Innovative Teaching Manual

PROJECT TITLE
Daylighting Design

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PROJECT LEVEL
Third Year

ABSTRACT
After gaining knowledge from lectures *Designing to Meet Psychological Need, Introduction to Daylighting Design, The Sustainable Built Environment, and State of the Art Daylighting Case Studies,* teams of interior design and architecture students: 1) constructed a study model of a significant architectural structure that emphasized daylighting design principles; 2) plotted the daylight patterns of three different daylight scenarios varying the seasonal and time of day sun angles and sky conditions in order to analyze the effectiveness of the daylight design intention; and 3) documented their processes with annotated photographs. Students evaluated the success of the daylighting design with regard to its potential for contributing to: 1) the psychological well-being of the users of the space; 2) the aesthetic design; and 3) an ecologically sound and sustainable built environment.

OBJECTIVES
The purpose of this assignment is to raise awareness in interior design and architecture students of the significance of daylighting design as it impacts on: the psychological well being of users of the built environment; contributing to aesthetic design; and contributing to an ecologically sound and sustainable built environment. Specific objectives are:

- students will learn to use a light meter and apply its data for analysis;
- students will learn to interpret sky luminance and horizontal illuminance charts; latitude and longitude charts; seasonal, latitudinal and time of day charts; and sun path charts;
- students will learn to set proper solar altitude and azimuth angles to emulate different daylight conditions;
- students will learn to document their processes with annotated photographs;
- students will learn to analyze the effectiveness of daylighting design with regard to specific criteria;
- students will gain the knowledge necessary to use daylighting design as a tool to help satisfy the basic psychological needs of the users of a built environment; and
- students will gain introductory knowledge of the impact of daylighting design on ecologically sound and sustainable environmental design.

CRITERIA
The background perspectives the students used to analyze the effectiveness of daylighting design in a particular built structure of their choosing were:

- an understanding of how daylighting design can make a positive contribution to the psychological well being of the users of a space;

- an understanding of how daylighting design contributes to the aesthetic design of a space; and
- an understanding of how daylighting design can make a positive contribution to an ecologically sound and sustainable built environment.

PROCESS

1. Background or foundation lectures were presented by the instructor on:
   - Designing to Meet Psychological Need — lighting design as a tool to help satisfy the basic psychological needs for orientation, predictability, control, competency, order, variety, privacy, comfort, movement, and beauty;
   - Introduction to Daylighting Design — quantity and quality of daylight, orientation, architectural elements, control elements, glazing, toplighting, sidelighting, obstructions, incident light, reflected light, transmitted light, glare, and atria design;
   - The Sustainable Built Environment — energy conservation, life cycle cost benefits, and ecological soundness; and
   - State of the Art Daylighting Case Studies — Seinajoki Library, Scandinavia; Evergreen State College, Olympia, Washington; Fantasia Office/Apartment Building, Tokyo, Japan; Lockheed Building 157, Sunnyvale, Ca; 3M's Twin City Towers, Minneapolis, MN.; Ark Mori Building, Tokyo, Japan; Kimball Art Museum, Fort Worth, TX.

2. Students were divided into four or five member teams. Each team was responsible for completing the assignment.

3. Each team constructed a study model of a significant architectural structure that emphasized daylighting design.

4. Each team set artificial daylight sources at proper solar altitude and azimuth angles using sky luminance and horizontal illuminance charts; latitude and longitude charts; seasonal, latitudinal and time of day charts; and sun path charts provided by the instructor.

5. Each team determined and set appropriate footcandle/lux levels using the light meter to emulate daylight conditions at three different, and approximately equally spaced, daytime settings.

6. Daylight patterns were plotted at each daytime setting on the exterior and interior of the study model, and measurements of footcandles/lux were made with a light meter at selected interior locations.

PRESENTATION

Each team submitted a report which included:

1. a brief description of the selected building, location, design, and design intention;
2. documentation of the daylight plotting process with annotated photographs;
3. photographs of the model with plotted interior and exterior daylight patterns at each of the three daytime settings noting sky conditions, season, latitude/longitude, time of day, and light meter readings;
4. a written analysis and discussion of the daylight effects relative to:
   - the building design (apertures, fenestrations, spatial volumes, site orientation, etc.);

- the design intention; and,
- its ability to contribute to the psychological well being of its users, the aesthetic design, and an ecologically sound and sustainable built environment; and

5. each team member submitted an objective and critical evaluation of each fellow team member's contribution to the project.

EVALUATION

Criteria for evaluation were:

- appropriateness of the building selected to be analyzed;
- construction accuracy and craftsmanship of the model;
- data recording of daylight plots and light meter readings;
- description of building context;
- quality of annotated photographs documenting the process;
- analysis of daylighting effects;
- individual team member participation; and
- the ability of each student to objectively and critically evaluate the work of fellow teammates.

PROJECT LENGTH

Four Weeks

RESOURCES

Erwine, B. (1998, December). Daylighting decisions — tools for an informed approach. *Architectural Lighting,* 12(4-5), pp. 86-90.

Guzowski, M. (2000). *Daylighting for Sustainable Design.* New York: McGraw-Hill.

Ho, C. L., & Bartolucci, M. (1995, April). Here comes the sun. *Metropolis,* 66-107.

Kasian Kennedy Design Partnership. (1995). *Design Smart: Energy Efficient Architectural Design.* Burnby, B. C., Canada: BC Hydro.

Rea, M. S. (Eds.). (2000). *IESNA Lighting Handbook,* 9th Edition. New York: Illuminating Engineering Society of North America.

DOCUMENTATION

Daylighting Analysis of The Tucker House by Robert Venturi

Sample of handouts and student work