Mini-Blind Solar Devices and Architectural Models

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Technological innovation is generally termed invention. Invention requires the completion of a first model or prototype. This idea was historically considered by LeCorbusier who stated that "there is a new spirit: it is the spirit of construction and of synthesis guided by clear conception."[1] This means that invention is a search and not research, but the first awareness of a technological solution. The use of the design studio is paramount in this aspect as was LeCorbusier's own architectural office.

The architecturalstudio is thus the arena for the integration of both technological and inspirational attitudes in design. Currently most technology is taught as an independent and separate issue from visual considerations and is considered a handicap in the teaching of architecture.The scientist teaches technology and the artist teaches visual design or the act of making space.The scientist uses the rules ofmeasurement and scale, the artist the rules of perception and vision.

Louis I. Kahn stated that the architect must use both the "measurable" and the "immeasurable."He stated "the scientist needs the presence of the unmeasurable, which is the realm of the artist."[2] There in lies the problem. The scientist often degenerates to the level of technician and the architect to the level of pure artist with no conceptionofbuilding construction or techniques. In order for architecture to exist in its finest form both conceptions, must exist simultaneously.

LeCorbusier was well known for his "free plan" as his "solar screens" and served as the model for both scientist and artists alike. The design studio should not just produce artists, but professionals who are technically competent. If they do not do this, they are failing to produce architects. They may be producing individuals who can function as specialists in major offices, but they are not producing people capable of innovation (i.e. some graduates work as engineers, computer operators, or technical experts while others function as illustrators, draftsmen, and concept generators, but not many as innovators).

LeCorbusier criticized "the eye that does not see"[3] because he felt that perception was an important component of creation. In fact, later in life, he painted in every portion of his day. However, he also invented the "Modulor," a mathematical proportioning system which he used as a device in the proportioning of his sunscreens and facades within architecture.

The second machine age dealt with the evolution of machinery. Our modem times have Inherited these products and their application along with use ofelectronic systems.The computer represents the new or third machine age with its ability for both numerical analysis and graphic representation. It is within our own times that we have the ability to innovate with the second machine age products through the use of the modem machine the computer. However, architecture is fundamentally a plastic art and the reality of the model is always of paramount importance because of its three dimensional nature. The computer is still a screen or flat surface within the realm of the three dimensional.

LeCorbusier, in Towards a New Architecture, not only discussed the use of the machine for construction, but the constructions of the machine. The hollow metal window and door sections made by modem manufacturing processes were two of the many items of mass production he illustrated within his book. These items he referred to as being beautiful because of their simplicity of construction which represented the new industrial age. Within the modem architectural studio students are generally introduced to manufactured items in their practice courses, but these are generally banned from the more "innovative" design studio.

In a practical manner, these hardware items might be of more actual visual stimulation than pictures of the latest trend in architectural styles. Leonardo DaVinci, the inventor and architect, gave up the luxury of painting to almost entirely focus on the exploration of mechanical devices through drawing, thus he achieved greater innovations than the architects and court painters of his era. The stimulation of the intellectual challenge of design foreshadowed and overpowered the desire to merely illustrate. The inventions that Leonardo graphically depicted were based upon existing mechanical properties of gears, wheels, chains, etc. in an endless array of creation.

Leonardo, like Le Corbusier, was both an analytical scientist and a creative innovator. The minds eye must see and the

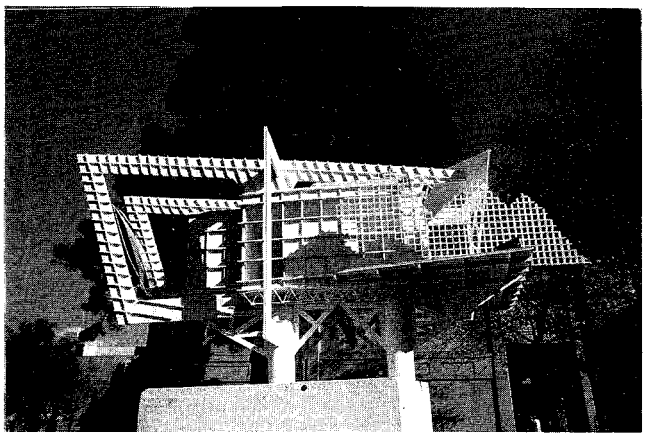

Fig. 1 Student Project Model (1)Cubist House with plastic diffuser grid for sunscreen. (Front View) Brian Messana

