

Thick Skins—Extending the Threshold

KARL DAUBMANN
University of Michigan

Rather than separating boundaries, borders are dynamic membranes through which interactions and diverse transformations occur. In ecological terms, the edge is always the most lively and rich place because it is where occupants and forces of one system meet and interact with those from another.

—James Corner from “Field Operations”

The façade is the zone of interaction between the interior and exterior. It is the zone through which the flows of light, heat, sound, space, and site are filtered. The sensitive manipulation of these qualities and this boundary are explored for the potential to unite architecture and technology, space and performance. This paper presents the work from two graduate design studios that investigated façade strategies as a means of learning about the integration of building systems. In the design studios an interstitial space emerged that trapped the external forces of site and the internal fluctuations of program creating a zone of technological / architectural occupation.

A “thick strategy” concept emerged from the studios which defined a building in terms of its flows of energies through its boundaries. A critical agenda for the studios was to explore the formal and spatial results of the generative potential of building performance. Rather than allowing all or none of the energy through its enclosure, a more subtle approach controlled varied amounts of energy to enter into the building in a designed manner. Solar, acoustic, wind and thermal energy were controlled within the interstitial zones captured by the bounding layers of the designs. This approach made the design processes more complex by making these interstitial zones full participants in the overall performance of the building.

STUDIO WORK

The two graduate design studios explored a performance approach to shaping buildings. In both cases the enclosures became a critical area of investigation connecting the interior with the exterior. The first studio extended the enclosure deep into the building, incorporating program and space. Building performance simulation software was used to conceptually develop, quantify, and qualify the designs. The second studio extended the boundaries and enclosures, exploiting exterior space, zones, and the landscape into the thick façades. Both studios were explicitly concerned with the building's response to the environment, utilizing orientation and contextual relationships to shape the building perimeter.

Because of the specialized nature of the studios, a conscious effort was made to involve external consultants whenever possible. This inclusion introduced students to a design paradigm that included collaborators,

downplaying the role of the heroic singular designer. Both studios integrated two workshops with a façade engineer. The workshops occurred over a weekend during the semester. This weekend façade workshop created an intense working environment on one specific topic per visit. A lecture of recent work related to the topic would be given followed by desk critiques with the design critic and façade engineer. The workshops would conclude with an informal group pin-up to discuss general issues and the revisions of the projects. The studio would then resume working on general design issues and the incorporation of the new information into the overall project. The studio that engaged site issues also included a landscape architect on all the juries. During the semester, the students developed their abilities to ask specific questions of the consultants and to respond and incorporate their input.

STUDIO 1: INTERSTITIAL INTEGRATION

The program for the studio project was an urban bathhouse. The bath / spa is a building use that creates an intimate relationship between building and user, demanding the intentional manipulation of light and heat. An initial program was given that included a number of group and private pools, health and spa spaces, circulation, and a major component of infrastructural / support space. The program was flexible, which permitted students to interpret the programmatic components and the sequence of spaces. Students were required to assign thermal and illumination qualities to the program, and use these qualities as a method to organize the program on the site. The projects would need to respond to elevation, orientation, and views into and out of the spaces and building.

The site both simplified and complicated the design process. It made the design more simple and focused because it occupied an infill condition in downtown Detroit. This condition reduced the amount of design time needed for site response because the project was internalized within a simple zoning envelope. The site footprint was narrow and deep (40'x100'), meaning that the students would need to organize their buildings vertically. This verticality made the structure more difficult, having to potentially suspend large pools high off the ground. The section became an absolutely essential document throughout the process as a means to explore the penetration light deep into the building. The street façade was also a critical component of the design because it became a face to the city and a face to the southern exposure.

Modeling Light

Light was the critical emphasis in this studio. It was used to organize the building and to refine the relationships of spaces to the exterior. The building enclosure was the main element used to filter and control of light and views. The students used Lightscape to model the light of their designs, focusing mainly on natural daylighting. Lightscape was the choice for lighting because of its ability to be seamlessly integrated with other geometric modeling packages of which the students were already familiar. Because of the availability of the software, students were able to use it throughout the process, starting with initial studies related to massing through to detailed room studies that included material and detail issues.

Because of the software's ability to visualize both qualitative and quantitative aspects of light, the students developed different approaches focused on the amount of light and the effects of light. The lighting analysis proved to be the aspect that students used to test their designs. Students were asked to develop a lighting strategy and then to test their assumptions using the simulations. If they wanted a space to be bright, they needed to determine how bright. The façade became the element to control the entry of light, either through material choices, orientation, and / or configuration. From this point the student would need to revise the scheme, either letting more light in, reducing light penetration, or accepting the results of the simulations.

