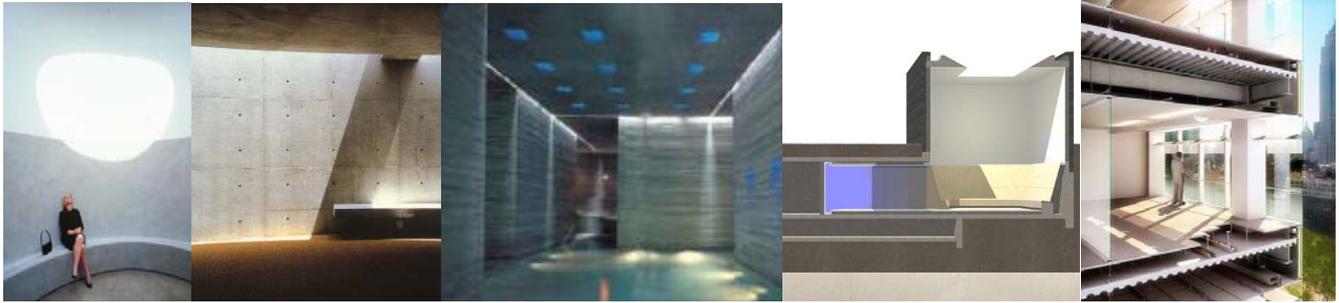


ARCH 5516 • LUMINOUS AND THERMAL DESIGN Technology Two

6 credits (6.5 weeks); NAAB Criteria: 15, 18

An Ecological Approach to Zero-Energy Carbon Neutral Design



“...The building is not a fixed object but part of the larger pattern that flows with change – a permeable membrane responding to changes in use and place...Architecture is part of the process of ‘re-membling’ – putting back together our collective dreams. I like to design buildings that are places for learning, healing, reflection, coming together. The building should tell a story about place and people and be a pathway to understanding ourselves within nature.”

– Sim Van der Ryn, Ecological Design Pioneer

“How sense-luscious the world is. In the summer, we can be decoyed out of bed by the sweet smell of the air soughing through our bedroom window. The sun playing across the curtains gives them a moire effect, and they seem to shudder in light, someone might hear the dawn sound of a cardinal....We need to return to feeling the textures of life.”

- Diane Ackerman, A Natural History of the Senses

Instructors

Mary Guzowski, Associate Professor, School of Architecture

Phone: 612 624-9017 (voice mail); E-mail: guzow001@umn.edu

Office hours: Wednesday, 12:00-1:00 p.m. or by appointment, Room 145D

Loren Abraham, AIA, LEED AP, Adjunct Assistant Professor

Abraham + Assoc, Minneapolis

Phone: 651 480-2237; E-mail: abrah221@umn.edu

Office hours: Monday 12:00-1:00 p.m. or by appointment, Room 71 (lower level)

Ian McLellan, Adjunct Instructor

Phone: 612 251-7151; E-mail: mcle0125@umn.edu

Office hours: TBD or by appointment, Room TBD

If you cannot make these office hours please see the instructors after class to make an appointment. Office hours can be used to discuss course work, review work in-process, get additional readings, or to talk about the subject matter in relation to your special interests.

Studio Critics

Renee Cheng, Professor, Head, School of Architecture, AIA

Bob Ganser, Citydesk Studio, AIA, Adjunct Instructor

Nat Madson, VJAA, Adjunct Instructor

Jeff Mandyck, Meyer Sherer and Rockcastle, AIA LEED AP, Adjunct Instructor

The studio critics will meet with teams each week and attend all formal project reviews. Their roles are to further support your design investigations and to help teams

look holistically at the integration of course issue and design excellence. Teams will meet with the same studio critic each week.

Teaching Assistants

Sarah Bremer (sarahbremer@gmail.com) Office hours: TBD
Kevin Ellingson (elli0464@umn.edu) Office hours: TBD
Joshua Grenier (gren0044@umn.edu) Office hours: TBD
Brady Hickcox (ghick0188@umn.edu) Office hours: TBD
Denisse Velez Rivera (velez.denisse@gmail.com) Office hours: TBD

The TAs are available to assist you with projects and lab work. Please take advantage of their office hours to clarify information and to review your work in-process.

COURSE DESCRIPTION

Introduction

ARCH 5516: Luminous and Thermal Design Integration

This semester you are asked to consider how architectural design can respond to the growing ecological challenges of global warming and climate change. While there are many issues related to carbon neutral and zero energy design, this investigation will focus on the roles of daylighting, thermal, and bioclimatic considerations to meaningfully inform architectural design while also reducing fossil fuel consumption and carbon emissions. Your challenge is to design a third floor addition to “old Rapson Hall” for the new “Minnesota Zero-Energy Design Lab” (mnZED Lab) for the College of Design. The design project will enable students to gain firsthand experience of the phenomena of thermal and luminous designs and their ecological design opportunities. Direct application of concepts, strategies, and principles as well as qualitative and quantitative assessment, and testing will be considered.

