THE SEMPERIAN PARADIGM: DEVELOPING ISSUES OF TECTONICS IN FOUNDATION DESIGN

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The tectonic and programmatic structure of the Semperian paradigm of the primitive hut is proposed as a semester long pedagogical framework providing an underlying structure for the ordering and focusing of the issue driven assignments. The use of the four Semperian elements (the earthwork, the hearth, the roof/framework and the textile wall) is seen as a device or lens to bring into focus, isolate and clarify issues central to the second year curricular agenda. This paradigm served as a primary discussion vehicle for the entire second year studio faculty The studio exercises that are presented in this paper begin with a joint or knot considered as a minimal unit in an architectural fabric which builds spatially, tectonically, and programmatically toward an architectural construct. Although a level of abstraction is maintaine in their design workd, the students each analyze historic precedents in Semperian terms: from the knot/woven structure to the four element and operations, as well as make a five day field study to Chicago. The semester long Semperian framework with well considered supporting systemic exercises builds a compelling density of issues that the students quite remarkably gain control of and through their own authorship develop a critical layered response and demonstration of the semester issues.

PREMISE

In 1852 the German theoretician and architectural designer Gottfried Semper wrote "The Four Elements of Architecture" followed in 1863 by the publication of *Style in the Technical and Tectonic Arts or Practical Aesthetics.* In these writings, Semper argues that two functions led man to connect and construct pieces of material: first was the desire to order and bind, and second the desire to cover and shelter. Semper continues his argument to propose the archetypal origin of all built form is textile production, recalling primitive nomadic tribes, with the knot serving as the primordial joint. With this, Gottfried Semper rejects the paradigm of Laugier's primitive hut by rationalizing the origins of architecture through an anthropomorphic and tectonic relationship based on four essential elements in conjunction with four material operations. Semper's four irreducible elements of architecture are: the hearth, the earthwork, the roof/framework and the enclosing textile wall along with four parallel operations: moulding for the hearth, carpentry and joinery for the roof, weaving and plaiting for the walls, to which is added stereotomy for the foundations. Significantly, these four operations can be distilled to two essential and yet, polar material preoccupation's: the tectonic frame and the stereotomic mass. Kenneth Frampton in his article "Rappel a l'ordre, the Case for the Tectonic," reminds us that despite our

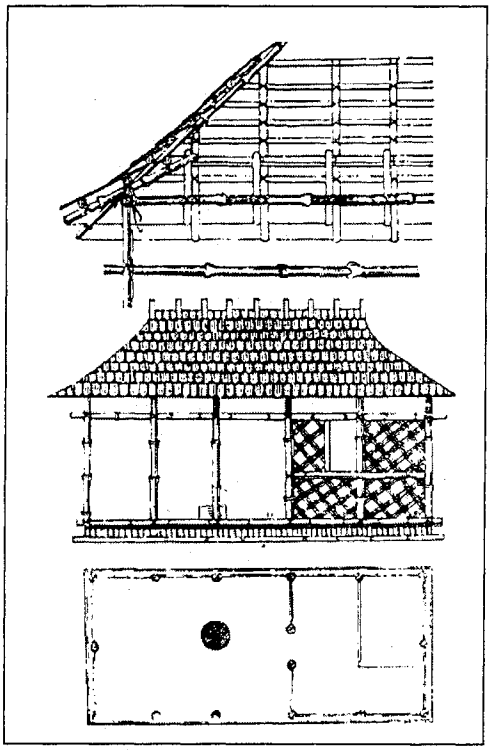

Figure 1: Gottfried Semper, Cariab Hut

"highly secularized techno-scientific age," the polarities of the aerial frame which seeks the lightness of the sky and the stereotomic mass embedding it self deeper into the earth, are still largely considered the experiential limits of our lives. For Frampton, Semper's archetypal emphasis on the knot or joint has deeply rooted significance in the fundamental syntactical transition that occurs in architectural space and form when rising from the stereotomic base to the tectonic frame. The Semperian model holds these transitions as the critical essence of all architectural making.

PLACE IN THE UNDERGRADUATE PROGRAM AND EDUCATIONAL GOALS

As a point of reference, the studio work considered in this paper is from second year design studios which follow two semesters of first year studio work based on the acquisition of "first principles." These first year studio exercises intend to heighten the student's perceptual awareness and skills of creative interpretation and making but significantly without any direct reference to architecture. The role of the second year studios is

to continue to build on the basic design and compositional skills studies in the first year, but specifically locates these issues within the discipline of architecture.

An excerpt of the collective second year studio course description is as follows: ARC 2105 is the third required studio course in the Foundation Program. The studio will continue to build on basic design and compositional skills studied in ARC 1106, but will specifically locate these issues within the discipline of architecture as related to making, production representation and inhabitation of architectural space, form and structure. Significantly, the student is to become aware of the important "tectonic" phenomena in architecture[2]. This concept of the tectonic is discussed by Eduard Sekler in his short article aptly titled "Structure, Construction, Tectonics":[3] Sekler explains:

When a structural concept has found its implication through construction, the visual result will affect us through certain expressive qualities which clearly have something to do with the play of forces and corresponding arrangement of parts in the building, yet cannot be described in terms of construction and structure alone. For these qualities which are expressive of a relation of form to force, the tectonic should be reserved.... Thus structure, the intangible concept is realized through construction and given expression through tectonics.

