Ecological Design and Technology: Enabling an Integrative Learning Process

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Introduction

This fifth year capstone studio in a five year Bachelor of Architecture program focuses on the exploration of environmentally sustainable technology not only in technical and environmental terms, but also as the expression of culture relative to an understanding of our place as human beings within the ecological framework. Based on the notion that cultural ideas and technology are inseparable, the students are challenged to maintain an integrative agenda for their exploration.[1] Whether the technology being used is traditional tools or contemporary technics, it is the means by which humans create a relationship with the earth.[2] In looking to the Greek origin of the word "technology," techne has often been defined as meaning both art and craft. However, according to Martin Heidegger, "techne signifies neither craft nor art, and not at all the technical in the present day sense; it never means a kind of practical performance...The word techne denotes a mode of knowing," or revealing.[3]

In this way, technology can become a mode to comprehend the site, as well as enhance the legibility of its essence by embodying issues of place. As such, technology, whether active or passive, is composed not only of artifacts and processes, but also inquiry into our relationship with the environment, thus elucidating a cultural bias to the environment. By intertwining choices concerning technology with the macro- and micro-scale site conditions, the program and the user, the resulting form can become an animated understanding of the specificities and diversity of place. The design has the opportunity to register environmental fluctuations and develop an aesthetics of changing response.

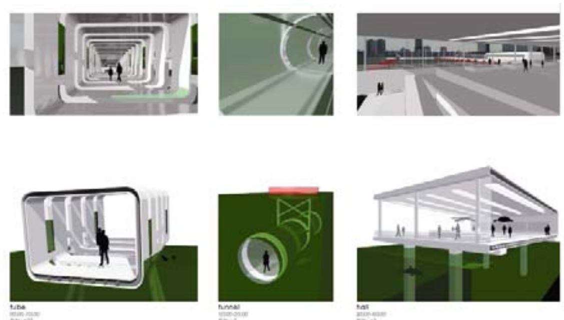

Fig. 1: Component Study - Hudson River Estuarium (Student Project)

Approach: Studio Methodology

This studio focuses on issues of ecological design and technology with an emphasis on creating fluidity between technology and the site. Thus, the building has the opportunity to register environmental fluctuations and develop an aesthetics of changing response. The objective is to find significance in building through the integration of technology with macro- and micro-scale site conditions that result in cultural meaning. The course involves individual program development, site selection, comprehensive site analysis, intensive research on environmentally sustainable technology, experimental constructs employing the research, and a comprehensive design of their choosing. The students are required to document the entire process as a means of holistically addressing the topic. Readings and class discussions are an integral part of the course content. The development of individual programs and the resulting site selection allows the student to apply these techniques to contemporary issues that they consider important, thus enhancing the integrative nature of the project.[4] Each student develops his/her own theoretical position on the topic resulting in a short position paper and a capstone project as a reflection of this discourse. In this way, their projects become a commentary of the environmental, social, cultural, political, and economic issues that contribute to the ideas of ecological design. This relates to the tenets put forth relative to the Scholarship of teaching and learning regarding integrative learning. As defined by the Carnegie Foundation for the Advancement of Learning, integrative learning occurs through "connecting skills and knowledge from multiple sources and experiences; applying theory to practice in various settings; utilizing diverse and even contradictory points of view; and, understanding issues and positions contextually." [5] Grounded in problem based learning and case studies; this project emphasizes exploration in expressing, critiquing, altering or responding to economic, political, social, historical, environmental and cultural context. This necessitates more than just technical skills. By integrating seemingly discrete subject matters, the exploration can then allow for greater creativity. In order to achieve this, the students need to be able to draw upon different methods of inquiry and analysis.

Of primary importance, analysis of the site takes place at the macro- and micro- scales taking into consideration that the conditions are often interdependent. The primary intent is to truly understand the natural processes on the site in order to later in the design process link the active or passive technologies with the environment. Another objective is to transform the site documentation into an analysis of the existing relationship between humans, the built environment and the natural environment. This foreshadows the intent that the final design becomes a statement concerning the potential relationship between humans and their surroundings with humans being a part of nature. Some of the analysis topics include: topography/terrain, seasonal and diurnal changes, natural resources, geology /soil conditions, vegetation, wildlife, hydrology, climatic conditions, temperatures / means, extremes / humidity, precipitation / average rainfall, number of clear, partly cloudy, cloudy days, solar orientation/angles, shade/shadows / direct, diffuse and reflected light conditions, prevailing winds/breezes – direction and velocities, potential natural energy resources on site, characteristic site features, existing land use, architectural context, existing utilities, existing transportation / pedestrian networks, cultural resources / heritage, community resources, historical features, social context, zoning and code study. The student uses this understanding of the site and represents it graphically as the springboard for the rest of the design process. In addition, the extensive site analysis establishes a graphic representation of the demarcation of the natural elements and the response to environmental conditions.

