

# Arms, Wings, & Mechanical Things Analog...Assimilation...Appropriation

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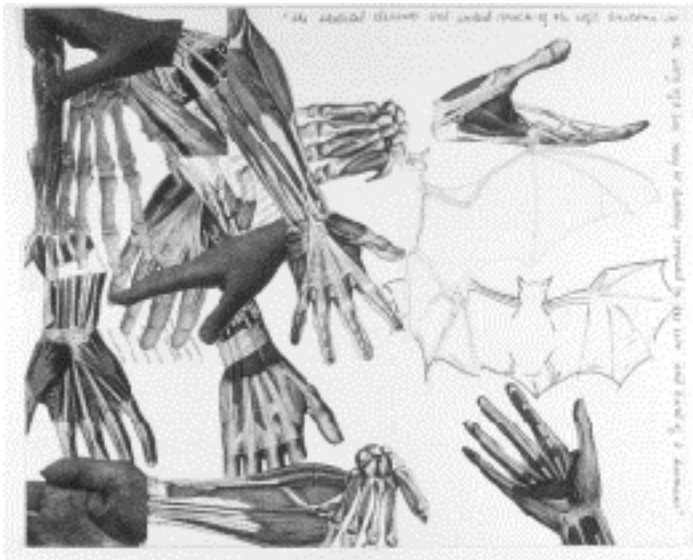


Fig. 1. Preliminary Arm Collage.

## INTRODUCTION

Through an analogical study of the joints in the body, the invention of a joint detail can form the basis of an architectural vocabulary that can lead to several forms of design development. By using analogy in the form of design assimilation, one is positioned to rely on his or her creative ability to associate and fabricate objects that engage materials in relationships that convey parallel meanings. These constructions can, in turn, establish formal orders that become the basis for an architectural grammar of details. Meaning is gained through the ability of the detail to conform or transform to the context in which they are placed. These construction details can also be employed as a point of departure in the development of a design process.

This studio is the third in the design sequence at our school. It acts as a bridge between the design principles of space and form stressed in earlier studios, to issues of 'materiality,' 'structure,' 'modes of representation,' and the 'process of making.' Design exercises utilize analogical investigations to explore the expressive potential that material can achieve in structure and detail. Models are the primary mode of representation. Drawing is used as a means of construing and constructing an idea. Together they work hand and hand with the process of design. Imagination and invention are emphasized in the process of interpretation and implementation of one's ideas into highly crafted artifacts.

Our design research begins with the investigation of joints and connections and their dynamic forces as inspired through our observation and analysis of the arm of the human body. Through comparative analysis we study 'the wing' and make creative relationships with our studies of the arm. The goal of this phase of our study is to search for conditions that simulate the particular dynamic structural qualities of tensile and compressive forces found in the direct and indirect actions of the muscles and joints of these two body forms.



Fig. 2. Batwing Drawing 1.

From these findings, we search/research existing mechanical devices that demonstrate similar differences and different similarities. This process directs design and construction of assimilations of these conditions in the form of highly crafted small wooden models; their evolution is simultaneously documented through drawing. These exercises eventually lead to studies that become specific creative structural and material propositions, such as, cantilevers, corbels, arches, trusses, hinges, and pivot joints. This form of study will hopefully provide “pieces that can eventually mediate between building and user in crucial ways, serving both an intermediate scale that people can immediately relate to and a sensually crafted presence that invites tactile contact. They should also elicit empathetic responses with structurally explicit forms that are often shaped to suggest they have a life of their own.”<sup>1</sup>

When subjected to natural growth patterns [component-element-unit, element-system network] these idiosyncratic pieces become less striated or autonomous transforming into continuous systems form the basis for architectural projects that focus on such things as interactive walls, ceilings/roofs, as well as, multiple frame and panel assemblies.

