A Room for Appreciating Sunrise: An Experimental Realm for the Building Arts and Sciences

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INTRODUCTION AND CLAIM

In fall of 1998, Virginia Tech's Department of Architecture proposed a novel alternative to the teaching of technology and design.[1] In an effort to stimulate education the experiment entailed the bringing together of an aspect of building science (namely, passive thermal design principles) with an aspect of building art (namely, the phenomenology of building form in the landscape). This science/art intersection was mediated through a project-based learning exercise that concurrently engaged learning modalities previously found separately in either technology and design courses. As a final check or test to the experiment, the students' work was entered into an in-house competition judged by two sets of jurors consisting of either environmental technology or design faculty members with three jurors on each jury.[2] Although the competition component of the experiment was conceived to explore the efficacy of an alternative way of learning, it fortuitously served to reveal the manner in which the two differing faculty groups evaluate building proposals. Laying open these diverse judgement systems that guide architectural education offers us an additional opportunity to critically examine the pedagogical efficacy of the experiment in terms of the diverse conceptions of architecture that drives us as educators. The research findings suggest that the building arts and sciences should not be integrated into one diffuse course of study as a the respective heuristic strengths of design and technology resides in a certain autonomy. This autonomy, however, should not be entrenched in the typical semester-long courses as is common in many schools of architecture. Instead, intersecting aspects of the building arts and sciences should be singled out to be taught separately by expert faculty while having a project-based learning to allow the students to address these occasionally complimenting and occasionally competing content areas.

AN EXPERIMENTAL REALM

Proposed for the desert southwest of Phoenix, Arizona, the project-based learning exercise, *A Room for Appreciating Sunrise*, was intended to be analogous to those building types where the phenomenological appreciation of Nature is desirable. Such buildings could include houses, nature centers, and even a chapel or library. As the appreciation of the nature in this harsh desert setting necessarily entails an acute awareness of thermal phenomena, including thermal comfort, the exercise brought into great relief the energy-efficiency of the students' proposals. Of course, the matter of energy-efficiency itself concerns sustainability, utility costs, and so on. With energy-efficiency pertaining both to the projects' esthetics and to their practicality, the issue intersected with both design and technology.

As the 120 undergraduate juniors participating in the experiment had no previous course work in environmental technology and very little exposure to building design, it was necessary to introduce them to these realms. Nine weekly formal lectures introduced students to the principles of passive thermal design, including the analysis of climatic factors, thermal physics, and solar geometry. Students also met five times in the computer laboratory in order to reiteratively model the thermal performance of their developing proposals, using the program Energy Scheming.[3] This user-friendly software conveniently offered the students immediate feedback on reiterative design changes, thus sensitizing them to the thermal consequences of diverse building forms.

To insure that the mechanics of energy efficiency did not highjack the design process, directing the students towards a myopic, technical solution, the specific technological content and methodologies were deliberately bracketed and complemented with esthetic matters. We did this in two ways: in our use of class time and in the design of the exercise itself. In a seminar setting of 20-25 students, discussions centered around formal building elements (e.g. door, window, skin, roof, and base) but addressed each of these elements in conjunction with various cultural matters. For example, students explored issues of sunrise signification (e.g. rebirth, time, and beginnings) relative to the cycle of daily human and natural events as experienced through an aperture or across a threshold (a "window" or a "door"). These discussions served as a counter-measure to the imperatives of energy-efficiency with its design criteria so well defined that it tends to overshadow abstract and diffuse esthetic concepts. Secondly, the design of the exercise had two features that also worked to halt this tendency to subordinate esthetic concerns to thermal efficiency. Principally, students were asked to integrally design both Indoor and Outdoor spaces. In contrast to a single room proposal which would invite the construction of an isolated figure against the desert as a mere background, the couplet of rooms tended to force ambiguity or complexity into the figure/ground relation. It also introduced notions of interiority and exteriority. Moreover, requiring attention to the exterior space prevented students from thinking only in the strict technological terms of the computer model, which could not analyze exterior space. This caused the students to broaden their scope beyond energy efficiency. Finally, the construction of physical study models that were subjected to sunrise conditions rendered the conceptual work as a concrete aspect of general design curriculum.

