Greener Foundations: Environmental Sensibilities and Beginning Design Education
"The Box Projects"

TERRI MEYER BOAKE
University of Waterloo

Introduction

The teaching of Design and the subsequent responsibility of "building" or "constructing" undertaken by Architects must go well beyond some of the more traditional "**D**esign" exercises that remain the backbone of Beginning Design studios in order to properly prepare students for global mobility. Whether graduates simply move "within the country", or cross the ocean, different grass roots issues must be addressed in architectural design. Environmentally based design concerns are the most highly affected by changes in climate, siting and general building location/orientation. Technological and environmental concerns need to become a fundamental influence in early design education, if students are to understand that these are to be taken seriously, and are not disciplines or problems to be solved, later, by "others". Architectural design is an inclusive discipline and the early studios establish the scope and culture that is carried through the program.

If such technical and environmental sensibilities are to be successfully incorporated into early design studios, they must be taught by engaging students interactively through exercises that are highly design motivated. These notions cannot begin with numbers, formulae and scientific terms that will undoubtedly evoke complete disinterest, or in the case of technically challenged students – fear and subsequent dismissal. Students need to understand the basic principles in environmental or climate based thinking in order to be able to evaluate situations from a global perspective.

The traditional placement of Environmental Control Systems courses in the intermediate section of most accredited architecture degree programs, tends to indicate to students: a) that the material is highly technical and is beyond the comprehension of Beginning "creative types"; b) that it is an aspect of design that is not central to the main ideas of design, hence remains unspoken in first year; and c) it is just not very important. "Greener Foundations: The Box Projects" seeks to bring these issues to bear on beginning design education so to create a base upon which to build the more technical, intermediate level ECS courses.[1] ECS courses have widely expanded from "mechanical only subjects" to also include key issues of sustainable and passive design. By setting up the questions early on in design education, these topics are given the importance required for students to take them seriously and to treat them inclusively. The Box Projects highlight the experiential intersection between environmental design and studio teaching for beginning design students.

Learning by Doing: Visualizing the Experiential

Learning by doing remains the most effective method of teaching any subject.[2] This has long been the accepted norm in the setting of Design Studio projects, and is increasingly being seen in supporting technical (structures/building construction) courses. With the growing demand for buildings and projects that can answer to sustainable and environmental design criteria, along with the increased global mobility of graduates, such is also required in the teaching of traditional ECS courses. Environmentally designed buildings must incorporate spatial and material "moves" from their design conception, in order to attain a high level of quality and effectiveness. Environmental considerations need to be intrinsically connected to the project from its conception because they affect the building's plan, section, materiality and orientation.

> "...a fundamental weakness in most discussions of architectural aesthetics is a failure to relate it to its matrix of experiential reality ... this leads immediately to serious misconceptions as to the actual relationship between the building and its human occupants."
> James Marston Fitch, 'Experiential Context of the Aesthetic Process', JOURNAL OF ARCHITECTURAL EDUCATION, Winter 1988.

The “Box Projects” have been developed as a series of highly engaging, experiential, interactive, environmentally motivated design exercises that have been specifically targeted at the beginning design curriculum. They can be easily used within the studio curriculum to raise sensitivity to environmental issues as well as to indicate to students that such issues are key to the development of highly successful architectural projects. They speak to the commonly used phrase “thinking outside the box”, using the box metaphorically as well as physically to demonstrate environmental design principles such as light, wind, temperature, view, and time.

One of the major issues in designing spaces for environmental concerns is in the visualization of sensory issues that may not be easily seen and therefore, understood. Although our experiences of everyday life from within and around “architectural and urban” elements, will include light, thermal, acoustic, olfactory and visual ingredients, these are more difficult to realistically include in beginning design studio projects whose highest level of realization may be in the form of scaled drawings and models. Models can be seen to most closely approximate three-dimensional reality – and the Box Projects only seeks to add a “fourth dimension” to raise the level to one of environmental experience.