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In the Renzo Piano Building Workshop, the “piece” with its immediate responsibility to engender formal and tectonic negotiations also serves to generate systemic grammars that direct design and development:

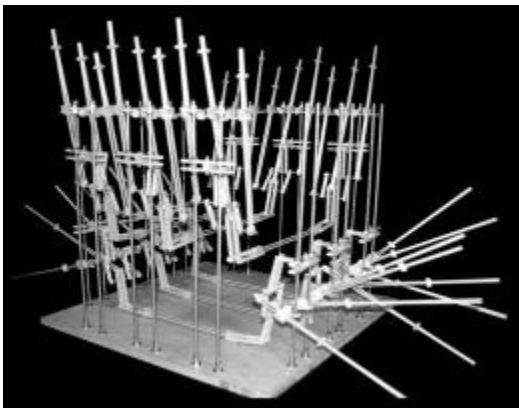


Fig. 3. Four Directional Spatial Study.

*More than anything, it is the piece that gives each building its particular identity; most of the buildings are as readily recognizable from the piece alone as by the whole. The pieces mediate between building and user in other crucial ways, providing both as intermediate scale people can immediately relate to and a sensually*

*crafted presence that invites tactile contact, both especially pertinent qualities in buildings of large fluid spaces. The also elicit empathetic responses with structurally explicit forms that are often shaped to suggest they have a life of their own. But there are other reasons for picking on the piece as the focus of so much attention. It is the piece that is most susceptible to a sustained and objective refinement. Technical improvements to it are easily judged, and so are aesthetic ones. Many may contribute to this refinement, architects, engineers, and clients. And contributions can be made at all stages of development through sketching and drawing, hand crafting of prototypes and preparing shop drawings. With all this input, intellectual, visual and tactile, the piece is the one element that might approximate both the precise tailoring to purpose and the satisfying sense of being exactly right that is found in the products of natural evolution. Often too, the piece can and does continue to be refined long after the rest of the design has been settled. In an analogy from evolution, focussing on the piece could be seen as a neoteny strategy. (Neoteny is a way by which evolution speeds itself up by prolonging childhood, as in the case of humans, and so the learning period of each generation. Of course, in developing the piece the concern is not with a single object in isolation, but equally with what is created by the collective assembly of the pieces. Obviously then, connections are important, and so too is the whole that results when the pieces are assembled with all the other elements. Those who see the piece as a mere component that can be taken up and easily used in other designs, profoundly misunderstand its far more intrinsic role to a specific building, its scale and place*<sup>2</sup>

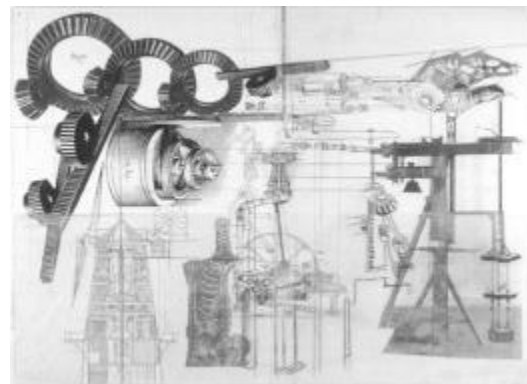


Fig. 4. Mechanical Things Collage.

### Forming Relationships through Analogy

To begin the design process, the students are asked to research, collect images and descriptions of the human arm, and make comparisons between collected images and descriptions of wings. After making an inventory of

parts, they are to speculate on the evolution or transformation between the wing and the arm. The students are asked to analyze the skeletal and muscular principles that direct its action and establish an individual focus on a particular aspect. Again, they must remain aware of the direct and indirect action of the muscles, tendons and joints and how they demonstrate the structural qualities of tensile and compressive forces.

**Exercise One:** The students are asked to make two collages — one focusing on the arm and another on the wing (on 11x 14 bond paper) — and to relate investigations by demonstrating findings through images, drawings, and words. They then define relationships and look for analogical connections. The students associate and disassociate from the images collected to find formal, as well as, literal correlation.

After completing the collages on the arm and the wing, the students develop a third collage (on 11x 14-bond paper) of mechanical things that have an affinity to previous studies. They look for simple devices such as lamp arms, car jacks, umbrellas, drawing instruments, before extending the search into more complex machines. How did Leonardo DaVinci use the notion of prosthetics in the design of his mechanical inventions? How is a drawing compass a prosthetic device?

