ARCH-4350/6350: ENVIRONMENTAL CONTROLS I/IG
University of Utah College of Architecture + Planning
Professor Robert A Young, FAPT, PE, LEED ap

COURSE OUTLINE

Description

This course explores stewardship of the built environment and how decisions affecting the built environment benefit or detract from sustainable design. The course introduces sustainable architecture, thermal comfort, microclimatic analysis, passive thermal systems, heating/cooling loads, daylighting systems, energy codes, and architectural acoustics.

Objectives

The primary objective of this course is to teach the student how to develop the lifelong learning skills needed to interact and communicate with others that they will be in contact with in professional practice (e.g., architects, engineers, clients, consultants, etc.) when designing sustainable solutions based on stewardship of the built environment. To achieve this objective, the course goals include the ability to understand:

- microclimate analysis and design;
- environmental comfort criteria for human occupancy;
- impacts of design on thermal system selection and energy usage;
- architectural form and tectonics as environmental control systems;
- thermal and daylighting performance in sustainable architecture;
- basic passive thermal and daylighting strategies employed in buildings;
- methods for selecting sustainable thermal and daylighting systems;
- reuse and rehabilitation of buildings as a sustainable design strategy;
- impacts of energy incentives and codes on building design.

The underlying objective is to enhance the students’ awareness of the built environment in developing their visual literacy of understanding what has been successful in terms of environmental control and sustainable design.

Teaching Philosophy

The built environment acts as the students’ own living learning laboratory and provides a means to integrate course concepts into explorations in studio and professional practice. Lectures and readings form the foundation of the course. Recitations allow for deeper exploration of specific course materials and concepts which typify situations that an architect encounters in practice. Projects
are designed to sensitize students to the past, present, and future built world and how proven concepts of environmental control and sustainability can be integrated into the built environment.

Student interaction forms an important part of my teaching philosophy. The questions and the resulting discussions bring significant vitality to the course. Students are strongly encouraged to proactively ask questions to initiate discussions as well as seek clarity on materials presented in the lecture and recitations.

Outside the classroom, it is expected that students will also seek further inquiry that fosters the formation of their life-long learning skills. This includes completing class readings before each lecture, investigations at the library and other resources, working in study groups, and consultations with the teaching assistant and the instructor.

**Organization**

**Instructor**  
Robert A. Young, FAPT, PE, LEED ap; Room 240 AAC; (801) 581-3909; young@arch.utah.edu; Office Hours M+W 9:30-10:30 AM; or by appointment. Students should periodically consult the instructor’s web site (http://www.arch.utah.edu/young) for updates on class information.

**Teaching Assistant**  
Xiomara Salazar will be available for consultation and will set separate office hours as needed. The TA will assist in the recitations, site visits, and project grading.

**Class Hours**  
Class will be held be 8:10-9:25 AM, in Room 127 AAC, MW. Recitation/Lab will be 2:00-5:00PM in Room 127 AAC or other locations as announced.

**Textbooks & Readings**  

There are selected readings on the Canvas website, the instructor’s class website or on reserve at Marriott Library. Refer to “Readings” section below for titles. Other readings will be added as need warrants.

**Recitation**  
There will be a recitation on Tuesdays from 2:00-5:00 PM. The recitation will meet in Room 127 AAC, the third floor studio, Bailey Hall, or at site visit locations as described in the course schedule.

“The real voyage of discovery consists not in seeking new landscapes but in having new eyes.”  
- M. Proust
Recitations will be composed of interactive exercises, site visits, discussions and review of course materials, and release time/desk consultations for projects.

**Decorum & Attendance**

Punctuality, professionalism, active participation, and leadership are valued by clients, employers, colleagues, and faculty. As such, students should be ready to begin class at the scheduled start time and be prepared to ask and answer questions.

