Critical Thinking in the Teaching of Architectural Technology

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INTRODUCTION

At the 1998 ARCC conference much of the discussion revolved around the question of what constitutes architectural research. There was some concern that the word research was too exclusive in the sense that it might inhibit the development of what some see as "softer," less quantifiable scholarship in architectural design. The fact that this type of discussion is taking place suggests that there is a certain uneasiness regarding the application of the scientific method, most definitely when it comes to architectural design issues, but equally in some cases to research in architectural technology. This uneasiness should not be ignored. Our collective intuition remains perhaps the last vestige of a tradition of thinking which is not based on progress and efficiency.

What is the difference between scholarship and research? It would appear that the answer lies with the use of numbers. "Real" research, it seems, must be quantified. Even if it is research about quality, this must be converted into numbers: take for example "light quality" which is difficult to measure as such, but which can be evaluated indirectly by relating it to "increased worker productivity" which is something that can be measured.

Neil Postman, in his book *Technopoly*, defines the assumptions of the thought-world in which we find ourselves today. These include, "the beliefs that the primary, if not the only goal of human labor and thought is efficiency; that technical calculation is in all respects superior to human judgement; that in fact human judgement cannot be trusted, because it is plagued by laxity, ambiguity, and unnecessary complexity; that subjectivity is an obstacle to clear thinking; that what cannot be measured either does not exist or is of no value; and that the affairs of citizens are best guided and conducted by experts."[1]

There is certainly a ring of truth to his statements. I am reminded of a recent experience at a conference on Lighting in which paper after paper sought to demonstrate how a few more lumens per watt could be eked out of a fluorescent tube. I was struck by the often narrow view that these "experts" took, focussing on demonstrating the increased efficiency of a system without any regard for the larger context in which that system would be found. I was left with many nagging questions: What is the ultimate goal of all this research? Is it to help us design the best possible architecture? What does that mean? How do we evaluate good architecture? Is it that which uses the least amount of energy? This, we can measure. Is it that which raises our spirit? This is harder to measure.

The dilemma exists in the fact that the feelings of uneasiness regarding the subservience of human judgement to numbers are equally apparent when we consider the alternative. The decision to opt out of the system altogether and just talk about the poetics of the world seems nostalgic at best. Words such as self-indulgent and light-weight come to mind.

Where to turn to when neither the technocratic nor the nostalgic approach appears to be an option?

There is no simple answer to this question nor do I feel it is my role as a teacher to offer one. It is my role, however, to offer the students ways of thinking about these issues; to encourage them to think carefully about the world into which they will be graduating and to prepare them to face the real pressures that will be brought to bear on them in practice. I characterize this activity as the art of critical thinking. More than ever, it is crucial that our students enter practice with an ability to analyze the various situations that they will encounter and to judge on what basis these situations should be evaluated.

There are a number of conditions necessary for the development of critical thought. First, the students must be aware of the existence of the "technopoly," and the fact that we are all subject to its tendencies. They must learn to question the viability of a tradition based on the "overcoming" the past, of solving problems with technological solutions, of trusting that technology will have "the" answer. They must recognize that every technological solution brings with it its own set of problems for which we will in turn find new technological solutions, and on and on. Progress is meaningless without a clear endpoint in mind. This message is fairly easy to convey, drawing from the myriad examples found in everyday life.

The more difficult task is to find a way to act critically in the world, to act in a way which does not mindlessly contribute to an instrumental way of thinking. Here I take my cue from contemporary Italian philosopher, Gianni Vattimo. In his book, *The End of Modernity*, Vattimo offers an alternative to the notion of "overcoming" (in German, "Uberwindung"). Vattimo proposes what I consider to be a more eastern attitude toward acting in the world which he identifies by the word "Verwindung." I find the metaphor of the balance of energy described in martial arts helpful in defining this term. The idea is to take the energy that is coming at you, absorb it and then redirect it. Similarly, Verwindung indicates "a going beyond that is both an acceptance (or resignation) and a deepening, while also suggesting both a 'convalescence,' 'cure,' or healing and a distorting or twisting."[2] Vattimo's aim then is "to perform an act of "Verwindung" on the metaphysical tradition; to remember and recollect the tradition, to traverse it once again but with a critical edge ... The intent is to distort and dissolve the tradition from the inside, erasing the vestiges of metaphysical thought still present in it, while at the same time—inevitably, but with self conscious irony —prolonging it as well."[3]

If we are interested in engaging in this project of Verwindung, not only do we need to know about modern technologies and understand