**Drawing Constructions/Constructing Drawings**

In this process of investigation and discovery, drawing acts as a means of construction of ideas, of images, of analysis and of association. The drawings are viewed as scaffolding—a temporary architecture used to help concretize an idea that leaves its trace in the final construction. This allows 2-D and 3-D to collude in the process of design.

**observation/analysis  
interpretation/translation  
transformation/fabrication**

This next series of observations begins with a detailed enlargement (at least double in scale) of a particular wing. This means of magnification and rendering intensifies ones focus to prevent shifting attention too quickly, thus helping to assure that observation will not be short-circuited into translation as mere imitation. It is more important to continue the seeing process by forcing hand/eye coordination to slow, permitting a closer look. This allows the mind to wander, generating creative associations while rendering tonal gradations. This releases the daydream. It is in this zone that tangential coincidence colludes to form new interpolations of hand/mind and mind/ hand thinking.

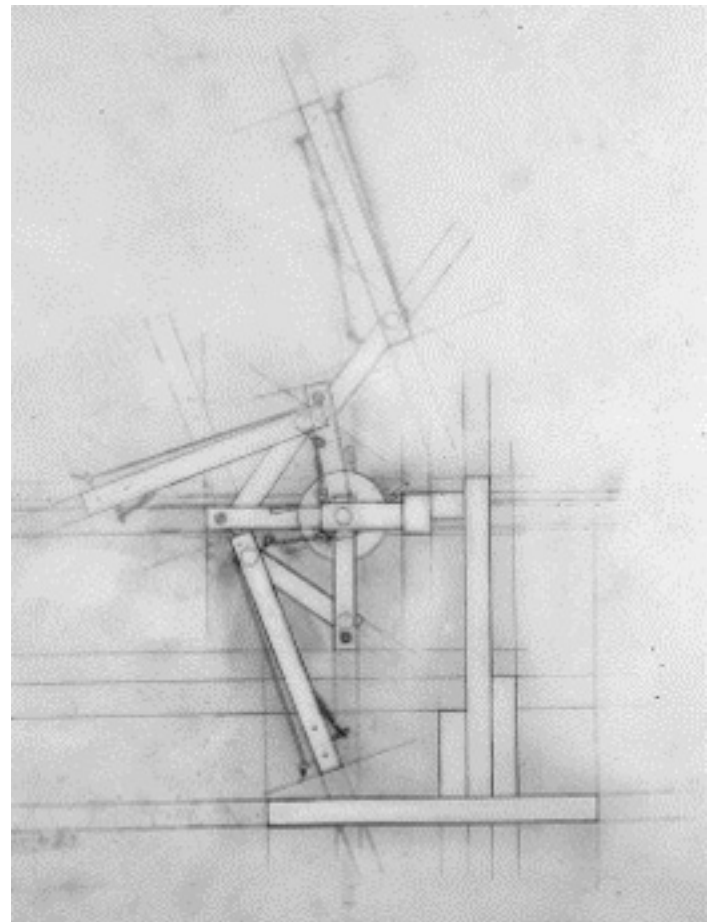


Fig. 5. Constructing Drawing.



Fig. 6. interpretation/translation drawing.

The exercise consists of three layers, each exploring a different aspect of the wing: a realistic look at the nature of its parts, a geometric abstraction, and a mechanical extrapolation. Each sheet conveys a distinct view of the specimen. The first sheet is on hot press watercolor paper. The remaining two drawings are in pencil on Mylar.

**observation/analysis .....as is**

The student begins to “inhabit the detail” by looking very close so that the eye attains a tactile sense. After reviewing the visual collages, each student clarifies a particular perspective that directs the next phase by

choosing an appropriate image of their wing to further their research. They are asked to draw the wing at least twice the size of the photo; it is then placed in the center of the 24x 32 inch piece of watercolor paper, leaving at least a 6" border on all sides for more detailed studies. This first sheet is to be pure **observation** of the actual wing analyzing its parts through realistic close-up rendering.

