ARCHITECTURAL SEGMENTATION: A STUDY OF MANUFACTURING TECHNOLOGY, FABRICATION METHODS AND ARCHITECTURAL DELIGHT

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Fred Johnson
thank-you for your fresh perspective, clear vision and willingness to enter the unknown mystery that is the architecture critique. your thoughtfulness has been a dependable asset to me, on this journey.

Wes Janz
you have challenged me to analyze my actions. you have encouraged me to question my motives. most importantly, you have given me new perspective from which to ask better questions. thank you for the trust, the respect and the energy that you have, unselfishly, shared with me.

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Sue Godfrey
words can not express how grateful i am for you. thank you for your unending sacrifice, patience and endurance during this season.
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While, tectonic theory does not address all of the architectural issues, which arose as a result of the modern movement and the industrial age, it does bring the relationship of the master-builder and the craftsmen to the forefront of design. Our current cultural condition, with its integrated information technology, affords a new opportunity to address the issue of architectural craft. The transportation industry has already begun to utilize highly sophisticated computer design processes to reduce time and overall cost while, increasing performance and the overall quality of design. A design model predicated on segment assemblies could radically change the practice of architecture through the development of integrated design, fabrication and assembly processes.
INTRODUCTION

This thesis project explores a process of architectural design that is predicated on the method of segment assembly. The segment assembly process is one utilized by the transportation industry and takes advantage of developing manufacturing technologies and processes. The benefits of this include: higher efficiency during the most uncontrolable period of time – on site assembly; less waste due to greater control of material transportation and sequencing; and a higher quality product for a lower cost.

Integrated information technology such as CAD/CAM and CATIA, affords a new opportunity to address the architectural issue of craft. The transportation industry has developed, similar, highly sophisticated computer design processes to reduce time and overall cost while, increasing performance and the overall quality of design. The outcome of these sophisticated computer design processes is an integrated design, fabrication and assembly process through the identification of segment assemblies.

The thesis project has explored impact of the transportation industry’s segment assembly method on an architectural design methodology. Segment assemblies, and the resultant spaces, have been considered in a 23,000 square foot architectural design project, exploring an manufacturing technology, fabrication methods and architectural delight.

Located in Muncie, Indiana, the museum of manufacturing technology is a facility intended to foster the relationship of the surrounding communities through interaction, research and education. The facility combines display areas, public meeting spaces and administrative areas. The physical site is located at the intersection of several community hubs; the cardinal greenway, the white river development area and a gateway into downtown Muncie. Research and analysis of existing facilities has considered types of architectural segmentation that could be accomplished; the skin segment, the volumetric segment and the programmatic segment. Preliminary design projects were undertaken to explore the skin segment and the volumetric segment, in relationship to simple segments creating sophisticated form and space. The design projects have been conducted to develop fabrication methods and issues of architectural delight, which were developed through the study of written precedents, notably, tectonic theory.

Final Thesis Design Model
BACKGROUND RESEARCH
Thesis Issues, Questions and Positions

Three types of architectural segmentation have been identified:

The skin segment defines a type of enclosure (floor, wall, roof, etc.), which can be organized to create space and form. The skin segment is defined by a consideration of the fabrication constraint and may be designed for replication. Consideration of material, composition, connection and assembly techniques, in relationship to the type of enclosure, defines the character of the segment. This segment type is probably of a relatively small scale to facilitate ease of movement to the site and in the assembly process.

The volumetric segment defines a three-dimensional space. In order to accommodate human occupancy, this segment type is probably of a relatively large scale. For this reason, sophisticated industrial processes need to be considered to facilitate fabrication and assembly techniques. Volumetric repetition can be utilized to achieve larger spaces. Inherent design flexibility should be a consideration for the location and number of penetrations to facilitate movement and view.

The programmatic segment defines a function that occurs within the space. The segments could then be configured or stacked to meet the requirements of the architectural program. The programmatic segment adheres to characteristics of the skin segment and the volumetric segment, as it defines enclosure and three-dimensional space. Special consideration would need to be made for the systems design, in order that the segments would fit together and perform the required function for human occupancy.

In each of the initial projects, the scope was very small. The type of space was singular in nature. For the thesis project, a greater variety of space should be explored. The thesis presumes that economic savings are possible. Architectural delight has been indicated as the main reason for the design methodology. Defining architectural delight (quantitatively and qualitatively) is subjective. Identification of the segment might occur in the connection between segments. Is this connection seamless or disjunctured? Is the transition obvious or unnoticeable? Is it important that the segment be identifiable? How do the ideas of segmentation extend into a larger program? Can segmentation be utilized to create architectural delight? What is the relationship of segment simplicity and complexity in the creation of architectural delight? A conscious effort to minimize economic impact has not been the main thrust of the exploration. Can the arbitrary assignment of constraint assist in the inquiry?
AN ANALYSIS OF DESIGN AND DELIVERY PROCESS

