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ASSEMBLY & JOINTURE: A Tectonics of Place & Structure in the Mississippi Heartland Delta

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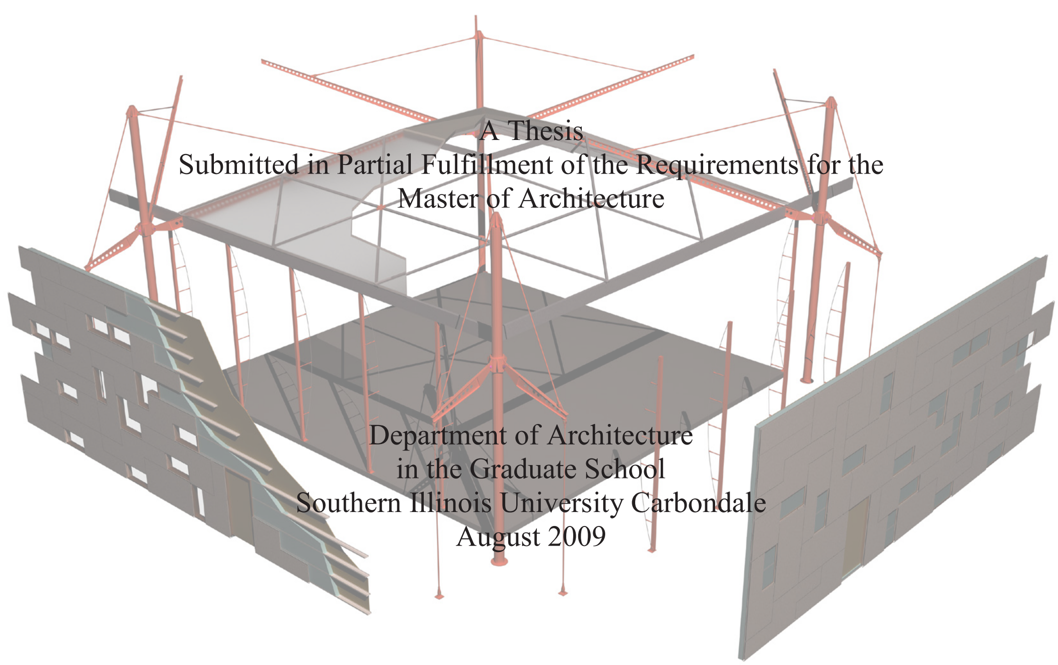
Degrees Earned
B.S. in Architectural Studies, Southern Illinois University, 2008



A Thesis
Submitted in Partial Fulfillment of the Requirements for the
Master of Architecture

Department of Architecture
in the Graduate School
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August 2009

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THESIS APPROVAL

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Approved by:

Dr. Craig Anz, Chair

Stewart Wessel

Peter Smith

Graduate School
Southern Illinois University Carbondale
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AN ABSTRACT OF THE THESIS OF

MATTHEW JOSEPH PICA, for the Master of Architecture degree in Architecture, presented on JULY 1, 2009, at Southern Illinois University at Carbondale.

TITLE: ASSEMBLY & JOINTURE: A TECTONICS OF PLACE & STRUCTURE IN THE MISSISSIPPI HEARTLAND DELTA

MAJOR PROFESSOR: Dr. Craig Anz

The structure can be considered the essence of an architectural solution. However, it is often a forgotten aspect of architecture that isn't always expressed to its highest potential, commonly left hidden within or behind the façade or the interior finishes. The main question was how the two separate fields could be brought together conceptually to create a project that paired out the ideas to build greater conceptual depth and a possible totality of ideas thus forming an architectonic of knowledge. The design and hands-on building aspect of furniture design as well as that of structural building design have both been of great interest. To bring these ideas together, this research and design proposes a place where both could co-exist, a furniture manufacturing facility. Here the ideas of *assembly* & *jointure* became the connective concepts between the two. These ideas can also be extended to connect architecture to its surrounding site context. The landscape as a transitional device can be incorporated to have a significant impact on the development of the building and how it interrelates to its contextual surroundings. Architecture can be thought of here as having a sense of being a larger, scaled piece of furniture that is affixed to the landscape and place where it is located. In essence sense, linking the concepts of both furniture and architecture together, the work this project attempts to maintain both a sense of composite structure and of its significant connection to its place as an esthetical expression.

DEDICATION

This thesis is dedicated to the memory of my brother Nicholas C. Pica (d. 07.13.2006), to my parents, Gerald and Jane Pica, my brothers, Nicholas, David, Michael, Mark and to all my extended family. Thank you for all your positive words of encouragement and support throughout this process.

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CHAPTER 1

INTRODUCTION

When this project was just starting to come to fruition, the areas of focus were primarily structural systems of buildings and its relation to furniture design. Analogously, the structure of furniture can be thought of as carrying similar attributes of the skeletal system of a building, but not purposeful in the same way as the services provided by a building (figures 1.1 and 1.2). The purpose of furniture isn't the same as the services provided by a building. Both the structure of a building and that of a piece of

Figure 1.1. Gerrit Rietveld Berlin Chair [Online Image]. Source: bonluxat.com

Figure 1.2. Gerrit Rietveld Schröder house in Utrecht [Online Image]. Source: flickr.com Photo by JIMWICh.

furniture both fundamentally require series of jointures to create a rigid frame which is used to support a human and associated loads. However, furniture is defined to be a movable object which may support the human body, provide storage, or hold objects on a horizontal surface above the ground. A building accomplishes all the same things by supporting a human body and loads by providing shelter and storage all on a horizontal surface but just at a larger scale. While allowing the structural components to be completely visible, this also requires the joints that hold the structural components together be visible as well. The key objective would be to express each joint between the structural members and possibly create new joint connections that can be used in multiple applications. Once this idea became the focus for the project, the formulation of ideas started to amount.

In order to obtain some better understanding of the functional operations of a furniture factory and the spaces needed, research into furniture manufacturing facilities are presented in the case-study section of this research. Beyond just looking into furniture manufacturers, research into industrial assembly facilities as well as furniture designers and their associated design movements are analyzed in relation to the ideas proposed by this project. Some of these primary architects whose projects became the major influences include the designs of Renzo Piano, Norman Foster, and Richard Rogers, all of whom had worked with each other on projects throughout their careers. These architects all had specific projects which were designed with the use of repetitive structural forms.

The scope and ideal of the project is to focus on how the structure can be celebrated and incorporated, in multiple structural grid formations, to create an adaptable building to any function or spatial arrangement. For instance, the use of a repetitive structural system in varying adaptations can be used to create buildings for industrial, office, or exhibition spaces. Since this project consists of an assemblage of varying functions, the building can test the structural assembly in multiple ways. This project will consist of the design of a furniture manufacturing facility in which there will be an office space and showroom included within the entire scope of the project, each with varying spatial needs within the same structural system. Each individual space is thus created as a result of the particular design of the structural system and the grid to which it has been attributed. Another key aspect of this project is to allow the jointure of the structure to be fully exposed and celebrated throughout the building(s). Thus, this will allow the general observer to gain a sense of understanding of how the building is supported and held together, as well as its spatial layout.

The location scope for the project is to be located within the Mississippi Heartland River Delta Region, which includes Southern Illinois, Southeastern Missouri, and Western Kentucky. At the inception of the project numerous sites were reviewed and analyzed for their advantages and disadvantages. Criteria for analysis include proximity to urban populations, to interstate transport, railway, river edges, and other significant features directly related to regional identity.

The site that indicated much promise and potential was in the Southeastern Missouri county of Cape Girardeau, and specifically in the city of Cape Girardeau. The city of Cape Girardeau has an extraordinary significance to the region. The site is approximately 10 acres in size and is immediately south of the Missouri approach for the Bill Emerson Memorial Bridge, which is the iconic cable-stayed bridge (figure 1.1) with a Santiago Calatrava-esque resemblance that connects Cape Girardeau, MO to East Cape

Figure 1.3. Bill Emerson Memorial Bridge, Cape Girardeau, MO.
Source: http://commons.wiki media.org

Girardeau, IL over the Mississippi River. On the north side of the Missouri approach for the bridge is the recently built Southeast Missouri State University River Campus, which indicates a new interest in building up this area. The bridge does not match the context and nature of the local features. The area around the west approach of the bridge bypasses Cape Girardeau's historic downtown, developing this site with a modern transitional building could connect the bridge and the historic downtown and create a sense of place on the Cape side of the Mississippi River. These positive attributes are immediately viewable from passersby coming over the bridge from Illinois thus allowing for an immediate visual connection and a hopeful peak of interest. In addition, the site has direct access to Missouri highways 34/74 which connects with Interstate 55 that runs from Chicago to New Orleans, providing connection ways for transport. Cape Girardeau has a great regional impact to the Heartland River Delta Region.

Figure 1.4. Project Site limits, Cape Girardeau, MO. Source: ARC GIS Explorer Edited by Author.

CHAPTER 2

IDEOLOGY OF FURNITURE

Furniture is an integral part of buildings and how we as humans inhabit and use the spaces. It can be made to be completely independent from the structure, designed to be dependent on the structure, or it can be designed to fit within the style of the surrounding built form, where if the furnishings were removed from the building it wouldn't make sense to be located anywhere else. Furniture can be used to help make us feel more comfortable within our surroundings, but also allow us to complete certain tasks in a more effective manner. Analogous to architecture, furniture could be thought of as a smaller version of a building or the structure that supports the building all because its primary function is the support of human life in one way or another. However, furniture doesn't exactly support human life in the same way that a building supports human life because a building supports human life by providing an additional attribute as shelter for protection from the elements.

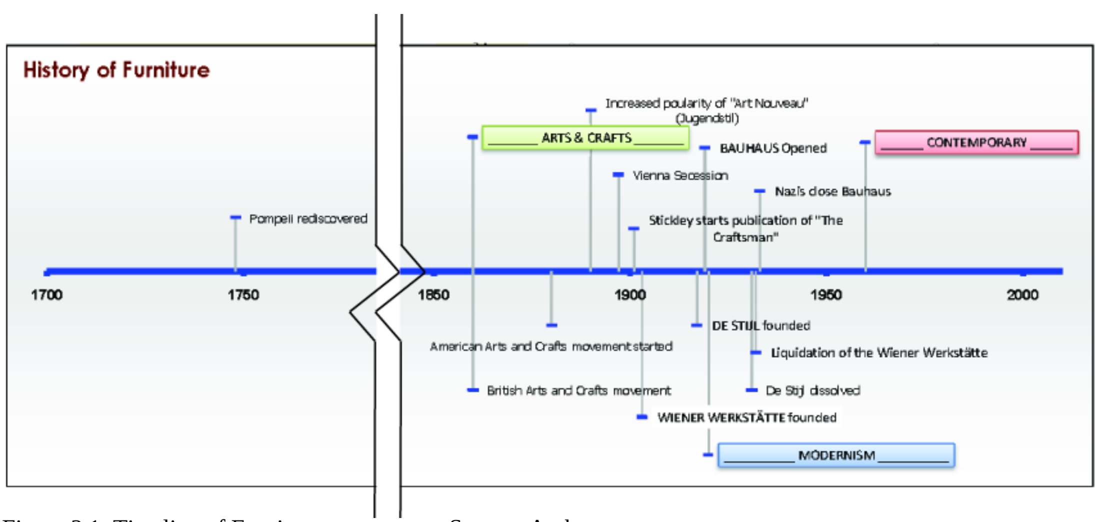

Figure 2.1. Timeline of Furniture movements. Source: Author

Furniture has been around since the Stone Age and later even shown in the form of murals in Pompeii which had been covered in ashes since 79 A.D. from the Mt.

Vesuvius eruption.[1] A lot of furniture in these times had been constructed of stone for it was a readily available material that could be rather easily manipulated. Stone seats, cupboards, shelves, dressers, and beds were some of the examples of the furniture that had been created. Furniture in the Middle Ages was typically created from heavy timbers and had intricate designs carved into its segments. Over time, furniture developed more refined characteristics and styles, especially in specific countries and regions and based on the need and the availability of materials within the region. In early North America, for instance the styles were based primarily on the use of typical woods that had been used were those of cherry and walnut trees, which are trees that produce edible fruit. Another style of furniture that is quite extraordinary is that of Asian furniture which is known for its use of bamboo and unfinished wood covered in lacquers. Figure 2.1 shows a timeline of some of the major design movements, which will be discussed throughout this chapter and chapter three.

Furniture can be thought of as a skeletal system, similar to that of a structural system of a building. In saying this, it can be stated that furniture is analogous to buildings. The four legs of typical chairs and tables can be thought of as the primary structural columns that support the distributed the weight of the user(s) evenly, whereas both the live load and dead load of an architectural solution is distributed amongst the structural columns. A majority of the vertical supports on furniture are constructed of wood or steel as is the same with construction in buildings with the exception of concrete.