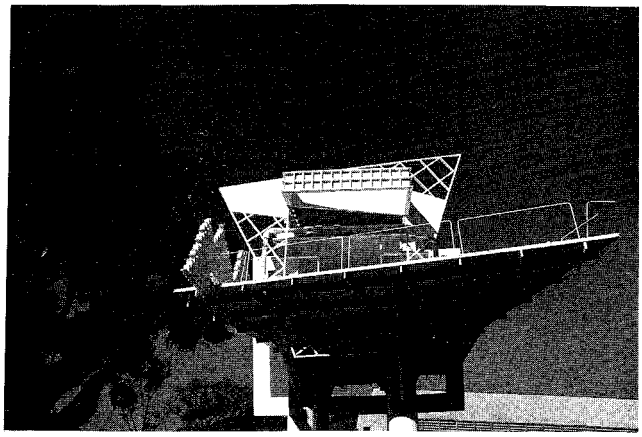

Fig. 2 Student Project Model (1) Cubist House with plastic diffuser grid for sunscreen. (End View) Brian Messana

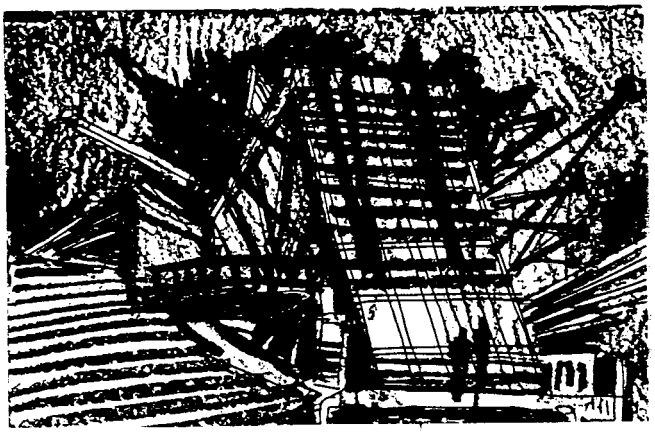

Fig. 3 Student Project Model (2) Solar Atrium House with diagonal braced window wall system. Jennifer Parks

hand hold before manipulation of object can begin within the transformation towards a new physical form. The architect is the system conceptualizer, the scientist the system builder or applicator of the architect's conceptual model.

Leonardo DaVinci called mechanics the paradise of mathematicians. All mathematical equations are generalized rules from our view of reality, thus art proceeds science

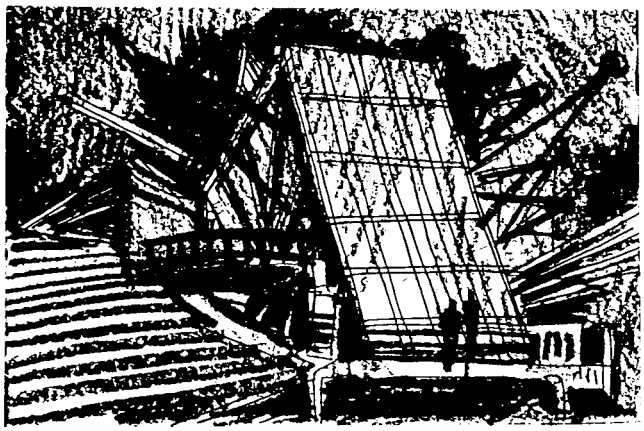

Fig. 4 Student Project Model (2) Solar Atrium House with diagonal braced window wall system. Jennifer Parks

in the spectrum of the visual before the measurable.

The five projects presented represent designs of students approaching that of an art or innovation based upon technical or scientific knowledge. Like Einstein, who stated "Imagination is more important than knowledge,"[4] the student work is based upon their own imagination as a solution to a studio program. Not all programs are presented, but each design will be discussed in terms of both its technical and artistic basis.

The first project is a student designea house that is simultaneously influenced by LeCorbusier's cubist spatial concepts and the use of an acrylic plastic diffuser grid for fluorescent light fixtures. The project at one scale represents an overlapping of both space and structure achieved through the use of fractured planes as diagonals in space. But on closer observation, the model is also encompassed by sun control devices which are fractured like the facade of the model. These sun control screens allow for the interpenetration of a filtered light into the structure at various angles in conjunction with the diagonal organization of the floor plans. When the sun shade devices are considered as integral to the entire design, there is both a more coherent aesthetic established as well as the possibility of more direct control of shadow patterns because the screen matches the window pattern itself. There is both a better aesthetic and technical fit simultaneously. The designer has used his imagination in both an artistic and scientific sense.