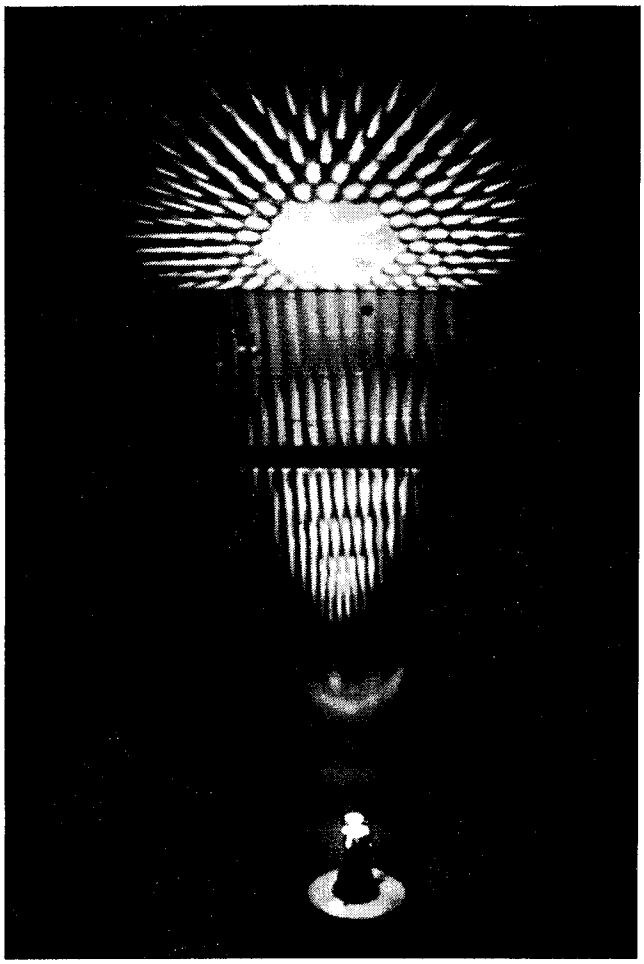

Fig. 1 Halogen Par 20 Narrow Flood Luminaire

their essences and histories but these technologies must actually become the inspirations for our projects; not as truths but as sources of critical reflection. This philosophy forms the basis for the assignment and project around which I have structured the course I teach entitled Lighting in Architecture. The course is a core course offered in the second semester of the third year of a five-year Bachelor of Architecture program. It is a standard lecture course with an enrollment of about 70. Assessment is based on one assignment, one research project and an exam. All the students do the assignment. Students sign up for one of the research projects which are done in groups of two or three students. The results of the research projects are presented in the appropriate lecture slot.

LUMINAIRE DESIGN ASSIGNMENT

The Luminaire Design assignment is very successful as a means of exploring notions associated with the concept of critical making, ("Verwindung"). The students are each supplied with an electric light source from a variety of incandescent, halogen, fluorescent, compact fluorescent and H.I.D. lamps. These become the starting point for the design of a light fixture. Unlike common practice, the program (function) and the site of the fixture will be the result rather than the initiator of the design process. The primary design intention for the luminaire is that it function as a critique of the source, that it reveal something about its shape, the colour of the light it produces, its beam shape and intensity, its efficacy, etc. One should come away from the luminaire, first with a deeper understanding of the conventional use of the source, but also with some ideas about how that

