If Texas Tech University campus operations are required to change because of health concerns related to the COVID-19 pandemic, it is possible that this course will move to a fully online delivery format. Should that be necessary, students will likely need a webcam and microphone and will be advised of additional technical and/or equipment requirements, including remote proctoring software.

ARCH 3355: Architectural Technology IV: Atmosphere (Online Only)
College of Architecture, Texas Tech University
Spring, 2021

Course Time: Lecture: Tuesday & Thursday, 12:30-1:50pm // Lab: Wednesday, 5:00-6:50pm
Instructor: Assistant Professor Dr. Peng Du, LEED AP, WELL AP (peng.du@ttu.edu)
Graduate Assistants: Alexis Calderon (cal77903@ttu.edu); Erica Grant (erica.grant@ttu.edu); Kleigh Hernandez (Kleigh.Hernandez@ttu.edu)

Architectural Technology IV: Atmosphere

Sustainable Design Strategies Towards Net Zero Architecture

Figure: Powerhouse Brattørkaia, “the world’s northernmost energy-positive building” @ Snøhetta

I. COURSE INFORMATION

Course Title: Architectural Technology IV: Atmosphere

Catalog Description

3 Semester Credit Hours

Introduction to concepts, principles, and design strategies of heating, cooling, lighting and other aspects of climate-responsive architecture; Introduction to sustainable design strategies towards net-zero architecture; Analysis of the environmental performance of buildings.

Course Description

The urban built environment is responsible for 75% of annual global greenhouse gas (GHG) emissions: buildings alone account for 39%. Eliminating these emissions is the key to addressing climate change and meeting Paris Climate Agreement targets. In 2006, Architecture 2030 issued the 2030 Challenge, a breakthrough vision that calls for all new buildings, developments, and major renovations to be carbon-neutral by 2030. In this backdrop, the course will focus on the introduction to sustainable design strategies for architects to respond to climate, as well as design strategies towards carbon-neutral architecture. The course will also introduce relevant computational simulation tools to model and analyze the environmental performance of buildings. The weekly class format will consist of two lecture sessions and one lab session.

Student Learning Objectives

Upon the completion of the studio the student will:

1. Be able to understand the interactions between climate, architecture, and humans.
2. Be able to understand the concepts, principles, and design strategies of heating, cooling, and lighting of climate-responsive architecture.
3. Be able to understand design strategies and possible paths towards net-zero buildings
4. Be able to use computational simulation tools to model and analyze the environmental performance of buildings at a basic level.

Student Performance Objectives

Upon the completion of the studio the student will:

1. Be able to understand sustainability guidelines as related to design of buildings.
2. Be able to make early design decisions with regard to appropriate architectural forms and passive systems that meet heating, cooling, and lighting needs of the occupants by responding to climate and surrounding environment.
3. Be able to analyze and visualize climatic data, and run basic computer simulations for the environmental performance of buildings, such as daylighting, operating energy, and solar energy.
4. Be able to develop design strategies and a path towards a net-zero building.

Means of Evaluation

Deliverables:

1. 2 in-class exams
2. 3 assignments (the 3rd assignment will be the final project)

Method of Assessment:

1. Attendance and active participation in both the lecture and lab sessions
2. Completion of all deliverables in a timely manner – no late work accepted

Teaching Methods

The course is not merely a math class that relates to building but rather a course that uses cities, buildings, technologies, and systems to convey to students sustainable design strategies and tools and how they shape sustainable architecture in fundamental and meaningful ways. Students will engage in educational objectives during both lecture and lab settings, while accessing your knowledge and skills throughout the term during assigned readings, lectures, software tutorials, exams and assignments.

Lecture: A topic related to sustainability and environmental performance in the built environment will be introduced in a lecture / presentation format by the instructor via Zoom. The lecture will be about 1 hour, followed by approx. 20-minute questions and answers (Q & A).