The design competition concluded nine-week long learning process, with the students submitting a final physical model, a computer-generated performance report, and two section drawings. Once the entries were gathered, each screening staged was guided by the same imperative: "Select the best proposal for a room for sunrise appreciation." The students made the first screening themselves by selecting the Top 30 projects for the professors to further evaluate. The second and third screening stages entailed the Technical and Design juries separately selecting the top fifteen projects and then ranking the top five projects.[4] Significantly, the screenings indicated a remarkably positive correlation between the endorsed entries and superior thermal performance (see graphs below).[5] However, to a certain extent, this correlation was anticipated as the project demanded sensitivity to thermal performance.

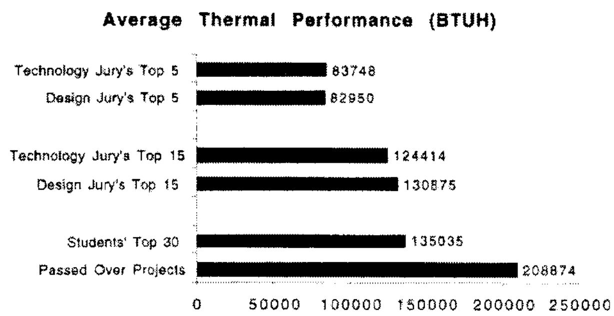

Fig. 1. Thermal Performances improves at each screening stage. Technology Jurors selected superior performing with Top 15 picks, while Design Jurors selected superior performing with Top 5 picks.

Careful inspection of the similarities and differences between the two juries' Top 5 picks opens a fertile line of educational inquiry opens upon. The slightly superior thermal performance of the Design Jury's selection over the Technical Jury (based on average performance values) challenges the conventional expectation that those with Technical expertise would6by virtue of their expertise6select vastly superior projects than those without this expertise. Relative to this conventional expectation, this finding comes as quite a surprise. In looking more carefully at individual selections within these Top 5 groupings, we find that the conventional expectation holds true only in terms of each jury's First Prize selection.

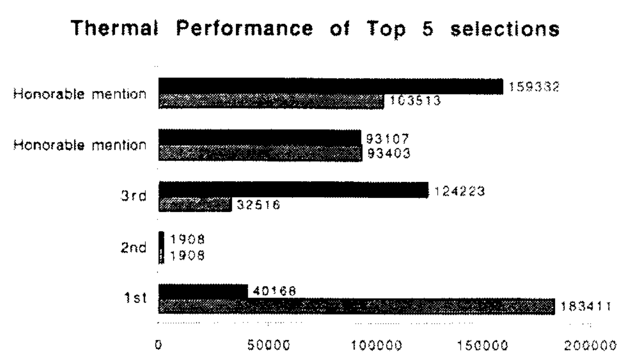

Fig. 2. Technology Jury's First Prize selection thermally out-performed the Design Jury's selection. Design Jury's Third Prize and a Honorable Mention project thermally out-performed those selected by the Technology Jury. Both juries selected the superior performing entry for Second Prize

Also noteworthy, both juries picked the same project for their Second Prize selection and, it turns out, that this project achieved the best thermal performance of all the entries. But, perhaps most remarkable of all is the curiosity that two of the Design jury's high-performing selections were not represented in any of the Technical jury's selections. With the Technical Jury's Top 15 picks ranked in terms of thermal performance, one of the overlooked projects surpassed nine out of the 15 picks and the other 13 out of 15 picks. Juxtaposing the Design jury's surprising performance-oriented sensitivity with the fact that the Technical jurors totally overlooked two energy efficient projects raises a question: How did these respective jurors actually judge the work at hand?

ARCHITECTURAL JUDGMENT

Although given the same general instructions for evaluation, the actual evaluation procedures employed by the Technical and Design juries paralleled the basic differences between art and science.[6] Proceeding like true empiricists, the environmental technology faculty precisely limited the project's goals to the logical integration of energy efficiency and "sunrise appreciation." Whereas, the design faculty—proceeding like true artists—boldly expanded the project's goals beyond that of sunrise appreciation in order to include more general, analogical references to the human condition.