**interpretation/translation** ..... as ab

The second Mylar drawing in pencil interprets the workings of the wing in a more geometric construction. This technique requires a translation of the parts into a geometric vocabulary which is viewed as an overlay upon the preliminary realistic drawing. This **abstraction** interprets the workings through geometry.

**transformation/fabrication** ..... as ob

The final sheet of Mylar transforms the visual information into a construction analog which directs the fabrication of a series of tectonic devices...workable, buildable **objects**

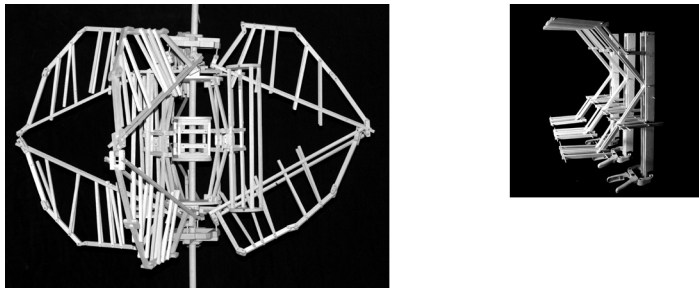


Fig. 7. Simulacrum/Analogue.

## two models simulation vs. analogy

### simulacrum

From their studies, each student creates a *mechanical simulacrum* that can demonstrate the dynamic actions from their wing analysis. Using the form language previously derived from the geometrical abstraction (sheet #2), these constructions attempt to translate the actions of the wing in its *entirety* not as a series of disconnected joints. [resemblance is good]

### analogue

The second model is developed as a *mechanical analogue* to a specific part or detail of the wing analysis. It gains its potency from the nature and fit of its parts. This model does not attempt to resemble but to demonstrate metonymically the action of a particular condition. The parts can be separated from their

context or viewed as a series of parts disconnected from the whole. [resemblance is not good]

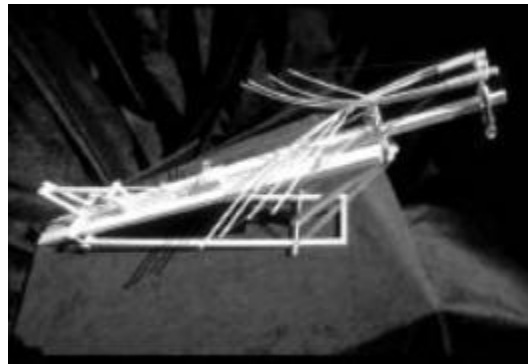


Fig. 8. Analog of Eagle's wing.

## Definitions

### sim•u•la•tion n

1) the reproduction of the essential features of something, for example, as an aid to study or training, 2) the imitation or feigning of something, 3) an artificial or imitation object, 4) the construction of a mathematical model to reproduce the characteristics of a phenomenon, system, or process, often using a computer, in order to infer information or solve problems

### sim•u•la•crum n

1) a representation or image of something, 2) something that has a vague, tentative, or shadowy resemblance to something else

### a•nal•o•gy n

1) a comparison between two things that are similar in some respects, often used to help explain something or make it easier to understand 2) a similarity in some respects

### an•a•log or an•a•logue n

a chemical [construction] with a similar structure to another but differing slightly in composition.<sup>3</sup>

## re-MAPPING the FINDINGS

The development of these models continues simultaneous to the evolution of the constructing drawings, each informing the other in an interactive dialogue. Each model obtains an intrinsic value in relation to its function and also acts as an initiator to new refinements and innovations. The models are well crafted, where each and every joint and connection acquires a distinct character.

After this phase of work, the students and I discuss the potential value of their discoveries and attempt to assign roles, relationships, and functions to their architectural constructs. We endeavor to find what the systems can do by looking at function as a response to the manufactured artifact rather than as the initiator of its design. How can the meaning of their tectonic inventions be derived through a re-mapping of these constructions as applied to several architectural situations? Do they become roofs, walls, or both simultaneously? Can they adapt to the body from which they were derived...housing habits as prosthetic extensions? The building systems guide this form of dialogue.