Clearly, tectonic relationships of form and space are at the heart of a beginning design student's education. The proposition of tectonics as a visible expression of a relationship of parts is directly linked to the conceptual understanding of "structure" as an intangible organizational order, such as geometry, proportion, number, and formal principles, which provide order for an architectural expression. For further consideration is that this broad definition of structure also supports the more objective or traditional associations of structure: such as the *structural frame* of a building or the claim that a building is a *masonry structure* or a *wood structure.* However, a tectonic expression or more commonly termed an "archi-tectonic" expression makes visible a relationship of parts (the structure) by going beyond simply acknowledging the mechanical revelation of not only construction, but also practicality and / or function. In this light, a tectonic language focuses on the poetic manifestation of structure in the original Greek sense of *poesis* as an act of both making and revealing. Architecture is then truly an art of "construction" or "constructing" in the manner in which one must simultaneously engage intellectual / conceptual and physical / practical processes. A tectonic language springs from the practice of construction yet transcends the overtly mechanical and strives to engaged as an integral component and foundation building block of architectural language of space, form and materiality.

The first and second year studio curriculum at UNC Charlotte is complimented by a writing intensive seminar which introduces conceptual topics that underlie architectural making through readings and lectures. The studio curriculum presented in this paper makes direct links to the second year seminar topics of "Space," "Literal and Phenomenal Transparency," "Spatial Sequence," "Proportion," "Structure, Construction and Tectonics."[1] Additionally, the five day field to study the work of the Chicago School demonstrates and supports the strong bond between the seminar and studio, which makes clear the significant and fertile relationship between what is theory and concept

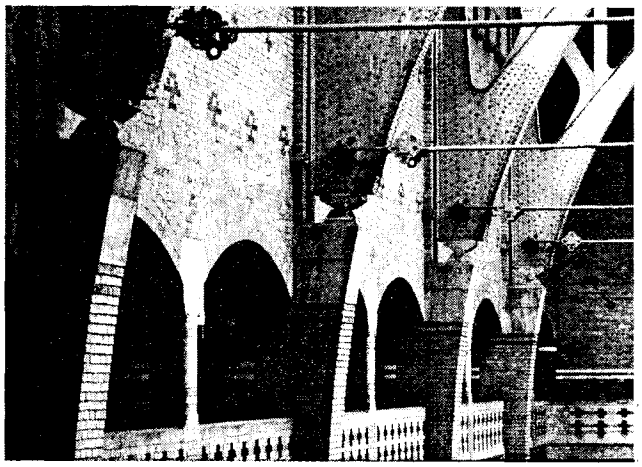

Figure 2: Hendrik Berlage, Amsterdam Exchange Building

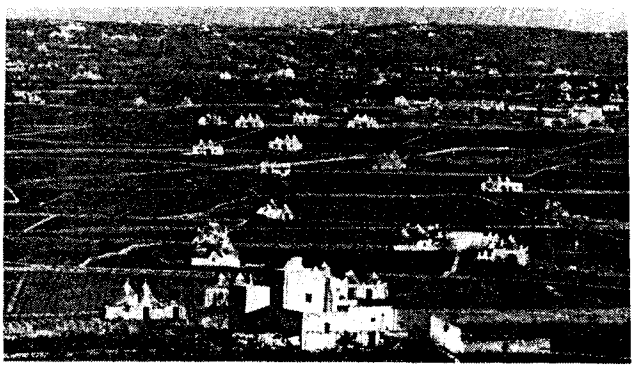

Figure 3: land: Valle d'Idria, Paglia

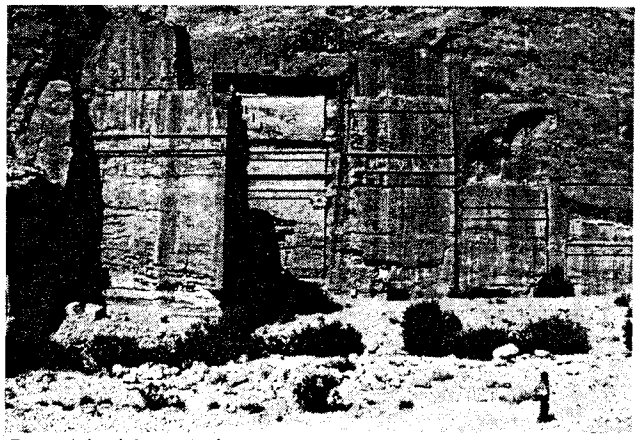

Figure 4: land: Petra, Jordan

and the manifestations ofsignificant and guiding principles in architecture.