Frank O. Gehry
Guggenheim Museum Bilbao
The transfer material process lists information technology as an instigator for a shifting paradigm in the delivery method of architectural service. Established computer modeling techniques are now being combined with developing computer fabrication techniques to eliminate many of the redundant steps involved to coordinate the intentions of the designer with methods of construction. Shop fabrication is executed from precise computer model developed by the architectural firm. In tandem with Dassault Systemes, Gehry's office has developed a highly sophisticated software package, based on a version of CATIA, for use in architectural applications to represent complex three-dimensional objects. CATIA is a product design solution in that allows manufacturers to simulate all the industrial design processes, from the pre-project phase, through detailed design, analysis, simulation, assembly and maintenance. The program is to create and maintain a direct link to the craftsmen who are building the buildings. "It's the old image of the architect as master builder."

Utilizing this integrated technology, contractors and suppliers have an accurate representation of all of the required elements to complete the design. The material shapes are represented, on disk, within the computer model. In addition, all of the building materials can be bar-coded, as they leave the manufacturer. A sophisticated tracking system monitors the movement of the parts as they arrive on the site for final assembly. Tracking and coordinating this movement allows the sequence of construction to operate smoothly, safely and efficiently. This translates directly into cost savings. None of which would be possible without the use of a technology capable of calculating quantities and qualities of materials, an appropriate fabrication technique to manufacture them and sophisticated tracking and monitoring devices as they make their way to final assembly.

While Gehry's process does embrace the notion of a clear understanding of the fabrication processes, the process does not fully embrace the ideals of segment assemblies. While the skins may be fabricated utilizing a highly sophisticated fabrication model, the interior systems (structural, mechanical, etc.) follow a more traditional path. Additionally, the size of the segment is in confluence to the segment assembly ideal. Masonry or metal panels, used for the exterior surface, are the dominant element that requires sophisticated design methods. Prefabricated assemblies of entire forms would be the goal of an embrace of the segment, as related to the transferable materials process.
If we consider the Rector Street Pedestrian Bridge Project by SHoP, we recognize a project that was highly formulated around issues of constructability. This project was constructed after the attacks of September 11th, 2001 to reestablish pedestrian traffic around the World Trade Center Site and highlights a distinct sensibility to issues of the user and sequencing. However, the spatial experience is something that is maybe quite separate from the experience of the fabrication techniques.
The transportation industries have made great strides toward the integration of technology in design and fabrication processes. Architecture, however, has lagged behind in its pursuit of integrated technology. Utilization of developing technologies through a process of integration would facilitate architecture with higher performance standards, greater quality control, utilizing more efficient methods of fabrication and assembly while delivery time and overall cost would be reduced.

An architectural design methodology that embraces the ideas developed for the transportation industry would be predicated on segments that are fabricated within a controlled environment. These segments would be transferred to the site for final assembly. The qualitative benefits of this methodology transfer are that design freedom and aesthetic inquiry can take on greater importance than would be possible without the apparent economic benefits.

In order to implement the transportation industries' transferable material process, a system of thinking must be developed relative to the segment. The transportation industry identifies the segment by its size, function, assembly-location and fabrication method. This allows an automotive manufacturer, for instance, to fabricate the chassis of a vehicle in one location while they build the engine in another. The ultimate goal of this systematized process is to produce a superior product in an efficient manner. This goal is achieved through the use of relatively simple components (when compared to the final product) that are joined together to form a segment. Segments are then assembled to form a much more sophisticated product than is represented by any of its component pieces.
A relatively simple form was conceived with the notion that subtle complexities, of material connections, could be layered on top of the form to create architectural delight. In the Kolonihavehaus, this took the form of a filter of wooded slats layered on a simply curved frame; the repetition of which created an egg-shaped enclosure. The subtlety of the curved, egg-shaped form coupled with the resultant space and wood-slatted skin, creates a contemplative sitting space. I disliked the proportion of the final design model. It was too squat and looked more like a tomato than an egg. The egg is better.
Installation Design Study

Design an installation to present the idea of the architectural segment. The installation acts, not only as a display of the qualities of segmentation but, also serves as a survey tool in the research of the thesis topic. The installation provides a venue to present ideas, test methods of presentation, as well as, elicit and record user responses to the ideas presented.

The volumetric segment was explored in the Installation project. Like the Kolonihavehaus design, the fabrication process was the main design consideration. The difference being that there was a greater emphasis placed on industrial processes. Plywood was the main material and an automated CNC router was used to fabricate the members. Steel nuts and bolts were used to connect the members. Aluminum channels were used to connect the fabrication to the site. The detail of the member connections allowed for slight variations of form that created complex space. Linear members could be configured to render undulating space. The resultant space has a rhythm, a variety and an interact-ability that began to inform the notion of delight as related to play. Potential for further manipulation of space became apparent as the space was modified by the movement of the plywood members.

A sequential architectural experience to present the idea of segmentation. The presentation of ideas facilitates an unfolding awareness/understanding of the thesis topic, provides an opportunity for user interaction and contemplation and enables users to leave their mark on the installation by recording their responses to the information/questions presented.