The technical jury's isolated objectives of energy efficiency and sunrise appreciation were further limited through a direct and literal understanding of these variables. Thus, the technical jury analyzed the energy component of the competition projects in direct reference to conventional guidelines (rules of thumb) regarding the "correct" climatically responsive approaches to the design of fenestration, shading devices, building massing, and orientation. Similarly, they understood sunrise appreciation as a condition achieved when the design allowed the inhabitants a direct visual experience of the sun emerging over the eastern horizon. With their evaluation protocols following focused and conventional (stereotypical) guidelines, a certain precision resulted in the technical jury's ability to select energy efficient projects. This perspective, however, caused the technical jury to overlook those energy-efficient designs that did not conform to conventional guidelines. Similarly overlooked were those projects that explored the wonders of sunrise without centering on its direct visual sighting.[7]

While the technical jury sought a certain objective correspondence between limited variables, the design jury sought projects that presented a powerful subjective image made present through its material construction. The design jury sought conceptually-minded proposals that resonated with conceptual clarity, formal elegance, and a sense of craft. The jurors generally passed designs guided by singular justifications, such as stereotypical apertures, massing, and orientations.

The evaluation differences between the two juries can be made concrete by presenting each jury's First Prize selection. Significantly, neither of the projects deemed as excellent by one jury were represented in the other jury's top15 picks, suggesting the polarity between their criteria. In describing their top prize winner (see figures 1 and 2), the design jury noted:

> The project considers, unlike any other, the absolute vastness of the desert as a conceptual landscape. It establishes a presence, partly by means of the material manifestation of four massive stone pylons which exudes permanence necessary in the merciless desert. Simultaneously, the project gives us place, but a place marked by an almost nomadic temporality implicit in the very nature of the canvas stretched over fine latticework which is both sensuous and non-durable and offers to shelter us.

In selecting this project as their top project, the design jurors polemically asserted their expectation that architecture must go beyond merely providing shelter and acknowledging one facet of the day (i.e. sunrise). For them, architecture must present a fitting image of the human condition in the phenomenological landscape (e.g. "nomadic temporality in the merciless desert").

In explaining their award of top prize (see fig. 3 and 4), the Technical jury commented:

> This project has the advantage of multiple ways of appreciating the sunrise: you can be in various locations, including being in the shade. And, from below, you can experience the instant of daybreak as the sunrise appears reflected on the "movie screen." From a thermal point of view, the underground design takes advantage of the soil's thermal inertia while the fenestration captures cooling breezes.

In selecting this project for first prize, the technical jury polemically asserted its expectation that project demonstrate a high level of integrating sunrise viewing and energy efficiency.

The evaluation differences reflecting the disparity between art and science were also embodied in the differing referential contexts employed by each juror. Like scientists, the environmental technology jurors desired to make objective evaluations. For instance, the jurors felt a need to isolate judgements relative to the student's specific intent in relation to environmental physics, with both the details of intent and physical phenomena being objectified through drawings and diagrams. By contrast, the design jurors' evaluation procedures were more open-ended, extending beyond the student's explicit intentions, appearing to operate with the conviction that once the project had been proposed that the project itself acquired a life of its own. With the project set forth into the cultivated world, the design jury's evaluation was not tied to the student's intention (objective), but rather to the subjective domain of Art. With this understanding, the jurors attempted to interpret the project based on its potential to serve Art, regardless of student intent. Acting on behalf of this subjective domain, the design jury took certain liberties with the competition entries, actually altering the work in an effort to make it even stronger.[8] For instance, in the project awarded Third Prize, the design faculty removed the outer shade roof as it was interpreted as interfering with the project's monolithic plinth. They argued that this project's chief contribution was "the consequential gesture of marking and establishing place within the desert site, where it resonates with an almost primordial force."[9] Here it was understood that the Art of place-making was better served without the roof, as it lessened the idea at hand. However, the removal of the roof violated the technical jury's sense of propriety as the roof objectively contributed to energy-efficiency and was part of this student's intention or objective. The different sensitivities towards this roof are symptomatic of the jurors' polemic polarization of architecture, with one group promoting the practical object, the other the reflective subject.

