Layering and Revealing:
Production Processes of Building

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> The architect who proposes to run with technology knows now that he will be in fast company, and that, in order to keep up, he may have to emulate the Futurists and discard his whole cultural load, including the professional garments by which he is recognized as an architect. If, on the other hand, he decides not to do this, he may find that a technological culture has decided to go without him. It is a choice that the masters of the Twenties failed to observe until they had made it by accident, but it is the kind of accident that architecture may not survive a second time—we may believe that the architects of the First Machine Age were wrong, but we in the Second Machine Age have no reason yet to be superior about them.'

The rapid advancement in technology has significantly effected the theory and practice of architecture. More than ever before, the practice of engineering has become an indispensable part of the act of building. The introduction of structural, mechanical, electrical, and lighting systems as design parameters is accompanied by an increased presence of "obscure zones" usually referred to as "unoccupied spaces". In certain buildings, these systems become the focus of the design as a whole. The magnitude of this integration is a direct function of the building type it serves; thus airports emphasize structural systems, libraries-lighting, musical halls-acoustics, hospitals-mechanical, etc. In spite of this amplification of engineering systems, architects are encouraged to maintain their leadership in the design process by acknowledging the necessity of these building systems and the existence of an aesthetic value in conjunction with its function. In order to achieve this, the introduction of new building systems must be accompanied by an understanding of this new building vocabulary, its applications and consequences. Only then can architects continue to charge forwardin search of continuity andchange.

This course aims at studying the active and actual integration of the various building systems in high-profile projects. To understand the process of integration, one method is to analyze, through comparison, the process of design and construction in buildings of similar typology. The intent is to bring forward the nature of the relationship between architectural design and engineering systems, and highlight the crucial communication skills required by both the architect and the engineer.

"Comparative Studies in Building Systems" is offered each semester as a three-hour core seminar for second year graduate students. They enroll for a semester and take one of three designated technology electives the other. These electives cover the subjects of construction, light and color, structure, and solar energy. Other technology courses are offered every semester as electives for students who wish to study and further their understanding of the history and theory of technology.

The semester is divided into four parts, each dedicated to a specific building type. These are selected based on the range of issues, scale, and particular building systems. Each building type is allocated four weeks distributed as follows: I. Evolution of the Building type, its history and theory, identification of technological systems and review of related basic technical knowledge; II. Current Practices, inviting a designer (architect/engineer) to present current technologies and applications; III. Site visit to a building that demonstrates effectively the design principles of its type's systems; IV. Contemporary Case Studies reviewed and presented by student groups.

As the course is offered every semester, two faculty members alternate teaching the course with differing case studies and focuses. The following represents the contents of the course offered by the author.

The first building type is the tall office building with a focus on structural and cladding systems. One of the most visible andinformative aspects of tall buildings is the skin that wraps its exterior and the skeletal system that supports it. There exists a tension between the strength and independence of the structural system as opposed to the fragility and dependency of the cladding system. The former is erected by the engineer and the latter is applied by the architect. This delicate balance of responsibilities is the focus of the first four weeks. By studying the construction of both systems, structural and cladding, one may begin to identify the various components and methods of assembly to comprehend the order and sequence of design and execution of the two interrelated systems. This study leads to exposing such issues as wind-bracing and moment connections, water proofing and sealants among others.

The second building type is laboratories, focusing on spatial planning and services. Utilities are the life support systems of a building where independent systems function as an integral unit that sustain and maintain the use of the enclosure. The concern of moving people within a building is dealt with on a physical, physiological and psychological level. Thus, circulating people involve the study of corridors as paths, lobbies or foyers as rest points, stairs and elevators as deflection and shifting mechanisms; similarly, circulating matter involves the study of pipes, ducts and conduits as paths, mechanical and utility rooms as generators, and shafts and cores as access points. Today, a laboratory building is the ultimate twentieth century building in which technical advancements are sought in its design and construction, as well as its ability to accommodate continuing transformation and change.

Museums are the third building type considered in this series with an emphasis on lighting and environmental systems. Museums, unlike offices, are more dependent on the quality rather than quantity of light within their spaces. The tendency is to bring in light and control its path particularly in its gallery spaces. Shape and height of the galleries, surface area and finishes, and type of exhibits are major factors in dictating the size, height and location of an opening – be it top-lighting or side-lighting. Given the number of new projects completed recently, it comes as no surprise that this building type captures the interest of students; a welcomed opportunity to bring attention to less apparent systems like security and fire distinguishing.