ASSIGNMENT #2: (re)SEARCHING AND MAKING AGAIN
CULTURAL CONTEXT

The coordinated effort envisioned by the transferable materials process is best explored in a first-world culture. The close ties between technological and fabrication innovation is integral to its success. Furthermore, it is important to have the ability for efficient material transportation to the assembly site. Community value for excellent building performance with an eye towards a communal interpretation of beauty should inform the design aesthetic. It is also important to connect community activities; work and play, learning and relaxing, etc.

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How can segmentation relate to the business development strategy of Muncie?

- Creates additional fabrication jobs
- Low-skill level labor for assembly
- Connection of business, culture, cardinal greenway and white river development

How can segmentation relate to community development?

- Sustainable process applications
- Community education
- White River Development

How can segmentation relate to physical site transportation?

- Railway (train)
- Car
- Cardinal Greenway
PHYSICAL CONTEXT

The Museum of Manufacturing Technology is an interactive educational center. Its interactivity is based on intervention and 'hands on' participation by the visitors, and centered on experimental and educational objectives. The facility's goal is to influence the community of Muncie through the transmission and acquisition of knowledge. Knowledge transforms the recipient and is at the center of encouragement of cultural and social cohesion. The facility should be an incubator for the delivery of knowledge, as such will be a 'jumpstart' for community transformation. A heightened awareness of community should emanate from active participation and engagement. This awareness should extend outside the boundaries of the facility and should be a catalyst for development in the cultural and social sector (this development would likewise stimulate economic development).
PROGRAM SUMMATION

The Museum of Manufacturing Technology will be approximately 23,000 square feet; 12,000 square feet of which will constitute the gallery space. The remaining 11,000 square feet will be divided into shared resources such as, public meeting rooms, administration, facilities, staff and unassignable areas.

1. The Gallery
   - A direct perceptual relationship between subject and object is not the facility's goal. Instead, the observer's intellectual efforts will be to follow an intellectual discourse through the different parts of the museum, as if it were a syllabus. The material exhibited in this museum will not, in general, have great economic value or display unique, artistic or irreplaceable works but, instead house objects of the natural and organic environment.
   - Participation and the interactive involvement of the visitor are definitive characteristics. As such, a large, central, flexible container which houses the collection with the predominance lying in the educational element is a requirement. The dominant element will be the discourse, as opposed to the object. Innovation and experimentation with alternative techniques for presentation and exploring the museum as an open and active place will take a dominant role as the source of education and understanding is facilitated in order to influence the social setting.
   - The facility is to be a place of continual transformation. The internal arrangement and form should allow for growth since the museum should be constantly rearranging itself for the presentation of new exhibits and themes. Accommodation for a variety of objects of greatly different scales should be considered.

2. The Shared Resources
   - Administrative areas to facilitate the coordination of events and acquisition of exhibit materials.
   - Public meeting areas for conferences, science fair exhibits and public meetings.
   - Coffee shop for the encouragement of interaction between the facilities users and the community at large.
   - A hub for the activities on the Cardinal Greenway and the White River development area.
PRELIMINARY STUDY

Initial studies of site and program developed into an organization of spatial relationships. The internal system of space is organized by a single spine or catwalk that is bookended by vertical circulation elements. The programatic spaces plug into the single spine. A hierarchy of public/private spaces are established from most public on the west and most private on the east.
The atrium space begins the dialogue between the public and private space. The public space is anchored on the street edge while the private space finds refuge along the interior of the site. The circulation path is positioned in such a way as to encourage views into spaces on differing levels. This juxtaposition of people separated by space but visually connected is another layer of the public/private dialogue.

The character of the atrium is intended to make a gesture to traditional manufacturing facilities with a clean, industrial feel, vertical volumes and expressed structure. Horizontal circulation occurs along a catwalk that runs the length of the spine. In order to allow light to penetrate into the atrium, a section of the roof is lifted to create space for window openings. Northern light would spill into the atrium and wash over the catwalks.
SECONDARY CONCEPTUAL STUDY
Thematic Considerations

Program and the built form/site relationship were the focus for the preliminary design study. In the subsequent conceptual study, it was my intention to filter the information, gathered in the initial study, through a series of architectural design moves. The first of these moves was to make a distinction between the circulation paths and the remaining building elements. This resulted in Bokendor Vertical Circulation Towers linked by a Horizontal Walkway. It became important to 'plug' the programmatic functions of the design into this circulation system to create an articulation of segmentation, both horizontally, as well as, vertically. The result of this determination was the development of the assembly segment; articulated by a series of Tower Segments and Floating Translucent Cubes.

The attitude of the assembly segment towards the whole of the design became a method for considering the relationship of the user with the building, the interplay of light and materials, and the notion of public/private space.