Class begins with announcements and questions to and from the students and the resultant discussions. Participation goes beyond just coming to class and taking notes. Active participants ask questions and seek clarity to foster greater understanding for themselves and for the class. Leaders engage the class in learning course materials both inside and outside the classroom.

We will be using Canvas periodically for extending class discussions in that forum. Part of the Leadership and Participation Grade will be based on students’ activity and relevant input on those discussions.

Pagers and cell phones must be turned off or set to non-audio mode. Student use of laptops and other internet accessible electronic devices is prohibited during the lecture.

All students are expected to maintain professional behavior in the classroom setting, according to the Student Code, spelled out in the Student Handbook. Students have specific rights in the classroom as detailed in Article III of the Code. The Code also specifies proscribed conduct (Article XI) that involves cheating on tests, plagiarism, and/or collusion, as well as fraud, theft, etc. Students should read the Code carefully and know they are responsible for the content. According to Faculty Rules and Regulations, it is the faculty responsibility to enforce responsible classroom behaviors, beginning with verbal warnings and progressing to dismissal from class and a failing grade. Students have the right to appeal such action to the Student Behavior Committee.

Unless you bring enough food to share with the class, do not eat in class.

Due to the quantity of materials covered, it is recommended that students attend class lectures regularly, ask questions, and keep up with the reading. Students’ participation and leadership qualities in class lectures, recitations, and projects will be used in consideration of their final course grade.
Projects

These projects are to be submitted to complete the course:

(1) Environmental Stewardship
(2) Vernacular Response
(3) Solar Geometry

Students are responsible for all in-class instructions and Canvas-released announcements on projects. Projects are due as shown on the Canvas “Assignments” page.

Due to the size of the class, projects will be done in teams of five students per team or a maximum of twelve student teams. Team sign up will be completed by the end of the first week of the semester.

Project grades will be based on completeness, accuracy, technical comprehension, legibility, and originality. See grading form for further information.

Examinations

Examinations will be given in the third floor design studio and will be completed during the regular class period. The open book and open notes examinations will cover all readings, recitations, site visits, case studies, discussions, and lecture materials. Bring a #2 pencil, and a calculator. Questions should be answered on the grading sheet. Answer sheets and examinations must be turned in at the end of the examination. Students should leave when done so others may finish the exam undisturbed.

Results will be posted at a minimum of 48 hours after all students have taken the examination.

Arrangements for students with learning difficulties should be made prior to the examination. Makeup examinations will only be given for medical or legal related reasons. Students arriving late will be penalized for their tardiness (e.g., no extra time).

Children, pets, and guests are not allowed during the examination. Do not eat during the exam.

Grading

Plagiarism will not be tolerated in this course. All work presented on all assignments must be properly cited. For the first instance of plagiarism, students submitting plagiarized materials will be required to resubmit the assignment with proper citations and will be penalized one full letter grade. A second case of plagiarism by the same student(s) will result in a failing grade in the course and referral to Director of the SOA for disciplinary action.
Late Policy: All assignments must be submitted by the time and date they are due or they are considered late. Late work will be penalized one full letter grade (e.g., an "A" will become a "B", etc.) for any part of the first calendar day and one full letter grade per day thereafter.

All unsubmitted late work must be turned in by 5:00 PM on the last day of the regular semester classes (not finals week) to receive completion credit even though it may be too late for a letter grade.

Final grades will be based on the following:

<table>
<thead>
<tr>
<th>Item</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>Class Leadership and Participation</td>
<td>100 points</td>
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<tr>
<td>Environmental Stewardship Project</td>
<td>100 points</td>
</tr>
<tr>
<td>Vernacular Response Project</td>
<td>100 points</td>
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<tr>
<td>Solar Geometry Project</td>
<td>100 points</td>
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<tr>
<td>Examinations (3@ 100 pts. each)</td>
<td>300 points</td>
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<tr>
<td>Total Possible Points</td>
<td>700 points</td>
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</tbody>
</table>

The cutoffs for final grades are:

- A: 93%  
- A-: 90%  
- B+: 87%  
- B: 83%  
- B-: 80%  
- C+: 77%  
- C: 73%  
- C-: 70%  
- D+: 67%  
- D: 63%  
- D-: 60%  
- E: <60%

Accessibility: The University of Utah College of Architecture + Planning seeks to provide equal access to its programs, services, and activities for people with disabilities. If you need accommodation, prior notice needs to be given to the Center for Disability Services, 162 Olpin Union Building, 581-5020 (V/TDD). All written course information can be made available in alternative format with prior notification to the Center for Disability Services.

University Notes
- Last day to drop classes: September 2, 2013
- Last day to add classes: September 4, 2013
### COURSE SCHEDULE

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Topic [Lecture No.]</th>
<th>Chapter or Reading</th>
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<tbody>
<tr>
<td>1</td>
<td>8/26 M</td>
<td>Introduction [1]</td>
<td>Course Pack (CP)</td>
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<td></td>
<td>8/27 T</td>
<td>Recitation (R) 1: Project 1 Consultations</td>
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<td></td>
<td>8/28 W</td>
<td>Environmental Stewardship-1 [2]</td>
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<td>2</td>
<td>9/02 M</td>
<td><strong>Labor Day</strong></td>
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<td></td>
<td>9/03 T</td>
<td>R 2: <strong>Thermal Oasis</strong></td>
<td>RR-1</td>
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<td></td>
<td>9/04 W</td>
<td>Environmental Stewardship-2 [3]</td>
<td>ES-1, 2, 3</td>
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<td></td>
<td>9/10 T</td>
<td>R 3: Project 1 Consultations</td>
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<td></td>
<td>9/11 W</td>
<td>Environmental Stewardship-4 [5]</td>
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<td></td>
<td>9/17 T</td>
<td>R 4: Project 1 Consultations</td>
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<td></td>
<td>9/18 W</td>
<td>Climate [7]</td>
<td>L: 5; RR-3</td>
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<td>5</td>
<td>9/23 M</td>
<td>Microclimate [8]</td>
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<td>9/24 T</td>
<td>R 5: <strong>Environmental Stewardship Presentations</strong></td>
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<td><strong>Environmental Stewardship Projects Due</strong></td>
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<td>6</td>
<td>9/30 M</td>
<td>Review &amp; Discussion</td>
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<td>10/1 T</td>
<td>R 6: Project 2 Consultations</td>
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<td></td>
<td>10/2 W</td>
<td><strong>Examination #1</strong></td>
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<td>7</td>
<td>10/07 M</td>
<td>Passive Thermal Systems [10]</td>
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<td></td>
<td>10/08 T</td>
<td>R 7: Project 2 Consultations</td>
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<td></td>
<td>10/09 W</td>
<td>Passive Thermal Systems</td>
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<td>10/14 M</td>
<td><strong>Fall Break</strong></td>
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<td>10/15 T</td>
<td><strong>Fall Break</strong></td>
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<td>10/16 W</td>
<td><strong>Fall Break</strong></td>
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<td>10/22 T</td>
<td>R 8: Project 2 Consultations</td>
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<td>9</td>
<td>10/28 M</td>
<td>Passive Thermal Systems</td>
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<td>10/29 T</td>
<td>R 9: Project 2 Consultations</td>
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<td>10/30 W</td>
<td>Passive Thermal Response</td>
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<td></td>
<td>11/5</td>
<td>T: Vernacular Response Presentations</td>
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<td>W: Vernacular Response Project Due</td>
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<td>11</td>
<td>11/11</td>
<td>M: Review &amp; Discussion</td>
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<td>11/12</td>
<td>T: Project 3 Consultations</td>
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<td>11/13</td>
<td>W: Examination #2</td>
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<td>12</td>
<td>11/18</td>
<td>M: Lighting Fundamentals</td>
<td>L: 13; DL2-3</td>
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<td>11/19</td>
<td>T: Project 3 Consultations</td>
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<td>11/20</td>
<td>W: Daylighting-1</td>
<td>DL5-6</td>
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<td>13</td>
<td>11/25</td>
<td>M: Daylighting-2</td>
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<td>T: Project 3 Consultations</td>
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<td>11/27</td>
<td>W: Daylighting-3</td>
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<tr>
<td>14</td>
<td>12/02</td>
<td>M: Daylighting-4</td>
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<td></td>
<td>12/03</td>
<td>T: Solar Geometry Presentations</td>
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<td>Solar Geometry Project Due</td>
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<td>12/04</td>
<td>W: Daylighting-5</td>
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<td>15</td>
<td>12/09</td>
<td>M: Daylighting-6</td>
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<td>12/10</td>
<td>T: TBD</td>
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<td>12/11</td>
<td>W: Review &amp; Discussion</td>
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<td>All unsubmitted late assignments due by 5:00 PM</td>
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<td>Finals</td>
<td>12/16</td>
<td>M: Examination #3 (8:00-10:00 AM)</td>
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**READINGS**