TEACHING STRATEGIES

As a semester long series of interrelated projects, Semper's primitive hut provides a thematic framework for the studio assignments. The specific use of the four Semperian elements and comapnion material operations act as a lens to isolate and clarify issues central to the young designer's first architectural studio.

Of the four Semperian elements, the earthwork (or mound) promotes the development of stereotomic issues asso-

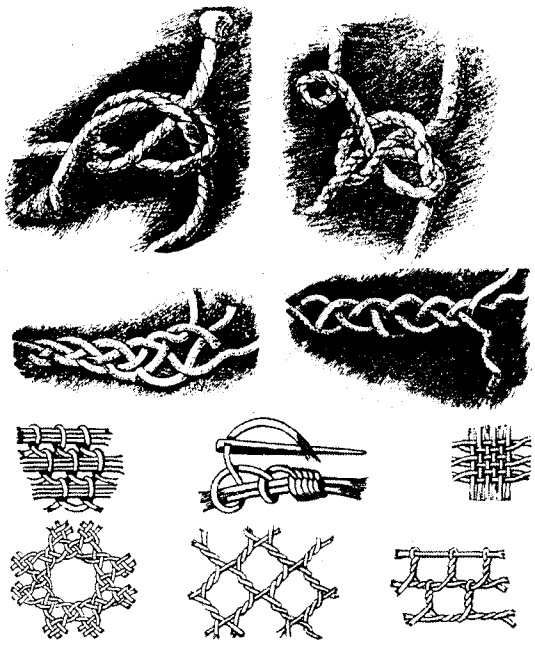

Figure 5: Gottfried Semper, Knots

ciated with carving, cutting, piling, and embedding. Additionally, the earthwork is a condition of ground proposing fundamental principles of site making, such as the claiming of a "site" by marking and giving order to a place. This simple act distinguishes this site, now a specific "place" with a definable order, from the vast continuum of the earthly world. The condition of ground as datum: ground zero, also introduces issues of sectional spatial relations of above and below. The qualities, principles and operations inherent to the stereotomic mass also support the spatial development of the "volumetric void." The volumetric void created by the absence of mass or the development of poche, stands in contrast to the spatial volume defined by the assembled boundary of the framework. The hearth is Semper's ritualized element that seeks to transcend its technical function in order to become a structurally-symbolic[4] programmatic element. With this in mind, the hearth is Semper's moral foundation for settlement as it becomes the central social gathering place. This gathering place around the fire, is a place of community and fellowship engendering the transmission and longevity of culture and values. The hearth's role can also be understood in the process of architectural making as the connection or joint to the ground and while rising towards the sky, this mass, the hearth, becomes the termination of the tulleric earthwork. As a constituent element of the Semperian house, the roof / framework exists hovering above the ground to protect the space of the hearth, a poignant condition which brings to bear the charged dialogue between the spatial boundary of the overhead plane of the roof and its relation to the ground or mound. Further, this condition reaffirms man's cosmic existence captured between the floating heavens above and the massive earthly mound below. The roof / framework (as carpentry) develops and expresses the tectonic properties of physical assemblage, in addition to hierarchical densities of elements and particular relationships of grid/frame and field/element. Lastly, Semper's textile wall is the fabric or dressing covering and spanning the roof / framework. This wall is a most significant expression in regard to the student's spatial development as this wall comes to act as a structured boundary and visual plane separating and connecting interior and exterior views, and space. This textile wall may then be defined as a dense

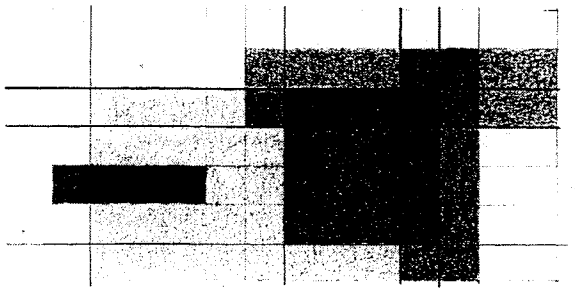

Figure 6: Matthew Fine, tonal study

tectonic fabric or a syntactical scrim that negotiates between the realms of inside and outside. The studio exercises in my section of thirteen students begins with the premise of a joint or "knot" as a minimal unit in an architectural fabric. For this exercise the condition of joint is considered through a volumetric composition and ultimately as a "parti" structure. This initial knot of relationships is woven spatially programmatically and tectonically toward an architectural construct which is individually authored by the student's critical observation, intentions and demonstrations of issues which present themselves in both the studio and the seminar.

THE SEMESTER'S STUDIO EXERCISES AND CRITERIA FOR THE EVALUATION OF THE WORK

The exercises that follow are essentially excerpted from the studio handouts and presented in their chronology of development. The students are not initially aware of an overriding paradigm of the semester beyond what is given as a course premise.

1. THE SEMPERIAN NAHT: A volumetric parti.

The first studio exercises begin with a composition of four volumes which must be composed to express one of the following conditions: a) interpenetration b) embrace and c) pierce.

