Aesthetics and Technology: Cultivating a Common Ground

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INTRODUCTION

According to Reyner Banham, there are two reasons why "architects as an organized profession have been happy to hand over all forms of environmental management, except the structural, to other specialists."[1] The first reason is because society has not demanded any more of architects than to be "creators of inefficient environmental sculptures;"[2] and the second is because "outsiders" force new aspects of environmental management upon the architects. As we approach a new millennium, it seems appropriate to re-visit and challenge these negative preconceptions regarding the relationship between environmental technology and architectural aesthetics.

The professions of architecture and engineering are technically complex and the desire to cultivate a common ground between these two disciplines formed the basis of this collaborative endeavor. In order to acknowledge and promote the role of aesthetics in "making technology visually acceptable,"[3] a working dialogue was initiated between architecture and mechanical engineering students. The objective was to develop an understanding and respect for other disciplines by creating an atmosphere/opportunity for interaction.

The strength of this type of cross-disciplinary collaborative effort lies in the commitment on the part of faculty members to challenge commonly held perceptions. The product of this collaborative effort was the building designed by the architecture students, the systems designed by the mechanical engineering students, and the experience gained by working with individuals outside of one's known discipline. The built environment is not only about aesthetics and art, but also about engineering and technology, business and management, and psychology and sociology, to name just a few. Making these cross-disciplinary connections will enable students—no matter what the discipline—to more successfully navigate the transition between academia and professional practice.

PERSPECTIVES OF THE ARCHITECTURE FACULTY

Background

The faculty in the School of Architecture at Mississippi State University (MSU) spend a great deal of collective time planning, reviewing, evaluating, criticizing, and replanning the Design Studio sequence. Studio objectives are identified and outlined in an effort to address global priorities, national design pedagogy, current faculty strengths and interests, and perceived student needs. The project types change from semester to semester and year to year, but always within a framework that challenges the student to synthesize, refine, and apply architectural knowledge.

The focus of this second-semester fourth-year studio was environmentally conscious design and consisted of three projects. The first project was a case-study environmental audit and analysis of an existing classroom on the MSU campus and lasted for two weeks. The second project involved designing and modeling a prototypical classroom and lasted for three weeks. The final project was the design of a new chemical engineering building on the MSU campus and lasted for ten weeks. The program called for a 65,000-square-foot building to house graduate and undergraduate labs and classrooms, as well as administrative and faculty offices.

Within the context of this studio the design, development, and integration of environmental technologies in ways that make them visually acceptable was defined as follows. In architecture, aesthetics deals with the way buildings look: the skin, form, site, and overall image within the culture to which they belong. In engineering, technology is informed by modern science and is systems and process oriented.[4] Controlling building environments (both actively and passively) can produce more insightful architecture when an understanding of the aesthetics of the building envelope (static) is paired with an appreciation of the technology of building systems (dynamic). Therefore, merging aesthetics and technology has the potential to transform the built environment from a collection of essentially static objects into a world of dynamic and interactive built forms.

The Collaboration

The value of an architectural process that promotes learning through experience is discussed in an article by Darlene Brady entitled "The Education of an Architect: Continuity and Change." Where Ms. Brady writes about the need to make connections between studio and lecture courses within the same discipline, this collaborative effort took the first steps at trying to make connections between studio and lecture courses across two disciplines.

In spite of problems associated with coordination, content, and scheduling, the collaborative interaction helped direct the architecture students towards a further awareness and understanding regarding the positive relationship between architectural aesthetics and environmental management. This was documented in a questionnaire distributed at the end of the semester where students were asked to describe a positive aspect of the collaboration effort, a negative aspect of the collaboration effort, and suggest improvements.

In response to the positive aspects of the collaboration, students indicated that they no longer thought about mechanical systems as a last minute activity. As the building design evolved, they understood how their building would function mechanically, they knew what mechanical system was being used, and they knew the amount of space needed for that system. For some students the project was no longer "mine" but "ours," and many found that "working outside" the architecture building was refreshing and a bit closer to reality. Most importantly, the architecture students came away feeling more confident about what they knew regarding environmental controls as their ideas were confirmed by the mechanical engineering students.

The negative aspects seemed to have more to do with the quality of the collaboration. The architecture students wanted to spend more time discussing the project with their partners and wanted to begin the collaborative process earlier in the semester. It was even recommended that this type of cross-disciplinary interaction begin earlier in the architecture curriculum—specifically during the third-year studio sequence. Not having the mechanical engineering student participate in the final jury was also perceived as a shortcoming.

With regards to suggestions for improvements, the architecture students expressed an interest in collaborating with other disciplines such as civil engineering, electrical engineering, and landscape architecture. They also felt that there should have been parallel goals set forth for both the architecture and mechanical engineering students, and that there should have been more coordination regarding expectations, grading, and scheduling.

