-5x3 J	Houston	Galveston	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: No standard design
734	120850050004322	3 Add 1980 2-5x4 T	Houston	Galveston	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
735	120850050004322	4 Add 1980 2-5x4 J	Houston	Galveston	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
736	121020005102007	1 Org 1925 2-10x9 T	Houston	Harris	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: No standard design
737	121020005102007	2 Wid 1967 2-10x9 T	Houston	Harris	3.8	3.3	Associated	MC#-# 1949-1977	1.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.557	1.716	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
738	121020005102007	3 Wid 1994 2-10x9 T	Houston	Harris	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
739	121020011101023	1 Org 1949 4-6x3 T	Houston	Harris	3.8	2.5	Associated	MBC ##-##	1.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.404	2.200	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
740	121020027114403	1 Org 1960 3-15x15 T	Houston	Harris	--	--	--	--	--	Medium Stiffness	1 CRCP	--	--	--	--	--	NLR: No standard design
741	121020027114403	2 Org 1960 3-15x15 T	Houston	Harris	--	--	--	--	--	Medium Stiffness	1 CRCP	--	--	--	--	--	NLR: No standard design

No	Structure No	Segment ID	District	County	Interpreted Parameter Score	Design Selection Score	Design Class	Design Name	Critical Cover Soil Depth	Soil Type	Pavement	HS20 Lvl1 ORF	HS20 Lvl3 ORF	Lvl3 Controlling Critical Section	Lvl3 Failure Mode	Lvl3 Fixity	Lvl3 Load Posting Class
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
742	121020027114403	3 Org 1960 3-15x15 T	Houston	Harris	--	--	--	--	--	Medium Stiffness	1 CRCP	--	--	--	--	--	NLR: No standard design
743	121020027114403	4 Org 1960 3-15x15 T	Houston	Harris	--	--	--	--	--	Medium Stiffness	1 CRCP	--	--	--	--	--	NLR: No standard design
744	121020050003094	1 Org 1960 3-15x15 T	Houston	Harris	--	--	--	--	--	Medium Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: No standard design
745	121020050801027	1 Org 1950 4-5x5 T	Houston	Harris	3.0	2.3	Associated	MC#-# 1949-1977	1.0	Low Stiffness	8 Overlaid Concrete	0.518	4.118	Bottom Corner	M	PIN	1: IR>=HS20, OR> HS20
746	121020059801021	1 Org 1978 3-7x4 T	Houston	Harris	3.8	3.5	Associated	MC#-# 1949-1977	6.0	Low Stiffness	8 Overlaid Concrete	2.521	6.280	Top Corner	V	FIX	1: IR>=HS20, OR> HS20
747	121700011003006	1 Org 1926 3-8x8 E	Houston	Montgomery	4.3	4.3	Specified	MBC-#	1.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	1.114	3.086	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
748	121700011003006	2 Org 1926 2-8x8 E	Houston	Montgomery	4.3	4.3	Specified	MBC-#	1.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	1.114	3.200	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
749	121700011003006	3 Exp 1926 1-8x8 E	Houston	Montgomery	--	--	--	--	--	Medium Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Expansion slab
750	121700011003006	4 Wid 1936 3-8x8 E	Houston	Montgomery	3.8	3.0	Associated	MBC-#	1.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.529	2.509	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
751	121700011003006	5 Wid 1936 2-8x8 E	Houston	Montgomery	3.8	3.0	Associated	MBC-#	1.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	1.114	3.200	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
752	121700011003006	6 Exp 1936 1-8x8 E	Houston	Montgomery	--	--	--	--	--	Medium Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Expansion slab
753	121700305002002	1 Org 1977 5-6x4 T	Houston	Montgomery	3.8	2.8	Associated	MC#-# 1949-1977	2.5	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.910	3.522	Top Corner	V	PIN	1: IR>=HS20, OR> HS20
754	130080027102221	1 Org 1966 5-6x5 T	Yoakum	Austin	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Low Stiffness	8 Overlaid Concrete	0.654	5.120	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
755	130080040802013	1 Org 1930 2-10x10 T	Yoakum	Austin	3.8	3.3	Associated	MBC-#	2.0	Low Stiffness	6 Thin ACP (<2.5in.)	1.313	3.635	Top Corner	M	FIX	1: IR>=HS20, OR> HS20
756	130080040802013	2 Wid 1971 2-10x10 T	Yoakum	Austin	3.8	3.0	Associated	MC#-# 1949-1977	2.0	Low Stiffness	6 Thin ACP (<2.5in.)	0.475	1.978	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
757	130290014403031	1 Org 1942 5-8x8 T	Yoakum	Calhoun	3.5	3.3	Associated	MBC ##-##	1.0	Low Stiffness	8 Overlaid Concrete	0.411	4.778	Wall Exterior Bottom	M	PIN	1: IR>=HS20, OR> HS20
758	130290014403031	2 Wid 1972 5-8x8 T	Yoakum	Calhoun	3.0	3.0	Associated	MC#-# 1949-1977	1.0	Low Stiffness	8 Overlaid Concrete	0.625	4.075	Bottom Corner	M	PIN	1: IR>=HS20, OR> HS20
759	130290014403031	3 Wid 1999 5-8x8 T	Yoakum	Calhoun	--	--	--	--	--	Low Stiffness	8 Overlaid Concrete	--	--	--	--	--	NLR: Post-1979
760	130290014405041	1 Org 1949 3-6x5 T	Yoakum	Calhoun	2.8	2.5	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.505	1.251	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
761	130290014405041	2 Wid 1956 3-6x5 T	Yoakum	Calhoun	4.3	4.8	Specified	MC#-# 1949-1977	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.639	1.492	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
762	130290014405041	3 Wid 1998 3-6x5 T	Yoakum	Calhoun	--	--	--	--	--	Medium Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Post-1979
763	130290014405045	1 Org 1961 2-10x8 T	Yoakum	Calhoun	3.8	3.0	Associated	MC#-# 1949-1977	1.5	Low Stiffness	6 Thin ACP (<2.5in.)	0.618	1.654	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
764	130290018001030	1 Org 1933 5-4x4 T	Yoakum	Calhoun	3.0	2.0	Associated	MBC-#	1.0	Low Stiffness	8 Overlaid Concrete	0.725	6.808	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
765	130290018001030	2 Wid 1959 5-4x4 T	Yoakum	Calhoun	3.8	3.0	Associated	MBC-#	1.0	Low Stiffness	8 Overlaid Concrete	0.905	8.241	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
766	130290051503013	1 Org 1960 2-10x10 T	Yoakum	Calhoun	5.0	5.0	Provided	MC#-# 1949-1977	0.5	Low Stiffness	8 Overlaid Concrete	0.376	5.306	Wall Exterior Bottom	M	PIN	1: IR>=HS20, OR> HS20
767	130290051503022	1 Org 1971 3-7x6 T	Yoakum	Calhoun	3.8	3.3	Associated	MC#-# 1949-1977	1.0	Low Stiffness	4 Thick ACP (>5in.)	0.608	1.583	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
768	130450026604032	1 Org 1932 5-5x5 O	Yoakum	Colorado	3.5	4.3	Specified	MBC-#	2.5	Low Stiffness	8 Overlaid Concrete	1.534	6.553	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
769	130450026604032	2 Wid 1958 5-5x5 O	Yoakum	Colorado	4.0	4.0	Specified	MC#-# 1949-1977	2.5	Low Stiffness	8 Overlaid Concrete	1.486	5.072	Top Corner	M	FIX	1: IR>=HS20, OR> HS20
770	130450026604032	3 Oth 1975 1-5x5 J	Yoakum	Colorado	--	--	--	--	--	Low Stiffness	8 Overlaid Concrete	--	--	--	--	--	NLR: Geometry outside sc
771	130450026608019	1 Org 1958 4-6x4 T	Yoakum	Colorado	2.5	2.8	Associated	MC#-# 1949-1977	1.0	Low Stiffness	6 Thin ACP (<2.5in.)	0.569	1.376	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
772	130450026608019	2 Wid 1982 4-6x4 T	Yoakum	Colorado	--	--	--	--	--	Low Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Post-1979
773	130450027101175	1 Org 1938 3-8x7 T	Yoakum	Colorado	4.3	3.8	Specified	MBC ##-##	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.382	1.661	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
774	130450027101175	2 Org 1966 3-8x7 T	Yoakum	Colorado	4.3	4.0	Specified	MC#-# 1949-1977	2.0	Medium Stiffness	8 Overlaid Concrete	0.703	4.561	Top Corner	V	FIX	1: IR>=HS20, OR> HS20
775	130450027101175	3 Org 1966 3-8x7 T	Yoakum	Colorado	4.3	4.3	Specified	MC#-# 1949-1977	1.0	Medium Stiffness	8 Overlaid Concrete	0.616	5.100	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
776	130450027101175	4 Wid 1986 3-8x7 T	Yoakum	Colorado	--	--	--	--	--	Medium Stiffness	8 Overlaid Concrete	--	--	--	--	--	NLR: Post-1979
777	130450044602026	1 Org 1950 5-7x6 T	Yoakum	Colorado	4.3	3.8	Specified	MBC-#-#(-F)	1.0	Low Stiffness	8 Overlaid Concrete	0.670	5.272	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
778	130450053508037	1 Org 1967 3-8x6 T	Yoakum	Colorado	--	--	--	--	--	Medium Stiffness	8 Overlaid Concrete	--	--	--	--	--	NLR: No standard design
779	130450053508037	2 Org 1967 3-8x6 T	Yoakum	Colorado	4.3	4.3	Specified	MC#-# 1949-1977	7.0	Medium Stiffness	8 Overlaid Concrete	1.214	4.957	Wall Exterior Bottom	M	FIX	1: IR>=HS20, OR> HS20
780	130450168901002	1 Org 1955 4-10x8 T	Yoakum	Colorado	3.8	3.0	Associated	MBC-#	1.0	Low Stiffness	6 Thin ACP (<2.5in.)	1.178	3.327	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
781	130620014308017	1 Org 1928 1-10x8 E	Yoakum	DeWitt	--	--	--	--	--	Medium Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: No standard design
782	130620014308017	2 Exp 1928 1-10x9 E	Yoakum	DeWitt	--	--	--	--	--	Medium Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Expansion slab
783	130620014308017	3 Org 1928 3-10x8 E	Yoakum	DeWitt	3.8	3.3	Associated	MBC-#	2.0	Medium Stiffness	6 Thin ACP (<2.5in.)	1.004	4.545	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
784	130620014308017	4 Wid 1958 1-10x8 E	Yoakum	DeWitt	3.8	3.0	Associated	SC- N	1.5	Medium Stiffness	6 Thin ACP (<2.5in.)	0.703	1.792	Top Corner	M	FIX	1: IR>=HS20, OR> HS20
785	130620014308017	5 Exp 1958 1-10x9 E	Yoakum	DeWitt	--	--	--	--	--	Medium Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Expansion slab
786	130620014308017	6 Wid 1958 3-10x8 E	Yoakum	DeWitt	3.8	3.0	Associated	MBC-#	2.0	Medium Stiffness	6 Thin ACP (<2.5in.)	1.262	5.370	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
787	130620026906038	1 Org 1971 4-6x5 T	Yoakum	DeWitt	3.8	3.5	Associated	MC#-# 1949-1977	4.5	Low Stiffness	5 Int. ACP (2.5-5in.)	1.607	4.901	Top Corner	V	FIX	1: IR>=HS20, OR> HS20
788	130620071503021	1 Org 1952 2-10x8 T	Yoakum	DeWitt	4.3	3.0	Associated	MBC-#	2.0	Low Stiffness	6 Thin ACP (<2.5in.)	1.281	3.553	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
789	130620071503021	2 Wid 2006 2-10x8 T	Yoakum	DeWitt	--	--	--	--	--	Low Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Post-1979
790	130620071503022	1 Org 1952 3-10x6 T	Yoakum	DeWitt	3.8	3.8	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.407	0.879	Wall Exterior Top	M	PIN	3: IR< HS20, OR> HS10
791	130620071503022	2 Wid 2006 3-10x6 T	Yoakum	DeWitt	--	--	--	--	--	Medium Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Post-1979
792	130620084002011	1 Org 1954 6-10x10 T	Yoakum	DeWitt	3.8	3.0	Associated	MBC-#	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	1.605	4.784	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
793	130620111301009	1 Org 1959 3-7x3 T	Yoakum	DeWitt	3.8	3.8	Associated	MC#-# 1949-1977	1.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.422	1.012	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
794	130760026702011	1 Oth 1923 3-8x6 T	Yoakum	Fayette	--	--	--	--	--	Low Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Geometry outside sc
795	130760026702011	2 Wid 1960 3-8x6 T	Yoakum	Fayette	3.8	3.0	Associated	MC#-# 1949-1977	1.0	Low Stiffness	6 Thin ACP (<2.5in.)	0.560	1.341	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
796	130760040801020	1 Org 1962 3-10x6 T	Yoakum	Fayette	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.507	1.820	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
797	130760251401002	1 Org 1961 3-10x10 T	Yoakum	Fayette	3.8	3.0	N/A	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.367	1.206	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
798	130760318601001	1 Org 1969 4-7x4 T	Yoakum	Fayette	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.479	1.073	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20

No (1)	Structure No (2)	Segment ID (3)	District (4)	County (5)	Interpreted Parameter Score (6)	Design Selection Score (7)	Design Class (8)	Design Name (9)	Critical Cover Soil Depth (10)	Soil Type (11)	Pavement (12)	HS20 Lvl1 ORF (13)	HS20 Lvl3 ORF (14)	Lvl3 Controlling Critical Section (15)	Lvl3 Failure Mode (16)	Lvl3 Fixity (17)	Lvl3 Load Posting Class (18)
799	130900002505071	1 Org 1949 3-8x8 T	Yoakum	Gonzales	5.0	5.0	Provided	MBC-#-#(-F)	2.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.825	3.080	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
800	130900002506084	1 Org 1949 4-6x6 T	Yoakum	Gonzales	5.0	5.0	Provided	MBC-#-#(-F)	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.883	2.341	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
801	130900002905023	1 Org 1932 4-8x8 T	Yoakum	Gonzales	3.5	3.0	Associated	MBC-#	1.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.565	2.516	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
802	130900053504086	1 Org 1970 5-6x3 T	Yoakum	Gonzales	3.0	2.5	Associated	MC#-# 1949-1977	6.5	Low Stiffness	10 Seal Coat or Surf. Tmt	1.619	5.485	Top Corner	V	PIN	1: IR>=HS20, OR> HS20
803	130900053505147	1 Org 1971 4-7x4 T	Yoakum	Gonzales	5.0	5.0	Provided	MC#-# 1949-1977	14.5	Low Stiffness	8 Overlaid Concrete	1.533	3.860	Wall Exterior Bottom	M	FIX	1: IR>=HS20, OR> HS20
804	130900053505147	2 Org 1971 4-7x4 T	Yoakum	Gonzales	5.0	5.0	Provided	MC#-# 1949-1977	8.5	Low Stiffness	10 Seal Coat or Surf. Tmt	0.788	3.090	Wall Exterior Bottom	M	FIX	1: IR>=HS20, OR> HS20
805	130900068701001	1 Org 1940 4-10x12 T	Yoakum	Gonzales	4.8	5.0	Provided	MBC ##-##	1.5	Low Stiffness	10 Seal Coat or Surf. Tmt	0.441	0.289	Wall Exterior Bottom	M	FIX	4: IR>=HS 3, OR< HS10
806	130900071502012	1 Org 1951 17-9x5 T	Yoakum	Gonzales	3.8	3.0	Associated	MC#-# 1949-1977	0.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.427	0.662	Wall Exterior Top	M	PIN	3: IR< HS20, OR> HS10
807	130900071502012	2 Wid 1967 17-9x5 T	Yoakum	Gonzales	3.8	2.5	Associated	MC#-# 1949-1977	0.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.530	0.839	Wall Exterior Top	M	PIN	3: IR< HS20, OR> HS10
808	130900071502018	1 Org 1951 3-8x7 T	Yoakum	Gonzales	3.8	4.0	Associated	MC#-# 1949-1977	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.475	1.523	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
809	130900144301007	1 Org 1963 4-5x2 T	Yoakum	Gonzales	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.564	1.290	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
810	130900208001002	1 Org 1954 3-8x6 T	Yoakum	Gonzales	3.8	3.0	Associated	MBC-#	2.0	Medium Stiffness	6 Thin ACP (<2.5in.)	1.206	5.261	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
811	130900208001002	2 Wid 2004 3-8x6 T	Yoakum	Gonzales	--	--	--	--	--	Medium Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Post-1979
812	131210008905153	1 Org 1972 4-10x10 T	Yoakum	Jackson	3.8	2.5	Associated	MC#-# 1949-1977	2.5	Low Stiffness	8 Overlaid Concrete	0.467	3.916	Wall Exterior Bottom	M	PIN	1: IR>=HS20, OR> HS20
813	131210008905162	1 Org 1972 3-7x3 T	Yoakum	Jackson	--	--	--	--	--	Low Stiffness	8 Overlaid Concrete	--	--	--	--	--	NLR: No standard design
814	131210008911012	1 Org 1929 4-5x5 O	Yoakum	Jackson	3.0	2.5	Associated	MBC-#	2.0	Low Stiffness	8 Overlaid Concrete	1.306	5.924	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
815	131210008911012	2 Wid 1956 4-5x5 O	Yoakum	Jackson	3.8	3.5	Associated	MC#-# 1949-1977	2.0	Low Stiffness	8 Overlaid Concrete	1.275	5.018	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
816	131210008911012	3 Oth 1956 1-O	Yoakum	Jackson	--	--	--	--	--	Low Stiffness	8 Overlaid Concrete	--	--	--	--	--	NLR: Geometry outside sc
817	131210042002004	1 Org 1933 6-4x4 T	Yoakum	Jackson	5.0	5.0	Provided	MBC-#	1.0	Low Stiffness	6 Thin ACP (<2.5in.)	0.725	2.028	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
818	131210042002004	2 Wid 1964 6-4x4 T	Yoakum	Jackson	3.8	3.0	Associated	MBC-#	1.0	Low Stiffness	6 Thin ACP (<2.5in.)	0.923	2.394	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
819	131430032403008	1 Org 1930 2-10x8 T	Yoakum	Lavaca	3.8	3.3	Associated	MBC-#	1.0	Medium Stiffness	8 Overlaid Concrete	0.952	7.700	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
820	131430032403008	2 Wid 1973 2-10x8 T	Yoakum	Lavaca	3.8	3.0	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	8 Overlaid Concrete	0.562	5.044	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
821	131430037002022	1 Org 1950 4-8x8 T	Yoakum	Lavaca	3.8	2.8	Associated	MBC-#-#(-F)	1.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.785	1.901	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
822	131430037002022	2 Wid 2008 4-8x8 T	Yoakum	Lavaca	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
823	131430044502005	1 Org 1938 4-6x6 T	Yoakum	Lavaca	3.8	3.0	Associated	MBC ##-##	1.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.737	2.788	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
824	131430044502008	1 Org 1938 5-9x9 T	Yoakum	Lavaca	3.8	3.3	Associated	MBC ##-##	1.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.433	2.359	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
825	131430044502008	2 Wid 2007 5-9x9 T	Yoakum	Lavaca	--	--	--	--	--	Medium Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
826	131430100703017	1 Org 1951 2-10x10 T	Yoakum	Lavaca	3.8	3.0	Associated	MBC-#	2.0	Low Stiffness	6 Thin ACP (<2.5in.)	1.599	3.498	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
827	131430206304002	1 Org 1977 3-10x8 T	Yoakum	Lavaca	3.8	2.5	Associated	MC#-# 1949-1977	1.0	Low Stiffness	6 Thin ACP (<2.5in.)	0.858	2.127	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
828	131430216801001	1 Org 1956 3-10x6 T	Yoakum	Lavaca	3.8	3.3	Associated	MC#-# 1949-1977	1.0	Low Stiffness	6 Thin ACP (<2.5in.)	0.509	1.086	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
829	131580024102002	1 Org 1932 6-4x4 T	Yoakum	Matagorda	3.0	2.8	Associated	MBC-#	1.0	Low Stiffness	8 Overlaid Concrete	0.725	6.817	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
830	131580024102002	2 Wid 1961 6-4x4 T	Yoakum	Matagorda	3.8	2.5	Associated	MBC-#	1.0	Low Stiffness	8 Overlaid Concrete	0.923	8.253	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
831	131580024102002	3 Wid 1991 6-4x4 T	Yoakum	Matagorda	--	--	--	--	--	Low Stiffness	8 Overlaid Concrete	--	--	--	--	--	NLR: Post-1979
832	131580084705008	1 Org 1951 4-6x5 T	Yoakum	Matagorda	5.0	5.0	Provided	MC#-# 1949-1977	2.5	Low Stiffness	10 Seal Coat or Surf. Tmt	0.867	2.081	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
833	132350037004029	1 Org 1958 6-10x7 J	Yoakum	Victoria	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.533	1.406	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
834	132350037004029	2 Add 2007 2-10x7 J	Yoakum	Victoria	--	--	--	--	--	Medium Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
835	132350043202013	1 Org 1963 3-6x8 J	Yoakum	Victoria	--	--	--	--	--	Medium Stiffness	4 Thick ACP (>5in.)	--	--	--	--	--	NLR: No standard design
836	132350043202013	2 Org 1963 2-8x8 J	Yoakum	Victoria	3.8	2.5	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	4 Thick ACP (>5in.)	0.408	-0.903	Bottom Midspan	M	FIX	6: IR< HS 3, OR< HS 3
837	132350043202013	3 Wid 1980 3-6x8 J	Yoakum	Victoria	--	--	--	--	--	Medium Stiffness	4 Thick ACP (>5in.)	--	--	--	--	--	NLR: Post-1979
838	132350043202013	4 Wid 1980 2-8x8 J	Yoakum	Victoria	--	--	--	--	--	Medium Stiffness	4 Thick ACP (>5in.)	--	--	--	--	--	NLR: Post-1979
839	132350084001012	1 Org 1958 3-10x8 T	Yoakum	Victoria	3.8	2.5	Associated	MC#-# 1949-1977	1.5	Low Stiffness	6 Thin ACP (<2.5in.)	0.602	1.620	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
840	132350084005018	1 Org 1976 4-5x2 T	Yoakum	Victoria	3.8	3.5	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.564	1.516	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
841	132350084005018	2 Wid 2007 4-5x2 T	Yoakum	Victoria	--	--	--	--	--	Medium Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Post-1979
842	132350113201003	1 Org 1955 2-10x9 T	Yoakum	Victoria	3.5	3.0	Associated	MC#-# 1949-1977	1.0	Low Stiffness	6 Thin ACP (<2.5in.)	0.557	1.477	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
843	132410008906181	1 Org 1976 4-5x4 T	Yoakum	Wharton	3.8	3.0	Associated	MC#-# 1949-1977	4.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.689	4.845	Bottom Corner	M	PIN	1: IR>=HS20, OR> HS20
844	132410008910034	1 Org 1933 4-7x7 E	Yoakum	Wharton	4.3	4.5	Specified	MBC-#	1.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.496	1.943	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
845	132410008910034	2 Exp 1933 1-7x7 E	Yoakum	Wharton	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Expansion slab
846	132410008910034	3 Wid 1948 4-7x7 E	Yoakum	Wharton	3.8	3.8	Associated	MBC-#	1.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.496	1.943	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
847	132410008910034	4 Exp 1948 1-7x7 E	Yoakum	Wharton	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Expansion slab
848	132410008915026	1 Org 1928 4-8x5 J	Yoakum	Wharton	3.0	2.8	Associated	MBC-#	2.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.874	4.262	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
849	132410008915026	2 Wid 1948 4-8x5 J	Yoakum	Wharton	3.8	3.5	Associated	MBC-#	2.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.874	4.262	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
850	132410008915026	3 Add 1996 1-3x3 J	Yoakum	Wharton	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
851	132410042010011	1 Org 1960 3-10x10 T	Yoakum	Wharton	3.8	3.0	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.367	1.206	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
852	132410083702006	1 Org 1966 3-10x8 T	Yoakum	Wharton	3.8	3.0	Associated	MC#-# 1949-1977	1.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.550	1.193	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
853	132410083801016	1 Org 1961 4-8x7 T	Yoakum	Wharton	3.5	3.8	Associated	MC#-# 1949-1977	1.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.605	1.173	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
854	132410281802002	1 Org 1965 3-7x4 T	Yoakum	Wharton	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.470	1.064	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
855	132410317301003	1 Org 1971 3-9x5 T	Yoakum	Wharton	5.0	5.0	Provided	MC#-# 1949-1977	3.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.705	2.424	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20

No (1)	Structure No (2)	Segment ID (3)	District (4)	County (5)	Interpreted Parameter Score (6)	Design Selection Score (7)	Design Class (8)	Design Name (9)	Critical Cover Soil Depth (10)	Soil Type (11)	Pavement (12)	HS20 Lvl1 ORF (13)	HS20 Lvl3 ORF (14)	Lvl3 Controlling Critical Section (15)	Lvl3 Failure Mode (16)	Lvl3 Fixity (17)	Lvl3 Load Posting Class (18)
856	140110047105054	1 Oth 1943 4-8x6 T	Austin	Bastrop	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Geometry outside sc
857	140110047105054	2 Wid 1991 4-9x6 T	Austin	Bastrop	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Post-1979
858	140110209801001	1 Org 1955 3-8x8 T	Austin	Bastrop	5.0	5.0	Provided	MC#-# 1949-1977	1.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.698	1.601	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
859	140110209801001	2 Wid 2010 3-8x8 T	Austin	Bastrop	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Post-1979
860	140110209801001	3 Wid 2010 3-8x10 T	Austin	Bastrop	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Post-1979
861	140160025203026	1 Org 1962 6-10x6 T	Austin	Blanco	4.8	5.0	Provided	MC#-# 1949-1977	2.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.515	1.732	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
862	140160095402003	1 Oth 1958 2-8.7x5.5 J	Austin	Blanco	--	--	--	--	--	Low Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Geometry outside sc
863	140160095402003	2 Oth 1965 2-8.7x5.5 J	Austin	Blanco	--	--	--	--	--	Low Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Geometry outside sc
864	140160095402003	3 Oth 1965 2-10x5.5 J	Austin	Blanco	--	--	--	--	--	Low Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Geometry outside sc
865	140270025107058	1 Org 1963 2-10x7 T	Austin	Burnet	5.0	5.0	Provided	MC#-# 1949-1977	7.0	Low Stiffness	10 Seal Coat or Surf. Tmt	1.463	3.410	Wall Exterior Bottom	M	FIX	1: IR>=HS20, OR> HS20
866	140270070001026	1 Org 1954 4-10x6 T	Austin	Burnet	4.3	4.8	Specified	MC#-# 1949-1977	2.0	High Stiffness	5 Int. ACP (2.5-5in.)	0.507	2.263	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
867	140270070001026	2 Wid 1988 4-10x6 T	Austin	Burnet	--	--	--	--	--	High Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
868	140280011503014	1 Org 1956 3-10x6 T	Austin	Caldwell	4.3	4.5	Specified	MC#-# 1949-1977	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.507	1.486	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
869	140280028603010	1 Org 1930 4-5x5 T	Austin	Caldwell	4.3	4.5	Specified	MBC-#	2.5	Medium Stiffness	5 Int. ACP (2.5-5in.)	1.534	4.848	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
870	140280028603010	2 Wid 1988 4-5x5 T	Austin	Caldwell	--	--	--	--	--	Medium Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
871	140280038404010	1 Org 1950 2-9x6 T	Austin	Caldwell	4.3	4.8	Specified	MC#-# 1949-1977	2.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.393	1.655	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
872	140280080503005	1 Org 1953 4-10x10 T	Austin	Caldwell	4.3	3.8	Specified	MC#-# 1949-1977	1.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.164	1.546	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
873	140280080503005	2 Wid 1996 4-10x10 T	Austin	Caldwell	--	--	--	--	--	Medium Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
874	140870011202005	1 Org 1931 4-8x8 T	Austin	Gillespie	4.8	5.0	Provided	MBC-#	1.0	Low Stiffness	10 Seal Coat or Surf. Tmt	1.121	2.333	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
875	140870011202005	2 Wid 1969 4-8x8 T	Austin	Gillespie	3.8	3.0	Associated	MC#-# 1949-1977	0.5	Low Stiffness	10 Seal Coat or Surf. Tmt	0.668	1.046	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
876	140870029003011	1 Org 1935 2-10x10 T	Austin	Gillespie	3.8	3.0	Associated	MBC-#	1.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.698	2.090	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
877	140870029003011	2 Wid 1975 2-10x10 T	Austin	Gillespie	3.8	3.0	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.369	1.991	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
878	140870029101048	1 Org 1942 5-8x8 T	Austin	Gillespie	5.0	5.0	Provided	MBC-#-#(-F)	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.842	2.572	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
879	140870029101048	2 Wid 1959 5-8x8 T	Austin	Gillespie	3.8	2.5	Associated	MC#-# 1949-1977	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.553	1.714	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
880	141060001602037	1 Org 1935 4-6x4 E	Austin	Hays	4.3	4.3	Specified	MBC-#	2.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.994	3.496	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
881	141060001602037	2 Exp 1935 1-6x4 E	Austin	Hays	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Expansion slab
882	141060001602037	3 Wid 1962 4-6x4 T	Austin	Hays	4.8	5.0	Provided	MC#-# 1949-1977	2.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.652	2.040	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
883	141060001602105	1 Org 1961 2-8x4 T	Austin	Hays	4.8	5.0	Provided	MC#-# 1949-1977	10.5	Low Stiffness	5 Int. ACP (2.5-5in.)	-0.540	4.599	Top Corner	V	FIX	1: IR>=HS20, OR> HS20
884	141060001602105	2 Wid 2010 2-8x4 T	Austin	Hays	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
885	141060047102066	1 Oth 1944 4-9x6 T	Austin	Hays	--	--	--	--	--	Low Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Geometry outside sc
886	141060047102066	2 Wid 2007 4-9x6 T	Austin	Hays	--	--	--	--	--	Low Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Post-1979
887	141440033405038	1 Org 1954 2-10x8 T	Austin	Lee	4.3	3.8	Specified	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.558	1.111	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
888	141440033405038	2 Wid 2011 2-10x8 T	Austin	Lee	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Post-1979
889	141500015003005	1 Org 1934 3-10x10 T	Austin	Llano	4.6	5.0	Provided	MBC-#	0.5	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.490	1.932	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
890	141500015003005	2 Wid 1969 3-10x10 T	Austin	Llano	3.8	3.0	Associated	MC#-# 1949-1977	0.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.296	0.984	Top Midspan	M	PIN	3: IR< HS20, OR> HS10
891	141500015004023	1 Org 1939 2-7x7 T	Austin	Llano	5.0	5.0	Provided	MBC-#-#(-F)	1.0	High Stiffness	10 Seal Coat or Surf. Tmt	0.547	1.792	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
892	141500028907028	1 Org 1934 4-6x3 T	Austin	Llano	3.0	2.3	Associated	MBC-#	2.0	High Stiffness	10 Seal Coat or Surf. Tmt	0.750	1.062	Top Corner	M	FIX	2: IR< HS20, OR>=HS20
893	141500028907028	2 Wid 1964 4-6x3 T	Austin	Llano	3.8	3.3	Associated	MC#-# 1949-1977	2.0	High Stiffness	10 Seal Coat or Surf. Tmt	0.691	2.251	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
894	141570007103054	1 Oth 1950 6-10x4 T	Austin	Mason	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Geometry outside sc
895	141570007103054	2 Org 1965 8-7x4 T	Austin	Mason	5.0	5.0	Provided	MBC-#-#(-F)	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.684	2.318	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
896	141570007107023	1 Org 1947 4-6x6 E	Austin	Mason	3.8	2.5	Associated	MBC-#	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.982	1.907	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
897	141570007107023	2 Exp 1947 1-6x6 E	Austin	Mason	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Expansion slab
898	141570015001018	1 Org 1939 4-6x4 T	Austin	Mason	5.0	5.0	Provided	MBC-#-#(-F)	1.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.765	2.715	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
899	141570015001033	1 Org 1946 3-7x6 T	Austin	Mason	3.8	3.0	Associated	MBC-#-#(-F)	2.0	High Stiffness	10 Seal Coat or Surf. Tmt	0.777	3.879	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
900	141570352501002	1 Org 1977 3-8x6 T	Austin	Mason	3.8	2.5	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.859	1.704	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
901	142270001510051	1 Org 1925 2-10x5 T	Austin	Travis	3.8	4.5	Specified	W.C.-2	1.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.490	1.145	Wall Exterior Top	M	FIX	2: IR< HS20, OR>=HS20
902	142270001510051	2 Wid 1936 2-10x5 T	Austin	Travis	5.0	5.0	Provided	MBC-#	1.5	Low Stiffness	5 Int. ACP (2.5-5in.)	0.183	1.314	Wall Exterior Top	M	FIX	2: IR< HS20, OR>=HS20
903	142270011313051	1 Org 1959 3-9x5 T	Austin	Travis	5.0	5.0	Provided	MC#-# 1949-1977	4.5	Low Stiffness	5 Int. ACP (2.5-5in.)	1.466	4.430	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
904	142270011313051	2 Org 1959 3-9x5 T	Austin	Travis	5.0	5.0	Provided	MC#-# 1949-1977	10.0	Low Stiffness	5 Int. ACP (2.5-5in.)	10.425	25.674	Top Corner	V	PIN	1: IR>=HS20, OR> HS20
905	142270011313051	3 Org 1959 3-9x5 T	Austin	Travis	5.0	5.0	Provided	MC#-# 1949-1977	21.5	Low Stiffness	5 Int. ACP (2.5-5in.)	11.672	23.080	Top Corner	V	PIN	1: IR>=HS20, OR> HS20
906	142270011313051	4 Org 1959 3-9x5 T	Austin	Travis	5.0	5.0	Provided	MC#-# 1949-1977	4.0	Low Stiffness	5 Int. ACP (2.5-5in.)	3.544	10.567	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
907	142270011313051	5 Org 1959 3-9x5 T	Austin	Travis	5.0	5.0	Provided	MC#-# 1949-1977	4.0	Low Stiffness	5 Int. ACP (2.5-5in.)	1.435	4.171	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
908	142270118601001	1 Org 1951 2-10x9 T	Austin	Travis	4.6	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.444	1.496	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
909	142270118601001	2 Wid 1958 2-10x9 T	Austin	Travis	4.6	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.563	1.850	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
910	142270118601003	1 Org 1939 2-10x5 T	Austin	Travis	3.8	3.3	Associated	W.C.-2	3.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.426	1.563	Wall Exterior Bottom	M	FIX	2: IR< HS20, OR>=HS20
911	142270118601003	2 Wid 1958 2-10x5 T	Austin	Travis	5.0	5.0	Provided	MC#-# 1949-1977	2.5	Low Stiffness	5 Int. ACP (2.5-5in.)	0.567	2.106	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
912	142270118601003	3 Wid 2005 2-10x5 T	Austin	Travis	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979

TABLE A: Summary Load Rating Results for 1,788 Segments/ 1,000 Culverts

No	Structure No	Segment ID	District	County	Interpreted Parameter Score	Design Selection Score	Design Class	Design Name	Critical Cover Soil Depth	Soil Type	Pavement	HS20 Lvl1 ORF	HS20 Lvl3 ORF	Lvl3 Controlling Critical Section	Lvl3 Failure Mode	Lvl3 Fixity	Lvl3 Load Posting Class
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
913	142270313601038	1 Org 1975 4-10x10 T	Austin	Travis	5.0	5.0	Provided	MC#-# 1949-1977	10.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	-0.050	-1.867	Wall Exterior Bottom	M	FIX	6: IR< HS 3, OR< HS 3
914	142270313601039	1 Org 1975 4-10x10 T	Austin	Travis	4.3	3.8	Specified	MC#-# 1949-1977	9.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.578	0.295	Wall Exterior Bottom	M	FIX	4: IR>=HS 3, OR< HS10
915	142460001517043	1 Org 1934 4-4x4 T	Austin	Williamson	5.0	5.0	Provided	MBC-#	1.0	High Stiffness	5 Int. ACP (2.5-5in.)	0.725	2.911	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
916	142460001517043	2 Wid 1955 4-4x4 T	Austin	Williamson	5.0	5.0	Provided	MBC-#	1.0	High Stiffness	5 Int. ACP (2.5-5in.)	0.923	3.278	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
917	142460015103003	1 Org 1923 2-10x5 T	Austin	Williamson	5.0	5.0	Provided	C - #	3.5	High Stiffness	10 Seal Coat or Surf. Tmt	0.190	1.110	Wall Exterior Bottom	M	FIX	2: IR< HS20, OR>=HS20
918	142460015103003	2 Wid 1958 2-10x5 T	Austin	Williamson	5.0	5.0	Provided	MC#-# 1949-1977	3.5	High Stiffness	10 Seal Coat or Surf. Tmt	1.430	4.511	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
919	142460015103004	1 Org 1923 2-10x4 T	Austin	Williamson	5.0	5.0	Provided	C - #	5.0	Low Stiffness	10 Seal Coat or Surf. Tmt	-0.319	0.323	Wall Exterior Bottom	M	FIX	4: IR>=HS 3, OR< HS10
920	142460015103004	2 Wid 1958 2-10x4 T	Austin	Williamson	5.0	5.0	Provided	MC#-# 1949-1977	4.5	Low Stiffness	10 Seal Coat or Surf. Tmt	1.626	4.265	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
921	142460015103006	1 Org 1923 2-10x5 J	Austin	Williamson	5.0	5.0	Provided	C - #	6.5	Low Stiffness	10 Seal Coat or Surf. Tmt	-0.988	-1.151	Wall Exterior Bottom	M	PIN	6: IR< HS 3, OR< HS 3
922	142460015103006	2 Add 1938 1-10x5 J	Austin	Williamson	2.8	1.3	Associated	BC-#	6.5	Low Stiffness	10 Seal Coat or Surf. Tmt	-0.787	10.646	Wall Exterior Top	M	FIX	1: IR>=HS20, OR> HS20
923	142460015103006	3 Wid 1958 3-10x5 T	Austin	Williamson	5.0	5.0	Provided	MC#-# 1949-1977	6.5	Low Stiffness	10 Seal Coat or Surf. Tmt	1.306	5.952	Wall Exterior Bottom	M	PIN	1: IR>=HS20, OR> HS20
924	142460015103006	4 Wid 2012 3-10x5 T	Austin	Williamson	--	--	--	--	--	Low Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Post-1979
925	142460020401005	1 Org 1926 5-10x8 T	Austin	Williamson	4.3	4.3	Specified	W.C.-2	2.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.447	-0.501	Wall Exterior Bottom	M	FIX	6: IR< HS 3, OR< HS 3
926	142460020401005	2 Wid 1940 5-10x8 T	Austin	Williamson	3.5	3.0	Associated	MBC-#	2.0	Low Stiffness	5 Int. ACP (2.5-5in.)	1.017	4.185	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
927	142460020401005	3 Wid 1960 5-10x8 T	Austin	Williamson	4.3	3.8	Specified	MC#-# 1949-1977	1.5	Low Stiffness	5 Int. ACP (2.5-5in.)	0.589	1.783	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
928	142460020401005	4 Wid 1988 5-10x8 T	Austin	Williamson	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
929	142460020401005	5 Wid 1995 5-10x11 T	Austin	Williamson	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
930	142460020401005	6 Oth 2002 5-10x5 T	Austin	Williamson	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Geometry outside sc
931	142460032003034	1 Org 1940 4-6x4 T	Austin	Williamson	4.8	5.0	Provided	MBC-#-#(-F)	1.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.765	1.275	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
932	142460032003034	2 Wid 1959 4-6x4 T	Austin	Williamson	4.8	5.0	Provided	MC#-# 1949-1977	1.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.405	1.370	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
933	142460033401001	1 Org 1929 4-6x6 T	Austin	Williamson	3.8	3.5	Associated	MBC-#	1.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.982	1.883	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
934	142460033401001	2 Wid 1942 4-6x6 T	Austin	Williamson	3.5	3.3	Associated	MBC-#	1.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.588	1.960	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
935	142460033401001	3 Wid 1958 4-6x6 T	Austin	Williamson	3.8	3.0	Associated	MC#-# 1949-1977	1.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.628	1.405	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
936	142460033702015	1 Org 1955 5-5x5 T	Austin	Williamson	5.0	5.0	Provided	MC#-# 1949-1977	3.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	1.789	4.907	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
937	142460033702015	2 Wid 1990 5-5x5 T	Austin	Williamson	--	--	--	--	--	Medium Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
938	142460098601007	1 Org 1935 5-6x6 T	Austin	Williamson	3.8	3.5	Associated	MBC-#	4.5	Low Stiffness	10 Seal Coat or Surf. Tmt	3.340	8.187	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
939	142460098601007	2 Wid 1960 5-6x6 T	Austin	Williamson	3.8	3.3	Associated	MC#-# 1949-1977	4.5	Low Stiffness	10 Seal Coat or Surf. Tmt	1.495	4.314	Bottom Corner	M	PIN	1: IR>=HS20, OR> HS20
940	142460120102008	1 Org 1955 4-7x4 T	Austin	Williamson	5.0	5.0	Provided	MC#-# 1949-1977	5.0	Low Stiffness	10 Seal Coat or Surf. Tmt	1.001	3.190	Bottom Corner	M	PIN	1: IR>=HS20, OR> HS20
941	142460120102008	2 Wid 1988 4-7x4 T	Austin	Williamson	--	--	--	--	--	Low Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Post-1979
942	142460156602002	1 Org 1953 2-10x10 T	Austin	Williamson	5.0	5.0	Provided	MC#-# 1949-1977	0.5	Low Stiffness	10 Seal Coat or Surf. Tmt	0.150	0.786	Top Midspan	M	PIN	3: IR< HS20, OR> HS10
943	142460156602002	2 Wid 1998 2-10x10 T	Austin	Williamson	--	--	--	--	--	Low Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Post-1979
944	142460203803009	1 Org 1965 2-10x8 J	Austin	Williamson	3.8	3.0	Associated	MC#-# 1949-1977	1.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.562	1.590	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
945	142460203803009	2 Add 1980 1-10x8 J	Austin	Williamson	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
946	142460269001003	1 Org 1964 2-10x6 J	Austin	Williamson	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.534	1.463	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
947	142460269001003	2 Add 1965 2-10x6 J	Austin	Williamson	3.8	3.0	Associated	MC#-# 1949-1977	2.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.534	1.463	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
948	142460269001003	3 Wid 2008 4-10x6 T	Austin	Williamson	--	--	--	--	--	Low Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Post-1979
949	150070007305029	1 Org 1955 4-6x4 T	San Antonio	Atascosa	4.3	4.3	Specified	MC#-# 1949-1977	11.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	-1.021	3.571	Top Corner	V	FIX	1: IR>=HS20, OR> HS20
950	150070007305029	2 Wid 1975 4-6x4 T	San Antonio	Atascosa	5.0	5.0	Provided	MC#-# 1949-1977	8.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	1.052	5.690	Top Corner	V	FIX	1: IR>=HS20, OR> HS20
951	150070007305029	3 Wid 1975 4-6x4 T	San Antonio	Atascosa	5.0	5.0	Provided	MC#-# 1949-1977	4.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	1.509	4.952	Top Corner	V	PIN	1: IR>=HS20, OR> HS20
952	150070007305029	4 Wid 1975 4-6x4 T	San Antonio	Atascosa	5.0	5.0	Provided	MC#-# 1949-1977	4.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	1.509	4.952	Top Corner	V	PIN	1: IR>=HS20, OR> HS20
953	150070007305029	5 Wid 1975 4-6x4 T	San Antonio	Atascosa	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.652	1.817	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
954	150070007306175	1 Org 1976 5-9x5 T	San Antonio	Atascosa	5.0	5.0	Provided	MC#-# 1949-1977	3.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.690	3.497	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
955	150070032803246	1 Org 1979 4-9x5 T	San Antonio	Atascosa	5.0	5.0	Provided	MC#-# 1949-1977	9.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	6.232	9.630	Top Corner	V	FIX	1: IR>=HS20, OR> HS20
956	150070042104012	1 Org 1947 7-6x6 T	San Antonio	Atascosa	5.0	5.0	Provided	MBC ##-##	1.0	Medium Stiffness	9 Overlaid Flexible	0.737	2.820	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
957	150070042104012	2 Wid 2004 7-6x6 T	San Antonio	Atascosa	--	--	--	--	--	Medium Stiffness	9 Overlaid Flexible	--	--	--	--	--	NLR: Post-1979
958	150070051701047	1 Org 1954 3-9x8 T	San Antonio	Atascosa	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.563	1.207	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
959	150070061302002	1 Org 1939 2-10x12 E	San Antonio	Atascosa	4.8	5.0	Provided	MBC ##-##	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.383	1.022	Top Midspan	M	FIX	2: IR< HS20, OR>=HS20
960	150070061302002	2 Exp 1939 1-10x12 E	San Antonio	Atascosa	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Expansion slab
961	150070061302002	3 Wid 1958 5-10x12 T	San Antonio	Atascosa	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	-0.525	1.268	Bottom Corner	M	PIN	2: IR< HS20, OR>=HS20
962	150070085302001	1 Org 1930 4-8x8 T	San Antonio	Atascosa	3.8	3.3	Associated	MBC-#	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	1.121	2.162	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
963	150070085302001	2 Wid 1961 4-8x8 T	San Antonio	Atascosa	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.639	1.293	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
964	150070101102007	1 Org 1962 3-7x5 T	San Antonio	Atascosa	5.0	5.0	Provided	MC#-# 1949-1977	0.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.625	0.927	Top Corner	M	PIN	3: IR< HS20, OR> HS10
965	150100042106032	1 Org 1963 2-10x10 T	San Antonio	Bandera	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.350	1.059	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
966	150100042106032	2 Wid 2009 2-10x10 T	San Antonio	Bandera	--	--	--	--	--	Low Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Post-1979
967	150100042106035	1 Org 1963 2-10x6 J	San Antonio	Bandera	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.550	1.090	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
968	150100042106035	2 Add 1976 3-10x6 J	San Antonio	Bandera	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.528	1.077	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
969	150150001703102	1 Org 1955 5-10x10 T	San Antonio	Bexar	5.0	5.0	Provided	MC#-# 1949-1977	0.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.272	0.801	Top Midspan	M	PIN	3: IR< HS20, OR> HS10

TABLE A: Summary Load Rating Results for 1,788 Segments/ 1,000 Culverts

No	Structure No	Segment ID	District	County	Interpreted Parameter Score	Design Selection Score	Design Class	Design Name	Critical Cover Soil Depth	Soil Type	Pavement	HS20 Lvl1 ORF	HS20 Lvl3 ORF	Lvl3 Controlling Critical Section	Lvl3 Failure Mode	Lvl3 Fixity	Lvl3 Load Posting Class
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
970	150150001709032	1 Org 1935 3-8x8 T	San Antonio	Bexar	3.0	2.0	Associated	MBC-#-#(-F)	2.5	Low Stiffness	5 Int. ACP (2.5-5in.)	0.868	3.725	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
971	150150001709032	2 Wid 1956 3-8x8 T	San Antonio	Bexar	5.0	5.0	Provided	MC#-# 1949-1977	2.5	Low Stiffness	5 Int. ACP (2.5-5in.)	0.899	2.459	Bottom Corner	M	PIN	1: IR>=HS20, OR> HS20
972	150150001709032	3 Wid 1961 3-8x8 T	San Antonio	Bexar	3.8	3.0	Associated	MC#-# 1949-1977	2.5	Low Stiffness	5 Int. ACP (2.5-5in.)	0.604	2.573	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
973	150150001709122	1 Org 1958 5-10x7 T	San Antonio	Bexar	5.0	5.0	Provided	MC#-# 1949-1977	0.5	Low Stiffness	4 Thick ACP (>5in.)	0.601	1.180	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
974	150150001709303	1 Org 1974 3-10x10 T	San Antonio	Bexar	5.0	5.0	Provided	MC#-# 1949-1977	0.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.296	0.984	Top Midspan	M	PIN	3: IR< HS20, OR> HS10
975	150150001710172	1 Org 1962 4-5x3 T	San Antonio	Bexar	5.0	5.0	Provided	MC#-# 1949-1977	5.0	Low Stiffness	10 Seal Coat or Surf. Tmt	2.645	4.583	Bottom Corner	M	PIN	1: IR>=HS20, OR> HS20
976	150150002502181	1 Org 1968 3-8x8 T	San Antonio	Bexar	5.0	5.0	Provided	MC#-# 1949-1977	13.5	Low Stiffness	4 Thick ACP (>5in.)	4.718	5.604	Wall Exterior Bottom	M	FIX	1: IR>=HS20, OR> HS20
977	150150010002043	1 Org 1936 5-6x6 T	San Antonio	Bexar	4.8	5.0	Provided	MBC-#-#(-F)	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.883	4.799	Top Midspan	M	FIX	1: IR>=HS20, OR> HS20
978	150150014301082	1 Org 1948 3-10x8 T	San Antonio	Bexar	3.8	2.5	Associated	MBC-#	4.0	Low Stiffness	4 Thick ACP (>5in.)	0.781	6.474	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
979	150150029109089	1 Org 1976 3-6x3 T	San Antonio	Bexar	5.0	5.0	Provided	MC#-# 1949-1977	1.5	Low Stiffness	5 Int. ACP (2.5-5in.)	0.622	1.674	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
980	150150029109096	1 Org 1979 2-9x5 T	San Antonio	Bexar	5.0	5.0	Provided	MC#-# 1949-1977	3.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	1.805	4.790	Top Corner	V	FIX	1: IR>=HS20, OR> HS20
981	150150029109097	1 Org 1979 4-8x5 T	San Antonio	Bexar	5.0	5.0	Provided	MC#-# 1949-1977	6.5	High Stiffness	5 Int. ACP (2.5-5in.)	3.607	8.320	Top Corner	V	FIX	1: IR>=HS20, OR> HS20
982	150150029110081	1 Org 1948 2-5x2 J	San Antonio	Bexar	5.0	5.0	Provided	MBC-#-#(-F)	3.0	Low Stiffness	5 Int. ACP (2.5-5in.)	1.074	4.244	Wall Exterior Bottom	M	PIN	1: IR>=HS20, OR> HS20
983	150150029110081	2 Wid 1955 2-5x2 J	San Antonio	Bexar	2.8	1.8	Associated	MBC-#-#(-F)	3.0	Low Stiffness	5 Int. ACP (2.5-5in.)	1.435	4.994	Wall Exterior Bottom	M	PIN	1: IR>=HS20, OR> HS20
984	150150029110081	3 Add 1972 4-5x2 J	San Antonio	Bexar	5.0	5.0	Provided	MC#-# 1949-1977	3.0	Low Stiffness	5 Int. ACP (2.5-5in.)	1.439	3.478	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
985	150150029110081	4 Wid 1972 6-5x2 T	San Antonio	Bexar	5.0	5.0	Provided	MC#-# 1949-1977	3.0	Low Stiffness	5 Int. ACP (2.5-5in.)	1.439	3.529	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
986	150150046502002	1 Org 1961 2-10x6 T	San Antonio	Bexar	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.534	1.010	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
987	150150052101005	1 Org 1942 4-5x3 J	San Antonio	Bexar	4.5	5.0	Provided	MBC-#-#(-F)	1.0	Low Stiffness	4 Thick ACP (>5in.)	0.638	2.646	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
988	150150052101005	2 Wid 1969 4-5x3 J	San Antonio	Bexar	4.8	5.0	Provided	MC#-# 1949-1977	1.0	Low Stiffness	4 Thick ACP (>5in.)	0.640	1.848	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
989	150150052101005	3 Add 1969 4-5x3 J	San Antonio	Bexar	4.8	5.0	Provided	MC#-# 1949-1977	1.0	Low Stiffness	4 Thick ACP (>5in.)	0.640	1.848	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
990	150150052102100	1 Org 1962 2-10x10 J	San Antonio	Bexar	4.8	5.0	Provided	MC#-# 1949-1977	2.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.433	2.587	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
991	150150052102100	2 Oth 2009 4-10x10 J	San Antonio	Bexar	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Geometry outside sc
992	150150052102252	1 Org 1968 4-8x6 T	San Antonio	Bexar	3.8	2.5	Associated	MC#-# 1949-1977	5.0	Low Stiffness	4 Thick ACP (>5in.)	1.460	4.499	Wall Exterior Bottom	M	PIN	1: IR>=HS20, OR> HS20
993	150150052106111	1 Org 1964 16-5x2 T	San Antonio	Bexar	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.564	1.941	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
994	150150143701001	1 Org 1940 5-10x10 J	San Antonio	Bexar	3.8	2.0	Associated	MBC-#	1.0	Low Stiffness	5 Int. ACP (2.5-5in.)	1.198	3.046	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
995	150150143701001	2 Wid 1955 5-10x10 J	San Antonio	Bexar	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.343	1.697	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
996	150150143701001	3 Wid 1980 5-10x10 J	San Antonio	Bexar	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
997	150150143701001	4 Wid 1998 5-10x10 J	San Antonio	Bexar	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
998	150150143701001	5 Add 1998 1-10x10 J	San Antonio	Bexar	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
999	150150245202041	1 Org 1975 4-7x3 J	San Antonio	Bexar	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: No standard design
1000	150150245202041	2 Add 1995 2-7x3 J	San Antonio	Bexar	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
1001	150150245202041	3 Wid 1995 8-7x3 J	San Antonio	Bexar	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
1002	150150245202041	4 Wid 1995 8-7x3 T	San Antonio	Bexar	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
1003	150150245202041	5 Oth 1995 1-7x3 J	San Antonio	Bexar	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Geometry outside sc
1004	150460025303054	1 Org 1978 8-6x4 T	San Antonio	Comal	5.0	5.0	Provided	MC#-# 1949-1977	20.0	High Stiffness	5 Int. ACP (2.5-5in.)	3.513	14.330	Top Corner	V	FIX	1: IR>=HS20, OR> HS20
1005	150460085701006	1 Org 1968 2-9x5 J	San Antonio	Comal	4.3	4.3	Specified	MC#-# 1949-1977	3.0	High Stiffness	10 Seal Coat or Surf. Tmt	1.050	3.757	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1006	150460085701006	2 Wid 2011 3-9x5 J	San Antonio	Comal	--	--	--	--	--	High Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Post-1979
1007	150460085701006	3 Add 2011 1-9x5 J	San Antonio	Comal	--	--	--	--	--	High Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Post-1979
1008	150830001706302	1 Org 1973 3-5x3 T	San Antonio	Frio	5.0	5.0	Provided	MC#-# 1949-1977	4.5	Low Stiffness	5 Int. ACP (2.5-5in.)	1.391	3.238	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1009	150830001706302	2 Org 1973 3-5x3 T	San Antonio	Frio	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.604	1.415	Top Midspan	M	FIX	2: IR< HS20, OR>=HS20
1010	150830001707070	1 Org 1947 4-7x7 E	San Antonio	Frio	5.0	5.0	Provided	MBC-#-#(-F)	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.680	1.973	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1011	150830001707070	2 Org 1947 3-7x7 E	San Antonio	Frio	5.0	5.0	Provided	MBC-#-#(-F)	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.669	1.982	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1012	150830001707070	3 Exp 1947 1-7x7 E	San Antonio	Frio	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Expansion slab
1013	150830001707070	4 Add 1973 3-7x5 J	San Antonio	Frio	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.382	0.863	Top Midspan	M	PIN	3: IR< HS20, OR> HS10
1014	150830001707070	5 Wid 1973 14-7x5 T	San Antonio	Frio	5.0	5.0	Provided	MC#-# 1949-1977	3.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.817	3.105	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1015	150830001707265	1 Org 1973 4-8x4 T	San Antonio	Frio	5.0	5.0	Provided	MC#-# 1949-1977	6.0	Medium Stiffness	6 Thin ACP (<2.5in.)	1.408	7.827	Top Corner	V	PIN	1: IR>=HS20, OR> HS20
1016	150830001716071	1 Org 1947 5-5x4 T	San Antonio	Frio	5.0	5.0	Provided	MBC-#-#(-F)	1.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.884	2.430	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1017	150830027607054	1 Org 1957 4-5x3 T	San Antonio	Frio	3.0	1.8	Associated	MC#-# 1949-1977	4.0	Low Stiffness	6 Thin ACP (<2.5in.)	2.363	4.294	Bottom Corner	M	PIN	1: IR>=HS20, OR> HS20
1018	150830027607054	2 Wid 1971 4-5x3 T	San Antonio	Frio	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Low Stiffness	9 Overlaid Flexible	1.038	2.664	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1019	150830030106027	1 Org 1975 7-8x6 T	San Antonio	Frio	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Low Stiffness	6 Thin ACP (<2.5in.)	0.594	1.323	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1020	150830353601001	1 Org 1978 3-10x6 T	San Antonio	Frio	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.911	2.472	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1021	150950053502116	1 Org 1969 4-6x4 T	San Antonio	Guadalupe	5.0	5.0	Provided	MC#-# 1949-1977	4.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	1.408	4.569	Top Corner	V	PIN	1: IR>=HS20, OR> HS20
1022	150950085001001	1 Org 1948 6-6x4 T	San Antonio	Guadalupe	5.0	5.0	Provided	MBC ##-##	1.0	Low Stiffness	6 Thin ACP (<2.5in.)	0.460	1.464	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1023	150950085001001	2 Wid 1999 6-6x4 T	San Antonio	Guadalupe	--	--	--	--	--	Low Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Post-1979
1024	151310007205123	1 Org 1967 5-10x6 T	San Antonio	Kendall	5.0	5.0	Provided	MC#-# 1949-1977	14.5	Low Stiffness	10 Seal Coat or Surf. Tmt	4.486	18.501	Top Corner	M	FIX	1: IR>=HS20, OR> HS20
1025	151310007205123	2 Org 1967 5-10x6 T	San Antonio	Kendall	5.0	5.0	Provided	MC#-# 1949-1977	7.0	Low Stiffness	10 Seal Coat or Surf. Tmt	4.933	14.928	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
1026	151330014205021	1 Org 1932 4-8x8 E	San Antonio	Kerr	5.0	5.0	Provided	MBC-#	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	1.121	2.162	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20