Lab: The lab sessions will mainly include the following three components, led by both the instructor and graduate assistants. For those lab sessions led by the graduate assistants, students will be likely assigned to different Zoom meetings or different "breakout" rooms on Zoom. One graduate assistant will be responsible of one specific group for tutorial, exam and discussion.

- Software Tutorial: Grasshopper-based energy modeling software will be taught at a basic level through hands-on tutorials by the instructor and graduate assistants. The rhino / grasshopper files taught in the lab session will be shared after the class. All the software tutorials will be recorded and shared after the lab session.
- Q & A: The instructor and graduate assistants will answer questions from the students on lectures, software tutorials, exams, assignments, etc.
- Exam: Students will take two exams in total during the lab sessions. Generally, the exam consists of short answer, multiple choice, fill-in-the-blank, true/false and problem sets.

Assignment: There will be three specific projects assigned to students across the semester. Students will complete the first two assignments individually, and the third (final) assignment by groups of 2. Each project will have further detailed explanation of specific requirements, due dates, etc. when assigned.

Recommended Texts

Required Textbook:

- Lechner, Norbert. *Heating, Cooling, Lighting: Sustainable Design Methods for Architects*. John Wiley & Sons, 2014. (Full digital access available at the TTU Library Link)

Recommended Reading:

- Roche, Pablo La. *Carbon-Neutral Architectural Design*. CRC Press, 2017. (Available at Architecture Library Link)
- AIA Committee on the Environment (COTE) Top Ten Toolkit (Free download Link)
- Architect's Guide to Building Performance: Integrating Simulation into the Design Process (Free download Link)
- DeKay, Mark, and G. Z. Brown. *Sun, Wind, and Light: Architectural Design Strategies*. John Wiley & Sons, 2014. (Full digital access available at the TTU Library Link)

Note: Other required or recommended readings may be assigned by the instructor throughout the semester.

Software / Tools:

1. Ladybug Tools (Link, free Grasshopper plugins)
2. DIVA-for-Rhino (Link, educational license is free, but an individual request to Solemma is needed)
3. ClimateStudio (Link, educational license is free, to be shared by the instructor)

Websites:

1. Architecture 2030
2. AIA 2030 Commitment

Course Requirements

Each student is required to have their own laptop computer with a webcam, microphone and internet capabilities. In addition, the project(s) will require 2D and 3D architectural software (AutoCAD, Rhino, and Adobe Suite) for the successful completion of this course. Specifically, several grasshopper plugins (free of charge) will be used for energy modeling, simulation and analysis, such as Ladybug Tools (mainly Ladybug and Honeybee), DIVA and ClimateStudio. The energy modeling software will be taught through hands-on tutorials by the instructor and graduate assistants.

Note-taking and class attendance are essential to being successful. Each class day, students are required to arrive on time and bring the necessary resources to take sufficient notes in an organized manner. An abbreviated version of the slides presented will be posted online after the class session. While these "visual notes" will posted on blackboard, it is essential to add additional notes, sketches, diagrams and calculations to allow these examples to better resonate. The use of the course materials (e.g., lecture

slides, recorded tutorials) must remain limited to educational purposes of this course. Due to copyright protection, distribution of materials must be strictly avoided.

All the course materials will be posted to Blackboard (and OneDrive, if needed), so students must regularly check blackboard for announcements, assignments, instruction and other vital class information. It is the responsibility of each student to check email multiple times each day.

The course will use both International System of Units (e.g., meter or square meter) as well as the Imperial (English) system (e.g., foot or square foot).

