

Teaching the Poetics of Structure

ERIC FISHER
Carnegie Mellon University

PREFACE:

The world is composed of systems, all of which, despite their incredible variety, are united in that they in some way exhibit order. A plant is a system, for example, whose leaves and stem and blossoms are all arranged with specific, genetically defined, relationships to one another. Architectural systems are just like any other systems in that they too are ordered. To get to the heart of an architectural system, it is necessary to learn intimately how it functions.

A brick, according to Louis Kahn, wants to be an arch. Air, so the mechanical engineer on my latest project informs me, wants to flow through round metal ducts. A wide flange, according to the structural engineer, wants to be connected to others to create a framed system. Learning what different architectural systems "want to be" is one of the most important skills that an architect acquires.

INTRODUCTION:

Architecture has changed dramatically in the last century. As a result, architects are no longer as connected to the process of constructing buildings as they were in the past. There are many

reasons for this but, whatever the reasons, the result is that for most professional architects, the knowledge of building techniques has become less strong. Structure has become a thing that is often relegated to engineers to make the architect's conception stand up.

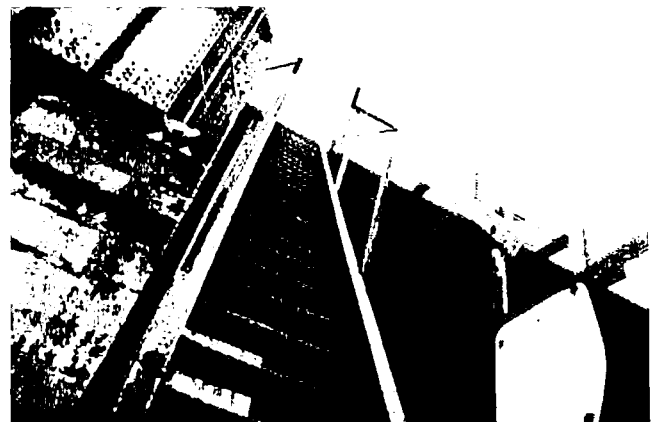
My belief is that this dis-connection between the architect and his creation is harmful to the profession of architecture, harmful to the quality of the buildings we create, and ultimately, harmful to the building user's experience of the space. How can an architectural education help to unclog the arteries between the architect and the world of structure? At Carnegie Mellon University, we address this question by focusing the entire third year, second semester student experience on, as the syllabus states, "the developing and refining of an architectural design as informed by the technical knowledge of structural systems, enclosure systems and the process of construction."

DEFINITIONS — STRUCTURAL SUPPORT VS. SUPPORTIVE STRUCTURE:

Structure, as it is commonly referred to by architects today, is the part of a building that is relegated to supporting the floors,



"The Carnegie Library and the Cathedral of Learning, Oakland".



"Bridge-Stair, The Strip District".



"Retaining Wall, East Liberty".

walls, and roof. It is the nature of structure as it relates to architecture and engineering that it is typically in the service of the primary function of the construction. Perhaps that primary function is to provide enclosure (by means of either roof or walls), or passage (either vertical or horizontal – e.g. bridge, tower), or lighting, or advertising. Whatever the function of the construction, the structure serves to hold it up, to buttress it, to lift it, or to support it in some manner.

The only time when this is now perceived to not be the case is when the construction is without function; in other words, when the construction is formed as a work of art. In this case, the structure is intended primarily to evoke feelings in the subject independent of any other use. The structure is sculpture. The secondary or supporting role of structure is what leads us as architects to think of it as a poor cousin to architectural design.

PROBLEM STATEMENT:

The supporting role of structure is the reason why building engineers – or, for that matter, architects who have concentrated on the technological aspects of the profession – have typically not been recognized in the twentieth century to the same extent as are those who were considered to be "pure designers". Jean Prouve, Robert Maillart, and Craig Elwood were all arguably not given their due while they were alive. Although the third year of a CMU architecture student's education is focused on the acquisition of knowledge about structure, we realize that the knowledge we are imparting is not considered primary at all schools.