The exterior facade has a dynamic role in the perception of the design. In the daytime, the translucent panels facilitate daylighting strategies while hinting at the activities occurring on the inside through moving shadows cast on the panels by users, display materials and equipment. In the evening the facade transforms. The programmatic cubes emit a diffused light that is intended to create a sense of mystery like a machine with an unknown internal energy.
The organization of the bookends and catwalks are articulated by a series of vertical tower structures. The structural system is determined by a regular pattern of these structures with joists that cantilever in both directions across the atrium. Stability is provided by this connection at the atrium. This system provides the basis for the organization of spaces and the horizontal segmentation.

Consider the moment where the system is broken. In this case, the system is broken at the main gallery space. The response is a further articulation and modification of the system. Through this response, a volumetric opening of space occurs. This opening creates the opportunity for phenomenological experiences.

The character of the built form is articulated in response to the study of materiality and fabrication methods. The articulated segmentation, horizontally and vertically, is translated into a segmentation that is responsive to transportation and assembly issues.
A STUDY OF THE ASSEMBLY SEQUENCE
Sequence 2, 3 & 4

Tower Segment D
Tower Segment C
Tower Segment B
Tower Segment A

Exploded Isometric
1. Deliver off-site fabrications - TOWER SEGMENTS to the site.
2. Tower Segment A is installed in foundation.
3. Tower Segment B is slipped over Tower Segment A.
   - Second floor TRUSSES are through-bolted at Tower Segments A & B.
4. Tower Segment C is slipped over Tower Segment B.
   - Third floor TRUSSES are through-bolted at Tower Segments B & C.
5. Tower Segment D is slipped over Tower Segment C.
   - Roof TRUSSES are through-bolted at Tower Segments C & D.

Assembly Isometric
A STUDY OF THE ASSEMBLY SEQUENCE
Sequence 6 & 7

Exploded Isometric
• Deliver off-site fabrications - SANDWICH SEGMENTS to the site.
• Install Sandwich Segments A, B & C by fastening fabrication to steel TRUSSES.
• Install steel TUBES near Tower Segments.
• Install HOLLOW CORE CONCRETE FLOOR SLABS - bear on Sandwich Segment and Steel Tube.
A STUDY OF THE ASSEMBLY SEQUENCE
Sequence 8

Translucent Wall Panel System

Exploded Isometric
• Deliver off-site fabrications - TRANSLUCENT WALL PANELS to the site.
• Install Translucent Wall Panels at all floors
Light poles with flags articulate the streetscape to signal entrance into the downtown Muncie area from the east - as vehicular traffic crosses the White River.

The staccato rhythm of the segment assembly towers reinforce the idea of the design acting as a gateway - leading the traffic flow into the city.

To reinforce the plug in quality of the exterior articulated segment assembly, the mechanical system connects to the concrete floor slab. The hollow cores are utilized as horizontal chases for supply air. This virtually eliminates sheet metal ductwork for the mechanical system - a significant cost savings.
Building Section A-A

Building Section B-B
My initial hypothesis indicated that larger segments would be developed. These larger segments were thought to encompass large volumes of space. As I began to develop this type of understanding of segments and there assembly, I discovered a new constraint, that took on greater importance than I was initially considering. That constraint had to do with the process of transporting the constructed segments to the site. It was determined that an attempt should be made to develop segments of such a volumetric size that special transportation permits would not be required to deliver them to the site. The Indiana Department of Transportation (INDOT) was consulted to make these volumetric constraints. While, special permits could be granted to transport segments of a larger dimension, designing with the smaller dimension, in mind, could have cost and timing benefits to the overall project.

Segments of differing characteristics were developed. A single trade segment would require the skills of a single trade type, in its fabrication. This type of segment is readily used in traditional architectural design. Possibly, the most common type of single trade segment is the steel truss or joist. The multi-trade or hybrid segment was identified. This segment type requires multiple contracting trades to engage the fabrication. For instance, the tower and sandwich segments require a structural steel trade, a carpentry trade and potentially a roofing or specialty wall panel installation trade. A third type of segment is the off-the-shelf segment. For this study, a pre-cast, hollow core concrete slab was used. Other segments of this type include architectural pre-cast concrete wall panels, translucent wall panel systems and various wall or roof sandwich panel systems.

For off-the-shelf segments, it was my strategy to consider multiple functions for these segments. In the case of the pre-cast, hollow core concrete slab units, it was my strategy to utilize these for, not only, the floor slab system (to eliminate a significant tonnage of steel) but, also to use the hollow cores as the horizontal chases for mechanical systems (to eliminate significant lengths of sheet metal ductwork).
Over the course of working on this thesis project, I struggled with the conflicting notions of the practicality of the assembly process and the desire to understand ideas of architectural delight. Developing an understanding of fabrication methods focused my attention on material constraints and assembly methods. This attention seemed in conflict with notions of architectural sequence. Selecting a material pallet became somewhat arbitrary, at times. In relationship to this project, ideas of architectural delight seem to reside in the relationship of fabrication and assembly methods with ideas of tectonics and material connection.