TABLE A: Summary Load Rating Results for 1,788 Segments/ 1,000 Culverts

No	Structure No	Segment ID	District	County	Interpreted Parameter Score	Design Selection Score	Design Class	Design Name	Critical Cover Soil Depth	Soil Type	Pavement	HS20 Lvl1 ORF	HS20 Lvl3 ORF	Lvl3 Controlling Critical Section	Lvl3 Failure Mode	Lvl3 Fixity	Lvl3 Load Posting Class
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
1027	151330014205021	2 Org 1932 3-8x8 E	San Antonio	Kerr	5.0	5.0	Provided	MBC-#	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	1.114	1.966	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1028	151330014205021	3 Exp 1932 1-8x8 E	San Antonio	Kerr	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Expansion slab
1029	151330014205021	4 Wid 1953 8-8x8 T	San Antonio	Kerr	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.525	1.050	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
1030	151330014205021	5 Wid 1987 8-8x8 T	San Antonio	Kerr	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Post-1979
1031	151330020108018	1 Org 1962 5-9x5 T	San Antonio	Kerr	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.522	1.012	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1032	151620051703033	1 Org 1948 4-6x3 T	San Antonio	McMullen	4.3	3.8	Specified	MBC ##-##	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.459	2.773	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1033	151620051703033	2 Wid 1959 4-6x3 T	San Antonio	McMullen	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.691	2.028	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1034	151620051703034	1 Org 1948 4-6x4 T	San Antonio	McMullen	4.3	3.8	Specified	MBC ##-##	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.460	1.323	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
1035	151620051703034	2 Wid 1959 4-6x4 T	San Antonio	McMullen	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.569	1.256	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1036	151620051703035	1 Org 1948 5-7x4 E	San Antonio	McMullen	4.3	3.8	Specified	MBC ##-##	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.439	1.458	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
1037	151620051703035	2 Org 1948 4-7x4 E	San Antonio	McMullen	4.3	3.8	Specified	MBC ##-##	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.439	1.492	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
1038	151620051703035	3 Exp 1948 1-7x4 E	San Antonio	McMullen	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Expansion slab
1039	151620051703035	4 Wid 1959 10-7x4 T	San Antonio	McMullen	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.614	1.768	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1040	151630002405095	1 Org 1949 6-10x8 T	San Antonio	Medina	5.0	5.0	Provided	MBC-#-#(-F)	1.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.884	1.729	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1041	151630002405095	2 Wid 1978 6-10x8 T	San Antonio	Medina	3.0	1.8	Associated	MC#-# 1949-1977	1.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.852	1.717	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1042	151630002405095	3 Wid 1987 6-10x8 T	San Antonio	Medina	--	--	--	--	--	Low Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Post-1979
1043	151630042108024	1 Org 1957 5-6x4 T	San Antonio	Medina	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.569	1.234	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1044	151630059503003	1 Org 1968 3-10x6 T	San Antonio	Medina	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.509	0.965	Wall Exterior Top	M	PIN	3: IR< HS20, OR> HS10
1045	151630059503008	1 Org 1968 2-10x10 T	San Antonio	Medina	5.0	5.0	Provided	MC#-# 1949-1977	0.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.312	0.839	Top Midspan	M	PIN	3: IR< HS20, OR> HS10
1046	152320002305032	1 Org 1929 2-10x8 T	San Antonio	Uvalde	5.0	5.0	Provided	MBC-#	2.0	High Stiffness	5 Int. ACP (2.5-5in.)	1.025	4.976	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
1047	152320002305032	2 Wid 1936 2-10x8 T	San Antonio	Uvalde	5.0	5.0	Provided	MBC-#-#(-F)	2.0	High Stiffness	5 Int. ACP (2.5-5in.)	1.046	4.884	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1048	152320002305032	3 Wid 1936 2-10x10 T	San Antonio	Uvalde	5.0	5.0	Provided	MBC-#-#(-F)	2.0	High Stiffness	5 Int. ACP (2.5-5in.)	0.985	4.983	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1049	152320002305032	4 Wid 2012 2-10x8 T	San Antonio	Uvalde	--	--	--	--	--	High Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
1050	152470010004013	1 Org 1930 3-8x8 T	San Antonio	Wilson	5.0	5.0	Provided	MBC-#	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	1.274	3.882	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1051	152470010004013	2 Wid 1952 3-8x8 T	San Antonio	Wilson	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.611	1.722	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
1052	152470010004013	3 Wid 1990 3-8x8 T	San Antonio	Wilson	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Post-1979
1053	152470036604017	1 Org 1931 3-8x8 T	San Antonio	Wilson	4.3	3.8	Specified	MBC-#	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	1.114	1.966	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1054	152470036604017	2 Wid 1956 3-8x8 T	San Antonio	Wilson	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.624	1.263	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
1055	152470036604018	1 Org 1931 5-5x5 T	San Antonio	Wilson	4.3	4.0	Specified	MBC-#	1.5	Low Stiffness	10 Seal Coat or Surf. Tmt	0.846	1.806	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1056	152470036604018	2 Wid 1956 5-5x5 T	San Antonio	Wilson	5.0	5.0	Provided	MC#-# 1949-1977	1.5	Low Stiffness	10 Seal Coat or Surf. Tmt	0.722	1.681	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1057	152470112204006	1 Org 1935 4-6x4 T	San Antonio	Wilson	3.0	2.0	Associated	MBC ##-##	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.575	2.017	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1058	152470112204006	2 Wid 1970 4-6x4 T	San Antonio	Wilson	3.8	3.0	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.625	1.252	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1059	160130010101024	1 Org 1940 6-5x3 T	Corpus Christi	Bee	4.3	4.5	Specified	MBC-#-#(-F)	1.5	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.716	3.251	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1060	160130010101024	2 Wid 1976 6-5x3 T	Corpus Christi	Bee	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	1.038	2.983	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1061	160130106301003	1 Org 1941 3-7x4 E	Corpus Christi	Bee	4.3	3.8	Specified	MBC ##-##	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.374	1.868	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1062	160130106301003	2 Exp 1941 1-7x4 E	Corpus Christi	Bee	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Expansion slab
1063	160130106301003	3 Wid 1968 3-7x4 E	Corpus Christi	Bee	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.470	1.047	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1064	160130106301003	4 Exp 1968 1-7x4 E	Corpus Christi	Bee	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Expansion slab
1065	160130106301011	1 Org 1941 5-4x2 T	Corpus Christi	Bee	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: No standard design
1066	160130106301011	2 Wid 1968 1-4x2 J	Corpus Christi	Bee	4.8	5.0	Provided	MC#-# 1949-1977	1.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.614	2.682	Wall Exterior Top	M	FIX	1: IR>=HS20, OR> HS20
1067	160130106301011	3 Wid 1968 1-8.5x2 J	Corpus Christi	Bee	4.8	5.0	Provided	MC#-# 1949-1977	2.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.243	1.602	Wall Exterior Top	M	FIX	2: IR< HS20, OR>=HS20
1068	160130106301011	4 Wid 2007 5-4x2 T	Corpus Christi	Bee	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Post-1979
1069	160890051602011	1 Org 1947 4-6x4 T	Corpus Christi	Goliad	5.0	5.0	Provided	MBC-#-#(-F)	2.0	Low Stiffness	6 Thin ACP (<2.5in.)	1.026	3.410	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1070	160890051602011	2 Wid 2001 4-6x4 T	Corpus Christi	Goliad	--	--	--	--	--	Low Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Post-1979
1071	160890069102001	1 Org 1940 6-6x5 T	Corpus Christi	Goliad	5.0	5.0	Provided	MBC-#-#(-F)	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	1.170	3.424	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1072	160890069103010	1 Org 1951 4-6x6 T	Corpus Christi	Goliad	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.514	1.112	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
1073	160890327901002	1 Org 1969 5-6x6 T	Corpus Christi	Goliad	3.8	4.0	Associated	MC#-# 1949-1977	1.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.728	1.701	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
1074	161260025502012	1 Org 1926 4-5x5 J	Corpus Christi	Jim Wells	4.3	4.3	Specified	MBC-#	1.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.739	2.232	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1075	161260025502012	2 Add 1941 2-5x5 J	Corpus Christi	Jim Wells	4.3	3.8	Specified	MBC-#-#(-F)	1.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.826	2.714	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1076	161260025502012	3 Wid 1962 6-5x5 T	Corpus Christi	Jim Wells	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.647	2.014	Wall Exterior Top	M	FIX	1: IR>=HS20, OR> HS20
1077	161260025502016	1 Org 1926 6-3x3 T	Corpus Christi	Jim Wells	3.8	3.8	Associated	MBC-#	1.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.534	1.841	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1078	161260025502016	2 Wid 1941 6-3x3 T	Corpus Christi	Jim Wells	4.3	4.0	Specified	MBC-#	1.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.534	1.841	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1079	161260025502016	3 Wid 1962 3-6.5x3 T	Corpus Christi	Jim Wells	4.8	5.0	Provided	MC#-# 1949-1977	1.5	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.594	1.811	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1080	161290010006076	1 Org 1956 2-10x8 T	Corpus Christi	Karnes	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.562	1.197	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
1081	161290027007018	1 Org 1937 4-8x8 T	Corpus Christi	Karnes	3.8	3.0	Associated	MBC-#-#(-F)	1.0	Low Stiffness	6 Thin ACP (<2.5in.)	0.731	1.743	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1082	161290027007018	2 Wid 1990 4-8x8 T	Corpus Christi	Karnes	--	--	--	--	--	Low Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Post-1979
1083	161290034804012	1 Org 1929 6-4x4 T	Corpus Christi	Karnes	4.3	4.3	Specified	MBC-#	1.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.725	1.652	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20

TABLE A: Summary Load Rating Results for 1,788 Segments/ 1,000 Culverts

No	Structure No	Segment ID	District	County	Interpreted Parameter Score	Design Selection Score	Design Class	Design Name	Critical Cover Soil Depth	Soil Type	Pavement	HS20 Lvl1 ORF	HS20 Lvl3 ORF	Lvl3 Controlling Critical Section	Lvl3 Failure Mode	Lvl3 Fixity	Lvl3 Load Posting Class
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
1084	161290034804012	2 Wid 1971 6-5x4 T	Corpus Christi	Karnes	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.635	1.385	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
1085	161290112101003	1 Org 1939 3-7x6 T	Corpus Christi	Karnes	3.8	3.0	Associated	MBC ##-##	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.448	1.898	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1086	161290129402001	1 Org 1940 4-5x5 T	Corpus Christi	Karnes	3.8	3.3	Associated	MBC-#	1.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.739	1.501	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
1087	161290129402001	2 Wid 2001 4-5x5 T	Corpus Christi	Karnes	--	--	--	--	--	Low Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Post-1979
1088	161490007401036	1 Org 1937 2-9x8 E	Corpus Christi	Live Oak	5.0	5.0	Provided	MBC ##-##	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.416	1.823	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1089	161490007401036	2 Exp 1937 1-9x8 E	Corpus Christi	Live Oak	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Expansion slab
1090	161490007401036	3 Wid 1957 5-9x8 T	Corpus Christi	Live Oak	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.578	1.235	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
1091	161490044701006	1 Org 1936 4-7x7 T	Corpus Christi	Live Oak	3.8	3.0	Associated	MBC ##-##	1.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.480	2.208	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1092	161490044701006	2 Wid 1960 4-7x7 T	Corpus Christi	Live Oak	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.594	1.580	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1093	161490044701006	3 Wid 2008 4-7x7 T	Corpus Christi	Live Oak	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
1094	161780010202004	1 Org 1924 1-10x5 J	Corpus Christi	Nueces	4.8	5.0	Provided	W.C.-2	2.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.178	1.066	Wall Exterior Top	M	FIX	2: IR< HS20, OR>=HS20
1095	161780010202004	2 Oth 1947 2-10x10 J	Corpus Christi	Nueces	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Geometry outside sc
1096	161780010202004	3 Wid 1947 1-10x5 J	Corpus Christi	Nueces	5.0	5.0	Provided	MBC-#	2.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.178	1.713	Wall Exterior Bottom	M	FIX	1: IR>=HS20, OR> HS20
1097	161780010202004	4 Wid 1947 2-10x10 J	Corpus Christi	Nueces	5.0	5.0	Provided	MBC-#	1.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.823	1.996	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1098	161780010202004	5 Oth 1992 4-10x5 O	Corpus Christi	Nueces	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Geometry outside sc
1099	161780010202005	1 Org 1924 4-10x7 J	Corpus Christi	Nueces	4.8	5.0	Provided	W.C.-2	2.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.478	0.450	Wall Exterior Bottom	M	FIX	4: IR>=HS 3, OR< HS10
1100	161780010202005	2 Wid 1947 7-10x7 T	Corpus Christi	Nueces	5.0	5.0	Provided	MBC-#-#(-F)	1.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.692	2.288	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1101	161780010202005	3 Wid 1947 7-10x7 T	Corpus Christi	Nueces	5.0	5.0	Provided	MBC-#-#(-F)	1.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.692	2.288	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1102	161780010202005	4 Add 1947 2-10x7 J	Corpus Christi	Nueces	5.0	5.0	Provided	MBC-#-#(-F)	1.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.871	2.307	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1103	161780010202005	5 Add 1947 1-10x7 J	Corpus Christi	Nueces	5.0	5.0	Provided	BC-#	1.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.918	2.292	Top Midspan	M	FIX	1: IR>=HS20, OR> HS20
1104	161780010203038	1 Org 1948 4-5x4 T	Corpus Christi	Nueces	5.0	5.0	Provided	MBC-#-#(-F)	2.0	Low Stiffness	5 Int. ACP (2.5-5in.)	1.307	3.696	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1105	161780010203038	2 Org 1955 4-5x4 T	Corpus Christi	Nueces	4.3	4.5	Specified	MC#-# 1949-1977	2.0	Low Stiffness	5 Int. ACP (2.5-5in.)	1.204	2.603	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1106	161780010203038	3 Wid 1990 4-5x4 T	Corpus Christi	Nueces	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
1107	161780010203053	1 Org 1964 4-6x3 T	Corpus Christi	Nueces	5.0	5.0	Provided	MC#-# 1949-1977	3.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	1.033	3.372	Wall Exterior Top	M	FIX	1: IR>=HS20, OR> HS20
1108	161780010203053	2 Wid 1990 4-6x3 T	Corpus Christi	Nueces	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Post-1979
1109	161780010211040	1 Org 1947 5-7x6 J	Corpus Christi	Nueces	5.0	5.0	Provided	MBC-#-#(-F)	1.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.662	2.191	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1110	161780010211040	2 Add 1955 6-7x6 J	Corpus Christi	Nueces	3.5	3.8	Associated	MC#-# 1949-1977	1.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.590	1.502	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1111	161780010211040	3 Wid 1968 5-7x6 J	Corpus Christi	Nueces	4.8	5.0	Provided	MC#-# 1949-1977	1.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.607	1.523	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
1112	161780010211040	4 Wid 1968 6-7x6 J	Corpus Christi	Nueces	4.8	5.0	Provided	MC#-# 1949-1977	1.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.590	1.502	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1113	161780037301001	1 Org 1933 8-4x4 O	Corpus Christi	Nueces	5.0	5.0	Provided	MBC-#	1.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.725	2.499	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1114	161780037301001	2 Wid 1954 8-4x4 O	Corpus Christi	Nueces	4.3	4.3	Specified	MBC-#	1.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.905	2.852	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1115	161780037301001	3 Wid 1973 8-4x4 O	Corpus Christi	Nueces	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.894	2.496	Top Midspan	M	FIX	1: IR>=HS20, OR> HS20
1116	161780037301001	4 Oth 1973 2-4x4 O	Corpus Christi	Nueces	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Geometry outside sc
1117	161780098902005	1 Org 1939 7-5x2 T	Corpus Christi	Nueces	3.0	1.8	Associated	MBC ##-##	1.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.565	2.179	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1118	161780098902005	2 Wid 1989 7-5x2 T	Corpus Christi	Nueces	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
1119	161780098902005	3 Wid 2000 7-5x2 T	Corpus Christi	Nueces	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
1120	161780106901010	1 Org 1968 3-7x7 J	Corpus Christi	Nueces	3.5	4.0	Specified	MC#-# 1949-1977	1.5	Low Stiffness	5 Int. ACP (2.5-5in.)	0.674	1.765	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1121	161780106901010	2 Org 1968 1-5x7 J	Corpus Christi	Nueces	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: No standard design
1122	161780106901010	3 Wid 1994 3-7x7 J	Corpus Christi	Nueces	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
1123	161780106901010	4 Wid 1994 1-5x7 J	Corpus Christi	Nueces	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
1124	161780106901010	5 Add 2014 2-7x7 J	Corpus Christi	Nueces	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
1125	161780106901010	6 Add 2014 1-7x7 J	Corpus Christi	Nueces	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
1126	161960015506031	1 Org 1965 6-7x3 T	Corpus Christi	Refugio	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.425	1.365	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1127	161960015506031	2 Wid 1988 6-7x3 T	Corpus Christi	Refugio	--	--	--	--	--	Medium Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
1128	161960018002020	1 Org 1930 9-4x4 T	Corpus Christi	Refugio	4.3	3.8	Specified	MBC-#	0.5	Low Stiffness	10 Seal Coat or Surf. Tmt	0.739	1.275	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
1129	161960018002020	2 Wid 1953 9-4x4 T	Corpus Christi	Refugio	4.8	5.0	Provided	MC#-# 1949-1977	0.5	Low Stiffness	10 Seal Coat or Surf. Tmt	0.637	1.062	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
1130	161960018002020	3 Wid 1983 9-4x4 T	Corpus Christi	Refugio	--	--	--	--	--	Low Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Post-1979
1131	161960034901004	1 Org 1930 4-3x3 J	Corpus Christi	Refugio	3.5	4.5	Specified	MBC-#	2.0	Low Stiffness	10 Seal Coat or Surf. Tmt	1.604	2.000	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1132	161960034901004	2 Add 1937 2-3x3 J	Corpus Christi	Refugio	2.5	2.3	Associated	MBC-#	2.0	Low Stiffness	10 Seal Coat or Surf. Tmt	1.613	2.033	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1133	161960034901004	3 Wid 1972 3-6.5x3 T	Corpus Christi	Refugio	4.8	5.0	Provided	MC#-# 1949-1977	2.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.785	1.675	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1134	161960044705038	1 Org 1941 5-5x2 T	Corpus Christi	Refugio	3.5	3.3	Associated	MBC ##-##	1.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.565	1.857	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1135	162050007405040	1 Org 1937 4-5x2 T	Corpus Christi	San Patricio	5.0	5.0	Provided	MBC ##-##	2.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.918	4.570	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1136	162050037201012	1 Org 1979 4-7x3 T	Corpus Christi	San Patricio	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.425	2.147	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1137	170210004912085	1 Org 1971 2-7x3 T	Bryan	Brazos	5.0	5.0	Provided	MC#-# 1949-1977	3.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.897	2.876	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1138	170210047501097	1 Org 1974 3-8x5 T	Bryan	Brazos	5.0	5.0	Provided	MC#-# 1949-1977	3.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.712	4.021	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1139	170210047501097	2 Wid 1999 3-8x5 T	Bryan	Brazos	--	--	--	--	--	Medium Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
1140	170210285101004	1 Org 1975 3-6x5 T	Bryan	Brazos	4.8	5.0	Provided	MC#-# 1949-1977	10.5	Medium Stiffness	5 Int. ACP (2.5-5in.)	3.770	4.815	Wall Exterior Bottom	M	FIX	1: IR>=HS20, OR> HS20

TABLE A: Summary Load Rating Results for 1,788 Segments/ 1,000 Culverts

No	Structure No	Segment ID	District	County	Interpreted Parameter Score	Design Selection Score	Design Class	Design Name	Critical Cover Soil Depth	Soil Type	Pavement	HS20 Lvl1 ORF	HS20 Lvl3 ORF	Lvl3 Controlling Critical Section	Lvl3 Failure Mode	Lvl3 Fixity	Lvl3 Load Posting Class
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
1141	170260011602026	1 Org 1936 4-6x4 T	Bryan	Burleson	4.8	5.0	Provided	MBC-#-#(-F)	4.5	Low Stiffness	5 Int. ACP (2.5-5in.)	2.156	7.654	Wall Exterior Bottom	M	PIN	1: IR>=HS20, OR> HS20
1142	170260011602026	2 Wid 1964 4-6x4 T	Bryan	Burleson	5.0	5.0	Provided	MC#-# 1949-1977	3.5	Low Stiffness	5 Int. ACP (2.5-5in.)	1.725	3.862	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1143	170260011602026	3 Wid 1993 4-6x4 T	Bryan	Burleson	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
1144	170260018602031	1 Org 1936 4-6x5 T	Bryan	Burleson	5.0	5.0	Provided	MBC-#-#(-F)	1.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.861	2.725	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1145	170260018602031	2 Wid 1971 4-6x5 T	Bryan	Burleson	5.0	4.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.649	1.761	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
1146	170260018603040	1 Org 1937 3-8x7 T	Bryan	Burleson	5.0	5.0	Provided	MBC-#-#(-F)	2.5	Low Stiffness	5 Int. ACP (2.5-5in.)	0.866	3.736	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1147	170260018603040	2 Wid 1965 3-8x7 T	Bryan	Burleson	5.0	5.0	Provided	MC#-# 1949-1977	2.5	Low Stiffness	5 Int. ACP (2.5-5in.)	0.742	2.675	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1148	170260018603040	3 Wid 2000 3-8x7 T	Bryan	Burleson	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
1149	170260071301004	1 Org 1964 3-8x6 T	Bryan	Burleson	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.560	1.492	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1150	170260311901001	1 Org 1968 3-6x6 T	Bryan	Burleson	5.0	5.0	Provided	MC#-# 1949-1977	5.5	Medium Stiffness	5 Int. ACP (2.5-5in.)	1.585	4.989	Top Corner	V	FIX	1: IR>=HS20, OR> HS20
1151	170260311901001	2 Wid 1990 3-6x6 T	Bryan	Burleson	--	--	--	--	--	Medium Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
1152	170820067501182	1 Org 1971 2-7x6 T	Bryan	Freestone	4.5	5.0	Provided	MC#-# 1949-1977	2.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.638	2.513	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1153	170940021204009	1 Org 1951 4-5x3 T	Bryan	Grimes	3.0	1.8	Associated	MC#-# 1949-1977	2.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.881	2.376	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1154	170940021204009	2 Wid 1958 4-5x3 T	Bryan	Grimes	3.0	1.8	Associated	MC#-# 1949-1977	2.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	1.038	2.922	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1155	170940021204009	3 Wid 2006 4-5x3 T	Bryan	Grimes	--	--	--	--	--	Medium Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
1156	170940031503061	1 Org 1962 3-8x8 T	Bryan	Grimes	3.8	2.5	Associated	MC#-# 1949-1977	2.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.726	2.949	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1157	170940072004031	1 Org 1959 5-5x5 T	Bryan	Grimes	3.8	3.0	Associated	MC#-# 1949-1977	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	1.245	2.639	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1158	170940233601005	1 Org 1958 6-6x6 T	Bryan	Grimes	3.8	3.3	Associated	MC#-# 1949-1977	2.0	Low Stiffness	10 Seal Coat or Surf. Tmt	1.027	2.055	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
1159	170940282701002	1 Org 1964 4-10x8 T	Bryan	Grimes	3.8	3.0	Associated	MC#-# 1949-1977	0.5	Low Stiffness	10 Seal Coat or Surf. Tmt	0.553	0.967	Top Midspan	M	PIN	3: IR< HS20, OR> HS10
1160	170940284901002	1 Org 1965 4-8x7 T	Bryan	Grimes	3.8	3.0	Associated	MC#-# 1949-1977	2.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.689	1.798	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
1161	170940284901002	2 Wid 1986 4-8x7 T	Bryan	Grimes	--	--	--	--	--	Low Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Post-1979
1162	171450033503012	1 Org 1944 4-10x10 T	Bryan	Leon	5.0	5.0	Provided	MBC-#-#(-F)	1.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.803	2.431	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1163	171450055201016	1 Org 1974 7-10x10 T	Bryan	Leon	4.8	5.0	Provided	MC#-# 1949-1977	5.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.664	6.465	Wall Exterior Bottom	M	PIN	1: IR>=HS20, OR> HS20
1164	171450067503140	1 Org 1969 6-9x5 T	Bryan	Leon	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.522	1.387	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1165	171450067504102	1 Org 1965 3-10x6 T	Bryan	Leon	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: No standard design
1166	171450067504119	1 Org 1966 2-10x10 T	Bryan	Leon	--	--	--	--	--	Medium Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: No standard design
1167	171450114701015	1 Org 1974 8-10x8 T	Bryan	Leon	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.634	2.467	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
1168	171540011703017	1 Org 1931 2-10x10 T	Bryan	Madison	3.8	3.0	Associated	MBC-#	2.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	1.313	4.376	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
1169	171540011703017	2 Wid 1963 2-10x10 T	Bryan	Madison	3.8	3.0	Associated	MC#-# 1949-1977	2.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.475	1.062	Top Midspan	M	FIX	2: IR< HS20, OR>=HS20
1170	171540011704023	1 Org 1934 3-10x10 T	Bryan	Madison	3.8	3.0	Associated	MBC-#	1.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.472	2.396	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
1171	171540011704023	2 Wid 1963 3-10x10 T	Bryan	Madison	3.8	3.0	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.367	1.941	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1172	171540011704023	3 Wid 1981 3-10x10 T	Bryan	Madison	--	--	--	--	--	Medium Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
1173	171540011705031	1 Org 1927 4-8x6 T	Bryan	Madison	3.8	3.5	Associated	MBC-#	0.5	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.898	2.413	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1174	171540011705031	2 Wid 1958 4-8x6 T	Bryan	Madison	3.5	3.0	Associated	MC#-# 1949-1977	0.5	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.589	1.263	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
1175	171540011705031	3 Wid 1968 4-8x6 T	Bryan	Madison	4.3	3.8	Specified	MC#-# 1949-1977	0.5	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.589	1.263	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
1176	171540055202010	1 Org 1951 2-8x8 T	Bryan	Madison	3.5	2.5	Associated	MBC-#	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	1.326	2.395	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1177	171540055202011	1 Org 1951 2-8x8 T	Bryan	Madison	3.5	2.5	Associated	MBC-#	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	1.326	2.395	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1178	171540057804017	1 Org 1968 4-9x5 T	Bryan	Madison	3.8	3.5	Associated	MC#-# 1949-1977	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.574	1.646	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1179	171540330301001	1 Org 1971 5-6x3 T	Bryan	Madison	3.8	3.0	Associated	MC#-# 1949-1977	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.761	1.978	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1180	171660021003012	1 Org 1964 2-10x6 T	Bryan	Milam	3.8	3.5	Associated	MC#-# 1949-1977	0.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.576	0.803	Wall Exterior Top	M	PIN	3: IR< HS20, OR> HS10
1181	171660026201038	1 Org 1956 6-10x7 T	Bryan	Milam	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.613	1.679	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1182	171660026201046	1 Org 1957 3-10x7 T	Bryan	Milam	3.8	4.0	Associated	MC#-# 1949-1977	2.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.615	1.720	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1183	171660033705006	1 Org 1951 4-6x5 T	Bryan	Milam	4.3	4.5	Specified	MC#-# 1949-1977	1.5	Low Stiffness	10 Seal Coat or Surf. Tmt	0.589	1.302	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
1184	171660085801009	1 Org 1960 11-8x4 T	Bryan	Milam	3.8	2.5	Associated	MC#-# 1949-1977	0.5	Low Stiffness	10 Seal Coat or Surf. Tmt	0.369	0.867	Wall Exterior Top	M	PIN	3: IR< HS20, OR> HS10
1185	171980004907034	1 Org 1934 4-6x6 T	Bryan	Robertson	4.3	4.3	Specified	MBC-#	2.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	1.314	4.623	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1186	171980004907034	2 Wid 1970 4-6x6 T	Bryan	Robertson	4.8	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.816	2.109	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
1187	171980004907034	3 Oth 2010 4-6x6 T	Bryan	Robertson	--	--	--	--	--	Medium Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Geometry outside sc
1188	171980004907171	1 Org 1971 3-6x3 T	Bryan	Robertson	5.0	5.0	Provided	MC#-# 1949-1977	5.0	Low Stiffness	5 Int. ACP (2.5-5in.)	1.692	5.206	Top Corner	V	PIN	1: IR>=HS20, OR> HS20
1189	171980004907171	2 Oth 2010 3-6x3 T	Bryan	Robertson	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Geometry outside sc
1190	171980020409065	1 Org 1965 3-6x3 T	Bryan	Robertson	3.8	2.0	Associated	MC#-# 1949-1977	7.5	Low Stiffness	5 Int. ACP (2.5-5in.)	1.370	5.501	Top Corner	V	FIX	1: IR>=HS20, OR> HS20
1191	171980202901003	1 Org 1962 3-8x5 T	Bryan	Robertson	3.8	2.8	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.519	1.107	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
1192	172360057802006	1 Org 1948 4-6x6 T	Bryan	Walker	5.0	5.0	Provided	MBC ##-##	4.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	1.787	7.128	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1193	172360057802006	2 Wid 1987 4-6x6 T	Bryan	Walker	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Post-1979
1194	172360057802006	3 Wid 1987 4-6x6 T	Bryan	Walker	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Post-1979
1195	172360067506046	1 Org 1962 2-10x10 T	Bryan	Walker	4.8	5.0	Provided	MC#-# 1949-1977	9.5	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.735	0.284	Wall Exterior Bottom	M	FIX	4: IR>=HS 3, OR< HS10
1196	172360067506047	1 Org 1962 2-10x6 T	Bryan	Walker	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.649	1.734	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1197	172360067507022	1 Org 1961 2-10x7 T	Bryan	Walker	5.0	5.0	Provided	MC#-# 1949-1977	8.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	1.206	3.275	Wall Exterior Bottom	M	FIX	1: IR>=HS20, OR> HS20

No	Structure No	Segment ID	District	County	Interpreted Parameter Score	Design Selection Score	Design Class	Design Name	Critical Cover Soil Depth	Soil Type	Pavement	HS20 Lvl1 ORF	HS20 Lvl3 ORF	Lvl3 Controlling Critical Section	Lvl3 Failure Mode	Lvl3 Fixity	Lvl3 Load Posting Class
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
1198	172360067507028	1 Org 1961 2-10x9 T	Bryan	Walker	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.803	2.221	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1199	172360075602001	1 Org 1950 4-6x6 T	Bryan	Walker	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.514	1.465	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1200	172360075602001	2 Wid 1994 4-6x6 T	Bryan	Walker	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
1201	172390305601004	1 Org 1971 4-8x8 T	Bryan	Washington	5.0	5.0	Provided	MC#-# 1949-1977	3.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.726	3.468	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1202	180430009104048	1 Org 1969 3-7x6 T	Dallas	Collin	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: No standard design
1203	180430009105040	1 Org 1955 3-7x7 J	Dallas	Collin	3.8	3.5	Associated	MC#-# 1949-1977	1.0	Low Stiffness	3 JPCP	0.369	2.980	Wall Exterior Bottom	M	PIN	1: IR>=HS20, OR> HS20
1204	180430009105040	2 Wid 1989 3-7x7 J	Dallas	Collin	--	--	--	--	--	Low Stiffness	3 JPCP	--	--	--	--	--	NLR: Post-1979
1205	180430009105040	3 Oth 1989 2-7x7 J	Dallas	Collin	--	--	--	--	--	Low Stiffness	3 JPCP	--	--	--	--	--	NLR: Geometry outside sc
1206	180430013502048	1 Org 1938 3-10x8 E	Dallas	Collin	3.0	2.0	Associated	MBC-#	2.0	Low Stiffness	5 Int. ACP (2.5-5in.)	1.004	5.389	Wall Exterior Midspan	M	FIX	1: IR>=HS20, OR> HS20
1207	180430013502048	10 Wid 2013 6-10x8 T	Dallas	Collin	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
1208	180430013502048	2 Org 1938 2-10x8 E	Dallas	Collin	3.0	2.0	Associated	MBC-#	2.0	Low Stiffness	5 Int. ACP (2.5-5in.)	1.025	3.785	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
1209	180430013502048	3 Exp 1938 1-10x9 E	Dallas	Collin	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Expansion slab
1210	180430013502048	4 Wid 1971 3-10x8 E	Dallas	Collin	4.3	3.8	Specified	MC#-# 1949-1977	1.5	Low Stiffness	5 Int. ACP (2.5-5in.)	0.590	1.726	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1211	180430013502048	5 Wid 1971 2-10x8 E	Dallas	Collin	4.3	3.8	Specified	MC#-# 1949-1977	1.5	Low Stiffness	5 Int. ACP (2.5-5in.)	0.619	1.793	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1212	180430013502048	6 Exp 1971 1-10x9 E	Dallas	Collin	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Expansion slab
1213	180430013502048	7 Wid 1996 3-10x8 E	Dallas	Collin	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
1214	180430013502048	8 Wid 1996 2-10x8 E	Dallas	Collin	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
1215	180430013502048	9 Exp 1996 1-10x9 E	Dallas	Collin	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Expansion slab
1216	180430013512084	1 Org 1954 2-10x10 T	Dallas	Collin	4.3	3.8	Specified	MC#-# 1949-1977	2.5	Low Stiffness	5 Int. ACP (2.5-5in.)	0.571	2.386	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
1217	180430028002033	1 Org 1966 3-6x3 T	Dallas	Collin	4.3	4.0	Specified	MC#-# 1949-1977	2.0	Low Stiffness	6 Thin ACP (<2.5in.)	0.759	1.907	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1218	180430101203015	1 Org 1951 4-5x5 T	Dallas	Collin	4.3	3.8	Specified	MC#-# 1949-1977	2.0	Low Stiffness	6 Thin ACP (<2.5in.)	0.987	2.129	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1219	180430101203015	2 Wid 2007 4-5x5 T	Dallas	Collin	--	--	--	--	--	Low Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Post-1979
1220	180570000903322	1 Org 1977 3-9x5 T	Dallas	Dallas	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Low Stiffness	3 JPCP	0.948	5.102	Top Corner	V	PIN	1: IR>=HS20, OR> HS20
1221	180570000903322	2 Org 1977 2-9x5 J	Dallas	Dallas	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Low Stiffness	3 JPCP	0.991	4.772	Top Corner	V	FIX	1: IR>=HS20, OR> HS20
1222	180570000903322	3 Wid 1998 3-9x5 T	Dallas	Dallas	--	--	--	--	--	Low Stiffness	3 JPCP	--	--	--	--	--	NLR: Post-1979
1223	180570000903322	4 Wid 1998 3-9x5 T	Dallas	Dallas	--	--	--	--	--	Low Stiffness	3 JPCP	--	--	--	--	--	NLR: Post-1979
1224	180570000903322	5 Wid 1998 1-9x5 J	Dallas	Dallas	--	--	--	--	--	Low Stiffness	3 JPCP	--	--	--	--	--	NLR: Post-1979
1225	180570000911202	1 Org 1961 3-6x5 T	Dallas	Dallas	--	--	--	--	--	High Stiffness	3 JPCP	--	--	--	--	--	NLR: No standard design
1226	180570000911202	2 Org 1961 3-6x5 T	Dallas	Dallas	5.0	5.0	Provided	MC#-# 1949-1977	8.0	High Stiffness	3 JPCP	1.151	6.673	Bottom Midspan	M	FIX	1: IR>=HS20, OR> HS20
1227	180570000911202	3 Wid 1980 3-6x5 T	Dallas	Dallas	--	--	--	--	--	High Stiffness	3 JPCP	--	--	--	--	--	NLR: Post-1979
1228	180570000911202	4 Wid 1980 3-6x5 T	Dallas	Dallas	--	--	--	--	--	High Stiffness	3 JPCP	--	--	--	--	--	NLR: Post-1979
1229	180570019603151	1 Org 1962 3-7x5 T	Dallas	Dallas	5.0	5.0	Provided	MC#-# 1949-1977	4.5	Medium Stiffness	8 Overlaid Concrete	1.617	6.569	Top Corner	V	FIX	1: IR>=HS20, OR> HS20
1230	180570019603165	1 Org 1963 3-9x5 T	Dallas	Dallas	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Low Stiffness	1 CRCP	0.430	3.940	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1231	180570019603165	2 Org 1963 3-9x5 T	Dallas	Dallas	5.0	5.0	Provided	MC#-# 1949-1977	9.0	Low Stiffness	8 Overlaid Concrete	2.086	7.487	Top Corner	V	FIX	1: IR>=HS20, OR> HS20
1232	180570019702173	1 Org 1971 4-10x10 T	Dallas	Dallas	5.0	5.0	Provided	MC#-# 1949-1977	2.5	Low Stiffness	8 Overlaid Concrete	0.547	3.916	Wall Exterior Bottom	M	PIN	1: IR>=HS20, OR> HS20
1233	180570035306087	1 Org 1968 6-7x3 T	Dallas	Dallas	5.0	5.0	Provided	MC#-# 1949-1977	3.0	Low Stiffness	1 CRCP	0.791	5.308	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1234	180570043001006	1 Org 1923 3-10x4.5 T	Dallas	Dallas	3.0	1.8	Associated	W.C.-2	2.5	Low Stiffness	8 Overlaid Concrete	0.419	2.225	Wall Exterior Bottom	M	FIX	1: IR>=HS20, OR> HS20
1235	180570043001006	2 Wid 1971 3-10x4.5 T	Dallas	Dallas	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Low Stiffness	8 Overlaid Concrete	0.804	5.938	Top Corner	V	PIN	1: IR>=HS20, OR> HS20
1236	180570044202058	1 Org 1965 2-7x3 T	Dallas	Dallas	5.0	5.0	Provided	MC#-# 1949-1977	3.0	Low Stiffness	1 CRCP	0.917	3.792	Top Corner	M	FIX	1: IR>=HS20, OR> HS20
1237	180570237401053	1 Oth 1967 4-9x9 T	Dallas	Dallas	--	--	--	--	--	Low Stiffness	1 CRCP	--	--	--	--	--	NLR: Geometry outside sc
1238	180570237402085	1 Org 1969 3-6x4 T	Dallas	Dallas	5.0	5.0	Provided	MC#-# 1949-1977	18.0	Low Stiffness	8 Overlaid Concrete	7.394	8.273	Wall Exterior Bottom	M	PIN	1: IR>=HS20, OR> HS20
1239	180570237402085	2 Org 1969 3-6x4 T	Dallas	Dallas	5.0	5.0	Provided	MC#-# 1949-1977	16.5	Low Stiffness	3 JPCP	-5.592	-215.515	Top Corner	M	FIX	6: IR< HS 3, OR< HS 3
1240	180570237403191	1 Org 1971 4-6x4 T	Dallas	Dallas	5.0	5.0	Provided	MC#-# 1949-1977	12.0	Medium Stiffness	8 Overlaid Concrete	3.725	2.429	Wall Exterior Bottom	M	FIX	1: IR>=HS20, OR> HS20
1241	180570300001002	1 Org 1974 10-5x7 T	Dallas	Dallas	5.0	5.0	Provided	MC#-# 1949-1977	11.0	Low Stiffness	3 JPCP	1.105	2.900	Wall Exterior Bottom	M	FIX	1: IR>=HS20, OR> HS20
1242	180570300001002	10 Org 1974 10-5x5 T	Dallas	Dallas	--	--	--	--	--	Low Stiffness	3 JPCP	--	--	--	--	--	NLR: No standard design
1243	180570300001002	2 Org 1974 10-5x7 T	Dallas	Dallas	5.0	5.0	Provided	MC#-# 1949-1977	25.0	Low Stiffness	3 JPCP	-3.104	-499.485	Wall Exterior Bottom	M	FIX	6: IR< HS 3, OR< HS 3
1244	180570300001002	3 Org 1974 10-5x6 T	Dallas	Dallas	--	--	--	--	--	Low Stiffness	3 JPCP	--	--	--	--	--	NLR: No standard design
1245	180570300001002	4 Org 1974 10-5x5 T	Dallas	Dallas	5.0	5.0	Provided	MC#-# 1949-1977	44.0	Low Stiffness	3 JPCP	-1206.638	-11186.750	Bottom Corner	V	FIX	6: IR< HS 3, OR< HS 3
1246	180570300001002	5 Org 1974 10-5x5 T	Dallas	Dallas	5.0	5.0	Provided	MC#-# 1949-1977	54.0	Low Stiffness	3 JPCP	-174.404	-9316.005	Top Corner	V	FIX	6: IR< HS 3, OR< HS 3
1247	180570300001002	6 Org 1974 10-5x5 T	Dallas	Dallas	5.0	5.0	Provided	MC#-# 1949-1977	62.5	Low Stiffness	3 JPCP	-396.713	-6956.624	Top Corner	V	FIX	6: IR< HS 3, OR< HS 3
1248	180570300001002	7 Org 1974 10-5x5 T	Dallas	Dallas	5.0	5.0	Provided	MC#-# 1949-1977	47.0	Low Stiffness	3 JPCP	-79.112	-34114.197	Top Corner	V	FIX	6: IR< HS 3, OR< HS 3
1249	180570300001002	8 Org 1974 10-5x5 T	Dallas	Dallas	5.0	5.0	Provided	MC#-# 1949-1977	42.0	Low Stiffness	3 JPCP	-395.934	-19366.850	Bottom Corner	V	FIX	6: IR< HS 3, OR< HS 3
1250	180570300001002	9 Org 1974 10-5x5 T	Dallas	Dallas	5.0	5.0	Provided	MC#-# 1949-1977	30.5	Low Stiffness	3 JPCP	-29.265	-2678.935	Bottom Corner	V	FIX	6: IR< HS 3, OR< HS 3
1251	180610008103039	1 Org 1942 5-7x7 T	Dallas	Denton	5.0	5.0	Provided	MBC-#-#(-F)	1.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.680	2.217	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1252	180610008113109	1 Org 1969 2-8x8 T	Dallas	Denton	5.0	5.0	Provided	MC#-# 1949-1977	10.0	Low Stiffness	8 Overlaid Concrete	1.267	1.070	Wall Exterior Bottom	M	FIX	2: IR< HS20, OR>=HS20
1253	180610019502094	1 Org 1958 5-9x9 T	Dallas	Denton	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Low Stiffness	2 JRCP	0.761	2.665	Bottom Corner	M	PIN	1: IR>=HS20, OR> HS20
1254	180610019601277	1 Org 1940 1-10x6 J	Dallas	Denton	3.8	2.3	Associated	BC-#	5.5	Low Stiffness	4 Thick ACP (>5in.)	0.009	10.178	Wall Exterior Top	M	FIX	1: IR>=HS20, OR> HS20

No (1)	Structure No (2)	Segment ID (3)	District (4)	County (5)	Interpreted Parameter Score (6)	Design Selection Score (7)	Design Class (8)	Design Name (9)	Critical Cover Soil Depth (10)	Soil Type (11)	Pavement (12)	HS20 Lvl1 ORF (13)	HS20 Lvl3 ORF (14)	Lvl3 Controlling Critical Section (15)	Lvl3 Failure Mode (16)	Lvl3 Fixity (17)	Lvl3 Load Posting Class (18)
1255	180610019601277	2 Wid 1970 1-10x6 J	Dallas	Denton	3.8	2.5	Associated	SC- N	5.5	Low Stiffness	4 Thick ACP (>5in.)	0.352	5.496	Wall Exterior Top	M	FIX	1: IR>=HS20, OR> HS20
1256	180610019601277	3 Oth 1990 1-10x6 J	Dallas	Denton	--	--	--	--	--	Low Stiffness	4 Thick ACP (>5in.)	--	--	--	--	--	NLR: Geometry outside sc
1257	180610081602045	1 Org 1956 2-10x8 T	Dallas	Denton	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Low Stiffness	9 Overlaid Flexible	0.562	1.680	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1258	180610081602045	2 Wid 1999 2-10x8	Dallas	Denton	--	--	--	--	--	Low Stiffness	9 Overlaid Flexible	--	--	--	--	--	NLR: Post-1979
1259	180610156802001	1 Org 1953 3-8x5 T	Dallas	Denton	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.435	1.242	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1260	180610235202003	1 Org 1969 3-8x4 T	Dallas	Denton	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Low Stiffness	3 JPCP	0.381	4.110	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1261	180610297901003	1 Org 1970 3-10x10 T	Dallas	Denton	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	9 Overlaid Flexible	0.367	2.078	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1262	180610297901004	1 Org 1970 3-7x4 T	Dallas	Denton	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	9 Overlaid Flexible	0.470	1.498	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1263	180710004804035	1 Org 1957 3-9x5 T	Dallas	Ellis	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Low Stiffness	6 Thin ACP (<2.5in.)	0.430	1.042	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
1264	180710009204149	1 Org 1957 5-6x5 T	Dallas	Ellis	5.0	5.0	Provided	MC#-# 1949-1977	1.5	Low Stiffness	1 CRCP	0.742	4.591	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1265	180710009204150	1 Org 1957 5-6x5 T	Dallas	Ellis	5.0	5.0	Provided	MC#-# 1949-1977	1.5	Low Stiffness	1 CRCP	0.742	4.591	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1266	180710017205093	1 Org 1971 5-7x3 T	Dallas	Ellis	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.425	1.018	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1267	180710056801023	1 Org 1971 3-7x4 T	Dallas	Ellis	5.0	5.0	Provided	MC#-# 1949-1977	19.5	Medium Stiffness	9 Overlaid Flexible	9.523	6.505	Wall Exterior Bottom	M	FIX	1: IR>=HS20, OR> HS20
1268	180710056801025	1 Org 1971 5-10x6 T	Dallas	Ellis	5.0	5.0	Provided	MC#-# 1949-1977	3.5	Low Stiffness	5 Int. ACP (2.5-5in.)	1.369	4.117	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1269	180710074706029	1 Org 1957 4-6x3 T	Dallas	Ellis	5.0	5.0	Provided	MC#-# 1949-1977	3.0	Low Stiffness	9 Overlaid Flexible	1.033	3.371	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1270	180710074706029	2 Wid 2010 4-6x3 T	Dallas	Ellis	--	--	--	--	--	Low Stiffness	9 Overlaid Flexible	--	--	--	--	--	NLR: Post-1979
1271	180710113901009	1 Org 1950 3-6x3 T	Dallas	Ellis	3.8	2.5	Associated	MBC ##-##	3.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.620	2.922	Wall Exterior Top	M	FIX	1: IR>=HS20, OR> HS20
1272	180710113901009	2 Wid 2012 3-6x3 T	Dallas	Ellis	--	--	--	--	--	Low Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Post-1979
1273	180710226401002	1 Org 1957 4-6x3 T	Dallas	Ellis	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.691	1.787	Wall Exterior Top	M	FIX	1: IR>=HS20, OR> HS20
1274	181300017304057	1 Org 1954 4-6x3 T	Dallas	Kaufman	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Medium Stiffness	3 JPCP	0.691	4.486	Top Corner	V	PIN	1: IR>=HS20, OR> HS20
1275	181300017304057	2 Wid 1960 4-6x3 T	Dallas	Kaufman	2.9	3.3	Associated	MC#-# 1949-1977	2.0	Medium Stiffness	3 JPCP	0.691	4.486	Top Corner	V	PIN	1: IR>=HS20, OR> HS20
1276	181300017304057	3 Wid 1975 4-6x3 T	Dallas	Kaufman	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Medium Stiffness	3 JPCP	0.761	4.932	Top Corner	V	PIN	1: IR>=HS20, OR> HS20
1277	181300017304057	4 Wid 1975 4-6x3 T	Dallas	Kaufman	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Medium Stiffness	3 JPCP	0.686	4.486	Top Corner	V	PIN	1: IR>=HS20, OR> HS20
1278	181300017305070	1 Org 1957 4-9x5 T	Dallas	Kaufman	4.8	5.0	Provided	MC#-# 1949-1977	4.5	Low Stiffness	4 Thick ACP (>5in.)	0.693	3.627	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1279	181300017305070	2 Wid 1990 4-9x5 T	Dallas	Kaufman	--	--	--	--	--	Low Stiffness	4 Thick ACP (>5in.)	--	--	--	--	--	NLR: Post-1979
1280	181300019704088	1 Org 1937 3-7x6 E	Dallas	Kaufman	5.0	5.0	Provided	MBC ##-##	1.0	Low Stiffness	8 Overlaid Concrete	0.448	5.861	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1281	181300019704088	2 Org 1937 4-7x6 E	Dallas	Kaufman	5.0	5.0	Provided	MBC ##-##	1.0	Low Stiffness	8 Overlaid Concrete	0.458	5.662	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1282	181300019704088	3 Exp 1937 1-7x6 E	Dallas	Kaufman	--	--	--	--	--	Low Stiffness	8 Overlaid Concrete	--	--	--	--	--	NLR: Expansion slab
1283	181300019704088	4 Wid 1958 3-7x6 E	Dallas	Kaufman	5.0	5.0	Provided	MBC ##-##	1.0	Low Stiffness	8 Overlaid Concrete	0.606	6.607	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1284	181300019704088	5 Wid 1958 4-7x6 E	Dallas	Kaufman	5.0	5.0	Provided	MBC ##-##	1.0	Low Stiffness	8 Overlaid Concrete	0.616	6.364	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1285	181300019704088	6 Exp 1958 1-7x6 E	Dallas	Kaufman	--	--	--	--	--	Low Stiffness	8 Overlaid Concrete	--	--	--	--	--	NLR: Expansion slab
1286	181300019704088	7 Wid 1984 8-7x6 T	Dallas	Kaufman	--	--	--	--	--	Low Stiffness	8 Overlaid Concrete	--	--	--	--	--	NLR: Post-1979
1287	181300044302017	1 Org 1962 3-8x5 T	Dallas	Kaufman	4.8	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.519	1.540	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1288	181300049501156	1 Org 1964 4-10x9 T	Dallas	Kaufman	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Low Stiffness	8 Overlaid Concrete	0.547	3.948	Wall Exterior Bottom	M	PIN	1: IR>=HS20, OR> HS20
1289	181300049501162	1 Org 1964 6-10x6 T	Dallas	Kaufman	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Medium Stiffness	8 Overlaid Concrete	0.507	4.474	Wall Exterior Top	M	FIX	1: IR>=HS20, OR> HS20
1290	181300075102027	1 Org 1971 3-7x7 T	Dallas	Kaufman	5.0	5.0	Provided	MC#-# 1949-1977	6.0	Low Stiffness	10 Seal Coat or Surf. Tmt	1.529	2.428	Wall Exterior Bottom	M	FIX	1: IR>=HS20, OR> HS20
1291	181300121703010	1 Org 1961 3-10x7 T	Dallas	Kaufman	4.8	5.0	Provided	MC#-# 1949-1977	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.570	1.628	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1292	181300197502002	1 Org 1955 4-5x3 T	Dallas	Kaufman	5.0	5.0	Provided	MC#-# 1949-1977	1.5	Low Stiffness	10 Seal Coat or Surf. Tmt	0.730	1.599	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1293	181750009301056	1 Org 1958 4-6x4 T	Dallas	Navarro	5.0	5.0	Provided	MC#-# 1949-1977	3.0	Low Stiffness	1 CRCP	1.177	5.359	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
1294	181750009301061	1 Org 1959 4-5x5 T	Dallas	Navarro	5.0	5.0	Provided	MC#-# 1949-1977	0.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.647	1.003	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
1295	181750009302007	1 Org 1930 2-10x10 T	Dallas	Navarro	4.3	4.0	Specified	MBC-#	2.0	Medium Stiffness	8 Overlaid Concrete	1.313	7.644	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
1296	181750009302007	2 Wid 1966 2-10x10 T	Dallas	Navarro	3.3	3.0	Associated	MC#-# 1949-1977	2.0	Medium Stiffness	8 Overlaid Concrete	0.475	4.447	Top Corner	M	FIX	1: IR>=HS20, OR> HS20
1297	181750099701002	1 Org 1948 6-6x4 T	Dallas	Navarro	5.0	5.0	Provided	MBC ##-##	1.5	Low Stiffness	10 Seal Coat or Surf. Tmt	0.574	1.092	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1298	181750099701002	2 Wid 1979 6-6x4 T	Dallas	Navarro	5.0	3.8	Specified	MC#-# 1949-1977	1.5	Low Stiffness	10 Seal Coat or Surf. Tmt	0.726	2.173	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1299	181750099701002	3 Wid 2010 6-6x4 T	Dallas	Navarro	--	--	--	--	--	Low Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Post-1979
1300	181750128801001	1 Org 1950 2-10x8 T	Dallas	Navarro	4.3	3.8	Specified	MC#-# 1949-1977	2.5	Low Stiffness	10 Seal Coat or Surf. Tmt	0.416	1.313	Wall Exterior Bottom	M	PIN	2: IR< HS20, OR>=HS20
1301	181750128801001	2 Wid 1964 2-10x8 T	Dallas	Navarro	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.647	1.763	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
1302	181750166304006	1 Org 1955 3-8x5 T	Dallas	Navarro	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Low Stiffness	9 Overlaid Flexible	0.631	2.196	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1303	181750166304006	2 Wid 1993 3-8x5 T	Dallas	Navarro	--	--	--	--	--	Low Stiffness	9 Overlaid Flexible	--	--	--	--	--	NLR: Post-1979
1304	181750166304009	1 Org 1955 3-10x6 T	Dallas	Navarro	4.3	4.5	Specified	MC#-# 1949-1977	2.0	Low Stiffness	8 Overlaid Concrete	0.507	4.000	Wall Exterior Bottom	M	FIX	1: IR>=HS20, OR> HS20
1305	181750166304009	2 Wid 1993 3-10x6 T	Dallas	Navarro	--	--	--	--	--	Low Stiffness	8 Overlaid Concrete	--	--	--	--	--	NLR: Post-1979
1306	181750184701002	1 Org 1948 4-6x6 T	Dallas	Navarro	4.3	3.0	Associated	MBC-#	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.588	1.879	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
1307	181990101501001	1 Org 1948 4-6x6 T	Dallas	Rockwall	3.8	3.5	Associated	MBC-#	4.0	Low Stiffness	9 Overlaid Flexible	2.883	8.176	Top Corner	M	FIX	1: IR>=HS20, OR> HS20
1308	181990101501001	2 Wid 1964 4-6x6 T	Dallas	Rockwall	5.0	5.0	Provided	MC#-# 1949-1977	5.0	Low Stiffness	9 Overlaid Flexible	-8.630	-2.595	Wall Exterior Bottom	M	FIX	6: IR< HS 3, OR< HS 3
1309	190190001013091	1 Org 1935 5-8x6 T	Atlanta	Bowie	4.3	4.0	Specified	MBC-#	2.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	1.079	5.192	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1310	190190001013149	1 Org 1947 3-7x6 T	Atlanta	Bowie	5.0	5.0	Provided	MBC-#-#(-F)	2.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.777	2.937	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1311	190190008502013	1 Org 1931 2-10x8 T	Atlanta	Bowie	4.8	5.0	Provided	MBC-#	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.952	2.501	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20