Here is a radical thought: it is not even a given that a technical approach to design is necessarily a good thing. David Billington, the author of *The Tower and the Bridge* has concluded that the three features that make an engineered structure successful are efficiency, economy, and elegance.¹ So it is ironic that in the past architects, who have concentrated on the design of structure have been criticized, sometimes with some justifica-

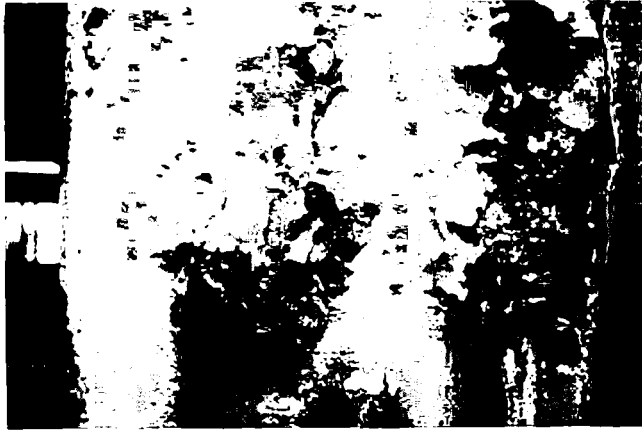
tion, for designing overly elaborate (inefficient), expensive (uneconomical), and inflexible, rigid (inelegant) constructions. I am no great fan of the naïve genre of 60s buildings that Michael Sorkin has called, "... the last gasp of Modernist urban science fiction and its precybernetic technical fix."²

Raphael Moneo has spoken about how the intimacy between architecture and construction has been broken. This intimacy was once the very nature of the architectural work and somehow was always manifested in its appearance. He wrote that to be an architect has traditionally implied being a builder: that is, explaining to others how to build. The knowledge, when not the mastery, of building techniques was always implicit in the idea of producing architecture. Architects in the past were both architects and builders. Before the present disassociation, the invention of form was also the invention of its construction. One implied the other.³

Today many artistic minded, creative people avoid structure instinctively, and with all their heart. According to Heino Engel, the author of *Structure Systems*, "Application of normative essentials – the analytical, the instrumental, the process-methodical – are generally considered an impediment to the creative unfolding."⁴ In Shakespeare's *Othello*, Iago persuades Othello that his romantic ideas are misplaced. "Iago, as the agent of rational argument, undermines those fragile characteristics of love and loyalty by the constant application of simple rational argument."⁵ Analytic thought is consistently perceived to be at odds with creative thinking. Poets, from Auden to Saint Exupier, have spoken against a love of numbers and facts in favor of a world of thought and feeling. This mistrust has been expanded to a distrust of engineers and their work. Technicians might be, as the architect Le Corbusier said, "healthy and virile, active and useful, balanced and happy in their work, but only the architect – by his arrangement of forms – realizes an order that is a pure creation of his spirit."⁶

It is natural that some creative minded architecture students should wish to avoid knowledge of structure. Artistic thought exists in a world of grays, a world in which a thousand possible solutions exist for every problem. Decisions are not so much right and wrong as much as they are more or less correct. Should I continue the decorative concrete block around the corner of the building on which I am working one foot or six feet? My reason for bringing the block around the corner is to reveal to people that there is brick beyond that is not currently visible to them. There are reasons for making either decision. One of the pleasures of designing buildings is in making these sorts of judgments.

Structure, on the other hand, is perceived to be the "pure" product of rational thought. Structure is perceived in blacks and whites: A structural system must not be "wrong" because people's lives depend on it being "right". My engineer will decide for me whether to make the steel pipe column I have



"Rusted Steel Column, Downtown Pittsburgh".

shown on my plans twelve inches in diameter – as I desire – or perhaps larger: fourteen inches or even sixteen inches. If he makes the column sixteen inches, I will be forced to move my curtain wall away from the column a couple inches so that it may still run continuously without interference. I won't want to make the change because it will take a day or so to adjust all of the building plans and sections, but I will because I realize that my engineer is responsible for making sure that the building won't collapse. If the building collapses, people may be harmed and, ultimately, I may even be held responsible. Numbers, facts, figures, people dying. No wonder structure turns some architecture students off.

HISTORICAL CONTEXT:

Although it may be true that the split between structure and form is not entirely new to the twenty-first century, in architecture the distance between the two has certainly become larger in recent history. To the Greeks and the Romans, there would have been no difference between the sort of analytic thinking that engineers do and the creative work that architects do. "The first people created things according to their own ideas . . . by virtue of a wholly corporeal imagination . . . for which they were called poets which is Greek for 'Creators'."⁷ To the classical philosophers, the word, "techne", referred to both the fine arts and the useful arts, which is why Aristotle's *Poetics* constantly suggests ideas regarding personal work, arrangement of materials, and structure.⁸ Every creative act upon an object was an attempt by the artist to coax forth the object's innate nature.