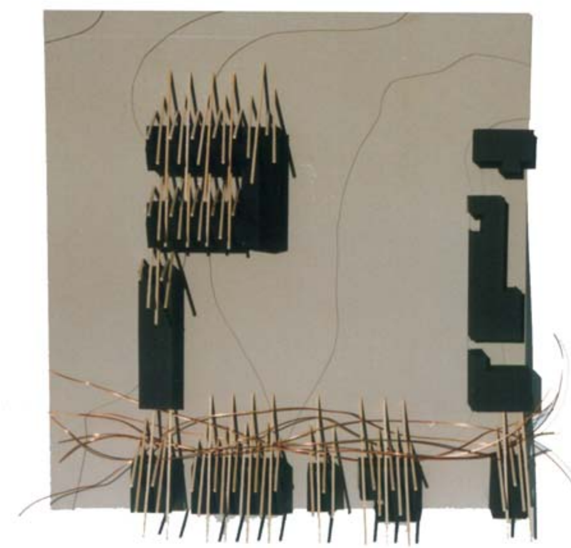

Fig. 2: Site Mapping (Student Work, Lab Building)

Concurrent with the site mapping and research phase, the students read and discuss several key readings that deal with the nature of technology and its subsequent meanings as related to culture. These critical discussions help the students to develop their own position on integrating technology and the related cultural meaning.

After establishing the site specificities, in the ensuing stage, the student researches technology, active and/or passive, as it relates to the issues of earth, air, sun and water. Several technologies are selected that deal with each of the issues. Some of the possible building components that are studied include the membrane, the structural system, the materials, heating/cooling systems, energy, and water systems. With the intention of understanding the logic forming the basis for the technology employed, the research and critical evaluation of technology centers on methodologies, systems evaluation, energy processes, membranes, as well as vernacular and contemporary case studies. The student is also asked to assess the cultural meaning of these case studies. The objective is to determine the systems as related to earth, air, sun and water that the student might use in their project. The students do a critical analysis of the case studies to illustrate the use of the selected technology in the design process. The criteria for visual and textual analysis included the following: diagramming the principles, analyzing a case study, critiquing the design process of the case study relative to the character that the technology takes, analyzing the relationship of the building to the site, as well as critiquing whether the technology and resulting form reveal the essence of the site and / or the elements. The primary intent behind this exercise is for the student to fully understand the logic of the technology before trying to incorporate it into a design. This step also aides in keeping the technology from being merely applied.

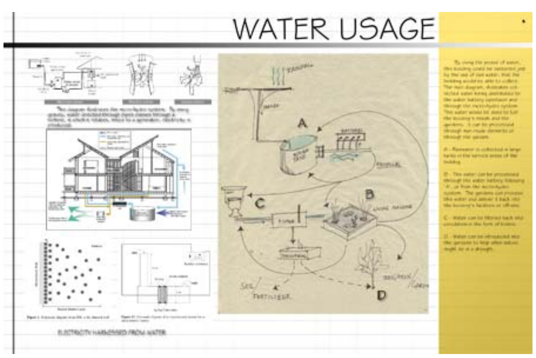

Fig. 3: Technology Research (Student Work, Lab Building)

Constructs

Leaving the spiritual realm of sustainability for the more focused applications in green architecture, it is strange that even the individual components of environmental technology are rarely interpreted by architects as artistic raw material. Ecologically favorable hardware like thermal glass, solar collectors, photovoltaic panels, air filtering systems, and recycled construction materials, which could all be used to enhance the final building-as-art statement, are usually treated indifferently as "installed" rather than "expressed" elements of design, with no clues to their sources in nature or contributions to the expanded life and communicative content of buildings.[5]
- James Wines, *Green Architecture*

Following the site analysis and technology research stage, the conventional design process is inverted. In this stage, the student is asked to employ the completed research in the exploration of four design constructs that deal with earth, air, sun and water. Essentially, the students are starting with the detail as an understanding of the project. They are often conditioned to begin the design process with a “concept” or parti. In this methodology, they are freed from the habit of design that enslaves them to the conventional formal process and its principles. In this way, they can then use the technology to reveal and respond to site and cultural conditions. For each instance, the student takes a component of a building and makes a model of the skin or membrane (i.e. foundation, wall and roof) at a large scale. In this way, the construct is a response to an experiential moment that acts as a transition between the interior and exterior. How the student chooses to negotiate this interface is essential in determining the intended statement concerning the relationship between the building, the user and the environment. In this way, the students’ first design decisions are at the micro scale, which is the scale of the individual user’s perspective. By working at a micro- scale, they can concentrate on the immediacy or intimacy of the proposed technology, thus allowing for a greater sense of the personal. These constructs are referred to as "moments" in their still un-designed building. This is an abstract notion that is experienced concretely. The students thus begin their design work at the scale the user experiences the building – at the scale of his/her hand. They can then apply this logic later to the design of the rest of the building.