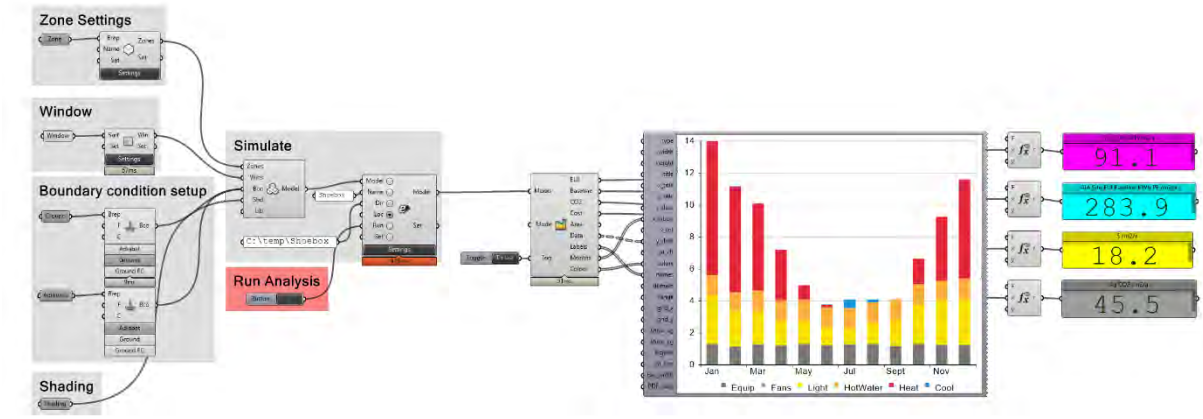

Figure: Parametric energy modeling via ClimateStudio

Course Schedule

Week	Date	Topic	Readings (Textbook)	Exams / Assignments
1	1/21	Lecture: Course Introduction		
2	1/26	Lecture: Sustainable Design I	Chapter 1	
	1/28	Lab: Ladybug Tools Introduction & Installation	Chapter 2	
	1/28	Lecture: Sustainable Design II	Chapter 2	
3	2/2	Lecture: Basic Thermal Principles	Chapter 3	
	2/3	Lab: Visualizing Climatic Data I		
	2/4	Lecture: Thermal Comfort	Chapter 4	
4	2/9	Lecture: Climate and Microclimate	Chapter 5	
	2/10	Lab: Visualizing Climatic Data II		
	2/11	Lecture: Solar Geometry	Chapter 6	**Assignment 1: Climate Analysis**
5	2/16	Lecture: Passive Heating	Chapter 7	
	2/17	Lab: DIVA – Installation + Sun Path and Shadow Analysis		
	2/18	Lecture: Solar Energy	Chapter 8	
6	2/23	Lecture: Sun and Shading	Chapter 9	
	2/24	Lab: DIVA – Solar Radiation		
	2/25	Lecture: Passive Cooling	Chapter 10	
7	3/2	Lecture: Thermal Envelope		
	3/3	Lab: DIVA – Daylight Modeling		
	3/4	Lecture: Sustainable Building Façade		**Assignment 2: Thermal and Daylighting Design**
8	3/16	Lecture: Lighting and Daylighting	Chapter 12 & 13	
	3/17	Lab: Exam + Q & A		**Exam 1**
	3/18	Lecture: Daylighting Design		
9	3/23	Lecture: HVAC Systems	Chapter 16	
	3/24	Lab: ClimateStudio or Honeybee – Energy Modeling I		
	3/25	Lecture: Performance-based Design & Energy Modeling		
10	3/30	Lecture: Carbon-Neutral Architectural Design I		
	3/31	Lab: ClimateStudio or Honeybee – Energy Modeling II		
	4/1	Lecture: Carbon-Neutral Architectural Design II		**Assignment 3 (Final): Net-Zero Space Design** by groups of 2
11	4/6	Lecture: Life-Cycle Analysis (LCA)		
	4/7	Lab: Exam + Q & A		**Exam 2**
	4/8	Lecture: Smart Building, Dynamic Design		
12	4/13	Lecture: Sound and Acoustics		
	4/14	Lab: Q & A		
	4/15	Lecture: Site Design, Community Planning and Landscaping		
13	4/20	Lecture: LEED Rating System		
	4/21	Lab: Q & A		
	4/22	Lecture: Future Cities // Last Day of Class		
14	4/27	Studio Review Week // No Class		
	4/28	Studio Review Week // No Class		
	4/29	Studio Review Week // No Class		
15	TBD	Final Report Submission		

Note: The topics and/or dates are subject to change at the discretion of the instructor, guest speakers, and/or the College of Architecture.