So how is it that structure has come to be viewed as separate from and secondary to a building's form? Well, for one thing, Modernism changed architecture forever by separating the enclosure of a building from its structure. In olden times, the walls of a building were structural and held up the building roof and walls. Now, the building enclosure system more often than not plays no role in supporting the building roof. Most of the time, it can't even hold itself up! Increasingly, architects have

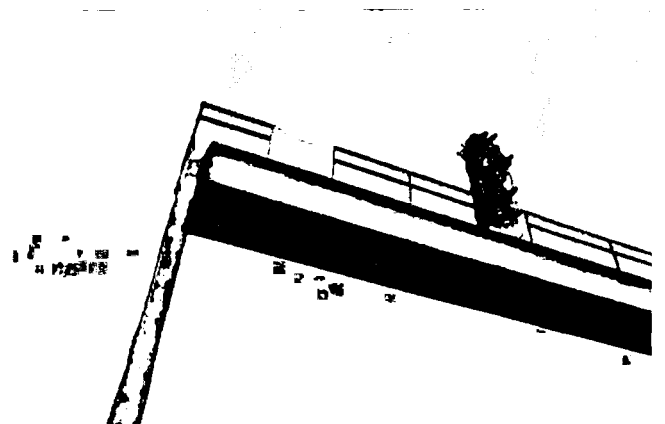
become designers of building skins while engineers are relegated the design of the structure.

In addition, architecture has simply become too complicated for any architect to master all aspects of the profession. I have heard architects say that, because the world in which we exist has become so convoluted and because building techniques have so sophisticated, we should leave construction to the builders and engineering to the engineers. "Let architects concentrate on what they know well, namely coordination, management, and design." It is true that architecture is a complicated profession, which is why the most famous architects tend to be older. It takes a lifetime to acquire the skills that you need to design a building of consequence. Yet, certain practicing architects, like Renzo Piano, and certain engineers, like Santiago Calatrava, have managed to combine engineering and aesthetics. "The evidence is that we live in a time when the intelligence, the knowledge, the skills, and the talents of architects are at a zenith."⁹

Further, most buildings are constructed in the most expedient way possible and any construction that varies from the norm costs more money. Special details are required if the skin of a building is to be pulled away to expose the structure and details cost money. Structural expression is tricky and therefore costly. Also, the structure of many new commercial buildings requires spray fireproofing, and it is generally agreed that any direct expression of that material is unsightly. So, architects are forced by code to express structure in these buildings indirectly, by means of a non-loadbearing layer of secondary structure that mimics the primary structure. This additional structure is redundant, and is therefore subject to deletion by cost conscious owners.

PHILOSOPHICAL PERSPECTIVE:

In order to repair the relationship between the architect and the structure of his creations, it is necessary to rise above the playing field of the argument and view it from above. First, let's



"Train Signal, Aspinwall".

examine the way in which Modern conditions have changed the way people view the constructed world:

When you, the designer, place your pencil to paper, you are choosing, whether you know it or not, to become a foot soldier in an ongoing struggle. The combatants in this struggle are:

- 1) *The architect (the artist) – formerly highly regarded, the Howard Roarkian, mythological, philosopher/king has suffered crippling blows this century from those who question whether the total content of the object (the artist's child) can ever be determined by the architect's intentions. Perhaps, like the British monarchy, today's creator is successful, but irrelevant.¹⁰*
- 2) *The object – At one time, a proud, independent, timeless warrior, the object is now thought to be the pawn of the subject, a chameleon who presents himself to the world based on the viewer's interpretation. Richard Meier, for example, is a designer of objects. His white forms are, literally, models of perfection. But Richard Meier, so successful when I was in school, is no longer a member of the avant-garde. Far from representing an ideal world in which form and representation are one, his new buildings are representations of corporate money and power.*
- 3) *The subject (the viewer) – Once a passive, idealized, male spectator/fan, the subject has thrown away his armor of rationality to reveal his true nature which is that of a hydra – a many faced, ambivalent, multivocal, multicultural beast.*

The relationship between these three has been the single dominant subject of twentieth century art theory, ever since modern experience began to call into question the Classical, realist, humanist tradition. In the twentieth century and, so far in the twenty-first century, the clear winner of this struggle has been the subject. The idea behind a subject-based universe is that "All we can know on the basis of sense perception are our own states of mind, or ideas." In art: The "immanent" – meaning, "within the mind of the subject" – characteristics of Art have precedence over any historical or ideological components. Unless there are ways of knowing that do not rest upon sense perception, this is all we can know.¹¹ The phenomenological reality of postmodern urban life throws objective conceptions into question. Experience is irrational: In real life, patterns fail: Things fall apart, people die or do not behave in the way we expect. Dreams may fail. It is natural for us to question our conceptions of cohesive idealized order. Following the lead of Berkeley and Hume, a philosophical theory of sense perception is today considered to be basic to the interpretation of the results of empirical investigations.¹²

People view the built world in a fundamentally different way than they did a century ago. As a result, today, in addition to the traditional objective criteria by which people evaluate buildings (such as context, history, and program), are added additional



"Tree Wall, Shadyside".

subjective criteria (such as gender, language, time, and all the concerns of the human body). Yet, as we have discussed, architectural structure is thought of still as arising from a world of rational, objective, scientific truth. It is the portion of a building that is not fleeting. Building structure is no longer seen as at the heart of today's architectural endeavors because it resists classification in the phenomenal world.