The project series also addresses general beginning design issues of representation. The projects ask that students relate 2-dimensional diagrammatic drawings, to 3-dimensional models, and ultimately to an actual experience. The experience can be taken back to re-inform and critique the 2-D and 3-D representations. Were these correct in their assumptions? Were they clear? These projects de-emphasize the use of the computer, as many students are numb to the realities seemingly indicated by simulated computer images, after years of “gaming” in virtual environments. These projects are designed to be “quicker” than could be achieved by using a computer.

This series of projects constantly changes the relationship of the student to the project itself. The majority of design exercises restrict the interaction to the creation and external observation of 2-D and 3-D scaled work. By adding environmental considerations as well as changing the size and the relative “position” of the student to the project, a different set of observations is possible. External observation is modified by adding “light” and “visualized air movement” to the assessment of a relatively normal 3-D model. The scale of some projects is enlarged to have the students, either in part (head) or in whole (body) inhabit the project. This expands the dimension of realism in the project. Lastly the student can “become” an element in the project, again resulting in a different interaction and level of understanding of the outcomes. Reporting methods also vary to include verbal, written, photographic or video, to impact both the permanence of the responses as well as to reflect the dynamic nature of the problem.

The Box Projects

The Oasis:
With increased global movement amongst architecture graduates, it becomes very important to assist students in understanding the impact that specific climate types will have on their building designs. Students tend to “shop” fairly liberally from international periodicals and monographs for ideas to fuel design projects. Some ideas are simply unsuitable for climate transfer. Some might work if they are modified. Students need to be able to understand critical aspects of climate suitability as a means to heighten the tectonic success of their design.

The idea behind the Oasis forms a spring point in the education of the beginning design student -- an introduction to the *sensual nature of heightened awareness*. The Oasis forms the pedagogical basis for discussions surrounding the connection between **A**rchitectural and **E**nvironmentally sensitive design. The intrinsic connection between the Oasis (sublime), Climate (regionally varied), Light (ethereal) and Materials (tactile) is Comfort (essential).[3]

Students design a tectonic small building or shelter, for an assigned variation of the four primary climate types: hot-arid, hot-humid, temperate and cold. Students focus on issues of thermal comfort (including natural ventilation and quality of light), with an attempt to make a space that is sublimely comfortable. As beginning design students tend to treat architecture as “objects” often viewed only from the exterior, this project directs them to examine the design of the “resting experience” from within the space, using solely

vernacular means to moderate climate. This project brings a multitude of design issues into play that speak to architecture that in many cases has been designed "without architects"[4], and without mechanical air conditioning for either heating or cooling. Experiences are shared in verbal presentations to the class.

The project normally consists of two 11" x 17" panels that are collage like in nature, including a variety of inspirational images, textures, sketch perspectives, design details and occasionally, layered potential materials or finishes. *This project is less three-dimensional but important nonetheless as this beginning design project introduces aspects of climatic difference to students whose life experiences may be limited to their home environment.*

The Light Box:
The Light Box singles out solar issues that have been raised in the Oasis project. *How can the sun be used for shading? What is the quality of the light? How does light animate the space/architecture?* It begins to address the problematic use of windows as a means to pierce and decorate façades, rather than to understand their full potential for light and solar control.[5] Perhaps the simplest and most provocative experience of any space is the effect that sunlight can have in bringing it to life. Consider the experience of any space, urban or architecture, on an overcast day with an even diffuse illumination level. And consider the same space in varying lighting conditions ranging from early morning, to noon to the orange glow of the setting sun. Most architectural studio models are viewed in constrained conditions much like an overcast sky day, or randomly lit for the purpose of photographic record. Students are not given the opportunity to understand how sunlight can be used, either "architecturally" – as a form giver, or "environmentally" – for passive solar gain or for shading.

Figure 1: The Lightbox comparing summer (left), interior (center) and winter (right) views (photos: Caroline Prochazka)

The Light Box asks that students design and construct a simple "room", with limited openings, and shading devices, as desired, viewable through an open "back wall". This model is tested on a heliodon for specified lighting conditions. This can be used to examine the sun penetration into a space measured at certain latitudes for winter and summer solstice conditions, and so also test the effectiveness of any solar shading devices that have been designed for the façades. It is advisable that this model be constructed in such a way as not to be "precious" so that it can be treated as a working model. Interactivity is more revealing when quick alterations can be made to the openings and shading devices. White foamcore is easily cut, taped or pinned, and modeled. The project also highlights the differences between models constructed to assist in design development, and those for finished projects. The project can also incorporate color of finish, texture, use of reflective materials, immediately outside and/or inside the space.