Furniture was also a common integral element that some of the more widely known architects had included in specific projects. In some instances the furniture was designed specifically for a project by the architect, while in other cases they would produce furniture to express their archetype of design. Some of these more known architects are Charles Rennie Mackintosh, Frank Lloyd Wright, Mies Van der Rohe, Le Corbusier, and Eero Saarinen. Both Mackintosh and Wright's designs would belong in the arts and crafts movement because they created pieces of furniture which exemplified the emphasis of detail and the workmanship of the craftsman. Though Frank Lloyd Wright's designs still focused on the arts and crafts ideals, his designs became more of a mediator between arts and crafts and modernism with the fact that he embraced modern mass production in his designs. Both Mies van der Rohe and Le Corbusier's architecture and furniture designs belong within the modernism movement because of the expression of simplistic use of materials, its design precision, and modern production. Eero Saarinen designs would be classified as both modern as well as contemporary because it exhibits his belief that furniture should be made of a single material and not consist of multiple parts, to celebrate its form or sculptural qualities.

A few projects that Charles Rennie Mackintosh is most known for is the Hill House, the series of Tea Rooms for Miss Cranston, and the Glasgow School of Art. The Hill House was built for Walter Blackie and was the largest domestic building designed by Mackintosh in 1902.[2] Mackintosh also designed the surrounding landscape for the house, which he had advised the manner of how the trees should be trimmed according to his drawings. Walter Blackie had allowed Mackintosh full control of the project in which he designed built-in-wardrobes, fireplaces, furniture, and even a set of fire tongs and poker both made of pewter. The interior walls were typically painted white and any elaborate decorative detailing was done in silver, pinks, and pale greens. When Mackintosh developed the separate rooms and spaces within the house he kept in mind

Figure 2.2. Mackintosh's Hill house ladder-back chair. Source: bonluxat.com

the individual users and the mood or feeling that each space could create. Through the development of his furnishings he considered the space in which the furniture occupied to be equally as important as the fabric coverings and the wood used in the furniture. For instance the ladder-back chair (figure 2.2) he designed in 1902 was designed to be an installation piece for decoration and not for functional use. It was designed to attract immediate attention upon entering the room in which it was located. The ladder-back chair may be among his most notable furniture pieces, but when examined the chair proved to be an essentially feeble design. The tall back would increase the probability of twisting from occurring and the rather skinny chair legs would be prone to breaking.[3] Mackintosh's more known client was Miss Cranston who owned and operated a series of tea rooms in Glasgow. The tea rooms were buildings that consisted of multiple spaces which would allow a vast range of users, from different economic classes, to be able to meet with friends over some non-alcoholic beverages. He originally designed the high-back chairs for Miss Cranston's tea rooms because when customers were sitting around the tables the backs of the chairs would act as a partition wall increasing the level of privacy for the patrons.[4] The high-back chairs also corresponded to the hats and tall hairstyles worn by the Glasgow women. Mackintosh never planned on his furniture to be viewed as individual pieces, but rather as just a single component that contributed to the space as a whole.[5]

Frank Lloyd Wright's Johnson Wax Headquarters is most recognized by the treelike structural columns (figure 2.3) that are repeated throughout the building. Wright had decided on a rather simple color scheme for the building, the mortar and columns would be cream colored and Cherokee red was used for the furniture, brick, and floors.[6] Wright was known to be an architect who liked to tamper with spaces and the way the

Figure 2.3. The Great Workroom at the Johnson Wax Headquarters. [Online Image] Source: Jeff Dean

observer would feel when moving between open and compressed areas. The design plans for the treelike dendriform columns did not meet the building codes at the time of its construction. In order to prove that the structural column could stand up and hold a set weight a mock column needed to be constructed and tested. Once the column was constructed Wright held a public demonstration to prove that it could hold the required twelve tons of weight. The column actually held over five times the required weight before it collapsed. The building contains a good amount of curved brick walls which imitate the curve of the large diameter of the columns. Wright referred to the large radius atop the column as the “lily pad.” The furniture for the Johnson Wax Headquarters was also designed by Wright. The design of the desks and the chairs (Figure 2.4) emulate the curves of the columns and the curved brick walls. The first chair design he had completed for the headquarters was a chair with three legs. It was brought to his attention after the chairs were made that if someone didn’t sit in the chair with correct posture it would result in the chair becoming unbalanced and cause the user to fall out of the chair. So, Wright designed a modified version of the same chair with four legs (Figure 2.5). The furniture designed for this space was very simplistic in which it wouldn’t take away from the splendor of the entire design but would compliment it. The

Figure 2.4. Original FLW desk and three-legged chair from SC Johnson headquarters in Racine, at the Chicago Institute of Art [Online Image]. Source: Flickr.com, photo by Sean Marshall

Figure 2.5. Three Tiered Secretarial Chair (Four Legs), 1936-39 [Online Image]. Source: ditext.com/chairs/

way that Wright incorporates natural light into the great workroom, it allows the observer or user to feel like they are not in an enclosed space but rather a forest, made of concrete trees, by allowing light to come through the canopy of “lily pads” and from the windows in the surrounding walls.

One of Ludwig Mies van der Rohe’s more famous buildings that he designed was the German pavilion at the 1929 international exposition in Barcelona, otherwise known as the Barcelona pavilion. The materials used to build the pavilion consisted of steel columns, four types of marble, and glass. The chrome clad steel columns supported the flat roof. It is the combination of the columns and the roof that probably became the inspiration for the chair design. The chair and ottoman (Figure 2.6) are each constructed from a solid piece of chrome clad steel and leather cushion. The Barcelona chair's simple yet rather elegant design has become one of the primary images that represent modernism. The pavilion design, analogous to that of the chair, was quite simplistic as well. Some of the major influences that Mies used and expanded from, for his designs, were those of Frank Lloyd Wright and the De Stijl movement. These influences can be clearly seen throughout much of Mies' architecture. The use of planes and rectilinear

Figure 2.6. Barcelona Chair and Ottoman [Online Image]. Source: retro-housewife.com.

Figure 2.7. Barcelona Pavilion [Online Image]. Source: Pepo Segura.

forms were used throughout the design of the Barcelona pavilion (Figure 2.7). Mies designed the pavilion to be a space which the visitor must experience in order to move onto the next exhibit. The walls were placed in a manner that directed pedestrian traffic through the structure, though the interior glass and marble walls could be rearranged for they were not structural walls, but non-weight bearing walls. Mies also shared the same ideal of Adolf Loos in leaving ornamentation off eloquent materials. The materials that were used in the pavilion, besides the glass and steel, were rather extrinsic marbles. These marbles were golden onyx from the Atlas Mountains, ancient green marble from Greece, Roman travertine, and green Alpine marble.[7] Mies was quoted in saying, "less is more," and this is clearly visible when an observer sees and enters the pavilion. Besides the furniture that Mies designed for the space, the only other installation that he included is Georg Kolbe's sculpture Alba. With the inclusion of the Barcelona chairs it allowed the visitors to sit down and gain a better sense of the surroundings and the elegance of the built environment that Mies created. Mies was able to create a smooth flow for pedestrian movement between the outdoor space and the indoor space.

Le Corbusier created the Modulor, which is based on the measurement of the human body as well as the golden ratio and Fibonacci numbers. It was in using the Modulor system that he strived to better the function, image, and scale of the architecture produced.[8] Corbusier used the proportions of the "Vitruvian Man" by da Vinci and

Figure 2.8. Fauteuil grand confort. [Online Image] Source: http://www.steelform.com/corbusier_lc2_chair.html

Figure 2.9. Chaise Longue. [Online Image] Source: stylehive.com

exaggerated them greatly to create his Modulor man which he had segmented the body by using the golden section. Mies had typically used pre-manufactured furniture to furnish his projects. It wasn't until he approached Charlotte Perriand to join his studio in 1928 that he started exploring the idea of designing furniture. He outlined three types of furniture in a book he wrote back in 1925. These types are: type-needs, type-furniture, and human-limb objects. Le Corbusier, in collaboration with Perriand, designed a few pieces of furniture specifically for two of his projects. The two projects for which Le Corbusier specifically had designed furniture for were a pavilion for the Barbara and Henry Church and the Maison la Roche – Jeanneret.[9] The chairs he designed were analogous to those that Mies had created, in the fact that they shared the same minimalist design aspect of clarity and simplicity of the form. The primary materials used for construction is the tubular steel frame and the leather cushions. Two of the more known pieces of furniture are the grand confort (Figure 2.8) and the chaise longue (Figure 2.9).

Eero Saarinen is renowned for quite a number of designs. The Gateway Arch, the TWA flight center, and the tulip chair are a few of the more known designs. Eero Saarinen had grown up under the teachings of the Cranbrook Academy being it is where his father Eliel was teaching. Eero's father, Eliel, came out of the arts and crafts movement and became known for his art nouveau style buildings. Eero had collaborated with Charles Eames for his first chair design, which was for the "Organic Design in Home Furnishings" competition in 1940.[10] The chair design that they designed was the

Figure 2.10. Organic Chair by Saarinen and Eames. [Online Image] Source: accurato.us

Figure 2.11. Tulip chairs. [Online Image] Source: knoll.com

"Organic Chair," (Figure 2.10) and it was this design that won first prize. Another chair that the two collaborated on was the quite notable "Tulip Chair" (Figure 2.11). It was the same "Tulip Chair" that was used in the television series, Star Trek. The Knoll furniture company produced the "Tulip Chair" along with all of the other chairs that Saarinen had designed. It was through his friendship with Florence Schust Knoll and the Eameses that helped in the design and production of the furniture designs. All of the furniture that he designed and collaborated on consisted of organic shapes and the materials used in the designs were plastics and plywood laminates, which at the time were breakthrough materials. His furniture designs have often been referred to as futuristic for the use of sweeping curves and the utilization of non-traditional materials. Some of his more recognized architecture was similar to the design of the furniture he produced in the sense that it was cutting-edge in its creativity and the use of materials. A few of Saarinen's projects that have become icons within modernism/contemporary architecture involved the use of catenary curves or concrete shells as a source for its structural design.[11] The first project he had worked on was with his father, in 1956, for the General Motors Technical Center in Michigan, and the primary building materials were steel and glass. It was done in a manner that resembled the iconic style of buildings that Mies van der Rohe had designed. After the completion of the GM building, other major American corporations approached Saarinen and asked him to design their new main office. These corporations were CBS, IBM, and John Deere. The IBM Rochester building was completed in 1958 and the IBM Thomas J Watson Research Center was completed in 1961. The CBS "Black Rock," Dulles International Airport, and John Deere World Headquarters were completed after Saarinen's death in 1961, and are thought to be some of his most exceptional designs.[12] A majority of these corporations head offices were box-like in structural form, but in the interiors Saarinen would include both his pedestal furniture and exciting sweeping staircases, which were designed to be ornamental elements showing off their large-scaled technological features.[13]

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[1] Wikipedia contributors, "Furniture," *Wikipedia, The Free Encyclopedia,* http://en.wikipedia.org/w/index.php?title=Furniture&oldid=298737289 (accessed June 26, 2009).

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[2] Jackie Cooper, *Mackintosh Architecture* (New York: St. Martin's Press, 1984), 40.

[3] Peter Trowles, *Charles Rennie Mackintosh CHAIRS – The artist and his life* (Alesund, Jugendstilsenteret, 2003), 37.

[4] Ibid

[5] Ibid, 31.

[6] Milwaukeestock.com, "S.C. Johnson Wax," http://cpd.typepad.com/milwaukeestock/2009/05/sc-johnson-wax.html (accessed June 25, 2009).

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[8] Wikipedia contributors, "Modulor," *Wikipedia, The Free Encyclopedia,* http://en.wikipedia.org/w/index.php?title=Modulor&oldid=300952635 (accessed June 16, 2009).

[9] Wikipedia contributors, "Le Corbusier," *Wikipedia, The Free Encyclopedia,* http://en.wikipedia.org/w/index.php?title=Le_Corbusier&oldid=303209616 (accessed June 16, 2009).

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[11] Wikipedia contributors, "Eero Saarinen," *Wikipedia, The Free Encyclopedia,* http://en.wikipedia.org/w/index.php?title=Eero_Saarinen&oldid=301621072 (accessed July 12, 2009).

[12] Edward R. Ford, The Details of Modern Architecture Volume 2: 1928 to 1988 (Cambridge, Massachusetts: The MIT Press, 2003), 299.

[13] Edward R. Ford, The Details of Modern Architecture Volume 2: 1928 to 1988 (Cambridge, Massachusetts: The MIT Press, 2003), 271.

CHAPTER 3

CASE AND PRECEDENT STUDIES

The areas of furniture styles and their respective companies or designers as well as the industrial assembly facilities were researched as case and precedent studies for this project. For furniture manufacturers and designers, trademark products and styles, year (style/company) founded and modernist versus post-modernist styles was analyzed in relation to the proposed thesis project. The case studies on the industrial facilities and/or what are considered structural expressionist focus more on specific buildings that have the structural system exposed or buildings that are constructed with repetitive forms in like fashion to modern assembly methods.