The second project utilizes a solar atrium created by a diagonal window wall system which both forms the spatial and structural enclosure for the central space of the building. The hillside itself has been abstracted into a truss system reminiscent of the internal structure of the facility. The openness of the structure allows for light and air penetration into the various levels or platforms as the building cascades down the hill side. All models in the studio are systematically photographed and exposed to outdoor light and air in an end of the quarter open courtyard display and discussion session. Thus, the student can test his or her lighting concepts in a natural outdoor environment rather than the artificial sunless condition of the classroom.

The third model presented represents an almost space

station appearance with its elevation above the ground plane and its composition of a twelve-sided truss system on a horizontal axis. The various levels are indicated by the semi-enclosed staircase on the end elevation. The model utilizes a series of roll up sun shades stretched across the various cells or modules of the structure where sun control is considered necessary. The interior core of the model also has a venting system attached to the trusses to allow for air circulation through the core of the model. Thus, the complex almost functions as a natural bee hive in both its engineering and visual identity. It is a rather compact environment with an interior core that provides air cooling, while the previous project was much more articulated in the thrusting of its outer forms which cooled itself by airflow across its fin-like projections.

Students in the studio are exposed to the ideas of natural organisms determining their own environmental protection systems, and this idea translates rather directly into the models themselves. Analogies to natural organisms is most instructive in this sense and the actual exposure of models to both sunlight and wind patterns allows the student to verify their initial assumptions in test runs outside the thermally controlled architectural studio as well as class trips to the actual project location.

The last models are projects from the same program that generated different solutions to a tension ring system of construction first envisioned by Robert LeRicolais. Both models represent duplex living environments derived from lightweight steel structures. The fourth model, a horizontal version has a stiff horizontal backbone which supports the cantilever of the structural pods from a centralized entrance court. The fifth model of a structure is an almost exact replication of a vertical D.N.A. system composed of vertical tension cables and a spiral composition of horizontal floor rings and dwelling areas. Both models are extremely light in appearance and structural connections which allows for maximum light and air penetration into the building. In this case, the use of internal sunshades and louvered blinds at various scales is almost a mandatory requirement obligated by the nature of the structure itself.

In conclusion, the design studio must include technical knowledge as well as innovation in order to be truly successful in an architectural sense. The five projects presented are only representative of the student's and future professionals ability to generate unique solutions to the problems of tomorrow that are just being realized today. In order to be successful at this they must be aware of both technological and artistic history, a strong need for the use of the imagination in creative problem solving and the ability to carry their ideas through from conception to completion in model or three-dimensional form.

The previous models are an illustration of a typical problem presented to third year students for a quarter length exploration. There is both an aesthetic **Introduction** and a technical **Problem** to be solved. It is up to the student to solve both criteria simultaneously. The innovators are able to solve both sides of the equation with the result that their solutions are both imaginative and highly functional. Many students are imaginative, but fail to solve the technological and functional problems presented by the program. Others solve all the functional problems, but in a preconceived manner

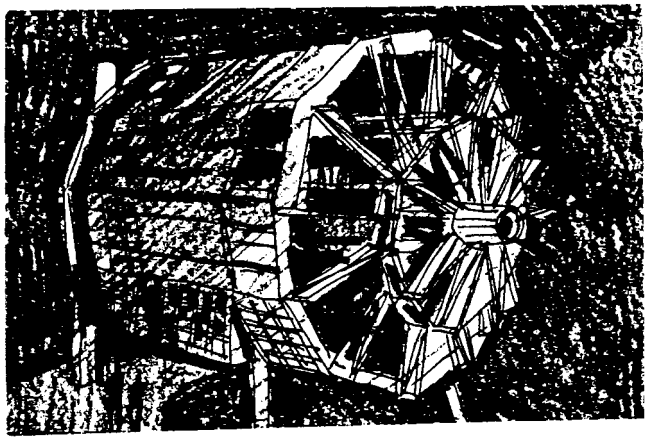

Fig. 5 Student Project Model (3) Housing System with roll-up sunshades around a twelve-sided truss structural system. (Core View) Fred Castro