Final Thoughts

The most significant outcome of this cross-disciplinary collaboration was that we even did it. As faculty members, we work hard at changing the preconceptions of our students with regards to architecture and the built environment; however, how often do we try to change our own preconceptions regarding collaboration and professional practice? Much of what we learn, we learn through example and as educators, if we take the first steps at searching for a common ground between architects and engineers, artists and scientists, and aesthetics and technology, we can encourage our students to cultivate innovative means and methods for improving the quality of the built environment.

PERSPECTIVE OF MECHANICAL ENGINEERING FACULTY

Background

Air Conditioning is a graduate/undergraduate mechanical engineering course offered in the spring semester of 1996. The course introduced the fundamental concepts and methods for analysis and design of heating, ventilating, and air conditioning (HVAC) systems. The major topics covered in the course were: types of HVAC systems, indoor air quality and comfort criteria, heating and cooling load calculations, psychrometric processes, energy efficiency, and duct design. The assignments included four projects: 1) evaluation of an existing HVAC system, 2) a collaborative project on planning and design of a HVAC system for a new chemical engineering building on the MSU campus, 3) a case study on psychometric processes, and 4) a ductwork design project.

Following the first project which familiarized the students with the types of HVAC systems, the collaborative project was assigned and progressed through the rest of the semester. Evaluation of the students performance on this project was based on a final oral presentation. At the end, feedback on the usefulness and drawbacks of the collaborative project was collected from the students.

Objectives and Scope

Overwhelmed by quantitative details, engineers may unintentionally exclude other important facets from their design approach. Aesthetics and cultural considerations are examples of qualitative aspects that have to be incorporated in the design of building systems in order to maintain the integrity of a larger picture envisioned by clients. Successful integration of the necessary elements in a comprehensive design work often requires a well orchestrated collaborative team effort between architects and engineers.

The main objective of the collaborative project was to provide a "hands-on" experience for the students that would familiarize them with characteristics of effective team work and potential problems encountered in the real-world work environment. In an article entitled "Rebuilding Engineering Education," Norman R. Augustine emphasizes the importance of real-world experience in engineering education and points out nontechnical factors such as political and economic constraints influencing the engineering accomplishments.

The project required interactive and collective efforts of both architecture and mechanical engineering students. Each engineering student was assigned to work with an architecture student, forming two-member teams. Due to the larger enrollment of the architecture studio class, the graduate students, honor students, and some undergraduate volunteers worked with more than one architecture student. The engineering students were provided with the basic design criteria in terms of spatial dimensions, functionality, and occupancy. The tasks performed by the engineering students included: obtaining and examining the floor plans from their architecture student counterparts; recommending effective and efficient HVAC systems; addressing and resolving design conflicts through an interactive effort with their counterparts; providing a simple layout for ductwork, piping, and equipment; and constantly incorporating any modifications in the design through a constructive dialogue.

Drawbacks

Team work by itself is not a panacea—it has its drawbacks. A number of problems were encountered during the course of the project which fall in the following categories.

a) Organizational

Organizational problems stemmed from schedule conflict, time constraints, and lack of coordination in group efforts.

b) Behavioral and Motivational

Simply stated, some students were not ready for the interdependent activities required in the collaborative project. These students might prefer or be accustomed to performing in a competitive environment which does not promote a "win-win" situation. Stephen R. Covey elaborates on the significance of interdependent and synergistic activities in team work. Based on Covey's discussion, one can realize that although the ability of each individual to function independently is a prerequisite, it is certainly not the sufficient condition for an effective interdependent activity. Full cooperation of each team member demands a higher level of understanding and maturity which can be, in part, acquired via education.

Recommendations

Despite the drawbacks, promoting collaborative projects can be beneficial to students in increasing their awareness of the importance of effective team work in producing high quality design schemes. Acknowledgment of related problems in itself can be valuable for faculty in overcoming obstacles. Based on the observations and the feedback from the students, the following suggestions are made to improve the effectiveness of the educational collaborative project in the future.

a) Motivation

Students can be further motivated to focus on the collaborative project in a number of ways. Shifting the priorities in grading is an obvious method. The collaborative project accounted for about 12% of the course grade which can be increased. Involvement of industry in the curriculum can also motivate the students by demonstrating the importance of team work in the real-world environment.

b) Composition and size of team

Allowing participation of two or more engineering students in each group would enhance the technical capability and confidence level of the team. Utilizing diverse talents is another positive attribute of a larger team if the composition is carefully arranged. Having more than one mechanical engineering student will alleviate unnecessary pressure and anxiety on participants as well.

c) Continuous evaluation

Continuous or incremental progress evaluation of team efforts can minimize unnecessary delays and help the groups clarify their directions.

d) Educational remedy

From previous experience, the main interest and priorities of engineering students lie with the technical aspects of their curriculum. The importance of personal development in leadership and communication skills is largely ignored. Students should be encouraged to take these issues more seriously which is important in the real-world work environment. The educational curriculum should be more responsive to these issues as well.