FURNITURE & THEIR DESIGNERS

Three main categories of furniture styles that were researched as precedent studies were the arts & crafts, modern, and contemporary. There are distinct features that separate certain styles from each other. As a starting point, the arts and crafts movement happened towards the middle of the nineteenth century and through to the beginning of the twentieth century. This was a movement focused on the artist or craftsman and handiwork. Another reason for why the arts and crafts movement came about was in reaction to industrialization and mass production. The movement wanted to venture away from the idea of the division of labor which helped make mass production of materials so successful. The idea promoted the master craftsman as a key aspect into the furniture making process, but also bringing craft to the masses in repeatable ways. This allowed the craftsman to actually complete all steps of creating all parts for one piece of furniture as well as having the privilege of being able to assemble all the parts and finishing or varnishing the final product. The use of apprentices was helpful to the master craftsman by allowing them to assist with projects and thusly decreasing the amount of time that the master craftsman would have to dedicate to one project. Some primary examples of designers and groups who followed the arts and crafts movement were Gustav Stickley, Frank Lloyd Wright, Wiener Werkstätte, Bauhaus, and De Stijl.

Gustav Stickley was not the founder of the arts and crafts movement but he did become one of the more widely known Americans within the movement. The American Arts and Craftsman movement originated from the British movement which has been dated back to the 1860s and was in rebellion to the Industrial Revolution. He became quite popular in a short amount of time and that is why it is hard to not associate him with the arts and crafts movement. Gustav's younger brothers Leopold and John George founded L. and J.G. Stickley, Inc. in 1900 and was brought back from an almost certain demise by the Audi family in 1974. Stickley had founded *The Craftsman* magazine in which he had shared the ideals concerns of the movement as well as the development of his home in New Jersey. Stickley also had established a Craftsman Home Builders Club which he used to relay his ideas about residential organic architecture.[1] It was these ideas of organic architecture which had a great impact on designers such as Frank Lloyd Wright, starting also in the arts and crafts traditions.

Frank Lloyd Wright has the title of "The greatest American architect" associated with his name. The Prairie style house and the Usonian house are two of the most know design styles that he adopted and made his own. Wright approached the Prairies style house with long commanding horizontal lines and that the structure would appear to arise from the ground. While the design of the Usonian house was a rather smaller style house which he would not include an abundance of storage space or a garage, but rather would include a carport. Though another design aspect that he used in a majority of his projects was the ideals of organic architecture, from which he built off the guidelines that Stickley had followed. When he would design a project Wright would primarily use materials that would be located within the context of where the project was located. One of the characteristics that he commonly used in a majority of his designs was the open floor plan with very few walls to separate spaces. It was in the open floor plans that he also included the central fireplace, which became one of the primary pinnacle design trademarks of Wright's style. Wright would not just design the house, but would go as far as to design the interior furnishings, the windows, and even the light fixtures for a number of his houses. As stated by Herbert V. Kohler, Jr., "Frank Lloyd Wright believed that it was the nature of the human being to love and desire beauty and to live in it." In this statement it explains why Wright had spent so much time in designing much more than just the building alone, but also the furnishing for the interior spaces.

The Wiener Werkstätte, also known as the Vienna Workshop, was a community comprised of architects, designers, and artists that was established in 1903. It derived from the Vienna Secession which had been founded in 1897 by a vanguard collaboration of artists and designers.[14] The creation of art for the everyday person to be able to purchase, was the primary obligation of the community. The group also had the focus to create better environments for their craftsmen, within the community, to work as well as the idea of recreating all usable and decorative objects they would encounter. The members of Wiener Werkstätte were intent on the focus of craftsmanship and they had a motto that they followed, "Better to work 10 days on one product than to manufacture 10 products in one day."[15] One of the most important architectural works that Wiener Werkstätte and specifically architect Josef Hoffmann were commissioned to build was the Sanatorium Purkersdorf. The Sanatorium was constructed in 1904 and has an architectural style of Viennese Jugendstil and was one of the few buildings which helped lead the way for modern architecture.[16] This building shared many commonalities with the buildings constructed within the modernism movement because of the minimal decoration on the exterior of the building thus allowing for more decoration on the interior.

De Stijl was a Dutch artistic movement that was founded in 1917 and was also journal that Theo van Doesburg had published.[17] De Stijl is Dutch for “The Style” and a majority of the works completed by the movement’s contributors is considered as being neoplasticism. Neoplasticism is defined as being an emphasis on the expressed configuration of a work of art, and limitation of spatial or linear relations to vertical and horizontal movements as well as restriction of the artist's palette to black, white, and the primary colors.[18] In the three-dimensional designs that follow the guidelines of de stijl every component, linear and planar, do not intertwine and can be seen as being separate autonomous objects. Perfect examples of this design principle would be the works of Gerrit Rietveld. Rietveld designed a series of furniture pieces such as the Red and Blue chair and the Schroder table as well as the Schröder House. In the early 1920s the De Stijl group’s primary founder, Theo van Doesburg, had began an association with Bauhaus thusly forming a rift between a few of the groups primary members. After van Doesburg’s death the De Stijl group dissolved. A few of the members from the group still continued to design along the De Stijl principles while others did not. Some modernist architects, such as Mies van der Rohe and J.J.P. Oud found the De Stijl principles to be influential.

Bauhaus is the name which often refers to the school in Germany, founded by Walter Gropius in 1919, which integrated crafts and fine arts and was known for their design process.[19] Throughout its fourteen year existence there had only been a total of three different directors, of which all were also architects. Bauhaus could almost be referred to as a transition school because it started when the arts and crafts movement was occurring, yet a majority of the teaching focused more towards the modernism movement and the reduction of building ornamentation. The primary design ideal of Bauhaus was very similar to that of the Wiener Werkstätte, which would be the creation of a single design style which incorporated all fields of art and architecture. The Bauhaus school embraced modernism and the idea of mass production. In 1923 Walter Gropius had stated, "we want an architecture adapted to our world of machines, radios and fast cars."[20] He felt that the architecture style needed to change and not keep spitting out buildings that resembled the styles from the arts and crafts movements and the 19th century, but to create new architectural solutions that conform to the advances of technology. Under Mies van der Rohe, the third director, Bauhaus began to focus more on becoming a technical school of architecture. In 1933 the Nazi's urged Bauhaus to disband.[21] Other well known contributors to the Bauhaus school were Hannes Meyer, the second director, Wassily Kandinsky, and Marcel Breuer.

The movement of modernism, on the other hand, in design and architecture was one in which believed that the older styles of buildings were obsolete with the finding of newer technologies. Modernism came about towards the end of the nineteenth century and continued to gain popularity into the early part of the twentieth century. One of the main design techniques that are used in this movement is the use of simple and apparent forms. Modernism also rejected the traditional sense of construction and design. It also took the idea of ornamentation out of the design and brought in the idea of bringing art, furniture, architecture, and other utilitarian objects to the masses (middle and lower classes), but also raised it to the status of modern art, very similar to the principles of Wiener Werkstätte and De Stijl. Modernism allowed those who were not rich to be able to live in a way which made it seem as if they had money and could live in style. Arts and crafts were still apparent throughout the modernism movement but primarily to those that were wealthy and could afford the original works of art. Charles and Ray Eames, Gerrit Rietveld, Mies van der Rohe, and Le Corbusier were some of the primary architect/furniture designers of modernism.

Gerrit Rietveld is one architect who can be clearly associated with the De Stijl group as well as modernism for his clarity of shapes throughout his designs. Rietveld is most recognized for his furniture designs and the Schroeder House. Some of the most recognized pieces of furniture he designed are the Red and Blue chair, the Schroeder table, the “Zig-Zag” chair, the Steltman chair, and the Berlin chair. Rietveld interpreted Piet Mondrian’s paintings and converted them into designs for buildings and furniture designs to express the bond between lines, mass, and space.[22] Another idea that he put into practice when designing furniture was letting the function of the piece influence the final appearance of the composition. The design of the Schröder House was designed to be a machine for living in, by creating the house in a manner which requires the occupant(s) to complete an operation, such as sliding a wall, in order to gain privacy or alter the size of the space.[23] The house was designed to accommodate the users as well as adapt to the specific needs.

Charles & Ray Eames are two of the more known architects/furniture designers within the modernism movement. Charles and Ray Eames are known primarily for the furniture they designed as well as their own house which now carries their name. The Eames House was built as part of the Case Study House program for the Arts & Architecture magazine published by John Entenza.[24] The house was designed from pre-manufactured structural steel parts in a fabricators catalog and was devised to able to assemble it by hand within a few days time. The color scheme for the Eames house uses the colors that the De Stijl principles had set in place. Charles had teamed up with Eero Saarinen for a furniture competition in 1940 in which they had won for their design of a molded plywood chair. The multiple collaborations of furniture that the Eames and Saarinen designed helped revolutionize furniture design for decades to come with their experimentation with different materials.

Mies van der Rohe was one of the major proponents of the modernist architecture. Both his architecture and furniture designs exemplified the principles of design for modernism. His architectural solutions would express every material used in the construction of the building, thus articulating the minimalism of materials. This design style would relate to his belief of "less is more." Mies would refer to his building designs as a "skin and bones" architecture.[25] A few of his more known buildings are the Barcelona Pavilion, the Farnsworth House, the Seagram building, and Crown Hall. Mies was a strong supporter of the De Stijl principles and this can be seen in the rectilinear and planar forms he would use in his buildings. Besides the steel and glass building designs

Mies also designed some furniture. The Barcelona chair is his most known furniture design partly because of the sleek steel frame which helps the cushions acquire the appearance of floating or weightlessness. His furniture designs are primary examples of modernism with the integration of manufactured technologies such as the steel frames and his use of glass and leather cushions.

The works of Le Corbusier were all based off his Modulor system which was based off the golden ratio. The Villa Savoye is a great example of Le Corbusier's "five points of a new architecture," which he conceived in 1927.[26] When he would design his buildings, Le Corbusier would commonly use pre-made furniture to furnish the spaces. Le Corbusier experimented with the design of furniture for two of his projects, the Maison la Roche and a pavilion used for the Barbara and Henry Church. The series of chairs that he created, in collaboration with Charlotte Perriand, have become icons of modernism. One of his major influences was the problems with overcrowding, dirtiness, and the lack of an honorable landscape.[27]

The contemporary times, from around the 1960s and 70s forward, partially fueled by postmodern thinking, came a movement of a new pluralistic approach to design - a hybrid of arts & crafts, modernism, and neoclassicism, but with a twist in which one can pick and choose what they would like. In these contemporary times it is just like looking for a specific item through an internet search market and the search result would be an eclectic mail-order catalog of design styles. Another way of thinking about it would be as if someone were to go up to a slot machine and put in the correct change, pull a lever, and then could walk away with the design which would look like it was pulled out of a melting pot that combined the multiple styles. Examples of companies that produce furniture which can be classified as contemporary designers are Vitra, Herman Miller, Knoll, Allsteel, Steelcase, Paoli, Haworth, and Gunlocke. A few of these companies replicate mass productions of furniture that was created by the more famous designers and architects. The rest of the companies mass produce creations that mix and match styles and current trends.

ARCHITECTURAL PRECEDENT STUDIES

Some of the current practicing architects, of whose designs were the most influential and expressed similar aspirations were: Renzo Piano, Richard Rogers, Norman Foster, Nicholas Grimshaw, and Santiago Calatrava. These architects have approached the design of buildings in a similar way that furniture designers, makers, and manufacturers approach furniture. They find key portions or components that can be repeated and expressed throughout the structure.

CENTRE GEORGES POMPIDOU

Figure 3.1. The Centre Georges Pompidou [Online Image]. Source: visitingdc.com

The Pompidou Center in Paris, France set an unprecedented new level of design for museums all around the world. This design of the Pompidou Center (figure 3.1) was awarded to the architectural team of Renzo Piano and Richard Rogers as a result of a design competition that ended in 1971.[28] The center is named after the French President, Georges Pompidou, who served in office from 1969 to 1974. The style of the building is high-tech or structural expressionism, which typically exposes the steel structure throughout the interior and exterior of the building. One of the primary motives for moving the mechanical and conveying systems to the outside of the building was to increase the space on the inside which would have been occupied by the systems. The Pompidou Center was selected to be a primary case study for this project because of its effective use of steel to span great distances and for its clear expression of jointure between the steel components. The Pompidou is anchored to the ground with fourteen pairs of columns that span a distance of 48 meters (157.5 ft.). The use of columns as the primary vertical structural component the building has the appearance as if it was just lightly joined the ground. The entire structure of the Pompidou is constructed of pre-manufactured and cast steel components which can be clearly seen from any location in and around the museum. With the exposure of the structural components the visitor can gain a better insight on how the structural members connect. The modular design that was employed in the Pompidou Center offered open immense spaces, with technical conduits visibly layered outside the building or in exposed roof ducts, even in galleries intended for the display of significant works of modern art.[29] The ducts are color-coded according to their function for the building: blue for air; green for fluids; yellow for electricity cables; and red for movement and flow (elevators) and safety (fire extinguishers).[30] The arrival experience for the Pompidou Center is done in a particular fashion to allow the visitor the chance to experience the exterior of the building before getting to the interior spaces, where in a typical building the visitor passes through the entrance and would not think once about the exterior of the building or the process in how it was assembled.