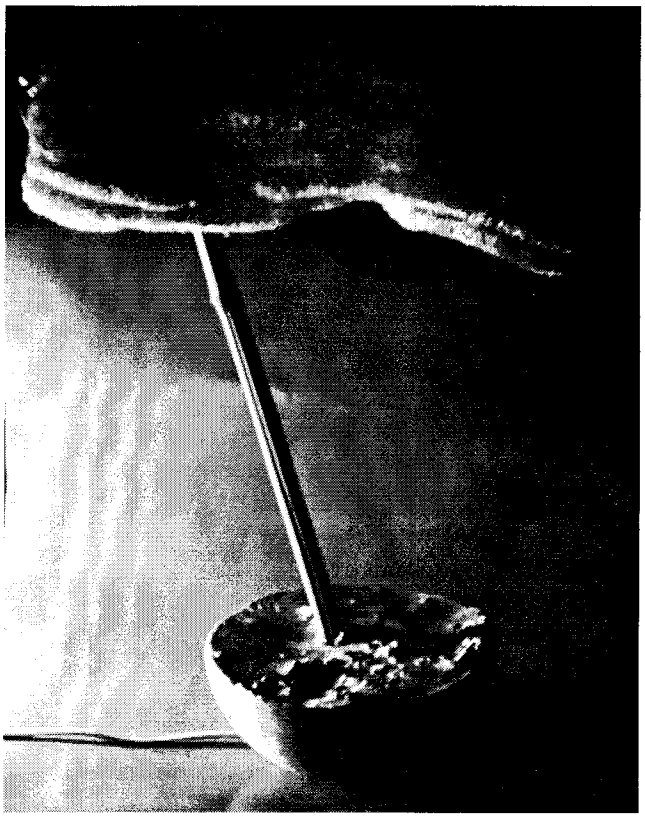

Fig.2 Compact Flurescent Luminaire

convention might be tweaked in such a way as to allow us to think of it differently.

Example 1: Halogen Par 20 Narrow Flood Luminaire by Derek Fleming

The halogen Par 20 narrow flood lamp is typically used for accent lighting, i.e., to light a focal element or display. In this case the student elected to make the focal element the lens of the lamp itself, using an additional lens located above the lamp to project the lens' image on the adjacent wall and ceiling above. The body of the luminaire houses an adjustable socket mount which allows for the focusing of different layers of the Par lens through the twisting of a knob. The luminaire literally deepens our understanding of the Par lamp and accepts but twists the program for which it is intended.

Example 2: Compact Fluorescent Luminaire by Jean Baptiste Bureaux

This student introduced an element of playfulness into his luminaire as a critique of its compact fluorescent source's more "serious" origins (it was developed to replace the standard A19 incandescent lamp offering the same lumen output at approximately four times the efficiency). This is a literal case of distorting the tradition from the inside (because of its low heat output, it is possible to totally encase the lamp in the porous louffa sponge) by means of satire. The ballast (which provides the starting voltage and regulates the current when the lamp is in use) is embedded in a concrete hemisphere whose rocking motion further emphasizes its lampoonlike quality.

RESEARCH PROJECTS

In addition to the luminaire design, each student participates in one of a series of group research projects designed to complement