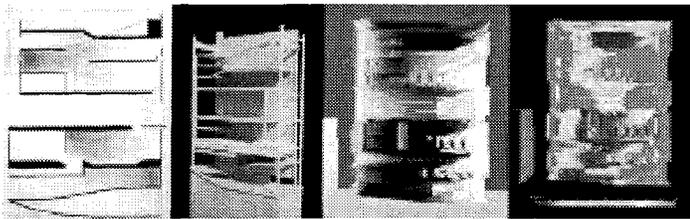


Fig. 1. Section drawing, physical model, Lightscape rendering and lighting analysis.

Students were also very interested in the effects that the dynamic qualities of the light could have on the space. Two issues that were of most interest were color bleeding and daily and seasonal shifts in solar position. In the first instance material and color were used to drastically affect the feel of a space either making it warm or cool depending on the ability of reflected light to transmit color. In the second instance, building geometry was manipulated to control when rays of sun might enter a space or whether a space might heat up or cool down at a certain point in the day or season.

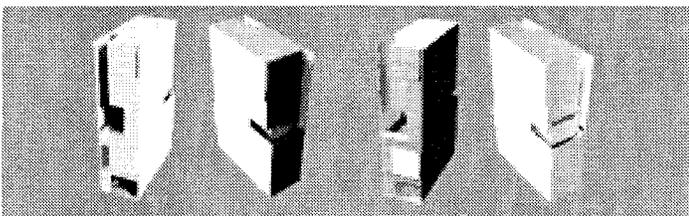


Fig. 2. Development of building enclosure for north and south facades.

Air Flow

Because of the complexity associated with modeling temperature and air flow, a doctoral student, working as a consultant to the studio, carried out computational fluid dynamics simulations. This type of simulation is able

to predict temperature striations and velocities of the air movement. Two examples are worth mentioning from this aspect of the studio: one that employed natural ventilation and one that developed an air curtain.

The scheme utilizing natural ventilation optimized the building section and façade to account for lighting as well as ventilation. The section underwent multiple iterations to adjust for the results from the various simulations. Window opening size and location were studied in relationship to the shape of the section. This air flow simulation was developed with 2D sections to simplify the modeling process.

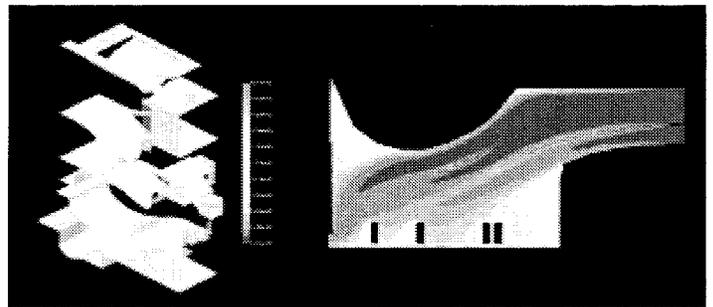


Fig. 3. Ventilation scheme illustrated by planar diagram (l) and CFD velocities (r).

The second project that made beneficial use of the CFD simulation attempted to minimize built spatial divisions. The scheme was concerned with creating leisure landscapes at various levels in the building. The designer needed a way to break down the spaces thermally without adding walls or enclosures. The solution employed air curtains of fast moving hot air to separate bathing spaces and relaxing spaces. The CFD simulations explored many possibilities for configuration, air speed, and air temperature and concluded with a low velocity, warm air curtain to thermally divide the spaces.

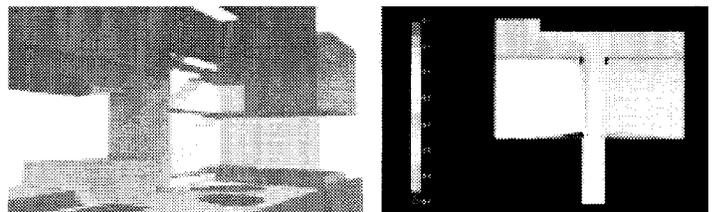


Fig. 4. Air curtain strategy illustrated by interior rendering (l) and CFD velocities (r).

STUDIO 2: INSIDE THE OUTSIDE

The second graduate design studio explored issues of thick skins that were not explored in the previous studio, mainly the building enclosure's relationship to the site. Where the previous studio had extreme site limitations, this studio gave freedom to the design of the site. The previous studio employed a complicated and dense program, this studio used a simple yet distributed program. The thick zone of the previous studio occurred between the exterior wall and the interior program, this studio investigated the space of landscape between the building and the site, exploiting it as another layer in the building enclosure system.

The Inside the Outside studio focused on the manipulation of boundary conditions related to the site, landscape, and environment. These manipulations consisted of multiple scales redefining the relationships of exterior spaces, landscape and building, and interior and exterior spaces. The studio began with a master-plan investigation and iteratively progressed

to an architectural scale exploring one building of a potential grouping in more detail. The site for the studio was within an arboretum. The program for the studio was the service buildings for the arboretum. This simple program was exploited for its infrastructural condition within the "natural" landscape. The buildings (a garage, field office, and care takers residence) were simple and small, permitting the students to spend their time on the issues related to siting the buildings.