INMOS MICROPROCESSOR

Figure 3.2. Exterior view of Inmos Microprocessor Factory [Online Image]. Source: richardrogers.co.uk/

The Inmos Microprocessor Factory (figure 3.2) designed by Richard Rogers in Newport, Wales. The floor area of this office and production facility is 8,900 square meters. There were a few significant requirements that were attached to the project when commissioned to be built. The overall design of this project had a requirement that it had to be adaptable to any site and on top of that it had a hastened process for design and fabrication of the building.[31] The building was primarily a slab on grade design, but the structural system consisted of tubular steel that was supported by a tensioning system off the central spine of the building. This allowed the interior spaces to be free of columns and created more space for needed functions. The slab on grade is the primary source for the appearance of how the building is joined to the site, while the structural steel frame appears to be the reinforcement for anchoring the building to the site. The Inmos facility clearly expresses the structure on the exterior of the building and makes sure the visitor can see the structure by painting it blue. It is also rather apparent the use of the tension cables is to help alleviate the load on the structural supports on either side of the building. The main entrance to the facility is the on either end of the primary circulation and service core. The Inmos Microprocessor factory was designed in a manner to allow for expansion along the main circulation core in 13 x 36 meter bays (42.6 x 118 feet).[32] Natural light is integrated into the design of the building, though opaque/solid panel walls are used specifically in production areas instead of exterior glazing.

RENAULT DISTRIBUTION CENTRE (SPECTRUM BUILDING)

Figure 3.3. Renault Distribution Centre. Source: archiweb.cz/, photo by Jan Kratochvil.

The Renault Distribution Centre (Spectrum Building) in Swindon, UK was designed for the UK division of Renault. The structural bay system was designed to accommodate the need of the multiple arrangements of the storage systems as well as the fork-lift movements between the storage units, thus the bay size is 24 x 24 meter (78.75 x 78.75 feet).[33] The Renault Centre (figure 3.3), as it was formally known, attains the sense of jointure to the ground with the concrete slab as well as the columns and tension rods. The structural system of the building is quite simple for the bay system was designed as a repetitive form thus simplifying the layout of the facility. The paint scheme on the structure was chosen as yellow for it was the color that was associated with Renault vehicles. The image that was brought by the design team for the first meeting with the structural engineers, Ove Arup and Partners, as an example of a structural column was Frank Lloyd Wright's Johnson Wax columns.

THE BRITISH PAVILION

Figure 3.4. The British Pavilion, Seville, Spain.
Source: grimshaw-architects.com.

The British Pavilion (figure 3.4) was designed by Nicholas Grimshaw for the 1992 Expo in Spain. The pavilion was designed as a temporary architectural solution for an exhibit that would represent the character of modern Britain.[34] Modern materials such as glass, steel, and plastic were utilized in a manner which expressed the ideals and execution of industrial production.[35] The building is connected to the site via the concrete foundations and the ground level floor slab. The structure of the pavilion is constructed of steel tubes which were designed to be erected strictly with the use of pin joints. It was with the design of these components that exhibited the use of the kit of parts approach for the pavilion. The structure is primarily on the exterior of the building thus allowing the construction methods to be clearly articulated. During the pavilions existence the visitors, when passing by or approaching, would be able to observe the water wall which was located on the East wall of the structure and would allow for a multitude of reflections and continually changing patterns.[36] The water wall served multiple purposes for the pavilion such as a changing art piece, reduces the temperature of the glass wall which the water moves along, and the water evaporates allowing the adjacent environment to cool down. The incorporation of natural light is achieved through the North and South walls which are constructed of steel masts that are curved and have translucent PVC coated fabric spanning between them.[37]

STADELHOFEN STATION

Figure 3.5. Stadelhofen Station, Zürich, Switzerland.
Source: Wikipedia.org Photo by Cacetudo

The reconstruction of the Stadelhofen train station (figure 3.5) in Zürich, Switzerland was designed by Santiago Calatrava in 1990. Calatrava was careful in the redevelopment of the station by responding to the terrain that surrounded the railway. In doing this he created a multiple layer platform which was created by excavating the hillside behind it and after completion of the hillside excavation Calatrava restored the walkway which was located on top of the hillside.[38] The upper level platform, on the hillside portion of the tracks, was formed from concrete that is supported by steel pylons with struts in three directions.[39] The large steel pylons, spaced 9 meters (29.5 feet) apart, are anchored in the concrete thus showing the strong connection between the steel and concrete. The side of the tracks, opposite the hillside, is located towards the downtown of Zürich. The platform awning for this side is a freestanding structure with a cantilevered overhang, comprised of steel and glass, which is attached by a pipe that follows the curve of the tracks and is supported by a series of columns spaced 12 meters (40 feet) apart.[40] All of the steel components for the station are custom designed and cut pieces thus allowing for a more organic and interesting form that is clearly exposed through the expanse of the station. Natural light is incorporated into the lower level of the station, beneath the tracks, through openings that are shaped like upside down teardrops via the use of glass blocks located in the platform floors.

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[1] A dwelling should be erected in a harmonious fashion with the surrounding landscape, and use materials that are from the surrounding region; The floor plan of the dwelling should be more open and allow for more reciprocal dialogue between participants and surroundings; The structure surroundings should allow for more incorporated furniture rather than those designed by outside sources; Minimize artificial light and integrate more natural light into the spaces through the use of more windows. Wikipedia contributors, "Gustav Stickley," *Wikipedia, The Free Encyclopedia,* http://en.wikipedia.org/w/index.php?title=Gustav_Stickley&oldid=296302540 (accessed June 14, 2009).

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CHAPTER 4

DEVELOPMENT OF BUILDING AND ITS COMPONENTS

To begin the development of the structural components, a methodology toward the components must first be developed. The approach chosen was the process of creating a basic 'kit of parts' design. This 'kit of parts' design approach focuses around specific objects or building components and then refines these components into repeatable forms which allow them to be slightly manipulated and rearranged to create separate instances. Then using these separate instances together, one can create multiple building types, varieties, yet each still sharing a majority of the same building components.

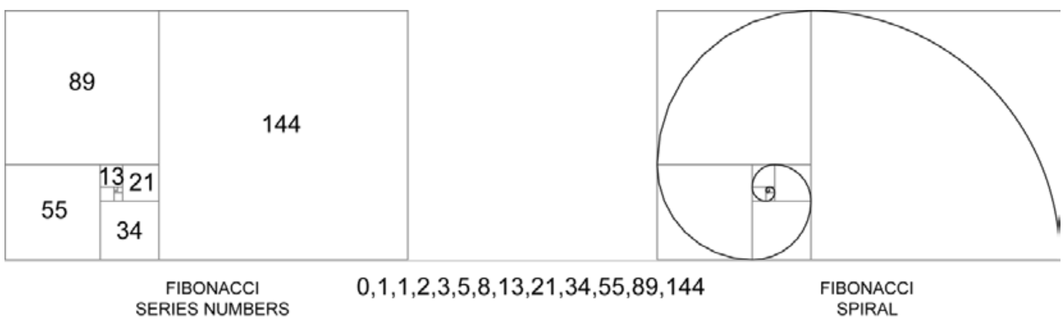


Figure 4.1. Fibonacci Series and Fibonacci Spiral. Source: Author.

After the selection of the design approach, another parameter needed to be set before further development of the 'kit of parts'. This parameter was that of sizes or proportions and of course the quantity of each member. Throughout the research of proportion systems, to be implemented for this project, one of the methods that were reviewed was that of the Fibonacci series (figure 4.1). The Fibonacci series was actually part of one of the first projects taught in undergraduate studio courses. This project actually reaches back to information from one of the primary lessons taught when one is first entering into the architecture curriculum. The Fibonacci series is very closely related to that of the golden ratio and both can be found reoccurring throughout nature. So in basing the structural components and the grid spacing all on the Fibonacci series, it can be said that the proportions are coming straight from nature. Fibonacci numbers that will be used throughout the project will be 8, 13, 21, 34, and 55.

The structural bay system design for the factory and office space goes along that of a stepped rectilinear pattern. The grid spacing is fifty-five feet apart in both the North-South and East-West directions. The fifty-five foot spacing allows for more open space for workspace as well as storage systems and circulation of products. The horizontal members that create the structural support for the roof will be attached twenty-one feet off the ground level. A mezzanine level for office space will be located thirteen feet off the ground level.

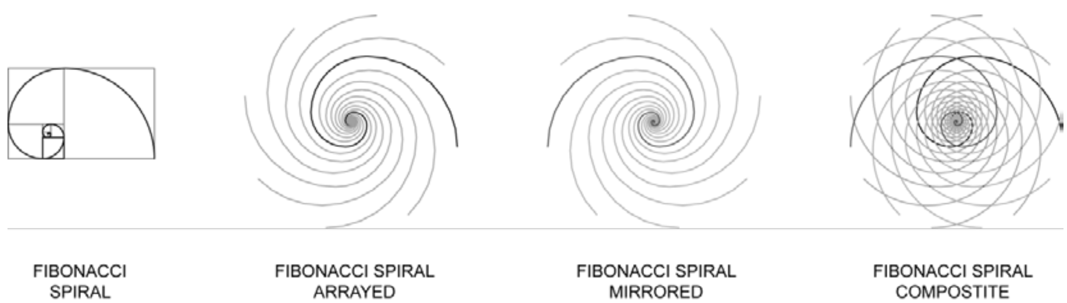


Figure 4.2. Formal operations of manipulating the Fibonacci Spiral. Source: Author.

The Structural system of the showroom facility has more of an irregular radial structural grid system. The structural grid is created from a series of two formal operations as seen in figure 4.2. The grid is formed from the Fibonacci spiral which has been arrayed eight times in the clockwise direction from the center of the spiral origin. Once the array has been completed the arrayed Fibonacci spirals are mirrored from the center point to create multiple intersection points which will be where columns will be erected. The structural system of the mezzanine floor, in the showroom, shares the same grid pattern as that of grid for the columns. The relationship between the showroom and factory/office spaces is displayed in the facilities structural grid (figure 4.3).

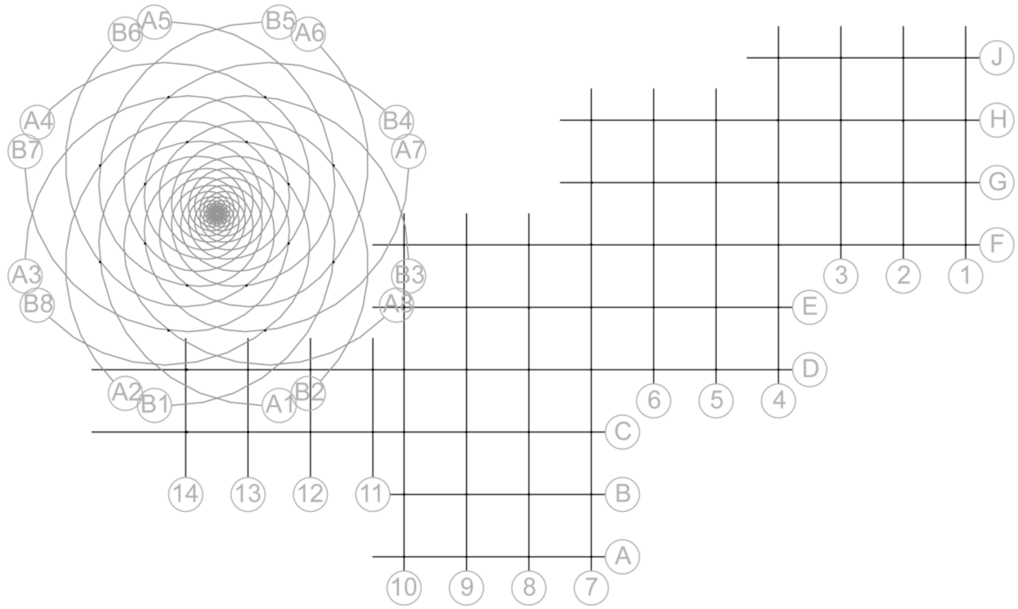


Figure 4.3. Structural grid for furniture manufacturing facility. Source: Author

The first component that was chosen and developed was that of the vertical structural members. A steel pipe column was selected for the columns. This allowed for an ease of how the column was orientated for steel erection because it wouldn't have to be rotated towards a specific direction. The columns height, in order to fall into accordance with the selected proportional system, is thirty-four feet tall.