The final four weeks of the semester focus on emerging technologies emphasizing sustainable know-how such as photovoltaics and new glass technologies. Lectures address issues of environmental responsiveness and sustainability utilizing applicable modes of technology. The goal is to situate technology within the contextual parameters of culture, economy of means, ethics and nature as applied to contemporary architectural practice. Questions of responsibility and accountability are posed and answers are offered by seeking non-traditional sources of technology (advanced electronic and space industry); as well as exploring unconventional "building" industries (i.e. boat manufacturers).

JUDGMENT IN THE CLASSROOM

> I tried to explain that the building was the outcome both of its context and the technology that made it realizable. The context would embrace all the functional, social and cultural considerations and the technology would be another way of saying the making of something or the means of production. How then could the very nature of a thing be separated from the way that it had been made - surely each one informed the other??

The introduction of complex as opposed to complicated projects is an opportunity to understand the multi-layered nature of architecture. Similar to practice, students collaborate on most assignments (except the final project). With varying probes for each building type, students are directed to examine buildings completed within the last decade. These are projects already receiving positive subjective evaluations through aesthetic judgment by the students (usually influenced by architectural journals and other publications) without reveling what lays beyond the surface. Judgment is objectified by reviewing the original design and construction drawings. Students are encouraged to contact the building's designers (one group received drawings from Germany and another from Denmark). This is an opportunity to read and study for the first time a construction drawing and compare it to the photograph at hand. The absence of a building's visit brings forth the importance of reading and relating the various construction drawings and emphasizes its crucial role in understanding the various layers of the building. Class presentations are usually a forum for a slide presentation with a discussion of similarities and differences between the projects presented, and discovery of projects that are less publicized but nevertheless intriguing in their own right.

Assignments for the individual building type include a 10-15 minute slide presentation, a series of analytical and exploratory drawings, and a precise and detailed partial model of the building's researched.

I. REVEALING SKELETON AND SKIN

By studying the construction of both systems, structural and cladding, one may begin to identify the various components and methods of assembly to comprehend the order and sequence of design and execution of the two interrelated systems. The architect is concerned with the cladding system and provides an understanding of the components' size, material, and method of assembly. The engineer focuses on the structure itself revealing the change in size in relation to the floor level and the complex bracing systems necessary to stabilize both the parts (cladding units) and the whole (entire building).

II. CIRCULATING MAN AND MATTER

The notion of services as an integral component of architecture was particularly celebrated in the modern movement. Architects, like Mies van der Rohe and Louis I. Kahn, recognized utilities as twentieth century icons in which its representation were explicitly embodied in their architecture. These systems were emphasized rather than hidden, and accentuated rather than ignored. Today, a laboratory building is the ultimate twentieth century building in which technical advancements are sought in its design and construction, as well as its ability to accommodate transformations and change.

III. LET THERE BE LIGHT

Traditionally, the use of natural light in museums was restricted to non-gallery spaces (i.e. lobbies) with the notion that any sunlight will lead to the deterioration of exhibits. Current practices encourage the introduction of natural light beyond its function in facilitating orientation, and contributing to ambient light. It directly contributes to display lighting while adhering to current art and energy conservation practices. This new direction in museum design has radically effected the cross section and profile of a gallery space; it has led architects to conduct in-depth studies (both in section and model format) of expected and projected light behavior. In most cases, architectural solutions have had to be altered following the results of such studies.

IV. IN SEARCH OF EMERGING TECHNOLOGIES

This investigation is open to address a building system(s) - be it structural, mechanical, etc., a method of construction, the application of non-traditional materials or experimenting with new technologies. The focus is on an existing building that is conceived as a pioneer in its attempt to incorporate emerging technologies of the present or future.

Architecture is a result of the act of production, where society and nature come together. It requires an understanding of TECHNOLOGY in its comprehensive state, in the bringing together of technics (tools), techniques (processes), and theories of production (ideas). Thus far, architects have been copying technologies of the past in an effort to be part of the present. Unfortunately, this led to a stagnant building process and a mediocre representation of architecture in general. Past attempts to mimic other technologies took various forms, from the adoption of the concept of mass-production from the automobile industry to the glorification of technology as an image. The former dealt with the process of production, while the latter addressed issues of style and representation. Yet none of the efforts dealt directly with the emerging technologies of their time. Architecture continued to be a step behind science and technology.