Grading

Grading Criteria: Performance-based grade evaluations will be made by the instructor and graduate / student assistants according to *Accuracy, Completeness,* and *Understanding* and based on student participation and the estimated coursework weighting below:

1. Attendance / Participation in Class = 10%
2. Exams = 30%
    - Exam 1 = 15%
    - Exam 2 = 15%
3. Assignments = 60%
    a. Project Report 1 = 15%
    b. Project Report 2 = 15%
    c. Project Report 3 (Final) = 30%

Total = 100%

The grading system is points-based, with each exam and assignment having a possible number of points. Grading will be based on the student performance on each assignment as described above. Opportunity for extra credit may be given throughout the semester, at the instructor's discretion. A student who has shown clear successful improvement throughout the semester may be given the advantage in the case of borderline final grade averages.

Grading Scale: Below are the numerical definitions of the grading scale to be used for this course:

1. A+: 97 – 100
2. A: 94 – 96.99
3. A-: 90 – 93.99
4. B+: 87 – 89.99
5. B: 84 – 86.99
6. B-: 80 – 83.99
7. C+: 77 – 79.99
8. C: 74 – 76.99

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9. C-: 70 – 73.99 Low Pass
10. D+: 67 – 69.99
11. D: 64 – 67.99
12. D-: 60 – 63.99
13. F: 0 – 59.99

Grade Definitions:

1. A (excellent) exceptional work, exceeding the requirements of the course, showing strong understanding, skills, effort, initiative, and independent resourcefulness.
2. B (good) performance above the norm; work demonstrates adequate understanding, skills, effort, initiative, and improvement beyond the minimum requirements of the course.
3. C (average) meets minimum requirements and demonstrates satisfactory understanding, skills, and effort; little initiative to investigate the problem without substantial prodding from the instructor; work shows minimal improvement.
4. D (inferior) work that does not satisfy minimum requirements, understanding, skills, and effort; initiative lacking; improvement not noticeable.
5. F (failure) does not meet requirements to the extent the student must repeat the course.

Note: More on grading: TTU OP. 34.12 on Grading (Link)

Attendance Policy

Attendance and active participation in all lectures and labs are mandatory. Absences in either lecture or lab are treated the same and shall count toward the same allotment of absences. A total of (3) three absences is considered excessive, and will result in the lowering of the final grade by one full letter. With a total of (4) four absences, you will be dropped from the course and receive an "F".

Attendance will be taken virtually, with the student being marked tardy for being more than 5 minutes late (e.g., logging into the class meeting at 12:36pm), and attendance requires students to have their tools, materials, and supplies available for all applicable activities. Any tardiness, leaving early, lack of participation, 'walking' in and out of lectures, undivided attention, disruptive behavior, etc. will count as 1/3 of an absence.

Missing more than 10 minutes of any class period will count as an absence. Students are not permitted to work on assignments from other classes during any of our meetings, and the instructor reserves the right to remove a student from class if she/he is disruptive in any of the above manners. Please be courteous to your classmates, graduate assistants and instructor.

All absence is considered UNEXCUSED, unless it meets the criteria discussed in the TTU Student Handbook, Part II Com-munity Policies, Section D: Class Absences (page 62) for the following:

1. Illness requiring an absence from class for more than one week.
2. Religious Holy Day Absences.
3. Student Absence due to Sponsorship of Student Activities and Off-Campus Trips.
4. See section II on specific COVID-19 Instructions related to attendance.

NAAB Criteria Met

B6. Environmental Systems: Ability to demonstrate the principles of environmental systems' design, how design criteria can vary by geographic region, and the tools used for performance assessment. This

demonstration must include active and passive heating and cooling, solar geometry, daylighting, natural ventilation, indoor air quality, solar systems, lighting systems, and acoustics.