The second component that was selected for the repeatable structural member was the tapered cellular beam. This type of beam was selected for multiple reasons and all are justifiable. A cellular beam was selected instead of a regular W-shaped beam because these beams are created for spanning longer distances. Another reason for the selection of the cellular beam is because it manufacturing process (figure 4.4) makes it a stronger beam and results in making it able to hold more weight. In addition, the cellular beam, because of its sleek and uniform shape is more aesthetically pleasing than the W-shapes.

A final reason on why the cellular beam was selected instead of a regular W-shaped beam is for the fact that it has a better eye appeal in an architectural sense.

The selection of a tapered beam for this project was for the purpose of lightening the load to span larger distances. Tapered beams are generally selected for use in

Figure 4.4. Manufacturing Process of Cellular Beams. Source: westok.co.uk.

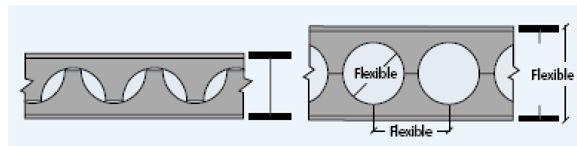


Figure 4.5. Side Elevation of a Cellular Beam from original size to finished manufactured size. Source: westok.co.uk.

stadiums and other long-span structures where it calls for a cantilevered roof or awning. The primary reason on why tapered beams are used for stadium roofs is because as the beam tapers it doesn't weigh as much as the bulkier end of the beam. So, all the weight of the beam is anchored at the bulkier ends to a vertical column or rigid frame. There are two different sized tapered cellular beams that will be in use for this project.

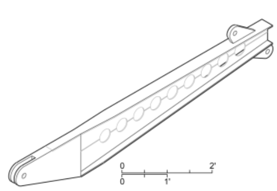


Figure 4.6. Eight foot Tapered Cellular Beam. Source: Author

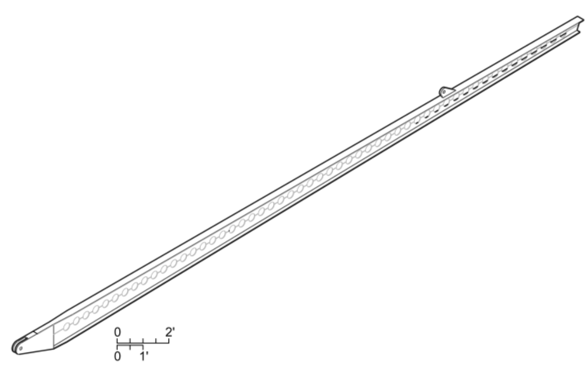


Figure 4.7. Thirty foot Tapered Cellular Beam design for the project. Source: Author.

CHAPTER 5

JOINING OF COMPONENTS

Once the structural components have been determined and designed, the next issue is how the components will be joined together. The structural joints are the most important part of the skeletal system of a building. The joints are the parts of the building that are always looked at when the structural integrity is in question. When creating a repeatable structural joint, every instance where the jointure will occur and its proper orientation needs to be known. The method of jointure is also a factor that needs to be decided on. For steel, there are two connection possibilities, welded and/or bolted or pinned.

For this structural system there is actually a combination of welded and bolted connections. The main structural joint which attaches the tapered beams to the columns will be a cast steel column sleeve with six triangular steel plates welded onto the sleeve (figure 5.1). All of the tapered cellular beams will be attached to the column sleeve with the use of the bolted connections to the triangular steel plates. The manufactured column sleeve will be welded to the pipe column. In addition, tension rods will be incorporated to further brace the tapered cellular beams to the column. The tension rods will be anchored to the column with the assistance of the component that will be welded to the

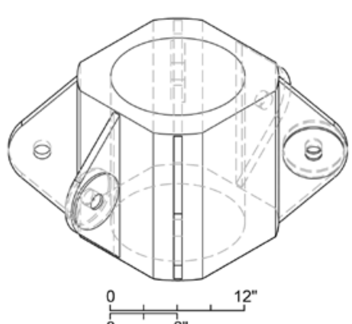


Figure 5.1. Column sleeve connection. Source: Author.

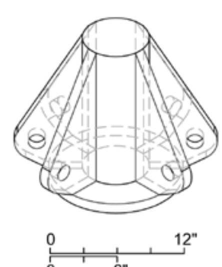


Figure 5.2. Top of column connection. Source: Author.

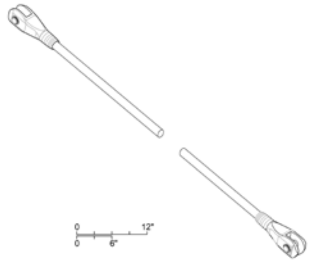


Figure 5.3. Tension Rod. Source: Author.

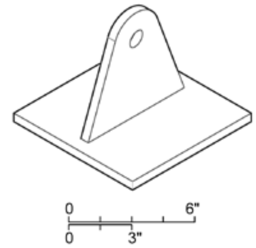


Figure 5.4. Anchor plate for tension rod . Source: Author.

top of the column (figure 5.2). This connection will also have six triangular steel plates welded to the cast cylindrical form. Tension rods (figure 5.3) will also be anchored from the eight foot tapered cellular beams to anchor plates (figure 5.4) located at ground level surrounding the perimeter of the building. Product information on the tension rod systems referenced in this project can be seen in Appendix C.

CHAPTER 6

PROJECT

The following pages show the graphical form of the design solution for this project from the beginning during the preliminary design process all the way throughout the final design process. Within this chapter the assembly of all the components discussed in the previous two chapters will come to fruition. During the design process a few key problems and solutions were kept in mind to implement into the overall design of the project.

The separation of public and private spaces throughout this project is needed being that the site is a rather flat area located at an elevation lower than that of the highway to the immediate north of the site. The spaces within the project require different levels of privacy than others. For instance the showroom facility is a space which is open to the public while the office space would require some level of privacy while also allowing for a lobby/entrance space for the public to enter. Another issue that comes about for this project is that of transportation into and out of the site. Since this project includes a manufacturing facility, which requires a private entrance and exit for shipping and receiving materials and products, this area needs to be separated from the public entrance and parking facilities. A primary solution to this issue would be to clearly label entrances for the public and private areas. Another solution would be to leave visual connections to the public spaces while landscaping and using trees and shrubs to disrupt the visual connection to the private spaces.

The ability for future expansion is another problem which was put into account while designing this facility. The design of this manufacturing facility should be done in a manner which allows for future expansion possibilities, while not making it blatantly obvious to the common visitor or occupant that building expansion is capable. The building façade should maintain a visual relationship throughout the building, whether it would be through the use of reveals in the exterior skin or a repeated pattern. The structural grid of the building should be the primary key to allowing for expansion. The structure should maintain a typical repetitive spacing between structural columns and beams.

The incorporation of natural light into the facility and especially into the manufacturing portion of the design is another design issue that was thought of throughout the design of this project. Typical factory spaces incorporate minimal daylight emittance into their facilities. Through the incorporation of natural light into the factory space it could improve the work productivity besides improving the well-being and work ethic of the employees. By incorporating daylight either in the upper portion of the walls, through the use of skylights, or even the implementation of translucent wall/roof panels would help increase the amount of natural light into the workspace. The incorporation of natural light into the spaces might even reduce the need for artificial light throughout a portion of the workday, thus reducing costs for the facility.

A final design problem that was thought of from the first day working on this project was the manner in which to be able to expose the structural parts and joints throughout the building allowing the occupants and visitors to gain a better understanding of the working skeletal structural system that supports the rest of the facility. The biggest issue when allowing the structure to be exposed throughout a building would be the increased chance of the integrity of the structure to be compromised by the forces of nature and weathering of the materials. The surfaces of the materials will need to be coated with a protective sealant in order to prevent the integrity of the structure from coming in contact with the elements. Structural steel is usually covered in an in tumescent paint which would protect the steel if it were to come in contact with fire as well as helps prevent the chances of rust. Another issue that is faced when incorporating an exposed structure in the building would be the openings in which the structural components penetrate the façade of the building and allowing for a proper method of sealing the opening and around the structure.

In figure 6.1 the preliminary sketches and column bay spacing explore the many different scenarios that came about from the research and case studies. These ideas spawned off of projects such as the Renault Centre, the Stadelhofen station, and the Fleetguard Factory as well as a few other projects. The design of the structural system was the primary focus at the start of this project, since the main goal is to be able to fully express the structure throughout the facilities as well as having the ability to understand how it is assembled. Figure 6.2 includes sketches and rough study models that allowed for the exploration of multiple methods of jointure and arrangements of spaces within the overall design of the factory portion of the facility. This includes the image of the model of the structural column and beam system of which became the precursor to the final design of the structural members. In the upper right hand side of the image is the study model of the floor support system of the mezzanine level for the showroom facility. Figure 6.3 is a rough study model which would allow for multiple arrangements of the spaces and along a grid system included on the multiple pieces as well as showing the spatial relationship to the Bill Emerson Memorial Bridge approach which is located immediately north of the site. In figure 6.4, the images show multiple design ideas of the landscape for the facility which led up to the final landscape design shown in figure 6.11.

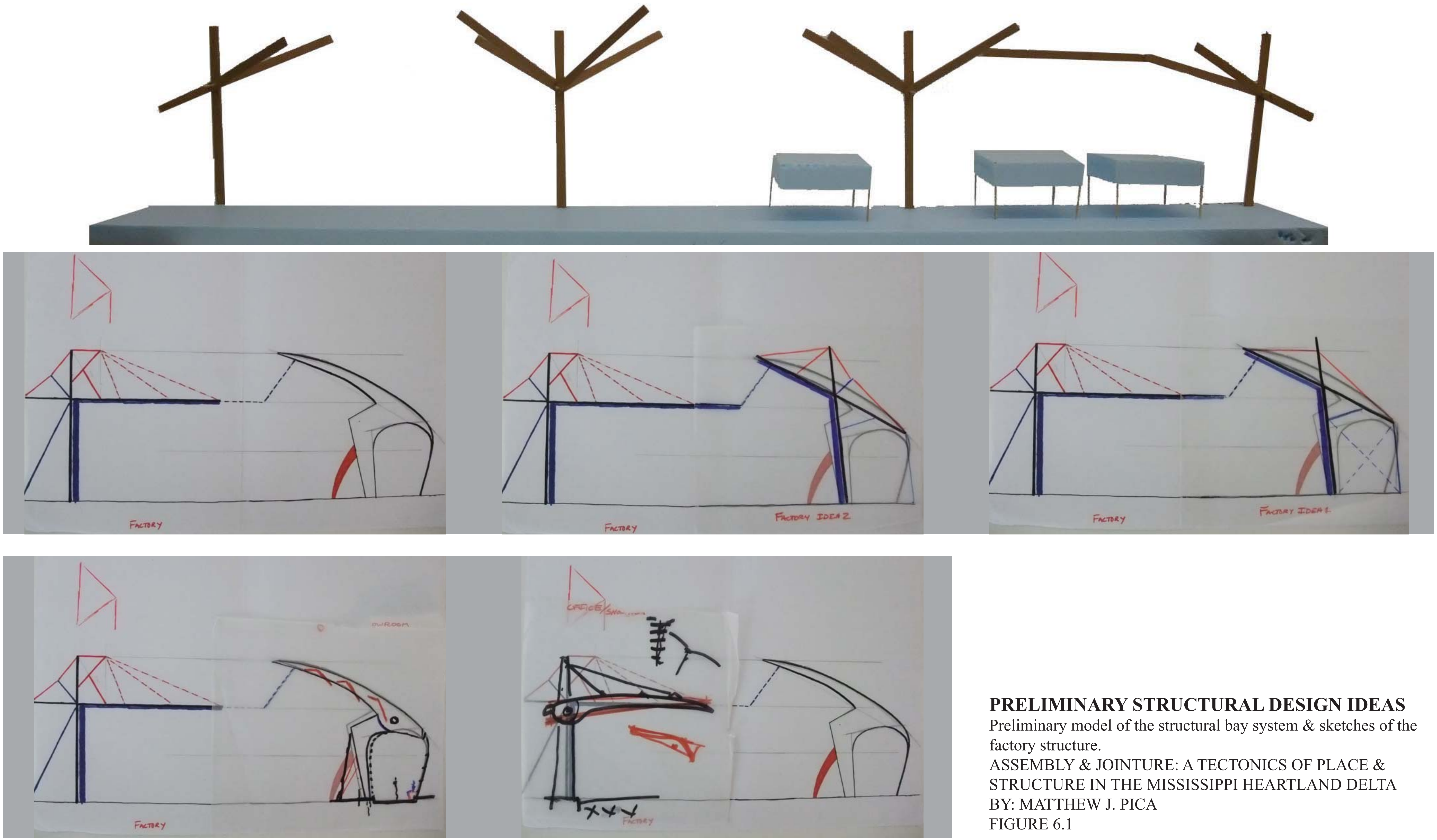
In conjunction with this project the integration of physical models was a required accessory thus enabling a further understanding of the structural components and their assembly methods. A model of a single bay for the factory space was built to the scale of ½" = 1'-0" and is shown in figure 6.5. Four separate column-beam situations were required throughout the entire design of this project, which are shown modeled in the image. These four column-beam situations shown relate to the columns located at H3, H4, J3, and J4 respectively as seen in figure 6.10 which shows the column grid for the facility in relation to the site. The repetitive use of the steel shapes which comprise the four situations allow for an ease in mass production thus making it not as much of a hassle for the steel fabricators and the workers that assemble the components in the field. Figure 6.6a is an exploded isometric image that shows the assembly process of a single structural bay for the factory. Figure 6.6b is an enlarged image of the tensioned structural support column which the façade system is anchored. The bracket which connects the individual members that comprise the purlin system is shown in figure 6.6c. The purlin system helps support the kalwall roof system which spans between each of the tapered cellular beams. The shallow ends of the cellular beams are anchored to a framework comprised of steel C-channels, as shown in figure 6.6d. The framework anchored to the ends of the cellular beams help increase the rigidity to the structure.