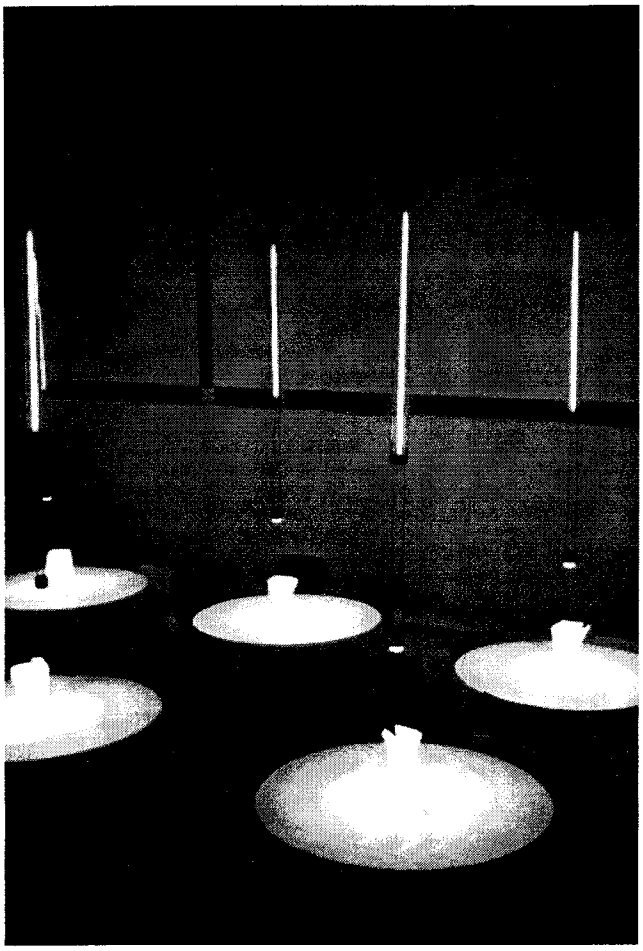

Fig. 3 IES dinner lighting design

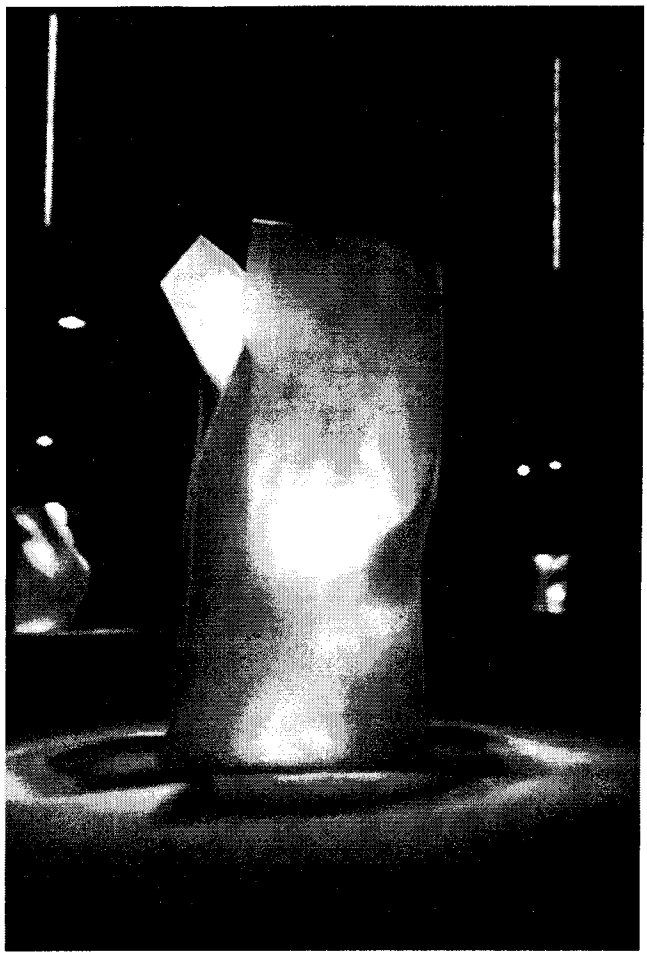

Fig. 4 Plexiglass table sculpture

the lecture schedule. Topics include such issues as daylight distribution, eye adaptation, colour rendering, reflected glare, etc. These projects are deliberately set up to explore the issue of attaching numbers to lighting design issues: To what extent did the measurements taken reflect the issue being explored? Did the taking of measurements stimulate a particular way of viewing the problem? Were there aspects of the project which were important at some level but which could not be quantified? How could these be represented? Was there an innovative way of representing quantitative and/or qualitative data which could reveal the students' critical thinking about the issue?

These projects were successful to the extent that the students learned the "how to" of research projects (establishing hypotheses, taking measurements, graphing results, writing reports, etc.). In terms of stimulating critical thinking, the projects were less successful than anticipated. I credit the failure of this aspect of the assignments to their lack of experience with research projects and the competition with Design Studio for time. The students had so much to learn about the basic techniques of doing a research project, that by the time they got around to writing up the research report, they just wanted to get it done so they could get back to studio. Products of the technological society, it appears that the students too are subject to its prime imperative of supplying the minimum energy to get the job done. The more positivistic activity of getting the numbers right was clearly what they interpreted to be the "important" part of the assignment (for which the majority of the grade would be alloted); this at the expense of following up with the more hermeneutic task of critiquing the project method which they incorrectly assumed to be nonessential.

I can think of only one instance where the students approached an act of "Verwindung" in the presentation of their research project. These students had selected to study the distribution of daylight through skylight apertures using daylight modelling techniques. Their presentation consisted of a description of each skylight condition through the juxtaposition of quantitative means of representation (ie. isolux graphs and daylight factor sections) with qualitative slides of the interiors of the models.

The students commented on the different information being conveyed in each case focusing on the fact that even though the photographs were a deceptive means of representation (in the sense that they could be manipulated through the choice of exposure time), they were much more evocative and accessible to the average person. This led to a discussion about manipulation; manipulation of numbers and manipulation of the audience; how to tune a presentation to suit a particular group of people. What are the ethical obligations of the architect to represent the full story of a project?

Finally, the students concluded their presentation with a video of the movement of sunlight through the room. The video started with a conventional time lapse type representation but suddenly, during one of the sequences, the sun startlingly reversed direction. Bored by the monotony of its circular orbit around the earth (or vice versa as the scientists would tell us) it appeared as if the sun had thrown caution to the wind and had begun to dance instead. That moment, when the sun broke with tradition, was incredibly powerful; a clear reflection of our unconscious dependence on certain constants in our lives.