TABLE A: Summary Load Rating Results for 1,788 Segments/ 1,000 Culverts

No	Structure No	Segment ID	District	County	Interpreted Parameter Score	Design Selection Score	Design Class	Design Name	Critical Cover Soil Depth	Soil Type	Pavement	HS20 Lvl1 ORF	HS20 Lvl3 ORF	Lvl3 Controlling Critical Section	Lvl3 Failure Mode	Lvl3 Fixity	Lvl3 Load Posting Class
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
1312	190190008502032	1 Org 1962 3-10x10 T	Atlanta	Bowie	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.489	3.002	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
1313	190190061005171	1 Org 1971 6-10x10 T	Atlanta	Bowie	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Medium Stiffness	8 Overlaid Concrete	0.467	5.910	Wall Exterior Bottom	M	PIN	1: IR>=HS20, OR> HS20
1314	190190061006116	1 Org 1967 3-6x6 T	Atlanta	Bowie	5.0	5.0	Provided	MC#-# 1949-1977	2.5	Low Stiffness	8 Overlaid Concrete	1.153	3.620	Bottom Corner	M	FIX	1: IR>=HS20, OR> HS20
1315	190190061006116	2 Org 1967 3-6x6 T	Atlanta	Bowie	5.0	5.0	Provided	MC#-# 1949-1977	2.5	Low Stiffness	8 Overlaid Concrete	1.153	3.793	Bottom Corner	M	FIX	1: IR>=HS20, OR> HS20
1316	190190061006116	3 Wid 1986 3-6x6 T	Atlanta	Bowie	--	--	--	--	--	Low Stiffness	8 Overlaid Concrete	--	--	--	--	--	NLR: Post-1979
1317	190190061007067	1 Org 1964 3-8x6 T	Atlanta	Bowie	5.0	5.0	Provided	MC#-# 1949-1977	3.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.663	4.019	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1318	190190061007067	2 Wid 2008 3-8x6 T	Atlanta	Bowie	--	--	--	--	--	Medium Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
1319	190190061007083	1 Org 1965 3-8x4 T	Atlanta	Bowie	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	8 Overlaid Concrete	0.360	5.039	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1320	190190061007088	1 Org 1965 3-8x8 T	Atlanta	Bowie	5.0	5.0	Provided	MC#-# 1949-1977	9.5	Medium Stiffness	8 Overlaid Concrete	-0.155	-13.544	Bottom Midspan	M	FIX	6: IR< HS 3, OR< HS 3
1321	190190094501007	1 Org 1970 3-6x4 T	Atlanta	Bowie	5.0	5.0	Provided	MC#-# 1949-1977	2.5	High Stiffness	5 Int. ACP (2.5-5in.)	0.992	3.650	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1322	190190121501002	1 Org 1952 3-8x6 T	Atlanta	Bowie	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.500	1.384	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
1323	190190121502004	1 Org 1953 3-10x8 T	Atlanta	Bowie	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.161	1.407	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
1324	190190198701003	1 Org 1958 4-10x10 T	Atlanta	Bowie	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.363	1.209	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
1325	190190242201001	1 Org 1960 3-10x10 T	Atlanta	Bowie	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.489	2.334	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
1326	190190252601001	1 Org 1961 3-7x5 T	Atlanta	Bowie	3.8	3.8	Associated	MC#-# 1949-1977	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.618	1.748	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1327	190190252601001	2 Wid 1975 3-7x5 T	Atlanta	Bowie	3.8	3.5	Associated	MC#-# 1949-1977	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.624	1.666	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
1328	190190277201001	1 Org 1963 3-8x4 T	Atlanta	Bowie	5.0	5.0	Provided	MC#-# 1949-1977	1.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.413	1.144	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
1329	190320101902004	1 Org 1951 5-10x10 T	Atlanta	Camp	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.164	0.933	Top Midspan	M	PIN	3: IR< HS20, OR> HS10
1330	190340021803031	1 Org 1947 5-8x7 T	Atlanta	Cass	5.0	5.0	Provided	MBC-#-#(-F)	2.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.841	3.074	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1331	190340021803031	2 Wid 1990 5-8x7 T	Atlanta	Cass	--	--	--	--	--	Medium Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Post-1979
1332	190340027702018	1 Org 1974 2-10x7 T	Atlanta	Cass	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.587	1.709	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1333	190340027703003	1 Org 1935 2-10x8 T	Atlanta	Cass	5.0	5.0	Provided	MBC-#	1.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.952	2.477	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1334	190340027703003	2 Wid 2010 2-10x8 T	Atlanta	Cass	--	--	--	--	--	Low Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Post-1979
1335	190340054609015	1 Org 1959 3-7x5 T	Atlanta	Cass	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.600	1.163	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1336	190340054609019	1 Org 1968 4-10x9 T	Atlanta	Cass	5.0	5.0	Provided	MC#-# 1949-1977	0.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.547	0.939	Top Midspan	M	PIN	3: IR< HS20, OR> HS10
1337	190340081201006	1 Org 1968 5-9x8 T	Atlanta	Cass	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.578	1.235	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
1338	190340121601002	1 Org 1950 4-8x6 T	Atlanta	Cass	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.479	0.907	Top Corner	M	PIN	3: IR< HS20, OR> HS10
1339	190340157301005	1 Org 1952 3-8x6 T	Atlanta	Cass	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.460	0.903	Top Corner	M	PIN	3: IR< HS20, OR> HS10
1340	190340157402003	1 Org 1953 6-8x7 T	Atlanta	Cass	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.491	0.930	Top Corner	M	PIN	3: IR< HS20, OR> HS10
1341	190340157402004	1 Org 1955 4-10x8 T	Atlanta	Cass	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.553	1.146	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
1342	190340277302003	1 Org 1967 7-10x8 T	Atlanta	Cass	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.547	1.135	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
1343	190340291901001	1 Org 1965 4-8x5 T	Atlanta	Cass	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.550	1.114	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
1344	190340319501001	1 Org 1971 2-10x9 T	Atlanta	Cass	5.0	5.0	Provided	MC#-# 1949-1977	1.5	Low Stiffness	6 Thin ACP (<2.5in.)	0.612	1.780	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1345	191030013813065	1 Org 1957 4-6x6 T	Atlanta	Harrison	3.5	3.5	Associated	MC#-# 1949-1977	4.0	Medium Stiffness	6 Thin ACP (<2.5in.)	1.795	4.132	Top Corner	V	FIX	1: IR>=HS20, OR> HS20
1346	191030049508247	1 Org 1965 3-8x8 T	Atlanta	Harrison	4.3	3.8	Specified	MC#-# 1949-1977	2.0	Medium Stiffness	8 Overlaid Concrete	0.549	5.226	Top Corner	V	PIN	1: IR>=HS20, OR> HS20
1347	191030049510131	1 Org 1965 4-7x7 T	Atlanta	Harrison	3.8	3.5	Associated	MC#-# 1949-1977	3.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.798	2.628	Wall Exterior Bottom	M	FIX	1: IR>=HS20, OR> HS20
1348	191030064001002	1 Org 1942 3-8x8 T	Atlanta	Harrison	3.8	3.3	Associated	MBC-#-#(-F)	2.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.825	3.516	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1349	191030288001001	1 Org 1966 4-9x9 T	Atlanta	Harrison	3.8	3.5	Associated	MC#-# 1949-1977	3.0	Low Stiffness	6 Thin ACP (<2.5in.)	0.816	1.877	Wall Exterior Bottom	M	PIN	1: IR>=HS20, OR> HS20
1350	191030288001001	2 Wid 2011 4-9x9 T	Atlanta	Harrison	--	--	--	--	--	Low Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Post-1979
1351	191550006206027	1 Org 1953 4-7x6 T	Atlanta	Marion	3.5	3.5	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.479	1.306	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1352	191550006206027	2 Wid 1988 4-7x6 T	Atlanta	Marion	--	--	--	--	--	Medium Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
1353	191720008501001	1 Org 1932 3-10x10 T	Atlanta	Morris	4.3	3.0	Specified	MBC-#	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	1.302	3.943	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1354	191720008501001	2 Wid 1980 3-10x10 T	Atlanta	Morris	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Post-1979
1355	191720022202040	1 Org 1962 3-10x9 T	Atlanta	Morris	3.8	3.5	Associated	MC#-# 1949-1977	1.5	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.596	2.171	Wall Exterior Top	M	FIX	1: IR>=HS20, OR> HS20
1356	191830039303028	1 Org 1950 4-6x5 T	Atlanta	Panola	3.8	2.5	Associated	MBC ##-##	8.5	Medium Stiffness	9 Overlaid Flexible	1.304	7.124	Wall Exterior Bottom	M	FIX	1: IR>=HS20, OR> HS20
1357	191830039401001	1 Org 1933 5-5x5 T	Atlanta	Panola	3.8	3.3	Associated	MBC-#	2.0	Medium Stiffness	6 Thin ACP (<2.5in.)	1.306	3.187	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1358	191830073102004	1 Org 1951 4-6x4 T	Atlanta	Panola	3.8	3.5	Associated	MC#-# 1949-1977	0.5	Medium Stiffness	6 Thin ACP (<2.5in.)	0.533	0.946	Wall Exterior Top	M	PIN	3: IR< HS20, OR> HS10
1359	191830122201002	1 Org 1952 3-8x6 T	Atlanta	Panola	5.0	5.0	Provided	MC#-# 1949-1977	0.5	Medium Stiffness	6 Thin ACP (<2.5in.)	0.469	0.859	Top Corner	M	PIN	3: IR< HS20, OR> HS10
1360	191830122201002	2 Wid 1982 3-8x6 T	Atlanta	Panola	--	--	--	--	--	Medium Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Post-1979
1361	192250008309039	1 Org 1954 6-10x10 T	Atlanta	Titus	4.8	5.0	Provided	MC#-# 1949-1977	1.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.425	1.402	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
1362	192250061003042	1 Org 1965 2-7x5 T	Atlanta	Titus	4.8	5.0	Provided	MC#-# 1949-1977	4.0	Low Stiffness	10 Seal Coat or Surf. Tmt	1.584	3.760	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1363	192250061003042	2 Wid 1986 2-7x5 T	Atlanta	Titus	--	--	--	--	--	Low Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Post-1979
1364	192250061003044	1 Org 1965 3-8x7 T	Atlanta	Titus	3.8	3.0	Associated	MC#-# 1949-1977	3.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.670	3.322	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1365	192250061003061	1 Org 1965 3-10x10 T	Atlanta	Titus	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: No standard design
1366	192250061003061	2 Wid 1986 3-10x10 T	Atlanta	Titus	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Post-1979
1367	192250061003061	3 Wid 2004 3-10x10 T	Atlanta	Titus	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Post-1979
1368	192250122603002	1 Org 1954 3-10x10 T	Atlanta	Titus	4.3	4.0	Specified	MC#-# 1949-1977	2.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.528	2.808	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20

No	Structure No	Segment ID	District	County	Interpreted Parameter Score	Design Selection Score	Design Class	Design Name	Critical Cover Soil Depth	Soil Type	Pavement	HS20 Lvl1 ORF	HS20 Lvl3 ORF	Lvl3 Controlling Critical Section	Lvl3 Failure Mode	Lvl3 Fixity	Lvl3 Load Posting Class
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
1369	192300024805033	1 Org 1957 3-8x6 T	Atlanta	Upshur	3.3	2.5	Associated	MBC-#	1.0	Medium Stiffness	2 JRCP	1.075	9.502	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
1370	192300039202015	1 Org 1942 3-7x7 T	Atlanta	Upshur	4.3	3.8	Specified	MBC-#-#(-F)	3.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	1.094	2.977	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1371	192300039202015	2 Wid 1957 3-7x7 T	Atlanta	Upshur	4.3	4.3	Specified	MC#-# 1949-1977	4.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	1.387	4.335	Wall Exterior Bottom	M	PIN	1: IR>=HS20, OR> HS20
1372	192300040104010	1 Org 1948 5-7x7 T	Atlanta	Upshur	3.5	3.0	Associated	MBC ##-##	2.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.504	3.738	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
1373	192300040104011	1 Org 1948 3-10x10 T	Atlanta	Upshur	3.5	3.5	Associated	MBC-#-#(-F)	2.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	1.020	4.132	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1374	192300052002003	1 Org 1941 3-10x9 T	Atlanta	Upshur	4.3	4.5	Specified	MBC-#-#(-F)	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.699	2.060	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1375	192300052002003	2 Wid 1964 3-10x9 T	Atlanta	Upshur	4.3	4.3	Specified	MC#-# 1949-1977	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.545	1.533	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
1376	192300138204004	1 Org 1952 3-7x6 T	Atlanta	Upshur	4.3	4.0	Specified	MC#-# 1949-1977	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.488	1.146	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1377	192300138204004	2 Wid 2012 3-7x6 T	Atlanta	Upshur	--	--	--	--	--	Medium Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Post-1979
1378	192300176101002	1 Org 1945 2-10x10 T	Atlanta	Upshur	3.8	3.3	Associated	MBC-#	2.0	Medium Stiffness	6 Thin ACP (<2.5in.)	1.313	4.123	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
1379	192300176101002	2 Wid 2003 2-10x10 T	Atlanta	Upshur	--	--	--	--	--	Medium Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Post-1979
1380	192300176201002	1 Org 1953 3-7x5 T	Atlanta	Upshur	3.0	2.8	Associated	MC#-# 1949-1977	2.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.674	1.781	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1381	192300176201002	2 Wid 2006 3-7x5 T	Atlanta	Upshur	--	--	--	--	--	Medium Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Post-1979
1382	192300203001002	1 Org 1955 3-9x7 T	Atlanta	Upshur	3.5	3.8	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.543	1.228	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1383	200360038902031	1 Org 1944 7-6x4 T	Beaumont	Chambers	5.0	5.0	Provided	MBC ##-##	1.0	Medium Stiffness	2 JRCP	0.575	7.400	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1384	200360038902031	2 Wid 1958 7-6x4 T	Beaumont	Chambers	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	2 JRCP	0.569	4.505	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1385	200360038902031	3 Wid 1980 7-6x4 T	Beaumont	Chambers	--	--	--	--	--	Medium Stiffness	2 JRCP	--	--	--	--	--	NLR: Post-1979
1386	200360038902031	4 Wid 1990 7-6x4 T	Beaumont	Chambers	--	--	--	--	--	Medium Stiffness	2 JRCP	--	--	--	--	--	NLR: Post-1979
1387	201010020009074	1 Org 1964 5-6x5 T	Beaumont	Hardin	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	1.010	2.710	Top Corner	V	PIN	1: IR>=HS20, OR> HS20
1388	201010070302006	1 Org 1939 10-4x4 T	Beaumont	Hardin	3.8	2.5	Associated	MBC-#	1.5	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.834	3.403	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1389	201010070302006	2 Wid 1958 10-4x4 T	Beaumont	Hardin	4.8	5.0	Provided	MBC-#	1.5	Medium Stiffness	5 Int. ACP (2.5-5in.)	1.066	3.920	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1390	201010081303002	1 Org 1949 4-5x3 T	Beaumont	Hardin	3.5	3.8	Specified	MBC ##-##	2.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.608	3.695	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1391	201010081303002	2 Wid 1962 4-5x3 T	Beaumont	Hardin	5.0	5.0	Provided	MC#-# 1949-1977	1.5	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.746	2.278	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1392	201010081303002	3 Wid 2012 4-5x3 T	Beaumont	Hardin	--	--	--	--	--	Medium Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
1393	201010194702012	1 Org 1965 3-5x5 T	Beaumont	Hardin	5.0	5.0	Provided	MC#-# 1949-1977	1.5	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.738	2.350	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1394	201010275701001	1 Org 1968 5-8x8 T	Beaumont	Hardin	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.808	2.782	Top Corner	V	PIN	1: IR>=HS20, OR> HS20
1395	201220024402062	1 Org 1961 4-8x5 T	Beaumont	Jasper	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.550	1.363	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
1396	201220078501009	1 Org 1965 5-8x4 T	Beaumont	Jasper	5.0	5.0	Provided	MC#-# 1949-1977	2.5	Medium Stiffness	6 Thin ACP (<2.5in.)	0.520	2.613	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1397	201220094703008	1 Oth 1938 2-10x3 T	Beaumont	Jasper	--	--	--	--	--	Medium Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Geometry outside sc
1398	201220094703008	2 Wid 1955 4-5x3 T	Beaumont	Jasper	5.0	5.0	Provided	MC#-# 1949-1977	3.5	Medium Stiffness	5 Int. ACP (2.5-5in.)	2.261	5.061	Bottom Corner	M	PIN	1: IR>=HS20, OR> HS20
1399	201220212001002	1 Org 1958 4-7x3 T	Beaumont	Jasper	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.425	1.230	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1400	201240020014066	1 Org 1960 4-6x6 T	Beaumont	Jefferson	5.0	5.0	Provided	MC#-# 1949-1977	1.5	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.431	1.988	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1401	201240036802021	1 Org 1937 5-5x5 T	Beaumont	Jefferson	5.0	5.0	Provided	MBC ##-##	1.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.690	2.969	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1402	201240036802021	2 Oth 1999 5-5x5 T	Beaumont	Jefferson	--	--	--	--	--	Medium Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Geometry outside sc
1403	201240036802028	1 Org 1937 4-6x4 T	Beaumont	Jefferson	5.0	5.0	Provided	MBC ##-##	0.5	Low Stiffness	5 Int. ACP (2.5-5in.)	0.585	2.019	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1404	201240036802028	2 Oth 1999 4-6x4 T	Beaumont	Jefferson	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Geometry outside sc
1405	201240050804042	1 Org 1954 5-6x4 T	Beaumont	Jefferson	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.569	1.518	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1406	201240050804042	2 Wid 1988 5-6x4 T	Beaumont	Jefferson	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
1407	201240050804042	3 Oth 1995 5-6x4 T	Beaumont	Jefferson	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Geometry outside sc
1408	201240050804045	1 Org 1954 4-5x3 T	Beaumont	Jefferson	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	1.038	2.922	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1409	201240050804045	2 Wid 1988 4-5x3 T	Beaumont	Jefferson	--	--	--	--	--	Medium Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
1410	201460002804024	1 Org 1925 5-8x6 T	Beaumont	Liberty	4.3	4.3	Specified	MBC-#	0.5	Low Stiffness	5 Int. ACP (2.5-5in.)	0.898	2.312	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1411	201460002804024	2 Wid 1959 5-8x6 T	Beaumont	Liberty	5.0	5.0	Provided	MC#-# 1949-1977	0.5	Low Stiffness	5 Int. ACP (2.5-5in.)	0.601	1.293	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1412	201460095101007	1 Org 1968 3-6x6 T	Beaumont	Liberty	3.8	4.0	Associated	MC#-# 1949-1977	3.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	1.472	4.182	Top Corner	V	PIN	1: IR>=HS20, OR> HS20
1413	201760021403010	1 Org 1939 3-10x12 T	Beaumont	Newton	5.0	5.0	Provided	MBC ##-##	0.5	Medium Stiffness	6 Thin ACP (<2.5in.)	0.495	0.785	Wall Interior Top	M	FIX	3: IR< HS20, OR> HS10
1414	201760049902007	1 Org 1945 7-5x2 T	Beaumont	Newton	3.0	1.8	Associated	MBC ##-##	1.0	Medium Stiffness	8 Overlaid Concrete	0.565	6.847	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1415	201760049902007	2 Wid 1971 7-5x2 T	Beaumont	Newton	3.8	2.5	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	8 Overlaid Concrete	0.564	5.606	--	M	PIN	1: IR>=HS20, OR> HS20
1416	201760062702002	1 Org 1940 5-6x6 T	Beaumont	Newton	5.0	5.0	Provided	MBC ##-##	1.0	Medium Stiffness	9 Overlaid Flexible	0.737	2.827	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1417	201760127701001	1 Org 1951 4-10x8 T	Beaumont	Newton	3.8	3.0	Associated	MBC-#	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	1.178	2.815	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1418	201760127701001	2 Wid 2011 4-10x8 T	Beaumont	Newton	--	--	--	--	--	Medium Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Post-1979
1419	201760130001007	1 Org 1955 3-8x4 T	Beaumont	Newton	3.8	3.5	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.360	1.204	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1420	201760130001007	2 Wid 2013 3-8x4 T	Beaumont	Newton	--	--	--	--	--	Medium Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Post-1979
1421	201810078404003	1 Org 1951 3-9x5 T	Beaumont	Orange	5.0	5.0	Provided	MC#-# 1949-1977	3.0	Medium Stiffness	9 Overlaid Flexible	0.376	2.569	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1422	201810078404003	2 Wid 1988 3-9x5 T	Beaumont	Orange	--	--	--	--	--	Medium Stiffness	9 Overlaid Flexible	--	--	--	--	--	NLR: Post-1979
1423	201810088202003	1 Org 1954 4-7x4 T	Beaumont	Orange	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.479	1.408	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1424	201810088202003	2 Wid 1969 4-7x4 T	Beaumont	Orange	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.479	1.408	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1425	202290020005016	1 Org 1932 6-8x8 T	Beaumont	Tyler	3.8	3.0	Associated	MBC-#	0.5	Low Stiffness	6 Thin ACP (<2.5in.)	1.144	2.078	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20

No	Structure No	Segment ID	District	County	Interpreted Parameter Score	Design Selection Score	Design Class	Design Name	Critical Cover Soil Depth	Soil Type	Pavement	HS20 Lvl1 ORF	HS20 Lvl3 ORF	Lvl3 Controlling Critical Section	Lvl3 Failure Mode	Lvl3 Fixity	Lvl3 Load Posting Class
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
1426	202290020005016	2 Wid 1985 6-8x8 T	Beaumont	Tyler	--	--	--	--	--	Low Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Post-1979
1427	202290020005017	1 Org 1932 2-10x10 T	Beaumont	Tyler	3.8	2.0	Associated	MBC-#	8.5	Medium Stiffness	6 Thin ACP (<2.5in.)	2.899	8.080	Top Corner	M	FIX	1: IR>=HS20, OR> HS20
1428	202290020005017	2 Wid 1985 2-10x8 T	Beaumont	Tyler	--	--	--	--	--	Medium Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Post-1979
1429	202290020005017	3 Wid 1985 2-10x8 T	Beaumont	Tyler	--	--	--	--	--	Medium Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Post-1979
1430	202290020008030	1 Org 1932 7-6x6 T	Beaumont	Tyler	3.8	3.8	Associated	MBC-#	1.0	Medium Stiffness	8 Overlaid Concrete	0.982	9.094	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
1431	202290020008030	2 Wid 1975 7-6x6 T	Beaumont	Tyler	3.8	2.5	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	8 Overlaid Concrete	0.650	5.570	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1432	202290070301013	1 Org 1953 5-6x5 T	Beaumont	Tyler	3.0	1.8	Associated	MC#-# 1949-1977	3.0	Medium Stiffness	6 Thin ACP (<2.5in.)	1.075	3.321	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1433	202290070301013	2 Wid 1970 5-6x5 T	Beaumont	Tyler	3.8	3.3	Associated	MC#-# 1949-1977	3.0	Medium Stiffness	6 Thin ACP (<2.5in.)	1.499	4.152	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1434	211090209401001	1 Org 1950 5-6x6 T	Pharr	Hidalgo	3.0	1.8	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.514	1.525	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
1435	211250051706071	1 Org 1961 4-7x4 T	Pharr	Jim Hogg	3.8	3.8	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.479	1.439	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1436	211250051706073	1 Org 1961 5-8x4 T	Pharr	Jim Hogg	3.5	3.3	Associated	MC#-# 1949-1977	4.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.871	4.628	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1437	212140003806030	1 Org 1929 4-8x4 E	Pharr	Starr	5.0	5.0	Provided	MBC-#	1.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.628	2.160	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1438	212140003806030	2 Org 1929 3-8x4 E	Pharr	Starr	5.0	5.0	Provided	MBC-#	1.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.621	2.154	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1439	212140003806030	3 Exp 1929 1-8x4 E	Pharr	Starr	--	--	--	--	--	Medium Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Expansion slab
1440	212140003806030	4 Wid 1958 8-8x4 T	Pharr	Starr	5.0	5.0	Provided	MC#-# 1949-1977	1.5	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.432	1.704	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1441	212140003806030	5 Wid 1958 8-8x4 T	Pharr	Starr	5.0	5.0	Provided	MC#-# 1949-1977	1.5	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.432	2.033	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1442	212140003807069	1 Org 1924 3-3x2 J	Pharr	Starr	4.3	4.5	Specified	C - #	1.5	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.724	1.917	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1443	212140003807069	2 Wid 1955 3-3x2 J	Pharr	Starr	5.0	5.0	Provided	C - #	1.5	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.907	2.234	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1444	212140003807069	3 Add 1955 5-5x2 J	Pharr	Starr	5.0	5.0	Provided	MC#-# 1949-1977	1.5	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.656	2.011	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1445	212140003807069	4 Wid 1980 3-3x2 J	Pharr	Starr	--	--	--	--	--	Medium Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
1446	212140003807069	5 Wid 1980 5-5x2 J	Pharr	Starr	--	--	--	--	--	Medium Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
1447	212530051707061	1 Org 1957 5-8x4 T	Pharr	Zapata	3.8	3.5	Associated	MC#-# 1949-1977	0.5	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.385	1.130	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1448	212530253001001	1 Org 1962 5-10x9 T	Pharr	Zapata	4.8	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.541	1.523	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
1449	212530309903003	1 Oth 1975 3-7x4 T	Pharr	Zapata	--	--	--	--	--	Medium Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Geometry outside sc
1450	220640003706064	1 Org 1958 6-10x8 T	Laredo	Dimmitt	3.8	3.0	Associated	MC#-# 1949-1977	4.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	1.071	3.093	Wall Exterior Bottom	M	PIN	1: IR>=HS20, OR> HS20
1451	220640023707049	1 Org 1972 3-7x4 T	Laredo	Dimmitt	3.8	3.5	Associated	MC#-# 1949-1977	1.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.597	1.287	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1452	220640030003021	1 Org 1963 5-6x4 T	Laredo	Dimmitt	3.8	3.3	Associated	MC#-# 1949-1977	3.0	Medium Stiffness	6 Thin ACP (<2.5in.)	1.177	3.820	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1453	220640030101006	1 Org 1925 5-6x6 T	Laredo	Dimmitt	3.8	3.5	Associated	MBC-#	1.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.982	1.889	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1454	220640030101006	2 Wid 1953 5-6x6 T	Laredo	Dimmitt	3.8	3.0	Associated	MC#-# 1949-1977	1.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.514	1.128	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
1455	220640266001001	1 Org 1961 2-10x6 T	Laredo	Dimmitt	3.8	3.5	Associated	MC#-# 1949-1977	1.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.546	1.010	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1456	220670023704027	1 Org 1954 4-5x4 T	Laredo	Duval	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.622	1.425	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1457	220670023705037	1 Org 1939 1-6x4 J	Laredo	Duval	4.3	3.8	Specified	NC - #	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.388	0.734	Wall Exterior Top	M	FIX	3: IR< HS20, OR> HS10
1458	220670023705037	2 Wid 1957 1-6x4 J	Laredo	Duval	5.0	5.0	Provided	SC- N	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.651	1.454	Wall Exterior Top	M	FIX	2: IR< HS20, OR>=HS20
1459	220670023705037	3 Add 1957 3-8x4 J	Laredo	Duval	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.360	1.010	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1460	220670023705042	1 Org 1959 4-10x9 T	Laredo	Duval	5.0	5.0	Provided	MC#-# 1949-1977	0.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.584	0.939	Top Midspan	M	PIN	3: IR< HS20, OR> HS10
1461	220670051708082	1 Org 1964 4-10x6 T	Laredo	Duval	5.0	5.0	Provided	MC#-# 1949-1977	0.5	Low Stiffness	10 Seal Coat or Surf. Tmt	0.544	0.855	Wall Exterior Top	M	PIN	3: IR< HS20, OR> HS10
1462	220670051708082	2 Wid 1989 4-10x6 T	Laredo	Duval	--	--	--	--	--	Low Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Post-1979
1463	220670051708087	1 Org 1964 3-10x7 T	Laredo	Duval	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.530	1.005	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1464	220670051709088	1 Org 1964 3-7x4 T	Laredo	Duval	5.0	5.0	Provided	MC#-# 1949-1977	0.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.480	0.843	Wall Exterior Top	M	PIN	3: IR< HS20, OR> HS10
1465	220670051709088	2 Wid 1990 3-7x4 T	Laredo	Duval	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Post-1979
1466	220670054203018	1 Org 1949 3-7x6 E	Laredo	Duval	5.0	5.0	Provided	MBC ##-##	1.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.448	1.709	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1467	220670054203018	2 Wid 1968 3-7x6 E	Laredo	Duval	3.8	3.3	Associated	MC#-# 1949-1977	1.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.608	1.538	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1468	220670054203018	3 Exp 1949 1-7x6 E	Laredo	Duval	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Expansion slab
1469	220670054203018	4 Exp 1968 1-7x6 E	Laredo	Duval	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Expansion slab
1470	220670054203018	5 Org 1949 4-7x6 E	Laredo	Duval	5.0	5.0	Provided	MBC ##-##	1.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.458	1.716	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1471	220670054203018	6 Wid 1968 4-7x6 E	Laredo	Duval	3.8	3.3	Associated	MC#-# 1949-1977	1.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.611	1.529	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1472	220670054204044	1 Org 1954 4-6x5 T	Laredo	Duval	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.640	1.539	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
1473	220670054204048	1 Org 1954 5-7x4 T	Laredo	Duval	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.479	1.318	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1474	220670198201003	1 Org 1947 3-10x10 T	Laredo	Duval	3.8	3.5	Associated	MBC ##-##	1.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.434	2.414	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1475	220670224401001	1 Org 1963 3-6x5 T	Laredo	Duval	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.977	2.074	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
1476	220670330501003	1 Org 1975 4-6x3 T	Laredo	Duval	3.8	3.0	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.556	1.206	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1477	221360002304022	1 Org 1932 5-4x4 T	Laredo	Kinney	3.0	2.0	Associated	MBC-#	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.725	1.753	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1478	221360002304022	2 Wid 1953 5-4x4 T	Laredo	Kinney	3.0	2.0	Associated	MBC-#	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.748	1.699	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1479	221360002304022	3 Wid 1967 5-4x4 T	Laredo	Kinney	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.771	1.750	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1480	221420001708145	1 Org 1959 16-5x5 T	Laredo	La Salle	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	1.275	2.572	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1481	221420001708145	2 Wid 1969 16-5x5 T	Laredo	La Salle	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	1.275	2.572	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1482	221420001802014	1 Org 1929 7-4x4 T	Laredo	La Salle	4.3	3.8	Specified	MBC-#	1.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.834	2.396	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20

TABLE A: Summary Load Rating Results for 1,788 Segments/ 1,000 Culverts

No	Structure No	Segment ID	District	County	Interpreted Parameter Score	Design Selection Score	Design Class	Design Name	Critical Cover Soil Depth	Soil Type	Pavement	HS20 Lvl1 ORF	HS20 Lvl3 ORF	Lvl3 Controlling Critical Section	Lvl3 Failure Mode	Lvl3 Fixity	Lvl3 Load Posting Class
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
1483	221420001802014	2 Wid 1954 3-8x4 J	Laredo	La Salle	3.8	3.0	Associated	MC#-# 1949-1977	1.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.413	1.144	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
1484	221420001802014	3 Add 1954 1-4x4 J	Laredo	La Salle	3.8	3.0	Associated	SC- N	1.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.778	2.451	Top Midspan	M	FIX	1: IR>=HS20, OR> HS20
1485	221420001802014	4 Wid 1977 4-99x4 T	Laredo	La Salle	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: No standard design
1486	221420001802014	5 Wid 1977 3-8x4 T	Laredo	La Salle	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.408	1.355	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
1487	221420001802132	1 Org 1978 4-7x3 T	Laredo	La Salle	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.597	2.728	Top Corner	V	PIN	1: IR>=HS20, OR> HS20
1488	221420001802133	1 Org 1978 3-7x4 T	Laredo	La Salle	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.518	1.354	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
1489	221420023701011	1 Org 1947 4-6x4 T	Laredo	La Salle	3.8	3.0	Associated	MBC ##-##	0.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.585	1.605	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
1490	221420023701011	2 Wid 1989 4-6x4 T	Laredo	La Salle	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Post-1979
1491	221590027602027	1 Org 1947 3-7x6 T	Laredo	Maverick	5.0	5.0	Provided	MBC-#-#(-F)	1.5	Medium Stiffness	6 Thin ACP (<2.5in.)	0.722	3.028	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1492	221590027602027	2 Wid 1968 3-7x6 T	Laredo	Maverick	5.0	5.0	Provided	MC#-# 1949-1977	1.5	Medium Stiffness	6 Thin ACP (<2.5in.)	0.420	1.566	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
1493	222330002208042	1 Org 1939 3-7x6 E	Laredo	Val Verde	3.8	3.0	Associated	MBC ##-##	1.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.448	1.866	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1494	222330002208042	2 Org 1939 2-7x6 E	Laredo	Val Verde	3.8	3.0	Associated	MBC ##-##	1.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.449	1.800	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
1495	222330002208042	3 Exp 1939 1-7x6 E	Laredo	Val Verde	--	--	--	--	--	Low Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Expansion slab
1496	222330002208042	4 Wid 1978 3-7x6 E	Laredo	Val Verde	3.8	3.3	Associated	MC#-# 1949-1977	1.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.908	1.827	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1497	222330002208042	5 Wid 1978 2-7x6 E	Laredo	Val Verde	3.8	3.5	Associated	MC#-# 1949-1977	1.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.932	1.886	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1498	222330002208042	6 Exp 1978 1-7x6 E	Laredo	Val Verde	--	--	--	--	--	Low Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Expansion slab
1499	222330002208043	1 Org 1939 4-7x6 E	Laredo	Val Verde	3.8	3.0	Associated	MBC ##-##	1.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.458	1.862	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1500	222330002208043	2 Exp 1939 1-7x6 E	Laredo	Val Verde	--	--	--	--	--	Low Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Expansion slab
1501	222330002208043	3 Wid 1978 4-7x6 E	Laredo	Val Verde	3.8	3.3	Associated	MC#-# 1949-1977	1.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.911	1.851	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1502	222330002208043	4 Exp 1978 1-7x6 E	Laredo	Val Verde	--	--	--	--	--	Low Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Expansion slab
1503	222330002301005	1 Org 1935 5-6x6 T	Laredo	Val Verde	3.0	1.8	Associated	MBC ##-##	1.5	Low Stiffness	5 Int. ACP (2.5-5in.)	0.823	3.181	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1504	222330002301005	2 Org 1961 5-6x6 T	Laredo	Val Verde	3.0	1.8	Associated	MC#-# 1949-1977	1.5	Low Stiffness	5 Int. ACP (2.5-5in.)	0.728	2.051	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1505	222330002301005	3 Wid 1976 5-6x6 T	Laredo	Val Verde	3.0	1.8	Associated	MC#-# 1949-1977	1.5	Low Stiffness	5 Int. ACP (2.5-5in.)	0.738	2.030	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1506	222330002301005	4 Wid 1985 5-6x6 T	Laredo	Val Verde	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
1507	222330002301063	1 Org 1962 10-6x5 T	Laredo	Val Verde	3.8	2.5	Associated	MC#-# 1949-1977	1.5	Low Stiffness	6 Thin ACP (<2.5in.)	0.742	1.793	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1508	222330002301063	2 Wid 1981 10-6x5 T	Laredo	Val Verde	--	--	--	--	--	Low Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Post-1979
1509	222400001803050	1 Org 1958 3-7x4 T	Laredo	Webb	5.0	5.0	Provided	MC#-# 1949-1977	0.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.470	0.843	Wall Exterior Top	M	PIN	3: IR< HS20, OR> HS10
1510	222400001803050	2 Wid 1983 3-7x4 T	Laredo	Webb	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Post-1979
1511	222400001803051	1 Org 1958 4-10x8 T	Laredo	Webb	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.553	1.146	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
1512	222400001803051	2 Wid 1983 4-10x8 T	Laredo	Webb	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Post-1979
1513	222400001803051	3 Wid 1983 4-10x8 T	Laredo	Webb	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Post-1979
1514	222400001804060	1 Org 1958 4-10x8 T	Laredo	Webb	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.553	1.146	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
1515	222400001804060	2 Wid 1982 4-10x8 T	Laredo	Webb	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Post-1979
1516	222400008604050	1 Org 1962 3-7x3 T	Laredo	Webb	3.8	3.8	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	8 Overlaid Concrete	0.422	4.905	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1517	222400023703032	1 Org 1954 5-7x7 T	Laredo	Webb	3.8	3.5	Associated	MC#-# 1949-1977	2.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.792	1.863	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1518	222400054201005	1 Org 1948 4-10x9 T	Laredo	Webb	3.8	2.3	Associated	MBC-#	2.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.341	0.168	Bottom Corner	M	FIX	5: IR< HS 3, OR>=HS 3
1519	222400054201005	2 Wid 1979 4-10x9 T	Laredo	Webb	3.8	1.8	Associated	MC#-# 1949-1977	2.0	Low Stiffness	5 Int. ACP (2.5-5in.)	1.106	3.093	Top Corner	V	PIN	1: IR>=HS20, OR> HS20
1520	222400054201005	3 Wid 2006 4-10x9 T	Laredo	Webb	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
1521	222400054202023	1 Org 1950 6-7x7 J	Laredo	Webb	3.8	2.5	Associated	MBC ##-##	2.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.514	2.521	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
1522	222400054202023	2 Wid 1973 6-7x7 J	Laredo	Webb	3.8	3.5	Associated	MC#-# 1949-1977	1.5	Low Stiffness	10 Seal Coat or Surf. Tmt	0.677	1.468	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1523	222400054202023	3 Add 1973 1-7x7 J	Laredo	Webb	3.8	3.0	Associated	SC- N	2.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.633	1.559	Top Corner	M	FIX	2: IR< HS20, OR>=HS20
1524	222400054202026	1 Org 1950 6-6x4 T	Laredo	Webb	3.0	1.8	Associated	MC#-# 1949-1977	1.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.511	0.987	Wall Exterior Top	M	PIN	3: IR< HS20, OR> HS10
1525	222400054202026	2 Wid 1971 6-6x4 T	Laredo	Webb	3.8	3.3	Associated	MC#-# 1949-1977	1.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.625	1.231	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1526	222400054202033	1 Org 1950 6-8x8 T	Laredo	Webb	3.8	1.8	Associated	MC#-# 1949-1977	0.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.537	0.797	Top Midspan	M	PIN	3: IR< HS20, OR> HS10
1527	222400054202033	2 Wid 1968 6-8x8 T	Laredo	Webb	3.8	3.0	Associated	MC#-# 1949-1977	0.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.668	0.989	Top Midspan	M	PIN	3: IR< HS20, OR> HS10
1528	222400202201004	1 Org 1957 4-8x4 T	Laredo	Webb	3.8	3.5	Associated	MC#-# 1949-1977	0.5	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.385	1.126	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1529	222540023602002	1 Org 1939 4-7x4 E	Laredo	Zavala	4.3	3.8	Specified	MBC ##-##	2.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.379	3.710	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1530	222540023602002	2 Exp 1939 1-7x4 E	Laredo	Zavala	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Expansion slab
1531	222540023602002	3 Wid 1973 9-7x4 T	Laredo	Zavala	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.527	1.337	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1532	222540027603075	1 Org 1967 3-8x5 T	Laredo	Zavala	5.0	5.0	Provided	MC#-# 1949-1977	2.5	Low Stiffness	5 Int. ACP (2.5-5in.)	0.600	2.537	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1533	222540027603075	2 Wid 1990 3-8x5 T	Laredo	Zavala	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
1534	230250005406025	1 Org 1931 5-4x4 T	Brownwood	Brown	5.0	5.0	Provided	MBC-#	0.5	High Stiffness	5 Int. ACP (2.5-5in.)	0.739	1.988	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1535	230250005406025	2 Org 1954 5-4x4 T	Brownwood	Brown	3.0	2.8	Associated	MBC-#	1.0	High Stiffness	5 Int. ACP (2.5-5in.)	0.905	3.238	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1536	230250005406025	3 Wid 1954 5-4x4 T	Brownwood	Brown	5.0	5.0	Provided	MC#-# 1949-1977	0.5	High Stiffness	5 Int. ACP (2.5-5in.)	0.770	1.892	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1537	230250005406025	4 Oth 1954 5-4x4 T	Brownwood	Brown	--	--	--	--	--	High Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Geometry outside sc
1538	230250005406025	5 Wid 1983 5-4x4 T	Brownwood	Brown	--	--	--	--	--	High Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
1539	230250007901029	1 Org 1957 3-9x9 T	Brownwood	Brown	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.473	1.483	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20

No	Structure No	Segment ID	District	County	Interpreted Parameter Score	Design Selection Score	Design Class	Design Name	Critical Cover Soil Depth	Soil Type	Pavement	HS20 Lvl1 ORF	HS20 Lvl3 ORF	Lvl3 Controlling Critical Section	Lvl3 Failure Mode	Lvl3 Fixity	Lvl3 Load Posting Class
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
1540	230250007901029	2 Oth 1991 3-9x9 T	Brownwood	Brown	--	--	--	--	--	Medium Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Geometry outside sc
1541	230250048004012	1 Org 1933 4-10x8 E	Brownwood	Brown	3.8	3.0	Associated	MBC-#	1.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.953	3.055	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1542	230250048004012	2 Org 1933 6-10x8 E	Brownwood	Brown	3.8	3.0	Associated	MBC-#	1.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.953	3.015	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1543	230250048004012	3 Exp 1933 1-10x8 E	Brownwood	Brown	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Expansion slab
1544	230250048004012	4 Wid 1965 4-10x8 E	Brownwood	Brown	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.595	1.615	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1545	230250048004012	5 Wid 1965 6-10x8 E	Brownwood	Brown	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.595	1.591	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1546	230250048004012	6 Exp 1965 1-10x8 E	Brownwood	Brown	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Expansion slab
1547	230250103302011	1 Org 1930 3-5x5 J	Brownwood	Brown	5.0	5.0	Provided	MBC-#	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.740	1.544	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
1548	230250103302011	2 Wid 1963 3-5x4 J	Brownwood	Brown	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	1.008	1.959	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1549	230250103302011	3 Add 1963 2-7x4 J	Brownwood	Brown	5.0	5.0	Provided	MC#-# 1949-1977	0.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.582	0.832	Wall Exterior Top	M	PIN	3: IR< HS20, OR> HS10
1550	230250103501004	1 Org 1956 5-8x8 T	Brownwood	Brown	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.625	1.281	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
1551	230250257001001	1 Org 1962 5-8x6 T	Brownwood	Brown	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.594	1.185	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1552	230250263804004	1 Org 1963 4-8x7 T	Brownwood	Brown	5.0	5.0	Provided	MC#-# 1949-1977	1.5	Low Stiffness	10 Seal Coat or Surf. Tmt	0.327	0.665	Top Corner	M	FIX	3: IR< HS20, OR> HS10
1553	230250310201001	1 Org 1967 2-10x10 T	Brownwood	Brown	5.0	5.0	Provided	MC#-# 1949-1977	3.5	Low Stiffness	10 Seal Coat or Surf. Tmt	0.733	3.324	Wall Exterior Bottom	M	PIN	1: IR>=HS20, OR> HS20
1554	230420005404051	1 Org 1937 3-7x7 T	Brownwood	Coleman	4.3	3.8	Specified	MBC-#-#(-F)	1.5	Low Stiffness	10 Seal Coat or Surf. Tmt	0.740	2.363	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1555	230420005404051	2 Wid 1963 3-7x7 T	Brownwood	Coleman	5.0	5.0	Provided	MC#-# 1949-1977	1.5	Low Stiffness	10 Seal Coat or Surf. Tmt	0.404	1.107	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
1556	230420005404051	3 Wid 1985 3-7x7 T	Brownwood	Coleman	--	--	--	--	--	Low Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Post-1979
1557	230420005405050	1 Org 1936 2-10x9 T	Brownwood	Coleman	3.8	4.0	Associated	MBC ##-##	0.5	Low Stiffness	5 Int. ACP (2.5-5in.)	0.380	1.778	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1558	230420005405050	2 Wid 2005 2-10x9 T	Brownwood	Coleman	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
1559	230420007805031	1 Org 1955 4-8x7 T	Brownwood	Coleman	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Low Stiffness	9 Overlaid Flexible	0.605	1.612	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1560	230420110401012	1 Org 1968 5-8x6 T	Brownwood	Coleman	3.8	4.0	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.594	1.138	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
1561	230420193801002	1 Org 1967 2-7x4 T	Brownwood	Coleman	5.0	5.0	Provided	MC#-# 1949-1977	1.5	Low Stiffness	10 Seal Coat or Surf. Tmt	0.684	1.293	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1562	230420201501001	1 Org 1955 3-8x6 T	Brownwood	Coleman	4.3	3.8	Specified	MC#-# 1949-1977	1.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.560	1.157	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1563	230420201501003	1 Org 1958 4-10x8 T	Brownwood	Coleman	5.0	5.0	Provided	MC#-# 1949-1977	0.5	Low Stiffness	10 Seal Coat or Surf. Tmt	0.553	0.967	Top Midspan	M	PIN	3: IR< HS20, OR> HS10
1564	230470018301027	1 Org 1938 2-10x10 T	Brownwood	Comanche	5.0	5.0	Provided	MBC-#	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	1.313	3.756	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
1565	230470018301027	2 Wid 1959 2-10x10 T	Brownwood	Comanche	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.452	2.046	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1566	230470028802027	1 Org 1963 4-10x6 T	Brownwood	Comanche	5.0	5.0	Provided	MC#-# 1949-1977	1.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.576	1.370	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
1567	230470102901002	1 Org 1951 2-10x7 T	Brownwood	Comanche	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.434	0.868	Wall Exterior Top	M	PIN	3: IR< HS20, OR> HS10
1568	230470102904006	1 Org 1961 2-10x6 T	Brownwood	Comanche	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.546	0.965	Wall Exterior Top	M	PIN	3: IR< HS20, OR> HS10
1569	230470210701003	1 Org 1956 3-10x10 T	Brownwood	Comanche	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.535	1.193	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
1570	230470210702007	1 Org 1958 3-7x4 T	Brownwood	Comanche	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.596	1.770	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1571	230470306602002	1 Org 1970 3-8x8 T	Brownwood	Comanche	5.0	5.0	Provided	MC#-# 1949-1977	3.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.996	3.995	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1572	230680012701025	1 Org 1962 5-5x5 T	Brownwood	Eastland	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.762	1.632	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
1573	230680012701025	2 Wid 1984 5-5x5.5 T	Brownwood	Eastland	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Post-1979
1574	230680045201018	1 Org 1954 2-10x10 T	Brownwood	Eastland	5.0	5.0	Provided	MC#-# 1949-1977	4.5	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.478	1.581	Wall Exterior Bottom	M	FIX	2: IR< HS20, OR>=HS20
1575	230680045201018	2 Wid 1980 2-10x10 T	Brownwood	Eastland	--	--	--	--	--	Medium Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
1576	230680055001018	1 Org 1959 2-10x8 T	Brownwood	Eastland	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.562	1.197	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
1577	230680055001030	1 Oth 1923 2-10x5 T	Brownwood	Eastland	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Geometry outside sc
1578	230680055001030	2 Wid 1987 2-10x5 T	Brownwood	Eastland	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Post-1979
1579	230680169702010	1 Org 1959 3-10x8 T	Brownwood	Eastland	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.550	1.162	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
1580	231410027205031	1 Org 1940 3-7x7 T	Brownwood	Lampasas	5.0	5.0	Provided	MBC-#-#(-F)	1.5	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.740	3.344	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1581	231410027205031	2 Wid 1960 3-7x7 T	Brownwood	Lampasas	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.810	2.601	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1582	231410027205032	1 Org 1940 4-6x6 T	Brownwood	Lampasas	5.0	5.0	Provided	MBC-#-#(-F)	1.5	Low Stiffness	10 Seal Coat or Surf. Tmt	0.992	2.342	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1583	231410027205032	2 Wid 1960 4-6x6 T	Brownwood	Lampasas	5.0	5.0	Provided	MC#-# 1949-1977	1.5	Low Stiffness	10 Seal Coat or Surf. Tmt	0.713	1.672	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
1584	231410228502007	1 Org 1960 3-9x6 T	Brownwood	Lampasas	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.543	1.422	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1585	231600007006035	1 Org 1935 2-10x9 E	Brownwood	McCulloch	3.8	4.0	Associated	MBC ##-##	0.5	Low Stiffness	5 Int. ACP (2.5-5in.)	0.502	1.778	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1586	231600007006035	2 Exp 1935 1-10x9 E	Brownwood	McCulloch	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Expansion slab
1587	231600007006035	3 Wid 1954 5-10x9 T	Brownwood	McCulloch	5.0	5.0	Provided	MC#-# 1949-1977	0.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.576	1.002	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
1588	231600087005009	1 Org 1958 6-10x5 T	Brownwood	McCulloch	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.704	1.303	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1589	231600130601001	1 Org 1940 6-3x3 T	Brownwood	McCulloch	5.0	5.0	Provided	MBC-#	0.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.545	0.935	Top Midspan	M	PIN	3: IR< HS20, OR> HS10
1590	231600130601001	2 Wid 1951 6-3x3 T	Brownwood	McCulloch	5.0	5.0	Provided	MBC-#	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.543	1.211	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
1591	231670005408078	1 Org 1969 4-8x8 T	Brownwood	Mills	5.0	5.0	Provided	MC#-# 1949-1977	8.0	Low Stiffness	5 Int. ACP (2.5-5in.)	3.641	5.870	Bottom Corner	V	PIN	1: IR>=HS20, OR> HS20
1592	231670005501029	1 Org 1938 4-7x7 T	Brownwood	Mills	5.0	5.0	Provided	MBC ##-##	1.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.480	2.208	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1593	231670005501029	2 Wid 1970 4-7x7 T	Brownwood	Mills	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.450	1.473	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
1594	232060027203051	1 Org 1954 4-6x6 T	Brownwood	San Saba	5.0	5.0	Provided	MC#-# 1949-1977	1.5	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.713	2.233	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1595	232060027203051	2 Oth 1994 4-6x6 T	Brownwood	San Saba	--	--	--	--	--	Medium Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Geometry outside sc
1596	232060027204029	1 Org 1940 4-9x8 T	Brownwood	San Saba	5.0	5.0	Provided	MBC-#-#(-F)	2.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.555	2.672	Wall Exterior Bottom	M	PIN	1: IR>=HS20, OR> HS20