To join, is to combine, unite, connect, relate, associate. A joint connects roof and wall; a joint connects and relates space to space. According to the Italian Architect Marco Frascari, the joint is the minimal unit of signification for both mental and physical processes of Architecture, it is the critical physical presence of ideation. The joint is the minimal tectonic unit, a strand of architectural DNA.[5]

If the joint can express a critical relation of parts, it will embody a latent structure with the capacity to order form, figure, and materiality. The focus of this studio exercise is to uncover and demonstrate latent and overt orders of composition through drawings of the joint composition. Drafted drawings and toned drawings are based on the notion of transparency and x-ray which allow, through the perceived collapse of space, the simultaneous viewing of exterior forms, geometrical relations (light lines) and an interior relation of joined volumes. Geometrical, hierarchical, figural and proportional relations present are examined. From a variety of study models, two are chosen by the student for development and documentation through planimetric and axonometric drawings. When one builds, constructs and assembles a building, both the physical function of making and the mental process of design rely on the role of the joint. The

students observations and investigations are centered on revealing, uncovering and discovering such a powerful yet intangible structure.

Evaluation: The student's ability to state properties / conditions of joint through model and the ability to demonstrate two dimensional compositional principles present in drawings of the model. The student's criteria for proposing a location for an additional volume or void within the composition to elucidates one's understanding of the order of structure or hierarchical relationships perceived or present which will support an additional element in the composition. This exercise intends to test and extend the students capacity for negotiating a series of interdependent relationships.

2. RELIEF MODELS:

The development and use of templates.

To continue to examine and demonstrate principles of organization, low relief models are constructed from the above joint exercise drawings. This is a method of investigation, translation and demonstration of simultaneous structure and order though the modeling of surface, material and physical properties of the relief model. The relatively straight forward translation from drawings to models requires the student's developing critical capacity of judgment because the representational relationship is not direct, but rather relies on the embodiment and extension of the organizational principles present and developing. Initially students are asked to "build," the inherent compositional structure of the tonal drawings: the primary organizational grid, and then consciously constructing the layer of secondary grid structure. In continuing the work, adding the influential "zones" of the grid—then building the possible emerging orders. The emerging orders are proposed as "fluctuating relationships" which include the order of phenomenal transparency, the identification of planes as fields: providing a local order and planes perceived as objects, with an elevated autonomy. All of this "building" requires decisions of materiality, texture, color, etc., all of which contribute to the manifestation and visibility of these organizing principles. The students investigate, isolate, compose and manipulate the possible reading of orders as well as reflect upon the usefulness of the ordering devices of materiality, color, form, proportion, relief, etc., through numerous model studies. The student's palette of modeling materials is intentionally limited to promote a methodological investigation of permutations and expressions. What is at issue is the translation and demonstration of simultaneous structure and order though the surface, material and physical modeling operations of the low relief plane. The final phase of the exercise places the three planes on a volume / box within a planimetric relationship so that the intangible orders of structured relations re-present a three dimensional volumetric relation. This new volumetric form is, "genetically" related to the initial volumetric parti of the first exercise, but has been significantly transformed through this series of investigations which focuses on compositional relationships of structure and order while subverting the once primary expression and operations of volumetric forms.

Evaluation: The individual authorship and thoroughness of investigation through model representations of the reference structure of the grid and its conditioned zones. A developed understanding of the relations established by material representation in modeling and the emerging orders of phenomenal transparency as guiding compositional frameworks for each student's project. This terminology is studio wide, yet individually demonstrated through prudent use of modeling materials.