Although heliodon modeling can only approximate the actual effects of the sun, using the sun is limiting as it confines the experiment to a certain time of day/year/latitude, and may not actually be working on the specified review day.[6] The simplest light source that can replicate high intensity, nearly parallel rays is an overhead projector. This has been one of the most popular student "self repeated" projects.

The Urban Scale Light Box (variation):
Whereas the Light Box examines the quality and effect of sunlight on interior spaces, the Urban Scale Light Box project helps students understand the impact of the sun on the spaces around and between buildings. It assists in understanding of the effect of latitude and time of year on the habitability of exterior and interstitial spaces. This project can easily be customized to suit any studio project, although it has been tried to support residential case studies that have been used alongside an existing residentially based studio design exercise.

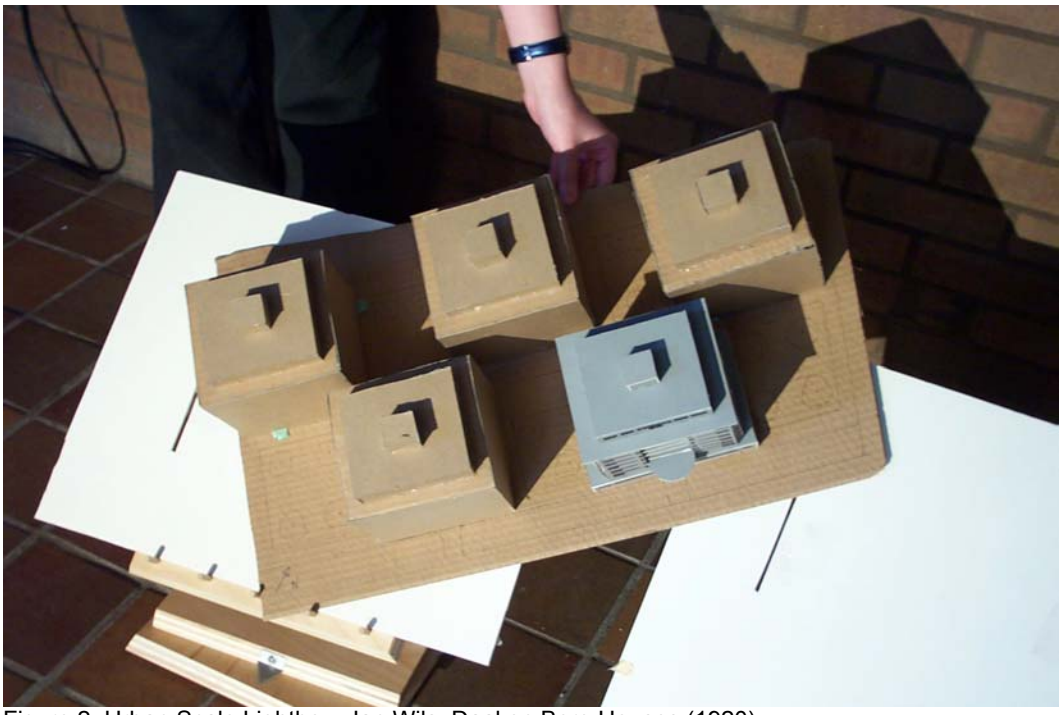
Figure 2: Urban Scale Lightbox: Jan Wils, Daal en Berg Houses (1920)

For the case study application students were divided into groups of four and assigned one of the residential projects from Roger Sherwood's book, "Modern Housing Prototypes"[7]. Using mostly information from his text, each group constructed a model of the housing development (or part thereof if the scale was too large), and tested the same on the heliodon. This allowed them to simultaneously become more familiar with some of the more renowned residential projects of the 20th century, via drawing and modeling the buildings, while at the same time, develop a critical stance as to their relative effectiveness in terms of siting, sustainable site development, fenestration patterns, shading devices (or lack thereof) and quality of exterior and interstitial spaces.