In early studies, I tried to gain understanding of the site and the program to organize the spatial relationships and develop a connection between the building and modes of transportation (which translates into people). These early studies began to take on the character of a more traditional approach to architectural design. In order to break from that tradition, I attempted to capitalize on some of the strengths that had been developed in the initial designs through consideration of the rules and system of thought that establishes the order for the resultant design. Out of these considerations, a strategy for material selection and assembly techniques were developed.

The idea of utilizing a method of segment assemblies in an architectural design is not predicated on the use of repetition. However, repetition is a method that can be used to achieve a certain level of efficiency in both, economics and assembly time. Additionally, repetition can occur with slight modifications to the segments. This idea of mass customization allows significant flexibility to the way the segment is formed, the function that it performs, the way it is connected and its overall appearance.

The design thesis exploration has considered the process of developing segments through the investigation of existing materials and fabrication methods from the architectural industry, as well as the transportation industry. Segments have been developed that are composed of relatively simple component forms. These segments have been utilized, through the development of subtle complexities (of size, function, assembly-location and fabrication method) to create space.
BIBLIOGRAPHY


Internet Websites

The architect designed this home for his parents, who would also be constructing the design. The design pays particular attention to the means of construction. Material awareness was considered to minimize waste and assembly time. Local availability defined the criteria for material selection. The home is situated under established tree shade in response to the physical context. Additionally, the porches and openings are oriented to make the most of available breeze. The simple forms of the design are responding to specific environment cues to create a rich, sophisticated space.
Appendix

The Salk Institute
La Jolla, California
1965
Louise I. Kahn

Simple, rectilinear forms are used to create a grand, poetic gesture to the ocean while creating a sophisticated plaza space. The forms respond to their context, both in their outward view and connection to the water, as well as their acceptance of the ocean breeze. The concrete forms are replicated to create a rhythmic pattern. The use of solid surface and void could be diagrammed as a programmatic segment.
Appendix

Mason's Bend Community Center
Mason's Bend, Alabama
2000
Samuel Mockbee's Rural Studio – Auburn University

Rural Studio: Samuel Mockbee and an Architecture of Decency
Andrea Openheimer Dean and Timothy Hursley
Arch NA2300.A9 D43 2002

The mission of the Rural Studio is to enable each participating student to cross the threshold of misconceived opinions to create/design/build and to allow students to put their educational values to work as citizens of a community. The Rural Studio seeks solutions to the needs of the community within the community's own context, not from outside it. Abstract ideas based upon knowledge and study is transformed into workable solutions forged by real human contact, personal realization, and a gained appreciation for the culture.
Appendix

Flawil House
Flawil, Switzerland
2000
Markus Wespi and Jerome de Meuron

This project uses the readily identifiable (simple) form of the barn or woodshed but gives it a twist (sophisticated space) through the use of modern materials. The perception of scale is manipulated by the directness of form and the seeming lack of penetrations. Interior light quality and view are achieved through a slatted-timber screen, which masks a glazed wall behind. This filter alludes to the vernacular agricultural tradition of a screen wall to help air circulate (for drying grass).
The Exercise of Detailing
Vittorio Gregotti

In this short criticism, Vittorio Gregotti discusses the notion of the detail as 'a revealing component of changing architectural language'. He states that the 'obsession with the new' has rendered the architectural language unable to competently express the differences in the structural changes in the architectural field. The implied hypothesis of the criticism is that detail is that which should signify the changing technologies in architecture without the necessity of an overall guiding concept. The detail should give form to these principles and help them become articulate but, its relationship to the concept is not necessarily intrinsic or maybe even desirable.

Gregotti quotes the work of Franco Albini, Carlo Scarpa, and Mario Ridolfi as examples of the 'eloquent detail' of the Fifties and Sixties. These works are held in contrast to the following time period with their 'reduced expressive content' and 'the return of the architectural detail to guiding concept'. The return to guiding concept is not about the elimination of the detail, all together but, the details place in the hierarchy of the whole of an architectural experience. The relationship of materials, as well as, their practical and symbolic uses begins to define the architectural expression. Gregotti points out a double meaning, at this point. 'On the one hand, a negation of the value of construction as a subject of importance regarding architectural expression, resulting in a gradual increase in the abstraction of detailing, and the progressive lack of interest in the handling of materials according to a model of modernity. On the other hand, there has been discussion in relation to a crisis of architectural language as an objectual language towards the revaluation of the notion of relation and modification, of physical and historical place and context of specificity and difference.'

The loss of practice, tradition and knowledge are cited as being worse for architecture as a result of consent with the lowest level of mass culture due to contemporary communication processes. The problem of detailing has been left to the 'culture of industry' with the outcome that much of contemporary architecture has a lack of articulation and an unthoughtful quality. The outcome of which is an architecture that looks as if a scale model has been enlarged and the level of detail that is achievable at that scale is what is constructed.