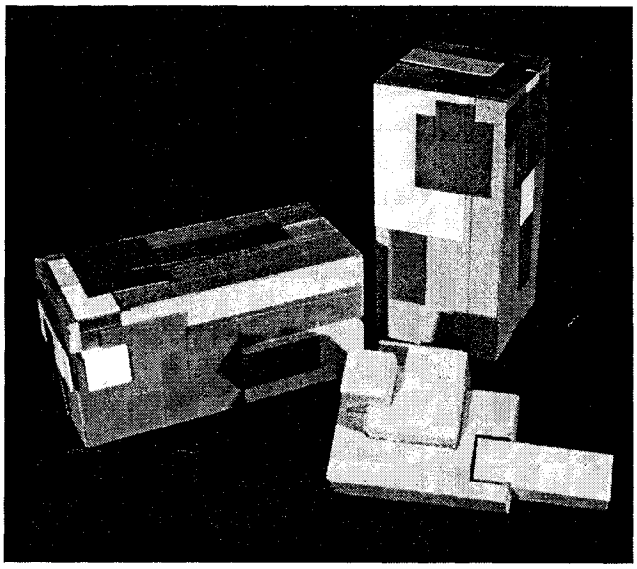

Figure 7: Selena Linkous, relief models + joint

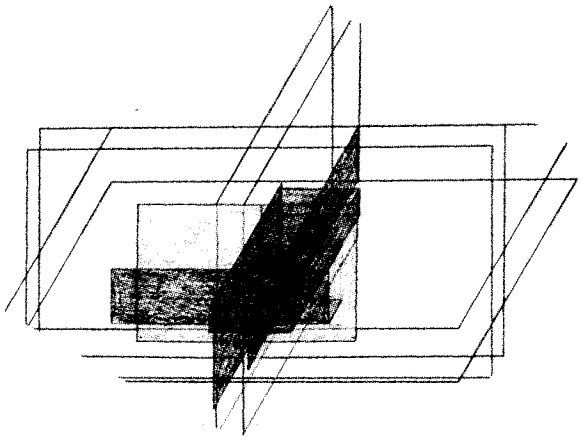

Figure 8: Kip Wilcox, joint stuay

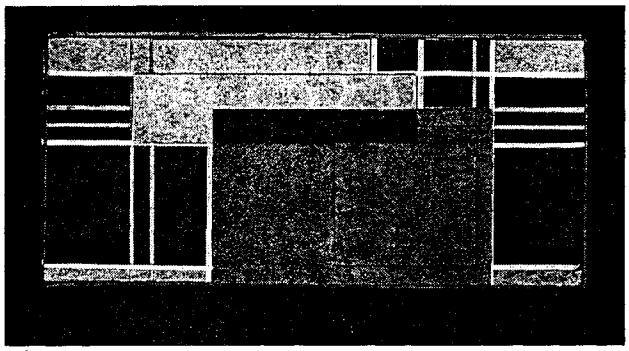

Figure 9: Brett Eichler, relief model

3. THE FIELD TRIP TO CHICAGO:

October 15-19.

All work in the studio and seminar is suspended or rather collapsed into this five day field study in Chicago. A history and powerful demonstration of the principles of the tectonic can be traced through not only the architecture, but also the architectural ornamentation of the Great Chicago architect: Louis Sullivan. Sullivan undoubtedly knew the writings of Gottfried Semper through the numerous German publications

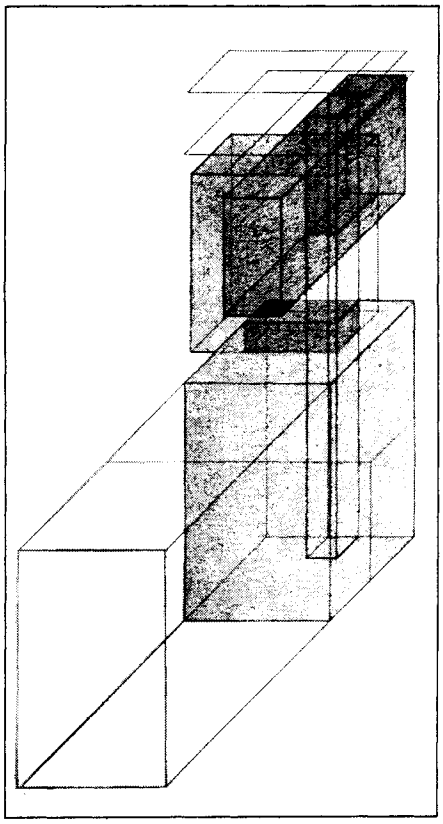

Figure 10: Matthew Fine, volumetric site

in Chicago at the time and perhaps most significantly his German partner, Dankmar Adler who was known to espouse "Semperisms" in their Chicago office. Reference to the knowledge of Gottfried Semper's Four Elements of Architecture appear in the work of an architect who was a young apprentice in Adler and Sullivan's Chicago practice: Frank Lloyd Wright. Many of Wright's early prairie houses epitomize Semper's Four Elements and Four Operations. The field study in Chicago exposes the students first hand to the works of Sullivan and Wright as well as the early history of the "frame-ed" Modern Skyscrapers.

4. THE FOUNDATION OF SETTLEMENT / THE STRUCTURE OF SITE: The mound.

(drawings only) The work in this exercise begins with the selection of one of the two relief model boxes from the previous exercise. This box is embedded within a larger site volume. The site volume is given simply and objectively as a volume with dimensions of length x width x height. The site is essentially a clean slate site, an open plot. The exercise is premised on primitive man's first act of placing a stone on a site to recognize, mark, and make specific a place in the midst of an unknown land. The student's specific location for the box is a strategy that is proposed and negotiated by the student through their growing knowledge and awareness of proportioning systems, organizational figures, compositional strategies, etc., that currently exist in their work (the box) or are systems of order that can embellish or extend their existing work of the box. The embedded box is the "marker" with the obvious potential to influence and order the entire larger site volume. The significance and meaningful potential of orders and organizations which seek an interdependence and influence is discussed by Marco Frascari who looks back to Alberti, in his article "The Tell the Tale Detail:"