B.7 Building Envelope Systems and Assemblies: Understanding of the basic principles involved in the appropriate selection and application of building envelope systems relative to fundamental performance, aesthetics, moisture transfer, durability, and energy and material resources.

B9. Building Service Systems: Understanding of the basic principles and appropriate application and performance of building service systems, including lighting, mechanical, plumbing, electrical, communication, vertical transportation, security, and fire protection systems.

II. COVID-19 INFORMATION

Face coverings are required. Texas Tech University requires that students wear face coverings while in classes, while otherwise in campus buildings, and when social distancing cannot be maintained outdoors on campus.

Signage. Be attentive to signage posted at external and some classroom doorways that indicates entry and exit ways, gathering and queuing spaces, and availability of masks and hand sanitizer.

Seating assignments. The purpose of assigned seating is to assist in contact tracing, if necessary, and to augment social distancing. Students are expected to sit at a minimum of six feet apart. A required seating chart will be created once everyone is positioned with appropriate social distancing. There will also be an orderly procedure, designed to ensure social distancing, for exiting the classroom.

Illness-Based Absence Policy
If at any time during this semester you feel ill, in the interest of your own health and safety as well as the health and safety of your instructors and classmates, you are encouraged not to attend face-to-face class meetings or events. Please review the steps outlined below that you should follow to ensure your absence for illness will be excused. These steps also apply to not participating in synchronous online class meetings if you feel too ill to do so and missing specified assignment due dates in asynchronous online classes because of illness.

1. If you are ill and think the symptoms might be COVID-19-related:

a) Call Student Health Services at 806.743.2848 or your health care provider.

b) Self-report as soon as possible using the ttucovid19.ttu.edu management system. This website has specific directions about how to upload documentation from a medical provider and what will happen if your illness renders you unable to participate in classes for more than one week.

c) If your illness is determined to be COVID-19-related, remaining documentation and communication will be handled through the Office of the Dean of Students, including notification to your instructors.

d) If your illness is determined not to be COVID-19-related, please follow steps 2.a-d below.

2. If you are ill and can attribute your symptoms to something other than COVID-19:

a) If your illness renders you unable to attend face-to-face classes, participate in synchronous online classes, or miss specified assignment due dates in asynchronous online classes, you are encouraged to visit with either Student Health Services at 806.743.2848 or your health care provider. Note that Student Health Services and your own and other health care providers may arrange virtual visits.

b) During the health provider visit, request a “return to school” note;

c) E-mail the instructor a picture of that note;

d) Return to class by the next class period after the date indicated on your note.

Following the steps outlined above helps to keep your instructors informed about your absences and ensures your absence or missing an assignment due date because of illness will be marked excused. You

will still be responsible to complete within a week of returning to class any assignments, quizzes, or exams you miss because of illness.

III. UNIVERSITY REQUIRED STATEMENTS

ADA STATEMENT:
Any student who, because of a disability, may require special arrangements in order to meet the course requirements should contact the instructor as soon as possible to make any necessary arrangements. Students should present appropriate verification from Student Disability Services during the instructor's office hours. Please note: instructors are not allowed to provide classroom accommodations to a student until appropriate verification from Student Disability Services has been provided. For additional information, please contact Student Disability Services in West Hall or call 806-742-2405.

ACADEMIC INTEGRITY STATEMENT:
Academic integrity is taking responsibility for one's own class and/or course work, being individually accountable, and demonstrating intellectual honesty and ethical behavior. Academic integrity is a personal choice to abide by the standards of intellectual honesty and responsibility. Because education is a shared effort to achieve learning through the exchange of ideas, students, faculty, and staff have the collective responsibility to build mutual trust and respect. Ethical behavior and independent thought are essential for the highest level of academic achievement, which then must be measured. Academic achievement includes scholarship, teaching, and learning, all of which are shared endeavors. Grades are a device used to quantify the successful accumulation of knowledge through learning. Adhering to the standards of academic integrity ensures grades are earned honestly. Academic integrity is the foundation upon which students, faculty, and staff build their educational and professional careers. [Texas Tech University ("University") Quality Enhancement Plan, Academic Integrity Task Force, 2010]