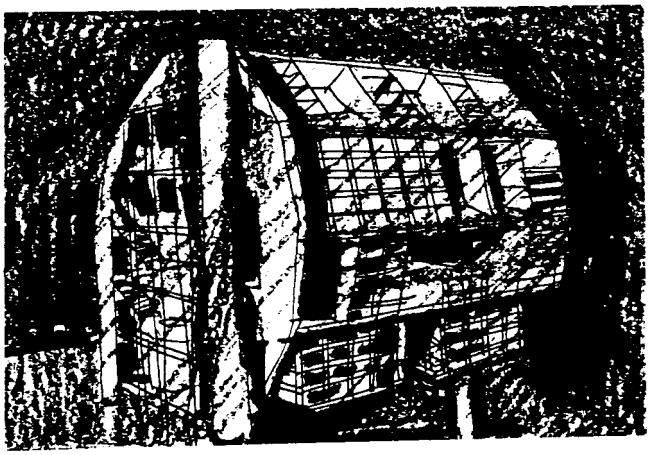

Fig. 6 Student Project Model (3) Housing System with roll-up sunshades around a twelve-sided truss structural system. (Stair View) Fred Castro

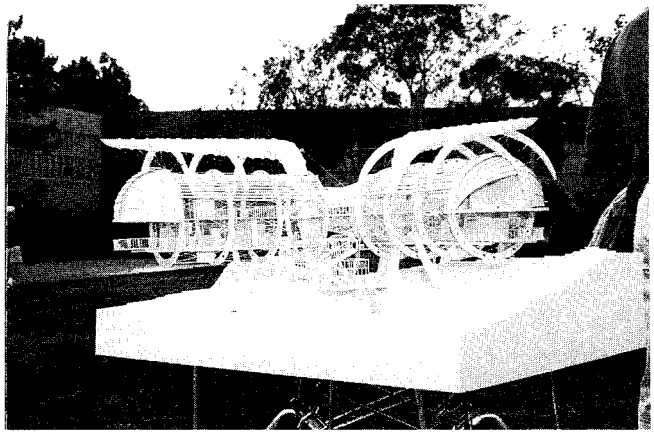

Fig. 7 Student Project Model (4) A Horizontal Duplex with sunshades and a tension structure as its core. Frank Edgerly

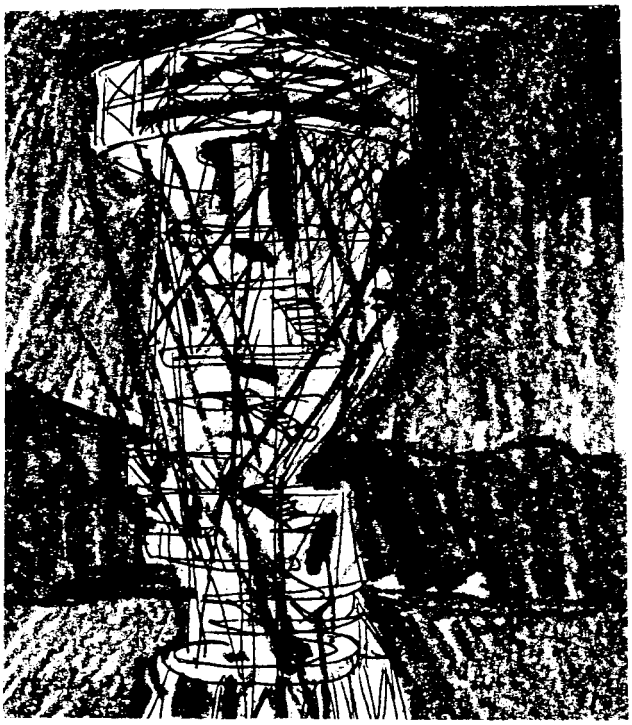

Fig. 8 Student Project Model (5) A Vertical Duplex with a spiral tension system as its core. Frank Edgerly

with no innovation. But as stated previously, architecture is the art and science of building. Both the idea of quantity and quality are essential to innovation.

The title of the paper, Mini-Blind Solar Devices and Architectural Models reflects on the duality of art and science. Perhaps the two are more interconnected than realized. The idea of architectural science represented by the mini-blind and the idea of architecture represented by scale models can be interconnected by the realization that art begets technology. In its first phase, this regeneration is normally termed art, or the first representation of any object has been traditionally the artists role. LeCorbusier was one of the first to see the interconnection between machine technology and new means of expression. The use of the small scale machine product as a model for the application of a small item or idea at a larger scale. Thus the technology of lighting and structure at small scale such as the mini-blind or acrylic plastic diffuser grid can be used to function at a larger scale as both a technological and visual device in design.

LeCorbusier stated, "In building and construction, mass production had already been begun; in face of new economic needs, mass-production units have been created both in mass and detail, and definite results have been achieved both in detail and in mass."[5] Thus the new machine product offers a new approach to the design of buildings both in detail and large scale structure. The mini-blind solar device is an attempt to put this philosophy into reality, through the use of model building in the architectural studio. The student sees the possibilities for future design in current day industrial items.