How does this affect the architect as he designs? After all, he or she may not even know of these airy problems. The answer to that question is clear: Architects are affected by theory whether they intend to be or not. C. J. Jung said at the beginning of the twentieth century that ideas lay buried within humanity's collective unconscious awaiting expression in the different arts. As the world changes, so do ideas, and so, necessarily, is the architect pulled along in the wake of these ideas whether he intends to be or not. From Pittsburgh to Havana, architects are responding to these new subjective criteria. Consciously or not, architects now consider the phenomenal experience of the future inhabitants of their buildings.

TOWARD A SUBJECT BASED VIEW OF STRUCTURE:

Like a skillful rower, a person who is creative must combine exuberance with control. For architects today, passion is too often associated with enclosure while structure is too often associated with control. How then, may students come to once again appreciate and investigate structure in the twenty-first century? My thought is that in order for the structure and construction of an edifice to become reintegrated with its conception, it is necessary to admit that structure is ephemeral in the same manner as all other forms are. A building's structure must be thought of and discussed with the same subject-based criteria as any other forms.

Even if structure were truly like bones, and always lay entirely beneath the skin of the building, then it would still be of interest to architects. Think of a sleeping couple underneath a blanket. The shape of the blanket is defined by the corpus of

the figures beneath. One might say even that the bodies give meaning to the blanket. Without the presence of the bodies, the blanket lies passive and inert; but with them, the blanket is brought to life. The coverlet may now exert its own active physical poetic presence because of the bones beneath. Consider Antoine Saint-Exupery's famous image of an elephant that has been swallowed by a snake, which to most people looks like a hat.¹³ The trick is to intuit the implied presence of the elephant even though you can see only its vague outline. I fear that when architects design buildings, we see only the hat and often ignore the presence of the boa constrictor and the elephant. The body of the unfortunate elephant defines the shape of the snake. Structure, the thing that lies beneath, defines form.

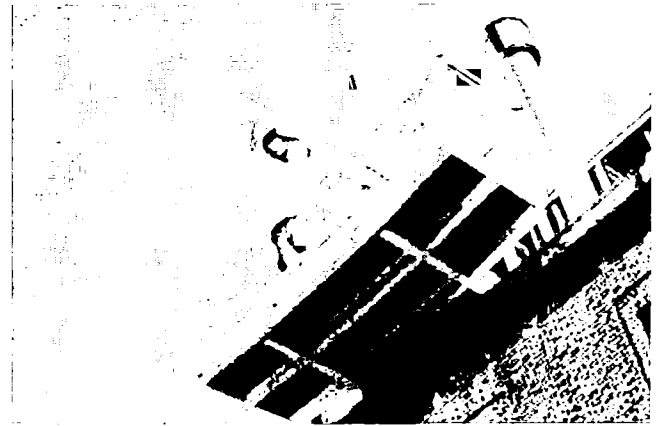
But there are times when structure does not lay beneath the skin of a building. As we all know, there are three possibilities regarding the design of a building's structure. The structure may be hidden within the skin of a building, it may be constructed in the same plane as the skin, or it may be constructed outside of the skin. Certain of these strategies may be less cost effective than others, but no matter. The point is that structure not only defines form, it becomes form. At a certain level, all of architecture is structure.

Phenomenologists like Henri Bachelard, the author of *The Poetics of Space*, saw the implied movements of forms as nothing less than expressions of compressed time. Every built space is a compilation of its own history. Its forms contain the memory of a succession of time-dependent phenomena, which explains why when architects speak of "reading" a building they are, in fact, accessing the building's story. In an odd sense, they are even empathizing with the building's condition. We all do this: A medieval peasant contemplating the towering spire of his town church could not help but think of Christ's ascent and of his own possible future upward path to Heaven.

People respond phenomenally to structure in the same way as they do to other forms. As Lucie Fontein has written in the *Yale Architectural Journal*,

*"To build a structure is in its essence a creative act of reinterpretation. We put things together, and through the juxtaposition or arrangement of the constituent parts, we determine the particular nature of character of the whole. In turn we are able to read within the structure all the knowledge, dreams and imaginations of the people who made them."*¹⁴

Structure connects people to the buildings they inhabit. Knowledge of building structure is necessary for an architect, in the words of Peter Rice, "to make real the presence of materials in use in a building, so that people warm to them, want to touch them, feel a sense of the material itself and of the people who made and designed it."¹⁵



"The Intelligent Workplace at CMU".