*Instructor's Website*

CP ARCH4350_6350 Coursepack

*Canvas*

CP ARCH4350_6350 Coursepack


RR-4 Young, Robert *Overhang & Fin Calculation*


RR-6 Young, Robert *Solar Geometry Worksheet*
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**Marriott Library**


DL3 Moore, Fuller, *Concepts and Practice in Architectural Daylighting*, Chapters 1,5,6,8.

DL4 Libby-Owens-Ford, "How to Predict Interior Daylight Illumination Conserve Energy and Increase Visual Performance by Effective Daylight Design"


**REFERENCE LIST**


THERMAL OASIS EXERCISE

Introduction

The oasis suggests a place of choice, a respite, a thermal transformation across time or space. The oasis evokes images of a place in many contexts -- a grove or orchard, a market or crossroads, an arcade or courtyard, a sanctuary.

The oasis links the entire realm of physical, mental, emotional, and spiritual senses to ideas of place - escape, harmony, comfort, contrast, connection, and perhaps safety and control. The oasis is a small compartment in the large scale-less boundary, where harsh light becomes dappled, the stillness gives way to the breeze, monotonous constancy is filtered by departure or transition.

The thermal oasis is a place to go to for renewal, and is often experienced as one of life’s rituals. The inherent value of the oasis lies in the awareness that thermal transitions are essential elements of daily rituals. Special moments in life are often recalled through associations with sensual experiences - a certain smell, a warm wind, sunlight, or sound - which contributed to its uniqueness. Directly or subtly, we purposely seek the relief that an oasis provides. An awareness of the value of thermal differences in our daily experiences allows us to appreciate, and design for thermal variability in the built environment.

An oasis is:

- a relatively small but highly identifiable place in a large field that is characterized by its sense of homogeneity.
- a special kind of destination, a stopping place but not a permanent habitation.
- a place of thermal differences created by architectural or natural elements.
- a place of refuge from a primary environment.

Review the "Delight" chapter in Lisa Heschong’s Thermal Delight in Architecture (on reserve at Marriott Library). Use the concepts Heschong talks about to enhance your awareness of the thermal oases in your life.
Throughout her book, Heschong uses examples of thermal variety to illustrate the pleasure and sense of renewal that is often associated with contrast, as compared to uniformity or saturation. These thermal transitions can be an essential element of simple daily rituals in our lives. (A common example would be the morning ritual of leaving a warm bed, placing bare feet on a cold floor, taking a hot steaming shower, then stepping back into the chilly air - an experience that may start off painful but often leaves one with a sense of aliveness).

Heschong also gives many examples of experiences from our other senses that are associated with a sense of coolness or warmth. Visual, auditory, tactile, or olfactory clues can all provide information about corresponding thermal sensations. Rituals and associated senses can all be subcomponents of the oasis experience.