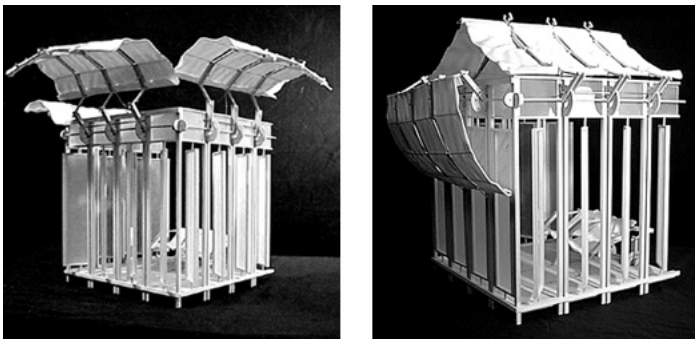


Fig. 9. Meditation Pavilion.

In several applications, the architectural projects turned to the body to generate function and form. Interactive wall and ceiling systems were designed as parasitic lobby and gallery installations for exhibit, small outdoor pavilions were produced, as well as, complete architectural interventions into dissimilar shells—something new in something old.

## AN ARCHITECTURAL INTERVENTION

According to the American Heritage Dictionary, to **intervene** means; 1) *to come, appear, or lie between two things*, 2) *to come or occur between two periods or points of time*, 3) *to occur as an extraneous or unplanned circumstance*, 4) a. — *to come in or between so as to hinder or alter an action*, b. — *to interfere, usually through force or threat of force...* <sup>4</sup>

The Unitarian Universalist Church in North Bethlehem asked us to design a temporary inner architecture that would give clarity to the nature of their new location in a former Presbyterian Church building. The interventions were to speak clearly to the present philosophy of the UU Church as a conceptual dichotomy coexisting within a predetermined context of another space and time (a brick miniature Gothic cathedral). Our design interventions should allow for a dialogue between the

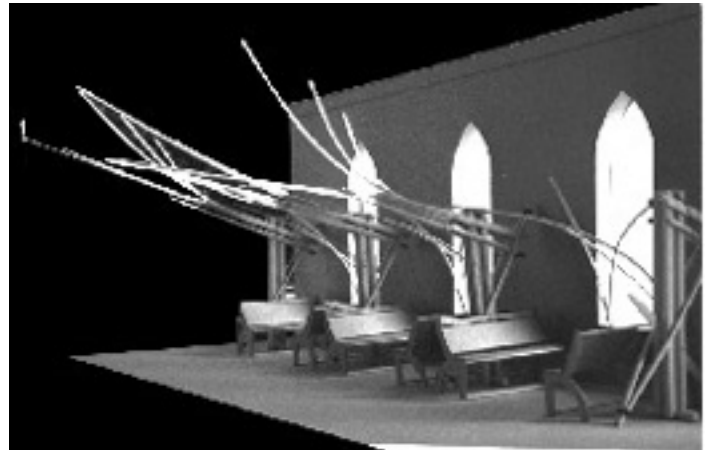


Fig. 10. Church Intervention.

old (memory) and the new (imagination), the permanent (static) and the temporary (dynamic), the container and the contents, and the body and the building.

As an architect, one is constantly confronted with this condition at all scales of the architectural project, from the relationship between two materials in a connection, to the formal relationship between two spaces in time. To intervene one must mediate to form a negotiation between the two, sometimes diametrically opposed, situations resulting in a negotiation and resolution. In this case, the relationship was to be either *symbiotic*: mutually beneficial to each party or one that is *parasitic*: unilaterally beneficial to one party while being destructive and/or *re-constructive* to the other.



Fig. 10b. Church Intervention close-up.

Through rigorous and creative design thinking, the students proposed interactive architectural frameworks that could create a place where science, spirit, and wonder commingle with function and experience. The earlier exercises were originally prepared to establish a tectonic vocabulary with this application in mind. Therefore, the students were to use their previously developed tectonic inventions as initiators for their new design proposals. This process of translation and inter-

pretation concluded as a series of architectural projects presented to the Church congregation. Many stimulating discussions ensued engaging the precepts of the UUC with the architectural concepts.