The Smoke Box:
Visualizing the movement of air through a space is difficult even for the most experienced designers. Sun can be easily modeled and so visualized. Wind cannot. Air movement can be quite "fickle" as well as unpredictable, as it is easily affected by a multitude of external factors. Yet if students are to understand where to position openings to promote natural ventilation, understanding simple air movement needs to be learned.

The Smoke Box is a simple variation of the Light Box. *Using transparent small models, this project visualizes the flow of air through spaces through the use of "theatrical smoke".* The variation is the use of black foamcore and clear plexiglass to allow for viewing the movement of the theatrical smoke through the spaces. Where white foamcore highlights sun and shadow, black foamcore provides contrast for the whiteness of the smoke. Students are encouraged to make an "architectonic space" for this performance, rather than a "room", which might not result in a wide enough set of variations to be adequately engaging. The theatrical smoke machine is fitted with a long cardboard cone that directs the smoke to an opening

on the windward side of the model. The smoke is injected into the model in a series of “bursts”. It is important that a fan be used to draw the smoke through the model and that a fume hood is available to remove the theatrical smoke from the room.

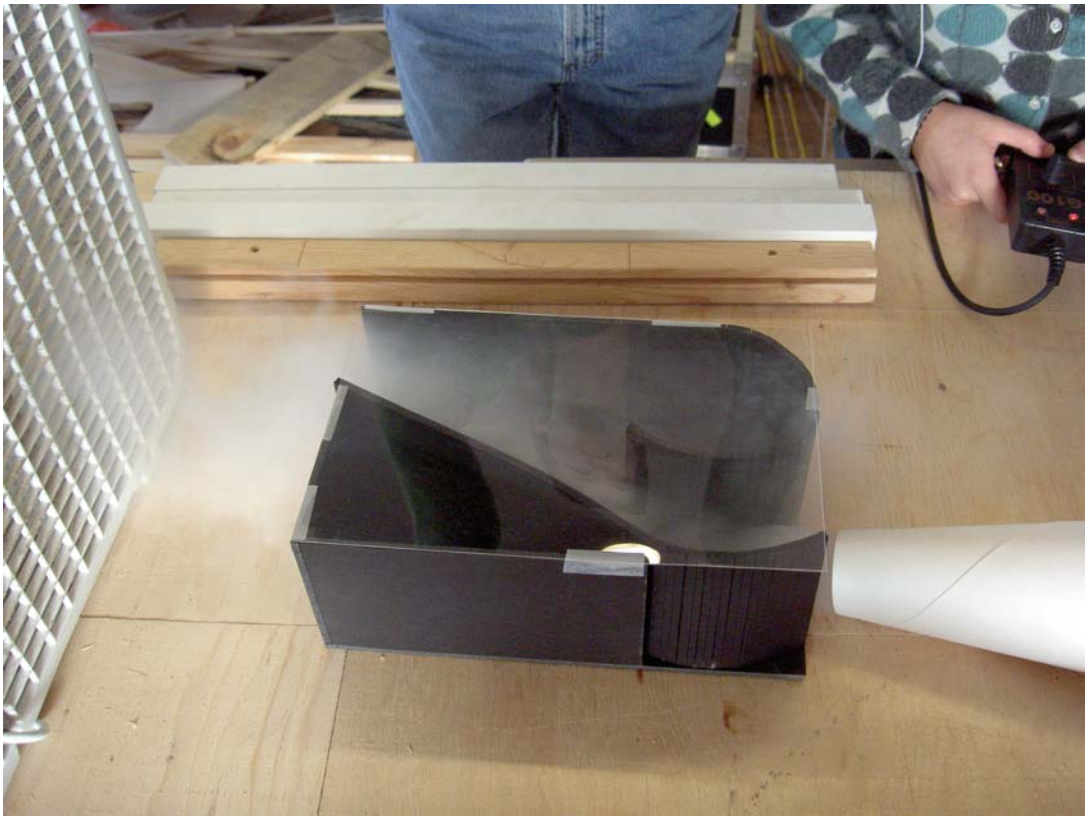

Figure 3: The Smokebox (under the direction of B. J. Smith, Master of Architecture candidate, photo credit)

For this exercise, students can be asked to create “magic arrow diagrams” to predict the assumed flow of air through their space. Such diagrams are routinely found in airflow analyses of many buildings, and are easily drawn (wrong), quite convincingly. Students can be asked to verify their initial assumptions after the model testing. Again, the models should be treated in such a way as to be able to be modified during the “performance”.