RELIGIOUS HOLY DAY STATEMENT:
"Religious holy day" means a holy day observed by a religion whose places of worship are exempt from property taxation under Texas Tax Code §11.20. A student who intends to observe a religious holy day should make that intention known in writing to the instructor prior to the absence. A student who is absent from classes for the observance of a religious holy day shall be allowed to take an examination or complete an assignment scheduled for that day within a reasonable time after the absence. A student who is excused under section 2 may not be penalized for the absence; however, the instructor may respond appropriately if the student fails to complete the assignment satisfactorily.

DISCRIMINATION, HARASSMENT, AND SEXUAL VIOLENCE STATEMENT:
Texas Tech University is committed to providing and strengthening an educational, working, and living environment where students, faculty, staff, and visitors are free from gender and/or sex discrimination of any kind. Sexual assault, discrimination, harassment, and other Title IX violations are not tolerated by the University. Report any incidents to the Office for Student Rights & Resolution, (806)-742-SAFE (7233) or file a report online at titleix.ttu.edu/students. Faculty and staff members at TTU are committed to connecting you to resources on campus. Some of these available resources are: TTU Student Counseling Center, 806- 742-3674, https://www.depts.ttu.edu/scc/(Provides confidential support on campus.) TTU 24-hour Crisis Helpline, 806-742-5555, (Assists students who are experiencing a mental health or interpersonal violence crisis. If you call the helpline, you will speak with a mental health counselor.) Voice of Hope Lubbock Rape Crisis Center, 806-763-7273, voiceofhopelubbock.org (24-hour hotline that provides support for survivors of sexual violence.) The Risk, Intervention, Safety and Education (RISE) Office, 806-742-2110, https://www.depts.ttu.edu/rise/ (Provides a range of resources and support

options focused on prevention education and student wellness.) Texas Tech Police Department, 806-742- 3931,http://www.depts.ttu.edu/ttpd/ (To report criminal activity that occurs on or near Texas Tech campus.)

CIVILITY IN THE CLASSROOM STATEMENT:
Texas Tech University is a community of faculty, students, and staff that enjoys an expectation of cooperation, professionalism, and civility during the conduct of all forms of university business, including the conduct of student–student and student–faculty interactions in and out of the classroom. Further, the classroom is a setting in which an exchange of ideas and creative thinking should be encouraged and where intellectual growth and development are fostered. Students who disrupt this classroom mission by rude, sarcastic, threatening, abusive or obscene language and/or behavior will be subject to appropriate sanctions according to university policy. Likewise, faculty members are expected to maintain the highest standards of professionalism in all interactions with all constituents of the university (www.depts.ttu.edu/ethics/matadorchallenge/ethicalprinciples.php).

LGBTQIA SUPPORT STATEMENT*:
I identify as an ally to the lesbian, gay, bisexual, transgender, queer, intersex, and asexual (LGBTQIA) community, and I am available to listen and support you in an affirming manner. I can assist in connecting you with resources on campus to address problems you may face pertaining to sexual orientation and/or gender identity that could interfere with your success at Texas Tech. Please note that additional resources are available through the Office of LGBTQIA within the Center for Campus Life, Student Union Building Room 201, www.lgbtqia.ttu.edu, 806.742.5433."

*If you prefer to list campus resources rather than a statement about ally status, you might include the following among other campus resources you wish to share:

Office of LGBTQIA, Student Union Building Room 201, www.lgbtqia.ttu.edu, 806.742.5433
Within the Center for Campus Life, the Office serves the Texas Tech community through facilitation and leadership of programming and advocacy efforts. This work is aimed at strengthening the lesbian, gay, bisexual, transgender, queer, intersex, and asexual (LGBTQIA) community and sustaining an inclusive campus that welcomes people of all sexual orientations, gender identities, and gender expressions.