Final Remarks

Collaboration between engineers and architects is not a new idea; it has been and will remain an essential part of any comprehensive building design process as long as diverse expertise is required. But, the question is how the full potential of collaborative activities can be realized. Are college graduates prepared to effectively function in a collaborative environment, or are they just trained within an isolated boundary? These are important issues in any work environment where quality and productivity are pursued. The assignment of the collaborative project in the air conditioning class was inspired by the need to address these concerns and was intended to broaden the knowledge of the engineering students in the related area.

PERSPECTIVES OF THE STUDENT

Background

I started my college education in the MSU mechanical engineering department knowing that I would eventually study architecture and completed the program in four consecutive years. I picked up one summer of construction experience along the way and started an engineering job performing energy and waste assessments for local industries. Upon receiving my BSME, I enrolled in the School of Architecture's accelerated program.

Collaborative Assignment

In my last semester of engineering, I enrolled in the air conditioning technical elective. I believed the class would expose me to new aspects of mechanical engineering, and the knowledge would be directly applicable to my future studies of architecture. One of the four design projects outlined in the course syllabus was to be performed in collaboration with a fourth-year architecture student. It was presented to the class as an experimental study in the interaction between students of different disciplines. The project had two goals: 1) the engineering students would apply design techniques learned in class, including specifying system types, air handlers, duct layout, duct sizes, and mechanical room layout; and, 2) all students would gain experience working with students on the same educational level but of a different discipline.

Initial Thoughts on the Assignment

I was anxious to work with a fourth-year architecture student because I wanted to learn all I could about the School of Architecture before starting the curriculum myself. Also, it seemed to be a good transition from one major study to the other. Working closely with an architecture student would allow us to experiment with how the mechanical system could enhance the function of a building without compromising form. I was aware that my outlook on the assignment was unique, but still felt that the project goals made good sense for the class as a whole.

Because the class was a technical elective, not a required course, it seemed reasonable to assume that the students had an interest in this type of mechanical engineering design work. They should, therefore, benefit from the experience. Because professional architects work with mechanical engineers, the project should be equally beneficial to the architecture students.

Execution of the Assignment

Because there were almost twice as many architecture students in the fourth-year design studio as mechanical engineering students in the air conditioning class, the engineering students were offered extra credit if they were willing to work with two or more architecture students independently. Because of my interest in the project, I volunteered to work with three architecture students. Initially, I imagined I would be working extensively with the architecture students, hunched over technical drawings, struggling to design mechanical systems that would work well and enhance the interests of the architect. That was not the case.

I met with each of the students about six times. Each of my partners provided me with floor plans and a project program but gave no instruction as to what he or she was trying to achieve with the building design. I took the floor plans and went to work. I recommended systems which I felt worked well given the function of the building. Two of the three architecture students took the suggestions and implemented them without argument. They allotted more than enough space for the mechanical room and expressed no opposition to the duct layout. It seemed like any design I recommended was fine with them; there was very little interaction. The third student was different; she was not as sure where to place the mechanical room. After exploring design alternatives, we decided together on a central location. I was pleased because it simplified my design for the duct layout. She was satisfied, but not pleased. Because each of the three students chose to conceal the duct runs in most occupied areas, there was little discussion on the visual qualities of the ductwork. I informed them how much room the ductwork would require, but did not question their decision to conceal it.

I provided each of my three partners with duct layouts, a mechanical room layout, and a list of advantages and disadvantages of the recommended HVAC system. My work was reviewed in my presence by both the architecture and engineering faculty members. The architecture students were invited to attend, but were not present. Likewise, I was given the option to observe the final review of the architects but did not attend.

Project Problems and Recommendations

The project had problems from the beginning. Many engineering students felt that the collaborative project was too much work in addition to other assignments, especially for an elective course. It would have been helpful to motivate the students at this point by bringing in a practicing engineer and architect to discuss with the HVAC class the importance of collaboration.

Another problem was that the architecture students' designs changed constantly throughout the semester; this required some engineering students to redesign the HVAC systems, which was not beneficial since no new knowledge was gained from redoing the calculations. In some cases, floor plans were not available until several weeks into the project, making it difficult to design duct runs and mechanical rooms. It would have been helpful if the team had been required to have floor plans ready by a specific date to insure ample time for completion of mechanical system calculations.