ARCHITECTURAL EDUCATION

The diverse expertise and corresponding polemics of the two juries impinges upon the educational relation between courses of design and technology: Should they be separated or integrated? With some clarification, analysis of the Virginia Tech experiment suggests that the building arts and sciences should remain separate as the respective heuristic strengths of design and technology reside in a certain autonomy. The precepts of subjectivity and objectivity must be first appreciated directly and without confusing or diluting the artist and scientific rules of conduct through nave cross-curricular integration. The separation between these realms, however, should not be drawn out to the typical semester-long solo event as is common in many schools of architecture. Instead, aspects of the building arts and sciences should be singled out to define a limited set of parametersólike two rule sets—to rigorously guide constructive actions for the game-like event of project-based learning. The educationally useful distinction between art and science achieves its greatest architectural relevance when these diverse points of view are played out, as if in an educational game. The challenges and opportunities created when these diverse parameters intersect represent the genuine locus of architectural learning. Here, at this meaningful intersection, the game turns on the critical mediation between a precisely-defined practical outcome and a diffuse, reflective one.

In our experiment, for instance, the game centered on a broad conceptual program which, in hindsight, could have been better named as "A Desert Place." The original reference in the exercise's title to "appreciating sunrise" was intended to insure that the students recognize the thermal consequences of their designs relative to a harsh desert sun. This concern, however, was unwarranted as the computer model's performance report constantly reminded the students of the gravity of this issue. Stemming from the emphasis of sunrise appreciation, the technology jurors tended to expect entries that presented inhabitant the direct view of the rising sun. Yet, in the serious constructional game of "A Desert Place" the phenomenological arts match wits with the practical sciences. This strategies of esthetics and practicality intertwine in the multi-staged event, occurring in various venues, including lecture hall, seminar room, studio, and cyberspace. The intertwining involving computer modelling is of particular interest as it simultaneously involves technical rigor with its embodied algorithms while granting students freedom from stereotypical or textbook solutions to their esthetic investigations of building elements ("door," "window," "skin," and "roof"). The software allows the students to creatively explore a form idea and test its thermal consequence, facilitating the sensitive building up of practical and reflective significance. Such decisions create a place of sensitivity in the student's memory. It should also be noted that this type of sensitivity might actually represent a mode of cultural responsibility to both esthetics and practicality that remains uncommon in architectural education. To the extend that this unique sensitivity was embodied in the student work it may have skewed the competition results, leading to the surprising thermal performance of the design jury's Top 5 selections and the technical jury's oversight of two of these thermally efficient works. Thedesign jury's selection of energy efficient projects may have been somewhat coincidental, stemming less from the design jury's foresight and more from the students going beyond the conventional criteria of "good design" in their clever consideration of thermal issues. Also, the technical jury may have inadvertently by-passed certain energy-efficient works as they did not conformed to their conventional expectations of "energy-efficient design." While the stereotypical expectations of design or technical faculty surely contributes positively to student learning of autonomous curricular contents, the curious findings from our competition suggests that there may be a superior realm of knowledge than the autonomous contents of design and technology. This superior realm stems from an epistemological game in which educational conventions, stereotypes, or rules of thumb are paired up in order to test their societal validity.

But we should remember that learning is a three-dimensionally layered event, requiring not only horizontal movement between diverse curricular realms that forced students to confront these educationally essential perspectives. Learning also entails continual reinforcement in the thoughtful mediation of the two conceptual poles in the same project throughout the student's education. Arguably, students should have to seriously confront aspects of the building arts and science at least once every year, elevating the complexity or difficulty at each cycle of what educational psychologist call "the learning spiral." Unfortunately, most schools make the mistake of assuming that its students have accomplished basic architectural competence and are ready to more on to mastery. The tendency is to move students on to advanced classes in the building arts and sciences, as if the school's educational mission to develop specialists: Building Artists or Scientists. If the educational mission and not only society's buildings is more architectural in nature, students need many serious gaming opportunities, like that of the present experiment.[10] If, if fact, architects are expected by society to strive to synthesize or mediate these perspective, then we as educators must do the same. The experiment offers one way for us to discuss how to best do that.