One of the most commonly used column-beam situations is located on the exterior of the straight segments of the wall as seen in figure 6.7a. Figure 6.7b shows an image of the column sleeve connection as well as an exploded isometric which shows the assembly process of the column sleeve. Another chance to gain a further understanding of the structural system and the methods of jointure was achieved by building a half scale model of the actual column sleeve connection and portions of the tapered cellular beams. This model shown in figure 6.7c allows the observer to gain a better sense of the actual scale of the structure as well as an understanding of the process in which the cellular beams are connected to the column sleeve. Figure 6.7d shows an isometric image as well as an exploded diagram to show the assembly of the piece. The component located at the top of the column is the primary support for the tension rods which help support the weight of the tapered beams. The next column-beam situation that is widely used throughout the interior of the factory and showroom spaces is shown in figure 6.8b. This column-beam combination is comprised of four of the 30’ tapered cellular beams that are anchored to the column sleeve. With four of the same sized tapered beams connected to the column it allows for an even distribution of weight throughout the interior of the structure to support the kalwall roof structure. An enlarged isometric drawing of the column sleeve connection with the four tapered beams attached is shown in figure 6.8a. Figure 6.8c features an isometric drawing of the anchoring of the column to the column footing. The anchoring component, located at the top of the column, for the tension rods is shown in figure 6.8d. The tension rod connection to the tapered cellular beam in is shown in figure 6.8e, and it is this connection that is used on every tapered beam throughout the project with the exception of the 8’ long tapered beam. An enlarged drawing and exploded isometric of the assembly of the wall, previously shown at a smaller scale in the isometric of the single bay, is shown in figure 6.9a. Figure 6.9b shows an enlarged isometric and exploded diagram of how the fibre-C panel is attached to the wall structure. Further drawings showing the methods of assembly for the wall panel system, were acquired from the manufacturer's cut sheets, and can be seen in Appendix A. The fibre-C wall panel cladding system will be used for the factory and the office facilities. Whereas the cladding system of the showroom facility will be a metal panel system produced by BAMCO Inc. For more information on how the metal panel system is assembled into place, see Appendix A. The rest of the façade and window systems will be comprised of the typical aluminum framed glass curtain wall system.

The landscape design for this project was another design element that was implemented into this scope of this project. The development of the site was rather important for this project being the surrounding site would be highly visible from the state highway and would also need to keep in mind the drainage and water flow. Throughout the design of the landscaped spaces, the Fibonacci spiral which was used in creating the structural grid for the showroom facility was used to articulate spaces within the landscape as seen in figure 6.11. Within the design of the overall landscape plan an idea to create a direct physical connection to the north side of the highway by creating a passageway under the highway. This would allow for pedestrians to safely travel between the landscaped premises of the furniture manufacturing facility to the South East Missouri State University (SEMO) River Campus and further into the older downtown.

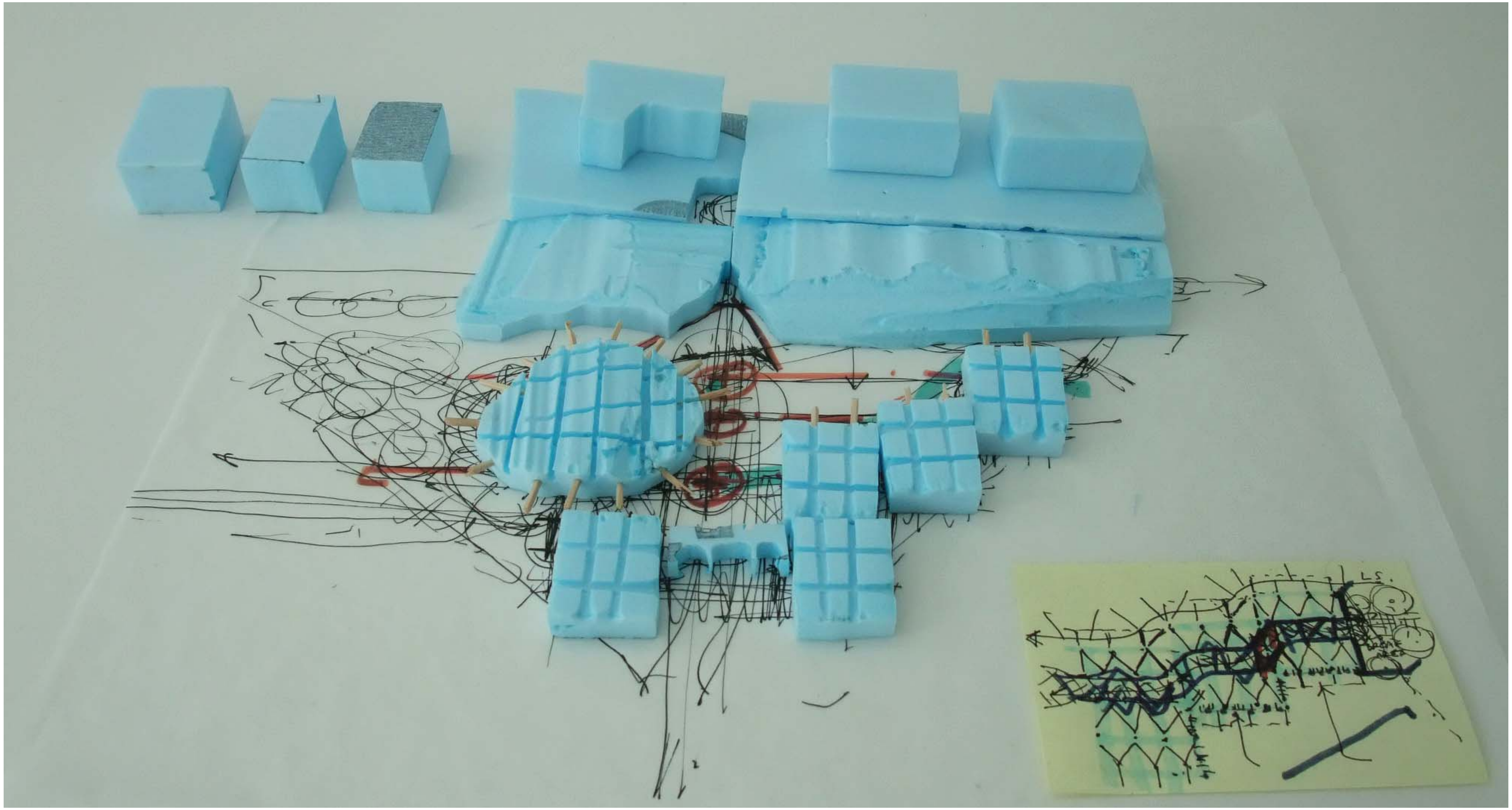
The first floor plan for the factory, office, and showroom facilities is shown in figure 6.12. The typical spaces such as restrooms, vertical circulation, and mechanical spaces are not included within the schematic design stages. The planning of the factory space was designed to be an open space to allow for multiple scenarios of spatial arrangement thus allowing for maximum usage of the facility. Within the factory area, the showroom, and office there is a mezzanine level (figure 6.13) located throughout the spaces to allow for more individual office locations and other needed functions. The overall roof plan can be seen in figure 6.14. The primary roofing system used for the factory, office, and portions of the showroom facilities is the kalwall 100 supported roof system. Typical assembly details for the kalwall supported roof system can be seen in Appendix B. The other prominent roof structure is the dome-like structure used in the showroom facility. The primary inspiration for this glazed dome structure came from seeing and experiencing the Great Court at the British Museum designed by Norman Foster. A delineated 3D perspective image showing the entire building within the context of the site can be seen in figure 6.15. Figure 6.16 is a form of an exploded diagram showing the primary building components of this project. This diagram is comprised of four separate pages, in which the first three pages are translucent pages allowing one to see through to the fourth page. The first page shows the roof system, the second page shows the wall system of the entire building, the third page shows the tensile structural system, and the fourth page shows the floor slabs and the surrounding site.

The next six pages are renderings that show some of the contextual feature around the site as well as color schemes for the building and structure. Figure 6.17 is a rendered version of figure 6.6a, which is an exploded diagram of the assembly of building components for a single bay of the factory space. Figure 6.18 is perspective shot looking to the Northeast along Aquamsi Street in Cape Girardeau, Mo. Figure 6.19 is a view of the furniture manufacturing facility from the Bill Emerson Memorial Bridge as one crosses the bridge into Missouri. Figure 6.20 is a view looking towards the Mississippi River along Maple Street which is the primary road access that leads to the manufacturing facility. Figure 6.21 is the view looking to the north towards the SEMO campus across the landscaped courtyard between the factory and the showroom. Figure 6.22 is a view looking to the southwest of the landscaped courtyard space from the embankment of the highway.



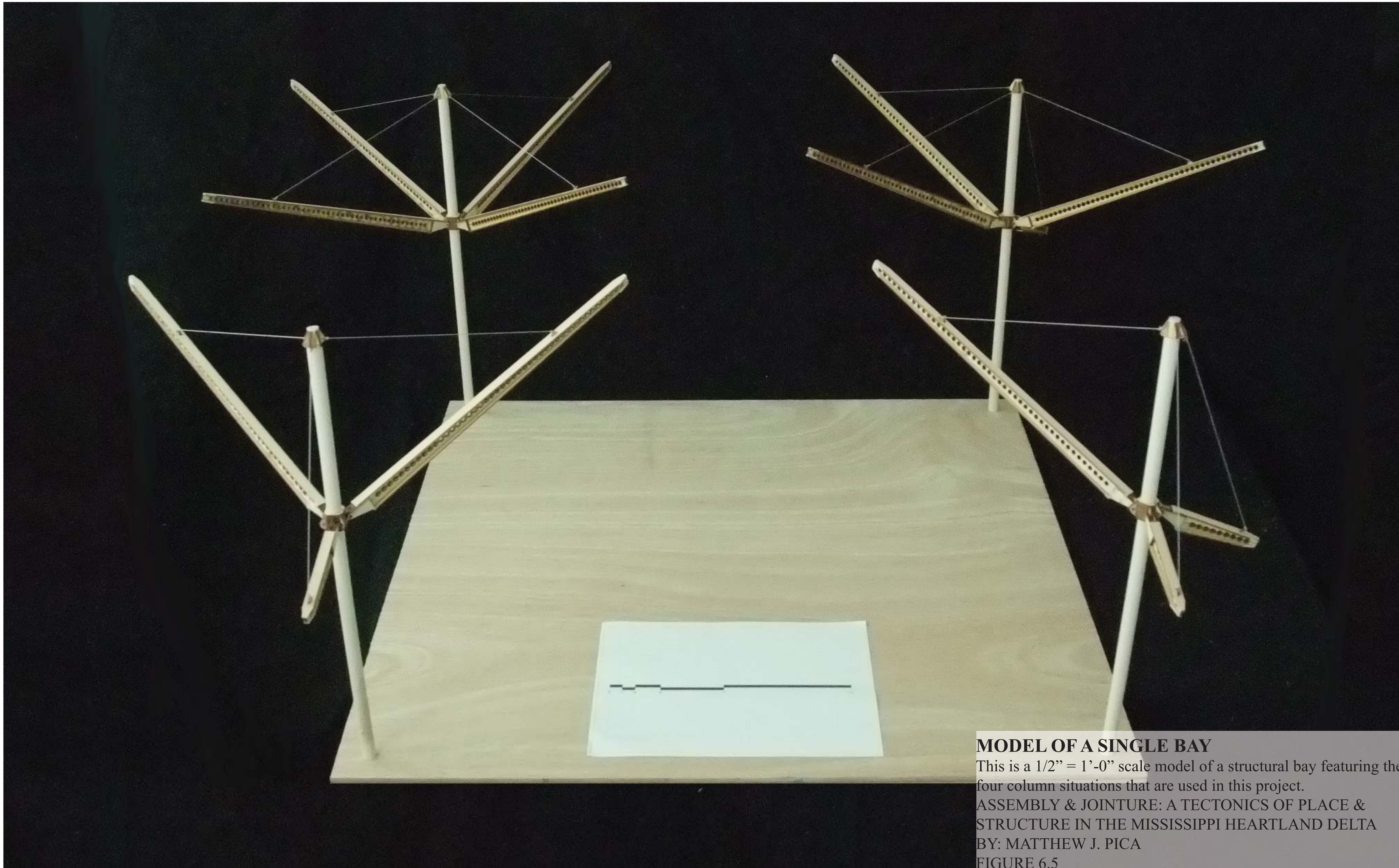
PRELIMINARY STRUCTURAL DESIGN IDEAS
Preliminary model of the structural bay system & sketches of the factory structure.
ASSEMBLY & JOINTURE: A TECTONICS OF PLACE & STRUCTURE IN THE MISSISSIPPI HEARTLAND DELTA
BY: MATTHEW J. PICA
FIGURE 6.1