Perhaps the biggest problem was one that I encountered personally with two of my partners; there was simply not enough discussion. Regarding their design intentions, they did not offer, and I did not ask. It may have been because we were newly acquainted and were not comfortable sharing ideas with each other. I certainly did not feel comfortable saying "why would you do that?" or "that doesn't make sense." What did I know about architecture? When I provided system designs, they did not hesitate to implement them, so minimal team work was required. I suspect that a more critical analysis of each other's work would have produced a better product. It is hard to recommend a solution when there are not enough problems. The one student I did collaborate with was satisfied but not pleased with the end result. Because I am now studying architecture, I know it was because she was dealing with issues more crucial to her design (and probably her grade). I think it would have helped if the final review of the collaborative work had been conducted with both the architecture and engineering students present.

Project Value

Despite the problems encountered during the execution of the collaborative project, it was still beneficial. It provided the opportunity to design against a changing list of requirements set by another student instead of a text book. I better understood the obstacles and, because I was contributing to another student's project, I felt more motivated to be creative. Not only did I get to see my design become part of something larger, but I met and learned about three students of a different discipline. I began considering issues important to others, not just myself.

Final Recommendation

Cross-disciplinary collaboration at MSU is a great idea. As a student of both architecture and mechanical engineering, I feel the two disciplines have much to contribute to one another. In the design of a building, the architecture student must consider many systems and how they contribute to and reinforce design objectives. The engineering student enhances the building design by providing detailed information on the mechanical system. I suggest a collaborative project which utilizes a broader range of the engineer's background. For example, a dynamic roof design responsive to sun position where the team members are mutually responsible for both design practicality and aesthetics.

CONCLUSION

Advancements in building systems technology have made the building design a multi-disciplinary task requiring collective efforts and collaboration from architects and engineers. Creating an effective collaborative environment takes more than just technical qualifications of the individuals involved in team work. Appreciation for other disciplines, communication skills, and management and leadership abilities are among the other useful components of such an environment. To familiarize the architecture and mechanical engineering students at MSU with the characteristics of team work, a cross-disciplinary project was assigned and evaluated for future improvements.

The idea of the educational cross-disciplinary project was also supported by the vast majority of the architecture and engineering students. Their feedback acknowledged the usefulness of collaborative team work in producing high quality design schemes via increased awareness of design conflicts and synergistic incorporation of different ideas from both disciplines. The issues raised by the students during and after completion of the project, however, pointed out the problems associated with the scope of work, coordination, scheduling, and uneven assumption of responsibilities among the partners. Some of these shortcomings can be easily overcome by fine tuning the work load and more faculty involvement. Of course, the significance of educational programs with respect to individual skills such as communication should not be underestimated.

The difficulties and shortcomings encountered in the course of the project are not construed as obstacles but as an opportunity for further improvement. As a matter of fact, faculty involvement in cross-disciplinary collaborative activities in itself is believed to have a positive impact on the students. The respective faculty members are viewed as role models, and their cooperative attitude can alleviate potential friction between the future architects and engineers.

NOTES

[1] Reyner Banham. *The Architecture of the Well-tempered Environment.* (Chicago: The University of Chicago Press, 1984 Edition), 269.

[2] Ibid., p. 270.

[3] Ibid., p. 264.

[4] P. Richard Rittelmann, FAIA. "The Architect as Technologist," *Advanced Technology Facilities Design* (1995): 6.

REFERENCES

Augustine, Norman R. "Rebuilding Engineering Education." *The Chronicle of Higher Education* (May 24, 1996): B1-B2.

Banham, Reyner. *The Architecture of the Well-tempered Environment.* 2d ed. Chicago: The University of Chicago Press, 1984.

Brady, Darlene A. "The Education of an Architect: Continuity and Change." *Journal of Architectural Education* (September 1996): 32-49.

Boyer, Ernest L. and Lee D. Mitgang. *Building Community: A New Future for Architecture Education and Practice.* Princeton, NJ: The Carnegie Foundation for the Advancement of Teaching, 1996.

Covey, Stephen R. *The Seven Habits of Highly Effective People.* New York: Simon and Schuster, 1990.

Cuff, Dana, and Elizabeth Robertson. "Words and Images: The Alchemy of Communication." *Journal of Architectural Education* (Winter 1982): 8-15.

Friedman, Daniel, Charles Thomsen, Frances Halsband, and John Gaunt. "The New Real World: Practice, Education and Profit in the 00's." *AIA National Convention* (May 10, 1996): Transcript.

Gutman, Robert. "Emerging Problems of Practice." *Journal of Architectural Education* (July 1992): 198-202.

The American Institute of Architects. *Advanced Technology Facilities Design.* Washington, DC: The American Institute of Architects, 1995.