As I walk through Pittsburgh, I—the subjective viewer—expand myself with the aid of my camera onto and across the fine, old constructions of my city. When a structure cantilevers in a daring way, I imagine myself leaning out over the space below, which explains why it moves me. As Jean Paul Sartre once said, "The human body always extends across the tool that it utilizes: it is at the end of the telescope, which shows me the stars . . . it is my adaptation to those tools."¹⁶ As human beings with a body that teaches us the nature of gravity, contraction, strength, and so on, we gather the experience that enables us to identify with the conditions of other forms, which explains why we identify intuitively with the noble serenity of a column.¹⁷ A subject oriented universe, far from trapping structure as the objective "other", frees structure to be treated in the same way as we treat other forms.

CONCLUSION:

My belief the first time I taught at CMU was that—we were perhaps overwhelming our students with all this talk about structure. In our effort to educate them about structure and its role in architecture, we were perhaps emphasizing its separation *from* architecture, and we surely did not want to do that. I argued for a more unified approach—one in which form and structure were more closely linked throughout all four years of the students' schooling. Today, however, I feel that we were on the right track. For the most part, my students felt good about their projects. They worked hard and learned a lot. I hope that in future semesters our students will continue to forgive our excessive zeal for our subject. I hope that they keep in mind that we are only trying to redress the wrongs of our profession as it currently exists.

One of the most rewarding aspects of being an architect is that it magnifies the humanity of those who practice it. An architect is like a giant whose feet are balanced firmly on the ground as his eyes scan the skies above the clouds. We are never more fully human than when we exhibit both sides of our nature, the creative and the analytic. As I was preparing for this talk, I was

reading Nietzsche, Bachelard, and Stavinsky at night while designing canopy and curtain wall details during the day. Dealing with the physical reality of built form is one of the challenges that architects face. At CMU, we teach our students to view building structure in the same way that they view the rest of a building: It takes analytic skills to manipulate form and it takes creativity to manipulate structure. The students learn to neither be intimidated by building construction nor to fear it. For inherent in the design of structure are the same dramatic possibilities inherent in the design of any other form.

NOTES

- ¹ David Billington, *The Tower and the Bridge* (Princeton: Princeton University Press, 1983) p.6
- ² Michael Sorkin, "Critique," *Architectural Record* (Jan. 2002) p.51-52
- ³ Rafael Moneo, *The Solitude of Buildings* (Cambridge, MA: Harvard University Press, 1986).
- ⁴ Heino Engel, *Structure Systems* (Ostfildern-Ruit, Germany: Verlag Gerd Hatje, 1997) Introduction
- ⁵ Peter Rice, *An Engineer Imagines* (London: Artemis, 1993) p.75
- ⁶ Le Corbusier, *Towards a New Architecture* (Trans. F. Etchells, London: Architectural Press, 1927) p.17-18
- ⁷ Gianbattista Vico, *The New Science*, Ithaca, NY: Cornell University Press, 1981) p.376
- ⁸ Igor Stravinsky, *The Poetics of Music*, (Cambridge, MA: Harvard University Press, 1942) p.4
- ⁹ Jeffrey Kipnis, "Forms of Irrationality," *Strategies in Architectural Thinking* (Cambridge, MA: MIT Press, 1992) p.151
- ¹⁰ *Ibid*
- ¹¹ Maurice Mandelbaum, *Philosophy, Science, and Sense Perception*, (Baltimore, MD: The Johns Hopkins Press, 1964) p.118-122
- ¹² *Ibid* (preface)
- ¹³ Antoine de Saint-Exupery, *The Little Prince* (London: Harcourt Inc, 1943)
- ¹⁴ Lucie Fontein, "Reading Structure Through the Frame," *Perspecta 31 - Reading Structures* (2000) p.51
- ¹⁵ Peter Rice, *An Engineer Imagines* (London: Artemis, 1993) preface
- ¹⁶ Jean Paul Sartre as quoted by Tony Vidler in an essay by Robert McAmuly, "Body Trouble," *Strategies in Architectural Thinking* (Cambridge, MA: MIT Press, 1992) p.181
- ¹⁷ Heinrich Wölfflin, "Prologue to a Psychology of Architecture," *Empathy, Form, and Space: Problems in German Aesthetics, 1873-1893* (Chicago, University of Chicago Press, 1994)