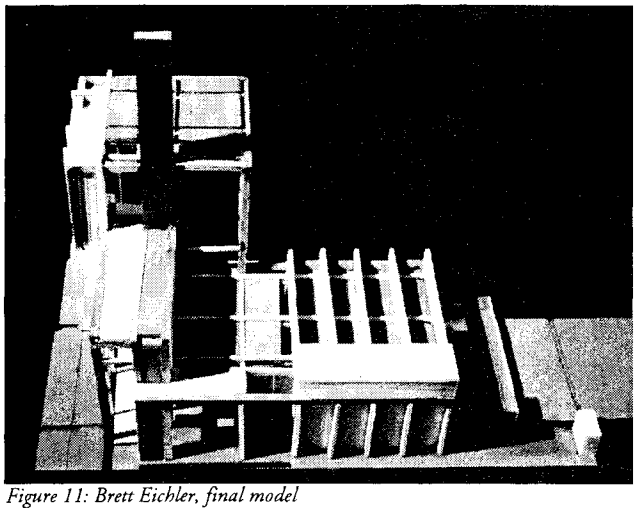

Figure 11: Brett Eichler, final model

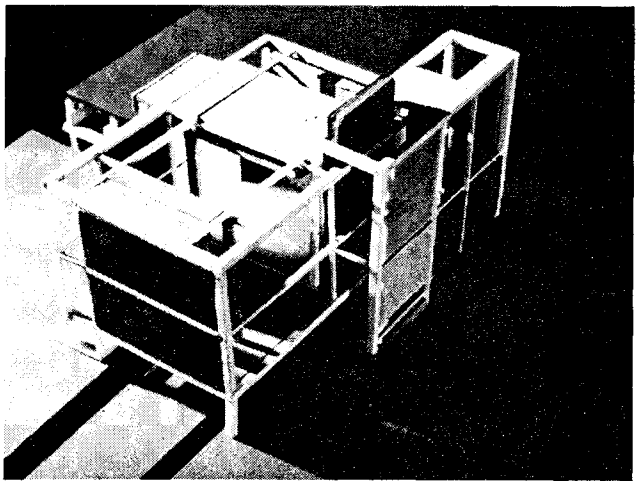

Figure 12: Greg Shue, final model

Leon Battista Alberti defines beauty as the concinnity of all the details in which they belong; in other words beauty is the skillful joining of parts by a normative way in which nothing can be added, subtracted or altered for the worse. Although this is often interpreted as a building should be complete and finished whole, a total architecture. Alberti, however does not apply this to the actual edifice but to the mental process of creation. The joint, that is the detail, is the place of the meeting for the mental construing and the actual construction. Concinnity is the process for achieving beauty and is defined by three terms or requirements: number, finishing, and collocation. Number is a system of calculation and a means of drawing relationships through numerical correlation. Finishing is a mathematical procedure for the definition of dimensions through a system of proportions or analogous measure: a module. In this care all parts of a building may stand to each other in a direct and intelligible relationship. The relationship may be known before the form is realized...[6]

As this exercise develops through transparent axonometric drawings, the surface planes of the embedded boxes are used as templates of measure and figure, to guide both the generation and location of three new spatial volumes. A location for a solid "pin" which passes through all three volumes is determined through the student's recognition of latent and emerging structures of order. The location for a path is also proposed by the student and with the addition of two more spatial volumes (proposed only as: one largest, one smallest)