No	Structure No	Segment ID	District	County	Interpreted Parameter Score	Design Selection Score	Design Class	Design Name	Critical Cover Soil Depth	Soil Type	Pavement	HS20 Lvl1 ORF	HS20 Lvl3 ORF	Lvl3 Controlling Critical Section	Lvl3 Failure Mode	Lvl3 Fixity	Lvl3 Load Posting Class
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
1597	232060027204029	2 Wid 2009 4-9x8 T	Brownwood	San Saba	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
1598	232060028904036	1 Org 1936 3-8x8 T	Brownwood	San Saba	5.0	5.0	Provided	MBC-#	2.0	Low Stiffness	5 Int. ACP (2.5-5in.)	1.274	4.323	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1599	232060028904036	2 Wid 1988 3-8x8 T	Brownwood	San Saba	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
1600	232060324901001	1 Org 1972 2-10x10 T	Brownwood	San Saba	4.6	5.0	Provided	MC#-# 1949-1977	2.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.475	1.810	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
1601	232150001109067	1 Org 1966 3-10x10 T	Brownwood	Stephens	4.6	5.0	Provided	MC#-# 1949-1977	3.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.561	5.304	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1602	240220002103088	1 Org 1949 4-7x4 E	El Paso	Brewster	3.8	3.0	Associated	MBC ##-##	2.0	Low Stiffness	6 Thin ACP (<2.5in.)	0.557	2.758	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1603	240220002103088	2 Exp 1949 1-7x4 E	El Paso	Brewster	--	--	--	--	--	Low Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Expansion slab
1604	240220002103088	3 Wid 1959 4-7x4 E	El Paso	Brewster	3.8	3.8	Associated	MC#-# 1949-1977	2.0	Low Stiffness	6 Thin ACP (<2.5in.)	0.593	1.713	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1605	240220002103088	4 Exp 1959 1-7x4 E	El Paso	Brewster	--	--	--	--	--	Low Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Expansion slab
1606	240220002105014	1 Org 1932 5-5x5 E	El Paso	Brewster	3.8	2.8	Associated	MBC-#	0.5	Medium Stiffness	6 Thin ACP (<2.5in.)	0.757	1.358	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
1607	240220002105014	2 Exp 1932 1-5x5 E	El Paso	Brewster	--	--	--	--	--	Medium Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Expansion slab
1608	240220002105014	3 Wid 1957 5-5x5 E	El Paso	Brewster	3.8	2.8	Associated	MC#-# 1949-1977	0.5	Medium Stiffness	6 Thin ACP (<2.5in.)	0.651	2.403	Bottom Midspan	M	FIX	1: IR>=HS20, OR> HS20
1609	240220002105014	4 Exp 1957 1-5x5 E	El Paso	Brewster	--	--	--	--	--	Medium Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Expansion slab
1610	240220007501025	1 Org 1937 4-6x3 T	El Paso	Brewster	3.8	2.5	Associated	MBC ##-##	1.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.404	2.200	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1611	240220007501025	2 Wid 2007 4-6x3 T	El Paso	Brewster	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
1612	240220035802018	1 Org 1954 6-5x3 T	El Paso	Brewster	3.8	2.8	Associated	MC#-# 1949-1977	0.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.653	1.032	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
1613	240220035802018	2 Wid 1983 6-5x3 T	El Paso	Brewster	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Post-1979
1614	240220035802021	1 Org 1954 12-10x6 T	El Paso	Brewster	3.8	2.5	Associated	MC#-# 1949-1977	0.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.555	0.799	Wall Exterior Top	M	PIN	3: IR< HS20, OR> HS10
1615	240220035802021	2 Wid 1979 12-10x6 T	El Paso	Brewster	3.8	2.5	Associated	MC#-# 1949-1977	0.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.832	1.247	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1616	240550000301004	1 Org 1931 5-4x4 T	El Paso	Culberson	4.6	4.3	Specified	MBC-#	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.725	1.753	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1617	240550000301004	2 Wid 1952 5-4x4 T	El Paso	Culberson	3.8	3.3	Associated	MBC-#	0.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.763	1.257	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
1618	240550000301159	1 Org 1974 5-10x7 T	El Paso	Culberson	3.8	3.5	Associated	MC#-# 1949-1977	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.568	1.619	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1619	240550000301166	1 Org 1974 6-10x7 T	El Paso	Culberson	4.0	4.3	Specified	MC#-# 1949-1977	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.628	1.867	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1620	240550000301169	1 Org 1974 5-6x3 T	El Paso	Culberson	4.3	4.0	Specified	MC#-# 1949-1977	3.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	1.002	3.637	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1621	240550000302108	1 Org 1970 3-10x6 T	El Paso	Culberson	4.0	4.3	Specified	MC#-# 1949-1977	3.0	Medium Stiffness	7 ACP w/ Stab. Base	1.010	4.355	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1622	240550000303119	1 Org 1970 3-7x3 T	El Paso	Culberson	3.8	3.5	Associated	MC#-# 1949-1977	4.0	High Stiffness	7 ACP w/ Stab. Base	1.205	4.958	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1623	240550002001071	1 Org 1937 4-7x4 E	El Paso	Culberson	3.8	3.0	Associated	MBC ##-##	0.5	Medium Stiffness	6 Thin ACP (<2.5in.)	0.381	1.727	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1624	240550002001071	2 Exp 1937 1-7x4 E	El Paso	Culberson	--	--	--	--	--	Medium Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Expansion slab
1625	240550002001071	3 Wid 1958 4-7x4 E	El Paso	Culberson	3.8	3.8	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.479	1.268	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1626	240550002001071	4 Exp 1958 1-7x4 E	El Paso	Culberson	--	--	--	--	--	Medium Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Expansion slab
1627	240550002001072	1 Org 1937 4-7x4 E	El Paso	Culberson	3.8	3.0	Associated	MBC ##-##	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.381	2.243	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1628	240550002001072	2 Exp 1937 1-7x4 E	El Paso	Culberson	--	--	--	--	--	Medium Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Expansion slab
1629	240550002001072	3 Wid 1958 4-7x4 E	El Paso	Culberson	3.8	3.8	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.479	1.268	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1630	240550002001072	4 Exp 1958 1-7x4 E	El Paso	Culberson	--	--	--	--	--	Medium Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Expansion slab
1631	240550002002100	1 Org 1937 4-6x5 T	El Paso	Culberson	3.8	3.0	Associated	MBC ##-##	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.642	2.418	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1632	240550002002100	2 Wid 1959 4-6x5 T	El Paso	Culberson	3.8	3.3	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.640	1.539	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
1633	240550002002101	1 Org 1937 4-7x4 T	El Paso	Culberson	3.8	3.0	Associated	MBC ##-##	1.0	High Stiffness	6 Thin ACP (<2.5in.)	0.381	2.264	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1634	240550002002101	2 Wid 1959 4-7x4 T	El Paso	Culberson	3.8	3.8	Associated	MC#-# 1949-1977	1.0	High Stiffness	6 Thin ACP (<2.5in.)	0.479	1.287	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1635	240550002002108	1 Org 1937 4-7x4 E	El Paso	Culberson	3.0	1.8	Associated	MBC ##-##	1.0	Low Stiffness	6 Thin ACP (<2.5in.)	0.381	2.138	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1636	240550002002108	2 Exp 1937 1-7x4 E	El Paso	Culberson	--	--	--	--	--	Low Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Expansion slab
1637	240550002002108	3 Wid 1959 4-7x4 E	El Paso	Culberson	3.8	3.8	Associated	MC#-# 1949-1977	1.0	Low Stiffness	6 Thin ACP (<2.5in.)	0.479	1.202	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1638	240550002002108	4 Exp 1959 1-7x4 E	El Paso	Culberson	--	--	--	--	--	Low Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Expansion slab
1639	240550002002110	1 Org 1937 5-7x4 E	El Paso	Culberson	3.8	1.8	Associated	MBC ##-##	0.5	Medium Stiffness	6 Thin ACP (<2.5in.)	0.381	1.691	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1640	240550002002110	2 Exp 1937 1-7x4 E	El Paso	Culberson	--	--	--	--	--	Medium Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Expansion slab
1641	240550002002110	3 Wid 1959 5-7x4 T	El Paso	Culberson	3.8	3.8	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.479	1.267	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1642	240550002002110	4 Exp 1959 1-7x4 T	El Paso	Culberson	--	--	--	--	--	Medium Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Expansion slab
1643	240550002002113	1 Org 1937 4-6x3 T	El Paso	Culberson	3.8	3.5	Associated	MBC-#	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.643	2.296	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1644	240550002002113	2 Wid 1959 4-6x3 T	El Paso	Culberson	3.8	3.5	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.506	1.435	Wall Exterior Top	M	FIX	2: IR< HS20, OR>=HS20
1645	240550013901033	1 Org 1935 10-3x3 T	El Paso	Culberson	3.8	2.5	Associated	MBC-#	0.5	Medium Stiffness	6 Thin ACP (<2.5in.)	0.545	1.128	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
1646	240550013901033	2 Wid 1960 10-3x3 T	El Paso	Culberson	3.8	3.0	Associated	MBC-#	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.661	1.735	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
1647	240550023305028	1 Org 1940 4-7x6 E	El Paso	Culberson	3.8	2.5	Associated	MBC ##-##	0.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.498	1.504	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
1648	240550023305028	2 Exp 1940 1-7x6 E	El Paso	Culberson	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Expansion slab
1649	240720016702008	1 Org 1966 20-8x5 T	El Paso	El Paso	5.0	5.0	Provided	MC#-# 1949-1977	0.5	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.546	0.743	Wall Interior Top	M	FIX	3: IR< HS20, OR> HS10
1650	240720066501001	1 Org 1942 3-7x4 E	El Paso	El Paso	4.3	3.0	Associated	MBC ##-##	2.0	High Stiffness	5 Int. ACP (2.5-5in.)	0.367	5.108	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1651	240720066501001	2 Exp 1942 1-7x4 E	El Paso	El Paso	--	--	--	--	--	High Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Expansion slab
1652	240720066501001	3 Wid 2000 3-7x4 E	El Paso	El Paso	--	--	--	--	--	High Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
1653	240720066501001	4 Exp 2000 1-7x4 E	El Paso	El Paso	--	--	--	--	--	High Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Expansion slab

TABLE A: Summary Load Rating Results for 1,788 Segments/ 1,000 Culverts

No	Structure No	Segment ID	District	County	Interpreted Parameter Score	Design Selection Score	Design Class	Design Name	Critical Cover Soil Depth	Soil Type	Pavement	HS20 Lvl1 ORF	HS20 Lvl3 ORF	Lvl3 Controlling Critical Section	Lvl3 Failure Mode	Lvl3 Fixity	Lvl3 Load Posting Class
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
1654	240720212104050	1 Org 1958 2-10x10 T	El Paso	El Paso	5.0	5.0	Provided	MC#-# 1949-1977	5.5	Medium Stiffness	4 Thick ACP (>5in.)	0.952	2.670	Wall Exterior Bottom	M	FIX	1: IR>=HS20, OR> HS20
1655	240720212104050	2 Wid 1960 2-10x10 T	El Paso	El Paso	5.0	5.0	Provided	MC#-# 1949-1977	5.5	Medium Stiffness	4 Thick ACP (>5in.)	0.952	2.370	Wall Exterior Bottom	M	FIX	1: IR>=HS20, OR> HS20
1656	240720212104050	3 Wid 1997 2-10x10 T	El Paso	El Paso	--	--	--	--	--	Medium Stiffness	4 Thick ACP (>5in.)	--	--	--	--	--	NLR: Post-1979
1657	241160000205095	1 Org 1963 5-6x4 E	El Paso	Hudspeth	5.0	5.0	Provided	MC#-# 1949-1977	3.0	Medium Stiffness	1 CRCP	1.177	5.677	Top Corner	V	PIN	1: IR>=HS20, OR> HS20
1658	241160000205095	2 Exp 1963 1-6x4 E	El Paso	Hudspeth	--	--	--	--	--	Medium Stiffness	1 CRCP	--	--	--	--	--	NLR: Expansion slab
1659	241160000205098	1 Org 1963 6-8x5 T	El Paso	Hudspeth	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Medium Stiffness	1 CRCP	0.672	4.201	Top Corner	V	FIX	1: IR>=HS20, OR> HS20
1660	241160000207040	1 Org 1933 4-6x3 T	El Paso	Hudspeth	3.0	2.3	Associated	MBC-#	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.643	2.296	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1661	241160000207040	2 Wid 1954 4-6x3 T	El Paso	Hudspeth	3.8	3.3	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.506	1.435	Wall Exterior Top	M	FIX	2: IR< HS20, OR>=HS20
1662	241160000209049	1 Org 1935 4-5x5 E	El Paso	Hudspeth	4.3	4.0	Specified	MBC-#	1.0	High Stiffness	6 Thin ACP (<2.5in.)	0.739	1.917	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1663	241160000209049	2 Exp 1935 1-5x5 E	El Paso	Hudspeth	--	--	--	--	--	High Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Expansion slab
1664	241160000209117	1 Org 1965 5-6x3 T	El Paso	Hudspeth	4.3	4.0	Specified	MC#-# 1949-1977	3.5	High Stiffness	1 CRCP	1.412	6.079	Top Corner	V	FIX	1: IR>=HS20, OR> HS20
1665	241160000209128	1 Org 1965 4-6x3 T	El Paso	Hudspeth	5.0	4.0	Specified	MC#-# 1949-1977	3.5	High Stiffness	6 Thin ACP (<2.5in.)	1.412	4.744	Top Corner	V	PIN	1: IR>=HS20, OR> HS20
1666	241160000219042	1 Org 1935 4-7x7 E	El Paso	Hudspeth	4.3	4.0	Specified	MBC ##-##	0.5	Medium Stiffness	4 Thick ACP (>5in.)	0.520	1.986	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1667	241160000219042	2 Org 1935 3-7x7 E	El Paso	Hudspeth	4.3	3.3	Associated	MBC ##-##	0.5	Medium Stiffness	4 Thick ACP (>5in.)	0.511	1.981	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1668	241160000219042	3 Exp 1935 1-7x7 E	El Paso	Hudspeth	--	--	--	--	--	Medium Stiffness	4 Thick ACP (>5in.)	--	--	--	--	--	NLR: Expansion slab
1669	241230002003114	1 Org 1937 5-6x3 T	El Paso	Jeff Davis	3.8	3.0	Associated	MBC ##-##	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.404	2.337	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1670	241230002003114	2 Wid 1961 5-6x3 T	El Paso	Jeff Davis	3.8	3.3	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.506	1.403	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1671	241230002003125	1 Org 1937 6-6x3 T	El Paso	Jeff Davis	3.8	3.0	Associated	MBC ##-##	1.0	Low Stiffness	6 Thin ACP (<2.5in.)	0.404	2.038	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1672	241230002003125	2 Wid 1961 6-6x3 T	El Paso	Jeff Davis	3.8	3.5	Associated	MC#-# 1949-1977	1.0	Low Stiffness	6 Thin ACP (<2.5in.)	0.506	1.312	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1673	241230002004061	1 Org 1937 5-7x6 E	El Paso	Jeff Davis	3.0	1.8	Associated	MBC ##-##	1.0	Low Stiffness	6 Thin ACP (<2.5in.)	0.458	2.014	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1674	241230002004061	2 Exp 1937 1-7x6 E	El Paso	Jeff Davis	--	--	--	--	--	Low Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Expansion slab
1675	241230002004061	3 Wid 1966 5-7x6 E	El Paso	Jeff Davis	3.8	3.3	Associated	MC#-# 1949-1977	1.0	Low Stiffness	6 Thin ACP (<2.5in.)	0.603	1.373	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1676	241230002004061	4 Exp 1966 1-7x6 E	El Paso	Jeff Davis	--	--	--	--	--	Low Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Expansion slab
1677	241230002004061	5 Wid 2000 5-7x6 E	El Paso	Jeff Davis	--	--	--	--	--	Low Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Post-1979
1678	241230002004061	6 Exp 2000 1-7x6 E	El Paso	Jeff Davis	--	--	--	--	--	Low Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Expansion slab
1679	241230002005082	1 Org 1937 4-5x2 T	El Paso	Jeff Davis	3.8	3.5	Associated	MBC ##-##	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.565	2.211	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1680	241230002005082	2 Wid 1966 4-5x2 T	El Paso	Jeff Davis	3.0	1.8	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.564	1.516	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1681	241230002005090	1 Org 1937 6-6x3 T	El Paso	Jeff Davis	3.8	3.0	Associated	MBC ##-##	1.0	Low Stiffness	6 Thin ACP (<2.5in.)	0.404	2.038	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1682	241230002005090	2 Wid 1966 6-6x3 T	El Paso	Jeff Davis	3.8	3.3	Associated	MC#-# 1949-1977	1.0	Low Stiffness	6 Thin ACP (<2.5in.)	0.556	1.298	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1683	241230002005091	1 Org 1937 5-6x4 E	El Paso	Jeff Davis	3.0	1.8	Associated	MBC ##-##	1.5	Low Stiffness	6 Thin ACP (<2.5in.)	0.664	2.813	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1684	241230002005091	2 Exp 1937 1-6x4 E	El Paso	Jeff Davis	--	--	--	--	--	Low Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Expansion slab
1685	241230002005091	3 Wid 1966 5-6x4 E	El Paso	Jeff Davis	3.0	1.8	Associated	MC#-# 1949-1977	1.5	Low Stiffness	6 Thin ACP (<2.5in.)	0.726	1.586	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1686	241230002005091	4 Exp 1966 1-6x4 E	El Paso	Jeff Davis	--	--	--	--	--	Low Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Expansion slab
1687	241230002005091	5 Wid 2000 5-6x4 E	El Paso	Jeff Davis	--	--	--	--	--	Low Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Post-1979
1688	241230002005091	6 Exp 2000 1-6x4 E	El Paso	Jeff Davis	--	--	--	--	--	Low Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Expansion slab
1689	241230010402034	1 Org 1940 4-6x4 T	El Paso	Jeff Davis	3.8	3.8	Specified	MBC ##-##	1.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.575	2.760	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1690	241230010402034	2 Wid 2005 4-6x4 T	El Paso	Jeff Davis	--	--	--	--	--	Medium Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
1691	241230010402036	1 Org 1940 5-7x4 T	El Paso	Jeff Davis	4.3	3.8	Specified	MBC ##-##	2.0	High Stiffness	5 Int. ACP (2.5-5in.)	0.379	5.135	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1692	241230010402036	2 Wid 2005 5-7x4 T	El Paso	Jeff Davis	--	--	--	--	--	High Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
1693	241230010402044	1 Org 1940 6-6x3 T	El Paso	Jeff Davis	4.0	3.8	Specified	MBC ##-##	1.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.404	2.214	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1694	241230010402044	2 Wid 2005 6-6x3 T	El Paso	Jeff Davis	--	--	--	--	--	Low Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
1695	241230269502001	1 Org 1961 5-8x6 T	El Paso	Jeff Davis	3.8	3.0	Associated	MC#-# 1949-1977	0.5	Low Stiffness	10 Seal Coat or Surf. Tmt	0.601	1.000	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
1696	241890002006013	1 Org 1933 6-6x3 T	El Paso	Presidio	5.0	5.0	Provided	MBC-#	1.5	Low Stiffness	6 Thin ACP (<2.5in.)	0.343	2.635	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1697	241890002006013	2 Wid 1970 6-6x3 T	El Paso	Presidio	5.0	5.0	Provided	MC#-# 1949-1977	1.5	Low Stiffness	6 Thin ACP (<2.5in.)	0.586	1.526	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1698	241890002006015	1 Org 1933 4-6x3 T	El Paso	Presidio	5.0	5.0	Provided	MBC-#	2.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.750	3.973	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1699	241890002006015	2 Wid 1970 4-6x3 T	El Paso	Presidio	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.691	2.318	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1700	241890002008031	1 Org 1932 4-6x6 E	El Paso	Presidio	3.8	3.5	Associated	MBC-#	2.0	Medium Stiffness	6 Thin ACP (<2.5in.)	1.314	4.096	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1701	241890002008031	2 Org 1932 3-6x6 E	El Paso	Presidio	3.8	3.5	Associated	MBC-#	2.0	Medium Stiffness	6 Thin ACP (<2.5in.)	1.297	4.104	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1702	241890002008031	3 Org 1932 2-6x6 E	El Paso	Presidio	3.8	3.5	Associated	MBC-#	2.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.684	1.114	Top Corner	M	FIX	2: IR< HS20, OR>=HS20
1703	241890002008031	4 Exp 1932 1-6x6 E	El Paso	Presidio	--	--	--	--	--	Medium Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Expansion slab
1704	241890002008031	5 Wid 1959 4-6x6 E	El Paso	Presidio	3.8	3.3	Associated	MC#-# 1949-1977	2.0	Medium Stiffness	6 Thin ACP (<2.5in.)	1.001	2.529	Top Corner	V	PIN	1: IR>=HS20, OR> HS20
1705	241890002008031	6 Wid 1959 3-6x6 E	El Paso	Presidio	3.8	3.3	Associated	MC#-# 1949-1977	2.0	Medium Stiffness	6 Thin ACP (<2.5in.)	1.018	2.480	Top Corner	V	FIX	1: IR>=HS20, OR> HS20
1706	241890002008031	7 Wid 1959 2-6x6 E	El Paso	Presidio	3.8	3.3	Associated	MC#-# 1949-1977	2.0	Medium Stiffness	6 Thin ACP (<2.5in.)	1.085	2.182	Top Corner	V	FIX	1: IR>=HS20, OR> HS20
1707	241890002008031	8 Exp 1959 1-6x6 E	El Paso	Presidio	--	--	--	--	--	Medium Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Expansion slab
1708	241890010409024	1 Org 1933 6-4x4 T	El Paso	Presidio	5.0	5.0	Provided	MBC-#	5.0	High Stiffness	6 Thin ACP (<2.5in.)	4.078	10.264	Top Corner	V	PIN	1: IR>=HS20, OR> HS20
1709	241890010409024	2 Wid 1987 6-4x4 T	El Paso	Presidio	--	--	--	--	--	High Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Post-1979
1710	250230031104011	1 Org 1955 3-10x10 T	Childress	Briscoe	3.8	4.0	Associated	MC#-# 1949-1977	5.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.776	5.335	Wall Exterior Bottom	M	PIN	1: IR>=HS20, OR> HS20

No (1)	Structure No (2)	Segment ID (3)	District (4)	County (5)	Interpreted Parameter Score (6)	Design Selection Score (7)	Design Class (8)	Design Name (9)	Critical Cover Soil Depth (10)	Soil Type (11)	Pavement (12)	HS20 Lvl1 ORF (13)	HS20 Lvl3 ORF (14)	Lvl3 Controlling Critical Section (15)	Lvl3 Failure Mode (16)	Lvl3 Fixity (17)	Lvl3 Load Posting Class (18)
1711	250230242401001	1 Org 1959 4-5x5 T	Childress	Briscoe	3.8	3.0	Associated	MC#-# 1949-1977	1.0	Low Stiffness	10 Seal Coat or Surf. Tmt	0.647	1.371	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
1712	250230243001002	1 Org 1959 3-7x3 T	Childress	Briscoe	3.8	3.8	Associated	MC#-# 1949-1977	0.5	Low Stiffness	10 Seal Coat or Surf. Tmt	0.431	0.856	Wall Exterior Top	M	PIN	3: IR< HS20, OR> HS10
1713	250380038101008	1 Org 1972 3-10x6 T	Childress	Childress	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.507	2.055	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1714	250380122501003	1 Org 1953 3-6x5 T	Childress	Childress	5.0	5.0	Provided	MC#-# 1949-1977	1.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.588	1.292	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
1715	250380122501005	1 Org 1953 6-6x6 T	Childress	Childress	5.0	5.0	Provided	MC#-# 1949-1977	3.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	1.077	2.537	Bottom Corner	M	PIN	1: IR>=HS20, OR> HS20
1716	250380123301002	1 Org 1950 6-6x6 T	Childress	Childress	3.5	3.8	Specified	MBC ##-##	1.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.717	2.029	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1717	250380123301002	2 Wid 1961 6-6x6 T	Childress	Childress	5.0	5.0	Provided	MBC ##-##	3.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	1.619	6.037	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1718	250380253302005	1 Org 1962 3-9x5 T	Childress	Childress	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.501	0.991	Wall Exterior Top	M	PIN	3: IR< HS20, OR> HS10
1719	250440079708008	1 Org 1954 5-8x8 T	Childress	Collingsworth	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.625	1.281	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
1720	250510214301001	1 Org 1956 5-6x3 T	Childress	Cottle	3.8	3.5	Associated	MC#-# 1949-1977	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.691	1.973	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1721	250510225101002	1 Org 1961 3-8x4 T	Childress	Cottle	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.360	1.010	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1722	250510225102004	1 Org 1965 2-10x6 T	Childress	Cottle	4.3	3.8	Specified	MC#-# 1949-1977	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.796	2.143	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1723	250630013106006	1 Org 1941 2-9x8 T	Childress	Dickens	4.8	5.0	Provided	MBC-#-#(-F)	3.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.567	3.804	Wall Exterior Bottom	M	FIX	1: IR>=HS20, OR> HS20
1724	250630013106006	2 Wid 1971 2-9x5 T	Childress	Dickens	4.3	4.3	Specified	MC#-# 1949-1977	8.0	Medium Stiffness	6 Thin ACP (<2.5in.)	1.144	5.046	Wall Exterior Bottom	M	FIX	1: IR>=HS20, OR> HS20
1725	250630013201020	1 Org 1938 5-7x7 T	Childress	Dickens	5.0	5.0	Provided	MBC-#-#(-F)	3.0	Medium Stiffness	6 Thin ACP (<2.5in.)	1.108	8.797	Wall Exterior Top	M	FIX	1: IR>=HS20, OR> HS20
1726	250630013201020	2 Wid 1963 5-7x7 T	Childress	Dickens	4.3	4.0	Specified	MC#-# 1949-1977	3.0	Medium Stiffness	6 Thin ACP (<2.5in.)	1.018	2.667	Wall Exterior Bottom	M	FIX	1: IR>=HS20, OR> HS20
1727	250630013201020	3 Wid 1974 5-7x7 T	Childress	Dickens	4.3	3.8	Specified	MC#-# 1949-1977	3.0	Medium Stiffness	6 Thin ACP (<2.5in.)	1.073	2.360	Wall Exterior Bottom	M	FIX	1: IR>=HS20, OR> HS20
1728	250630094901004	1 Org 1957 5-10x6 T	Childress	Dickens	5.0	5.0	Provided	MC#-# 1949-1977	0.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.555	0.806	Wall Exterior Top	M	PIN	3: IR< HS20, OR> HS10
1729	250630095005013	1 Org 1959 2-10x6 T	Childress	Dickens	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.534	1.582	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1730	250630231801002	1 Org 1959 3-10x8 T	Childress	Dickens	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.550	1.162	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
1731	250650004206007	1 Org 1934 6-6x6 T	Childress	Donley	3.0	2.3	Associated	MBC-#	2.0	Medium Stiffness	6 Thin ACP (<2.5in.)	1.314	4.092	Top Midspan	M	FIX	1: IR>=HS20, OR> HS20
1732	250650004206007	2 Org 1934 4-9x7 T	Childress	Donley	3.0	2.0	Associated	MBC-#	2.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.562	3.390	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
1733	250650004206007	3 Wid 1978 6-6x6 T	Childress	Donley	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Medium Stiffness	6 Thin ACP (<2.5in.)	1.066	2.201	Top Corner	V	FIX	1: IR>=HS20, OR> HS20
1734	250650004206007	4 Wid 1978 4-9x6 T	Childress	Donley	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Medium Stiffness	6 Thin ACP (<2.5in.)	1.009	2.895	Top Corner	V	PIN	1: IR>=HS20, OR> HS20
1735	250650004206007	5 Wid 1978 4-9x7 T	Childress	Donley	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Medium Stiffness	6 Thin ACP (<2.5in.)	1.071	2.903	Top Corner	V	PIN	1: IR>=HS20, OR> HS20
1736	250650004206007	6 Wid 1978 2-18x6 T	Childress	Donley	--	--	--	--	--	Medium Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: No standard design
1737	250650004206046	1 Org 1958 3-10x7 T	Childress	Donley	4.3	4.3	Specified	MC#-# 1949-1977	2.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.570	1.966	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1738	250650004206046	2 Org 1958 3-10x7 T	Childress	Donley	4.3	4.3	Specified	MC#-# 1949-1977	2.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.570	1.966	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1739	250650004206046	3 Wid 1978 3-10x7 T	Childress	Donley	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.991	3.050	Top Corner	V	PIN	1: IR>=HS20, OR> HS20
1740	250650004207014	1 Org 1935 4-4x4 T	Childress	Donley	3.0	3.0	Associated	MBC-#	4.5	Medium Stiffness	6 Thin ACP (<2.5in.)	3.661	8.404	Top Corner	V	PIN	1: IR>=HS20, OR> HS20
1741	250650004207014	2 Wid 1967 4-4x4 T	Childress	Donley	5.0	5.0	Provided	MC#-# 1949-1977	4.5	Medium Stiffness	6 Thin ACP (<2.5in.)	1.617	1.243	Wall Exterior Bottom	M	FIX	2: IR< HS20, OR>=HS20
1742	250650004207014	3 Wid 1979 4-4x4 T	Childress	Donley	3.8	3.0	Associated	MBC-#	4.5	Medium Stiffness	6 Thin ACP (<2.5in.)	4.667	10.202	Top Corner	V	PIN	1: IR>=HS20, OR> HS20
1743	250650004208019	1 Org 1935 3-10x10 T	Childress	Donley	4.3	4.3	Specified	MBC-#	5.0	Medium Stiffness	6 Thin ACP (<2.5in.)	3.132	8.600	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
1744	250650004208019	2 Wid 1958 3-10x10 T	Childress	Donley	3.0	2.5	Associated	MC#-# 1949-1977	5.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.761	6.102	Wall Exterior Bottom	M	PIN	1: IR>=HS20, OR> HS20
1745	250650004208019	3 Wid 1969 3-10x10 T	Childress	Donley	5.0	5.0	Provided	MC#-# 1949-1977	5.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.761	6.102	Wall Exterior Bottom	M	PIN	1: IR>=HS20, OR> HS20
1746	250650004208019	4 Wid 1980 3-10x10 T	Childress	Donley	--	--	--	--	--	Medium Stiffness	6 Thin ACP (<2.5in.)	--	--	--	--	--	NLR: Post-1979
1747	250650225201003	1 Org 1957 3-9x5 T	Childress	Donley	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.501	0.991	Wall Exterior Top	M	PIN	3: IR< HS20, OR> HS10
1748	250790009803026	1 Org 1937 4-5x3 T	Childress	Foard	4.5	5.0	Provided	MBC ##-##	0.5	Low Stiffness	10 Seal Coat or Surf. Tmt	0.621	1.769	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1749	250790070203007	1 Org 1955 6-7x7 T	Childress	Foard	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.594	1.199	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1750	250790216402006	1 Org 1960 2-10x10 T	Childress	Foard	4.3	5.0	Provided	MC#-# 1949-1977	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.452	2.046	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1751	250790318301003	1 Org 1969 3-7x5 T	Childress	Foard	5.0	5.0	Provided	MC#-# 1949-1977	1.0	Low Stiffness	5 Int. ACP (2.5-5in.)	0.600	1.494	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1752	250970010502012	1 Org 1925 7-3x3 T	Childress	Hall	3.0	2.8	Associated	MBC-#	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.534	1.255	Top Midspan	M	FIX	2: IR< HS20, OR>=HS20
1753	250970010502012	2 Wid 1960 7-3x3 T	Childress	Hall	2.8	3.5	Associated	MBC-#	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.661	1.464	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
1754	250970054102009	1 Org 1931 6-5x5 T	Childress	Hall	3.8	3.3	Associated	MBC-#	1.0	Medium Stiffness	8 Overlaid Concrete	0.739	7.292	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
1755	250970054102009	2 Wid 1958 6-5x5 T	Childress	Hall	3.8	3.0	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	8 Overlaid Concrete	0.647	5.907	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1756	250970054102021	1 Org 1931 6-6x4 T	Childress	Hall	3.8	3.5	Associated	MBC-#	1.0	Medium Stiffness	8 Overlaid Concrete	0.825	6.897	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1757	250970054102021	2 Wid 1958 6-6x4 T	Childress	Hall	3.8	3.3	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	8 Overlaid Concrete	0.569	5.339	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1758	250970263001001	1 Org 1962 3-10x6 T	Childress	Hall	5.0	5.0	Provided	MC#-# 1949-1977	12.5	High Stiffness	10 Seal Coat or Surf. Tmt	-5.980	-7.028	Wall Exterior Bottom	M	FIX	6: IR< HS 3, OR< HS 3
1759	251000004302146	1 Org 1970 3-9x7 T	Childress	Hardeman	3.8	3.0	Associated	MC#-# 1949-1977	4.5	Low Stiffness	6 Thin ACP (<2.5in.)	1.445	2.750	Wall Exterior Bottom	M	PIN	1: IR>=HS20, OR> HS20
1760	251000004302147	1 Org 1970 3-9x6 T	Childress	Hardeman	5.0	5.0	Provided	MC#-# 1949-1977	2.5	Low Stiffness	6 Thin ACP (<2.5in.)	0.446	2.175	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1761	251000071101018	1 Org 1947 5-6x6 T	Childress	Hardeman	3.8	3.0	Associated	MBC-#	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.982	1.916	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1762	251000071101018	2 Wid 1958 5-6x6 T	Childress	Hardeman	3.8	3.0	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.642	1.314	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
1763	251000191601004	1 Org 1969 5-8x5 T	Childress	Hardeman	3.8	3.3	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.550	1.111	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
1764	251350003205016	1 Org 1932 4-10x10 T	Childress	King	3.0	1.8	Associated	MBC-#	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.351	0.712	Top Midspan	M	PIN	3: IR< HS20, OR> HS10
1765	251350003205016	2 Wid 1964 4-10x10 T	Childress	King	3.8	3.0	Associated	MC#-# 1949-1977	0.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.329	0.936	Top Midspan	M	PIN	3: IR< HS20, OR> HS10
1766	251350003205017	1 Org 1932 4-5x5 T	Childress	King	3.0	2.0	Associated	MBC-#	1.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.739	1.547	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20
1767	251350003205017	2 Wid 1964 4-5x5 T	Childress	King	3.8	3.0	Associated	MC#-# 1949-1977	0.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.647	1.003	Top Midspan	M	PIN	2: IR< HS20, OR>=HS20

No	Structure No	Segment ID	District	County	Interpreted Parameter Score	Design Selection Score	Design Class	Design Name	Critical Cover Soil Depth	Soil Type	Pavement	HS20 Lvl1 ORF	HS20 Lvl3 ORF	Lvl3 Controlling Critical Section	Lvl3 Failure Mode	Lvl3 Fixity	Lvl3 Load Posting Class
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
1768	251350003206026	1 Org 1932 4-6x6 T	Childress	King	3.8	3.3	Associated	MBC-#	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.588	2.067	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
1769	251350003206026	2 Wid 1962 4-6x6 T	Childress	King	3.8	3.0	Associated	MC#-# 1949-1977	0.5	Medium Stiffness	6 Thin ACP (<2.5in.)	0.628	1.241	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
1770	251350003206026	3 Wid 1976 4-6x6 T	Childress	King	3.8	3.0	Associated	MC#-# 1949-1977	1.0	Medium Stiffness	6 Thin ACP (<2.5in.)	0.650	1.616	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
1771	251350071104026	1 Org 1961 5-8x5 T	Childress	King	3.8	3.3	Associated	MC#-# 1949-1977	1.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.637	1.399	Top Corner	M	PIN	2: IR< HS20, OR>=HS20
1772	251350095002003	1 Org 1949 7-5x4 T	Childress	King	3.0	1.8	Associated	MBC-#-#(-F)	3.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	1.687	5.900	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1773	251350095002003	2 Wid 1969 7-5x4 T	Childress	King	3.8	2.5	Associated	MC#-# 1949-1977	3.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	1.743	4.028	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1774	251380015702005	1 Org 1931 6-10x10 T	Childress	Knox	4.3	4.8	Specified	MBC-#	4.5	Medium Stiffness	5 Int. ACP (2.5-5in.)	2.893	8.420	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
1775	251380015702005	2 Wid 1954 6-10x10 T	Childress	Knox	4.3	4.8	Specified	MC#-# 1949-1977	2.0	Medium Stiffness	5 Int. ACP (2.5-5in.)	0.464	2.933	Top Midspan	M	PIN	1: IR>=HS20, OR> HS20
1776	251380015702005	3 Org 2005 6-10x10 T	Childress	Knox	--	--	--	--	--	Medium Stiffness	5 Int. ACP (2.5-5in.)	--	--	--	--	--	NLR: Post-1979
1777	251380216403008	1 Org 1960 3-7x4 T	Childress	Knox	3.8	3.8	Associated	MC#-# 1949-1977	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.596	1.770	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1778	251380216403010	1 Org 1960 5-7x3 T	Childress	Knox	3.8	3.8	Associated	MC#-# 1949-1977	1.5	Low Stiffness	10 Seal Coat or Surf. Tmt	0.490	1.188	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1779	251730242503002	1 Org 1972 3-8x4 T	Childress	Motley	3.5	3.3	Associated	MC#-# 1949-1977	4.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	1.308	5.052	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1780	252420003009016	1 Org 1930 5-6x3 T	Childress	Wheeler	3.5	4.5	Specified	MBC-#	2.0	Medium Stiffness	8 Overlaid Concrete	0.495	8.027	Top Corner	M	PIN	1: IR>=HS20, OR> HS20
1781	252420003009016	2 Wid 1963 5-6x3 T	Childress	Wheeler	5.0	5.0	Provided	MC#-# 1949-1977	1.5	Medium Stiffness	8 Overlaid Concrete	0.586	5.249	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20
1782	252420003009016	3 Wid 2007 5-6x3 T	Childress	Wheeler	--	--	--	--	--	Medium Stiffness	8 Overlaid Concrete	--	--	--	--	--	NLR: Post-1979
1783	252420076105007	1 Org 1957 3-7x3 T	Childress	Wheeler	5.0	5.0	Provided	MC#-# 1949-1977	1.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.485	1.256	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1784	252420076105007	2 Wid 2013 3-7x3 T	Childress	Wheeler	--	--	--	--	--	Medium Stiffness	10 Seal Coat or Surf. Tmt	--	--	--	--	--	NLR: Post-1979
1785	252420123501004	1 Org 1953 4-7x3 T	Childress	Wheeler	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.502	1.324	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1786	252420123501004	2 Wid 1971 4-7x3 T	Childress	Wheeler	5.0	5.0	Provided	MC#-# 1949-1977	1.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.540	1.246	Wall Exterior Top	M	PIN	2: IR< HS20, OR>=HS20
1787	252420134701001	1 Org 1951 5-8x8 T	Childress	Wheeler	4.8	5.0	Provided	MC#-# 1949-1977	0.5	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.537	0.795	Top Midspan	M	PIN	3: IR< HS20, OR> HS10
1788	252420205101004	1 Org 1960 4-6x4 T	Childress	Wheeler	5.0	5.0	Provided	MC#-# 1949-1977	2.0	Medium Stiffness	10 Seal Coat or Surf. Tmt	0.782	2.088	Wall Exterior Top	M	PIN	1: IR>=HS20, OR> HS20

APPENDIX B

Summary of

CULVERT STURCTURE

Load Rating Results

TABLE B
Summary Load Rating Results
for
1,000 Batch 1 Culvert Structures

TABLE B: Column identification and data dictionary

Column No.	Column Label	Column Description
1	No	Record locator for load-rated culvert segment (1,000 culvert sample)
2	Structure No	National Bridge Inventory structure number for load- rated culvert
3	Segment ID	Segment identification for load-rated culvert segment
4	District	TxDOT District in which culvert segment is located
5	County	Texas County in which culvert segment is located
6	Structure History Score	Relative data quality score assigned to interpretation of structure history and segment identification: 5 = excellent, 4 = very good, 3 = fair, 2 = poor, 1 = very poor
7	Number of Segments	Number of segments interpreted for the culvert structure based on available information in the culvert digital file
8	Condition Rating	NBIS condition rating for the in-place, existing culvert structure. Low condition ratings (0 to 4) indicate failed to poor condition, middle ratings (5 to 6) indicate fair to satisfactory condition, and high ratings (7 to 9) indicate good to excellent condition.
9	Soil Type	The resilient modulus of soil used for live load demand analysis based on a linear-elastic constitutive soil model: Low = 12,000psi; Medium = 24,000psi; High – 36,000 psi
10	Critical Cover Soil Depth	Thickness of cover soil above the top slab of the culvert segment, inclusive of both soil and pavement; the critical value is the specific thickness of cover soil within the range of cover soil that yields the lowest load rating based on a structural frame (Level 1) demand analysis
11	Pavement	Type of pavement as determined by the TxDOT Pavement Management Information Systerm (PMIS)
12	HS20 Lvl1 ORF	Operating rating factor associated with HS20 vehicle load for the approved analysis condition, calculated using a structural frame (Level 1) demand model
13	HS20 Lvl3 ORF	Operating rating factor associated with HS20 vehicle load for the approved analysis condition, calculated using a soil-structure interaction (Level 3) demand model
14	Lvl3 Load Posting Class	Load posting classification per TxDOT Bridge Inspection policy; calculated based on Level 3 (soil structure interaction) operating rating and inventory rating: RT = RF * 20 tons (specific to HS-20 truck load). Explanatory notes accompany this classification.

TABLE B: Summary Load Rating Results for 1,000 Culvert Structures (Aggregated from Segment Rating Data)

No.	Structure No	Segment ID	District	County	Structure History Score	Number of Segments	Culvert Condition Rating	Soil Type	Critical Cover Soil Depth	Pavement	HS20 Level 1 ORF	HS20 Level 3 ORF	Level 3 Load Posting Class
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
1	10600073501016	1 Org 1954 2-10x8 T	Paris	Delta	5	2	7	Low Stiffness	1	10 Seal Coat or Surf. Tmt	0.562	1.191	2: IR< HS20, OR>=HS20
2	10750004505032	2 Wid 1974 6-5x5 T	Paris	Fannin	5	2	6	Low Stiffness	4	5 Int. ACP (2.5-5in.)	2.532	4.976	1: IR>=HS20, OR> HS20
3	10750017404023	1 Org 1952 5-8x4 T	Paris	Fannin	5	2	6	Low Stiffness	1	10 Seal Coat or Surf. Tmt	0.376	0.795	3: IR< HS20, OR> HS10‡
4	10750020203039	1 Org 1943 3-5x3 T	Paris	Fannin	5	2	6	Low Stiffness	2	9 Overlaid Flexible	0.785	3.942	1: IR>=HS20, OR> HS20‡
5	10750027904013	1 Org 1936 3-5x4 T	Paris	Fannin	5	1	7	Low Stiffness	1.5	5 Int. ACP (2.5-5in.)	0.832	2.966	1: IR>=HS20, OR> HS20
6	10750051005011	1 Org 1960 7-9x5 T	Paris	Fannin	5	1	7	Low Stiffness	0.5	10 Seal Coat or Surf. Tmt	0.530	0.883	3: IR< HS20, OR> HS10
7	10750054902017	1 Org 1962 5-6x6 T	Paris	Fannin	5	2	7	Low Stiffness	3	9 Overlaid Flexible	1.471	3.601	1: IR>=HS20, OR> HS20‡
8	10750170802005	1 Org 1954 2-10x10 T	Paris	Fannin	5	1	5	Low Stiffness	2	10 Seal Coat or Surf. Tmt	1.599	4.384	1: IR>=HS20, OR> HS20
9	10750197901001	1 Org 1956 4-10x6 E	Paris	Fannin	5	2	6	Low Stiffness	2	10 Seal Coat or Surf. Tmt	0.507	1.410	2: IR< HS20, OR>=HS20
10	10810001004084	1 Org 1942 4-10x7 T	Paris	Franklin	5	1	7	Medium Stiffness	1	8 Overlaid Concrete	0.805	14.20	1: IR>=HS20, OR> HS20
11	10810001005066	2 Wid 1954 4-6x4 T	Paris	Franklin	5	2	6	Medium Stiffness	1	8 Overlaid Concrete	0.569	5.279	1: IR>=HS20, OR> HS20
12	10810273102001	1 Org 1977 3-10x10 T	Paris	Franklin	5	1	7	Medium Stiffness	3	6 Thin ACP (<2.5in.)	1.412	4.910	1: IR>=HS20, OR> HS20
13	10920004504018	2 Wid 1955 2-10x10 T	Paris	Grayson	5	2	6	Low Stiffness	5	5 Int. ACP (2.5-5in.)	0.660	4.654	1: IR>=HS20, OR> HS20*
14	10920004701008	1 Org 1930 4-6x6 T	Paris	Grayson	5	2	6	High Stiffness	4	5 Int. ACP (2.5-5in.)	2.883	11.34	1: IR>=HS20, OR> HS20
15	10920008107089	1 Org 1966 3-7x3 T	Paris	Grayson	5	1	7	Low Stiffness	1	9 Overlaid Flexible	0.422	1.398	2: IR< HS20, OR>=HS20
16	10920031602004	2 Org 1960 4-10x10 T	Paris	Grayson	5	2	7	Medium Stiffness	3	8 Overlaid Concrete	0.616	5.414	1: IR>=HS20, OR> HS20
17	10920041002007	2 Wid 1967 3-10x10 T	Paris	Grayson	5	3	7	Low Stiffness	4	8 Overlaid Concrete	0.887	3.100	1: IR>=HS20, OR> HS20†
18	10920051001005	1 Org 1954 3-9x9 T	Paris	Grayson	5	1	7	Low Stiffness	2	10 Seal Coat or Surf. Tmt	0.749	1.914	1: IR>=HS20, OR> HS20
19	10920072803004	1 Org 1954 2-10x9 T	Paris	Grayson	5	2	7	Low Stiffness	4.5	6 Thin ACP (<2.5in.)	1.112	2.221	1: IR>=HS20, OR> HS20‡
20	11130001003013	2 Wid 1952 2-10x8 T	Paris	Hopkins	5	2	6	Medium Stiffness	1	8 Overlaid Concrete	0.952	7.110	1: IR>=HS20, OR> HS20
21	11130008302041	1 Org 1954 2-10x8 J	Paris	Hopkins	5	6	6	Medium Stiffness	3	5 Int. ACP (2.5-5in.)	0.859	4.173	1: IR>=HS20, OR> HS20†‡
22	11130008303013	1 Org 1934 7-9x7 T	Paris	Hopkins	3	3	6	Medium Stiffness	0.5	5 Int. ACP (2.5-5in.)	0.490	1.954	1: IR>=HS20, OR> HS20‡
23	11130010809039	2 Wid 1969 3-6x6 T	Paris	Hopkins	5	2	7	Medium Stiffness	6.5	5 Int. ACP (2.5-5in.)	1.506	4.704	1: IR>=HS20, OR> HS20
24	11130040002024	1 Org 1964 10-10x8 T	Paris	Hopkins	5	1	6	Medium Stiffness	0.5	5 Int. ACP (2.5-5in.)	0.590	1.292	2: IR< HS20, OR>=HS20
25	11130054604005	1 Org 1950 4-6x6 T	Paris	Hopkins	5	1	7	Low Stiffness	5	5 Int. ACP (2.5-5in.)	2.157	5.349	1: IR>=HS20, OR> HS20
26	11130061001001	1 Org 1962 3-6x6 T	Paris	Hopkins	5	1	6	Medium Stiffness	5.5	6 Thin ACP (<2.5in.)	1.585	4.893	1: IR>=HS20, OR> HS20
27	11130061001030	1 Org 1963 3-6x4 T	Paris	Hopkins	5	1	7	Low Stiffness	3	5 Int. ACP (2.5-5in.)	1.165	3.376	1: IR>=HS20, OR> HS20
28	11130064104015	1 Org 1955 4-10x10 T	Paris	Hopkins	5	1	6	Medium Stiffness	2	10 Seal Coat or Surf. Tmt	1.605	4.682	1: IR>=HS20, OR> HS20
29	11130253801002	1 Org 1963 3-9x9 T	Paris	Hopkins	4	1	7	Medium Stiffness	1.5	10 Seal Coat or Surf. Tmt	0.631	1.569	2: IR< HS20, OR>=HS20
30	11130314403001	1 Org 1969 3-8x6 T	Paris	Hopkins	5	1	7	Medium Stiffness	2	5 Int. ACP (2.5-5in.)	0.683	2.543	1: IR>=HS20, OR> HS20
31	11170000913105	1 Org 1950 2-10x9 T	Paris	Hunt	5	1	7	Low Stiffness	2	6 Thin ACP (<2.5in.)	0.958	3.047	1: IR>=HS20, OR> HS20
32	11170000913222	1 Org 1960 2-8x6 T	Paris	Hunt	5	1	7	Low Stiffness	2	6 Thin ACP (<2.5in.)	0.713	1.973	1: IR>=HS20, OR> HS20
33	11170013601075	1 Org 1957 2-10x5 J	Paris	Hunt	2	3	7	Low Stiffness	2	5 Int. ACP (2.5-5in.)	0.534	1.766	1: IR>=HS20, OR> HS20
34	11170020210031	1 Org 1966 2-8x8 T	Paris	Hunt	5	1	7	Low Stiffness	2	5 Int. ACP (2.5-5in.)	0.833	2.396	1: IR>=HS20, OR> HS20
35	11170172501004	1 Org 1954 4-8x8 T	Paris	Hunt	5	1	7	Low Stiffness	2	6 Thin ACP (<2.5in.)	1.579	4.674	1: IR>=HS20, OR> HS20
36	11170265801001	1 Org 1963 3-6x3 T	Paris	Hunt	5	1	7	Low Stiffness	2	5 Int. ACP (2.5-5in.)	0.688	2.118	1: IR>=HS20, OR> HS20
37	11390022101006	2 Wid 1959 3-10x10 T	Paris	Lamar	5	2	6	Medium Stiffness	1	6 Thin ACP (<2.5in.)	0.367	1.561	2: IR< HS20, OR>=HS20
38	11390043501019	1 Org 1962 2-10x10 T	Paris	Lamar	5	1	7	Low Stiffness	2.5	6 Thin ACP (<2.5in.)	0.523	2.838	1: IR>=HS20, OR> HS20
39	11390073002016	1 Org 1954 4-6x6 T	Paris	Lamar	3	3	7	Medium Stiffness	4	5 Int. ACP (2.5-5in.)	1.795	4.010	1: IR>=HS20, OR> HS20‡
40	11390074902024	1 Org 1949 4-6x4 T	Paris	Lamar	5	2	7	Low Stiffness	3	10 Seal Coat or Surf. Tmt	0.944	2.390	1: IR>=HS20, OR> HS20

Key for Load Posting Class:
NLR - Not Load Rated, * - No Standard Design, ^ - Expansion Slab, † - Geometry Out-side Scope, ‡ - Post 1979 Construction

TABLE B: Summary Load Rating Results for 1,000 Culvert Structures (Aggregated from Segment Rating Data)