A distinction is made between the construction detail and the decorative detail. These form a continuing dialogue regarding the classical rules on 'ornament in architecture' with the outcome of comprehension and re-articulation of classical ornament. The dialogue centers on the question of potential links between ornament and construction techniques in classical architecture. Gregotti seems to be making a connecting statement with our contemporary architectural culture here in that the current technology and construction culture has corrallied the architectural profession (in a broad sense) into thinking about building technologies in a very narrow way. It is the duty of the architect to reintegrate the outcome of these technologies into a meaningful and articulate architecture.
The Tell-The-Tale Detail
Marco Frascari

'The detail expresses the process of signification; that is, the attaching of meanings to man-produced objects.' The detail is the generator of the design because it is the union of the 'construction' and the 'construing'. It represents that which is built and that which is thought. Details cannot be thought of only as small parts, separate from the whole and achieve significance. Instead, they are to be seen as intrinsic to the whole of architectural experience, giving rise to connection and architectural relationships.

Adhering to the notions of function and aesthetic, the joining of materials, elements, components and building parts is the art of detailing. It is through the art of detail making that the architect is able to interact with the possibility of innovation and invention. This is achieved by two methods: the theoretical and the empirical. The result of the theoretical method of detail making is that through the making of a joint, an order can be imposed on the whole through the order of the joint. The empirical method is presented through the work of Carlo Scarpa. 'The architectural production of this architect, in which the adoration of the making of joints is almost obsessive, allows an empirical interpretation of the role of detail in the process of signification, seen within culturally definable modes of construction and construing'.

French theoreticians of the architecture parlante and the Beaux-Arts analytique both point to the details role in the development of character in a building. Even minor details have the ability to shape the character. This deification of the detail differs greatly from the contemporary view of construction where economics drive design. Building are no longer viewed as 'long-lasting cultural and social repositories' but, instead as 'economic investment'. As a result, building trades are no longer expected to be masters of the craft of detail making. They detail has been taken out of the building character. What was once looked at as a joint, in the construction of a building, is now looked at as a production drawing. If the drawing does not indicate a significant detail, it is no longer the responsibility of the workman to include it in built form.

Leon Battista Alberti's architectural theory is based on the art of achieving beauty through the selection of 'appropriate details'. Beauty is defined as the creation of a unity of materials and details where no single element can be added, subtracted or altered without affecting the whole for the detriment. The joint, then, is the point where the thought of design meets the act of building. This search for beauty implies a relationship between the detail and meaning. Beauty is achieved when thoughtful design is brought into fruition by crafted workmanship.

Further development of the idea of beauty is explored through the notion of geometry and perception. Hermann von Helmholtz is referenced by the phenomenon of 'indirect vision'. This is the theory that through the movement of the eye, in geometric space, will develop relationships between form and material. The details of architecture are like signs that assist in the acquisition of meaning and knowledge through association and comparison by geometric inference.

The detail is the minimal unit in the manipulation of meaning within the art and profession of architecture. This is coupled with the understanding generated by the detail as joint. The joint is the place where the thought and the actuality of building occur. By bringing together the notion of function and representation, the detail becomes the catalyst for design and meaning.
Appendix

Rappel A L'Ordre, The Case for the Tectonic
Kenneth Frampton

In an attempt to retreat from a scenographic state of architectural theory, Kenneth Frampton takes up the torch of the tectonic. 'Cultural degeneration' and 'extreme tenuousness' are reasons that Frampton offers as justification for this retreat. The case for the tectonic that follows is being made to combat what the author sees as a commodity culture, in order to define the necessity and grounds for architecture. The scenographic is presented as 'an end' to the search for significance in architecture. Frampton seems to feel that proclaiming 'an end' or a point of having 'arrived' is in opposition to his proclamation that architecture should be viewed in terms of continuity and infection.

Tectonic form is presented as a part of that continuity, in opposition to spatial intervention. And the essence of this architectural form lies in the structural unit. This interpretation of form is meant in the poetic, 'as in the act of making and revealing'. Ignasi de Sola-Morales Rubio states that, "Architecture...is the practical application of established knowledge through rules of the different levels of intervention." Built form is presented as that which exists rather than that which is absent; "as a 'thing' rather than a 'sign'."

The presence of the tectonic is perceived as it relates to the built form that surrounds it (or is defined by it). Neither Constructivism nor Deconstructivism, tectonic is stylistic. It does not look for its relevance within culture. Gottfried Semper divides the tectonic into two material procedures; the frame and the mass. The frame indicates the spatial field while the mass makes a reference to gravity. "These gravitational opposites, the immateriality of the frame and the materiality of the mass, may be said to symbolize the two cosmological opposites to which they aspire: the sky and the earth."

Semper also discusses the notion that the joint is the 'nexus' or 'primordial tectonic element' by which the rest of the architecture is defined. The notion of culture is, again, revived in that the joint is presented as the place where a culture might differentiate itself from another, in built form. The joint is where the 'spiritual' or 'thingness' of a constructed object is found. Social and spiritual connotations are evoked by the notion of anthropological qualities in tectonic form. Semper discusses four constructs; a hearth, an earthwork, a framework & roof and an enclosing membrane.