Thinking Inside the Box:
Although models can be approximately experienced as “real spaces” via computer imaging or photography with model scopes, this project makes students realize what it feels like to be inside a space, and understand the importance of the view out, orientation, and solar aspects. Essentially, the box is constructed in a similar fashion to the Lightbox, with apertures, shading devices attached, and placed over top of the student’s head. With assistance from other students, experiences are recorded as the box is worn during a range of potential experiments, including, but not limited to the heliodon simulation, or wearing the box on a potential building “site” and understanding view, orientation and better the advantages and disadvantages of different site locations. The extreme scale reversal is somewhat akin to “Alice in Wonderland”, having eaten the “enlarging” piece of mushroom.

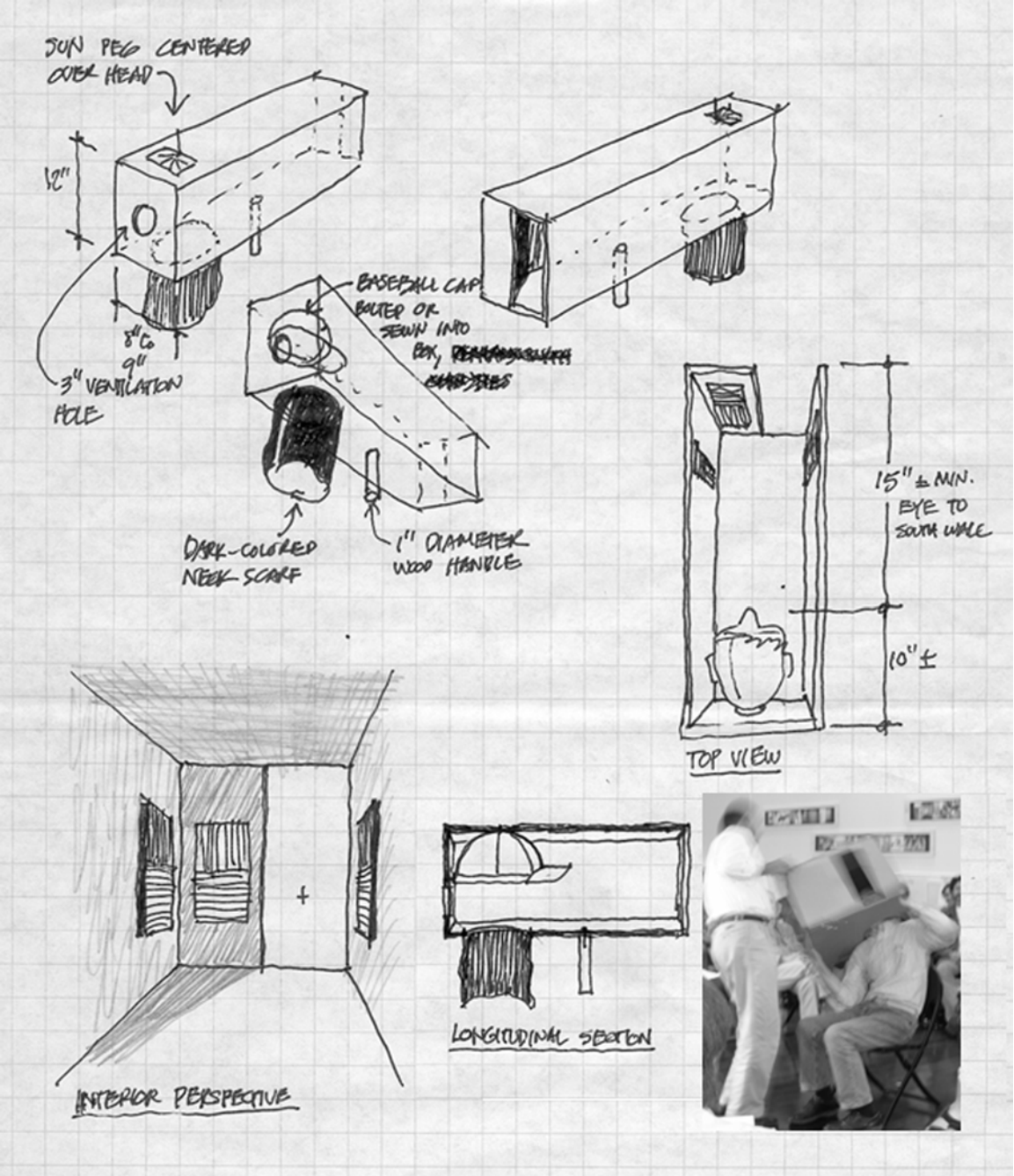

Figure 4: Sketch proposal for the Thinking Box by Edward Allen, FAIA, SBSE Retreat 2005 (Credits: sketch/Edward Allen; photo/Tisha Egashira)

The Four Dimensional Cube:
The project asks students to create and inhabit a small "cube" to begin to understand inhabitation, construction, found materials and environmental impacts on space. The box is now large enough to sit inside for a while, but is still highly portable. Environmental limitations on this project can include making the box with found or recycled materials, rather than purchased goods. Students take the notions from the Lightbox and Thinking Inside the Box, to create a small habitation to assist in experiencing varying outdoor spaces. Where some aspects of this exercise will reaffirm previous notions of light and air movement, new issues of sound and smell can also be included if the installation is positioned in varying microclimates. For instance the same “box” sitting in the middle of an asphalt parking lot will be quite

different than if it is sitting in an open field or a wooded area. The different performances and experiences of the space can be documented and compared.

To raise this project to an engaging design installation, our students have designed and built “dining pavilions”, using timber products. These have been taken to a natural site during a summer studio and used for an evening of festive eating as well as a sleepover event.

Beyond the Boundaries:
Architectural design involves both creating and delimiting space. The boundaries that create, define and confine spaces impact the environmental state of the space. This project divides the students into groups that are large enough to create spatial boundaries using themselves as the architectural elements that separate the spaces. Whereas the other projects ask students to use their powers of observation and senses to understand the environmental impacts on architecture, this project draws them into “becoming” part of the architecture itself. A suggested list of boundaries might include: Protective boundary, Shading boundary, Interconnecting boundary, Dynamic boundary, Thermal boundary, Closing boundary, Opening boundary, Filtering boundary, Embracing boundary.

Conclusion:

The “Box Projects” describes an intrinsic intersection between the like pedagogical motivations that underlie Beginning Design studio and environmental design courses. The projects describe a series of highly energetic, engaging -- short – teaching exercises that can form a vital link between issues found in design studio and basic principles of environmentally motivated design, which can assist in preparing students for mobility within the practice of architecture. Each of the projects validates one key aspect of environmental concern that intersects with the act of architectural **D**esign, and that if used properly, will improve **D**esign. All projects can be easily incorporated into a Beginning Design curriculum and can raise awareness and quality of design in the intersection between environmental and general design concerns, without the use of alienating levels of technicality.

Notes:

1 The Box Projects are part of the outcomes of the Society of Building Science Educators Annual Retreat held in Savannah, Georgia in 2005. Full information on the retreat outcomes is available through: http://vsav.scad.edu/sbse2005/papers.htm

2 Connector, a series of newsletter publications initiated by Ed Allen in the 1990s features a series of articles regarding effective teaching of Technology based courses using project based work.

3 14th National Conference on the Beginning Design Student, 1997. Terri Meyer Boake. “OASIS: The Fourth Dimension of Architecture”

4 Rudofsky, Bernard. “Architecture Without Architects: A Short Introduction to Non-Pedigreed Architecture”. University of New Mexico Press. Reprint Edition, 1987. (Originally published 1964).

5 16th National Conference on the Beginning Design Student, 1999. Terri Meyer Boake.
“Beginning to see the light: PIERCING SKIN: Significance~*Light*~Tectonic”

6 Instructions on how to construct a simple Heliodon are to be found in “Heating, Cooling, Lighting”, by Norbert Lechner.

7 Sherwood, Roger. “Modern Housing Prototypes”. Harvard University Press, 2002.