No.	Structure No	Segment ID	District	County	Structure History Score	Number of Segments	Culvert Condition Rating	Soil Type	Critical Cover Soil Depth	Pavement	HS20 Level 1 ORF	HS20 Level 3 ORF	Level 3 Load Posting Class
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
41	11390076901005	1 Org 1953 3-8x7 T	Paris	Lamar	5	2	7	Medium Stiffness	2	10 Seal Coat or Surf. Tmt	0.475	1.523	2: IR< HS20, OR>=HS20‡
42	11390169001002	1 Org 1959 3-9x9 T	Paris	Lamar	4	2	6	Low Stiffness	3	2 JRCP	0.807	2.132	1: IR>=HS20, OR> HS20
43	11900020304029	1 Org 1962 2-10x9 T	Paris	Rains	5	1	6	Medium Stiffness	1.5	10 Seal Coat or Surf. Tmt	0.612	1.592	2: IR< HS20, OR>=HS20
44	11900184903002	1 Org 1955 5-8x5 T	Paris	Rains	3	3	7	Medium Stiffness	5	6 Thin ACP (<2.5in.)	1.363	6.340	1: IR>=HS20, OR> HS20‡
45	11940004510064	1 Org 1925 2-10x6 T	Paris	Red River	5	2	6	Medium Stiffness	2	10 Seal Coat or Surf. Tmt	0.459	1.580	2: IR< HS20, OR>=HS20‡
46	11940004601021	1 Org 1936 5-10x10 T	Paris	Red River	5	2	6	Low Stiffness	3	8 Overlaid Concrete	0.322	1.916	1: IR>=HS20, OR> HS20
47	11940018902025	2 Wid 1967 5-6x5 T	Paris	Red River	5	2	7	Medium Stiffness	0.5	9 Overlaid Flexible	0.539	1.502	2: IR< HS20, OR>=HS20
48	11940018903038	1 Org 1956 4-8x7 T	Paris	Red River	5	1	7	Low Stiffness	1	10 Seal Coat or Surf. Tmt	0.605	1.173	2: IR< HS20, OR>=HS20
49	11940215501001	1 Org 1956 2-10x9 T	Paris	Red River	5	1	7	Low Stiffness	2	10 Seal Coat or Surf. Tmt	0.663	1.222	2: IR< HS20, OR>=HS20
50	20730034303025	1 Org 1947 2-10x10 T	Fort Worth	Erath	5	2	6	Medium Stiffness	0.5	6 Thin ACP (<2.5in.)	0.473	1.750	1: IR>=HS20, OR> HS20†
51	20730257802002	1 Org 1961 2-10x6 T	Fort Worth	Erath	5	1	7	Low Stiffness	1	10 Seal Coat or Surf. Tmt	0.546	1.010	2: IR< HS20, OR>=HS20
52	21120008003042	1 Org 1942 3-7x6 T	Fort Worth	Hood	5	1	7	Medium Stiffness	5	4 Thick ACP (>5in.)	1.790	9.236	1: IR>=HS20, OR> HS20
53	21120008003043	1 Org 1942 4-6x3 T	Fort Worth	Hood	5	1	7	Medium Stiffness	1.5	4 Thick ACP (>5in.)	0.498	3.532	1: IR>=HS20, OR> HS20
54	21120008003044	1 Org 1942 4-6x5 E	Fort Worth	Hood	5	2	7	Medium Stiffness	1	4 Thick ACP (>5in.)	0.861	2.861	1: IR>=HS20, OR> HS20
55	21120008004041	3 Wid 1974 5-6x4 T	Fort Worth	Hood	5	3	7	Medium Stiffness	2	4 Thick ACP (>5in.)	0.861	2.593	1: IR>=HS20, OR> HS20
56	21120038504001	1 Org 1938 3-6x6 T	Fort Worth	Hood	5	2	7	Medium Stiffness	2	5 Int. ACP (2.5-5in.)	1.178	4.605	1: IR>=HS20, OR> HS20‡
57	21120246301002	1 Org 1960 3-7x4 T	Fort Worth	Hood	5	2	7	Medium Stiffness	2	6 Thin ACP (<2.5in.)	0.596	2.058	1: IR>=HS20, OR> HS20‡
58	21200013405018	1 Org 1926 3-10x8 T	Fort Worth	Jack	5	1	5	Medium Stiffness	1	6 Thin ACP (<2.5in.)	0.944	2.786	1: IR>=HS20, OR> HS20
59	21200039106025	2 Wid 1944 5-7x6 T	Fort Worth	Jack	5	2	7	Medium Stiffness	3	6 Thin ACP (<2.5in.)	0.596	5.367	1: IR>=HS20, OR> HS20
60	21270001404277	1 Org 1966 2-7x4 T	Fort Worth	Johnson	5	1	7	Low Stiffness	1	10 Seal Coat or Surf. Tmt	0.582	1.089	2: IR< HS20, OR>=HS20
61	21270159901002	1 Org 1952 5-5x3 T	Fort Worth	Johnson	5	2	6	Medium Stiffness	2.5	10 Seal Coat or Surf. Tmt	1.009	2.451	1: IR>=HS20, OR> HS20‡
62	21270159901003	1 Org 1952 5-5x3 T	Fort Worth	Johnson	5	2	8	Medium Stiffness	2	10 Seal Coat or Surf. Tmt	0.881	1.867	1: IR>=HS20, OR> HS20‡
63	21270221301004	1 Org 1970 2-7x4 T	Fort Worth	Johnson	5	1	6	Low Stiffness	2.5	6 Thin ACP (<2.5in.)	0.689	2.316	1: IR>=HS20, OR> HS20
64	21820024908030	2 Wid 1949 3-10x7 T	Fort Worth	Palo Pinto	5	2	7	Medium Stiffness	1	4 Thick ACP (>5in.)	0.618	2.570	1: IR>=HS20, OR> HS20†
65	21820024908041	1 Org 1949 2-10x9 T	Fort Worth	Palo Pinto	5	1	7	Medium Stiffness	3	4 Thick ACP (>5in.)	1.214	7.774	1: IR>=HS20, OR> HS20
66	21820031402105	1 Org 1971 3-9x9 T	Fort Worth	Palo Pinto	5	1	7	Medium Stiffness	2	10 Seal Coat or Surf. Tmt	0.615	1.818	1: IR>=HS20, OR> HS20
67	21820031403158	3 Add 1972 1-10x10 J	Fort Worth	Palo Pinto	4	3	7	Medium Stiffness	1.5	6 Thin ACP (<2.5in.)	0.687	1.760	1: IR>=HS20, OR> HS20
68	21820039108046	2 Wid 1964 4-7x4 T	Fort Worth	Palo Pinto	3	2	7	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.439	1.067	2: IR< HS20, OR>=HS20
69	21820053904022	1 Org 1968 5-10x6 T	Fort Worth	Palo Pinto	5	1	7	Medium Stiffness	1	6 Thin ACP (<2.5in.)	0.542	1.129	2: IR< HS20, OR>=HS20
70	21820073601002	1 Org 1950 3-8x8 T	Fort Worth	Palo Pinto	5	1	7	Low Stiffness	1	10 Seal Coat or Surf. Tmt	0.506	1.081	2: IR< HS20, OR>=HS20
71	21820073602013	1 Org 1961 3-7x5 T	Fort Worth	Palo Pinto	5	1	7	Low Stiffness	1	10 Seal Coat or Surf. Tmt	0.613	1.189	2: IR< HS20, OR>=HS20
72	21820152502001	1 Org 1961 2-10x7 T	Fort Worth	Palo Pinto	5	1	6	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.552	1.052	2: IR< HS20, OR>=HS20
73	21820228901001	1 Org 1959 4-5x3 T	Fort Worth	Palo Pinto	5	1	6	Medium Stiffness	1.5	10 Seal Coat or Surf. Tmt	0.730	1.766	1: IR>=HS20, OR> HS20
74	21840031401001	2 Org 1933 2-8x8 E	Fort Worth	Parker	5	3	7	Medium Stiffness	1	8 Overlaid Concrete	1.114	8.532	1: IR>=HS20, OR> HS20
75	21840316301001	1 Org 1970 4-8x4 T	Fort Worth	Parker	5	1	8	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.376	1.010	2: IR< HS20, OR>=HS20
76	22130025902008	2 Wid 1953 3-8x6 T	Fort Worth	Somervell	5	2	6	Medium Stiffness	4.5	4 Thick ACP (>5in.)	0.437	1.750	1: IR>=HS20, OR> HS20
77	22200000812073	1 Org 1957 5-8x8 O	Fort Worth	Tarrant	3	3	6	Low Stiffness	3.5	4 Thick ACP (>5in.)	1.350	4.262	1: IR>=HS20, OR> HS20†‡
78	22200001415337	2 Wid 1976 6-7x4 T	Fort Worth	Tarrant	4	2	6	Low Stiffness	4	5 Int. ACP (2.5-5in.)	1.280	3.776	1: IR>=HS20, OR> HS20
79	22200008112080	1 Org 1967 6-10x6 T	Fort Worth	Tarrant	5	4	7	Low Stiffness	15	5 Int. ACP (2.5-5in.)	1.531	12.86	1: IR>=HS20, OR> HS20‡
80	22200009402012	4 Add 1964 2-8x7 J	Fort Worth	Tarrant	4	6	6	Medium Stiffness	3	4 Thick ACP (>5in.)	1.017	4.890	1: IR>=HS20, OR> HS20‡

Key for Load Posting Class:
NLR - Not Load Rated, * - No Standard Design, ^ - Expansion Slab, † - Geometry Out-side Scope, ‡ - Post 1979 Construction

TABLE B: Summary Load Rating Results for 1,000 Culvert Structures (Aggregated from Segment Rating Data)

No.	Structure No	Segment ID	District	County	Structure History Score	Number of Segments	Culvert Condition Rating	Soil Type	Critical Cover Soil Depth	Pavement	HS20 Level 1 ORF	HS20 Level 3 ORF	Level 3 Load Posting Class
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
81	22200017209132	1 Org 1973 4-10x7 T	Fort Worth	Tarrant	5	1	7	Medium Stiffness	1.5	10 Seal Coat or Surf. Tmt	0.574	1.334	2: IR< HS20, OR>=HS20
82	22200017209138	2 Org 1973 6-10x7 T	Fort Worth	Tarrant	5	2	6	Medium Stiffness	2	10 Seal Coat or Surf. Tmt	0.628	1.867	1: IR>=HS20, OR> HS20
83	22200017209144	2 Org 1973 6-8x7 T	Fort Worth	Tarrant	5	2	6	Low Stiffness	2	10 Seal Coat or Surf. Tmt	0.705	1.679	1: IR>=HS20, OR> HS20
84	22200071802010	1 Org 1935 3-10x5.5 T	Fort Worth	Tarrant	5	2	7	Low Stiffness	3	5 Int. ACP (2.5-5in.)	0.432	0.688	3: IR< HS20, OR> HS10
85	22200109802003	1 Org 1939 4-7x6 T	Fort Worth	Tarrant	5	2	6	Low Stiffness	1.5	5 Int. ACP (2.5-5in.)	0.572	2.008	1: IR>=HS20, OR> HS20‡
86	22200220801015	1 Org 1975 2-7x6 J	Fort Worth	Tarrant	5	5	7	Medium Stiffness	6	1 CRCP	1.665	3.040	1: IR>=HS20, OR> HS20‡
87	22200226602013	9 Add 1972 2-5x10 J	Fort Worth	Tarrant	5	11	6	Low Stiffness	3.5	1 CRCP	-5.922	3.109	1: IR>=HS20, OR> HS20*
88	22200237405198	1 Org 1972 4-7x5 T	Fort Worth	Tarrant	5	1	6	Low Stiffness	11	1 CRCP	3.873	6.507	1: IR>=HS20, OR> HS20
89	22200237405301	1 Org 1973 3-6x5 T	Fort Worth	Tarrant	5	1	6	Low Stiffness	2.5	1 CRCP	0.758	4.970	1: IR>=HS20, OR> HS20
90	22490031204035	1 Org 1958 3-7x6 T	Fort Worth	Wise	5	2	7	Medium Stiffness	4	5 Int. ACP (2.5-5in.)	1.423	4.305	1: IR>=HS20, OR> HS20
91	22490031301025	2 Wid 1965 3-5x4 T	Fort Worth	Wise	4	2	7	Medium Stiffness	2	5 Int. ACP (2.5-5in.)	0.344	1.738	1: IR>=HS20, OR> HS20
92	22490241801002	1 Org 1961 2-10x10 T	Fort Worth	Wise	5	2	7	Medium Stiffness	2	6 Thin ACP (<2.5in.)	0.433	2.741	1: IR>=HS20, OR> HS20‡
93	30050013707015	2 Wid 1967 4-5x5 T	Wichita Falls	Archer	5	2	7	Medium Stiffness	2	5 Int. ACP (2.5-5in.)	1.275	3.222	1: IR>=HS20, OR> HS20
94	30050015605013	2 Wid 1941 6-6x6 T	Wichita Falls	Archer	3	3	7	Medium Stiffness	1	5 Int. ACP (2.5-5in.)	0.642	1.423	2: IR< HS20, OR>=HS20
95	30050028303006	1 Org 1928 5-10x8 T	Wichita Falls	Archer	5	2	5	Medium Stiffness	2	8 Overlaid Concrete	1.017	8.440	1: IR>=HS20, OR> HS20
96	30050028304013	2 Wid 1954 4-5x5 T	Wichita Falls	Archer	5	2	6	Medium Stiffness	0.5	8 Overlaid Concrete	0.665	6.203	1: IR>=HS20, OR> HS20
97	30050080403006	1 Org 1951 3-7x4 T	Wichita Falls	Archer	5	1	6	Medium Stiffness	1	6 Thin ACP (<2.5in.)	0.470	1.000	2: IR< HS20, OR>=HS20
98	30050211301002	1 Org 1961 4-10x10 T	Wichita Falls	Archer	5	1	7	Medium Stiffness	2	10 Seal Coat or Surf. Tmt	0.478	2.299	1: IR>=HS20, OR> HS20
99	30120012405018	1 Org 1933 3-8x8 T	Wichita Falls	Baylor	5	2	7	Low Stiffness	2	6 Thin ACP (<2.5in.)	1.274	3.918	1: IR>=HS20, OR> HS20‡
100	30390004402007	1 Org 1925 4-5x5 T	Wichita Falls	Clay	5	3	7	Medium Stiffness	2	8 Overlaid Concrete	1.141	6.969	1: IR>=HS20, OR> HS20‡
101	30390004402076	1 Org 1963 4-5x5 T	Wichita Falls	Clay	5	2	6	Medium Stiffness	2	8 Overlaid Concrete	1.275	6.320	1: IR>=HS20, OR> HS20‡
102	30390013708043	1 Org 1956 3-8x8 T	Wichita Falls	Clay	5	1	7	Medium Stiffness	2	10 Seal Coat or Surf. Tmt	1.569	4.547	1: IR>=HS20, OR> HS20
103	30390022401044	1 Org 1972 5-6x6 T	Wichita Falls	Clay	5	1	6	Medium Stiffness	2	1 CRCP	1.036	4.965	1: IR>=HS20, OR> HS20
104	30390023906016	2 Wid 1950 2-10x10 T	Wichita Falls	Clay	5	3	7	Medium Stiffness	2	10 Seal Coat or Surf. Tmt	0.263	1.420	2: IR< HS20, OR>=HS20‡
105	30390039105044	1 Org 1947 4-8x8 T	Wichita Falls	Clay	5	1	6	Medium Stiffness	2.5	10 Seal Coat or Surf. Tmt	0.360	3.784	1: IR>=HS20, OR> HS20
106	30390068105022	1 Org 1960 4-6x4 T	Wichita Falls	Clay	5	1	6	Medium Stiffness	2	10 Seal Coat or Surf. Tmt	0.782	2.088	1: IR>=HS20, OR> HS20
107	30390161502005	1 Org 1958 4-5x2 T	Wichita Falls	Clay	5	1	6	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.564	1.290	2: IR< HS20, OR>=HS20
108	30490004408112	1 Org 1968 3-8x6 T	Wichita Falls	Cooke	4	1	6	Low Stiffness	2	5 Int. ACP (2.5-5in.)	0.683	2.179	1: IR>=HS20, OR> HS20
109	30490019501026	2 Wid 1963 3-7x6 T	Wichita Falls	Cooke	5	2	6	Low Stiffness	1.5	10 Seal Coat or Surf. Tmt	0.675	1.427	2: IR< HS20, OR>=HS20
110	31690001305045	1 Org 1972 3-10x6 T	Wichita Falls	Montague	5	2	6	Medium Stiffness	2	10 Seal Coat or Surf. Tmt	0.773	2.117	1: IR>=HS20, OR> HS20
111	31690001305047	1 Org 1972 3-8x6 T	Wichita Falls	Montague	5	1	6						NLR*
112	31690001313038	1 Org 1972 3-7x5 T	Wichita Falls	Montague	5	1	6						NLR*
113	32240012503015	2 Wid 1961 4-5x5 T	Wichita Falls	Throckmorton	5	2	7	Medium Stiffness	1	6 Thin ACP (<2.5in.)	0.647	1.789	1: IR>=HS20, OR> HS20
114	32240012503016	2 Wid 1961 4-6x6 T	Wichita Falls	Throckmorton	5	2	7	Medium Stiffness	0.5	8 Overlaid Concrete	0.650	6.196	1: IR>=HS20, OR> HS20
115	32240161201001	1 Org 1954 3-9x5 T	Wichita Falls	Throckmorton	5	1	7	Medium Stiffness	1	6 Thin ACP (<2.5in.)	0.501	1.210	2: IR< HS20, OR>=HS20
116	32240161301001	1 Org 1954 3-7x6 T	Wichita Falls	Throckmorton	5	1	7	Medium Stiffness	0.5	10 Seal Coat or Surf. Tmt	0.626	0.934	3: IR< HS20, OR> HS10
117	32430004309074	1 Org 1960 4-9x7 T	Wichita Falls	Wichita	5	2	5	Low Stiffness	2	3 JPCP	0.598	4.016	1: IR>=HS20, OR> HS20‡
118	32430004309085	2 Org 1961 6-10x6 T	Wichita Falls	Wichita	5	2	6	Medium Stiffness	2	8 Overlaid Concrete	0.781	6.309	1: IR>=HS20, OR> HS20
119	32430004317045	1 Org 1936 5-7x7 T	Wichita Falls	Wichita	5	2	7	Medium Stiffness	1	5 Int. ACP (2.5-5in.)	0.480	2.039	1: IR>=HS20, OR> HS20
120	32430024901053	1 Org 1968 6-6x4 T	Wichita Falls	Wichita	5	1	7	Low Stiffness	2	6 Thin ACP (<2.5in.)	0.782	2.495	1: IR>=HS20, OR> HS20

Key for Load Posting Class:
NLR - Not Load Rated, * - No Standard Design, ^ - Expansion Slab, † - Geometry Out-side Scope, ‡ - Post 1979 Construction

TABLE B: Summary Load Rating Results for 1,000 Culvert Structures (Aggregated from Segment Rating Data)

No.	Structure No	Segment ID	District	County	Structure History Score	Number of Segments	Culvert Condition Rating	Soil Type	Critical Cover Soil Depth	Pavement	HS20 Level 1 ORF	HS20 Level 3 ORF	Level 3 Load Posting Class
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
121	32430068104018	1 Org 1956 3-10x8 T	Wichita Falls	Wichita	5	1	7	Medium Stiffness	1.5	5 Int. ACP (2.5-5in.)	0.602	1.979	1: IR>=HS20, OR> HS20
122	32430080201007	1 Org 1960 4-10x10 T	Wichita Falls	Wichita	5	2	6	Medium Stiffness	2	5 Int. ACP (2.5-5in.)	0.478	2.959	1: IR>=HS20, OR> HS20‡
123	32430135301002	1 Org 1961 4-10x10 T	Wichita Falls	Wichita	5	1	7	Low Stiffness	2	10 Seal Coat or Surf. Tmt	0.478	1.967	1: IR>=HS20, OR> HS20
124	32430232301002	1 Org 1960 4-10x10 T	Wichita Falls	Wichita	5	1	6	Medium Stiffness	0.5	5 Int. ACP (2.5-5in.)	0.329	1.394	2: IR< HS20, OR>=HS20
125	32440082102010	1 Org 1959 5-8x4 T	Wichita Falls	Wilbarger	5	1	6	Medium Stiffness	1	5 Int. ACP (2.5-5in.)	0.376	1.420	2: IR< HS20, OR>=HS20
126	32440083202004	1 Org 1950 6-5x3 T	Wichita Falls	Wilbarger	5	1	6	Low Stiffness	1	5 Int. ACP (2.5-5in.)	0.524	1.437	2: IR< HS20, OR>=HS20
127	32440083202005	1 Org 1940 4-8x7 T	Wichita Falls	Wilbarger	5	1	5	Medium Stiffness	2.5	6 Thin ACP (<2.5in.)	0.338	2.861	1: IR>=HS20, OR> HS20
128	32440116201002	1 Org 1949 4-6x3 T	Wichita Falls	Wilbarger	5	1	6	Medium Stiffness	0.5	6 Thin ACP (<2.5in.)	0.411	1.221	2: IR< HS20, OR>=HS20
129	32440116202004	1 Org 1965 4-8x4 T	Wichita Falls	Wilbarger	5	1	7	Medium Stiffness	1.5	10 Seal Coat or Surf. Tmt	0.432	1.250	2: IR< HS20, OR>=HS20
130	32440161601002	1 Org 1955 3-8x6 T	Wichita Falls	Wilbarger	5	1	6	Medium Stiffness	2	10 Seal Coat or Surf. Tmt	0.515	1.698	1: IR>=HS20, OR> HS20
131	32440177001002	1 Org 1956 4-6x4 T	Wichita Falls	Wilbarger	5	1	7	Low Stiffness	1.5	6 Thin ACP (<2.5in.)	0.660	1.568	2: IR< HS20, OR>=HS20
132	32520028401011	1 Org 1957 8-10x10 T	Wichita Falls	Young	5	1	6	Medium Stiffness	2	5 Int. ACP (2.5-5in.)	0.451	3.036	1: IR>=HS20, OR> HS20
133	32520036102008	2 Wid 1973 4-8x8 T	Wichita Falls	Young	5	2	6	Medium Stiffness	1	6 Thin ACP (<2.5in.)	0.649	1.591	2: IR< HS20, OR>=HS20
134	32520036201024	1 Org 1966 5-6x6 T	Wichita Falls	Young	5	1	7	Medium Stiffness	1	9 Overlaid Flexible	0.642	1.966	1: IR>=HS20, OR> HS20
135	40060078902001	1 Org 1946 4-6x4 T	Amarillo	Armstrong	5	1	7	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.765	1.933	1: IR>=HS20, OR> HS20
136	40590124301001	1 Org 1950 4-5x2 T	Amarillo	Deaf Smith	5	1	7	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.393	1.275	2: IR< HS20, OR>=HS20
137	40590149101001	1 Org 1951 4-9x5 T	Amarillo	Deaf Smith	5	1	7	Medium Stiffness	1.5	10 Seal Coat or Surf. Tmt	0.379	0.935	3: IR< HS20, OR> HS10
138	40910049001005	1 Org 1952 6-8x6 T	Amarillo	Gray	4	2	6	Medium Stiffness	1	6 Thin ACP (<2.5in.)	0.298	0.869	3: IR< HS20, OR> HS10‡
139	40910079705011	1 Org 1947 3-8x8 T	Amarillo	Gray	5	1	5	Medium Stiffness	0.5	10 Seal Coat or Surf. Tmt	0.542	1.373	2: IR< HS20, OR>=HS20
140	40990272401001	1 Org 1962 5-5x2 T	Amarillo	Hansford	5	1	6	Low Stiffness	0.5	10 Seal Coat or Surf. Tmt	0.570	1.070	2: IR< HS20, OR>=HS20
141	41040004101014	2 Wid 1953 7-4x4 T	Amarillo	Hartley	5	3	7	Medium Stiffness	1	5 Int. ACP (2.5-5in.)	0.725	2.518	1: IR>=HS20, OR> HS20‡
142	41070233001001	1 Org 1958 4-5x3 T	Amarillo	Hemphill	5	1	8	Medium Stiffness	2	5 Int. ACP (2.5-5in.)	1.038	2.922	1: IR>=HS20, OR> HS20
143	41180151503001	1 Org 1951 5-6x5 T	Amarillo	Hutchinson	5	1	7	Medium Stiffness	2	10 Seal Coat or Surf. Tmt	0.773	1.753	1: IR>=HS20, OR> HS20
144	41480035502007	1 Org 1933 3-8x8 T	Amarillo	Lipscomb	3	1	6	Medium Stiffness	7.5	10 Seal Coat or Surf. Tmt	4.761	12.252	1: IR>=HS20, OR> HS20
145	41790035503012	4 Wid 1973 6-7x6 T	Amarillo	Ochiltree	3	4	6	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.470	1.180	2: IR< HS20, OR>=HS20
146	41800009003049	1 Org 1969 3-7x3 T	Amarillo	Oldham	5	1	7	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.422	1.008	2: IR< HS20, OR>=HS20
147	41880004105007	1 Org 1931 6-5x5 T	Amarillo	Potter	5	2	7	Medium Stiffness	1.5	5 Int. ACP (2.5-5in.)	0.846	2.789	1: IR>=HS20, OR> HS20
148	41880009006023	1 Org 1959 4-5x3 T	Amarillo	Potter	5	1	7	Medium Stiffness	1.5	6 Thin ACP (<2.5in.)	0.730	2.047	1: IR>=HS20, OR> HS20
149	41880016902023	1 Org 1962 4-6x3 T	Amarillo	Potter	5	1	7	Medium Stiffness	1	5 Int. ACP (2.5-5in.)	0.506	1.617	2: IR< HS20, OR>=HS20
150	41970016908006	2 Wid 1962 3-8x8 T	Amarillo	Roberts	5	2	6	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.624	1.288	2: IR< HS20, OR>=HS20
151	41970079801002	1 Org 1947 3-10x12 T	Amarillo	Roberts	5	1	7	Medium Stiffness	2	10 Seal Coat or Surf. Tmt	0.753	2.202	1: IR>=HS20, OR> HS20
152	42110023806012	1 Org 1946 3-7x4 E	Amarillo	Sherman	4	4	6	Medium Stiffness	2	10 Seal Coat or Surf. Tmt	0.656	3.444	1: IR>=HS20, OR> HS20
153	50090005202024	1 Org 1968 4-9x5 T	Lubbock	Bailey	3	1	7	Medium Stiffness	2	6 Thin ACP (<2.5in.)	0.574	1.967	1: IR>=HS20, OR> HS20
154	50350241901001	1 Org 1962 6-9x7 T	Lubbock	Castro	4	1	7	Low Stiffness	1	10 Seal Coat or Surf. Tmt	0.545	1.058	2: IR< HS20, OR>=HS20
155	50780045307003	1 Org 1936 4-6x4 T	Lubbock	Floyd	5	1	6	Low Stiffness	1	10 Seal Coat or Surf. Tmt	0.825	2.013	1: IR>=HS20, OR> HS20
156	50860055801025	1 Org 1960 2-10x8 T	Lubbock	Garza	5	1	7	High Stiffness	8.5	10 Seal Coat or Surf. Tmt	1.104	0.072	6: IR< HS 3, OR< HS 3
157	50960104101005	1 Org 1960 10-7x5 T	Lubbock	Hale	5	1	5	Low Stiffness	0.5	10 Seal Coat or Surf. Tmt	0.640	0.968	3: IR< HS20, OR> HS10
158	51850163404004	1 Org 1974 3-10x6 T	Lubbock	Parmer	5	1	7	Medium Stiffness	0.5	10 Seal Coat or Surf. Tmt	0.521	0.810	3: IR< HS20, OR> HS10
159	52190035704001	1 Org 1946 4-5x3 T	Lubbock	Swisher	5	2	7	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.638	1.943	1: IR>=HS20, OR> HS20‡
160	60520022903005	2 Wid 1966 6-4x4 T	Odessa	Crane	5	3	6	High Stiffness	2	6 Thin ACP (<2.5in.)	1.151	3.653	1: IR>=HS20, OR> HS20‡

Key for Load Posting Class:
NLR - Not Load Rated, * - No Standard Design, ^ - Expansion Slab, † - Geometry Out-side Scope, ‡ - Post 1979 Construction

TABLE B: Summary Load Rating Results for 1,000 Culvert Structures (Aggregated from Segment Rating Data)

No.	Structure No	Segment ID	District	County	Structure History Score	Number of Segments	Culvert Condition Rating	Soil Type	Critical Cover Soil Depth	Pavement	HS20 Level 1 ORF	HS20 Level 3 ORF	Level 3 Load Posting Class
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
161	60520022903006	2 Wid 1966 6-4x4 T	Odessa	Crane	5	3	6	High Stiffness	2	6 Thin ACP (<2.5in.)	1.151	3.653	1: IR>=HS20, OR> HS20‡
162	60520022903033	2 Add 1964 2-6x4 J	Odessa	Crane	5	5	6	Medium Stiffness	2	6 Thin ACP (<2.5in.)	0.868	2.448	1: IR>=HS20, OR> HS20‡
163	60690022901017	5 Wid 1969 12-7x7 J	Odessa	Ector	4	6	6	Medium Stiffness	1	6 Thin ACP (<2.5in.)	0.480	1.417	2: IR< HS20, OR>=HS20
164	60690022901019	2 Wid 1969 5-6x3 T	Odessa	Ector	5	3	7	Medium Stiffness	3	5 Int. ACP (2.5-5in.)	0.639	3.852	1: IR>=HS20, OR> HS20‡
165	60690187001002	1 Org 1969 6-6x4 T	Odessa	Ector	5	2	7	Medium Stiffness	3	5 Int. ACP (2.5-5in.)	1.299	3.944	1: IR>=HS20, OR> HS20‡
166	61650000515189	2 Org 1966 4-6x3 J	Odessa	Midland	3	4	7	Medium Stiffness	1	6 Thin ACP (<2.5in.)	0.506	1.435	2: IR< HS20, OR>=HS20‡
167	61860002106020	2 Wid 1960 4-5x5 T	Odessa	Pecos	5	2	6	High Stiffness	3	6 Thin ACP (<2.5in.)	1.836	5.216	1: IR>=HS20, OR> HS20
168	61860007503049	2 Wid 1971 4-6x3 T	Odessa	Pecos	5	2	7	Medium Stiffness	1	6 Thin ACP (<2.5in.)	0.404	1.413	2: IR< HS20, OR>=HS20
169	61860007503051	2 Wid 1966 7-5x2 T	Odessa	Pecos	5	2	6	Medium Stiffness	1	6 Thin ACP (<2.5in.)	0.564	1.501	2: IR< HS20, OR>=HS20
170	61860007503053	2 Wid 1966 4-5x2 T	Odessa	Pecos	5	2	7	Medium Stiffness	1	6 Thin ACP (<2.5in.)	0.564	1.516	2: IR< HS20, OR>=HS20
171	61860007503056	2 Wid 1966 6-5x2 T	Odessa	Pecos	5	3	7	Medium Stiffness	1	6 Thin ACP (<2.5in.)	0.564	1.501	2: IR< HS20, OR>=HS20‡
172	61860007503057	2 Wid 1966 4-5x2 T	Odessa	Pecos	5	2	7	Medium Stiffness	1	6 Thin ACP (<2.5in.)	0.564	1.516	2: IR< HS20, OR>=HS20
173	61860013908064	2 Wid 1968 6-7x3 T	Odessa	Pecos	5	2	6	Low Stiffness	3	6 Thin ACP (<2.5in.)	0.791	2.574	1: IR>=HS20, OR> HS20
174	61860014001120	1 Org 1974 4-7x4 T	Odessa	Pecos	5	1	7	High Stiffness	3	6 Thin ACP (<2.5in.)	0.807	3.561	1: IR>=HS20, OR> HS20
175	61860014002018	1 Org 1932 6-5x5 E	Odessa	Pecos	5	2	7	Medium Stiffness	0.5	6 Thin ACP (<2.5in.)	0.757	1.359	2: IR< HS20, OR>=HS20
176	61860014002105	1 Org 1975 5-7x3 T	Odessa	Pecos	5	1	7	High Stiffness	2	6 Thin ACP (<2.5in.)	0.597	2.119	1: IR>=HS20, OR> HS20
177	61860014002136	1 Org 1975 5-10x8 T	Odessa	Pecos	5	1	7	Medium Stiffness	1	6 Thin ACP (<2.5in.)	0.553	1.401	2: IR< HS20, OR>=HS20
178	61860014002141	1 Org 1975 5-6x3 T	Odessa	Pecos	5	1	7	High Stiffness	3	6 Thin ACP (<2.5in.)	0.135	2.798	1: IR>=HS20, OR> HS20
179	61860014003162	1 Org 1975 3-7x3 T	Odessa	Pecos	5	1	7	High Stiffness	4	6 Thin ACP (<2.5in.)	1.205	4.622	1: IR>=HS20, OR> HS20
180	61860014004183	1 Org 1978 15-9x5 T	Odessa	Pecos	5	1	6	Medium Stiffness	1	6 Thin ACP (<2.5in.)	0.785	1.883	1: IR>=HS20, OR> HS20
181	61860014004230	1 Org 1977 5-8x4 T	Odessa	Pecos	5	1	7	Medium Stiffness	2	6 Thin ACP (<2.5in.)	0.452	2.731	1: IR>=HS20, OR> HS20
182	61860014005208	1 Org 1978 8-8x6 T	Odessa	Pecos	5	1	6	Medium Stiffness	1	6 Thin ACP (<2.5in.)	0.889	2.086	1: IR>=HS20, OR> HS20
183	61860014005248	1 Org 1978 3-7x3 T	Odessa	Pecos	5	1	7	High Stiffness	2	6 Thin ACP (<2.5in.)	0.581	3.142	1: IR>=HS20, OR> HS20
184	61860014005251	1 Org 1978 6-7x3 T	Odessa	Pecos	5	1	7	Medium Stiffness	2	6 Thin ACP (<2.5in.)	0.597	3.039	1: IR>=HS20, OR> HS20
185	61860014007047	3 Wid 1972 7-6x3 T	Odessa	Pecos	5	3	6	High Stiffness	1	6 Thin ACP (<2.5in.)	0.556	1.456	2: IR< HS20, OR>=HS20
186	61860014012090	1 Org 1936 5-4x4 T	Odessa	Pecos	5	2	7	High Stiffness	0.5	6 Thin ACP (<2.5in.)	0.739	1.510	2: IR< HS20, OR>=HS20‡
187	61860014015077	1 Org 1937 5-7x4 E	Odessa	Pecos	5	3	7	Medium Stiffness	0.5	6 Thin ACP (<2.5in.)	0.413	1.691	1: IR>=HS20, OR> HS20
188	61860022906023	2 Wid 1963 4-5x5 T	Odessa	Pecos	5	2	7	High Stiffness	1	6 Thin ACP (<2.5in.)	0.647	1.804	1: IR>=HS20, OR> HS20
189	61860029205011	3 Wid 1962 7-6x3 T	Odessa	Pecos	3	3	7	Medium Stiffness	0.5	6 Thin ACP (<2.5in.)	0.434	1.086	2: IR< HS20, OR>=HS20
190	61860029301026	1 Org 1963 4-7x3 J	Odessa	Pecos	2	4	7	High Stiffness	2	6 Thin ACP (<2.5in.)	0.541	2.173	1: IR>=HS20, OR> HS20
191	61860029301029	1 Org 1963 3-6x3 T	Odessa	Pecos	5	2	7	Medium Stiffness	2	6 Thin ACP (<2.5in.)	0.688	2.297	1: IR>=HS20, OR> HS20
192	61860044107025	2 Add 1959 2-8x6 J	Odessa	Pecos	5	3	6	Low Stiffness	0.5	6 Thin ACP (<2.5in.)	0.650	1.160	2: IR< HS20, OR>=HS20
193	61860044107169	1 Org 1964 3-7x3 T	Odessa	Pecos	5	2	7	High Stiffness	2	6 Thin ACP (<2.5in.)	0.525	2.173	1: IR>=HS20, OR> HS20‡
194	61860044108029	2 Wid 1959 4-6x6 T	Odessa	Pecos	5	2	5	Low Stiffness	1.5	6 Thin ACP (<2.5in.)	0.713	1.864	1: IR>=HS20, OR> HS20
195	61860044108097	1 Org 1971 3-7x3 T	Odessa	Pecos	5	1	7	Medium Stiffness	1	6 Thin ACP (<2.5in.)	0.465	1.204	2: IR< HS20, OR>=HS20
196	61860055603007	1 Org 1958 6-6x5 T	Odessa	Pecos	5	1	6	High Stiffness	1.5	6 Thin ACP (<2.5in.)	0.742	2.047	1: IR>=HS20, OR> HS20
197	61860055603008	1 Org 1958 5-8x8 T	Odessa	Pecos	5	1	7	Medium Stiffness	3	6 Thin ACP (<2.5in.)	0.726	4.063	1: IR>=HS20, OR> HS20
198	61860086605009	1 Org 1968 4-5x2 T	Odessa	Pecos	5	1	7	Medium Stiffness	1	6 Thin ACP (<2.5in.)	0.564	1.516	2: IR< HS20, OR>=HS20
199	61860086605012	1 Org 1968 3-7x4 T	Odessa	Pecos	5	1	6	Low Stiffness	1	6 Thin ACP (<2.5in.)	0.470	1.196	2: IR< HS20, OR>=HS20
200	61950000305042	1 Org 1941 4-6x5 T	Odessa	Reeves	5	1	6	High Stiffness	0.5	6 Thin ACP (<2.5in.)	0.727	1.808	1: IR>=HS20, OR> HS20

Key for Load Posting Class:
NLR - Not Load Rated, * - No Standard Design, ^ - Expansion Slab, † - Geometry Out-side Scope, ‡ - Post 1979 Construction

TABLE B: Summary Load Rating Results for 1,000 Culvert Structures (Aggregated from Segment Rating Data)

No.	Structure No	Segment ID	District	County	Structure History Score	Number of Segments	Culvert Condition Rating	Soil Type	Critical Cover Soil Depth	Pavement	HS20 Level 1 ORF	HS20 Level 3 ORF	Level 3 Load Posting Class
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
201	61950000306046	1 Org 1955 4-6x3 T	Odessa	Reeves	5	1	5	Medium Stiffness	0.5	6 Thin ACP (<2.5in.)	0.512	1.113	2: IR< HS20, OR>=HS20
202	61950013902034	2 Wid 1960 6-6x4 T	Odessa	Reeves	3	2	7	Medium Stiffness	1	6 Thin ACP (<2.5in.)	0.569	1.475	2: IR< HS20, OR>=HS20
203	61950013903018	2 Wid 1959 3-8x8 T	Odessa	Reeves	5	3	6	High Stiffness	1	6 Thin ACP (<2.5in.)	0.529	1.583	2: IR< HS20, OR>=HS20‡
204	61950013903056	1 Org 1959 6-7x7 T	Odessa	Reeves	5	1	6	High Stiffness	1	6 Thin ACP (<2.5in.)	0.594	1.471	2: IR< HS20, OR>=HS20
205	61950013905069	1 Org 1977 5-5x2 T	Odessa	Reeves	5	1	6	Medium Stiffness	0.5	6 Thin ACP (<2.5in.)	0.570	1.791	1: IR>=HS20, OR> HS20
206	61950044106051	1 Org 1964 9-5x2 E	Odessa	Reeves	4	2	7	Medium Stiffness	1	6 Thin ACP (<2.5in.)	0.564	1.501	2: IR< HS20, OR>=HS20‡
207	61950044109062	2 Org 1971 3-5x5 T	Odessa	Reeves	5	2	7	High Stiffness	8	6 Thin ACP (<2.5in.)	0.724	3.298	1: IR>=HS20, OR> HS20
208	61950044109105	1 Org 1974 5-6x4 T	Odessa	Reeves	5	1	7	High Stiffness	4	6 Thin ACP (<2.5in.)	1.457	5.055	1: IR>=HS20, OR> HS20
209	61950044109111	1 Org 1974 4-7x3 T	Odessa	Reeves	5	1	7	Medium Stiffness	4	6 Thin ACP (<2.5in.)	1.430	4.454	1: IR>=HS20, OR> HS20
210	61950296802005	1 Org 1966 5-5x4 T	Odessa	Reeves	5	1	7	High Stiffness	1	6 Thin ACP (<2.5in.)	0.635	1.679	1: IR>=HS20, OR> HS20
211	62220002107110	2 Wid 1961 1-8.5x3 J	Odessa	Terrell	5	3	7	Medium Stiffness	1.5	6 Thin ACP (<2.5in.)	0.032	0.277	4: IR>=HS 3, OR< HS10
212	62220002202062	1 Org 1954 4-5x2 T	Odessa	Terrell	5	2	8	Medium Stiffness	1	6 Thin ACP (<2.5in.)	0.564	1.516	2: IR< HS20, OR>=HS20‡
213	62310007605016	2 Wid 1955 9-6x4 T	Odessa	Upton	3	2	6	Medium Stiffness	0.5	6 Thin ACP (<2.5in.)	0.576	1.142	2: IR< HS20, OR>=HS20
214	62310022904026	2 Org 1934 7-4x4 E	Odessa	Upton	1	5	6	Medium Stiffness	1	6 Thin ACP (<2.5in.)	0.725	2.174	1: IR>=HS20, OR> HS20
215	62310055601033	1 Org 1969 4-7x3 T	Odessa	Upton	5	1	7	Medium Stiffness	2	6 Thin ACP (<2.5in.)	0.597	1.949	1: IR>=HS20, OR> HS20
216	62380000402066	1 Org 1968 5-6x4 T	Odessa	Ward	5	2	7	High Stiffness	1	6 Thin ACP (<2.5in.)	0.625	1.456	2: IR< HS20, OR>=HS20‡
217	62380100101002	1 Org 1947 4-6x5 T	Odessa	Ward	5	1	5	Medium Stiffness	1	6 Thin ACP (<2.5in.)	0.550	1.880	1: IR>=HS20, OR> HS20
218	70410040604007	2 Wid 1969 4-6x4 T	San Angelo	Coke	5	2	7	Medium Stiffness	1	6 Thin ACP (<2.5in.)	0.380	1.147	2: IR< HS20, OR>=HS20
219	70410040701010	2 Wid 1957 7-6x3 T	San Angelo	Coke	5	2	7	Medium Stiffness	1	5 Int. ACP (2.5-5in.)	0.404	1.615	2: IR< HS20, OR>=HS20
220	70410045404031	1 Org 1946 3-7x6 T	San Angelo	Coke	5	1	6	Medium Stiffness	2	6 Thin ACP (<2.5in.)	0.554	3.095	1: IR>=HS20, OR> HS20
221	70410045404041	1 Org 1956 3-7x5 T	San Angelo	Coke	5	1	7	Medium Stiffness	1	6 Thin ACP (<2.5in.)	0.600	1.368	2: IR< HS20, OR>=HS20
222	70480007004063	1 Org 1973 4-5x3 J	San Angelo	Concho	5	3	7	Medium Stiffness	2.5	5 Int. ACP (2.5-5in.)	1.230	3.774	1: IR>=HS20, OR> HS20‡
223	70480007005019	3 Wid 1968 6-6x5 E	San Angelo	Concho	5	4	6	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.531	1.312	2: IR< HS20, OR>=HS20
224	70480087004015	1 Org 1959 6-10x8 T	San Angelo	Concho	5	1	7	Low Stiffness	1	10 Seal Coat or Surf. Tmt	0.553	1.202	2: IR< HS20, OR>=HS20
225	70480087004016	1 Org 1959 4-9x6 T	San Angelo	Concho	5	1	7	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.566	1.021	2: IR< HS20, OR>=HS20
226	70480087004031	1 Org 1970 4-8x6 T	San Angelo	Concho	5	1	7	Low Stiffness	2	10 Seal Coat or Surf. Tmt	0.703	1.763	1: IR>=HS20, OR> HS20
227	70480227801001	1 Org 1958 5-8x4 T	San Angelo	Concho	5	1	7	Medium Stiffness	1.5	10 Seal Coat or Surf. Tmt	0.417	1.178	2: IR< HS20, OR>=HS20
228	70530014010269	1 Org 1979 6-9x7 T	San Angelo	Crockett	5	1	7	High Stiffness	2	5 Int. ACP (2.5-5in.)	1.071	2.852	1: IR>=HS20, OR> HS20
229	70530014010274	1 Org 1979 4-7x3 T	San Angelo	Crockett	5	1	7	High Stiffness	6.5	5 Int. ACP (2.5-5in.)	2.466	7.369	1: IR>=HS20, OR> HS20
230	70530014014087	1 Org 1937 5-5x3 T	San Angelo	Crockett	5	1	7	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.602	2.167	1: IR>=HS20, OR> HS20
231	70530014113003	1 Org 1933 5-6x3 T	San Angelo	Crockett	5	1	7	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.643	1.924	1: IR>=HS20, OR> HS20
232	70530041204021	1 Org 1967 5-7x3 T	San Angelo	Crockett	5	1	7	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.467	1.020	2: IR< HS20, OR>=HS20
233	70530055810039	1 Org 1965 6-10x10 T	San Angelo	Crockett	5	1	7	Low Stiffness	0.5	10 Seal Coat or Surf. Tmt	0.329	0.968	3: IR< HS20, OR> HS10
234	70530164502002	1 Org 1935 4-6x4 T	San Angelo	Crockett	5	2	7	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.461	1.019	2: IR< HS20, OR>=HS20‡
235	70880040501009	1 Org 1954 4-9x5 T	San Angelo	Glasscock	5	3	7	Medium Stiffness	4	10 Seal Coat or Surf. Tmt	0.759	3.442	1: IR>=HS20, OR> HS20‡
236	71190007705007	4 Wid 1958 10-6x5 T	San Angelo	Irion	4	4	6	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.531	1.306	2: IR< HS20, OR>=HS20
237	71190164804011	2 Org 1957 5-10x8 J	San Angelo	Irion	5	2	7	Low Stiffness	0.5	10 Seal Coat or Surf. Tmt	0.590	0.940	3: IR< HS20, OR> HS10
238	71640003505046	2 Wid 1957 7-8x8 T	San Angelo	Menard	3	2	6	High Stiffness	3	6 Thin ACP (<2.5in.)	0.726	4.564	1: IR>=HS20, OR> HS20
239	71640003506038	3 Wid 1960 3-7x6 E	San Angelo	Menard	5	4	7	Low Stiffness	0.5	10 Seal Coat or Surf. Tmt	0.489	1.032	2: IR< HS20, OR>=HS20
240	71640039601015	2 Wid 1957 6-6x4 T	San Angelo	Menard	5	2	6	Medium Stiffness	6.5	10 Seal Coat or Surf. Tmt	1.476	5.490	1: IR>=HS20, OR> HS20

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NLR - Not Load Rated, * - No Standard Design, ^ - Expansion Slab, † - Geometry Out-side Scope, ‡ - Post 1979 Construction

TABLE B: Summary Load Rating Results for 1,000 Culvert Structures (Aggregated from Segment Rating Data)

No.	Structure No	Segment ID	District	County	Structure History Score	Number of Segments	Culvert Condition Rating	Soil Type	Critical Cover Soil Depth	Pavement	HS20 Level 1 ORF	HS20 Level 3 ORF	Level 3 Load Posting Class
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
241	71640039605034	1 Org 1963 5-8x4 T	San Angelo	Menard	5	1	7	High Stiffness	2	10 Seal Coat or Surf. Tmt	0.452	0.939	3: IR< HS20, OR> HS10
242	71920055808033	1 Org 1961 8-10x8 T	San Angelo	Reagan	5	1	7	Low Stiffness	0.5	10 Seal Coat or Surf. Tmt	0.590	0.973	3: IR< HS20, OR> HS10
243	71920055809028	1 Org 1960 3-8x4 T	San Angelo	Reagan	5	1	7	Medium Stiffness	2	10 Seal Coat or Surf. Tmt	0.428	1.719	1: IR>=HS20, OR> HS20
244	71920055809031	1 Org 1960 3-8x4 T	San Angelo	Reagan	5	1	7	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.360	1.010	2: IR< HS20, OR>=HS20
245	71920055809032	1 Org 1960 3-8x4 T	San Angelo	Reagan	5	2	8	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.360	1.010	2: IR< HS20, OR>=HS20‡
246	71930020106008	5 Wid 1960 4-6x5 J	San Angelo	Real	4	6	7	High Stiffness	1	10 Seal Coat or Surf. Tmt	0.531	1.310	2: IR< HS20, OR>=HS20†
247	71930023503019	1 Org 1957 2-10x10 T	San Angelo	Real	5	1	7	High Stiffness	2	10 Seal Coat or Surf. Tmt	1.599	5.004	1: IR>=HS20, OR> HS20
248	72000003403052	1 Org 1972 6-10x8 T	San Angelo	Runnels	5	1	7	Low Stiffness	1	6 Thin ACP (<2.5in.)	0.553	1.375	2: IR< HS20, OR>=HS20
249	72000003501005	1 Org 1930 5-4x4 T	San Angelo	Runnels	5	2	6	Medium Stiffness	1.5	6 Thin ACP (<2.5in.)	0.834	2.898	1: IR>=HS20, OR> HS20
250	72000015801040	1 Org 1961 5-8x4 T	San Angelo	Runnels	5	2	7	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.376	1.011	2: IR< HS20, OR>=HS20‡
251	72000107003007	1 Org 1959 5-6x4 T	San Angelo	Runnels	5	1	7	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.569	1.233	2: IR< HS20, OR>=HS20
252	72000164102001	1 Org 1957 4-7x5 T	San Angelo	Runnels	5	1	7	Medium Stiffness	2	10 Seal Coat or Surf. Tmt	0.831	1.965	1: IR>=HS20, OR> HS20
253	72000228001002	1 Org 1965 4-7x3 T	San Angelo	Runnels	5	1	7	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.425	1.031	2: IR< HS20, OR>=HS20
254	72000228002001	1 Org 1958 4-8x4 T	San Angelo	Runnels	5	1	7	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.376	1.010	2: IR< HS20, OR>=HS20
255	72000247001001	1 Org 1960 3-9x5 T	San Angelo	Runnels	5	1	7	Medium Stiffness	2	10 Seal Coat or Surf. Tmt	0.574	1.644	2: IR< HS20, OR>=HS20
256	72070015903032	1 Org 1965 7-10x6 T	San Angelo	Schleicher	5	1	7	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.542	0.935	3: IR< HS20, OR> HS10
257	72070039603039	1 Org 1965 5-5x3 T	San Angelo	Schleicher	5	1	7	Medium Stiffness	2	10 Seal Coat or Surf. Tmt	1.038	2.347	1: IR>=HS20, OR> HS20
258	72070039603045	1 Org 1967 5-9x5 T	San Angelo	Schleicher	5	1	7	Low Stiffness	2	10 Seal Coat or Surf. Tmt	0.574	1.520	2: IR< HS20, OR>=HS20
259	72160040502011	1 Org 1956 2-10x6 T	San Angelo	Sterling	5	1	7	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.546	0.965	3: IR< HS20, OR> HS10
260	72160040502013	1 Org 1956 5-10x10 T	San Angelo	Sterling	5	1	6	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.343	1.165	2: IR< HS20, OR>=HS20
261	72180014103013	2 Org 1933 5-6x6 E	San Angelo	Sutton	5	3	6	Medium Stiffness	1.5	10 Seal Coat or Surf. Tmt	1.127	2.491	1: IR>=HS20, OR> HS20
262	72180014103082	1 Org 1969 5-6x5 T	San Angelo	Sutton	3	1	6	Low Stiffness	10.5	10 Seal Coat or Surf. Tmt	-0.270	3.138	1: IR>=HS20, OR> HS20
263	72180014116042	1 Org 1948 4-6x5 T	San Angelo	Sutton	5	1	7	Low Stiffness	1.5	10 Seal Coat or Surf. Tmt	0.772	2.425	1: IR>=HS20, OR> HS20
264	72260006906128	1 Org 1974 7-10x8 T	San Angelo	Tom Green	5	1	7	Medium Stiffness	2	5 Int. ACP (2.5-5in.)	0.652	2.895	1: IR>=HS20, OR> HS20
265	72260006907102	1 Org 1968 4-5x2 T	San Angelo	Tom Green	5	1	7	Medium Stiffness	1.5	10 Seal Coat or Surf. Tmt	0.656	1.612	2: IR< HS20, OR>=HS20
266	72260006907104	1 Oth 1968 2-10x3.5 T	San Angelo	Tom Green	5	1	7						NLR†
267	72260007002048	1 Org 1969 6-5x3 T	San Angelo	Tom Green	5	1	7	Medium Stiffness	0.5	5 Int. ACP (2.5-5in.)	0.653	1.506	2: IR< HS20, OR>=HS20
268	72260007706058	1 Org 1968 2-10x8 T	San Angelo	Tom Green	3	2	6	Medium Stiffness	2	6 Thin ACP (<2.5in.)	0.647	2.224	1: IR>=HS20, OR> HS20‡
269	72260015802019	1 Org 1958 4-8x6 T	San Angelo	Tom Green	5	1	7	Medium Stiffness	0.5	10 Seal Coat or Surf. Tmt	0.582	0.911	3: IR< HS20, OR> HS10
270	72260015902038	1 Org 1975 2-10x8 T	San Angelo	Tom Green	5	1	7	Low Stiffness	4.5	10 Seal Coat or Surf. Tmt	1.167	1.947	1: IR>=HS20, OR> HS20
271	72260087003029	1 Org 1970 10-10x8 T	San Angelo	Tom Green	4	1	6	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.553	1.157	2: IR< HS20, OR>=HS20
272	80170029502023	1 Org 1939 3-10x10 T	Abilene	Borden	2	1	7	Medium Stiffness	0.5	10 Seal Coat or Surf. Tmt	0.472	1.515	2: IR< HS20, OR>=HS20
273	80170029502024	2 Wid 1969 5-8x7 T	Abilene	Borden	5	2	7	Medium Stiffness	2.5	10 Seal Coat or Surf. Tmt	0.575	2.516	1: IR>=HS20, OR> HS20
274	80170029503039	1 Org 1970 5-6x5 T	Abilene	Borden	4	1	7	Medium Stiffness	1.5	4 Thick ACP (>5in.)	0.753	2.223	1: IR>=HS20, OR> HS20
275	80300018102003	2 Wid 1959 5-8x7 T	Abilene	Callahan	5	2	6	Low Stiffness	1	5 Int. ACP (2.5-5in.)	0.605	1.530	2: IR< HS20, OR>=HS20
276	80300043703025	1 Org 1940 3-7x4 T	Abilene	Callahan	5	2	7	Low Stiffness	7.5	10 Seal Coat or Surf. Tmt	1.400	9.129	1: IR>=HS20, OR> HS20‡
277	80300210801006	1 Org 1958 2-10x8 T	Abilene	Callahan	3	2	7	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.562	1.197	2: IR< HS20, OR>=HS20‡
278	80770031701009	1 Org 1955 5-7x4 T	Abilene	Fisher	5	1	7	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.479	1.040	2: IR< HS20, OR>=HS20
279	80770237901004	1 Org 1964 2-7x6 T	Abilene	Fisher	3	1	7	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.618	1.247	2: IR< HS20, OR>=HS20
280	81050009807021	2 Wid 1970 3-8x8 T	Abilene	Haskell	5	2	7	Low Stiffness	2	10 Seal Coat or Surf. Tmt	0.671	1.963	1: IR>=HS20, OR> HS20

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TABLE B: Summary Load Rating Results for 1,000 Culvert Structures (Aggregated from Segment Rating Data)