PRELIMINARY DESIGN IMAGES AND MODELS
Images of study models and sketches used to design the bay system and the structural arrangement.
ASSEMBLY & JOINTURE: A TECTONICS OF PLACE & STRUCTURE IN THE MISSISSIPPI HEARTLAND DELTA
BY: MATTHEW J. PICA
FIGURE 6.2



PRELIMINARY BUILDING LAYOUT
Study model featuring building layout and structural grid system in relation to highway bridge approach.
ASSEMBLY & JOINTURE: A TECTONICS OF PLACE & STRUCTURE IN THE MISSISSIPPI HEARTLAND DELTA
BY: MATTHEW J. PICA
FIGURE 6.3

PRELIMINARY LANDSCAPE DESIGN IDEAS
Design ideas for the landscaping plan of the furniture manufacturing facility.
ASSEMBLY & JOINTURE: A TECTONICS OF PLACE & STRUCTURE IN THE MISSISSIPPI HEARTLAND DELTA
BY: MATTHEW J. PICA
FIGURE 6.4



MODEL OF A SINGLE BAY
This is a 1/2” = 1’-0” scale model of a structural bay featuring the four column situations that are used in this project.
ASSEMBLY & JOINTURE: A TECTONICS OF PLACE & STRUCTURE IN THE MISSISSIPPI HEARTLAND DELTA
BY: MATTHEW J. PICA
FIGURE 6.5

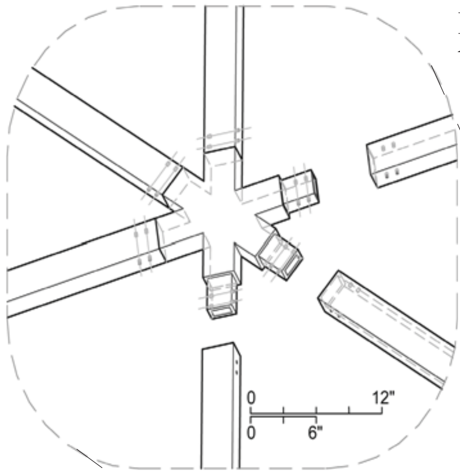


Figure 6.6c Enlarged view of connection bracket for the purlin system. Source: Author

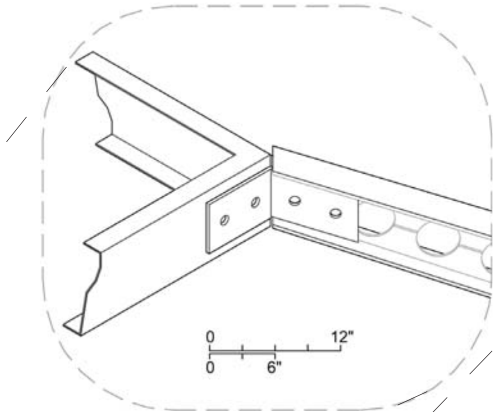


Figure 6.6d Enlarged view of the end of the tapered beam connection. Source: Author

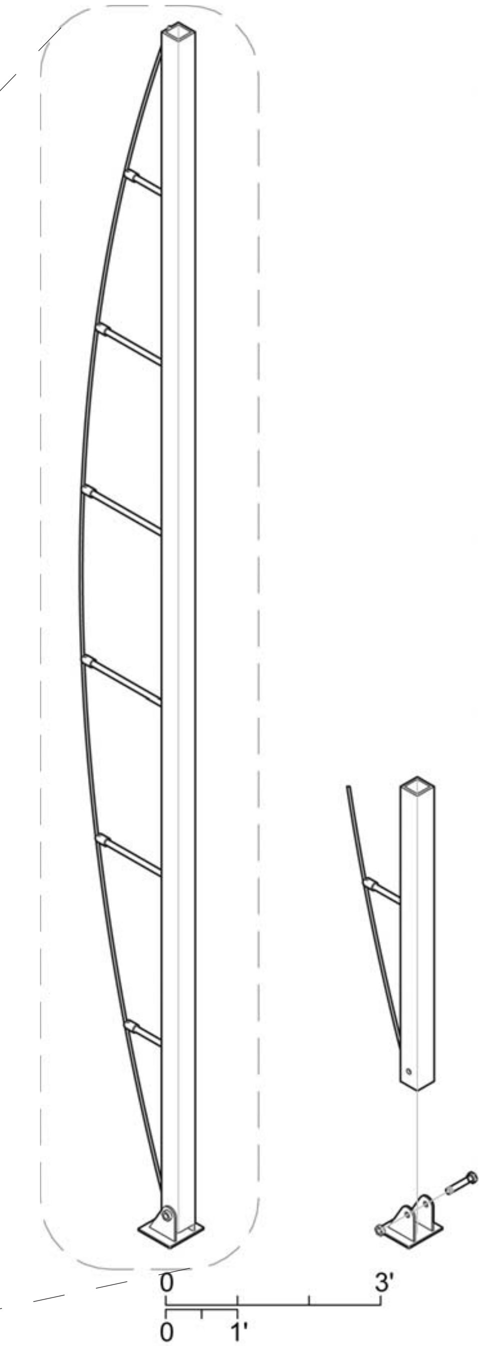


Figure 6.6b Enlarged view of tensioned wall support assembly. Source: Author

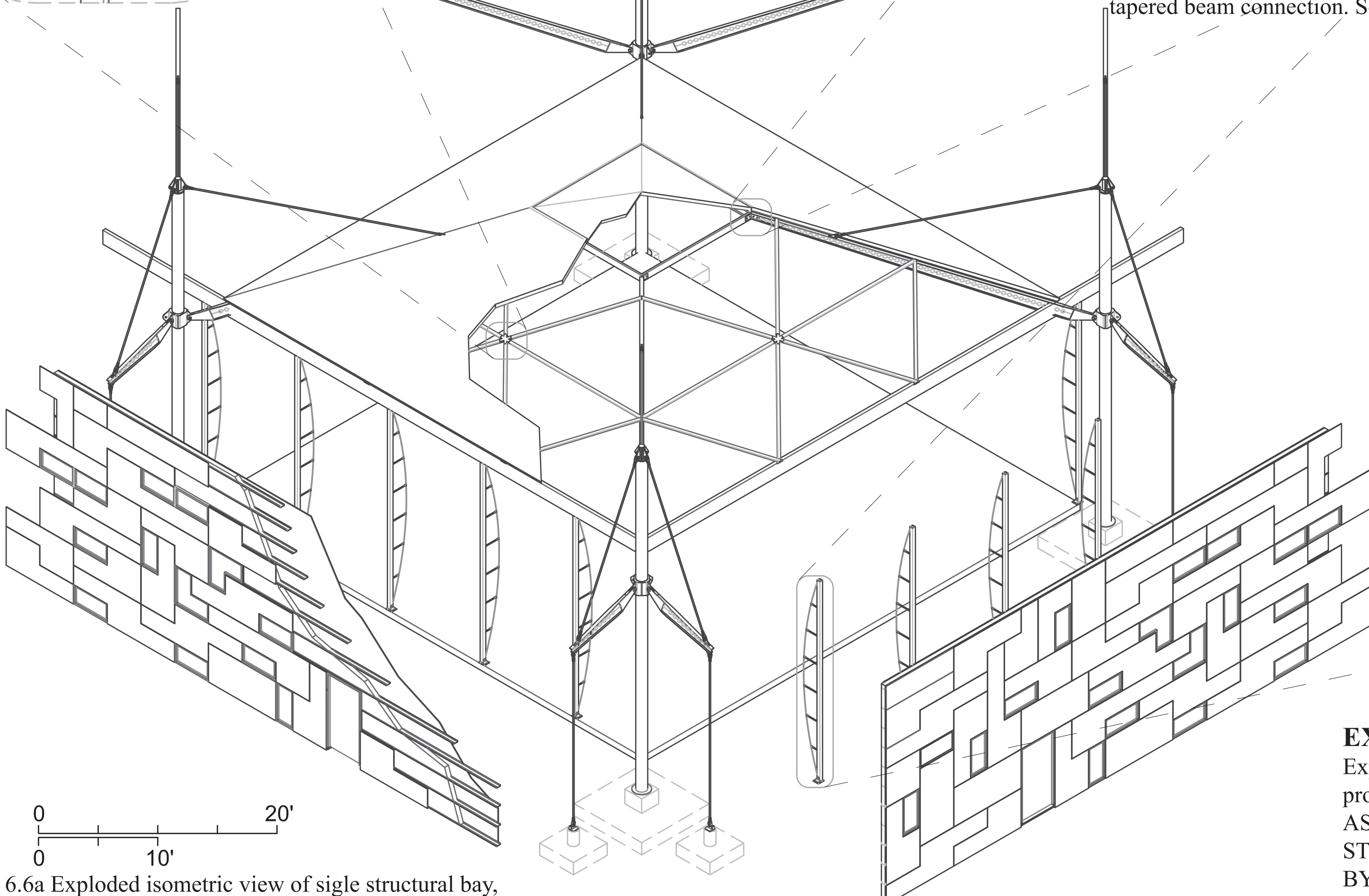


Figure 6.6a Exploded isometric view of sigle structural bay, showing the process of assembly of its compoents. Source: Author

EXPLODED ISOMETRIC FOR SINGLE BAY

Exploded details of a typical single bay showing the assembly process of all building details.