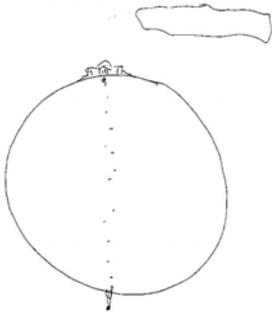
Course Focus & Objectives

ARCH 5516: Luminous and Thermal Design introduces the ecological design concepts and principles of daylighting, thermal, energy, and systems integration. The course will provide students with an understanding of the primary architectural and technological implications of lighting and thermal to inform design and ecological thinking and to support sustainable design decision-making. An integrated approach to the course topics will be explored from a variety of perspectives to address the following course objectives:

The objectives of the course include:

1. Promoting Ecological and Holistic Systems Thinking: To provide students with daylighting and thermal design processes and integrated tools that enable them to evaluate, assess, and apply a holistic approach to zero-energy carbon-neutral design.
2. Exploring Formal, Aesthetic and Experiential Design Opportunities: To introduce students to the formal, aesthetic, and experiential opportunities of an ecological approach to daylighting, thermal, and systems integration in design.
3. Integrating Appropriate Design and Technology Applications: To learn to employ design and technology appropriately to achieve optimal ecological effectiveness.
4. Developing Methods of Design and Performance Assessment and Testing: To introduce and apply qualitative and quantitative methods and design tools for ecological assessment and performance analysis.

“The building should tell a story about place and people and be a pathway to understanding ourselves within nature.”
- Sim Van der Ryn



Course Work

PROJECTS, GRADING, AND EXPECTATIONS

The course will include three design projects, which enable students to assess and apply concepts, strategies, and assessment methods through direct application to design. Students will work in a team; however, there will be both individual and team grading.

Projects are *tentatively* weighted accordingly:

Project Tentative Grade Weighting

<i>Project One: Daylighting Design</i>	<i>30%</i>
<i>Phase 1: Site and Bioclimatic Design</i>	
<i>Phase 2: Daylighting Program and Quantitative Assessment</i>	
<i>Project Two: Thermal Design</i>	<i>30%</i>
<i>Phase 1: Baseline Analysis and Passive Studies</i>	
<i>Phase 2: Envelope Optimization and Thermal Analysis</i>	
<i>Project Three: Integrated Design</i>	<i>40%</i>
<i>Phase 1: Room & Envelope</i>	
<i>Phase 2: Systems Integration</i>	
<i>TOTAL</i>	<i>100%</i>

All projects are due at the beginning of class on the project due date (or it will be considered late). Late projects will be lowered one grade for each calendar day that it is late (i.e. from an A to A- if it is submitted late on the due date, from an A to a B+ if it is submitted the day following the due date, etc.).

Note on the computer methods portion of the class: In addition to the design projects the course includes a required computer component. Attendance is required for all class periods unless there is a legitimate reason. Completion of all assignments is required for the computer portion of the course and must be completed to receive a passing grade. All assignments are due at the beginning of class on the assignment due date.

Grading Standards

All projects must be completed to receive a passing grade. Explicit grading criteria will be provided with each project assignments. The UMN grading standards will be used for project grading:

University of Minnesota Grading Standards:

- A Achievement that is outstanding relative to the level necessary to meet course requirements
- B Achievement that is significantly above the level necessary to meet course requirements
- C Achievement that meets the course requirements in every respect
- D Achievement that is worthy of credit even though it fails to meet fully the course requirements
- SAchievement that is satisfactory, which is equivalent to a C- or better
- F (or N) Represents failure (or no credit) and signifies that the work was either: 1) completed but at a level of achievement that is not worthy of credit or 2) was not completed and there was no agreement between the instructor and the student that the student would be awarded an incomplete.
- I (Incomplete) Assigned at the discretion of the instructor when, due to extraordinary circumstance, e.g., hospitalization, a student is prevented from completing the work of the course on time. Requires a written agreement between instructor and student.

Collaboration

You will be working on a collaborative project throughout the 6.5 week period. You are asked to form teams comprised of four students to include a combination of students from the M.Arch 3+ and B.S. programs. There should be no more than two M.Arch 3+ students on a team. Teams should include at least at least one person whom you have not worked with in the past. Consider balancing your team members varied skills and strengths.

Academic Dishonesty

Academic dishonesty in any portion of the academic work for a course shall be grounds for awarding a grade of *F* or *N* for the entire course.