No.	Structure No	Segment ID	District	County	Structure History Score	Number of Segments	Culvert Condition Rating	Soil Type	Critical Cover Soil Depth	Pavement	HS20 Level 1 ORF	HS20 Level 3 ORF	Level 3 Load Posting Class
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
281	81050036004019	1 Org 1939 5-6x6 T	Abilene	Haskell	5	1	6	Medium Stiffness	0.5	10 Seal Coat or Surf. Tmt	0.596	1.606	2: IR< HS20, OR>=HS20
282	81050036004020	1 Org 1939 4-5x5 T	Abilene	Haskell	5	1	6	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.739	1.547	2: IR< HS20, OR>=HS20
283	81050124701001	1 Org 1954 4-6x3 T	Abilene	Haskell	5	1	7	Medium Stiffness	0.5	10 Seal Coat or Surf. Tmt	0.512	0.961	3: IR< HS20, OR> HS10
284	81050151202002	1 Org 1957 3-8x4 T	Abilene	Haskell	5	1	7	Medium Stiffness	0.5	10 Seal Coat or Surf. Tmt	0.369	0.826	3: IR< HS20, OR> HS10
285	81150000505025	2 Wid 1954 5-6x6 T	Abilene	Howard	5	2	5	Medium Stiffness	3.5	10 Seal Coat or Surf. Tmt	1.312	4.227	1: IR>=HS20, OR> HS20
286	81150000505142	1 Org 1964 3-8x4 T	Abilene	Howard	5	2	6	Medium Stiffness	2.5	10 Seal Coat or Surf. Tmt	0.558	2.351	1: IR>=HS20, OR> HS20‡
287	81150000510158	1 Org 1963 3-5x4 T	Abilene	Howard	5	1	7	High Stiffness	2	5 Int. ACP (2.5-5in.)	1.215	3.113	1: IR>=HS20, OR> HS20
288	81150006901076	2 Wid 1969 4-6x3 T	Abilene	Howard	4	3	8	Medium Stiffness	1	4 Thick ACP (>5in.)	0.458	1.641	2: IR< HS20, OR>=HS20‡
289	81150069301021	1 Org 1969 5-7x3 T	Abilene	Howard	5	1	7	Medium Stiffness	2	10 Seal Coat or Surf. Tmt	0.597	1.662	2: IR< HS20, OR>=HS20
290	81280029604043	2 Wid 1970 6-5x2 T	Abilene	Jones	5	2	8	Medium Stiffness	2	10 Seal Coat or Surf. Tmt	0.807	2.219	1: IR>=HS20, OR> HS20
291	81280029605031	2 Wid 1949 5-8x8 T	Abilene	Jones	5	2	6	Medium Stiffness	1.5	10 Seal Coat or Surf. Tmt	0.540	1.329	2: IR< HS20, OR>=HS20
292	81280097207012	1 Org 1962 3-8x4 T	Abilene	Jones	5	1	6	Medium Stiffness	2	10 Seal Coat or Surf. Tmt	0.488	1.698	1: IR>=HS20, OR> HS20
293	81320201102002	1 Org 1955 2-10x10 T	Abilene	Kent	5	1	6	Medium Stiffness	2	10 Seal Coat or Surf. Tmt	0.452	2.046	1: IR>=HS20, OR> HS20
294	81680051802003	1 Org 1955 3-6x6 T	Abilene	Mitchell	5	1	7	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.627	1.235	2: IR< HS20, OR>=HS20
295	81680096603005	1 Org 1955 4-5x4 T	Abilene	Mitchell	5	1	7	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.622	1.425	2: IR< HS20, OR>=HS20
296	81770000603272	1 Org 1962 2-8x5 T	Abilene	Nolan	5	1	7	Medium Stiffness	0	10 Seal Coat or Surf. Tmt	0.641	0.880	3: IR< HS20, OR> HS10
297	82080005308014	1 Org 1978 3-9x9 T	Abilene	Scurry	4	1	7	Medium Stiffness	1	4 Thick ACP (>5in.)	0.875	2.807	1: IR>=HS20, OR> HS20
298	82080152603004	1 Org 1953 5-6x6 T	Abilene	Scurry	5	1	6	Medium Stiffness	2	10 Seal Coat or Surf. Tmt	0.780	1.813	1: IR>=HS20, OR> HS20
299	82090001104010	1 Org 1929 5-4x4 T	Abilene	Shackelford	4	3	7	Medium Stiffness	6	10 Seal Coat or Surf. Tmt	4.664	10.15	1: IR>=HS20, OR> HS20
300	82170003301001	1 Org 1932 2-10x10 T	Abilene	Stonewall	5	2	7	Medium Stiffness	1	6 Thin ACP (<2.5in.)	0.698	1.922	1: IR>=HS20, OR> HS20
301	82170010606038	1 Org 1934 3-8x8 T	Abilene	Stonewall	5	2	6	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.529	1.836	1: IR>=HS20, OR> HS20‡
302	82170036001023	1 Org 1941 4-5x2 T	Abilene	Stonewall	5	2	7	Low Stiffness	2	10 Seal Coat or Surf. Tmt	0.698	2.927	1: IR>=HS20, OR> HS20‡
303	82210000604085	2 Wid 1977 3-8x8 T	Abilene	Taylor	5	2	6	Low Stiffness	2	10 Seal Coat or Surf. Tmt	1.197	2.224	1: IR>=HS20, OR> HS20
304	82210000605222	1 Org 1961 17-7x3 T	Abilene	Taylor	5	1	7	Medium Stiffness	3	4 Thick ACP (>5in.)	0.791	3.491	1: IR>=HS20, OR> HS20
305	82210000606226	1 Org 1961 6-9x5 T	Abilene	Taylor	5	1	7	High Stiffness	1	10 Seal Coat or Surf. Tmt	0.522	1.001	2: IR< HS20, OR>=HS20
306	82210000606252	1 Org 1961 6-8x6 T	Abilene	Taylor	5	1	6	Low Stiffness	6.5	10 Seal Coat or Surf. Tmt	1.345	4.259	1: IR>=HS20, OR> HS20
307	82210000618032	5 Wid 1959 5-5x4.66 E	Abilene	Taylor	3	6	6	Medium Stiffness	0.5	5 Int. ACP (2.5-5in.)	0.651	1.588	2: IR< HS20, OR>=HS20^
308	82210003306062	1 Org 1959 5-8x5 T	Abilene	Taylor	5	2	7	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.550	1.111	2: IR< HS20, OR>=HS20‡
309	82210003306064	1 Org 1959 5-8x4 T	Abilene	Taylor	5	2	7	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.376	1.011	2: IR< HS20, OR>=HS20‡
310	82210005401003	1 Oth 1923 4-10x7 T	Abilene	Taylor	3	3	7						NLR†
311	82210065002005	1 Org 1946 4-5x2 T	Abilene	Taylor	5	2	7	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.633	1.954	1: IR>=HS20, OR> HS20‡
312	82210066303018	1 Org 1957 6-8x4 T	Abilene	Taylor	5	1	6	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.376	1.010	2: IR< HS20, OR>=HS20
313	82210067701003	1 Oth 1943 3-6x2 T	Abilene	Taylor	3	2	7						NLR†‡
314	82210067702008	1 Org 1960 4-6x3 T	Abilene	Taylor	5	2	7	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.506	1.216	2: IR< HS20, OR>=HS20‡
315	82210073303014	1 Org 1954 3-7x4 T	Abilene	Taylor	5	1	7	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.470	1.024	2: IR< HS20, OR>=HS20
316	82210203204007	1 Org 1959 4-5x2 T	Abilene	Taylor	5	2	7	Medium Stiffness	1	6 Thin ACP (<2.5in.)	0.564	1.516	2: IR< HS20, OR>=HS20
317	90140018402004	1 Org 1940 3-6x6 T	Waco	Bell	5	1	7	Low Stiffness	1	5 Int. ACP (2.5-5in.)	0.874	2.651	1: IR>=HS20, OR> HS20
318	90140083603014	1 Org 1965 5-10x8 T	Waco	Bell	5	2	7	Low Stiffness	1.5	5 Int. ACP (2.5-5in.)	0.606	1.757	1: IR>=HS20, OR> HS20‡
319	90140156501006	1 Org 1968 4-8x4 T	Waco	Bell	5	1	7	Low Stiffness	2	10 Seal Coat or Surf. Tmt	0.452	1.580	2: IR< HS20, OR>=HS20
320	90140203801002	1 Org 1955 4-8x6 T	Waco	Bell	5	1	7	Low Stiffness	1	10 Seal Coat or Surf. Tmt	0.582	1.147	2: IR< HS20, OR>=HS20

Key for Load Posting Class:
NLR - Not Load Rated, * - No Standard Design, ^ - Expansion Slab, † - Geometry Out-side Scope, ‡ - Post 1979 Construction

TABLE B: Summary Load Rating Results for 1,000 Culvert Structures (Aggregated from Segment Rating Data)

No.	Structure No	Segment ID	District	County	Structure History Score	Number of Segments	Culvert Condition Rating	Soil Type	Critical Cover Soil Depth	Pavement	HS20 Level 1 ORF	HS20 Level 3 ORF	Level 3 Load Posting Class
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
321	90140213601001	1 Org 1957 3-10x10 T	Waco	Bell	5	1	6	Low Stiffness	2	10 Seal Coat or Surf. Tmt	0.489	1.988	1: IR>=HS20, OR> HS20
322	90140260202004	1 Org 1961 6-7x7 T	Waco	Bell	5	1	7	Low Stiffness	1	10 Seal Coat or Surf. Tmt	0.594	1.255	2: IR< HS20, OR>=HS20
323	90180025805014	2 Wid 1968 3-10x10 T	Waco	Bosque	5	2	6	Low Stiffness	1.5	5 Int. ACP (2.5-5in.)	0.454	2.062	1: IR>=HS20, OR> HS20
324	90180025805048	2 Wid 1968 3-5x5 T	Waco	Bosque	5	2	7	Low Stiffness	1	5 Int. ACP (2.5-5in.)	0.647	1.076	2: IR< HS20, OR>=HS20
325	90180072402017	2 Wid 1961 5-6x5 T	Waco	Bosque	3	3	7	Low Stiffness	1	5 Int. ACP (2.5-5in.)	0.560	1.734	1: IR>=HS20, OR> HS20‡
326	90500005505022	2 Wid 1964 3-10x10 T	Waco	Coryell	5	3	7	Low Stiffness	2	5 Int. ACP (2.5-5in.)	0.489	2.327	1: IR>=HS20, OR> HS20‡
327	90500018401020	1 Org 1950 3-9x9 T	Waco	Coryell	5	1	6	Low Stiffness	2.5	5 Int. ACP (2.5-5in.)	0.490	0.517	3: IR< HS20, OR> HS10
328	90500023102029	2 Wid 1960 3-6x6 T	Waco	Coryell	3	2	6	Low Stiffness	2	5 Int. ACP (2.5-5in.)	1.018	2.417	1: IR>=HS20, OR> HS20†
329	90500086703015	1 Org 1958 3-9x5 T	Waco	Coryell	5	1	7	Low Stiffness	1	10 Seal Coat or Surf. Tmt	0.501	1.011	2: IR< HS20, OR>=HS20
330	90500192601004	2 Wid 1956 4-5x5 T	Waco	Coryell	5	2	6	Medium Stiffness	0.5	10 Seal Coat or Surf. Tmt	0.665	1.003	2: IR< HS20, OR>=HS20
331	90500213801002	1 Org 1930 6-3x3 T	Waco	Coryell	5	2	7	Low Stiffness	2	10 Seal Coat or Surf. Tmt	1.604	1.980	1: IR>=HS20, OR> HS20
332	90740038201022	1 Org 1957 3-9x8 T	Waco	Falls	5	1	6	Low Stiffness	2	5 Int. ACP (2.5-5in.)	0.621	2.086	1: IR>=HS20, OR> HS20
333	90740081902004	1 Org 1966 2-10x6 T	Waco	Falls	5	1	7	Low Stiffness	3	10 Seal Coat or Surf. Tmt	0.585	2.089	1: IR>=HS20, OR> HS20
334	90740217101002	1 Org 1957 3-10x6 T	Waco	Falls	5	1	7	Low Stiffness	1.5	5 Int. ACP (2.5-5in.)	0.509	1.404	2: IR< HS20, OR>=HS20
335	90740302801002	1 Org 1967 3-10x9 T	Waco	Falls	5	1	6	Low Stiffness	1.5	10 Seal Coat or Surf. Tmt	0.596	1.505	2: IR< HS20, OR>=HS20
336	90980012001014	1 Org 1947 3-6x5 T	Waco	Hamilton	5	1	7	High Stiffness	1	5 Int. ACP (2.5-5in.)	0.847	2.920	1: IR>=HS20, OR> HS20
337	90980025101053	1 Org 1958 2-10x10 T	Waco	Hamilton	5	1	6	High Stiffness	2.5	5 Int. ACP (2.5-5in.)	0.523	4.573	1: IR>=HS20, OR> HS20
338	90980025102046	1 Org 1942 3-6x4 T	Waco	Hamilton	5	1	6	Low Stiffness	1	5 Int. ACP (2.5-5in.)	0.752	2.602	1: IR>=HS20, OR> HS20
339	90980025102047	1 Org 1942 4-8x7 T	Waco	Hamilton	5	1	6	Low Stiffness	1	5 Int. ACP (2.5-5in.)	0.773	1.969	1: IR>=HS20, OR> HS20
340	90980077405004	1 Org 1954 4-6x4 T	Waco	Hamilton	5	1	6	High Stiffness	1	10 Seal Coat or Surf. Tmt	0.569	1.255	2: IR< HS20, OR>=HS20
341	90980077405005	1 Org 1954 6-8x4 T	Waco	Hamilton	5	1	6	High Stiffness	1	10 Seal Coat or Surf. Tmt	0.376	1.002	2: IR< HS20, OR>=HS20
342	90980178003004	1 Org 1965 3-10x7 T	Waco	Hamilton	5	1	7	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.530	1.005	2: IR< HS20, OR>=HS20
343	91100001424222	1 Org 2007 3-10x6 T	Waco	Hill	5	1	6						1: IR>=HS20, OR> HS20a‡
344	91100004806029	2 Wid 1964 3-8x7 T	Waco	Hill	5	3	7	Low Stiffness	2	5 Int. ACP (2.5-5in.)	0.690	2.318	1: IR>=HS20, OR> HS20‡
345	91100020906056	1 Org 1957 4-9x5 T	Waco	Hill	5	1	7	Low Stiffness	1	10 Seal Coat or Surf. Tmt	0.522	1.022	2: IR< HS20, OR>=HS20
346	91100166103007	1 Org 1958 4-6x5 T	Waco	Hill	5	1	8	Low Stiffness	2	10 Seal Coat or Surf. Tmt	0.985	1.998	1: IR>=HS20, OR> HS20
347	91100230502003	1 Org 1964 4-7x6 T	Waco	Hill	5	1	7	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.603	1.179	2: IR< HS20, OR>=HS20
348	91470005602044	2 Wid 1968 3-7x7 T	Waco	Limestone	5	2	7	Low Stiffness	4	5 Int. ACP (2.5-5in.)	1.074	1.250	2: IR< HS20, OR>=HS20
349	91470005701012	1 Org 1958 3-10x10 T	Waco	Limestone	5	1	6	Medium Stiffness	5	5 Int. ACP (2.5-5in.)	0.761	6.198	1: IR>=HS20, OR> HS20
350	91470009305065	1 Org 1960 4-7x4 T	Waco	Limestone	5	1	7	Low Stiffness	1.5	5 Int. ACP (2.5-5in.)	0.417	1.543	2: IR< HS20, OR>=HS20
351	91470041902008	2 Wid 1966 3-8x6 T	Waco	Limestone	5	2	7	Medium Stiffness	1	5 Int. ACP (2.5-5in.)	0.560	1.603	2: IR< HS20, OR>=HS20
352	91470083102015	1 Org 1961 4-6x6 T	Waco	Limestone	5	1	6	Low Stiffness	1	10 Seal Coat or Surf. Tmt	0.628	1.405	2: IR< HS20, OR>=HS20
353	91470089803008	1 Org 1957 3-10x7 T	Waco	Limestone	5	1	6	Medium Stiffness	2	10 Seal Coat or Surf. Tmt	0.615	1.894	1: IR>=HS20, OR> HS20
354	91610001408087	2 Wid 1959 3-6x6 T	Waco	McLennan	4	3	7	Low Stiffness	1.5	5 Int. ACP (2.5-5in.)	0.726	2.030	1: IR>=HS20, OR> HS20‡
355	91610001410321	1 Org 1960 12-3x3 T	Waco	McLennan	5	1	6	Medium Stiffness	1	5 Int. ACP (2.5-5in.)	0.661	2.085	1: IR>=HS20, OR> HS20
356	91610001502161	1 Org 1960 2-6x6 T	Waco	McLennan	5	2	7	Low Stiffness	1	5 Int. ACP (2.5-5in.)	0.652	1.859	1: IR>=HS20, OR> HS20‡
357	91610016201001	2 Wid 1955 7-3x3 T	Waco	McLennan	5	2	7	Medium Stiffness	0.5	5 Int. ACP (2.5-5in.)	0.534	1.628	2: IR< HS20, OR>=HS20
358	91610020907054	1 Org 1957 3-10x10 T	Waco	McLennan	5	2	6	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.367	1.206	2: IR< HS20, OR>=HS20‡
359	91610041301001	2 Wid 1964 3-8x8 T	Waco	McLennan	5	3	7	Low Stiffness	1.5	5 Int. ACP (2.5-5in.)	0.698	1.975	1: IR>=HS20, OR> HS20‡
360	91610083103010	1 Org 1956 3-10x6 T	Waco	McLennan	5	1	7	Medium Stiffness	2	10 Seal Coat or Surf. Tmt	0.507	1.486	2: IR< HS20, OR>=HS20

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NLR - Not Load Rated, * - No Standard Design, ^ - Expansion Slab, † - Geometry Out-side Scope, ‡ - Post 1979 Construction

TABLE B: Summary Load Rating Results for 1,000 Culvert Structures (Aggregated from Segment Rating Data)

No.	Structure No	Segment ID	District	County	Structure History Score	Number of Segments	Culvert Condition Rating	Soil Type	Critical Cover Soil Depth	Pavement	HS20 Level 1 ORF	HS20 Level 3 ORF	Level 3 Load Posting Class
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
361	91610118702003	1 Org 1951 3-8x8 T	Waco	McLennan	5	1	6	Low Stiffness	1.5	10 Seal Coat or Surf. Tmt	0.560	1.276	2: IR< HS20, OR>=HS20
362	91610230503005	1 Org 1964 4-9x5 T	Waco	McLennan	5	1	7	Low Stiffness	2	10 Seal Coat or Surf. Tmt	0.543	1.386	2: IR< HS20, OR>=HS20
363	91610250601002	1 Org 1961 2-8x5 T	Waco	McLennan	5	2	7	Low Stiffness	2	5 Int. ACP (2.5-5in.)	0.700	2.165	1: IR>=HS20, OR> HS20‡
364	91610267402002	1 Org 1963 3-7x4 T	Waco	McLennan	5	1	7	Low Stiffness	3	10 Seal Coat or Surf. Tmt	0.787	2.532	1: IR>=HS20, OR> HS20
365	91610303201001	1 Org 1969 3-10x7 T	Waco	McLennan	5	1	7	Low Stiffness	1	5 Int. ACP (2.5-5in.)	0.530	1.316	2: IR< HS20, OR>=HS20
366	91610323401002	1 Org 1972 3-7x5 T	Waco	McLennan	5	1	7	Low Stiffness	1.5	10 Seal Coat or Surf. Tmt	0.674	1.388	2: IR< HS20, OR>=HS20
367	91610323401005	1 Org 1972 3-10x10 T	Waco	McLennan	5	1	6	Low Stiffness	2.5	5 Int. ACP (2.5-5in.)	0.560	3.020	1: IR>=HS20, OR> HS20
368	100010089102004	1 Org 1954 2-10x8 T	Tyler	Anderson	5	1	7	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	1.175	1.145	2: IR< HS20, OR>=HS20
369	100370011805065	1 Org 1958 3-10x10 T	Tyler	Cherokee	5	1	6	Medium Stiffness	2	10 Seal Coat or Surf. Tmt	0.489	2.334	1: IR>=HS20, OR> HS20
370	100370020604010	2 Wid 1953 2-8x8 T	Tyler	Cherokee	4	2	6	Medium Stiffness	1.5	5 Int. ACP (2.5-5in.)	1.282	3.769	1: IR>=HS20, OR> HS20
371	100370037808024	1 Org 1970 4-7x3 T	Tyler	Cherokee	5	1	7	Medium Stiffness	2	10 Seal Coat or Surf. Tmt	0.597	1.682	1: IR>=HS20, OR> HS20
372	100370045001021	1 Org 1947 2-10x9 T	Tyler	Cherokee	5	1	7	Medium Stiffness	3	5 Int. ACP (2.5-5in.)	1.214	7.554	1: IR>=HS20, OR> HS20
373	100370192901001	1 Org 1954 3-10x10 T	Tyler	Cherokee	5	1	6	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	1.440	2.972	1: IR>=HS20, OR> HS20
374	100370274201001	1 Org 1964 5-10x10 T	Tyler	Cherokee	5	1	7	Medium Stiffness	2	10 Seal Coat or Surf. Tmt	0.455	2.311	1: IR>=HS20, OR> HS20
375	100930264201001	1 Org 1964 2-10x6 T	Tyler	Gregg	5	1	7	Medium Stiffness	6.5	5 Int. ACP (2.5-5in.)	1.542	5.612	1: IR>=HS20, OR> HS20
376	100930308201002	1 Org 1968 3-10x10 T	Tyler	Gregg	5	1	6	Medium Stiffness	4	5 Int. ACP (2.5-5in.)	0.716	6.746	1: IR>=HS20, OR> HS20
377	101080010803008	2 Wid 1968 2-10x8 T	Tyler	Henderson	5	2	7	Medium Stiffness	5	6 Thin ACP (<2.5in.)	1.625	4.878	1: IR>=HS20, OR> HS20
378	101080010803009	1 Org 1933 4-10x12 T	Tyler	Henderson	5	2	6						NLR*
379	101080016402006	2 Wid 1976 4-8x6 T	Tyler	Henderson	3	3	6	Medium Stiffness	2	10 Seal Coat or Surf. Tmt	0.478	1.891	1: IR>=HS20, OR> HS20*
380	101080016402009	2 Wid 1965 4-8x4 T	Tyler	Henderson	5	2	7	Medium Stiffness	0.5	10 Seal Coat or Surf. Tmt	0.385	0.834	3: IR< HS20, OR> HS10
381	101080016403033	1 Org 1965 5-8x6 T	Tyler	Henderson	5	1	7	Medium Stiffness	4	10 Seal Coat or Surf. Tmt	1.348	5.286	1: IR>=HS20, OR> HS20
382	101080089001003	1 Org 1948 3-8x7 T	Tyler	Henderson	5	1	6	Medium Stiffness	1.5	5 Int. ACP (2.5-5in.)	0.605	3.119	1: IR>=HS20, OR> HS20
383	102010012305014	1 Org 1932 3-10x10 T	Tyler	Rusk	5	1	7	Medium Stiffness	7	5 Int. ACP (2.5-5in.)	3.991	10.98	1: IR>=HS20, OR> HS20
384	102010013802011	1 Org 1968 3-10x9 T	Tyler	Rusk	5	2	7						NLR*‡
385	102010013809090	1 Org 1930 3-10x7 T	Tyler	Rusk	5	2	6	Medium Stiffness	2.5	10 Seal Coat or Surf. Tmt	0.075	0.041	6: IR< HS 3, OR< HS 3
386	102010020702016	1 Org 1936 4-6x5 T	Tyler	Rusk	5	2	7	Low Stiffness	1	5 Int. ACP (2.5-5in.)	0.693	2.557	1: IR>=HS20, OR> HS20‡
387	102010020703015	1 Org 1935 5-9x9 T	Tyler	Rusk	5	2	6	Low Stiffness	1	5 Int. ACP (2.5-5in.)	0.433	1.999	1: IR>=HS20, OR> HS20‡
388	102010042405023	1 Org 1966 2-10x8 T	Tyler	Rusk	5	1	7	Low Stiffness	1.5	10 Seal Coat or Surf. Tmt	0.618	1.469	2: IR< HS20, OR>=HS20
389	102010059202007	1 Org 1961 3-8x8 T	Tyler	Rusk	5	1	7	Low Stiffness	2	10 Seal Coat or Surf. Tmt	0.780	1.963	1: IR>=HS20, OR> HS20
390	102010059402015	1 Org 1959 3-10x10 T	Tyler	Rusk	5	2	6						NLR*
391	102010070602019	1 Org 1940 5-4x4 T	Tyler	Rusk	5	1	6	Low Stiffness	2	10 Seal Coat or Surf. Tmt	1.151	2.794	1: IR>=HS20, OR> HS20
392	102010193302001	1 Org 1963 2-10x8 T	Tyler	Rusk	5	1	6	Medium Stiffness	2	6 Thin ACP (<2.5in.)	0.647	2.224	1: IR>=HS20, OR> HS20
393	102010194001002	1 Org 1959 4-8x6 T	Tyler	Rusk	5	1	6	Low Stiffness	2	10 Seal Coat or Surf. Tmt	0.535	1.433	2: IR< HS20, OR>=HS20
394	102010215902013	1 Org 1958 3-8x8 T	Tyler	Rusk	5	1	7	Low Stiffness	6	10 Seal Coat or Surf. Tmt	1.439	3.096	1: IR>=HS20, OR> HS20
395	102010215903015	1 Org 1955 3-10x7 T	Tyler	Rusk	5	2	6	Low Stiffness	1	10 Seal Coat or Surf. Tmt	0.530	1.043	2: IR< HS20, OR>=HS20
396	102010323901001	1 Org 1976 3-8x7 T	Tyler	Rusk	5	1	7	Low Stiffness	1	10 Seal Coat or Surf. Tmt	0.381	0.660	3: IR< HS20, OR> HS10
397	102120024507022	1 Org 1925 2-10x10 T	Tyler	Smith	5	2	6	Medium Stiffness	4.5	8 Overlaid Concrete	2.939	9.441	1: IR>=HS20, OR> HS20
398	102120034501022	1 Org 1959 4-10x6 T	Tyler	Smith	5	2	7	Medium Stiffness	2	5 Int. ACP (2.5-5in.)	0.507	2.056	1: IR>=HS20, OR> HS20‡
399	102120042401029	1 Org 1960 2-10x7 T	Tyler	Smith	4	1	6	Medium Stiffness	2	5 Int. ACP (2.5-5in.)	0.783	3.084	1: IR>=HS20, OR> HS20
400	102120049505147	1 Org 1964 6-10x10 T	Tyler	Smith	5	1	7	Medium Stiffness	2	5 Int. ACP (2.5-5in.)	0.464	2.933	1: IR>=HS20, OR> HS20

Key for Load Posting Class:
NLR - Not Load Rated, * - No Standard Design, ^ - Expansion Slab, † - Geometry Out-side Scope, ‡ - Post 1979 Construction

TABLE B: Summary Load Rating Results for 1,000 Culvert Structures (Aggregated from Segment Rating Data)

No.	Structure No	Segment ID	District	County	Structure History Score	Number of Segments	Culvert Condition Rating	Soil Type	Critical Cover Soil Depth	Pavement	HS20 Level 1 ORF	HS20 Level 3 ORF	Level 3 Load Posting Class
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
401	102120049505168	1 Org 1964 2-10x10 T	Tyler	Smith	4	2	6						NLR*‡
402	102120049505170	1 Org 1964 2-10x10 T	Tyler	Smith	5	1	6	Medium Stiffness	2	1 CRCP	0.433	6.009	1: IR>=HS20, OR> HS20
403	102120049506237	1 Org 1966 2-10x8 T	Tyler	Smith	5	1	7	Medium Stiffness	2	10 Seal Coat or Surf. Tmt	0.664	2.028	1: IR>=HS20, OR> HS20
404	102120052204015	1 Org 1941 6-6x5 T	Tyler	Smith	5	2	7	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.861	1.916	1: IR>=HS20, OR> HS20‡
405	102120207502005	2 Wid 1967 5-10x10 J	Tyler	Smith	5	3	6	Medium Stiffness	2	5 Int. ACP (2.5-5in.)	0.455	2.978	1: IR>=HS20, OR> HS20†
406	102120295601001	1 Org 1966 4-7x6 T	Tyler	Smith	5	1	7	Medium Stiffness	2	10 Seal Coat or Surf. Tmt	0.603	1.767	1: IR>=HS20, OR> HS20
407	102340010802005	1 Org 1934 3-10x10 T	Tyler	Van Zandt	5	2	7	Medium Stiffness	1	5 Int. ACP (2.5-5in.)	0.472	2.396	1: IR>=HS20, OR> HS20‡
408	102340010802007	5 Wid 1970 2-10x10 E	Tyler	Van Zandt	5	6	6	Medium Stiffness	0	10 Seal Coat or Surf. Tmt	0.296	0.840	3: IR< HS20, OR> HS10^
409	102340044303019	1 Org 1971 3-8x7 T	Tyler	Van Zandt	5	1	6	Medium Stiffness	5	10 Seal Coat or Surf. Tmt	1.388	5.104	1: IR>=HS20, OR> HS20
410	102340049503074	1 Org 1962 5-10x10 T	Tyler	Van Zandt	5	1	6	Medium Stiffness	3	10 Seal Coat or Surf. Tmt	0.616	3.831	1: IR>=HS20, OR> HS20
411	102340049503075	1 Org 1962 5-10x7 T	Tyler	Van Zandt	5	1	6	Medium Stiffness	2	10 Seal Coat or Surf. Tmt	0.568	1.619	2: IR< HS20, OR>=HS20
412	102340049503085	1 Org 1962 2-10x8 T	Tyler	Van Zandt	5	3	6	Medium Stiffness	2.5	10 Seal Coat or Surf. Tmt	0.733	2.894	1: IR>=HS20, OR> HS20‡
413	102340167101004	1 Org 1965 5-10x6 T	Tyler	Van Zandt	5	1	7	Medium Stiffness	4.5	10 Seal Coat or Surf. Tmt	1.015	4.029	1: IR>=HS20, OR> HS20
414	102500008306049	1 Org 1955 5-8x7 T	Tyler	Wood	5	1	5	Medium Stiffness	1.5	5 Int. ACP (2.5-5in.)	0.677	1.910	1: IR>=HS20, OR> HS20
415	102500020305043	1 Org 1952 3-6x6 T	Tyler	Wood	5	2	7	Medium Stiffness	1	5 Int. ACP (2.5-5in.)	0.513	1.496	2: IR< HS20, OR>=HS20
416	102500064702008	1 Org 1957 3-7x4 T	Tyler	Wood	5	1	5	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.470	1.024	2: IR< HS20, OR>=HS20
417	102500139003006	1 Org 1951 4-5x5 T	Tyler	Wood	5	1	5	Medium Stiffness	0.5	10 Seal Coat or Surf. Tmt	0.537	0.832	3: IR< HS20, OR> HS10
418	110030017602063	2 Wid 1956 4-7x7 T	Lufkin	Angelina	4	2	7	Medium Stiffness	2	8 Overlaid Concrete	0.504	3.566	1: IR>=HS20, OR> HS20
419	110030211501001	1 Org 1957 4-7x4 T	Lufkin	Angelina	5	1	7	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.479	1.067	2: IR< HS20, OR>=HS20
420	111740070605014	1 Org 1959 3-10x8 T	Lufkin	Nacogdoches	5	1	6	Medium Stiffness	1.5	10 Seal Coat or Surf. Tmt	0.602	1.412	2: IR< HS20, OR>=HS20
421	111740230001003	1 Org 1959 4-10x10 T	Lufkin	Nacogdoches	5	1	7	Medium Stiffness	2	10 Seal Coat or Surf. Tmt	0.464	1.985	1: IR>=HS20, OR> HS20
422	111870017701088	1 Org 1963 5-5x3 T	Lufkin	Polk	5	1	5	Low Stiffness	2	9 Overlaid Flexible	1.038	2.686	1: IR>=HS20, OR> HS20
423	111870034103025	1 Org 1958 3-7x7 T	Lufkin	Polk	5	1	6	Medium Stiffness	2.5	9 Overlaid Flexible	0.625	2.744	1: IR>=HS20, OR> HS20
424	112030033607028	1 Org 1956 2-10x7 T	Lufkin	San Augustine	5	1	7	Medium Stiffness	1	5 Int. ACP (2.5-5in.)	0.552	1.467	2: IR< HS20, OR>=HS20
425	112030168001005	1 Org 1956 2-10x8 T	Lufkin	San Augustine	5	1	6	Medium Stiffness	2	10 Seal Coat or Surf. Tmt	0.664	2.028	1: IR>=HS20, OR> HS20
426	112040017702046	1 Org 1948 6-5x5 T	Lufkin	San Jacinto	3	2	6	Medium Stiffness	1	8 Overlaid Concrete	0.739	7.292	1: IR>=HS20, OR> HS20
427	112100030401079	1 Org 1978 3-10x10 T	Lufkin	Shelby	5	1	7	Low Stiffness	6	5 Int. ACP (2.5-5in.)	2.025	7.584	1: IR>=HS20, OR> HS20
428	112100074203016	1 Org 1975 4-8x4 T	Lufkin	Shelby	5	1	7	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.376	1.014	2: IR< HS20, OR>=HS20
429	112100074302004	1 Org 1947 3-8x7 T	Lufkin	Shelby	5	1	7	Low Stiffness	0.5	10 Seal Coat or Surf. Tmt	0.430	1.389	2: IR< HS20, OR>=HS20
430	112280207103002	1 Org 1957 4-7x6 T	Lufkin	Trinity	5	1	6	Medium Stiffness	1.5	10 Seal Coat or Surf. Tmt	0.678	1.485	2: IR< HS20, OR>=HS20
431	112280211701005	1 Org 1961 2-10x10 T	Lufkin	Trinity	5	1	7	Medium Stiffness	1.5	10 Seal Coat or Surf. Tmt	0.449	1.669	1: IR>=HS20, OR> HS20
432	120200018806013	2 Wid 1958 3-6x4 J	Houston	Brazoria	3	2	7	Medium Stiffness	2	9 Overlaid Flexible	0.779	2.658	1: IR>=HS20, OR> HS20
433	120200018806014	2 Wid 1958 6-6x4 T	Houston	Brazoria	5	3	6	Low Stiffness	2	1 CRCP	0.782	4.438	1: IR>=HS20, OR> HS20‡
434	120800002708053	2 Wid 1957 4-6x5 T	Houston	Fort Bend	4	2	7	Low Stiffness	1	5 Int. ACP (2.5-5in.)	0.640	1.743	1: IR>=HS20, OR> HS20
435	120800052708010	1 Org 1958 2-8x8 T	Houston	Fort Bend	5	1	6	Low Stiffness	1	5 Int. ACP (2.5-5in.)	0.652	1.779	1: IR>=HS20, OR> HS20
436	120800052708011	1 Org 1958 4-8x5 T	Houston	Fort Bend	5	1	6	Low Stiffness	2	5 Int. ACP (2.5-5in.)	0.672	2.120	1: IR>=HS20, OR> HS20
437	120800304801001	1 Org 1968 3-8x7 T	Houston	Fort Bend	5	1	7	Low Stiffness	2	5 Int. ACP (2.5-5in.)	0.703	2.193	1: IR>=HS20, OR> HS20
438	120850019204015	2 Wid 1964 2-10x8 T	Houston	Galveston	4	2	7	Medium Stiffness	1	5 Int. ACP (2.5-5in.)	0.562	1.715	1: IR>=HS20, OR> HS20†
439	120850019204017	2 Wid 1964 3-10x10 T	Houston	Galveston	5	2	6	Low Stiffness	1	5 Int. ACP (2.5-5in.)	0.367	1.733	1: IR>=HS20, OR> HS20†
440	120850019204021	2 Wid 1961 3-10x8 T	Houston	Galveston	5	2	5	Low Stiffness	1	5 Int. ACP (2.5-5in.)	0.550	1.522	2: IR< HS20, OR>=HS20†

Key for Load Posting Class:
NLR - Not Load Rated, * - No Standard Design, ^ - Expansion Slab, † - Geometry Out-side Scope, ‡ - Post 1979 Construction

TABLE B: Summary Load Rating Results for 1,000 Culvert Structures (Aggregated from Segment Rating Data)

No.	Structure No	Segment ID	District	County	Structure History Score	Number of Segments	Culvert Condition Rating	Soil Type	Critical Cover Soil Depth	Pavement	HS20 Level 1 ORF	HS20 Level 3 ORF	Level 3 Load Posting Class
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
441	120850050004322	1 Org 1948 3-5x3 T	Houston	Galveston	5	4	7						NLR*‡
442	121020005102007	2 Wid 1967 2-10x9 T	Houston	Harris	4	3	7	Low Stiffness	1	5 Int. ACP (2.5-5in.)	0.557	1.716	1: IR>=HS20, OR> HS20*‡
443	121020011101023	1 Org 1949 4-6x3 T	Houston	Harris	5	1	7	Low Stiffness	1	5 Int. ACP (2.5-5in.)	0.404	2.200	1: IR>=HS20, OR> HS20
444	121020027114403	1 Org 1960 3-15x15 T	Houston	Harris	5	4	7						NLR*
445	121020050003094	1 Org 1960 3-15x15 T	Houston	Harris	5	1	7						NLR*
446	121020050801027	1 Org 1950 4-5x5 T	Houston	Harris	5	1	6	Low Stiffness	1	8 Overlaid Concrete	0.518	4.118	1: IR>=HS20, OR> HS20
447	121020059801021	1 Org 1978 3-7x4 T	Houston	Harris	5	1	7	Low Stiffness	6	8 Overlaid Concrete	2.521	6.280	1: IR>=HS20, OR> HS20
448	121700011003006	4 Wid 1936 3-8x8 E	Houston	Montgomery	5	6	6	Medium Stiffness	1	5 Int. ACP (2.5-5in.)	0.529	2.509	1: IR>=HS20, OR> HS20^
449	121700305002002	1 Org 1977 5-6x4 T	Houston	Montgomery	5	1	6	Medium Stiffness	2.5	5 Int. ACP (2.5-5in.)	0.910	3.522	1: IR>=HS20, OR> HS20
450	130080027102221	1 Org 1966 5-6x5 T	Yoakum	Austin	5	1	7	Low Stiffness	1	8 Overlaid Concrete	0.654	5.120	1: IR>=HS20, OR> HS20
451	130080040802013	2 Wid 1971 2-10x10 T	Yoakum	Austin	5	2	6	Low Stiffness	2	6 Thin ACP (<2.5in.)	0.475	1.978	1: IR>=HS20, OR> HS20
452	130290014403031	2 Wid 1972 5-8x8 T	Yoakum	Calhoun	4	3	7	Low Stiffness	1	8 Overlaid Concrete	0.411	4.075	1: IR>=HS20, OR> HS20‡
453	130290014405041	1 Org 1949 3-6x5 T	Yoakum	Calhoun	5	3	7	Medium Stiffness	1	6 Thin ACP (<2.5in.)	0.505	1.251	2: IR< HS20, OR>=HS20‡
454	130290014405045	1 Org 1961 2-10x8 T	Yoakum	Calhoun	5	1	7	Low Stiffness	1.5	6 Thin ACP (<2.5in.)	0.618	1.654	2: IR< HS20, OR>=HS20
455	130290018001030	1 Org 1933 5-4x4 T	Yoakum	Calhoun	5	2	7	Low Stiffness	1	8 Overlaid Concrete	0.725	6.808	1: IR>=HS20, OR> HS20
456	130290051503013	1 Org 1960 2-10x10 T	Yoakum	Calhoun	5	1	7	Low Stiffness	0.5	8 Overlaid Concrete	0.376	5.306	1: IR>=HS20, OR> HS20
457	130290051503022	1 Org 1971 3-7x6 T	Yoakum	Calhoun	5	1	7	Low Stiffness	1	4 Thick ACP (>5in.)	0.608	1.583	2: IR< HS20, OR>=HS20
458	130450026604032	2 Wid 1958 5-5x5 O	Yoakum	Colorado	4	3	7	Low Stiffness	2.5	8 Overlaid Concrete	1.486	5.072	1: IR>=HS20, OR> HS20†
459	130450026608019	1 Org 1958 4-6x4 T	Yoakum	Colorado	3	2	7	Low Stiffness	1	6 Thin ACP (<2.5in.)	0.569	1.376	2: IR< HS20, OR>=HS20‡
460	130450027101175	1 Org 1938 3-8x7 T	Yoakum	Colorado	5	4	6	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.382	1.661	2: IR< HS20, OR>=HS20‡
461	130450044602026	1 Org 1950 5-7x6 T	Yoakum	Colorado	5	1	7	Low Stiffness	1	8 Overlaid Concrete	0.670	5.272	1: IR>=HS20, OR> HS20
462	130450053508037	2 Org 1967 3-8x6 T	Yoakum	Colorado	5	2	6	Medium Stiffness	7	8 Overlaid Concrete	1.214	4.957	1: IR>=HS20, OR> HS20*
463	130450168901002	1 Org 1955 4-10x8 T	Yoakum	Colorado	5	1	7	Low Stiffness	1	6 Thin ACP (<2.5in.)	1.178	3.327	1: IR>=HS20, OR> HS20
464	130620014308017	4 Wid 1958 1-10x8 E	Yoakum	DeWitt	5	6	6	Medium Stiffness	1.5	6 Thin ACP (<2.5in.)	0.703	1.792	1: IR>=HS20, OR> HS20*^
465	130620026906038	1 Org 1971 4-6x5 T	Yoakum	DeWitt	5	1	7	Low Stiffness	4.5	5 Int. ACP (2.5-5in.)	1.607	4.901	1: IR>=HS20, OR> HS20
466	130620071503021	1 Org 1952 2-10x8 T	Yoakum	DeWitt	5	2	7	Low Stiffness	2	6 Thin ACP (<2.5in.)	1.281	3.553	1: IR>=HS20, OR> HS20‡
467	130620071503022	1 Org 1952 3-10x6 T	Yoakum	DeWitt	5	2	7	Medium Stiffness	1	6 Thin ACP (<2.5in.)	0.407	0.879	3: IR< HS20, OR> HS10‡
468	130620084002011	1 Org 1954 6-10x10 T	Yoakum	DeWitt	5	1	7	Medium Stiffness	2	10 Seal Coat or Surf. Tmt	1.605	4.784	1: IR>=HS20, OR> HS20
469	130620111301009	1 Org 1959 3-7x3 T	Yoakum	DeWitt	5	1	6	Low Stiffness	1	10 Seal Coat or Surf. Tmt	0.422	1.012	2: IR< HS20, OR>=HS20
470	130760026702011	2 Wid 1960 3-8x6 T	Yoakum	Fayette	5	2	6	Low Stiffness	1	6 Thin ACP (<2.5in.)	0.560	1.341	2: IR< HS20, OR>=HS20†
471	130760040801020	1 Org 1962 3-10x6 T	Yoakum	Fayette	5	1	7	Medium Stiffness	2	6 Thin ACP (<2.5in.)	0.507	1.820	1: IR>=HS20, OR> HS20
472	130760251401002	1 Org 1961 3-10x10 T	Yoakum	Fayette	5	1	7	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.367	1.206	2: IR< HS20, OR>=HS20
473	130760318601001	1 Org 1969 4-7x4 T	Yoakum	Fayette	5	1	7	Low Stiffness	1	10 Seal Coat or Surf. Tmt	0.479	1.073	2: IR< HS20, OR>=HS20
474	130900002505071	1 Org 1949 3-8x8 T	Yoakum	Gonzales	5	1	7	Medium Stiffness	2	6 Thin ACP (<2.5in.)	0.825	3.080	1: IR>=HS20, OR> HS20
475	130900002506084	1 Org 1949 4-6x6 T	Yoakum	Gonzales	5	1	7	Medium Stiffness	1	6 Thin ACP (<2.5in.)	0.883	2.341	1: IR>=HS20, OR> HS20
476	130900002905023	1 Org 1932 4-8x8 T	Yoakum	Gonzales	5	1	7	Medium Stiffness	1	5 Int. ACP (2.5-5in.)	0.565	2.516	1: IR>=HS20, OR> HS20
477	130900053504086	1 Org 1970 5-6x3 T	Yoakum	Gonzales	5	1	7	Low Stiffness	6.5	10 Seal Coat or Surf. Tmt	1.619	5.485	1: IR>=HS20, OR> HS20
478	130900053505147	2 Org 1971 4-7x4 T	Yoakum	Gonzales	5	2	7	Low Stiffness	8.5	10 Seal Coat or Surf. Tmt	0.788	3.090	1: IR>=HS20, OR> HS20
479	130900068701001	1 Org 1940 4-10x12 T	Yoakum	Gonzales	5	1	7	Low Stiffness	1.5	10 Seal Coat or Surf. Tmt	0.441	0.289	4: IR>=HS 3, OR< HS10
480	130900071502012	1 Org 1951 17-9x5 T	Yoakum	Gonzales	3	2	7	Medium Stiffness	0.5	10 Seal Coat or Surf. Tmt	0.427	0.662	3: IR< HS20, OR> HS10

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TABLE B: Summary Load Rating Results for 1,000 Culvert Structures (Aggregated from Segment Rating Data)

No.	Structure No	Segment ID	District	County	Structure History Score	Number of Segments	Culvert Condition Rating	Soil Type	Critical Cover Soil Depth	Pavement	HS20 Level 1 ORF	HS20 Level 3 ORF	Level 3 Load Posting Class
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
481	130900071502018	1 Org 1951 3-8x7 T	Yoakum	Gonzales	5	1	7	Medium Stiffness	2	10 Seal Coat or Surf. Tmt	0.475	1.523	2: IR< HS20, OR>=HS20
482	130900144301007	1 Org 1963 4-5x2 T	Yoakum	Gonzales	5	1	7	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.564	1.290	2: IR< HS20, OR>=HS20
483	130900208001002	1 Org 1954 3-8x6 T	Yoakum	Gonzales	5	2	7	Medium Stiffness	2	6 Thin ACP (<2.5in.)	1.206	5.261	1: IR>=HS20, OR> HS20‡
484	131210008905153	1 Org 1972 4-10x10 T	Yoakum	Jackson	5	1	7	Low Stiffness	2.5	8 Overlaid Concrete	0.467	3.916	1: IR>=HS20, OR> HS20
485	131210008905162	1 Org 1972 3-7x3 T	Yoakum	Jackson	5	1	7						NLR*
486	131210008911012	2 Wid 1956 4-5x5 O	Yoakum	Jackson	4	3	7	Low Stiffness	2	8 Overlaid Concrete	1.275	5.018	1: IR>=HS20, OR> HS20†
487	131210042002004	1 Org 1933 6-4x4 T	Yoakum	Jackson	5	2	7	Low Stiffness	1	6 Thin ACP (<2.5in.)	0.725	2.028	1: IR>=HS20, OR> HS20
488	131430032403008	2 Wid 1973 2-10x8 T	Yoakum	Lavaca	5	2	7	Medium Stiffness	1	8 Overlaid Concrete	0.562	5.044	1: IR>=HS20, OR> HS20
489	131430037002022	1 Org 1950 4-8x8 T	Yoakum	Lavaca	5	2	7	Low Stiffness	1	5 Int. ACP (2.5-5in.)	0.785	1.901	1: IR>=HS20, OR> HS20‡
490	131430044502005	1 Org 1938 4-6x6 T	Yoakum	Lavaca	5	1	7	Medium Stiffness	1	5 Int. ACP (2.5-5in.)	0.737	2.788	1: IR>=HS20, OR> HS20
491	131430044502008	1 Org 1938 5-9x9 T	Yoakum	Lavaca	5	2	7	Medium Stiffness	1	5 Int. ACP (2.5-5in.)	0.433	2.359	1: IR>=HS20, OR> HS20‡
492	131430100703017	1 Org 1951 2-10x10 T	Yoakum	Lavaca	5	1	7	Low Stiffness	2	6 Thin ACP (<2.5in.)	1.599	3.498	1: IR>=HS20, OR> HS20
493	131430206304002	1 Org 1977 3-10x8 T	Yoakum	Lavaca	5	1	7	Low Stiffness	1	6 Thin ACP (<2.5in.)	0.858	2.127	1: IR>=HS20, OR> HS20
494	131430216801001	1 Org 1956 3-10x6 T	Yoakum	Lavaca	5	1	6	Low Stiffness	1	6 Thin ACP (<2.5in.)	0.509	1.086	2: IR< HS20, OR>=HS20
495	131580024102002	1 Org 1932 6-4x4 T	Yoakum	Matagorda	4	3	6	Low Stiffness	1	8 Overlaid Concrete	0.725	6.817	1: IR>=HS20, OR> HS20‡
496	131580084705008	1 Org 1951 4-6x5 T	Yoakum	Matagorda	5	1	7	Low Stiffness	2.5	10 Seal Coat or Surf. Tmt	0.867	2.081	1: IR>=HS20, OR> HS20
497	132350037004029	1 Org 1958 6-10x7 J	Yoakum	Victoria	5	2	7	Medium Stiffness	1	5 Int. ACP (2.5-5in.)	0.533	1.406	2: IR< HS20, OR>=HS20‡
498	132350043202013	2 Org 1963 2-8x8 J	Yoakum	Victoria	5	4	6	Medium Stiffness	1	4 Thick ACP (>5in.)	0.408	-0.903	6: IR< HS 3, OR< HS 3*‡
499	132350084001012	1 Org 1958 3-10x8 T	Yoakum	Victoria	5	1	7	Low Stiffness	1.5	6 Thin ACP (<2.5in.)	0.602	1.620	2: IR< HS20, OR>=HS20
500	132350084005018	1 Org 1976 4-5x2 T	Yoakum	Victoria	5	2	7	Medium Stiffness	1	6 Thin ACP (<2.5in.)	0.564	1.516	2: IR< HS20, OR>=HS20‡
501	132350113201003	1 Org 1955 2-10x9 T	Yoakum	Victoria	5	1	6	Low Stiffness	1	6 Thin ACP (<2.5in.)	0.557	1.477	2: IR< HS20, OR>=HS20
502	132410008906181	1 Org 1976 4-5x4 T	Yoakum	Wharton	5	1	7	Low Stiffness	4	5 Int. ACP (2.5-5in.)	0.689	4.845	1: IR>=HS20, OR> HS20
503	132410008910034	1 Org 1933 4-7x7 E	Yoakum	Wharton	5	4	6	Low Stiffness	1	5 Int. ACP (2.5-5in.)	0.496	1.943	1: IR>=HS20, OR> HS20^
504	132410008915026	1 Org 1928 4-8x5 J	Yoakum	Wharton	5	3	6	Low Stiffness	2	5 Int. ACP (2.5-5in.)	0.874	4.262	1: IR>=HS20, OR> HS20‡
505	132410042010011	1 Org 1960 3-10x10 T	Yoakum	Wharton	5	1	7	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.367	1.206	2: IR< HS20, OR>=HS20
506	132410083702006	1 Org 1966 3-10x8 T	Yoakum	Wharton	5	1	7	Low Stiffness	1	10 Seal Coat or Surf. Tmt	0.550	1.193	2: IR< HS20, OR>=HS20
507	132410083801016	1 Org 1961 4-8x7 T	Yoakum	Wharton	5	1	6	Low Stiffness	1	10 Seal Coat or Surf. Tmt	0.605	1.173	2: IR< HS20, OR>=HS20
508	132410281802002	1 Org 1965 3-7x4 T	Yoakum	Wharton	5	1	7	Low Stiffness	1	10 Seal Coat or Surf. Tmt	0.470	1.064	2: IR< HS20, OR>=HS20
509	132410317301003	1 Org 1971 3-9x5 T	Yoakum	Wharton	5	1	7	Low Stiffness	3	10 Seal Coat or Surf. Tmt	0.705	2.424	1: IR>=HS20, OR> HS20
510	140110047105054	1 Oth 1943 4-8x6 T	Austin	Bastrop	5	2	6						NLR†‡
511	140110209801001	1 Org 1955 3-8x8 T	Austin	Bastrop	5	3	7	Medium Stiffness	1.5	10 Seal Coat or Surf. Tmt	0.698	1.601	2: IR< HS20, OR>=HS20‡
512	140160025203026	1 Org 1962 6-10x6 T	Austin	Blanco	5	1	7	Low Stiffness	2	5 Int. ACP (2.5-5in.)	0.515	1.732	1: IR>=HS20, OR> HS20
513	140160095402003	1 Oth 1958 2-8.7x5.5 J	Austin	Blanco	5	3	6						NLR†
514	140270025107058	1 Org 1963 2-10x7 T	Austin	Burnet	5	1	7	Low Stiffness	7	10 Seal Coat or Surf. Tmt	1.463	3.410	1: IR>=HS20, OR> HS20
515	140270070001026	1 Org 1954 4-10x6 T	Austin	Burnet	5	2	7	High Stiffness	2	5 Int. ACP (2.5-5in.)	0.507	2.263	1: IR>=HS20, OR> HS20‡
516	140280011503014	1 Org 1956 3-10x6 T	Austin	Caldwell	5	1	6	Medium Stiffness	2	10 Seal Coat or Surf. Tmt	0.507	1.486	2: IR< HS20, OR>=HS20
517	140280028603010	1 Org 1930 4-5x5 T	Austin	Caldwell	5	2	6	Medium Stiffness	2.5	5 Int. ACP (2.5-5in.)	1.534	4.848	1: IR>=HS20, OR> HS20‡
518	140280038404010	1 Org 1950 2-9x6 T	Austin	Caldwell	5	1	6	Medium Stiffness	2.5	10 Seal Coat or Surf. Tmt	0.393	1.655	2: IR< HS20, OR>=HS20
519	140280080503005	1 Org 1953 4-10x10 T	Austin	Caldwell	5	2	7	Medium Stiffness	1	5 Int. ACP (2.5-5in.)	0.164	1.546	2: IR< HS20, OR>=HS20‡
520	140870011202005	2 Wid 1969 4-8x8 T	Austin	Gillespie	5	2	7	Low Stiffness	0.5	10 Seal Coat or Surf. Tmt	0.668	1.046	2: IR< HS20, OR>=HS20

Key for Load Posting Class:
NLR - Not Load Rated, * - No Standard Design, ^ - Expansion Slab, † - Geometry Out-side Scope, ‡ - Post 1979 Construction

TABLE B: Summary Load Rating Results for 1,000 Culvert Structures (Aggregated from Segment Rating Data)