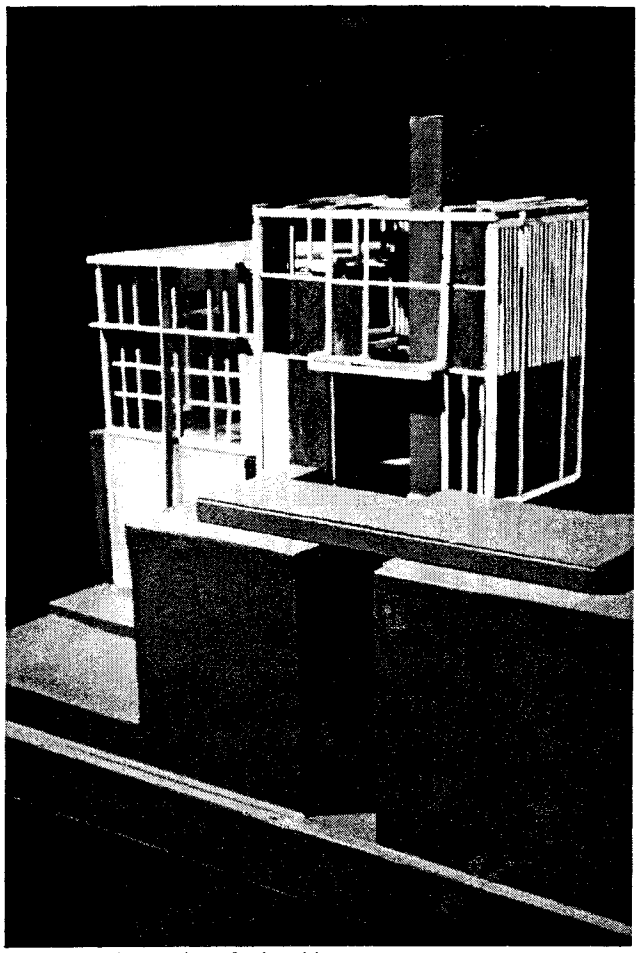

Figure 13: Selena Linkous, final model

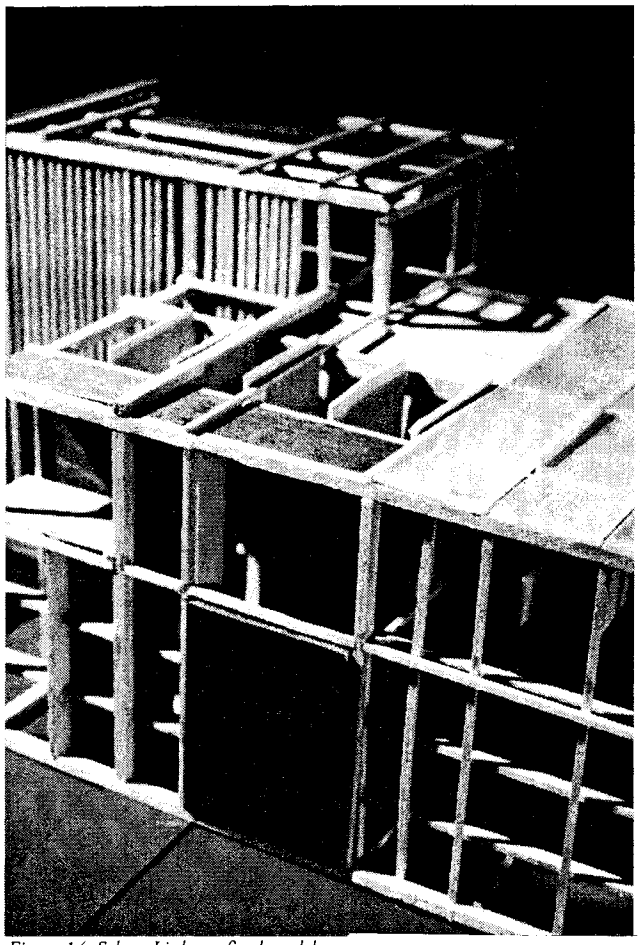

Figure 14: Selena Linkous, final model

confirms and extends the growing understanding of the simultaneous relations among the path, the volumes, the site and the interdependence of guiding structure and order. Principles for the composition of new volumes, solids and planes are proposed through the student's ability to challenge and add onto the existing structure of relationships.

Evaluation: Student's ability to propose site location strategy; developing the ability to transfer, translate and transform preceding organizational structures to support location of the pin and the addition of volumes, path, and solids. Student's cognitive development (both through physical production and verbal description) of the transparent, layered axonometric and planimetric drawings with ephemera of structural, regulating lines and organizational orders.

THE SEMPERIAN ELEMENTS

Developing the Tectonic Frame and the Stereotomic Mass (models).

The structure and syntax of the assembled frame and the carved / piled stereotomic mass are developed in direct reference to the guiding principles of order established in the drawings from the previous exercise. Intentionally, there is no possible direct translation of the ephemeral planimetric drawings to three dimensional form. A critical re-interpretation of these drawn relationships reveal the possibility for a variety of form manifestations that stem from the essential constituents of tectonic frame and the stereotomic mass. Christian Norberg-Schulz reminds us, that when considering the design of the "frame:"

...the problem is formal rather than technical, There is of course no technical reason for emphasizing particular members, for instance by means of colors. But a logical realization of a skeleton system naturally leads to a certain articulation, often because the primary and secondary elements have to be made of different materials....Because of its repetitious and hierarchical properties we may characterize the skeletal system as 'architectural', while the massive system is sculptural.[7]

The frame is presented in this project as a repetitious construct, a three dimensional grid of sorts, which defines spatial volumes. The frame or framework can on one hand, be a neutral foil for a highly articulated infill panel, or conversely a highly expressive woven frame with a simple covering or infill. The structural dialogue (one of expressed relationships) of frame, panel, space, path, elevation figure and articulated language is of primary consideration. The formal order of the frame, order of the infill and order of the assembled joint (both material and spatial) are vital investigations. The programmatic notion of inhabitation is first introduced through a "walking path" which serves as an experiential narrative through the volumetric spaces and the massive site. The path may also take on a spatial role as it becomes defined or is implied as a specific spatial volume. Conversely, it is understood that the spatial volume of this path may become the definer of other spatial volumes and edges with relation to a specific room / volume occurring within either the framework or the stereotomic mass of the site volume.