Credit/Workload Expectations

This 6 credit course will run for 6.5 weeks. The expected workload for this course provided by the School of Architecture and based on University standard is an estimated total of *42 hours per week*. This can include any combination of time in the class or outside the class. We will work with students to assess the workload and make adjustments as needed.

Schedule and Attendance

The courses meet on Monday, Wednesday, and Friday mornings and afternoons (locations are listed in the schedule for each day). Attendance is required at all reviews and class meetings. It is critical that you fully participate and attend all class periods (lectures, computer methods, reviews, and field studies). Please make every effort to be to class on time. Punctuality is important in maintaining and building community and as a means of minimizing class disruptions. To further minimize disruptions, we request that no computers or electronic devices be used during Mary and Loren's lecture portion of the class (even for note taking), unless the computer is needed for an in-class assignment. A detailed daily schedule is provided as a separate handout.

Supporting Materials**READING*****Required Text (on reserve and available in UMN Bookstore)***

Each team is asked to purchase one copy of each of the following books:

- Kwok, Alison and Walter Grondzik. *The Green Studio Handbook*. London: Architectural Press, 2007.
- Lechner, Norbert. *Heating, Cooling, Lighting: Design Methods for Architects*, 2nd or 3rd Edition, New York, Wiley, 2009.

Required Software

- *Autodesk Ecotect Analysis 2010*; required for first day of class.
- *Desktop Radiance* (Lighting and Daylighting Simulations); installation instructions will be given in class.
- *DAYSIM* (Dynamic Daylighting Simulations); installation instructions in class.

E-Reserve Reading Assignments

Specific readings will be assigned with the individual course projects in 1-2 week increments. E-Reserve readings are on *electronic reserve* through the University of Minnesota library system. The e-Reserve course page is located at:

<http://eres.lib.umn.edu/eres/coursepage.aspx?cid=1788>.

The password is: gkEd8ra.

ARCH 5516 • LUMINOUS AND THERMAL DESIGN

Technology Two

REFERENCE BOOKS ON RESERVE in the College of Design Library, Rapson Hall

Listed below are reference books on daylighting, thermal, passive design, systems integration, and zero-energy design that are on reserve in the College of Design library for your reference (please see following list).

Please note related case study and carbon-neutral websites at the end of the list.

Daylighting Design

- Baker, N.V, Fanchiotti, A., and K. Steemers, editors. *Daylighting in Architecture: A European Reference Book*. London: James & James, 2001.
- Deutsches Architektur Museum, editor. *The Secret of the Shadow: Light and Shadow in Architecture*. Germany: DAM, 2002.
- Gannon, Todd, editor. *The Light Construction Reader*. New York: The Monacelli Press, 2002.
- Guzowski, Mary. *Daylighting for Sustainable Design*. New York: McGraw-Hill, 2000.
- Hegger, Manfred, Matthias Fuchs, Thomas Sstark, and Martin Zeumer. *Energy Manual: Sustainable Architecture*. Basel: Birkhäuser Publishers, 2008 (energy, thermal, daylight, and systems).
- Herzog, Krippner, and Lang. *Facade Construction Manual*, Basel: Birkhäuser Publishers, 2004 (please browse – excellent reference).
- Illuminating Engineering Society of North America (IESNA). *The IESNA Lighting Handbook*, New York: IESNA.
- Licht, Ulrike Brandi. *Lighting Design: Principles, Implementation, Case Studies*. Basel: Birkhäuser Publishers, DETAIL Practice, 2006 (daylighting and electric lighting).
- Meyers, Victoria. *Designing with Light*. New York: Abbeville Press Publishers, 2006.
- Millet, Marietta. *Light Revealing Architecture*. New York: Van Nostrand Reinhold, 1996.
- Richards, Brent. *New Glass Architecture*. New Haven: Yale University Press, 2006.
- Schittich, Christian, editor. *inDETAIL: Building Simply*. Basel: Birkhäuser Publishers, 2005.
- Schittich, Christian, editor. *inDETAIL: Interior Spaces: Space, Light, Materials*. Basel: Birkhäuser Publishers, 2002.
- Schittich, Christian, editor. *inDETAIL: Solar Architecture*. Basel: Birkhäuser Publishers, 2003.
- Klaus Daniels, *Low-tech Light-tech High-tech*, Basel: Birkhauser, 2000.

Electric Lighting Design

- Byars, Mel. *50 Lights: Innovations in Design and Materials*. Switzerland: RotoVision, 1997.
- Egan, David M. and Victor Olgyay. *Architectural Lighting, second edition*. New York: McGraw-Hill, 2002.
- Gardner, Carl and Barry Hannaford. *Lighting Design: An Introductory Guide for Professionals*, New York: John Wiley & Sons, 1993.
- Karlen, Mark and James Benya. *Lighting Design Basics*. New York: John Wiley & Sons, 2004.
- Licht, Ulrike Brandi. *Lighting Design: Principles, Implementation, Case Studies*. Basel: Birkhäuser Publishers, DETAIL Practice, 2006 (daylighting and electric lighting).
- Steffy, Gary. *Architectural Lighting Design, second edition*. New York: John Wiley & Sons, 2002.
- Thureau, Vanessa. *Ultimate Lighting Design*, New York: teNeues, 2005.