Approximately mid-semester, each student begins to explore the overall form of his/her building. Throughout the process, the students weave back and forth between the micro, the mezzo and the macro scale. In the further development of their projects, the students do sometimes discover that the different constructs are in opposition to each other. In these instances, the students have to adapt their initial studies in order to avoid a collage of disharmonious techniques.

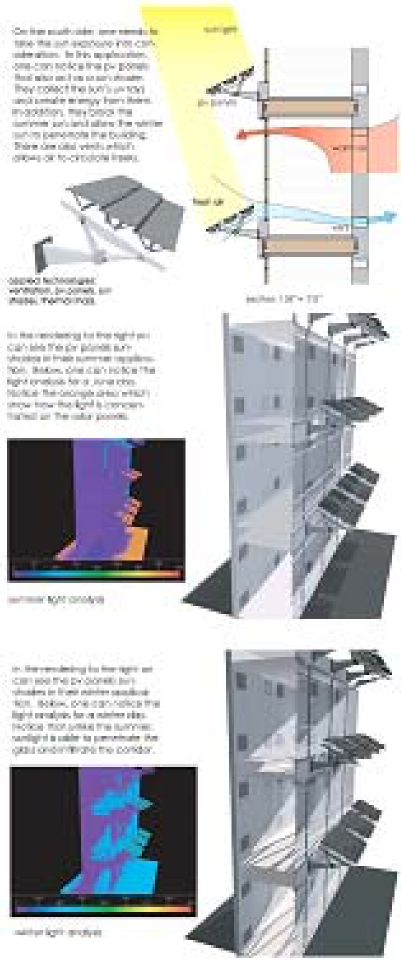

Fig. 4: Construct Example (Student work, Lab Building)

Conclusion:

Because architectural theory is assumed to imply absolute rationality, it has been considered capable of standing on its own, free of all relations to fundamental philosophical questions. Subject to the values of technology (and commerce), its interest is not in meaning, but in conceptual or material efficiency dominating design and construction. This has naturally created a peculiar tension between theory and practice. Theory may work smoothly on a formal level, but it is unable to come to terms with reality. Correlatively, practice has been transformed into a process of production without existential meaning, clearly defined aims, or reference to human values. [7]

\- Alberto Perez-Gomez, *Architecture and the Crisis of Modern Science*

The currently, widely held perception of environmental sustainability in the architectural field has created a barrier to its greater dissemination into the overall curriculum and practice as, quite simply, tenets of good design. Mainstream architecture, both academic and professional, has relegated the idea of environmentally sustainable architecture to the technical and not relevant to conceptual and integrative design. It is often seen as lacking in cultural significance and/or poetry. Indeed, it can even be seen as a specialty or add on. Many highly regarded architects have considered the topic to be mundane as a source for creativity. In this way, the environment is not seen as an essential of form giving. This, of course, is a specialist, rather than integrative thinking on all sides. Issues of the environment cannot be separated from a greater ecological framework, which includes cultural, social, economic, political, spiritual and ethical issues.

Fig. 5: Hudson River Estuarium (Student Work, final project)

Endnotes

[1] The term "integrative learning" is used here as defined by the Scholarship of Teaching and Learning. Specifically, the Carnegie Foundation for the Advancement of Teaching indicates that "Significant knowledge within individual disciplines serves as the foundation, but integrative learning goes beyond academic boundaries. Indeed, integrative experiences often occur as learners address real-world problems, unscripted and sufficiently framed to require multiple areas of knowledge and multiple modes of inquiry, offering multiple solutions and benefiting from multiple perspectives." See http://www.carnegiefoundation.org/dynamic/downloads/file_1_185.pdf.

[2] Richard Critchfield, *The Villagers: Changed Values, Altered Lives: The Closing of the Urban-Rural Gap* (New York: An Anchor Book, 1994), p. 12.

[3] Martin Heidegger, "The Origin of the Work of Art," in Albert Hofstadter, translator, *Poetry, Language, Thought* (New York: Harper & Row, Publishers, 1971), p. 59.

[4] Student chosen programs and topics have ranged widely, including an estuarium in the Hudson River, a fresh produce market in North Philadelphia, and a multi-use facility involving adaptive reuse and modular housing.

[5] Carnegie Foundation for the Advancement of Teaching, See http://www.carnegiefoundation.org/dynamic/downloads/file_1_185.pdf.

[6] James Wines, *Green Architecture*, (New York: Taschen, 2000), p. 21.

[7] Alberto Perez-Gomez, *Architecture and the Crisis of Modern Science* (Cambridge: The MIT Press, 1983), pp. 1-5.