No.	Structure No	Segment ID	District	County	Structure History Score	Number of Segments	Culvert Condition Rating	Soil Type	Critical Cover Soil Depth	Pavement	HS20 Level 1 ORF	HS20 Level 3 ORF	Level 3 Load Posting Class
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
521	140870029003011	2 Wid 1975 2-10x10 T	Austin	Gillespie	5	2	7	Medium Stiffness	1	5 Int. ACP (2.5-5in.)	0.369	1.991	1: IR>=HS20, OR> HS20
522	140870029101048	2 Wid 1959 5-8x8 T	Austin	Gillespie	5	2	7	Medium Stiffness	2	10 Seal Coat or Surf. Tmt	0.553	1.714	1: IR>=HS20, OR> HS20
523	141060001602037	3 Wid 1962 4-6x4 T	Austin	Hays	5	3	7	Low Stiffness	2	5 Int. ACP (2.5-5in.)	0.652	2.040	1: IR>=HS20, OR> HS20^
524	141060001602105	1 Org 1961 2-8x4 T	Austin	Hays	5	2	7	Low Stiffness	10.5	5 Int. ACP (2.5-5in.)	-0.540	4.599	1: IR>=HS20, OR> HS20‡
525	141060047102066	1 Oth 1944 4-9x6 T	Austin	Hays	5	2	7						NLR†‡
526	141440033405038	1 Org 1954 2-10x8 T	Austin	Lee	5	2	7	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.558	1.111	2: IR< HS20, OR>=HS20‡
527	141500015003005	2 Wid 1969 3-10x10 T	Austin	Llano	5	2	7	Medium Stiffness	0	5 Int. ACP (2.5-5in.)	0.296	0.984	3: IR< HS20, OR> HS10
528	141500015004023	1 Org 1939 2-7x7 T	Austin	Llano	5	1	7	High Stiffness	1	10 Seal Coat or Surf. Tmt	0.547	1.792	1: IR>=HS20, OR> HS20
529	141500028907028	1 Org 1934 4-6x3 T	Austin	Llano	5	2	7	High Stiffness	2	10 Seal Coat or Surf. Tmt	0.691	1.062	2: IR< HS20, OR>=HS20
530	141570007103054	2 Org 1965 8-7x4 T	Austin	Mason	5	2	7	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.684	2.318	1: IR>=HS20, OR> HS20†
531	141570007107023	1 Org 1947 4-6x6 E	Austin	Mason	5	2	7	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.982	1.907	1: IR>=HS20, OR> HS20^
532	141570015001018	1 Org 1939 4-6x4 T	Austin	Mason	5	1	7	Medium Stiffness	1	5 Int. ACP (2.5-5in.)	0.765	2.715	1: IR>=HS20, OR> HS20
533	141570015001033	1 Org 1946 3-7x6 T	Austin	Mason	5	1	7	High Stiffness	2	10 Seal Coat or Surf. Tmt	0.777	3.879	1: IR>=HS20, OR> HS20
534	141570352501002	1 Org 1977 3-8x6 T	Austin	Mason	5	1	7	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.859	1.704	1: IR>=HS20, OR> HS20
535	142270001510051	1 Org 1925 2-10x5 T	Austin	Travis	4	2	7	Low Stiffness	1	5 Int. ACP (2.5-5in.)	0.183	1.145	2: IR< HS20, OR>=HS20
536	142270011313051	5 Org 1959 3-9x5 T	Austin	Travis	5	5	7	Low Stiffness	4	5 Int. ACP (2.5-5in.)	1.435	4.171	1: IR>=HS20, OR> HS20
537	142270118601001	1 Org 1951 2-10x9 T	Austin	Travis	5	2	7	Medium Stiffness	1	5 Int. ACP (2.5-5in.)	0.444	1.496	2: IR< HS20, OR>=HS20
538	142270118601003	1 Org 1939 2-10x5 T	Austin	Travis	5	3	6	Low Stiffness	3	5 Int. ACP (2.5-5in.)	0.426	1.563	2: IR< HS20, OR>=HS20‡
539	142270313601038	1 Org 1975 4-10x10 T	Austin	Travis	5	1	7	Medium Stiffness	10	5 Int. ACP (2.5-5in.)	-0.050	-1.867	6: IR< HS 3, OR< HS 3
540	142270313601039	1 Org 1975 4-10x10 T	Austin	Travis	5	1	6	Medium Stiffness	9	5 Int. ACP (2.5-5in.)	0.578	0.295	4: IR>=HS 3, OR< HS10
541	142460001517043	1 Org 1934 4-4x4 T	Austin	Williamson	5	2	7	High Stiffness	1	5 Int. ACP (2.5-5in.)	0.725	2.911	1: IR>=HS20, OR> HS20
542	142460015103003	1 Org 1923 2-10x5 T	Austin	Williamson	5	2	7	High Stiffness	3.5	10 Seal Coat or Surf. Tmt	0.190	1.110	2: IR< HS20, OR>=HS20
543	142460015103004	1 Org 1923 2-10x4 T	Austin	Williamson	5	2	7	Low Stiffness	5	10 Seal Coat or Surf. Tmt	-0.319	0.323	4: IR>=HS 3, OR< HS10
544	142460015103006	1 Org 1923 2-10x5 J	Austin	Williamson	4	4	7	Low Stiffness	6.5	10 Seal Coat or Surf. Tmt	-0.988	-1.151	6: IR< HS 3, OR< HS 3‡
545	142460020401005	1 Org 1926 5-10x8 T	Austin	Williamson	1	6	6	Low Stiffness	2	5 Int. ACP (2.5-5in.)	0.447	-0.501	6: IR< HS 3, OR< HS 3†‡
546	142460032003034	1 Org 1940 4-6x4 T	Austin	Williamson	5	2	6	Low Stiffness	1	5 Int. ACP (2.5-5in.)	0.405	1.275	2: IR< HS20, OR>=HS20
547	142460033401001	3 Wid 1958 4-6x6 T	Austin	Williamson	4	3	5	Low Stiffness	1	10 Seal Coat or Surf. Tmt	0.588	1.405	2: IR< HS20, OR>=HS20
548	142460033702015	1 Org 1955 5-5x5 T	Austin	Williamson	4	2	7	Medium Stiffness	3	5 Int. ACP (2.5-5in.)	1.789	4.907	1: IR>=HS20, OR> HS20‡
549	142460098601007	2 Wid 1960 5-6x6 T	Austin	Williamson	5	2	5	Low Stiffness	4.5	10 Seal Coat or Surf. Tmt	1.495	4.314	1: IR>=HS20, OR> HS20
550	142460120102008	1 Org 1955 4-7x4 T	Austin	Williamson	5	2	7	Low Stiffness	5	10 Seal Coat or Surf. Tmt	1.001	3.190	1: IR>=HS20, OR> HS20‡
551	142460156602002	1 Org 1953 2-10x10 T	Austin	Williamson	5	2	7	Low Stiffness	0.5	10 Seal Coat or Surf. Tmt	0.150	0.786	3: IR< HS20, OR> HS10‡
552	142460203803009	1 Org 1965 2-10x8 J	Austin	Williamson	4	2	6	Low Stiffness	1	5 Int. ACP (2.5-5in.)	0.562	1.590	2: IR< HS20, OR>=HS20‡
553	142460269001003	1 Org 1964 2-10x6 J	Austin	Williamson	5	3	7	Low Stiffness	2	10 Seal Coat or Surf. Tmt	0.534	1.463	2: IR< HS20, OR>=HS20‡
554	150070007305029	5 Wid 1975 4-6x4 T	San Antonio	Atascosa	5	5	7	Medium Stiffness	2	10 Seal Coat or Surf. Tmt	-1.021	1.817	1: IR>=HS20, OR> HS20
555	150070007306175	1 Org 1976 5-9x5 T	San Antonio	Atascosa	5	1	7	Medium Stiffness	3	5 Int. ACP (2.5-5in.)	0.690	3.497	1: IR>=HS20, OR> HS20
556	150070032803246	1 Org 1979 4-9x5 T	San Antonio	Atascosa	5	1	6	Medium Stiffness	9	5 Int. ACP (2.5-5in.)	6.232	9.630	1: IR>=HS20, OR> HS20
557	150070042104012	1 Org 1947 7-6x6 T	San Antonio	Atascosa	5	2	7	Medium Stiffness	1	9 Overlaid Flexible	0.737	2.820	1: IR>=HS20, OR> HS20‡
558	150070051701047	1 Org 1954 3-9x8 T	San Antonio	Atascosa	5	1	7	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.563	1.207	2: IR< HS20, OR>=HS20
559	150070061302002	1 Org 1939 2-10x12 E	San Antonio	Atascosa	4	3	6	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	-0.525	1.022	2: IR< HS20, OR>=HS20^
560	150070085302001	2 Wid 1961 4-8x8 T	San Antonio	Atascosa	5	2	7	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.639	1.293	2: IR< HS20, OR>=HS20

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No.	Structure No	Segment ID	District	County	Structure History Score	Number of Segments	Culvert Condition Rating	Soil Type	Critical Cover Soil Depth	Pavement	HS20 Level 1 ORF	HS20 Level 3 ORF	Level 3 Load Posting Class
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
561	150070101102007	1 Org 1962 3-7x5 T	San Antonio	Atascosa	5	1	6	Medium Stiffness	0.5	10 Seal Coat or Surf. Tmt	0.625	0.927	3: IR< HS20, OR> HS10
562	150100042106032	1 Org 1963 2-10x10 T	San Antonio	Bandera	5	2	7	Low Stiffness	1	10 Seal Coat or Surf. Tmt	0.350	1.059	2: IR< HS20, OR>=HS20‡
563	150100042106035	2 Add 1976 3-10x6 J	San Antonio	Bandera	5	2	**7**	Low Stiffness	1	10 Seal Coat or Surf. Tmt	0.528	1.077	2: IR< HS20, OR>=HS20
564	150150001703102	1 Org 1955 5-10x10 T	San Antonio	Bexar	5	1	6	Medium Stiffness	0	10 Seal Coat or Surf. Tmt	0.272	0.801	3: IR< HS20, OR> HS10
565	150150001709032	2 Wid 1956 3-8x8 T	San Antonio	Bexar	5	3	6	Low Stiffness	2.5	5 Int. ACP (2.5-5in.)	0.604	2.459	1: IR>=HS20, OR> HS20
566	150150001709122	1 Org 1958 5-10x7 T	San Antonio	Bexar	5	1	7	Low Stiffness	0.5	4 Thick ACP (>5in.)	0.601	1.180	2: IR< HS20, OR>=HS20
567	150150001709303	1 Org 1974 3-10x10 T	San Antonio	Bexar	5	1	7	Medium Stiffness	0	5 Int. ACP (2.5-5in.)	0.296	0.984	3: IR< HS20, OR> HS10
568	150150001710172	1 Org 1962 4-5x3 T	San Antonio	Bexar	5	1	6	Low Stiffness	5	10 Seal Coat or Surf. Tmt	2.645	4.583	1: IR>=HS20, OR> HS20
569	150150002502181	1 Org 1968 3-8x8 T	San Antonio	Bexar	5	1	7	Low Stiffness	13.5	4 Thick ACP (>5in.)	4.718	5.604	1: IR>=HS20, OR> HS20
570	150150010002043	1 Org 1936 5-6x6 T	San Antonio	Bexar	5	1	6	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.883	4.799	1: IR>=HS20, OR> HS20
571	150150014301082	1 Org 1948 3-10x8 T	San Antonio	Bexar	5	1	6	Low Stiffness	4	4 Thick ACP (>5in.)	0.781	6.474	1: IR>=HS20, OR> HS20
572	150150029109089	1 Org 1976 3-6x3 T	San Antonio	Bexar	5	1	7	Low Stiffness	1.5	5 Int. ACP (2.5-5in.)	0.622	1.674	1: IR>=HS20, OR> HS20
573	150150029109096	1 Org 1979 2-9x5 T	San Antonio	Bexar	5	1	7	Medium Stiffness	3	5 Int. ACP (2.5-5in.)	1.805	4.790	1: IR>=HS20, OR> HS20
574	150150029109097	1 Org 1979 4-8x5 T	San Antonio	Bexar	5	1	7	High Stiffness	6.5	5 Int. ACP (2.5-5in.)	3.607	8.320	1: IR>=HS20, OR> HS20
575	150150029110081	3 Add 1972 4-5x2 J	San Antonio	Bexar	4	4	7	Low Stiffness	3	5 Int. ACP (2.5-5in.)	1.074	3.478	1: IR>=HS20, OR> HS20
576	150150046502002	1 Org 1961 2-10x6 T	San Antonio	Bexar	5	1	7	Low Stiffness	1	10 Seal Coat or Surf. Tmt	0.534	1.010	2: IR< HS20, OR>=HS20
577	150150052101005	2 Wid 1969 4-5x3 J	San Antonio	Bexar	5	3	7	Low Stiffness	1	4 Thick ACP (>5in.)	0.638	1.848	1: IR>=HS20, OR> HS20
578	150150052102100	1 Org 1962 2-10x10 J	San Antonio	Bexar	5	2	7	Low Stiffness	2	5 Int. ACP (2.5-5in.)	0.433	2.587	1: IR>=HS20, OR> HS20†
579	150150052102252	1 Org 1968 4-8x6 T	San Antonio	Bexar	4	1	6	Low Stiffness	5	4 Thick ACP (>5in.)	1.460	4.499	1: IR>=HS20, OR> HS20
580	150150052106111	1 Org 1964 16-5x2 T	San Antonio	Bexar	5	1	7	Low Stiffness	1	5 Int. ACP (2.5-5in.)	0.564	1.941	1: IR>=HS20, OR> HS20
581	150150143701001	2 Wid 1955 5-10x10 J	San Antonio	Bexar	4	5	6	Low Stiffness	1	5 Int. ACP (2.5-5in.)	0.343	1.697	1: IR>=HS20, OR> HS20‡
582	150150245202041	1 Org 1975 4-7x3 J	San Antonio	Bexar	4	5	7						NLR*†‡
583	150460025303054	1 Org 1978 8-6x4 T	San Antonio	Comal	5	1	7	High Stiffness	20	5 Int. ACP (2.5-5in.)	3.513	14.33	1: IR>=HS20, OR> HS20
584	150460085701006	1 Org 1968 2-9x5 J	San Antonio	Comal	5	3	7	High Stiffness	3	10 Seal Coat or Surf. Tmt	1.050	3.757	1: IR>=HS20, OR> HS20‡
585	150830001706302	2 Org 1973 3-5x3 T	San Antonio	Frio	5	2	7	Low Stiffness	2	5 Int. ACP (2.5-5in.)	0.604	1.415	2: IR< HS20, OR>=HS20
586	150830001707070	4 Add 1973 3-7x5 J	San Antonio	Frio	5	5	6	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.382	0.863	3: IR< HS20, OR> HS10^
587	150830001707265	1 Org 1973 4-8x4 T	San Antonio	Frio	5	1	7	Medium Stiffness	6	6 Thin ACP (<2.5in.)	1.408	7.827	1: IR>=HS20, OR> HS20
588	150830001716071	1 Org 1947 5-5x4 T	San Antonio	Frio	5	1	7	Medium Stiffness	1.5	10 Seal Coat or Surf. Tmt	0.884	2.430	1: IR>=HS20, OR> HS20
589	150830027607054	2 Wid 1971 4-5x3 T	San Antonio	Frio	5	2	7	Low Stiffness	2	9 Overlaid Flexible	1.038	2.664	1: IR>=HS20, OR> HS20
590	150830030106027	1 Org 1975 7-8x6 T	San Antonio	Frio	5	1	7	Low Stiffness	1	6 Thin ACP (<2.5in.)	0.594	1.323	2: IR< HS20, OR>=HS20
591	150830353601001	1 Org 1978 3-10x6 T	San Antonio	Frio	5	1	7	Medium Stiffness	2	10 Seal Coat or Surf. Tmt	0.911	2.472	1: IR>=HS20, OR> HS20
592	150950053502116	1 Org 1969 4-6x4 T	San Antonio	Guadalupe	5	1	7	Medium Stiffness	4	10 Seal Coat or Surf. Tmt	1.408	4.569	1: IR>=HS20, OR> HS20
593	150950085001001	1 Org 1948 6-6x4 T	San Antonio	Guadalupe	5	2	7	Low Stiffness	1	6 Thin ACP (<2.5in.)	0.460	1.464	2: IR< HS20, OR>=HS20‡
594	151310007205123	2 Org 1967 5-10x6 T	San Antonio	Kendall	5	2	7	Low Stiffness	7	10 Seal Coat or Surf. Tmt	4.486	14.93	1: IR>=HS20, OR> HS20
595	151330014205021	4 Wid 1953 8-8x8 T	San Antonio	Kerr	5	5	7	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.525	1.050	2: IR< HS20, OR>=HS20^‡
596	151330020108018	1 Org 1962 5-9x5 T	San Antonio	Kerr	5	1	7	Low Stiffness	1	10 Seal Coat or Surf. Tmt	0.522	1.012	2: IR< HS20, OR>=HS20
597	151620051703033	2 Wid 1959 4-6x3 T	San Antonio	McMullen	5	2	7	Medium Stiffness	2	10 Seal Coat or Surf. Tmt	0.459	2.028	1: IR>=HS20, OR> HS20
598	151620051703034	2 Wid 1959 4-6x4 T	San Antonio	McMullen	5	2	6	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.460	1.256	2: IR< HS20, OR>=HS20
599	151620051703035	1 Org 1948 5-7x4 E	San Antonio	McMullen	5	4	6	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.439	1.458	2: IR< HS20, OR>=HS20^
600	151630002405095	2 Wid 1978 6-10x8 T	San Antonio	Medina	5	3	7	Low Stiffness	1	10 Seal Coat or Surf. Tmt	0.852	1.717	1: IR>=HS20, OR> HS20‡

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(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
601	151630042108024	1 Org 1957 5-6x4 T	San Antonio	Medina	5	1	6	Low Stiffness	1	10 Seal Coat or Surf. Tmt	0.569	1.234	2: IR< HS20, OR>=HS20
602	151630059503003	1 Org 1968 3-10x6 T	San Antonio	Medina	5	1	7	Low Stiffness	1	10 Seal Coat or Surf. Tmt	0.509	0.965	3: IR< HS20, OR> HS10
603	151630059503008	1 Org 1968 2-10x10 T	San Antonio	Medina	5	1	6	Low Stiffness	0	10 Seal Coat or Surf. Tmt	0.312	0.839	3: IR< HS20, OR> HS10
604	152320002305032	2 Wid 1936 2-10x8 T	San Antonio	Uvalde	5	4	7	High Stiffness	2	5 Int. ACP (2.5-5in.)	0.985	4.884	1: IR>=HS20, OR> HS20‡
605	152470010004013	2 Wid 1952 3-8x8 T	San Antonio	Wilson	5	3	6	Medium Stiffness	2	10 Seal Coat or Surf. Tmt	0.611	1.722	1: IR>=HS20, OR> HS20‡
606	152470036604017	2 Wid 1956 3-8x8 T	San Antonio	Wilson	5	2	7	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.624	1.263	2: IR< HS20, OR>=HS20
607	152470036604018	2 Wid 1956 5-5x5 T	San Antonio	Wilson	5	2	7	Low Stiffness	1.5	10 Seal Coat or Surf. Tmt	0.722	1.681	1: IR>=HS20, OR> HS20
608	152470112204006	2 Wid 1970 4-6x4 T	San Antonio	Wilson	5	2	7	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.575	1.252	2: IR< HS20, OR>=HS20
609	160130010101024	2 Wid 1976 6-5x3 T	Corpus Christi	Bee	5	2	6	Medium Stiffness	2	5 Int. ACP (2.5-5in.)	0.716	2.983	1: IR>=HS20, OR> HS20
610	160130106301003	3 Wid 1968 3-7x4 E	Corpus Christi	Bee	5	4	7	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.374	1.047	2: IR< HS20, OR>=HS20^
611	160130106301011	3 Wid 1968 1-8.5x2 J	Corpus Christi	Bee	5	4	7	Medium Stiffness	2.5	10 Seal Coat or Surf. Tmt	0.243	1.602	2: IR< HS20, OR>=HS20*‡
612	160890051602011	1 Org 1947 4-6x4 T	Corpus Christi	Goliad	5	2	7	Low Stiffness	2	6 Thin ACP (<2.5in.)	1.026	3.410	1: IR>=HS20, OR> HS20‡
613	160890069102001	1 Org 1940 6-6x5 T	Corpus Christi	Goliad	5	1	6	Medium Stiffness	2	10 Seal Coat or Surf. Tmt	1.170	3.424	1: IR>=HS20, OR> HS20
614	160890069103010	1 Org 1951 4-6x6 T	Corpus Christi	Goliad	5	1	6	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.514	1.112	2: IR< HS20, OR>=HS20
615	160890327901002	1 Org 1969 5-6x6 T	Corpus Christi	Goliad	5	1	6	Medium Stiffness	1.5	10 Seal Coat or Surf. Tmt	0.728	1.701	1: IR>=HS20, OR> HS20
616	161260025502012	3 Wid 1962 6-5x5 T	Corpus Christi	Jim Wells	5	3	7	Medium Stiffness	1	5 Int. ACP (2.5-5in.)	0.647	2.014	1: IR>=HS20, OR> HS20
617	161260025502016	3 Wid 1962 3-6.5x3 T	Corpus Christi	Jim Wells	5	3	7	Medium Stiffness	1.5	5 Int. ACP (2.5-5in.)	0.534	1.811	1: IR>=HS20, OR> HS20
618	161290010006076	1 Org 1956 2-10x8 T	Corpus Christi	Karnes	5	1	7	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.562	1.197	2: IR< HS20, OR>=HS20
619	161290027007018	1 Org 1937 4-8x8 T	Corpus Christi	Karnes	5	2	7	Low Stiffness	1	6 Thin ACP (<2.5in.)	0.731	1.743	1: IR>=HS20, OR> HS20‡
620	161290034804012	2 Wid 1971 6-5x4 T	Corpus Christi	Karnes	5	2	6	Low Stiffness	1	10 Seal Coat or Surf. Tmt	0.635	1.385	2: IR< HS20, OR>=HS20
621	161290112101003	1 Org 1939 3-7x6 T	Corpus Christi	Karnes	5	1	6	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.448	1.898	1: IR>=HS20, OR> HS20
622	161290129402001	1 Org 1940 4-5x5 T	Corpus Christi	Karnes	5	2	5	Low Stiffness	1	10 Seal Coat or Surf. Tmt	0.739	1.501	2: IR< HS20, OR>=HS20‡
623	161490007401036	3 Wid 1957 5-9x8 T	Corpus Christi	Live Oak	5	3	7	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.416	1.235	2: IR< HS20, OR>=HS20^
624	161490044701006	2 Wid 1960 4-7x7 T	Corpus Christi	Live Oak	5	3	7	Low Stiffness	1	5 Int. ACP (2.5-5in.)	0.480	1.580	2: IR< HS20, OR>=HS20‡
625	161780010202004	1 Org 1924 1-10x5 J	Corpus Christi	Nueces	5	5	6	Low Stiffness	2	5 Int. ACP (2.5-5in.)	0.178	1.066	2: IR< HS20, OR>=HS20†
626	161780010202005	1 Org 1924 4-10x7 J	Corpus Christi	Nueces	3	5	6	Low Stiffness	2	5 Int. ACP (2.5-5in.)	0.478	0.450	4: IR>=HS 3, OR< HS10
627	161780010203038	2 Org 1955 4-5x4 T	Corpus Christi	Nueces	5	3	6	Low Stiffness	2	5 Int. ACP (2.5-5in.)	1.204	2.603	1: IR>=HS20, OR> HS20‡
628	161780010203053	1 Org 1964 4-6x3 T	Corpus Christi	Nueces	5	2	7	Medium Stiffness	3	10 Seal Coat or Surf. Tmt	1.033	3.372	1: IR>=HS20, OR> HS20‡
629	161780010211040	2 Add 1955 6-7x6 J	Corpus Christi	Nueces	4	4	6	Low Stiffness	1	5 Int. ACP (2.5-5in.)	0.590	1.502	2: IR< HS20, OR>=HS20
630	161780037301001	3 Wid 1973 8-4x4 O	Corpus Christi	Nueces	5	4	6	Low Stiffness	1	5 Int. ACP (2.5-5in.)	0.725	2.496	1: IR>=HS20, OR> HS20†
631	161780098902005	1 Org 1939 7-5x2 T	Corpus Christi	Nueces	5	3	8	Low Stiffness	1	5 Int. ACP (2.5-5in.)	0.565	2.179	1: IR>=HS20, OR> HS20‡
632	161780106901010	1 Org 1968 3-7x7 J	Corpus Christi	Nueces	5	6	7	Low Stiffness	1.5	5 Int. ACP (2.5-5in.)	0.674	1.765	1: IR>=HS20, OR> HS20*‡
633	161960015506031	1 Org 1965 6-7x3 T	Corpus Christi	Refugio	5	2	7	Medium Stiffness	1	5 Int. ACP (2.5-5in.)	0.425	1.365	2: IR< HS20, OR>=HS20‡
634	161960018002020	2 Wid 1953 9-4x4 T	Corpus Christi	Refugio	5	3	7	Low Stiffness	0.5	10 Seal Coat or Surf. Tmt	0.637	1.062	2: IR< HS20, OR>=HS20‡
635	161960034901004	3 Wid 1972 3-6.5x3 T	Corpus Christi	Refugio	4	3	7	Low Stiffness	2	10 Seal Coat or Surf. Tmt	0.785	1.675	1: IR>=HS20, OR> HS20
636	161960044705038	1 Org 1941 5-5x2 T	Corpus Christi	Refugio	5	1	6	Low Stiffness	1	10 Seal Coat or Surf. Tmt	0.565	1.857	1: IR>=HS20, OR> HS20
637	162050007405040	1 Org 1937 4-5x2 T	Corpus Christi	San Patricio	5	1	7	Medium Stiffness	2.5	10 Seal Coat or Surf. Tmt	0.918	4.570	1: IR>=HS20, OR> HS20
638	162050037201012	1 Org 1979 4-7x3 T	Corpus Christi	San Patricio	3	1	7	Medium Stiffness	1	5 Int. ACP (2.5-5in.)	0.425	2.147	1: IR>=HS20, OR> HS20
639	170210004912085	1 Org 1971 2-7x3 T	Bryan	Brazos	5	1	7	Low Stiffness	3	5 Int. ACP (2.5-5in.)	0.897	2.876	1: IR>=HS20, OR> HS20
640	170210047501097	1 Org 1974 3-8x5 T	Bryan	Brazos	5	2	7	Medium Stiffness	3	5 Int. ACP (2.5-5in.)	0.712	4.021	1: IR>=HS20, OR> HS20‡

Key for Load Posting Class:
NLR - Not Load Rated, * - No Standard Design, ^ - Expansion Slab, † - Geometry Out-side Scope, ‡ - Post 1979 Construction

TABLE B: Summary Load Rating Results for 1,000 Culvert Structures (Aggregated from Segment Rating Data)

No.	Structure No	Segment ID	District	County	Structure History Score	Number of Segments	Culvert Condition Rating	Soil Type	Critical Cover Soil Depth	Pavement	HS20 Level 1 ORF	HS20 Level 3 ORF	Level 3 Load Posting Class
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
641	170210285101004	1 Org 1975 3-6x5 T	Bryan	Brazos	5	1	7	Medium Stiffness	10.5	5 Int. ACP (2.5-5in.)	3.770	4.815	1: IR>=HS20, OR> HS20
642	170260011602026	2 Wid 1964 4-6x4 T	Bryan	Burleson	5	3	7	Low Stiffness	3.5	5 Int. ACP (2.5-5in.)	1.725	3.862	1: IR>=HS20, OR> HS20‡
643	170260018602031	2 Wid 1971 4-6x5 T	Bryan	Burleson	5	2	6	Medium Stiffness	1	5 Int. ACP (2.5-5in.)	0.649	1.761	1: IR>=HS20, OR> HS20
644	170260018603040	2 Wid 1965 3-8x7 T	Bryan	Burleson	5	3	6	Low Stiffness	2.5	5 Int. ACP (2.5-5in.)	0.742	2.675	1: IR>=HS20, OR> HS20‡
645	170260071301004	1 Org 1964 3-8x6 T	Bryan	Burleson	5	1	7	Low Stiffness	1	5 Int. ACP (2.5-5in.)	0.560	1.492	2: IR< HS20, OR>=HS20
646	170260311901001	1 Org 1968 3-6x6 T	Bryan	Burleson	5	2	7	Medium Stiffness	5.5	5 Int. ACP (2.5-5in.)	1.585	4.989	1: IR>=HS20, OR> HS20‡
647	170820067501182	1 Org 1971 2-7x6 T	Bryan	Freestone	5	1	6	Medium Stiffness	2	5 Int. ACP (2.5-5in.)	0.638	2.513	1: IR>=HS20, OR> HS20
648	170940021204009	1 Org 1951 4-5x3 T	Bryan	Grimes	5	3	7	Medium Stiffness	2	5 Int. ACP (2.5-5in.)	0.881	2.376	1: IR>=HS20, OR> HS20‡
649	170940031503061	1 Org 1962 3-8x8 T	Bryan	Grimes	5	1	7	Medium Stiffness	2	5 Int. ACP (2.5-5in.)	0.726	2.949	1: IR>=HS20, OR> HS20
650	170940072004031	1 Org 1959 5-5x5 T	Bryan	Grimes	5	1	7	Medium Stiffness	2	10 Seal Coat or Surf. Tmt	1.245	2.639	1: IR>=HS20, OR> HS20
651	170940233601005	1 Org 1958 6-6x6 T	Bryan	Grimes	5	1	6	Low Stiffness	2	10 Seal Coat or Surf. Tmt	1.027	2.055	1: IR>=HS20, OR> HS20
652	170940282701002	1 Org 1964 4-10x8 T	Bryan	Grimes	5	1	7	Low Stiffness	0.5	10 Seal Coat or Surf. Tmt	0.553	0.967	3: IR< HS20, OR> HS10
653	170940284901002	1 Org 1965 4-8x7 T	Bryan	Grimes	5	2	7	Low Stiffness	2	10 Seal Coat or Surf. Tmt	0.689	1.798	1: IR>=HS20, OR> HS20‡
654	171450033503012	1 Org 1944 4-10x10 T	Bryan	Leon	5	1	4	Medium Stiffness	1	5 Int. ACP (2.5-5in.)	0.803	2.431	1: IR>=HS20, OR> HS20
655	171450055201016	1 Org 1974 7-10x10 T	Bryan	Leon	5	1	6	Medium Stiffness	5	5 Int. ACP (2.5-5in.)	0.664	6.465	1: IR>=HS20, OR> HS20
656	171450067503140	1 Org 1969 6-9x5 T	Bryan	Leon	5	1	6	Medium Stiffness	1	5 Int. ACP (2.5-5in.)	0.522	1.387	2: IR< HS20, OR>=HS20
657	171450067504102	1 Org 1965 3-10x6 T	Bryan	Leon	5	1	7						NLR*
658	171450067504119	1 Org 1966 2-10x10 T	Bryan	Leon	5	1	6						NLR*
659	171450114701015	1 Org 1974 8-10x8 T	Bryan	Leon	5	1	6	Medium Stiffness	2	5 Int. ACP (2.5-5in.)	0.634	2.467	1: IR>=HS20, OR> HS20
660	171540011703017	2 Wid 1963 2-10x10 T	Bryan	Madison	5	2	6	Medium Stiffness	2	5 Int. ACP (2.5-5in.)	0.475	1.062	2: IR< HS20, OR>=HS20
661	171540011704023	2 Wid 1963 3-10x10 T	Bryan	Madison	5	3	5	Medium Stiffness	1	5 Int. ACP (2.5-5in.)	0.367	1.941	1: IR>=HS20, OR> HS20‡
662	171540011705031	2 Wid 1958 4-8x6 T	Bryan	Madison	4	3	6	Medium Stiffness	0.5	5 Int. ACP (2.5-5in.)	0.589	1.263	2: IR< HS20, OR>=HS20
663	171540055202010	1 Org 1951 2-8x8 T	Bryan	Madison	5	1	6	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	1.326	2.395	1: IR>=HS20, OR> HS20
664	171540055202011	1 Org 1951 2-8x8 T	Bryan	Madison	5	1	6	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	1.326	2.395	1: IR>=HS20, OR> HS20
665	171540057804017	1 Org 1968 4-9x5 T	Bryan	Madison	5	1	6	Medium Stiffness	2	10 Seal Coat or Surf. Tmt	0.574	1.646	2: IR< HS20, OR>=HS20
666	171540330301001	1 Org 1971 5-6x3 T	Bryan	Madison	5	1	7	Medium Stiffness	2	10 Seal Coat or Surf. Tmt	0.761	1.978	1: IR>=HS20, OR> HS20
667	171660021003012	1 Org 1964 2-10x6 T	Bryan	Milam	5	1	6	Medium Stiffness	0	10 Seal Coat or Surf. Tmt	0.576	0.803	3: IR< HS20, OR> HS10
668	171660026201038	1 Org 1956 6-10x7 T	Bryan	Milam	5	1	7	Low Stiffness	2	10 Seal Coat or Surf. Tmt	0.613	1.679	1: IR>=HS20, OR> HS20
669	171660026201046	1 Org 1957 3-10x7 T	Bryan	Milam	5	1	7	Low Stiffness	2	10 Seal Coat or Surf. Tmt	0.615	1.720	1: IR>=HS20, OR> HS20
670	171660033705006	1 Org 1951 4-6x5 T	Bryan	Milam	5	1	7	Low Stiffness	1.5	10 Seal Coat or Surf. Tmt	0.589	1.302	2: IR< HS20, OR>=HS20
671	171660085801009	1 Org 1960 11-8x4 T	Bryan	Milam	5	1	6	Low Stiffness	0.5	10 Seal Coat or Surf. Tmt	0.369	0.867	3: IR< HS20, OR> HS10
672	171980004907034	2 Wid 1970 4-6x6 T	Bryan	Robertson	3	3	7	Medium Stiffness	1	5 Int. ACP (2.5-5in.)	0.816	2.109	1: IR>=HS20, OR> HS20†
673	171980004907171	1 Org 1971 3-6x3 T	Bryan	Robertson	5	2	7	Low Stiffness	5	5 Int. ACP (2.5-5in.)	1.692	5.206	1: IR>=HS20, OR> HS20†
674	171980020409065	1 Org 1965 3-6x3 T	Bryan	Robertson	4	1	6	Low Stiffness	7.5	5 Int. ACP (2.5-5in.)	1.370	5.501	1: IR>=HS20, OR> HS20
675	171980202901003	1 Org 1962 3-8x5 T	Bryan	Robertson	5	1	6	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.519	1.107	2: IR< HS20, OR>=HS20
676	172360057802006	1 Org 1948 4-6x6 T	Bryan	Walker	5	3	7	Medium Stiffness	4	10 Seal Coat or Surf. Tmt	1.787	7.128	1: IR>=HS20, OR> HS20‡
677	172360067506046	1 Org 1962 2-10x10 T	Bryan	Walker	5	1	7	Medium Stiffness	9.5	5 Int. ACP (2.5-5in.)	0.735	0.284	4: IR>=HS 3, OR< HS10
678	172360067506047	1 Org 1962 2-10x6 T	Bryan	Walker	5	1	6	Low Stiffness	2	10 Seal Coat or Surf. Tmt	0.649	1.734	1: IR>=HS20, OR> HS20
679	172360067507022	1 Org 1961 2-10x7 T	Bryan	Walker	5	1	7	Medium Stiffness	8	5 Int. ACP (2.5-5in.)	1.206	3.275	1: IR>=HS20, OR> HS20
680	172360067507028	1 Org 1961 2-10x9 T	Bryan	Walker	5	1	6	Medium Stiffness	2	10 Seal Coat or Surf. Tmt	0.803	2.221	1: IR>=HS20, OR> HS20

Key for Load Posting Class:
NLR - Not Load Rated, * - No Standard Design, ^ - Expansion Slab, † - Geometry Out-side Scope, ‡ - Post 1979 Construction

TABLE B: Summary Load Rating Results for 1,000 Culvert Structures (Aggregated from Segment Rating Data)

No.	Structure No	Segment ID	District	County	Structure History Score	Number of Segments	Culvert Condition Rating	Soil Type	Critical Cover Soil Depth	Pavement	HS20 Level 1 ORF	HS20 Level 3 ORF	Level 3 Load Posting Class
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
681	172360075602001	1 Org 1950 4-6x6 T	Bryan	Walker	5	2	7	Low Stiffness	1	5 Int. ACP (2.5-5in.)	0.514	1.465	2: IR< HS20, OR>=HS20‡
682	172390305601004	1 Org 1971 4-8x8 T	Bryan	Washington	5	1	6	Medium Stiffness	3	10 Seal Coat or Surf. Tmt	0.726	3.468	1: IR>=HS20, OR> HS20
683	180430009104048	1 Org 1969 3-7x6 T	Dallas	Collin	5	1	7						NLR*
684	180430009105040	1 Org 1955 3-7x7 J	Dallas	Collin	5	3	7	Low Stiffness	1	3 JPCP	0.369	2.980	1: IR>=HS20, OR> HS20†‡
685	180430013502048	4 Wid 1971 3-10x8 E	Dallas	Collin	4	10	7	Low Stiffness	1.5	5 Int. ACP (2.5-5in.)	0.590	1.726	1: IR>=HS20, OR> HS20^‡
686	180430013512084	1 Org 1954 2-10x10 T	Dallas	Collin	5	1	7	Low Stiffness	2.5	5 Int. ACP (2.5-5in.)	0.571	2.386	1: IR>=HS20, OR> HS20
687	180430028002033	1 Org 1966 3-6x3 T	Dallas	Collin	5	1	7	Low Stiffness	2	6 Thin ACP (<2.5in.)	0.759	1.907	1: IR>=HS20, OR> HS20
688	180430101203015	1 Org 1951 4-5x5 T	Dallas	Collin	5	2	7	Low Stiffness	2	6 Thin ACP (<2.5in.)	0.987	2.129	1: IR>=HS20, OR> HS20‡
689	180570000903322	2 Org 1977 2-9x5 J	Dallas	Dallas	5	5	7	Low Stiffness	2	3 JPCP	0.948	4.772	1: IR>=HS20, OR> HS20‡
690	180570000911202	2 Org 1961 3-6x5 T	Dallas	Dallas	5	4	6	High Stiffness	8	3 JPCP	1.151	6.673	1: IR>=HS20, OR> HS20*‡
691	180570019603151	1 Org 1962 3-7x5 T	Dallas	Dallas	5	1	6	Medium Stiffness	4.5	8 Overlaid Concrete	1.617	6.569	1: IR>=HS20, OR> HS20
692	180570019603165	1 Org 1963 3-9x5 T	Dallas	Dallas	5	2	6	Low Stiffness	1	1 CRCP	0.430	3.940	1: IR>=HS20, OR> HS20
693	180570019702173	1 Org 1971 4-10x10 T	Dallas	Dallas	5	1	7	Low Stiffness	2.5	8 Overlaid Concrete	0.547	3.916	1: IR>=HS20, OR> HS20
694	180570035306087	1 Org 1968 6-7x3 T	Dallas	Dallas	5	1	7	Low Stiffness	3	1 CRCP	0.791	5.308	1: IR>=HS20, OR> HS20
695	180570043001006	1 Org 1923 3-10x4.5 T	Dallas	Dallas	4	2	6	Low Stiffness	2.5	8 Overlaid Concrete	0.419	2.225	1: IR>=HS20, OR> HS20
696	180570044202058	1 Org 1965 2-7x3 T	Dallas	Dallas	5	1	6	Low Stiffness	3	1 CRCP	0.917	3.792	1: IR>=HS20, OR> HS20
697	180570237401053	1 Oth 1967 4-9x9 T	Dallas	Dallas	5	1	6						NLR†
698	180570237402085	2 Org 1969 3-6x4 T	Dallas	Dallas	5	2	6	Low Stiffness	16.5	3 JPCP	-5.592	-216	6: IR< HS 3, OR< HS 3
699	180570237403191	1 Org 1971 4-6x4 T	Dallas	Dallas	5	1	7	Medium Stiffness	12	8 Overlaid Concrete	3.725	2.429	1: IR>=HS20, OR> HS20
700	180570300001002	7 Org 1974 10-5x5 T	Dallas	Dallas	5	10	7	Low Stiffness	47	3 JPCP	-1206.638	-34114	6: IR< HS 3, OR< HS 3*
701	180610008103039	1 Org 1942 5-7x7 T	Dallas	Denton	5	1	7	Low Stiffness	1	5 Int. ACP (2.5-5in.)	0.680	2.217	1: IR>=HS20, OR> HS20
702	180610008113109	1 Org 1969 2-8x8 T	Dallas	Denton	5	1	7	Low Stiffness	10	8 Overlaid Concrete	1.267	1.070	2: IR< HS20, OR>=HS20
703	180610019502094	1 Org 1958 5-9x9 T	Dallas	Denton	5	1	6	Low Stiffness	2	2 JRCP	0.761	2.665	1: IR>=HS20, OR> HS20
704	180610019601277	2 Wid 1970 1-10x6 J	Dallas	Denton	5	3	6	Low Stiffness	5.5	4 Thick ACP (>5in.)	0.009	5.496	1: IR>=HS20, OR> HS20†
705	180610081602045	1 Org 1956 2-10x8 T	Dallas	Denton	5	2	7	Low Stiffness	1	9 Overlaid Flexible	0.562	1.680	1: IR>=HS20, OR> HS20‡
706	180610156802001	1 Org 1953 3-8x5 T	Dallas	Denton	5	1	7	Medium Stiffness	1	5 Int. ACP (2.5-5in.)	0.435	1.242	2: IR< HS20, OR>=HS20
707	180610235202003	1 Org 1969 3-8x4 T	Dallas	Denton	5	1	7	Low Stiffness	1	3 JPCP	0.381	4.110	1: IR>=HS20, OR> HS20
708	180610297901003	1 Org 1970 3-10x10 T	Dallas	Denton	5	1	6	Medium Stiffness	1	9 Overlaid Flexible	0.367	2.078	1: IR>=HS20, OR> HS20
709	180610297901004	1 Org 1970 3-7x4 T	Dallas	Denton	5	1	7	Medium Stiffness	1	9 Overlaid Flexible	0.470	1.498	2: IR< HS20, OR>=HS20
710	180710004804035	1 Org 1957 3-9x5 T	Dallas	Ellis	5	1	7	Low Stiffness	1	6 Thin ACP (<2.5in.)	0.430	1.042	2: IR< HS20, OR>=HS20
711	180710009204149	1 Org 1957 5-6x5 T	Dallas	Ellis	5	1	6	Low Stiffness	1.5	1 CRCP	0.742	4.591	1: IR>=HS20, OR> HS20
712	180710009204150	1 Org 1957 5-6x5 T	Dallas	Ellis	5	1	5	Low Stiffness	1.5	1 CRCP	0.742	4.591	1: IR>=HS20, OR> HS20
713	180710017205093	1 Org 1971 5-7x3 T	Dallas	Ellis	5	1	7	Low Stiffness	1	10 Seal Coat or Surf. Tmt	0.425	1.018	2: IR< HS20, OR>=HS20
714	180710056801023	1 Org 1971 3-7x4 T	Dallas	Ellis	5	1	6	Medium Stiffness	19.5	9 Overlaid Flexible	9.523	6.505	1: IR>=HS20, OR> HS20
715	180710056801025	1 Org 1971 5-10x6 T	Dallas	Ellis	5	1	7	Low Stiffness	3.5	5 Int. ACP (2.5-5in.)	1.369	4.117	1: IR>=HS20, OR> HS20
716	180710074706029	1 Org 1957 4-6x3 T	Dallas	Ellis	5	2	7	Low Stiffness	3	9 Overlaid Flexible	1.033	3.371	1: IR>=HS20, OR> HS20‡
717	180710113901009	1 Org 1950 3-6x3 T	Dallas	Ellis	5	2	6	Low Stiffness	3	10 Seal Coat or Surf. Tmt	0.620	2.922	1: IR>=HS20, OR> HS20‡
718	180710226401002	1 Org 1957 4-6x3 T	Dallas	Ellis	5	1	7	Low Stiffness	2	10 Seal Coat or Surf. Tmt	0.691	1.787	1: IR>=HS20, OR> HS20
719	181300017304057	1 Org 1954 4-6x3 T	Dallas	Kaufman	4	4	7	Medium Stiffness	2	3 JPCP	0.686	4.486	1: IR>=HS20, OR> HS20
720	181300017305070	1 Org 1957 4-9x5 T	Dallas	Kaufman	5	2	7	Low Stiffness	4.5	4 Thick ACP (>5in.)	0.693	3.627	1: IR>=HS20, OR> HS20‡

Key for Load Posting Class:
NLR - Not Load Rated, * - No Standard Design, ^ - Expansion Slab, † - Geometry Out-side Scope, ‡ - Post 1979 Construction

TABLE B: Summary Load Rating Results for 1,000 Culvert Structures (Aggregated from Segment Rating Data)

No.	Structure No	Segment ID	District	County	Structure History Score	Number of Segments	Culvert Condition Rating	Soil Type	Critical Cover Soil Depth	Pavement	HS20 Level 1 ORF	HS20 Level 3 ORF	Level 3 Load Posting Class
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
721	181300019704088	2 Org 1937 4-7x6 E	Dallas	Kaufman	5	7	7	Low Stiffness	1	8 Overlaid Concrete	0.448	5.662	1: IR>=HS20, OR> HS20^‡
722	181300044302017	1 Org 1962 3-8x5 T	Dallas	Kaufman	5	1	7	Medium Stiffness	1	5 Int. ACP (2.5-5in.)	0.519	1.540	2: IR< HS20, OR>=HS20
723	181300049501156	1 Org 1964 4-10x9 T	Dallas	Kaufman	5	1	6	Low Stiffness	1	8 Overlaid Concrete	0.547	3.948	1: IR>=HS20, OR> HS20
724	181300049501162	1 Org 1964 6-10x6 T	Dallas	Kaufman	5	1	6	Medium Stiffness	2	8 Overlaid Concrete	0.507	4.474	1: IR>=HS20, OR> HS20
725	181300075102027	1 Org 1971 3-7x7 T	Dallas	Kaufman	5	1	6	Low Stiffness	6	10 Seal Coat or Surf. Tmt	1.529	2.428	1: IR>=HS20, OR> HS20
726	181300121703010	1 Org 1961 3-10x7 T	Dallas	Kaufman	5	1	7	Medium Stiffness	2	10 Seal Coat or Surf. Tmt	0.570	1.628	2: IR< HS20, OR>=HS20
727	181300197502002	1 Org 1955 4-5x3 T	Dallas	Kaufman	5	1	6	Low Stiffness	1.5	10 Seal Coat or Surf. Tmt	0.730	1.599	2: IR< HS20, OR>=HS20
728	181750009301056	1 Org 1958 4-6x4 T	Dallas	Navarro	5	1	6	Low Stiffness	3	1 CRCP	1.177	5.359	1: IR>=HS20, OR> HS20
729	181750009301061	1 Org 1959 4-5x5 T	Dallas	Navarro	5	1	6	Medium Stiffness	0.5	10 Seal Coat or Surf. Tmt	0.647	1.003	2: IR< HS20, OR>=HS20
730	181750009302007	2 Wid 1966 2-10x10 T	Dallas	Navarro	3	2	7	Medium Stiffness	2	8 Overlaid Concrete	0.475	4.447	1: IR>=HS20, OR> HS20
731	181750099701002	1 Org 1948 6-6x4 T	Dallas	Navarro	5	3	7	Low Stiffness	1.5	10 Seal Coat or Surf. Tmt	0.574	1.092	2: IR< HS20, OR>=HS20‡
732	181750128801001	1 Org 1950 2-10x8 T	Dallas	Navarro	5	2	7	Low Stiffness	2.5	10 Seal Coat or Surf. Tmt	0.416	1.313	2: IR< HS20, OR>=HS20
733	181750166304006	1 Org 1955 3-8x5 T	Dallas	Navarro	5	2	6	Low Stiffness	2	9 Overlaid Flexible	0.631	2.196	1: IR>=HS20, OR> HS20‡
734	181750166304009	1 Org 1955 3-10x6 T	Dallas	Navarro	5	2	7	Low Stiffness	2	8 Overlaid Concrete	0.507	4.000	1: IR>=HS20, OR> HS20‡
735	181750184701002	1 Org 1948 4-6x6 T	Dallas	Navarro	5	1	6	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.588	1.879	1: IR>=HS20, OR> HS20
736	181990101501001	2 Wid 1964 4-6x6 T	Dallas	Rockwall	5	2	7	Low Stiffness	5	9 Overlaid Flexible	-8.630	-2.595	6: IR< HS 3, OR< HS 3
737	190190001013091	1 Org 1935 5-8x6 T	Atlanta	Bowie	5	1	6	Medium Stiffness	2.5	10 Seal Coat or Surf. Tmt	1.079	5.192	1: IR>=HS20, OR> HS20
738	190190001013149	1 Org 1947 3-7x6 T	Atlanta	Bowie	5	1	7	Low Stiffness	2	10 Seal Coat or Surf. Tmt	0.777	2.937	1: IR>=HS20, OR> HS20
739	190190008502013	1 Org 1931 2-10x8 T	Atlanta	Bowie	3	1	5	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.952	2.501	1: IR>=HS20, OR> HS20
740	190190008502032	1 Org 1962 3-10x10 T	Atlanta	Bowie	5	1	7	Medium Stiffness	2	5 Int. ACP (2.5-5in.)	0.489	3.002	1: IR>=HS20, OR> HS20
741	190190061005171	1 Org 1971 6-10x10 T	Atlanta	Bowie	5	1	6	Medium Stiffness	2	8 Overlaid Concrete	0.467	5.910	1: IR>=HS20, OR> HS20
742	190190061006116	1 Org 1967 3-6x6 T	Atlanta	Bowie	5	3	6	Low Stiffness	2.5	8 Overlaid Concrete	1.153	3.620	1: IR>=HS20, OR> HS20‡
743	190190061007067	1 Org 1964 3-8x6 T	Atlanta	Bowie	5	2	7	Medium Stiffness	3	5 Int. ACP (2.5-5in.)	0.663	4.019	1: IR>=HS20, OR> HS20‡
744	190190061007083	1 Org 1965 3-8x4 T	Atlanta	Bowie	5	1	7	Medium Stiffness	1	8 Overlaid Concrete	0.360	5.039	1: IR>=HS20, OR> HS20
745	190190061007088	1 Org 1965 3-8x8 T	Atlanta	Bowie	5	1	7	Medium Stiffness	9.5	8 Overlaid Concrete	-0.155	-13.54	6: IR< HS 3, OR< HS 3
746	190190094501007	1 Org 1970 3-6x4 T	Atlanta	Bowie	5	1	6	High Stiffness	2.5	5 Int. ACP (2.5-5in.)	0.992	3.650	1: IR>=HS20, OR> HS20
747	190190121501002	1 Org 1952 3-8x6 T	Atlanta	Bowie	5	1	7	Low Stiffness	2	10 Seal Coat or Surf. Tmt	0.500	1.384	2: IR< HS20, OR>=HS20
748	190190121502004	1 Org 1953 3-10x8 T	Atlanta	Bowie	5	1	7	Low Stiffness	2	10 Seal Coat or Surf. Tmt	0.161	1.407	2: IR< HS20, OR>=HS20
749	190190198701003	1 Org 1958 4-10x10 T	Atlanta	Bowie	5	1	6	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.363	1.209	2: IR< HS20, OR>=HS20
750	190190242201001	1 Org 1960 3-10x10 T	Atlanta	Bowie	5	1	7	Medium Stiffness	2	10 Seal Coat or Surf. Tmt	0.489	2.334	1: IR>=HS20, OR> HS20
751	190190252601001	2 Wid 1975 3-7x5 T	Atlanta	Bowie	5	2	7	Medium Stiffness	2	10 Seal Coat or Surf. Tmt	0.618	1.666	2: IR< HS20, OR>=HS20
752	190190277201001	1 Org 1963 3-8x4 T	Atlanta	Bowie	5	1	6	Medium Stiffness	1.5	10 Seal Coat or Surf. Tmt	0.413	1.144	2: IR< HS20, OR>=HS20
753	190320101902004	1 Org 1951 5-10x10 T	Atlanta	Camp	5	1	7	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.164	0.933	3: IR< HS20, OR> HS10
754	190340021803031	1 Org 1947 5-8x7 T	Atlanta	Cass	5	2	6	Medium Stiffness	2	6 Thin ACP (<2.5in.)	0.841	3.074	1: IR>=HS20, OR> HS20‡
755	190340027702018	1 Org 1974 2-10x7 T	Atlanta	Cass	5	1	7	Medium Stiffness	2	10 Seal Coat or Surf. Tmt	0.587	1.709	1: IR>=HS20, OR> HS20
756	190340027703003	1 Org 1935 2-10x8 T	Atlanta	Cass	5	2	7	Low Stiffness	1	10 Seal Coat or Surf. Tmt	0.952	2.477	1: IR>=HS20, OR> HS20‡
757	190340054609015	1 Org 1959 3-7x5 T	Atlanta	Cass	5	1	6	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.600	1.163	2: IR< HS20, OR>=HS20
758	190340054609019	1 Org 1968 4-10x9 T	Atlanta	Cass	5	1	6	Medium Stiffness	0.5	10 Seal Coat or Surf. Tmt	0.547	0.939	3: IR< HS20, OR> HS10
759	190340081201006	1 Org 1968 5-9x8 T	Atlanta	Cass	5	1	6	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.578	1.235	2: IR< HS20, OR>=HS20
760	190340121601002	1 Org 1950 4-8x6 T	Atlanta	Cass	5	1	6	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.479	0.907	3: IR< HS20, OR> HS10

Key for Load Posting Class:
NLR - Not Load Rated, * - No Standard Design, ^ - Expansion Slab, † - Geometry Out-side Scope, ‡ - Post 1979 Construction

TABLE B: Summary Load Rating Results for 1,000 Culvert Structures (Aggregated from Segment Rating Data)