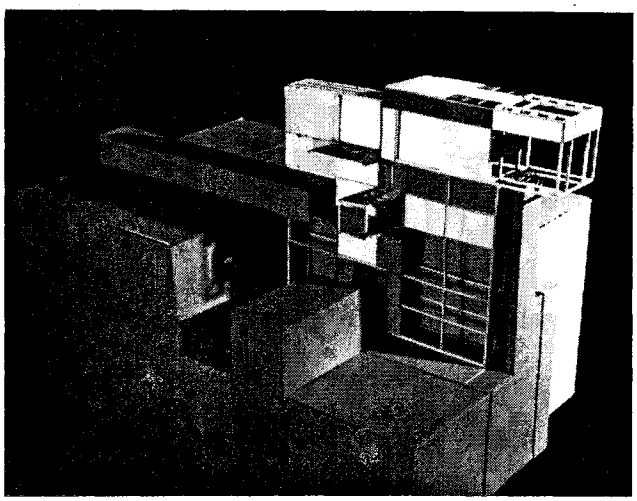

Figure 15:Dean Schimentti, study model

Evaluation: Student's ability to interpret, translate, criticize and negotiate a three dimensional tectonic frame language and stereotomic mass language from the existing ephemeral structure of the drawings. This includes the ability to interpret, translate, criticize and negotiate the cutting and carving of the stereotomic mass with relation to principles in the existing drawings and the spatial narrative of the walking path. A clear recognition of the organizational structure which supports the useful co-existence of the tectonic frame and stereotomic mass / site (a Semperian knot and an essential condition for all architecture). The ability to develop an expressive language of frame and infill, frame and cladding in relation to the student's stated and developed spatial conditions and the experiential qualities of the path journey. At this point in the studio work and perhaps most significant in evaluating the student's progress is their ability to explain the interdependence of all the studio issues and exercises given during the semester and identify the specific operative principles developed in their projects.

THE SECOND YEAR SEMINAR

A companion seminar provides an invaluable discussion and writing opportunities for these studio issues. Most of the studio faculty also teach the seminar, however, not to their section of studio students, but rather to a class which is comprised of students from other studio sections. is organization of class make-up intends to promote a "class-wide" discussion of these issues. The following are the weekly readings presented in through lecture and discussion.

Week 1: Perceptual Nature of Space

Rudolf Arnheim, "The Elements of Space," in *Dynamics of Architectural Form* (Berkeley: University of California Press, 1977), PP 67-109

Week 2: Classical vs. Modern Space Making

Steven Kent Peterson, "Space and Anti-Space," *The Harvard Architecture Review: Beyond the Modern Movement, vol. 1*, spring 1980, (Cambridge: MIT Press, 1980), pp. 89-113.

Week 3: Principles of Phenomenal Transparency, Cubism, and the foundations of Modern Space

Colin Rowe and Robert Slutzky, "Transparency: Literal and Phenomenal," in *Mathematics of an Ideal Villa*, (Cambridge: MIT Press, 1982)

Week 4: Sequential Spatial Structure

Luigi Moretti, "Structures and the Sequences of Space," *Oppositions 4* (New York: Wittenborn Art Books for the Institute of Architecture and Urban Studies, 1975)

Week 5: The Spatial Parti vs. Historical Style

Colin Rowe, "Mathematics of an Ideal Villa," in *Mathematics of an Ideal Villa*, (Cambridge: MIT Press, 1982)

Week 6: The Development of the Frame

Colin Rowe, "The Chicago Frame," in *Mathematics of an Ideal Villa*, (Cambridge: MIT Press, 1982)

Week 7: Chicago Field Study

Week 8: Proportioning Systems

Rudolph Wittkover, "The Changing Concept of Proportion," *Idea and Image: Studies in the Italian Renaissance*, (London: Thames and Hudson, 1978)

Week 9: Transcendent Structures of Order

Thomas Beeby, "The Grammar of Ornament, Ornament as Grammar" in *VIA III: Ornament*, (Cambridge: MIT Press, 1978), pp. 11-28.

Week 10: Tectonics

Eduard Sekler, "Structure, Construction, Tectonics," *Structure in Art and Science*, Gyorgy Kepes, ed., (New York: George Brazilier, Inc., 1965) pp. 89-95. Kenneth Frampton, "Rappel a l'orde, The Case for the Tectonic", *Architectural Design v.60*, #3-4
(New York: St. Martin's Press, 1990), pp. 19-26.

Week 11: Semper's Four Elements

Joseph Rykwert, "Semper and the Conception of Style," *The Necessity of Artifice* (New York: Rizzoli International, 1982), pp. 123-130.

Week 12: The Detail + Tectonic Form

Marco Frascari, "The Tell-the-Tale Detail", in *VIA 7: The Building of Architecture* (Cambridge: MIT Press, 1984), pp. 23-37. Adolf Loos, "Building Material" & "The Principles of Cladding," Spoken into the Void (Cambridge: MIT Press, 1982), pp. 63-69.

NOTES

1. A listing of these semiar readings is on the last page of this document.
2. paraphrased from the fall 94 ARC 2105 course syllabus.
3. Eduard Sekler, "Structure, Construction, Tectonics," *Structure in Art and Science*, Gyorgy Kepes, ed., (New York: 1965)
4. see Kenneth Frampton, "Rappel a l'orde, The Case for the Tectonic", *Architectural Design v.60* #3-4 (New York: 1990) for a discussion of the structuall-technical and the structural-symbolic in relationship to Semper.
5. excerpted from a studio handout.
6. Marco Frascari, "The Tell-the-Tale Detail," *VIA 7* (Cambridge: 1984)
7. Christian Norberg-Schulz, *Intentions in Architecture* (Cambridge: 1965)