**An Oasis of Current Experience**

Find a separate example of your own warming or cooling oasis in the built environment that is part of your current lifestyle. These can be a place in your home, at work, where you go for entertainment or relaxation, etc. In completing the assignment answer the following:

- What architectural elements influence your perception of the thermal environment (e.g., the shape and size of the room, the color and light, the texture of surfaces, the circulation and entry points, the functional role of the room, and the source of the thermal variation)?

- What visual, auditory, tactile, or olfactory clues provide information about corresponding thermal sensation (see Heschong for examples)? Are they accurate or misleading with regard to the actual thermal environment of the space?

- What about environmental control? To what extent is change controlled by the person occupying the oasis? Is it low energy control - opening a window, removing a rug, adjusting a louver? Is it high energy control - mechanical ventilation, heating, or cooling?

- What about the ideas of ritual and daily seasonal variation. To what extent do these help create the sense of oasis in your chosen space, and how do the architectural elements of the space contribute to these ideas?

Prepare in 250-500 words (1 to 2 pages of 8 -1/2 x 11 double spaced, typed text) a personal narrative describing your oasis. Bring the printed narrative to the recitation as scheduled on the syllabus. The narrative should also be uploaded to Canvas by the date and time indicated as part of your participation grade.
PROJECT 1: ENVIRONMENTAL STEWARDSHIP

Introduction

Environmental stewardship enhances the built environment by recognizing how new construction and the reuse of existing buildings can have substantial impacts on sustainability. Age-old strategies that are being (re)discovered or “new” processes that are being developed are becoming seen as critically imperative to the sustainability of the built environment in the twenty-first century.

This project provides a broad range for exploration limited only by your imagination and encompasses an extensive spectrum. At the micro level are the range of specific individual building processes, materials, and fabrication methods that have recently (re)emerged. Some examples are photovoltaics, LEED and other “green” scoring programs, straw bales, double envelopes, recycled materials, and other emerging “green” products and strategies.

Moving along the continuum, we find buildings themselves used for environmental control by the inclusion of passive thermal design and daylighting. Examples of this are contemporary climate adaptive buildings that are gaining recognition worldwide and those that also integrate the micro level products and processes mentioned above.

Next are existing buildings, such as Audubon House (see left) and the Empire State Building in New York City and the Big-D building in Salt Lake City, that are being rehabilitated or adaptively used and contribute to sustainability by incorporating new green systems and products and are the highest form of recycling as they significantly reduce demands for new raw material for construction and landfill space for demolition wastes.

Possible paper topics include:

- Adaptive reuse of existing buildings for 21st century uses and needs.
- LEED and existing buildings (Note: This includes LEED-NC and/or LEED EB case studies).
- Passive thermal and lighting technologies used in pre-1940 buildings.
- Recycling buildings in place to reduce demolition materials in landfills.
- Recycling buildings to reduce demand for the use of new raw materials.
- Incentives for reusing buildings.
- Case studies of contemporary architects who specialize in adaptive reuse.
- Social, environmental, and economic sustainability of reusing buildings.
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Objectives

The objectives of this assignment are:

- To introduce the student to the practice of evaluating how good stewardship can create sustainable spaces, buildings, and communities.
- To heighten the student’s sensitivities to how the built environment (e.g., new and existing buildings) can be enhanced by these processes.

Procedure

In a team of five people, develop a paper that includes a case study or series of examples that illustrates the topic you are investigating which will (A) define the topic (500 words), (B) explain how you researched or developed the topic (250 words), (C) explain why an architect should be familiar with this topic (250 words), (D) explore examples and describe the implications for the future and continued use of buildings (1500-2000 words) and how they existing buildings can be enhanced to improve building performance, and (E) provide your conclusions about this topic (500 words). The paper should be approximately 3500-4000 words (e.g., 14-16 double-spaced 8-1/2” x 11” pages of text; note: images will lengthen this page count).