No.	Structure No	Segment ID	District	County	Structure History Score	Number of Segments	Culvert Condition Rating	Soil Type	Critical Cover Soil Depth	Pavement	HS20 Level 1 ORF	HS20 Level 3 ORF	Level 3 Load Posting Class
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
761	190340157301005	1 Org 1952 3-8x6 T	Atlanta	Cass	5	1	6	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.460	0.903	3: IR< HS20, OR> HS10
762	190340157402003	1 Org 1953 6-8x7 T	Atlanta	Cass	5	1	6	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.491	0.930	3: IR< HS20, OR> HS10
763	190340157402004	1 Org 1955 4-10x8 T	Atlanta	Cass	5	1	5	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.553	1.146	2: IR< HS20, OR>=HS20
764	190340277302003	1 Org 1967 7-10x8 T	Atlanta	Cass	5	1	7	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.547	1.135	2: IR< HS20, OR>=HS20
765	190340291901001	1 Org 1965 4-8x5 T	Atlanta	Cass	5	1	5	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.550	1.114	2: IR< HS20, OR>=HS20
766	190340319501001	1 Org 1971 2-10x9 T	Atlanta	Cass	5	1	6	Low Stiffness	1.5	6 Thin ACP (<2.5in.)	0.612	1.780	1: IR>=HS20, OR> HS20
767	191030013813065	1 Org 1957 4-6x6 T	Atlanta	Harrison	5	1	7	Medium Stiffness	4	6 Thin ACP (<2.5in.)	1.795	4.132	1: IR>=HS20, OR> HS20
768	191030049508247	1 Org 1965 3-8x8 T	Atlanta	Harrison	5	1	7	Medium Stiffness	2	8 Overlaid Concrete	0.549	5.226	1: IR>=HS20, OR> HS20
769	191030049510131	1 Org 1965 4-7x7 T	Atlanta	Harrison	5	1	7	Medium Stiffness	3	5 Int. ACP (2.5-5in.)	0.798	2.628	1: IR>=HS20, OR> HS20
770	191030064001002	1 Org 1942 3-8x8 T	Atlanta	Harrison	5	1	7	Medium Stiffness	2	5 Int. ACP (2.5-5in.)	0.825	3.516	1: IR>=HS20, OR> HS20
771	191030288001001	1 Org 1966 4-9x9 T	Atlanta	Harrison	5	2	7	Low Stiffness	3	6 Thin ACP (<2.5in.)	0.816	1.877	1: IR>=HS20, OR> HS20‡
772	191550006206027	1 Org 1953 4-7x6 T	Atlanta	Marion	5	2	6	Medium Stiffness	1	5 Int. ACP (2.5-5in.)	0.479	1.306	2: IR< HS20, OR>=HS20‡
773	191720008501001	1 Org 1932 3-10x10 T	Atlanta	Morris	5	2	7	Medium Stiffness	2	10 Seal Coat or Surf. Tmt	1.302	3.943	1: IR>=HS20, OR> HS20‡
774	191720022202040	1 Org 1962 3-10x9 T	Atlanta	Morris	5	1	6	Medium Stiffness	1.5	5 Int. ACP (2.5-5in.)	0.596	2.171	1: IR>=HS20, OR> HS20
775	191830039303028	1 Org 1950 4-6x5 T	Atlanta	Panola	5	1	7	Medium Stiffness	8.5	9 Overlaid Flexible	1.304	7.124	1: IR>=HS20, OR> HS20
776	191830039401001	1 Org 1933 5-5x5 T	Atlanta	Panola	5	1	6	Medium Stiffness	2	6 Thin ACP (<2.5in.)	1.306	3.187	1: IR>=HS20, OR> HS20
777	191830073102004	1 Org 1951 4-6x4 T	Atlanta	Panola	5	1	7	Medium Stiffness	0.5	6 Thin ACP (<2.5in.)	0.533	0.946	3: IR< HS20, OR> HS10
778	191830122201002	1 Org 1952 3-8x6 T	Atlanta	Panola	5	2	6	Medium Stiffness	0.5	6 Thin ACP (<2.5in.)	0.469	0.859	3: IR< HS20, OR> HS10‡
779	192250008309039	1 Org 1954 6-10x10 T	Atlanta	Titus	5	1	6	Medium Stiffness	1.5	10 Seal Coat or Surf. Tmt	0.425	1.402	2: IR< HS20, OR>=HS20
780	192250061003042	1 Org 1965 2-7x5 T	Atlanta	Titus	5	2	6	Low Stiffness	4	10 Seal Coat or Surf. Tmt	1.584	3.760	1: IR>=HS20, OR> HS20‡
781	192250061003044	1 Org 1965 3-8x7 T	Atlanta	Titus	5	1	6	Medium Stiffness	3	10 Seal Coat or Surf. Tmt	0.670	3.322	1: IR>=HS20, OR> HS20
782	192250061003061	1 Org 1965 3-10x10 T	Atlanta	Titus	4	3	7						NLR*‡
783	192250122603002	1 Org 1954 3-10x10 T	Atlanta	Titus	5	1	6	Medium Stiffness	2.5	10 Seal Coat or Surf. Tmt	0.528	2.808	1: IR>=HS20, OR> HS20
784	192300024805033	1 Org 1957 3-8x6 T	Atlanta	Upshur	5	1	7	Medium Stiffness	1	2 JRCP	1.075	9.502	1: IR>=HS20, OR> HS20
785	192300039202015	1 Org 1942 3-7x7 T	Atlanta	Upshur	5	2	7	Medium Stiffness	3	5 Int. ACP (2.5-5in.)	1.094	2.977	1: IR>=HS20, OR> HS20
786	192300040104010	1 Org 1948 5-7x7 T	Atlanta	Upshur	5	1	7	Medium Stiffness	2	6 Thin ACP (<2.5in.)	0.504	3.738	1: IR>=HS20, OR> HS20
787	192300040104011	1 Org 1948 3-10x10 T	Atlanta	Upshur	5	1	7	Medium Stiffness	2	5 Int. ACP (2.5-5in.)	1.020	4.132	1: IR>=HS20, OR> HS20
788	192300052002003	2 Wid 1964 3-10x9 T	Atlanta	Upshur	5	2	7	Medium Stiffness	1	6 Thin ACP (<2.5in.)	0.545	1.533	2: IR< HS20, OR>=HS20
789	192300138204004	1 Org 1952 3-7x6 T	Atlanta	Upshur	5	2	7	Medium Stiffness	1	6 Thin ACP (<2.5in.)	0.488	1.146	2: IR< HS20, OR>=HS20‡
790	192300176101002	1 Org 1945 2-10x10 T	Atlanta	Upshur	5	2	6	Medium Stiffness	2	6 Thin ACP (<2.5in.)	1.313	4.123	1: IR>=HS20, OR> HS20‡
791	192300176201002	1 Org 1953 3-7x5 T	Atlanta	Upshur	5	2	7	Medium Stiffness	2	6 Thin ACP (<2.5in.)	0.674	1.781	1: IR>=HS20, OR> HS20‡
792	192300203001002	1 Org 1955 3-9x7 T	Atlanta	Upshur	5	1	7	Medium Stiffness	1	6 Thin ACP (<2.5in.)	0.543	1.228	2: IR< HS20, OR>=HS20
793	200360038902031	2 Wid 1958 7-6x4 T	Beaumont	Chambers	4	4	8	Medium Stiffness	1	2 JRCP	0.569	4.505	1: IR>=HS20, OR> HS20‡
794	201010020009074	1 Org 1964 5-6x5 T	Beaumont	Hardin	5	1	6	Medium Stiffness	2	5 Int. ACP (2.5-5in.)	1.010	2.710	1: IR>=HS20, OR> HS20
795	201010070302006	1 Org 1939 10-4x4 T	Beaumont	Hardin	5	2	7	Medium Stiffness	1.5	5 Int. ACP (2.5-5in.)	0.834	3.403	1: IR>=HS20, OR> HS20
796	201010081303002	2 Wid 1962 4-5x3 T	Beaumont	Hardin	5	3	7	Medium Stiffness	1.5	5 Int. ACP (2.5-5in.)	0.608	2.278	1: IR>=HS20, OR> HS20‡
797	201010194702012	1 Org 1965 3-5x5 T	Beaumont	Hardin	5	1	7	Medium Stiffness	1.5	5 Int. ACP (2.5-5in.)	0.738	2.350	1: IR>=HS20, OR> HS20
798	201010275701001	1 Org 1968 5-8x8 T	Beaumont	Hardin	5	1	7	Medium Stiffness	2	5 Int. ACP (2.5-5in.)	0.808	2.782	1: IR>=HS20, OR> HS20
799	201220024402062	1 Org 1961 4-8x5 T	Beaumont	Jasper	5	1	6	Medium Stiffness	1	6 Thin ACP (<2.5in.)	0.550	1.363	2: IR< HS20, OR>=HS20
800	201220078501009	1 Org 1965 5-8x4 T	Beaumont	Jasper	5	1	6	Medium Stiffness	2.5	6 Thin ACP (<2.5in.)	0.520	2.613	1: IR>=HS20, OR> HS20

Key for Load Posting Class:
NLR - Not Load Rated, * - No Standard Design, ^ - Expansion Slab, † - Geometry Out-side Scope, ‡ - Post 1979 Construction

TABLE B: Summary Load Rating Results for 1,000 Culvert Structures (Aggregated from Segment Rating Data)

No.	Structure No	Segment ID	District	County	Structure History Score	Number of Segments	Culvert Condition Rating	Soil Type	Critical Cover Soil Depth	Pavement	HS20 Level 1 ORF	HS20 Level 3 ORF	Level 3 Load Posting Class
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
801	201220094703008	2 Wid 1955 4-5x3 T	Beaumont	Jasper	5	2	5	Medium Stiffness	3.5	5 Int. ACP (2.5-5in.)	2.261	5.061	1: IR>=HS20, OR> HS20†
802	201220212001002	1 Org 1958 4-7x3 T	Beaumont	Jasper	5	1	7	Medium Stiffness	1	6 Thin ACP (<2.5in.)	0.425	1.230	2: IR< HS20, OR>=HS20
803	201240020014066	1 Org 1960 4-6x6 T	Beaumont	Jefferson	5	1	7	Medium Stiffness	1.5	5 Int. ACP (2.5-5in.)	0.431	1.988	1: IR>=HS20, OR> HS20
804	201240036802021	1 Org 1937 5-5x5 T	Beaumont	Jefferson	5	2	6	Medium Stiffness	1	5 Int. ACP (2.5-5in.)	0.690	2.969	1: IR>=HS20, OR> HS20†
805	201240036802028	1 Org 1937 4-6x4 T	Beaumont	Jefferson	5	2	7	Low Stiffness	0.5	5 Int. ACP (2.5-5in.)	0.585	2.019	1: IR>=HS20, OR> HS20†
806	201240050804042	1 Org 1954 5-6x4 T	Beaumont	Jefferson	4	3	7	Low Stiffness	1	5 Int. ACP (2.5-5in.)	0.569	1.518	2: IR< HS20, OR>=HS20†‡
807	201240050804045	1 Org 1954 4-5x3 T	Beaumont	Jefferson	5	2	7	Medium Stiffness	2	5 Int. ACP (2.5-5in.)	1.038	2.922	1: IR>=HS20, OR> HS20‡
808	201460002804024	2 Wid 1959 5-8x6 T	Beaumont	Liberty	5	2	6	Low Stiffness	0.5	5 Int. ACP (2.5-5in.)	0.601	1.293	2: IR< HS20, OR>=HS20
809	201460095101007	1 Org 1968 3-6x6 T	Beaumont	Liberty	5	1	7	Medium Stiffness	3	5 Int. ACP (2.5-5in.)	1.472	4.182	1: IR>=HS20, OR> HS20
810	201760021403010	1 Org 1939 3-10x12 T	Beaumont	Newton	5	1	7	Medium Stiffness	0.5	6 Thin ACP (<2.5in.)	0.495	0.785	3: IR< HS20, OR> HS10
811	201760049902007	2 Wid 1971 7-5x2 T	Beaumont	Newton	5	2	7	Medium Stiffness	1	8 Overlaid Concrete	0.564	5.606	1: IR>=HS20, OR> HS20
812	201760062702002	1 Org 1940 5-6x6 T	Beaumont	Newton	5	1	7	Medium Stiffness	1	9 Overlaid Flexible	0.737	2.827	1: IR>=HS20, OR> HS20
813	201760127701001	1 Org 1951 4-10x8 T	Beaumont	Newton	5	2	5	Medium Stiffness	1	6 Thin ACP (<2.5in.)	1.178	2.815	1: IR>=HS20, OR> HS20‡
814	201760130001007	1 Org 1955 3-8x4 T	Beaumont	Newton	5	2	7	Medium Stiffness	1	6 Thin ACP (<2.5in.)	0.360	1.204	2: IR< HS20, OR>=HS20‡
815	201810078404003	1 Org 1951 3-9x5 T	Beaumont	Orange	5	2	8	Medium Stiffness	3	9 Overlaid Flexible	0.376	2.569	1: IR>=HS20, OR> HS20‡
816	201810088202003	1 Org 1954 4-7x4 T	Beaumont	Orange	5	2	6	Medium Stiffness	1	5 Int. ACP (2.5-5in.)	0.479	1.408	2: IR< HS20, OR>=HS20
817	202290020005016	1 Org 1932 6-8x8 T	Beaumont	Tyler	5	2	6	Low Stiffness	0.5	6 Thin ACP (<2.5in.)	1.144	2.078	1: IR>=HS20, OR> HS20‡
818	202290020005017	1 Org 1932 2-10x10 T	Beaumont	Tyler	4	3	6	Medium Stiffness	8.5	6 Thin ACP (<2.5in.)	2.899	8.080	1: IR>=HS20, OR> HS20‡
819	202290020008030	2 Wid 1975 7-6x6 T	Beaumont	Tyler	5	2	7	Medium Stiffness	1	8 Overlaid Concrete	0.650	5.570	1: IR>=HS20, OR> HS20
820	202290070301013	1 Org 1953 5-6x5 T	Beaumont	Tyler	5	2	6	Medium Stiffness	3	6 Thin ACP (<2.5in.)	1.075	3.321	1: IR>=HS20, OR> HS20
821	211090209401001	1 Org 1950 5-6x6 T	Pharr	Hidalgo	5	1	7	Medium Stiffness	1	5 Int. ACP (2.5-5in.)	0.514	1.525	2: IR< HS20, OR>=HS20
822	211250051706071	1 Org 1961 4-7x4 T	Pharr	Jim Hogg	5	1	7	Medium Stiffness	1	5 Int. ACP (2.5-5in.)	0.479	1.439	2: IR< HS20, OR>=HS20
823	211250051706073	1 Org 1961 5-8x4 T	Pharr	Jim Hogg	5	1	7	Medium Stiffness	4	5 Int. ACP (2.5-5in.)	0.871	4.628	1: IR>=HS20, OR> HS20
824	212140003806030	4 Wid 1958 8-8x4 T	Pharr	Starr	5	5	7	Medium Stiffness	1.5	5 Int. ACP (2.5-5in.)	0.432	1.704	1: IR>=HS20, OR> HS20^
825	212140003807069	1 Org 1924 3-3x2 J	Pharr	Starr	5	5	8	Medium Stiffness	1.5	5 Int. ACP (2.5-5in.)	0.656	1.917	1: IR>=HS20, OR> HS20‡
826	212530051707061	1 Org 1957 5-8x4 T	Pharr	Zapata	5	1	7	Medium Stiffness	0.5	5 Int. ACP (2.5-5in.)	0.385	1.130	2: IR< HS20, OR>=HS20
827	212530253001001	1 Org 1962 5-10x9 T	Pharr	Zapata	5	1	7	Medium Stiffness	1	6 Thin ACP (<2.5in.)	0.541	1.523	2: IR< HS20, OR>=HS20
828	212530309903003	1 Oth 1975 3-7x4 T	Pharr	Zapata	5	1	8						NLR†
829	220640003706064	1 Org 1958 6-10x8 T	Laredo	Dimmitt	5	1	6	Medium Stiffness	4.5	10 Seal Coat or Surf. Tmt	1.071	3.093	1: IR>=HS20, OR> HS20
830	220640023707049	1 Org 1972 3-7x4 T	Laredo	Dimmitt	5	1	7	Medium Stiffness	1.5	10 Seal Coat or Surf. Tmt	0.597	1.287	2: IR< HS20, OR>=HS20
831	220640030003021	1 Org 1963 5-6x4 T	Laredo	Dimmitt	5	1	7	Medium Stiffness	3	6 Thin ACP (<2.5in.)	1.177	3.820	1: IR>=HS20, OR> HS20
832	220640030101006	2 Wid 1953 5-6x6 T	Laredo	Dimmitt	5	2	6	Low Stiffness	1	10 Seal Coat or Surf. Tmt	0.514	1.128	2: IR< HS20, OR>=HS20
833	220640266001001	1 Org 1961 2-10x6 T	Laredo	Dimmitt	5	1	7	Low Stiffness	1	10 Seal Coat or Surf. Tmt	0.546	1.010	2: IR< HS20, OR>=HS20
834	220670023704027	1 Org 1954 4-5x4 T	Laredo	Duval	5	1	-999	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.622	1.425	2: IR< HS20, OR>=HS20
835	220670023705037	1 Org 1939 1-6x4 J	Laredo	Duval	5	3	7	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.360	0.734	3: IR< HS20, OR> HS10
836	220670023705042	1 Org 1959 4-10x9 T	Laredo	Duval	5	1	7	Medium Stiffness	0.5	10 Seal Coat or Surf. Tmt	0.584	0.939	3: IR< HS20, OR> HS10
837	220670051708082	1 Org 1964 4-10x6 T	Laredo	Duval	5	2	7	Low Stiffness	0.5	10 Seal Coat or Surf. Tmt	0.544	0.855	3: IR< HS20, OR> HS10‡
838	220670051708087	1 Org 1964 3-10x7 T	Laredo	Duval	5	1	7	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.530	1.005	2: IR< HS20, OR>=HS20
839	220670051709088	1 Org 1964 3-7x4 T	Laredo	Duval	5	2	7	Medium Stiffness	0.5	10 Seal Coat or Surf. Tmt	0.480	0.843	3: IR< HS20, OR> HS10‡
840	220670054203018	6 Wid 1968 4-7x6 E	Laredo	Duval	5	6	6	Low Stiffness	1	5 Int. ACP (2.5-5in.)	0.448	1.529	2: IR< HS20, OR>=HS20^

Key for Load Posting Class:
NLR - Not Load Rated, * - No Standard Design, ^ - Expansion Slab, † - Geometry Out-side Scope, ‡ - Post 1979 Construction

TABLE B: Summary Load Rating Results for 1,000 Culvert Structures (Aggregated from Segment Rating Data)

No.	Structure No	Segment ID	District	County	Structure History Score	Number of Segments	Culvert Condition Rating	Soil Type	Critical Cover Soil Depth	Pavement	HS20 Level 1 ORF	HS20 Level 3 ORF	Level 3 Load Posting Class
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
841	220670054204044	1 Org 1954 4-6x5 T	Laredo	Duval	5	1	7	Medium Stiffness	1	6 Thin ACP (<2.5in.)	0.640	1.539	2: IR< HS20, OR>=HS20
842	220670054204048	1 Org 1954 5-7x4 T	Laredo	Duval	5	1	6	Low Stiffness	1	5 Int. ACP (2.5-5in.)	0.479	1.318	2: IR< HS20, OR>=HS20
843	220670198201003	1 Org 1947 3-10x10 T	Laredo	Duval	5	1	6	Medium Stiffness	1	5 Int. ACP (2.5-5in.)	0.434	2.414	1: IR>=HS20, OR> HS20
844	220670224401001	1 Org 1963 3-6x5 T	Laredo	Duval	5	1	7	Medium Stiffness	2	10 Seal Coat or Surf. Tmt	0.977	2.074	1: IR>=HS20, OR> HS20
845	220670330501003	1 Org 1975 4-6x3 T	Laredo	Duval	5	1	7	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.556	1.206	2: IR< HS20, OR>=HS20
846	221360002304022	2 Wid 1953 5-4x4 T	Laredo	Kinney	5	3	6	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.725	1.699	1: IR>=HS20, OR> HS20
847	221420001708145	1 Org 1959 16-5x5 T	Laredo	La Salle	5	2	6	Medium Stiffness	2	10 Seal Coat or Surf. Tmt	1.275	2.572	1: IR>=HS20, OR> HS20
848	221420001802014	2 Wid 1954 3-8x4 J	Laredo	La Salle	5	5	6	Medium Stiffness	1.5	10 Seal Coat or Surf. Tmt	0.408	1.144	2: IR< HS20, OR>=HS20*
849	221420001802132	1 Org 1978 4-7x3 T	Laredo	La Salle	5	1	7	Medium Stiffness	2	10 Seal Coat or Surf. Tmt	0.597	2.728	1: IR>=HS20, OR> HS20
850	221420001802133	1 Org 1978 3-7x4 T	Laredo	La Salle	5	1	7	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.518	1.354	2: IR< HS20, OR>=HS20
851	221420023701011	1 Org 1947 4-6x4 T	Laredo	La Salle	5	2	7	Medium Stiffness	0.5	10 Seal Coat or Surf. Tmt	0.585	1.605	2: IR< HS20, OR>=HS20‡
852	221590027602027	2 Wid 1968 3-7x6 T	Laredo	Maverick	5	2	7	Medium Stiffness	1.5	6 Thin ACP (<2.5in.)	0.420	1.566	2: IR< HS20, OR>=HS20
853	222330002208042	2 Org 1939 2-7x6 E	Laredo	Val Verde	5	6	6	Low Stiffness	1	10 Seal Coat or Surf. Tmt	0.448	1.800	1: IR>=HS20, OR> HS20^
854	222330002208043	3 Wid 1978 4-7x6 E	Laredo	Val Verde	5	4	6	Low Stiffness	1	10 Seal Coat or Surf. Tmt	0.458	1.851	1: IR>=HS20, OR> HS20^
855	222330002301005	3 Wid 1976 5-6x6 T	Laredo	Val Verde	5	4	7	Low Stiffness	1.5	5 Int. ACP (2.5-5in.)	0.728	2.030	1: IR>=HS20, OR> HS20‡
856	222330002301063	1 Org 1962 10-6x5 T	Laredo	Val Verde	5	2	7	Low Stiffness	1.5	6 Thin ACP (<2.5in.)	0.742	1.793	1: IR>=HS20, OR> HS20‡
857	222400001803050	1 Org 1958 3-7x4 T	Laredo	Webb	5	2	7	Medium Stiffness	0.5	10 Seal Coat or Surf. Tmt	0.470	0.843	3: IR< HS20, OR> HS10‡
858	222400001803051	1 Org 1958 4-10x8 T	Laredo	Webb	5	3	7	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.553	1.146	2: IR< HS20, OR>=HS20‡
859	222400001804060	1 Org 1958 4-10x8 T	Laredo	Webb	5	2	7	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.553	1.146	2: IR< HS20, OR>=HS20‡
860	222400008604050	1 Org 1962 3-7x3 T	Laredo	Webb	5	1	7	Medium Stiffness	1	8 Overlaid Concrete	0.422	4.905	1: IR>=HS20, OR> HS20
861	222400023703032	1 Org 1954 5-7x7 T	Laredo	Webb	5	1	7	Low Stiffness	2	10 Seal Coat or Surf. Tmt	0.792	1.863	1: IR>=HS20, OR> HS20
862	222400054201005	1 Org 1948 4-10x9 T	Laredo	Webb	5	3	7	Low Stiffness	2	5 Int. ACP (2.5-5in.)	0.341	0.168	5: IR< HS 3, OR>=HS 3‡
863	222400054202023	2 Wid 1973 6-7x7 J	Laredo	Webb	5	3	6	Low Stiffness	1.5	10 Seal Coat or Surf. Tmt	0.514	1.468	2: IR< HS20, OR>=HS20
864	222400054202026	1 Org 1950 6-6x4 T	Laredo	Webb	5	2	7	Low Stiffness	1	10 Seal Coat or Surf. Tmt	0.511	0.987	3: IR< HS20, OR> HS10
865	222400054202033	1 Org 1950 6-8x8 T	Laredo	Webb	5	2	7	Medium Stiffness	0.5	10 Seal Coat or Surf. Tmt	0.537	0.797	3: IR< HS20, OR> HS10
866	222400202201004	1 Org 1957 4-8x4 T	Laredo	Webb	5	1	7	Medium Stiffness	0.5	5 Int. ACP (2.5-5in.)	0.385	1.126	2: IR< HS20, OR>=HS20
867	222540023602002	3 Wid 1973 9-7x4 T	Laredo	Zavala	5	3	7	Low Stiffness	1	5 Int. ACP (2.5-5in.)	0.379	1.337	2: IR< HS20, OR>=HS20^
868	222540027603075	1 Org 1967 3-8x5 T	Laredo	Zavala	5	2	7	Low Stiffness	2.5	5 Int. ACP (2.5-5in.)	0.600	2.537	1: IR>=HS20, OR> HS20‡
869	230250005406025	3 Wid 1954 5-4x4 T	Brownwood	Brown	3	5	6	High Stiffness	0.5	5 Int. ACP (2.5-5in.)	0.739	1.892	1: IR>=HS20, OR> HS20†‡
870	230250007901029	1 Org 1957 3-9x9 T	Brownwood	Brown	5	2	7	Medium Stiffness	1	5 Int. ACP (2.5-5in.)	0.473	1.483	2: IR< HS20, OR>=HS20†
871	230250048004012	5 Wid 1965 6-10x8 E	Brownwood	Brown	5	6	6	Low Stiffness	1	5 Int. ACP (2.5-5in.)	0.595	1.591	2: IR< HS20, OR>=HS20^
872	230250103302011	3 Add 1963 2-7x4 J	Brownwood	Brown	5	3	6	Medium Stiffness	0	10 Seal Coat or Surf. Tmt	0.582	0.832	3: IR< HS20, OR> HS10
873	230250103501004	1 Org 1956 5-8x8 T	Brownwood	Brown	5	1	7	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.625	1.281	2: IR< HS20, OR>=HS20
874	230250257001001	1 Org 1962 5-8x6 T	Brownwood	Brown	5	1	6	Low Stiffness	1	10 Seal Coat or Surf. Tmt	0.594	1.185	2: IR< HS20, OR>=HS20
875	230250263804004	1 Org 1963 4-8x7 T	Brownwood	Brown	5	1	7	Low Stiffness	1.5	10 Seal Coat or Surf. Tmt	0.327	0.665	3: IR< HS20, OR> HS10
876	230250310201001	1 Org 1967 2-10x10 T	Brownwood	Brown	5	1	7	Low Stiffness	3.5	10 Seal Coat or Surf. Tmt	0.733	3.324	1: IR>=HS20, OR> HS20
877	230420005404051	2 Wid 1963 3-7x7 T	Brownwood	Coleman	5	3	7	Low Stiffness	1.5	10 Seal Coat or Surf. Tmt	0.404	1.107	2: IR< HS20, OR>=HS20‡
878	230420005405050	1 Org 1936 2-10x9 T	Brownwood	Coleman	5	2	7	Low Stiffness	0.5	5 Int. ACP (2.5-5in.)	0.380	1.778	1: IR>=HS20, OR> HS20‡
879	230420007805031	1 Org 1955 4-8x7 T	Brownwood	Coleman	5	1	7	Low Stiffness	1	9 Overlaid Flexible	0.605	1.612	2: IR< HS20, OR>=HS20
880	230420110401012	1 Org 1968 5-8x6 T	Brownwood	Coleman	5	1	6	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.594	1.138	2: IR< HS20, OR>=HS20

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TABLE B: Summary Load Rating Results for 1,000 Culvert Structures (Aggregated from Segment Rating Data)

No.	Structure No	Segment ID	District	County	Structure History Score	Number of Segments	Culvert Condition Rating	Soil Type	Critical Cover Soil Depth	Pavement	HS20 Level 1 ORF	HS20 Level 3 ORF	Level 3 Load Posting Class
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
881	230420193801002	1 Org 1967 2-7x4 T	Brownwood	Coleman	5	1	7	Low Stiffness	1.5	10 Seal Coat or Surf. Tmt	0.684	1.293	2: IR< HS20, OR>=HS20
882	230420201501001	1 Org 1955 3-8x6 T	Brownwood	Coleman	5	1	7	Low Stiffness	1	10 Seal Coat or Surf. Tmt	0.560	1.157	2: IR< HS20, OR>=HS20
883	230420201501003	1 Org 1958 4-10x8 T	Brownwood	Coleman	5	1	7	Low Stiffness	0.5	10 Seal Coat or Surf. Tmt	0.553	0.967	3: IR< HS20, OR> HS10
884	230470018301027	2 Wid 1959 2-10x10 T	Brownwood	Comanche	5	2	6	Medium Stiffness	2	10 Seal Coat or Surf. Tmt	0.452	2.046	1: IR>=HS20, OR> HS20
885	230470028802027	1 Org 1963 4-10x6 T	Brownwood	Comanche	5	1	7	Medium Stiffness	1.5	10 Seal Coat or Surf. Tmt	0.576	1.370	2: IR< HS20, OR>=HS20
886	230470102901002	1 Org 1951 2-10x7 T	Brownwood	Comanche	5	1	5	Low Stiffness	1	10 Seal Coat or Surf. Tmt	0.434	0.868	3: IR< HS20, OR> HS10
887	230470102904006	1 Org 1961 2-10x6 T	Brownwood	Comanche	5	1	7	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.546	0.965	3: IR< HS20, OR> HS10
888	230470210701003	1 Org 1956 3-10x10 T	Brownwood	Comanche	5	1	5	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.535	1.193	2: IR< HS20, OR>=HS20
889	230470210702007	1 Org 1958 3-7x4 T	Brownwood	Comanche	5	1	6	Medium Stiffness	2	10 Seal Coat or Surf. Tmt	0.596	1.770	1: IR>=HS20, OR> HS20
890	230470306602002	1 Org 1970 3-8x8 T	Brownwood	Comanche	5	1	7	Medium Stiffness	3	10 Seal Coat or Surf. Tmt	0.996	3.995	1: IR>=HS20, OR> HS20
891	230680012701025	1 Org 1962 5-5x5 T	Brownwood	Eastland	5	2	6	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.762	1.632	2: IR< HS20, OR>=HS20‡
892	230680045201018	1 Org 1954 2-10x10 T	Brownwood	Eastland	5	2	7	Medium Stiffness	4.5	5 Int. ACP (2.5-5in.)	0.478	1.581	2: IR< HS20, OR>=HS20‡
893	230680055001018	1 Org 1959 2-10x8 T	Brownwood	Eastland	5	1	7	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.562	1.197	2: IR< HS20, OR>=HS20
894	230680055001030	1 Oth 1923 2-10x5 T	Brownwood	Eastland	5	2	6						NLR†‡
895	230680169702010	1 Org 1959 3-10x8 T	Brownwood	Eastland	5	1	7	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.550	1.162	2: IR< HS20, OR>=HS20
896	231410027205031	2 Wid 1960 3-7x7 T	Brownwood	Lampasas	5	2	7	Medium Stiffness	2	5 Int. ACP (2.5-5in.)	0.740	2.601	1: IR>=HS20, OR> HS20
897	231410027205032	2 Wid 1960 4-6x6 T	Brownwood	Lampasas	5	2	7	Low Stiffness	1.5	10 Seal Coat or Surf. Tmt	0.713	1.672	1: IR>=HS20, OR> HS20
898	231410228502007	1 Org 1960 3-9x6 T	Brownwood	Lampasas	5	1	7	Medium Stiffness	1	5 Int. ACP (2.5-5in.)	0.543	1.422	2: IR< HS20, OR>=HS20
899	231600007006035	3 Wid 1954 5-10x9 T	Brownwood	McCulloch	4	3	7	Low Stiffness	0	5 Int. ACP (2.5-5in.)	0.502	1.002	2: IR< HS20, OR>=HS20^
900	231600087005009	1 Org 1958 6-10x5 T	Brownwood	McCulloch	5	1	6	Low Stiffness	1	10 Seal Coat or Surf. Tmt	0.704	1.303	2: IR< HS20, OR>=HS20
901	231600130601001	1 Org 1940 6-3x3 T	Brownwood	McCulloch	5	2	7	Medium Stiffness	0.5	10 Seal Coat or Surf. Tmt	0.543	0.935	3: IR< HS20, OR> HS10
902	231670005408078	1 Org 1969 4-8x8 T	Brownwood	Mills	5	1	7	Low Stiffness	8	5 Int. ACP (2.5-5in.)	3.641	5.870	1: IR>=HS20, OR> HS20
903	231670005501029	2 Wid 1970 4-7x7 T	Brownwood	Mills	5	2	7	Low Stiffness	1	5 Int. ACP (2.5-5in.)	0.450	1.473	2: IR< HS20, OR>=HS20
904	232060027203051	1 Org 1954 4-6x6 T	Brownwood	San Saba	5	2	7	Medium Stiffness	1.5	5 Int. ACP (2.5-5in.)	0.713	2.233	1: IR>=HS20, OR> HS20†
905	232060027204029	1 Org 1940 4-9x8 T	Brownwood	San Saba	5	2	7	Low Stiffness	2	5 Int. ACP (2.5-5in.)	0.555	2.672	1: IR>=HS20, OR> HS20‡
906	232060028904036	1 Org 1936 3-8x8 T	Brownwood	San Saba	5	2	6	Low Stiffness	2	5 Int. ACP (2.5-5in.)	1.274	4.323	1: IR>=HS20, OR> HS20‡
907	232060324901001	1 Org 1972 2-10x10 T	Brownwood	San Saba	5	1	7	Low Stiffness	2	10 Seal Coat or Surf. Tmt	0.475	1.810	1: IR>=HS20, OR> HS20
908	232150001109067	1 Org 1966 3-10x10 T	Brownwood	Stephens	5	1	7	Medium Stiffness	3	5 Int. ACP (2.5-5in.)	0.561	5.304	1: IR>=HS20, OR> HS20
909	240220002103088	3 Wid 1959 4-7x4 E	El Paso	Brewster	5	4	7	Low Stiffness	2	6 Thin ACP (<2.5in.)	0.557	1.713	1: IR>=HS20, OR> HS20^
910	240220002105014	1 Org 1932 5-5x5 E	El Paso	Brewster	5	4	6	Medium Stiffness	0.5	6 Thin ACP (<2.5in.)	0.651	1.358	2: IR< HS20, OR>=HS20^
911	240220007501025	1 Org 1937 4-6x3 T	El Paso	Brewster	5	2	7	Low Stiffness	1	5 Int. ACP (2.5-5in.)	0.404	2.200	1: IR>=HS20, OR> HS20‡
912	240220035802018	1 Org 1954 6-5x3 T	El Paso	Brewster	5	2	7	Medium Stiffness	0.5	10 Seal Coat or Surf. Tmt	0.653	1.032	2: IR< HS20, OR>=HS20‡
913	240220035802021	1 Org 1954 12-10x6 T	El Paso	Brewster	4	2	6	Medium Stiffness	0.5	10 Seal Coat or Surf. Tmt	0.555	0.799	3: IR< HS20, OR> HS10
914	240550000301004	2 Wid 1952 5-4x4 T	El Paso	Culberson	5	2	6	Medium Stiffness	0.5	10 Seal Coat or Surf. Tmt	0.725	1.257	2: IR< HS20, OR>=HS20
915	240550000301159	1 Org 1974 5-10x7 T	El Paso	Culberson	5	1	7	Medium Stiffness	2	10 Seal Coat or Surf. Tmt	0.568	1.619	2: IR< HS20, OR>=HS20
916	240550000301166	1 Org 1974 6-10x7 T	El Paso	Culberson	5	1	7	Medium Stiffness	2	10 Seal Coat or Surf. Tmt	0.628	1.867	1: IR>=HS20, OR> HS20
917	240550000301169	1 Org 1974 5-6x3 T	El Paso	Culberson	5	1	7	Medium Stiffness	3	10 Seal Coat or Surf. Tmt	1.002	3.637	1: IR>=HS20, OR> HS20
918	240550000302108	1 Org 1970 3-10x6 T	El Paso	Culberson	5	1	7	Medium Stiffness	3	7 ACP w/ Stab. Base	1.010	4.355	1: IR>=HS20, OR> HS20
919	240550000303119	1 Org 1970 3-7x3 T	El Paso	Culberson	5	1	6	High Stiffness	4	7 ACP w/ Stab. Base	1.205	4.958	1: IR>=HS20, OR> HS20
920	240550002001071	3 Wid 1958 4-7x4 E	El Paso	Culberson	4	4	6	Medium Stiffness	1	6 Thin ACP (<2.5in.)	0.381	1.268	2: IR< HS20, OR>=HS20^

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(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
921	240550002001072	3 Wid 1958 4-7x4 E	El Paso	Culberson	5	4	6	Medium Stiffness	1	6 Thin ACP (<2.5in.)	0.381	1.268	2: IR< HS20, OR>=HS20^
922	240550002002100	2 Wid 1959 4-6x5 T	El Paso	Culberson	5	2	7	Medium Stiffness	1	6 Thin ACP (<2.5in.)	0.640	1.539	2: IR< HS20, OR>=HS20
923	240550002002101	2 Wid 1959 4-7x4 T	El Paso	Culberson	5	2	7	High Stiffness	1	6 Thin ACP (<2.5in.)	0.381	1.287	2: IR< HS20, OR>=HS20
924	240550002002108	3 Wid 1959 4-7x4 E	El Paso	Culberson	4	4	6	Low Stiffness	1	6 Thin ACP (<2.5in.)	0.381	1.202	2: IR< HS20, OR>=HS20^
925	240550002002110	3 Wid 1959 5-7x4 T	El Paso	Culberson	4	4	6	Medium Stiffness	1	6 Thin ACP (<2.5in.)	0.381	1.267	2: IR< HS20, OR>=HS20^
926	240550002002113	2 Wid 1959 4-6x3 T	El Paso	Culberson	5	2	7	Medium Stiffness	1	6 Thin ACP (<2.5in.)	0.506	1.435	2: IR< HS20, OR>=HS20
927	240550013901033	1 Org 1935 10-3x3 T	El Paso	Culberson	3	2	6	Medium Stiffness	0.5	6 Thin ACP (<2.5in.)	0.545	1.128	2: IR< HS20, OR>=HS20
928	240550023305028	1 Org 1940 4-7x6 E	El Paso	Culberson	5	2	7	Medium Stiffness	0.5	10 Seal Coat or Surf. Tmt	0.498	1.504	2: IR< HS20, OR>=HS20^
929	240720016702008	1 Org 1966 20-8x5 T	El Paso	El Paso	5	1	7	Medium Stiffness	0.5	5 Int. ACP (2.5-5in.)	0.546	0.743	3: IR< HS20, OR> HS10
930	240720066501001	1 Org 1942 3-7x4 E	El Paso	El Paso	5	4	6	High Stiffness	2	5 Int. ACP (2.5-5in.)	0.367	5.108	1: IR>=HS20, OR> HS20^‡
931	240720212104050	2 Wid 1960 2-10x10 T	El Paso	El Paso	5	3	6	Medium Stiffness	5.5	4 Thick ACP (>5in.)	0.952	2.370	1: IR>=HS20, OR> HS20‡
932	241160000205095	1 Org 1963 5-6x4 E	El Paso	Hudspeth	5	2	6	Medium Stiffness	3	1 CRCP	1.177	5.677	1: IR>=HS20, OR> HS20^
933	241160000205098	1 Org 1963 6-8x5 T	El Paso	Hudspeth	5	1	6	Medium Stiffness	2	1 CRCP	0.672	4.201	1: IR>=HS20, OR> HS20
934	241160000207040	2 Wid 1954 4-6x3 T	El Paso	Hudspeth	5	2	7	Medium Stiffness	1	6 Thin ACP (<2.5in.)	0.506	1.435	2: IR< HS20, OR>=HS20
935	241160000209049	1 Org 1935 4-5x5 E	El Paso	Hudspeth	5	2	6	High Stiffness	1	6 Thin ACP (<2.5in.)	0.739	1.917	1: IR>=HS20, OR> HS20^
936	241160000209117	1 Org 1965 5-6x3 T	El Paso	Hudspeth	5	1	7	High Stiffness	3.5	1 CRCP	1.412	6.079	1: IR>=HS20, OR> HS20
937	241160000209128	1 Org 1965 4-6x3 T	El Paso	Hudspeth	5	1	7	High Stiffness	3.5	6 Thin ACP (<2.5in.)	1.412	4.744	1: IR>=HS20, OR> HS20
938	241160000219042	2 Org 1935 3-7x7 E	El Paso	Hudspeth	5	3	7	Medium Stiffness	0.5	4 Thick ACP (>5in.)	0.511	1.981	1: IR>=HS20, OR> HS20^
939	241230002003114	2 Wid 1961 5-6x3 T	El Paso	Jeff Davis	5	2	7	Medium Stiffness	1	6 Thin ACP (<2.5in.)	0.404	1.403	2: IR< HS20, OR>=HS20
940	241230002003125	2 Wid 1961 6-6x3 T	El Paso	Jeff Davis	5	2	7	Low Stiffness	1	6 Thin ACP (<2.5in.)	0.404	1.312	2: IR< HS20, OR>=HS20
941	241230002004061	3 Wid 1966 5-7x6 E	El Paso	Jeff Davis	3	6	7	Low Stiffness	1	6 Thin ACP (<2.5in.)	0.458	1.373	2: IR< HS20, OR>=HS20^‡
942	241230002005082	2 Wid 1966 4-5x2 T	El Paso	Jeff Davis	5	2	7	Medium Stiffness	1	6 Thin ACP (<2.5in.)	0.564	1.516	2: IR< HS20, OR>=HS20
943	241230002005090	2 Wid 1966 6-6x3 T	El Paso	Jeff Davis	5	2	7	Low Stiffness	1	6 Thin ACP (<2.5in.)	0.404	1.298	2: IR< HS20, OR>=HS20
944	241230002005091	3 Wid 1966 5-6x4 E	El Paso	Jeff Davis	4	6	7	Low Stiffness	1.5	6 Thin ACP (<2.5in.)	0.664	1.586	2: IR< HS20, OR>=HS20^‡
945	241230010402034	1 Org 1940 4-6x4 T	El Paso	Jeff Davis	5	2	7	Medium Stiffness	1	5 Int. ACP (2.5-5in.)	0.575	2.760	1: IR>=HS20, OR> HS20‡
946	241230010402036	1 Org 1940 5-7x4 T	El Paso	Jeff Davis	5	2	7	High Stiffness	2	5 Int. ACP (2.5-5in.)	0.379	5.135	1: IR>=HS20, OR> HS20‡
947	241230010402044	1 Org 1940 6-6x3 T	El Paso	Jeff Davis	5	2	7	Low Stiffness	1	5 Int. ACP (2.5-5in.)	0.404	2.214	1: IR>=HS20, OR> HS20‡
948	241230269502001	1 Org 1961 5-8x6 T	El Paso	Jeff Davis	5	1	6	Low Stiffness	0.5	10 Seal Coat or Surf. Tmt	0.601	1.000	2: IR< HS20, OR>=HS20
949	241890002006013	2 Wid 1970 6-6x3 T	El Paso	Presidio	5	2	7	Low Stiffness	1.5	6 Thin ACP (<2.5in.)	0.343	1.526	2: IR< HS20, OR>=HS20
950	241890002006015	2 Wid 1970 4-6x3 T	El Paso	Presidio	5	2	7	Medium Stiffness	2	6 Thin ACP (<2.5in.)	0.691	2.318	1: IR>=HS20, OR> HS20
951	241890002008031	3 Org 1932 2-6x6 E	El Paso	Presidio	5	8	6	Medium Stiffness	2	6 Thin ACP (<2.5in.)	0.684	1.114	2: IR< HS20, OR>=HS20^
952	241890010409024	1 Org 1933 6-4x4 T	El Paso	Presidio	5	2	7	High Stiffness	5	6 Thin ACP (<2.5in.)	4.078	10.264	1: IR>=HS20, OR> HS20‡
953	250230031104011	1 Org 1955 3-10x10 T	Childress	Briscoe	3	1	6	Medium Stiffness	5.5	10 Seal Coat or Surf. Tmt	0.776	5.335	1: IR>=HS20, OR> HS20
954	250230242401001	1 Org 1959 4-5x5 T	Childress	Briscoe	5	1	6	Low Stiffness	1	10 Seal Coat or Surf. Tmt	0.647	1.371	2: IR< HS20, OR>=HS20
955	250230243001002	1 Org 1959 3-7x3 T	Childress	Briscoe	5	1	7	Low Stiffness	0.5	10 Seal Coat or Surf. Tmt	0.431	0.856	3: IR< HS20, OR> HS10
956	250380038101008	1 Org 1972 3-10x6 T	Childress	Childress	5	1	7	Medium Stiffness	2	5 Int. ACP (2.5-5in.)	0.507	2.055	1: IR>=HS20, OR> HS20
957	250380122501003	1 Org 1953 3-6x5 T	Childress	Childress	5	1	7	Medium Stiffness	1.5	10 Seal Coat or Surf. Tmt	0.588	1.292	2: IR< HS20, OR>=HS20
958	250380122501005	1 Org 1953 6-6x6 T	Childress	Childress	5	1	7	Medium Stiffness	3	10 Seal Coat or Surf. Tmt	1.077	2.537	1: IR>=HS20, OR> HS20
959	250380123301002	1 Org 1950 6-6x6 T	Childress	Childress	5	2	6	Medium Stiffness	1.5	10 Seal Coat or Surf. Tmt	0.717	2.029	1: IR>=HS20, OR> HS20
960	250380253302005	1 Org 1962 3-9x5 T	Childress	Childress	5	1	6	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.501	0.991	3: IR< HS20, OR> HS10

Key for Load Posting Class:
NLR - Not Load Rated, * - No Standard Design, ^ - Expansion Slab, † - Geometry Out-side Scope, ‡ - Post 1979 Construction

TABLE B: Summary Load Rating Results for 1,000 Culvert Structures (Aggregated from Segment Rating Data)

No.	Structure No	Segment ID	District	County	Structure History Score	Number of Segments	Culvert Condition Rating	Soil Type	Critical Cover Soil Depth	Pavement	HS20 Level 1 ORF	HS20 Level 3 ORF	Level 3 Load Posting Class
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
961	250440079708008	1 Org 1954 5-8x8 T	Childress	Collingsworth	5	1	7	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.625	1.281	2: IR< HS20, OR>=HS20
962	250510214301001	1 Org 1956 5-6x3 T	Childress	Cottle	5	1	7	Medium Stiffness	2	10 Seal Coat or Surf. Tmt	0.691	1.973	1: IR>=HS20, OR> HS20
963	250510225101002	1 Org 1961 3-8x4 T	Childress	Cottle	5	1	7	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.360	1.010	2: IR< HS20, OR>=HS20
964	250510225102004	1 Org 1965 2-10x6 T	Childress	Cottle	5	1	7	Medium Stiffness	2	10 Seal Coat or Surf. Tmt	0.796	2.143	1: IR>=HS20, OR> HS20
965	250630013106006	1 Org 1941 2-9x8 T	Childress	Dickens	5	2	7	Medium Stiffness	3	6 Thin ACP (<2.5in.)	0.567	3.804	1: IR>=HS20, OR> HS20
966	250630013201020	3 Wid 1974 5-7x7 T	Childress	Dickens	5	3	7	Medium Stiffness	3	6 Thin ACP (<2.5in.)	1.018	2.360	1: IR>=HS20, OR> HS20
967	250630094901004	1 Org 1957 5-10x6 T	Childress	Dickens	5	1	6	Medium Stiffness	0.5	10 Seal Coat or Surf. Tmt	0.555	0.806	3: IR< HS20, OR> HS10
968	250630095005013	1 Org 1959 2-10x6 T	Childress	Dickens	5	1	7	Medium Stiffness	2	10 Seal Coat or Surf. Tmt	0.534	1.582	2: IR< HS20, OR>=HS20
969	250630231801002	1 Org 1959 3-10x8 T	Childress	Dickens	5	1	7	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.550	1.162	2: IR< HS20, OR>=HS20
970	250650004206007	3 Wid 1978 6-6x6 T	Childress	Donley	4	6	7	Medium Stiffness	2	6 Thin ACP (<2.5in.)	0.562	2.201	1: IR>=HS20, OR> HS20*
971	250650004206046	1 Org 1958 3-10x7 T	Childress	Donley	4	3	6	Medium Stiffness	2	6 Thin ACP (<2.5in.)	0.570	1.966	1: IR>=HS20, OR> HS20
972	250650004207014	2 Wid 1967 4-4x4 T	Childress	Donley	5	3	6	Medium Stiffness	4.5	6 Thin ACP (<2.5in.)	1.617	1.243	2: IR< HS20, OR>=HS20
973	250650004208019	2 Wid 1958 3-10x10 T	Childress	Donley	1	4	6	Medium Stiffness	5	6 Thin ACP (<2.5in.)	0.761	6.102	1: IR>=HS20, OR> HS20‡
974	250650225201003	1 Org 1957 3-9x5 T	Childress	Donley	5	1	6	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.501	0.991	3: IR< HS20, OR> HS10
975	250790009803026	1 Org 1937 4-5x3 T	Childress	Foard	5	1	6	Low Stiffness	0.5	10 Seal Coat or Surf. Tmt	0.621	1.769	1: IR>=HS20, OR> HS20
976	250790070203007	1 Org 1955 6-7x7 T	Childress	Foard	5	1	6	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.594	1.199	2: IR< HS20, OR>=HS20
977	250790216402006	1 Org 1960 2-10x10 T	Childress	Foard	5	1	7	Medium Stiffness	2	10 Seal Coat or Surf. Tmt	0.452	2.046	1: IR>=HS20, OR> HS20
978	250790318301003	1 Org 1969 3-7x5 T	Childress	Foard	5	1	7	Low Stiffness	1	5 Int. ACP (2.5-5in.)	0.600	1.494	2: IR< HS20, OR>=HS20
979	250970010502012	1 Org 1925 7-3x3 T	Childress	Hall	5	2	5	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.534	1.255	2: IR< HS20, OR>=HS20
980	250970054102009	2 Wid 1958 6-5x5 T	Childress	Hall	5	2	6	Medium Stiffness	1	8 Overlaid Concrete	0.647	5.907	1: IR>=HS20, OR> HS20
981	250970054102021	2 Wid 1958 6-6x4 T	Childress	Hall	5	2	6	Medium Stiffness	1	8 Overlaid Concrete	0.569	5.339	1: IR>=HS20, OR> HS20
982	250970263001001	1 Org 1962 3-10x6 T	Childress	Hall	5	1	7	High Stiffness	12.5	10 Seal Coat or Surf. Tmt	-5.980	-7.028	6: IR< HS 3, OR< HS 3
983	251000004302146	1 Org 1970 3-9x7 T	Childress	Hardeman	5	1	6	Low Stiffness	4.5	6 Thin ACP (<2.5in.)	1.445	2.750	1: IR>=HS20, OR> HS20
984	251000004302147	1 Org 1970 3-9x6 T	Childress	Hardeman	5	1	7	Low Stiffness	2.5	6 Thin ACP (<2.5in.)	0.446	2.175	1: IR>=HS20, OR> HS20
985	251000071101018	2 Wid 1958 5-6x6 T	Childress	Hardeman	5	2	6	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.642	1.314	2: IR< HS20, OR>=HS20
986	251000191601004	1 Org 1969 5-8x5 T	Childress	Hardeman	5	1	7	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.550	1.111	2: IR< HS20, OR>=HS20
987	251350003205016	1 Org 1932 4-10x10 T	Childress	King	5	2	6	Medium Stiffness	1	10 Seal Coat or Surf. Tmt	0.329	0.712	3: IR< HS20, OR> HS10
988	251350003205017	2 Wid 1964 4-5x5 T	Childress	King	5	2	7	Medium Stiffness	0.5	10 Seal Coat or Surf. Tmt	0.647	1.003	2: IR< HS20, OR>=HS20
989	251350003206026	2 Wid 1962 4-6x6 T	Childress	King	4	3	5	Medium Stiffness	0.5	6 Thin ACP (<2.5in.)	0.588	1.241	2: IR< HS20, OR>=HS20
990	251350071104026	1 Org 1961 5-8x5 T	Childress	King	5	1	6	Medium Stiffness	1.5	10 Seal Coat or Surf. Tmt	0.637	1.399	2: IR< HS20, OR>=HS20
991	251350095002003	2 Wid 1969 7-5x4 T	Childress	King	5	2	6	Medium Stiffness	3	10 Seal Coat or Surf. Tmt	1.687	4.028	1: IR>=HS20, OR> HS20
992	251380015702005	2 Wid 1954 6-10x10 T	Childress	Knox	5	3	6	Medium Stiffness	2	5 Int. ACP (2.5-5in.)	0.464	2.933	1: IR>=HS20, OR> HS20‡
993	251380216403008	1 Org 1960 3-7x4 T	Childress	Knox	5	1	7	Medium Stiffness	2	10 Seal Coat or Surf. Tmt	0.596	1.770	1: IR>=HS20, OR> HS20
994	251380216403010	1 Org 1960 5-7x3 T	Childress	Knox	5	1	7	Low Stiffness	1.5	10 Seal Coat or Surf. Tmt	0.490	1.188	2: IR< HS20, OR>=HS20
995	251730242503002	1 Org 1972 3-8x4 T	Childress	Motley	5	1	7	Medium Stiffness	4	10 Seal Coat or Surf. Tmt	1.308	5.052	1: IR>=HS20, OR> HS20
996	252420003009016	2 Wid 1963 5-6x3 T	Childress	Wheeler	5	3	7	Medium Stiffness	1.5	8 Overlaid Concrete	0.495	5.249	1: IR>=HS20, OR> HS20‡
997	252420076105007	1 Org 1957 3-7x3 T	Childress	Wheeler	5	2	7	Medium Stiffness	1.5	10 Seal Coat or Surf. Tmt	0.485	1.256	2: IR< HS20, OR>=HS20‡
998	252420123501004	2 Wid 1971 4-7x3 T	Childress	Wheeler	5	2	8	Medium Stiffness	1.5	10 Seal Coat or Surf. Tmt	0.502	1.246	2: IR< HS20, OR>=HS20
999	252420134701001	1 Org 1951 5-8x8 T	Childress	Wheeler	3	1	5	Medium Stiffness	0.5	10 Seal Coat or Surf. Tmt	0.537	0.795	3: IR< HS20, OR> HS10
1000	252420205101004	1 Org 1960 4-6x4 T	Childress	Wheeler	5	1	6	Medium Stiffness	2	10 Seal Coat or Surf. Tmt	0.782	2.088	1: IR>=HS20, OR> HS20

Key for Load Posting Class:
NLR - Not Load Rated, * - No Standard Design, ^ - Expansion Slab, † - Geometry Out-side Scope, ‡ - Post 1979 Construction

APPENDIX C

LOAD RATING REPORT DECLARATION

Load Rating Summary Reports

TxDOT Batch 1 Culvert Structures

TEXAS TECH UNIVERSITY
Center for
Multidisciplinary Research in Transportation

LOAD RATING REPORT DECLARATION

Date:	July 21, 2018
TO:	Bridge Division, Texas Department of Transportation
FROM:	William D. Lawson, P.E., Ph.D.
COPY:	File 88-4XXIA001
SUBJECT:	Load Rating Summary Results TxDOT Batch 1 Culvert Structures

This Load Rating Report Declaration transmits load rating summary results for TxDOT's Batch 1 culvert structures prepared in partial fulfillment of the requirements of TxDOT Project Number 88-4XXIA001, "Load Rating pre-1980 In-Service Culverts," as per the Interagency Cooperation Contract between the Texas Department of Transportation and Texas Tech University dated August 1, 2014.

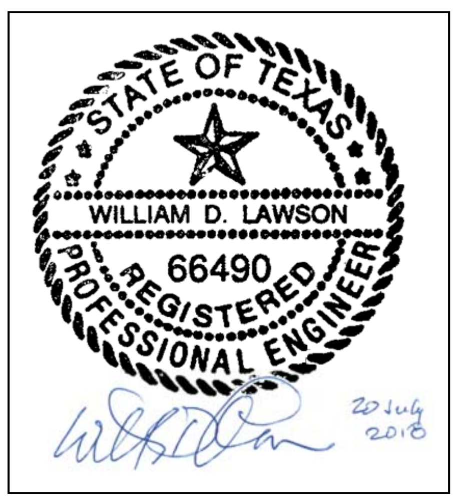
The load rating summary results reported in Appendix A and Appendix B of this report reflect the review, classification and interpretation of culvert documents provided in the *digital* culvert file or from other *digital* databases such TxDOT's Pavement Management Information System or the USNRCS web soil survey. In no case was Texas Tech University provided with project-specific, hard-copy culvert documents. In no case did Texas Tech University obtain contemporary, project-specific field data for soil, pavement, structural materials or other culvert properties.

The reported load rating values are based on parameters obtained from TxDOT's design standards – either provided, specified or associated –so the results incorporate and reflect the default assumptions associated with the designs. Design data were not modified to reflect structure-specific flaws or defects that may have been noted in structural inspection reports. The load rating calculations assumed fully-drained backfill soils, and did not directly account for the hydrostatic loads associated with undrained or partially-drained backfill.

Level 1 load rating values reflect structural analysis and demand modeling using TxDOT's CULV5 program, which uses a simply-supported structural frame model. Level 3 load rating values reflect structural analysis and demand modeling using RISA software, which uses a linear-elastic finite element soil-structure model. Level 1 and Level 3 load ratings were performed generally as described in the TxDOT *Culvert Rating Guide (2009)* and were implemented using TxDOT's culvert load rating program, CULVLR (2013). Program and procedural updates are as noted in the project report, and it is emphasized that the Level 3 demand model was extensively updated and revised for this project.

Reported load ratings are subject to the limitations of the analytical methods and are not intended to supersede the independent professional judgment of load rating engineers who perform physical inspection of in-service culvert structures.

The work associated with this study was performed over a 25-month period by a team of approximately seven to nine faculty, one to two research associates, four to twelve graduate students, ten to sixty undergraduate students, plus other support personnel. Given the scope of the project – including 10,829 culvert structures which were the focus of this study and the millions of parameters associated with the culvert data files – the potential for variance in the form of errors, missed data, and inconsistent interpretation was recognized. Steps to achieve repeatable, reliable, high-quality data and results included project orientation, documentation, development of specifications and procedures, ongoing training and instruction, data review, formal quality control checks, and periodic quality assurance review.



The load rating calculations were performed using that degree of care and skill ordinarily exercised under similar conditions by reputable members of the profession practicing in the same or similar locality at the time of service. No other warranty, express or implied, is made or intended by the load rating summary results.

TechMRT · Box 41023 · Lubbock, TX · 79409-1023 · Phone 806.742.3523