The final pair of group projects were of a slightly different nature (less research based), and involved actually designing and installing

the electric lighting for an Illuminating Engineering Society dinner held at the School of Architecture. The dinner took place in the large central multipurpose space of the school known as the "pit." This is a rather austere, high ceilinged space open to the major circulation paths in the building. The students wanted to emphasize the verticality of the space while simultaneously bringing the light down to the level of the tables to create a more intimate dining environment. The resulting lighting design consisted of columnar suspensions from the ceiling each of which contained a 4 foot T8 fluorescent tube in a red sleeve. Suspended from the base of each structure was a low voltage narrow spot halogen lamp which directed its light to a molded plexiglass sculpture on the table. The indirect light from the glow of the sculpture provided a wonderfully warm focal glow for each table, balanced nicely by the reddish ambient light above.

When it came time for the students to write up their reports on the dinner designs, they rebelled at the prospect of doing this in a conventional format. They felt it was inappropriate to evaluate them based on quantitative analysis. The students felt that the success of the design had nothing to do with numbers, and any attempt to talk about it in quantitative terms would only serve to "kill" the magic of the work. Determined that this not happen, the students proposed that they write a poem about the design instead. This seemed to me to be a fair compromise. The thought process leading to this proposal embodied significant critical reflection on the part of the students and demonstrated a clear and thoughtful position that in some cases, quantitative analysis simply has no place.

Moreover, given the meagre equipment we had for evaluating the design in quantitative terms (just a couple of relatively inaccurate illuminance meters), I was not in a position to press the point. We had no means of measuring the amount of energy being consumed, nor the luminance ratios which had contributed to the wonderful sense of intimacy at each dinner table.

FUTURE PROJECTS

Which brings me to the final section of this paper: my interest in the Vital Signs Project as a model to elaborate some of the ideas initiated in the Lighting in Architecture course into a larger pedagogy for an architectural technology curriculum. To loosely quote the Vital Signs web page: the Vital Signs Project is a curriculum materials development effort coordinated through the Center for Environmental Design Research at the University of California, Berkeley. The premise of the project is that existing buildings hold fascinating lessons on a variety of topics, from occupant well-being and architectural spacemaking, to the operations of technical systems and building energy consumption. Vital Signs encourages the development of a set of measurement techniques to test hypotheses or "hunches" about how and why an actual building performs in a given way. The existing building then serves as a site where students can test design hypotheses through direct experience. These case studies are written up and shared with other students via the web.[4]

Without in any way implying the concurrence of the founding members of the Vital Signs program with the philosophy described in the body of this paper, I believe that the Vital Signs project offers a propitious environment in which to continue thoughtful discussion around the role of quantitative analysis as a research method in architecture. It is a particularly fertile environment precisely because it takes quantitative analysis very seriously, offering resource packages and equipment loans to encourage and facilitate accurate monitoring of the "vital signs" of buildings. In order to engage the students' attention regarding quantitative research, it is important that they at least feel that the data they are collecting has some validity, and that the tools they are using approximate those used by the experts. (The lack of credible tools contributed significantly to the weak development of the research projects in the Lighting in architecture course.)

I believe that the real opportunity that the Vital Signs Project offers however, results from its focus on the case study method. It is this aspect which favours critical thinking. With case studies, the collected information remains at the level of the specific; it resists being systematized. The collection of all the case studies affords a wealth of practical knowledge in the true sense of common wisdom but it remains up to the individual to make judgements concerning the relevance of the various case study data to future applications. Using this information demands active interpretation in the same way that case law demands interpretation:

> "What the law prescribes, what a case of a given law is, is only determined unequivocally in the eyes of a formalist who endangers life. Finding the law means thinking the case together with the law so that what is actually just or the law gets concretized. For this reason the body of precedents (the decisions already laid down) is more crucial for the legal systems than the universal laws in accord with which the decisions are made."[5]

While accepting the quantitative scientific method of research which is at the root of the "Technopoly," the Vital Signs project's constant reference to the building as a living organism in a symbiotic (or often not so symbiotic) relationship with its particular environment, acts as a critical reminder that each aspect of a building must be considered in relation to all its other aspects, including those which cannot be measured. It demands critical thinking, providing a clearing in which to exist between the scientific method and human judgement.

NOTES

[1] Neil Postman, *Technopoly, The Surrender of Culture to Technology* (New York: Vintage Books, 1993) p.51.

[2] Gianni Vattimo, *The End of Modernity, Nihilism and Hermeneutics in Post Modern Culture* (Great Britain: Polity Press, 1988) p. xxvi.

[3] Ibid.

[4] http://www-archfp.ced.berkeley.edu/vitalsigns/Default.htm

[5] Hans-Georg Gadamer, *Reason in the Age of Science* (Cambridge, Massachusetts: the MIT Press: 1984) p. 82.