#### GROWTH "THE FORM IS IN THE FORMING"

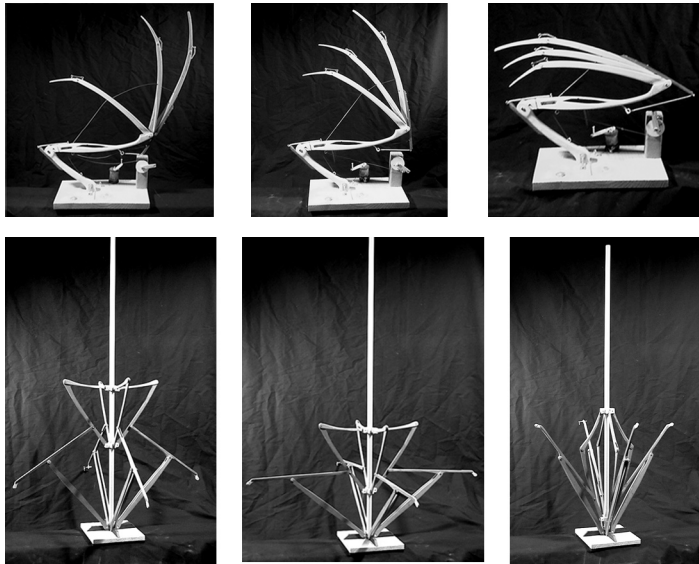


Fig. 11 & 12. Evolution of Form.

In all things natural, growth generates form. Paul Klee, in his *Pedagogical Sketchbook*, refers to form as having a conjugational nature, allowing elements to transgress from active to medial to passive in the process of becoming. In other words, it is in the act of making or in the transformation of matter that meaning can be imbued into form... "the Form is in the FORMING."

In the first part of this study we focused on the nature of the part and the detail as the mode for analogy, starting the process with the body as a collection of parts that could be artificially separated from the whole. It is necessary now to reconstruct the body and observe it dynamically as an instrument of change or metamorphosis. Dynamic growth symmetries such as repetition and rotation can initiate causes of growth as a strategy to generate geometric moves on the field. These causes can be further clarified by studying the growth patterns of vegetables and minerals to understand and translate into guidelines for formal multiplication. This means of growth can be hierarchical in nature and rigid in their formative principals. Therefore, it would also be important to look at the **rhizomatic forms** of growth (bulbs) and attempt to translate non-hierarchical growth patterns as form generators. These forms of action can transform striated space (differenti-



Fig. 13. Dynamic Construction.

ated) into smooth through repetition, allowing the idiosyncratic to transform into collective meanings through multiples (This process is articulated in my recent paper titled, *Form from Form*).

## SUMMARY

### A Different Form of Inquiry Based in Growth

In this studio, I encouraged the project to gain its meaning through its own conception and evolution. This is not simply a description of a specific design studio, but a proposition for a different means of design thinking. To allow discovery to continue to regenerate upon itself, one must be placed in a more fluid form of thought/action experience. I have found that this regenerative process can be short-circuited when the design process becomes too goal oriented and deterministic early in the idea/design development. On the contrary, when the students' design/research becomes more investigative in nature and reliant on analogical relationships, they become more open to unsterotypical thinking and prepared for amazement. This provides increased opportunities for discovery and invention. Wonder becomes the motivation for the acquisition of knowledge and imagination provides the stimulus for thought. Meaning is derived from an implicit search for understanding formative principals rather than definitive conclusions.

This design pedagogy is predicated on a non-problem solving technique that allows palimpsests of analogical screens to generate new worlds of discovery, thus opening up alternate views or perspectives. Through this type of investigative process new analogical screens are continually overlaid to project new interpretations of what one "sees" thus encouraging innovative forms of transformation.