Louis I. Kahn stated, "the artist offers his work to his art in the sanctuary of all expression, which I like to call the Treasury of the Shadow, lying in that ambiance; Light to Silence, Silence to Light. Light the giver of presence casts its Shadow, which belongs to Light. What it made belongs to Light and to Desire."[6] This statement implies that architecture has much to do with the control and manipulation of light. Light defines both form and space through the structure of architecture. The current technology of construction and also new lightweight structures in steel allow us to combine some of the imaginative tension structures of LeRicolais with the latest technology in the control of light through mini-blind solar devices. Architecture is becoming the artful control of light.

The architectural design studio should serve as the focus of all courses within the architectural curriculum. Design is the integration of knowledge from the various technical sciences and the social sciences. The resolution of these forces along with the site determine the parameters within which the creative imagination co-exists. Architectural students should be allowed to sketch their creative imaginations. Frank Lloyd Wright stated while designing the Johnson Wax Building, "Until now no one has looked through the box at the sky up there at the upper angle, they have. . . .But in the Johnson building you catch no sense of enclosure at any angle, top, or sides. You are looking at the sky and feel the freedom of space."[7] Thus the freedom of space that Wright talks about can only be realized through the free use of technology and through freedom of mind in its application. The Coming company produced Plexiglas tubing which allowed Frank Lloyd Wright to introduce light into the workplace at angles undreamed of by previous architects. The concept of structure surrounded by light was maximized by Wright in this design. His unusual mushroom columns provided a structural system in which glass tubing was a transparent infill. The model (5) of a vertical duplex with a spiral tension system as its core relates to this concept. In this project the spiral core is similar to Wright's idea of freeing space with a central support axis. The student project continues the concept that Wright demonstrated in 1937. In fact the Research and Administration Tower later added by Wright to the Johnson Wax Building is also in many ways similar to the student model.

Kahn's concept of centralized space in structure occurs in the student model **(3)** of a twelve sided truss structural system. In Kahn's work in Dacca, Bangladesh in 1962 the National Assembly Hall, he stated that "A great hall is at the center of this building and is lit by natural light from above. The roof over the hall becomes a giant structure for transforming the light as it shines in through holes of various shapes and reflects off the great beams before coming down into the space."[8] The student model reflects this concern between light and structure. Or the penetration of light through structure.

The artist studio designed by LeCorbusier and Pierre Jeannevet pictured in *Towards a New Architecture* reflects the first use of a ceiling system with a light grid. This ceiling

system provides a three-dimensional extension of the lighting in the open window wall system of the gallery intersection. It is through this realization by LeCorbusier that the student model (1) a Cubist House with a plastic diffuser grid for a sunscreen was developed as a latter-day extension of LeCorbusier's theory on lighting.

CONCLUSION

The student work presented represents the intersection of awareness of the history of modem architecture, modem technology and the ability to study design solutions in three dimensional model form. The initial theory of light and technology was provided by the instructor as a statement in the design problem. The students extended these theories in their own personal search for creative design solutions. The five models presented represent case studies in the ability to integrate solar, site and structural principles into new architectural inventions or dwelling units of one type or another. The apparent success of the student designs reflects upon their abilities to manipulate the program and products as well as the directness of the connection between light, technology and form.

NOTES

1 LeCorbusier, *Towards a New Architecture,* Praeger Publishers, New York, NY, 1974, p. 83.
2 Lobell, John, *Between Silence and Light,* Shambhala Publications, Boulder, Colorado, 1979, p. 76.
3 LeCorbusier, op cit., p. 84-97.
4 Einstein, Albert, *Ideas and Opinions,* Crown Publishers, New York, NY, 1982, p. 66.
5 LeCorbusier, op cit., p. 250.
6 Lobell, op cit., p. 20.
7 Lipman, Jonathan, *Frank Lloyd Wright and the Johnson Wax Building,* Rizzoli, New York, NY, 1986, p. 65.
8 Lobell, op cit., p. 90.

PHOTOGRAPHS

1 Student Project Model 1, Brian Messana
2 Student Project Model 1, Brian Messana
3 Student Project Model 2, Jennifer Parks
4 Student Project Model 2, Jennifer Parks
5 Student Project Model 3, Fred Castro
6 Student Project Model 3, Fred Castro
7 Student Project Model 4, Frank Edgerly
8 Student Project Model 5, Frank Edgerly