In writing the paper, keep the following criteria in mind:

1. Do not use Wikipedia for references in the paper.
2. Proofread manually. Spellchecker is not a proofreader.
3. Use only third person voice (e.g., he, she, they).
4. Avoid contractions (e.g., “do not” instead of “don’t”).
5. Use headings to delineate major areas of the paper (e.g., introduction of research question or issues, case studies, discussion, and conclusion).
6. Include captioned graphics (e.g., “Figure 1: Front façade of XYZ building”) within the body of the text for visual interest and to clarify a point of discussion. Call out figures in text (e.g., “Figure 1”).
7. Cite sources of images and quotes.
8. Include a bibliography at the end (note: the text for this is not included in the word count).
9. Use appendices where appropriate to maintain flow within the main body of the paper. Use call outs (e.g., “see Appendix A”) where appropriate.

From the summary, prepare a power point presentation for a 10 minute presentation. The presentation should consist of an integration of still images, drawings, text, and, if available short video clips/animations. Use captions to note sources of photographs, video clips, and animations.
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Grading Criteria

Refer to the grading criteria on Canvas or the class website. Presentations that do not conform to the expected content and paper format will be penalized.

Schedule

This project will take the first five weeks of the semester. Teams should be working loosely along the following schedule:

Week 1: Form teams of 5 students; sign up team with TA; select topic and begin research
Week 2: Continue research
Week 3: Continue research
Week 4: Finalize research; prepare paper  Prepare and rehearse presentation
Week 5: Make presentation to class. All team members must attend.

Products

Class presentations will be given during the recitation indicated on the syllabus. The ability to effectively communicate ideas and concepts in a concise manner is a valued skill for many practitioners. Due to time constraints, the presentation will be limited to 10 minutes only. Upload paper and presentation media to Canvas by the deadline indicated. The file names should include the following information:

ARCH4350-6350F13_Project1_ES_TeamMember1-TeamMember2-TeamMember3-TeamMember4-TeamMember5_Paper.docx
ARCH4350-6350F13_Project1_ES_TeamMember1-TeamMember2-TeamMember3-TeamMember4-TeamMember5_Presentation.ppt
PROJECT 2: VERNACULAR RESPONSE PROJECT

Introduction

Beginning with Roger Bailey, our first Dean, the College of Architecture + Planning has a long history of observing built environments to gain appreciation for architectural design. Since buildings reflect the technology of when they were built, buildings built before the mid-twentieth century used a much different building vocabulary than those built in the past fifty years. Each construction was considered appropriate for its time however there are societal, technological, and natural design principles that shaped their formation and selection.

Objectives

The objectives of this assignment are:

- To explore the forces that affect climate responsive design.
- To develop skills in recognizing/designing climatic-responsive designs.
- To recognize climate responsive or rejecting designs.

Procedure

Explore the vernacular architecture of a non-Utah climate region. In teams of five people, describe how environmental forces affect the vernacular architecture of a climatic region and analyze the thermal performance implications for existing buildings. Identify the climatic determinants (e.g., earth, wind, fire (sun), and water). Identify thermal strategies in the vernacular architecture. Document how architectural elements and site features enhance their effectiveness. If features were a reflection of available materials or local culture, analyze their thermal implications.

Next, find a contemporary building in that region which has adapted the vernacular concepts into its design. Then, find a building in the region which has rejected the responsive concepts. Develop conclusions about thermal implications.

Climate Adaptive: Rocky Mountain Institute, Old Snowmass, CO

Climate Rejecting: Salt Lake City Public Library, SLC, UT
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performance from a climatic perspective and how the thermal systems are affected by climate adaptive and rejecting designs.