> . . . perhaps the most important change has been in the technological, rather than architectural, climate. Technology has moved on and once again left architecture behind. There may be an architectural equivalent of the jet aeroplane or the lunar module, but there is no architectural equivalent to the silicon chip.[3]

In the end, the course is organized to encourage the posing of critical questions regarding the technological and technical aspects of architecture with a view to experimental technology and its practice. It is the culmination of the required technology sequence of the program and the commencement of its integration in design.

NOTES

[1] Reyner Banham. *Theory and Design in the First Machine Age.* (Cambridge: The MIT Press, 1982), pp. 329-330.
[2] Norman Foster in Foster Tower: Hong-Kong Bank.
[3] Colin Davis, *High Tech Architecture.* (New York: Rizzoli, 1988), pp. 20-21.

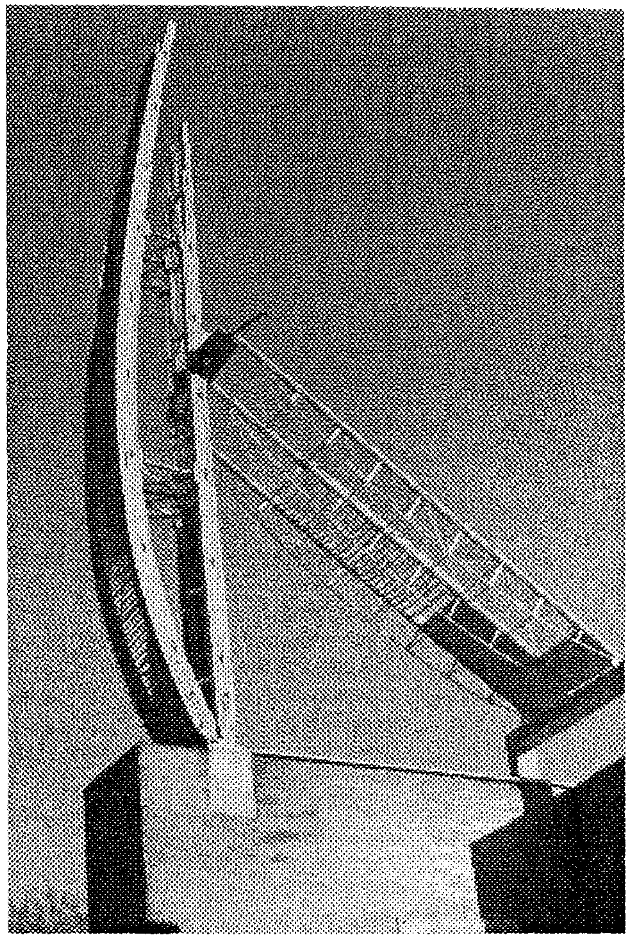

Fig. 1. Group Project, Fall, 1997. Renzo Piano Building Workshop, Culture Center Jean Marie Tjibaou, Noumea, New Caledonia.

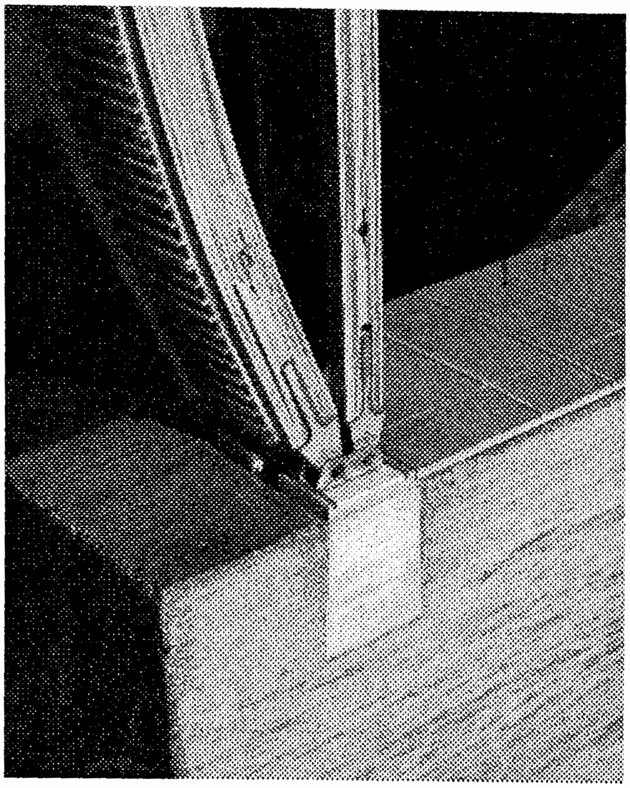

Fig. 2. Detail of Croup Project, Fall, 1997. Culture Center Jean Marie Tjibaou.