Further argument is made for the significance of the joint. Karl Botticher presents the 'appropriate interlocking of constructional elements', in order to define a 'body-form'. Additionally, he makes a distinction between the essential tectonic form and the non-essential. This distinction is made in order to attempt to enrich the tectonic through further emphasis while, de-emphasizing non-essential form. This distinction is made to indicate that the joint is the essential point in the art of building and that it is of irreducible importance.

Structural form cannot be the concern of the tectonic. Marco Frascari states, "The joint, that is the fertile detail, is the place where both construction and the construing of architecture takes place." Within the joint lies the very 'thingness' that defines the architecture of the tectonic. It is the place where the story of man is told. The tectonic joint points to the continuity of time that sees architecture, not as an end, but as a thread within the context of history.
Appendix

From Techne to Tectonics
Demetri Porphyrios

The first half of this writing is entitled FORM AND KNOWLEDGE. In it, Demetri Porphyrios begins to give shape to the Greek word, techne. He discusses the notions of craft making and the fine arts, as it pertains to procedure. The Greeks use the word techne to describe both procedural activities. However, according to Porphyrios, ‘techne refers neither to craft nor to art and it does not have the sense of the technical or of technique’, but instead to a type of knowledge attained through reasoned practice and consistent methodology by deliberate human intervention. This intervention is perceived as being opposed to nature, which acts out of sheer necessity. Techne must follow rational rules, which are related to production, in order to be purposeful.

A discussion of the artifact follows to define purpose. Porphyrios states that an artifact must ‘exhibit a selection of matter and form that is guided by the respective purpose and usefulness’. The intended design use is the artifact’s purpose. Over time, some purposes become obsolete. Occasionally, the form becomes undecipherable, at this point. ‘But as long as the utensil or tool, as the product of a craft, is still useful and is being used then its form, which was the outcome of pure necessity and usefulness in the first place, now becomes a typical form. It becomes a form by which the intended use is recognized’.

For the purposes of my thesis topic, I am beginning to define the notion of the chunk. I see similarities arising from Porphyrios definition of artifact. The question remains, how does the chunk begin to function like a tool in the architecture, either through process or form? How does this function evolve into purpose? [I want to be very careful to separate actual meaning from symbolic meaning and metaphor due to what I see as a potential architectural deception. I am more interested in considering and attempting to present the very thingness of the architecture (or the chunk) as opposed to presenting the architecture (or chunk) as something else.] The exploration of these questions should take a prevalent position in my thesis design method.

The second half of Porphyrios’s writing is entitled NECESSITY AND FREEDOM. In this section, the archaeology of language is further discussed following the origin and development of the Greek word, oekodomoe. Oekodomoe (to build) derives from oekos (house or dwelling) and the root demo (to lie and put together, to construct). Porphyrios states, ‘that the Greek word oekodomoe distinguishes between the act of dwelling and the act of constructing dwelling’. Continuing the study further reveals derivatives from Sanskrit and Indo-European roots that point to a specific method for the building of one’s house by the joining and fitting together of pieces. Instead of proving the vernacular significance, Porphyrios holds that coming to an understanding of the meaning of building and constructing brings us closer to the body of knowledge implied by techne.

The step from techne to tectonike, which describes the knowledge of carpentry. This connection is made in to describe a potential order that is described by the ‘form-giving capacity of the material’. Timber (or any other material, likewise) is suggestive of form. It has dimension and thus invokes a certain scale of use. Additionally, since it is dimensional, it begs the skill and knowledge of jointing. Tectonics then delineates the methodology and experience of construction, in three ways. First, the nature and properties of building materials. Second, the methods for joining materials. Third, the visual form that is created by the craft. Order is derived by the understanding and use of these three items to inform the sense of tectonic experience.
Facing one of Albany's major thoroughfares, the Albany Institute of Art and History is located just one block from the New York State Capitol. A new three-level glass-walled lobby serves as the new entrance and primary thoroughfare for the Institute, linking three landmark structures. Set at a fifteen-degree angle to the orthogonal grid of the existing buildings, the axis of the entrance intersects the axis of the historic museum entrance at a new gate on the public sidewalk.

Existing exterior walls, windows, doors, and decorative detailing have been cleaned, preserved, and retained. In the lobby, existing window openings have been converted to doors to access galleries and other public support spaces. The rearrangement of functions within the existing and new structures provides ideal museum zoning, separating and aggregating public and nonpublic, collections and noncollections spaces. A new storage building, which houses mechanical equipment and provides environmental control in exhibit areas, has replaced an underutilized auditorium at the rear of the site.

Galleries have been thoroughly modernized while preserving historic details. Restoration of daylight in second-floor galleries and installation of controlled artificial lighting has drastically transformed the galleries. Existing first-floor gallery windows have been walled over on the interior to provide much needed gallery wall space. The contrast between the transparent new lobby structure and the elegantly restored existing structures has added excitement to the facility creating a much sought-after open and inviting public space.