Develop a paper that illustrates the region you are investigating. The paper will (A) define the climate region (250 words), (B) explain the climatic forces that inform the vernacular climate adaptive buildings (750 words), (C) describe the modern climate adaptive building and how the climatic forces are expressed in the design (1000-1250 words), (D) describe the modern climate rejecting building and how the rejection reduces the sustainability of the building (1000-1250 words), and (E) compare and contrast the success or failures of the two buildings (500 words). The case study should be approximately 3500-4000 words (e.g., 14-16 double- spaced 8-1/2” x 11” pages of text; note: images will lengthen this page count).

In writing the paper, keep the following criteria in mind:

1. Do not use Wikipedia for references in the paper.
2. Proofread manually. Spellchecker is not a proofreader.
3. Use only third person voice (e.g., he, she, they).
4. Avoid contractions (e.g., “do not” instead of “don’t”).
5. Use headings to delineate major areas of the paper (e.g., introduction of research question or issues, case studies, discussion, and conclusion).
6. Include captioned graphics (e.g., “Figure 1: Front façade of XYZ building”) within the body of the text for visual interest and to clarify a point of discussion. Call out figures in text (e.g., “see Figure 1”).
7. Cite sources of images and quotes.
8. Include a bibliography at the end (note: the text for this is not included in the word count).
9. Use appendices where appropriate to maintain flow within the main body of the paper. Use call outs (e.g., “see Appendix A”) where appropriate.

Grading Criteria

Refer to the grading criteria on the class website. Presentations and papers that do not conform to the expected content or time lengths will be penalized.

Schedule

Suggested activities for each week are as follows:

Week 6: Form teams of 5 students; sign up team with TA; begin research
Week 7: Identify climate region, vernacular typologies, and example buildings
Week 8: Refine information; conduct research into case study
Week 9: Finalize case study and develop/rehearse presentation
Week 10: Make presentation as scheduled by the TA. All team members must be present.
Team desk consultations will be held in the design studio during the recitation. There will be a signup sheet for scheduled times. All team members must attend.

Products

Class presentations will be given during the recitation indicated on the syllabus. The ability to effectively communicate ideas and concepts in a concise manner is a valued skill for many practitioners. Due to time constraints, the presentation will be limited to 10 minutes only. Upload paper and presentation media to Canvas by the deadline indicated. The file names should include the following information:

ARCH4350-6350F13_Project2_VR_TeamMember1-TeamMember2-TeamMember3-TeamMember4-TeamMember5_Paper.docx
ARCH4350-6350F13_Project2_VR_TeamMember1-TeamMember2-TeamMember3-TeamMember4-TeamMember5_Presentation.ppt
PROJECT 3: SOLAR GEOMETRY PROJECT

Introduction

This project involves the design of a solar geometry-based building detail. Throughout time, the sun has been used to denote the change of the seasons, to celebrate specific solar calendar events, and to track the passage of time. Ancient civilizations would erect monumental constructions (e.g., Stone Henge) or incorporate architectural details (e.g., the Pantheon) that would allow the sun to indicate either by a shadow (using a gnomon) or the passage of light (using an oculus) a specific time or date.

An oculus is an opening through which the sunlight, when the sun is at a specific angle in the sky, will pass through and illuminate a celebratory spot such as a niche, a carving, a portrait, or other important artifact or architectural detail. On the other hand, the gnomon is a solid material that is used to cast a shadow that terminated at a specific spot or along a specific line. The oculus and gnomon could be used in a horizontal or vertical orientation depending upon location and the nature of the design.

These details are still being reconsidered and re-expressed in contemporary designs in modern times (see Wil Bruder’s Solar Candle at the Phoenix Library shown on next page).