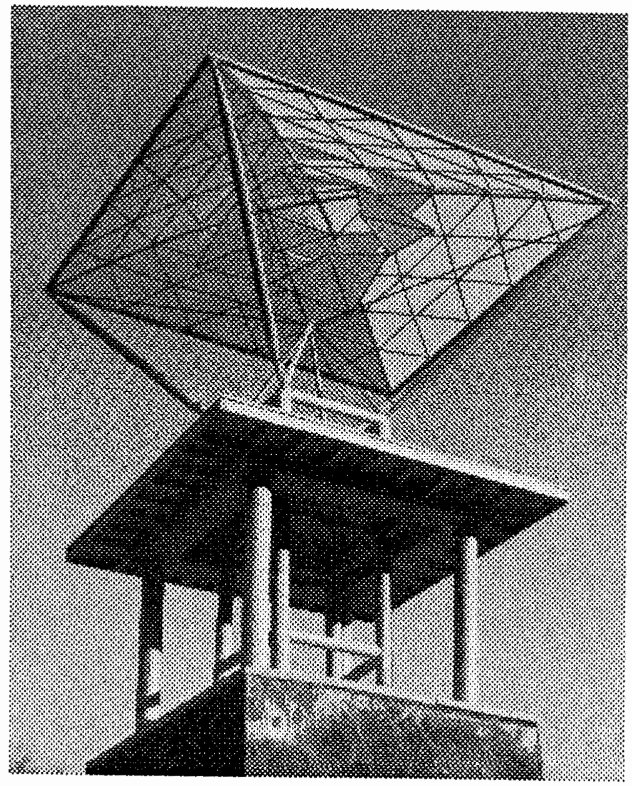

Fig. 4. Group Project, Fall, 1997. Sir Norman Foster, Stanstead Airport, London.

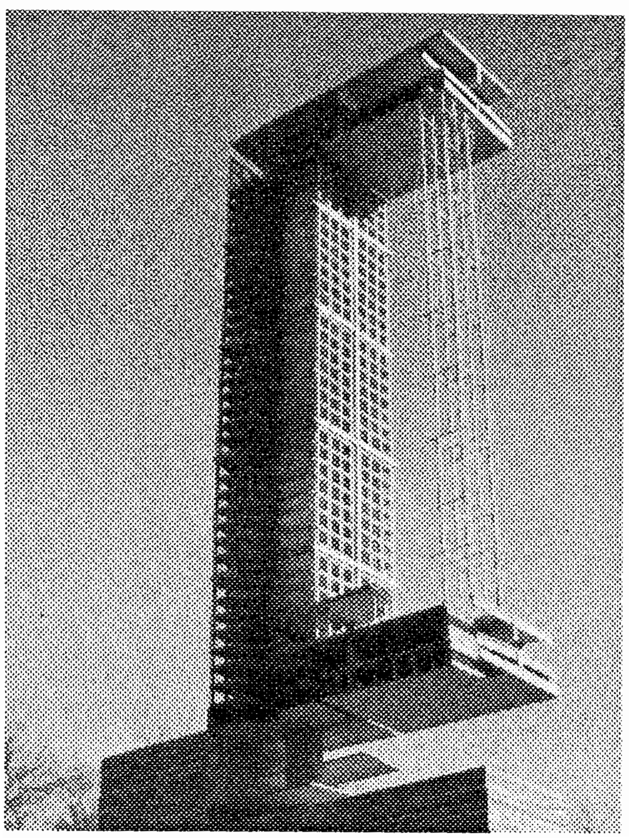

Fig. 3. Group Project, Fall, 1997. Johann Otto von Spreckelsen, La Grande Arche de La Defense, Paris.