Gross square footage: 68,200 sq ft  
Total construction cost: $11.5 million
Appendix

The Charles M. Schulz Museum and Research Center
Santa Rosa, Calif.
C. David Robinson Architects

The design of this small museum devoted to Charles M. Schulz and his Peanuts characters responds not only to its residential context, but to the sense of quiet humor and strong community which is evident in the comic strip. It is specifically designed to present Schulz’s small-scale, original artwork.

From the outset, every design decision has been based on a single question: "Would Sparky (a.k.a., Charles Schulz) be comfortable here?" His Minnesota roots have determined a palette of rich stone and dark wood. The overall structure of the building is intended to have the comfortable ambiance of a residence. The scale is intended to put visitors in the shoes of the small characters who inhabit the Peanuts world. The building’s exterior is a series of walls, or planes, distinguished from each other by color and texture. This planar approach reflects the two-dimensionality of the cartoon strips themselves. The use of black refers to the famous Schulz "line," and the accents of strong color suggest the playful whimsy of his cartoon world.

Internally, the design strives to provide museum staff with a variety of spaces within which to display all kinds and scales of materials. Displays range from Schulz’s original artwork, which is the collection’s heart, to very large-scale pictures derived from the fifty-year legacy of the Peanuts gang. The variety of spatial scale and configuration offers flexibility to an institution whose vision may evolve for years to come.

Gross square footage: 27,364 sq ft  Total construction cost: $11 million
Minnetonka Center for the Arts
Wayzata, Minnesota
James Dayton Design, Ltd.

Part gallery, part studio, and part gathering place for the community, the Minnetonka Center for the Arts (MCA) is not a staid museum, but it has a clear focus: the process of art. An amalgam of playful forms in Wayzata, Minnesota, a western suburb of Minneapolis, the building calls attention to its creative intent.

The MCA, which celebrated its 50th anniversary in 2002, is a nonprofit organization providing affordable courses in the visual arts and crafts, with an annual enrollment of more than 5,000 people ranging from children to senior citizens. For more than 30 years, the MCA was located in what had been an elementary school, and the former gymnasium was the art gallery. After initially considering a $3.9 million renovation of the school, the MCA thought wiser and hired Minneapolis architect James Dayton for a new building, 30 percent larger than the old one, at $5.8 million.

Spaces in the new MCA are clearly differentiated between public uses, studios, and administration. The public component includes a 3,000-square-foot exhibition gallery, a café, and a lecture room, all near the main entrance. The studios, comprising the bulk of the ground floor, are organized along a corridor that is intended as a street through the length of the building. Administrative offices are on the second floor.

Dayton initially proposed a courtyard scheme, but that plan was inefficient and was discarded. Instead, the architect organized the studios so that each has access to daylight and exterior courtyards. Painting and drawing as well as multimedia studios have large amounts of northern exposure, and ceramics and sculpture studios face south, with adjacent space for outdoor work. A concrete art wall in front of the building (previous page, bottom left) is intended for outdoor art installations, and the courtyard in front of the wall is lined with rows of Little Leaf lindens. Minneapolis landscape architect Tom Oslund designed the outdoor spaces.

The gallery, which opened with an exhibition that Dayton curated of Minnesota artists' work, is topped by a square skylight that can be shaded when necessary. Dayton smartly embraced a more industrial aesthetic of materials to complete the building for $157 a square foot. On the inside, floors are poured concrete throughout the ground level, and the steel structure is exposed on the ceiling of most spaces. Cor-Ten steel siding sheaths the gallery cube, both in the corridor and outdoors. Dayton designed most of the tables in the building, as well as the reception desk, using birch veneer plywood.

Gross square footage: 31,433 sq ft
Total construction cost: $5.8 Million
Appendix

Paper Art Museum
Shizuoka, Japan
Shigeru Ban Architects

Shigeru Ban's work can best be understood through his innovative use of existing natural resources as building materials. He first began experimenting with alternative materials in 1986, when he used paper, instead of wood, to build an exhibition display. He was surprised at the strength of the paper and began to experiment with it on building structures. The Paper Art Museum (PAM) A is the private museum of a paper manufacturer. All facades are composed of Fiberglass Reinforced Panels. The square floor plan is divided into three rows, and in the middle is a three-story atrium. By opening stacking shutters and awnings (shitomido), a spatial continuity of the interior and exterior is achieved.

PAM B is a former laboratory and has been renovated as a gallery for contemporary art. By reversing the rails of the overhead sliding doors, when they are opened, they act as a large shading device and create a comfortable shaded patio space. Both buildings use contemporary materials in an effort to recreate spaces for modern life, while maintaining continuity between interior and exterior in very Japanese fashion.

Gross square footage: 18,000 sq ft
ARCHITECTURAL SEGMENTATION: A STUDY OF MANUFACTURING TECHNOLOGY, FABRICATION METHODS AND ARCHITECTURAL DELIGHT

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