Envelope Design (Daylight and Thermal Issues)

- Balkow et al. *Glass Construction Manual*, Boston: Birkhäuser, 1999.
- Compagno, Andrea. *Intelligente Glasfassaden : Material, Anwendung, Gestaltung : Intelligent Glass Facades: Material, Practice, Design*. Boston : Birkhauser-Verlag, 2002.

- Schittich, Christian, editor. *inDETAIL: Building Simply*. Basel: Birkhäuser Publishers, 2005.
- Schittich, Christian, editor. *Building Skins*. Basel: Birkhäuser Publishers, 2001.
- Schittich, Staib, Balkow, Schuler, and Sobek. *Glass Construction Manual*. Basel: Birkhäuser Publishers, 1999.
- Wigginton, Michael and Jude Harris. *Intelligent Skins*, Oxford: Butterworth-Heinemann, 2002.

Thermal, Passive Solar, Zero and Low Energy Design, and/or Integrated Systems

- Abraham, Loren E. (adaptation) and Thomas Schmitz-Gunther, editor. *Living Spaces: Ecological Building and Design*; Cologne, Germany : Konemann Verlag., 1999.
- Allen, Edward. *Fundamentals of Building Construction*; 3rd ed.; New York : Wiley, 1999.
- Brown, G.Z., Mark DeKay, *Sun, Wind & Light*; 2nd ed., New York : J. Wiley, 2001.
- Burke, Bill and Marian Keeler, *Fundamentals of Integrated Design for Sustainable Building*; New York : J. Wiley, 2009.
- Guzowski, Mary. *Towards Zero Energy Architecture: New Solar Design*. London: Laurence King Publishers Ltd., 2010.
- Hegger, Manfred, Matthias Fuchs, Thomas Sstark, and Martin Zeumer. *Energy Manual: Sustainable Architecture*. Basel: Birkhäuser Publishers, 2008 (energy, thermal, daylight, and systems).
- Kwok, Alison and Walter Grondzik. *The Green Studio Handbook*. London: Architectural Press, 2007.
- Lechner, Norbert. *Heating, Cooling, Lighting: Design Methods for Architects*, 3rd Edition, New York, Wiley, 2009.
- Mazria, E. *The Passive Solar Energy Book*. expanded professional edition. Emmaus, PA, Rodale Press, 1979.
- Schittich, Christian, editor. *inDETAIL: Building Simply*. Basel: Birkhäuser Publishers, 2005.
- Stein, B. and J. Reynolds, W. Grondzik, and A. Kwok. *Mechanical and Electrical Equipment for Buildings*, 10th Edition, Wiley, 2006

WEBSITES: Case Studies and Carbon-Neutral Design

- Architecture 2030, www.architecture2030.org.
- AIA Committee on the Environment (COTE) Top Ten Projects, <http://www.aiatopten.org/>.
- AIA/SBSE Carbon Neutral Design Project, http://www.architecture.uwaterloo.ca/faculty_projects/terri/carbon-aia/.
- Build Carbon Neutral, <http://buildcarbonneutral.org>.
- Department of Energy, Energy Efficiency and Renewable Energy (EERE) Buildings Database, <http://eere.buildinggreen.com/>
- Greensource Building Projects, http://greensource.construction.com/green_building_projects/default.asp
- IEA Net-Zero Energy Buildings Database, <http://iea40.buildinggreen.com/index.cfm>.
- U.S. Department of Energy, Net Zero Energy Commercial Building Initiative, http://www1.eere.energy.gov/buildings/commercial_initiative/

“Ecological design is the art that reconnects us as sensuous creatures evolved over millions of years to a beautiful world. That world does not need to be remade but rather revealed. To do that, we do not need research as much as the rediscovery of old and forgotten things. We do not need more economic growth as much as we need to relearn the ancient lessons of generosity, as trustees for a moment between those who preceded us and those who will follow. Our greatest needs have nothing to do with the possessions of things but rather with heart, wisdom, thankfulness, and generosity of spirit. And these virtues are part of larger ecologies that embrace spirit, body, and mind – the beginning of design.” - David Orr, *Nature of Design*

“A phosphorescent jewel gives off its glow and color in the dark and loses its beauty in the light of day. Were it not for shadows, there would be no beauty.” Jun'ichiro Tanizaki, *In Praise of Shadows*