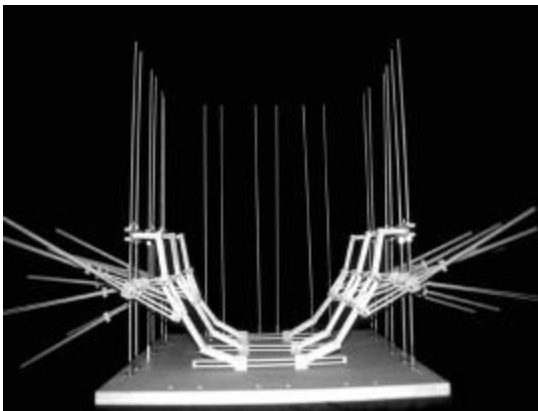


Fig. 14a. Two Directional Spatial Study.

The challenge of keeping the discovery process fluid and open-ended as more specific architectonic criteria is introduced is of great concern and difficulty. Ideally, the form gains its meaning and function through programmatic readings of it's newly formed character. One might say that function and meaning, in this case, become a product of the imagination rather than the impetus for its action. As the implicit actions begin to collude with explicit targets, design gains a new dialectic form of intuitive actions and reactions followed by rational juxtapositions.

These forms of thought/action fold into each other to present propositions *that* still allow the form to remain fluid with its newly found function and meaning. For once, function is allowed to be as fluid as form letting design research to remain open ended and implicit rather than deterministic and explicit in its nature. Granted the architectural practice must find explicit ways to address client needs but does this preclude the need for the art of invention as a means and directive for design inquiry? Can form be allowed to direct the search for meaning and resolution? Can function be the product of imaginative formal manipulations that foster the art of invention? These are not new questions and obviously, the answer is yes, testified by the work and writings of great thinkers/inventors such as Leonardo DaVinci or Albert Einstein who said, "Imagination is more important than Knowledge"

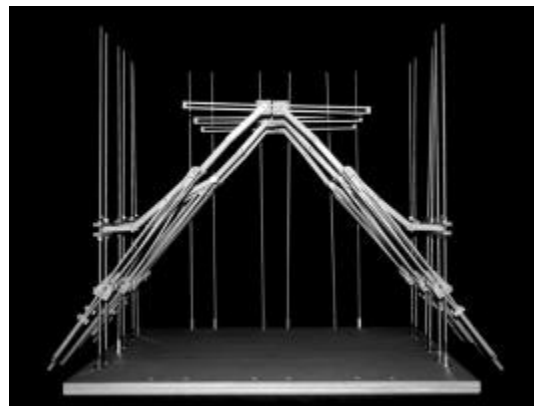


Fig. 14b. Two Directional Spatial Study II.

In the final stage of this design studio our design research pointed in the direction of natural forms of growth and habitation. We began with three sketch problems focusing on vegetable growth, animal architecture and geometric patterns and constructions. After producing several pictorial collage studies, the students were required to subject their idiosyncratic devices from part one to a rigorous series of growth exercises in drawing format to generate dynamic systems. [Specific symmetrical moves learned in earlier design studios were used. i.e., repetition, rotation, and accumulation].