Objectives

The objectives of this assignment are:

• To gain experience in designing a detail that uses solar geometry to activate or enhance the environment.
• To enhance analytical skills.
• To gain experience with modeling sun angles.
**Procedure**

As a team of five students, select a design strategy (either a gnomon or an oculus) and design a solar sculpture which celebrates the autumnal and vernal equinoxes at solar noon for a location at 40°N. For this exercise ignore daylight savings time and the solar time displacement due to longitude. The intention is to indicate the center of a spot that is located 16' due north of the vertical projection of the center of the gnomon or oculus onto the ground plane below the oculus or gnomon. Other elements of the support system for the solar detail should not obstruct the sunlight from the target point at the time of the celebratory "moment in time."

Pick a Pritzker Prize winning architect and use her or his body of work as a source of your parti for the solar sculpture. Using hand calculations or computer modeling software, confirm that the celebratory spot is in fact indicated by the oculus or gnomon at the celebratory moment in time.

Using digital modeling, record the shading sequence or develop an accurate computer animation for a simulation of the performance of the detail from 8 AM to 4 PM with the specific "moment in time" highlighted. As part of the documentation, develop a separate single still image from the computer that shows the solar detail works correctly at the celebratory moment in time listed above.

Next, based on your performance analysis, construct a physical model of your solar detail (Scale=1"=1'-0"). For simplicity, the model should fit within a 24" cube. Photograph your model in elevation, plan, and from two other different points of perspective (4 photos in total; 4"x6", 300 dpi, using Photo lab and SLR Digital camera (no cell phone images)). The model should maximize the use of found objects, materials with recycled content or materials that can later be recycled. The model should minimize the use of non-recyclable materials such as foam core.

Develop a video or power point presentation that identifies your chosen architect, explains your parti, and then provides a visual record of the performance of the
solar detail. The presentation should consist of an integration of still images, drawings, and simple text, and video clips/animations. Use captions to note sources of photographs, video clips, and animations. Finally, prepare a separate written summary description of your project.

Grading Criteria

The solar sculpture model will be used for your presentation. The media submission will be used to record your submission in the course archives and as a basis for grading the actual solar detail performance. Grading will be based on the completeness of submitted materials, the organization of the presentation media, the clarity of the animations and images that prove that the detail works correctly as well as the design and craft of the final physical model.

Schedule

Activities for each week are as follows:

Week 11: Identify architect and confirm choice with TA. Formulate parti and begin preliminary design of solar sculpture. Preliminary digital (or physical) models can be used to verify accurate performance.

Week 12: Finalize design; Construct a physical model.

Week 13: Test and photograph model and rehearse presentation

Week 14: Make presentation

Team desk consultations will be held in the design studio during the recitation. There will be a signup sheet for scheduled times. All team members must attend.

Products

In a team of five people, develop the written summary that will describe how you developed your solar sculpture. In the summary you will (A) identify and describe the characteristics of the work of the Pritkzer Prize winning architect from whom you are drawing inspiration (500 words), (B) explain design process (500 words), (C) describe your project parti (250 words), (D) show images and illustrations that demonstrate how your sculpture works (500-750 words) (E) provide your conclusions about the solar sculpture and what (if anything) you would change about it (500 words). The paper should be approximately 2000-2500 words (e.g., 8-10 double-spaced 8-1/2” x 11” pages of text; note: images will lengthen this page count). The presentation will be performed as indicated on the syllabus. Each team will have 10 minutes to present their sculpture. Upload your summary, the video/power-point images and simulations developed for the
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Professor Robert A Young, FAPT, PE, LEED ap

performance analysis, and the photographs of your final design to Canvas. The photos will be later used on the class gallery on the CA+P website.

ARCH4350-6350F13_Project1_SS_TeamMember1-TeamMember2-TeamMember3-
TeamMember4-TeamMember5_Paper.docx
ARCH4350-6350F13_Project1_SS_TeamMember1-TeamMember2-TeamMember3-
TeamMember4-TeamMember5_Presentation.ppt
ARCH4350-6350F13_Project1_SS_TeamMember1-TeamMember2-TeamMember3-
TeamMember4-TeamMember5_Phot01.jpg [repeat for photos 2, 3, and 4]