Two general concepts emerged from the work of the studio that increased the thickness of the perceived building boundaries. The first strategy was that of layering. This approach used both the layering of building elements to trap exterior space within the building's realm, but it also began to layer the landscape. In the extreme case, the layering began to completely dissolve the boundary between building interior and exterior. The second strategy was the development of infrastructural relationships between building and landscape. Projects began to exploit the landscape and building relationship as a means of doing work and servicing the grounds. The appearance of a building was downplayed as a means of intensifying the building's ability to perform a function or service to the arboretum.

Layering

There were two projects from the studio that investigated the role of layering as a siting strategy. The first used multiple layers to achieve a coherence of many smaller building parts. The multiple buildings created a condition of permeability across the site, allowing the building to enter into a dialog with the surrounding spaces of the landscape. As one moved through the site / building, one perceived the movement through multiple layers. The layers of different material densities simultaneously permitted readings of specific volumes and tied the different volumes into one composition. This strategy was explored at multiple scales, to the development of a thick wall that contained cut logs for heating, changing and responding to the seasons.

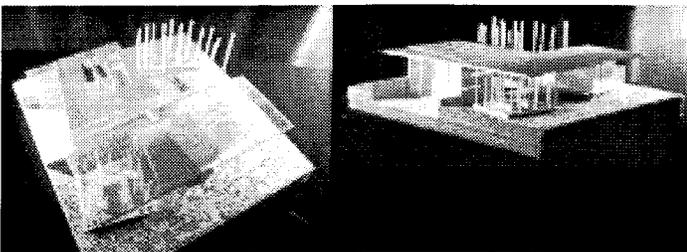


Fig. 5. Model views of a layered strategy linking four buildings together.

The second project to extend the concept of layering was extremely concerned with a layering and lamination of building and landscape, attempting to blur the condition of building and landscape. Building elements were located in the landscape and trees were located in the building. Beyond the condition of questioning the boundaries, the interior trees operated as shading elements. The vegetation was also exploited for its dynamic conditions, shading with leaves, allowing light to enter when the trees are without leaves. The seasonal possibilities were investigated through multiple cycles and scales concluding with the creation of a complex phenomenological organization.

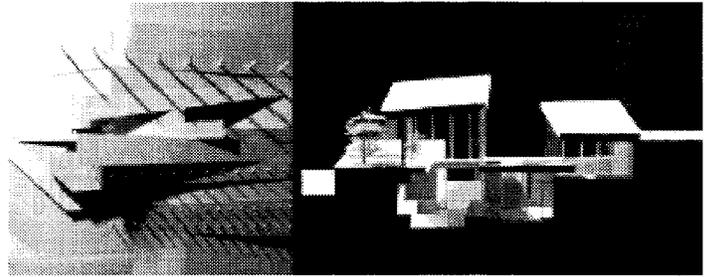


Fig. 6. Model views from a building / landscape lamination scheme.

Infrastructure

The second thick strategy to emerge from the studio was that of using the landscape as infrastructure for the building enclosure. The most successful project developed a roof for a service garage that contained compost. The mass acted as an insulator and the compost was also exploited for its ability to give off heat during the process of composting. The weight of the organic material was supported by pre-cast concrete beams that could be opened on one end to be emptied into a truck for transportation. Tall prairie grasses were planted in these containers which acted as a shading device for integrated skylights. The light through the skylights would take on a dynamic quality because windblown grasses would shade it. This dynamic shadow would create a connection between interior and exterior. The project utilized organic landscape material no differently than conventional building materials, in this instance they were used to create depth in the roof plane.

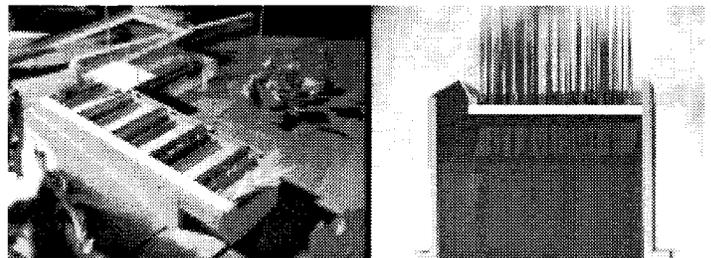


Fig. 7. Infrastructural scheme making use of organic roofing materials.

CONCLUSION

The work produced from the design studios set out many clear examples illustrating varying strategies of enclosure thickness. Although the façade can be seen as a specific sub-discipline within architecture, the range of work from the studios begins to show that this zone has a strong potential to be inhabited in an architectural manner. The emphasis of enclosure has also shown that its specific educational focus allows for the investigation of many other issues within the design process.