NOTES

[1]Virginia Tech's Department of Architecture faculty engaged in another curricular experiment in 1986. They included the teaching of Structures and Environmental Technology in the Design Studio, utilizing all-encompassing project-based learning exercises. Lasting only two years due to the exhaustion of faculty, the experiment was most successful in elevating the faculty's awareness of the diverse concerns of design and technology.

[2]Although the students were officially enrolled in the Environmental Building System course, they were advised to approach the project as a matter of design and environmental technology as each project was going to be entered into a design competition judged by design and environmental technology faculty. The author was not on either jury.

[3]Energy Scheming, an University of Oregon software, analyzed the project's thermal performance in a climatic context by rendering heat flows occurring on the winter and summer solstice and the fall and spring equinox, presenting the data in both easy-to-understand graphs and numerically, in terms of the total adverse heat flow (measured in British Thermal Units per hour, BTUH). It is important to stress that the data of thermal performance is not necessarily 100% accurate as the students themselves did the modeling.

[4]Both sets of jurors were instructed to use their expertise in selecting projects that represented the best proposal for "a room for the appreciation of sunrise." It is useful to note that upon receiving this instruction, the technical jurors cautioned that they were unable to evaluate the work from a strictly environmental technological point of view, as they would not be able to artificially separate their design and technical interests. Also, the Design faculty jurors cautioned that they had no expertise in energy efficient design. In response to their concerns, both juries were advised to judge the competition as they normally judge works of architecture, as one of the chief educational purposes of the competition was to better understand the manner in which the two differing faculty groups evaluated building proposals.

[5] The students made the first screening, selecting the Top 30 projects that thermally out-performed the 90 projects passed-over by a whooping 48% (141,000 BTUH average vs. 209,000 BTUH average). The more selective judgements by faculty juror surpassed this performance. The Technical jury Top 15 projects that thermally out-performed the Design jury's selection by 5% (124,414 BTUH average vs. 130,875 BTUH average). Also, of some interest, is the fact that those projects commonly-cited by both groups thermally out-performed the selections of those cited by the technical faculty alone by 8% (114,338 BTUH average). The Design jury's Top 5 selections slightly out-performed those selected by the Technology jury (Ave. 82,950 vs. 83,748 BTUH).

[6]Some of the judgement differences are subtle, reflecting the fact that all jury members have undergraduate degrees in architecture, thus having roughly similar backgrounds in design fundamentals. However, the substantial difference stems from the jurors advanced studies, with jurors gaining either scientific or esthetic expertise. This expertise accounted for the differing manner each jury independently interpreted the central task implicit in the design of "A Room for the Appreciation of Sunrise."

[7]In general, the technical jury demanded "a high level of integration" in specific terms of energy efficiency and sunrise appreciation. With such focused expectations, there can be little wonder why the Technical jurors unanimously and repeated expressed the desire for greater explanation from the students of technology and esthetic concepts explored. Specifically requested were diagrams indicating how the design of fenestration and shading devices correctly responded to solar geometry. Also desired were drawings showing scale figures in relation to the sun, specifically illustrating the student's intention for sunrise appreciation. In short, the Technical jury expected the competition entries to display isolated focused inquiries characteristic of all objective analyses.

In contrast to the Technical jurors who lamented that the competition entries demonstrated a certain inadequacy, the Design jurors were impressed with students' design methodologies. For example, after surveying the student work, one juror who teaches third year design studio reflectively inquired, "Wait a minute, I know these students; how is it possible that they are doing more serious design work in this class than in my studio?" The central observation alluded to in this comment and similar comments from other design faculty related to the project's emphasis on a broad design concept (sunrise appreciation).

[8]The design jury modified the two of their top five project selections.

[9]The Design jurors noted that this roof appeared as "an afterthought created just to fulfill the (energy-efficiency) requirements of the project. Without the roof this project is very good."

[10]In order to better ascertain student learning of architecturally relevant knowledge, the students themselves should be asked to judge the competition entries and then compare them to the Design and Technical faculty's comments.