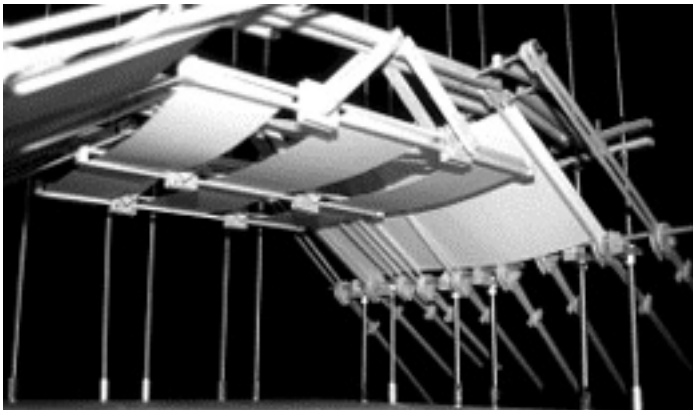
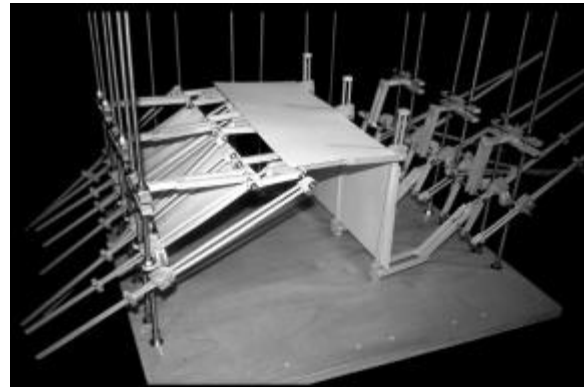
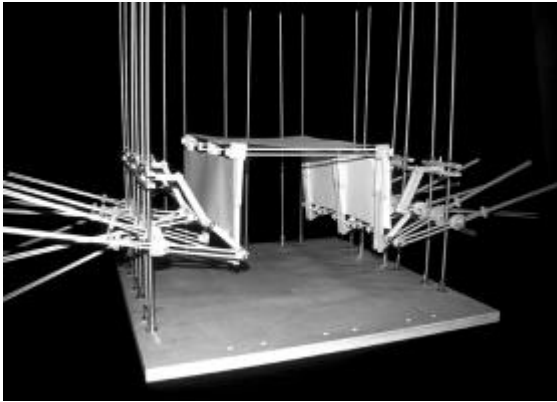
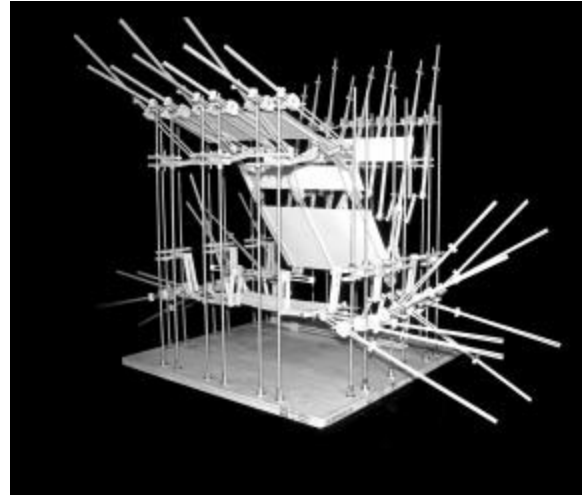
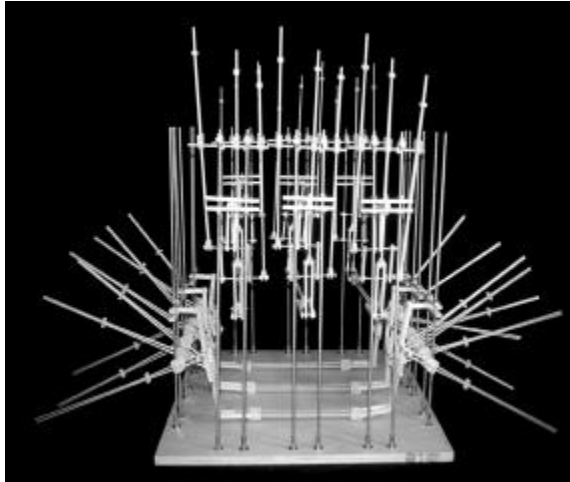


Fig. 15. Four Directional Spatial studies

Model and drawing studies were produced in direct response to the first three sketch problems. The cumulative progressions of 1,5,50, and 500 were to guide the range of growth projections. The following series of images show several architectural propositions that demonstrate the studio's progressions from **simulation** through **analogue** toward **appropriation**. I have found that this form of design exploration remains open and in constant motion and is one of the most important aspects of my design research, as well as, the most mystifying aspect of this particular design methodology.

It continues to reform-ulate upon itself...forming from its own form.

#### NOTES

<sup>1</sup> Time and Place, Technology and Nature in the Work of The Renzo Piano Building Workshop.1996

<sup>2</sup> Ibid.

<sup>3</sup> The American Heritage Dictionary, Second College Edition (Boston: Houghton Mifflin Co., 1982).

<sup>4</sup> Ibid.