ASSEMBLY & JOINTURE: A TECTONICS OF PLACE & STRUCTURE IN THE MISSISSIPPI HEARTLAND DELTA

BY: MATTHEW J. PICA

FIGURE 6.6

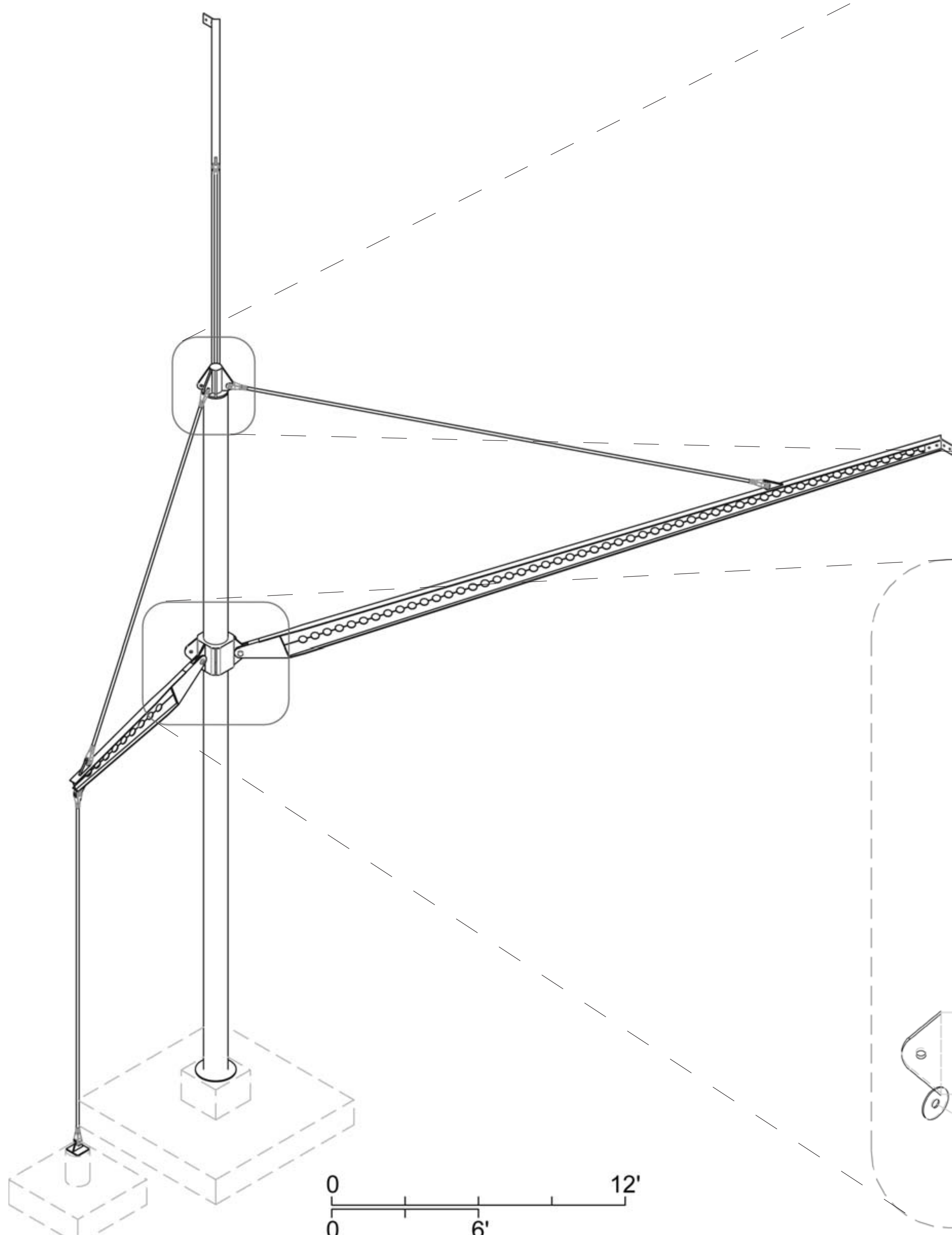


Figure 6.7a Isometric of typical exterior column. Source: Author

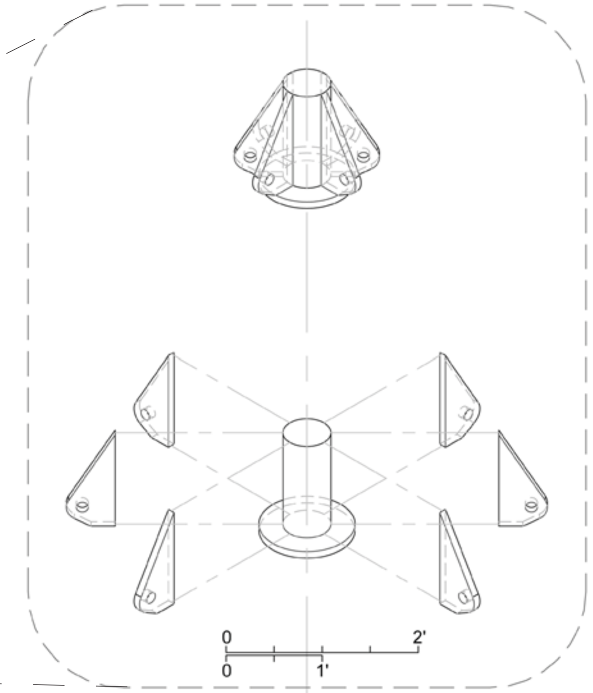


Figure 6.7d Exploded isometric of top of column connection assembly. Source: Author

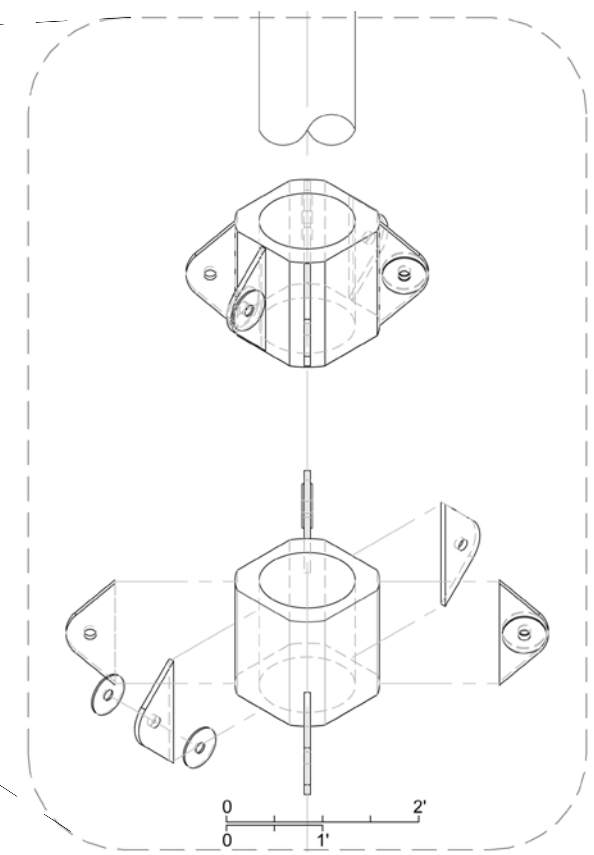


Figure 6.7b Exploded isometric of column sleeve assembly. Source: Author

Figure 6.7c Fabricated half scale model of column sleeve connection. Source: Author

TYPICAL EXTERIOR COLUMN ISOMETRIC
Exterior isometric details and exploded isometric assembly diagrams.
ASSEMBLY & JOINTURE: A TECTONICS OF PLACE & STRUCTURE IN THE MISSISSIPPI HEARTLAND DELTA
BY: MATTHEW J. PICA
FIGURE 6.7

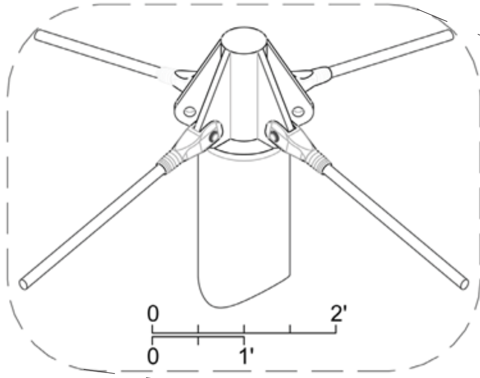


Figure 6.8d Exlarged isometric of top of column connection. Source: Author

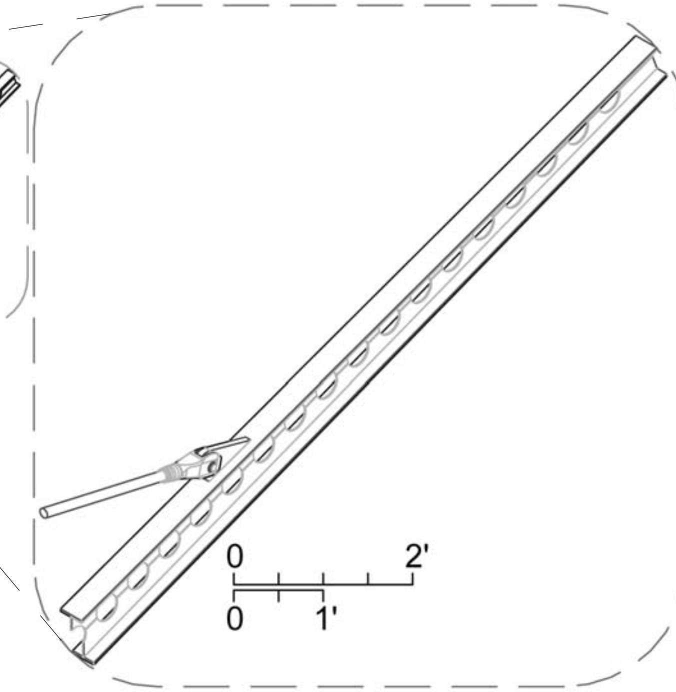


Figure 6.8e Exlarged isometric of tension rod to tapered cellular beam connection. Source: Author

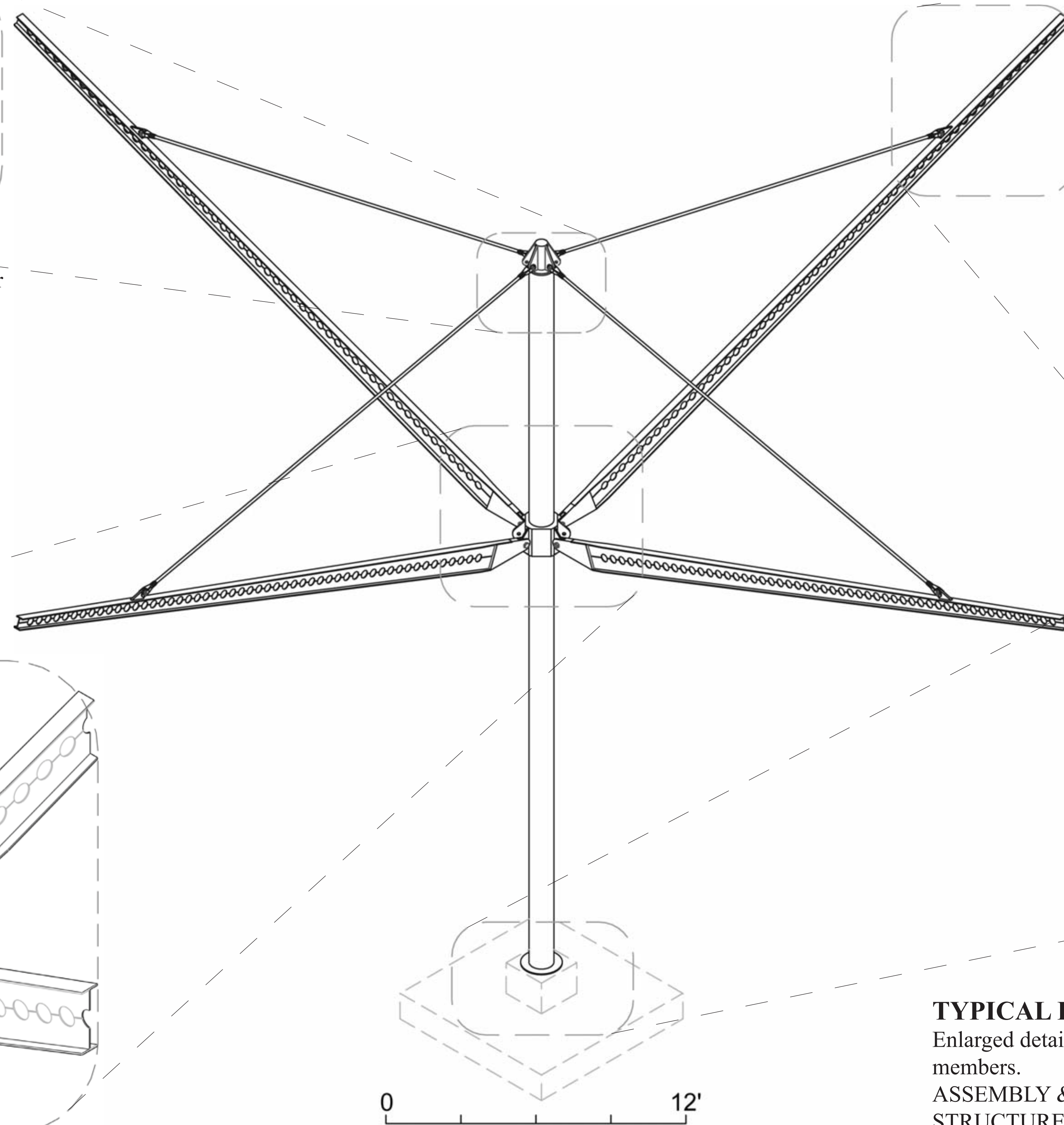


Figure 6.8b Isometric of typical interior column. Source: Author

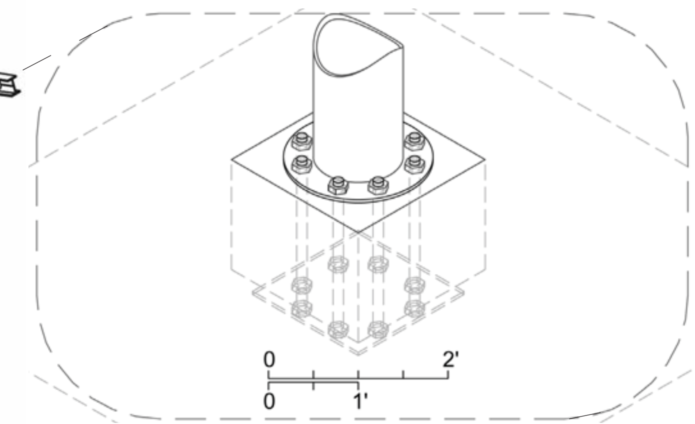


Figure 6.8c Exlarged isometric of column base connection. Source: Author

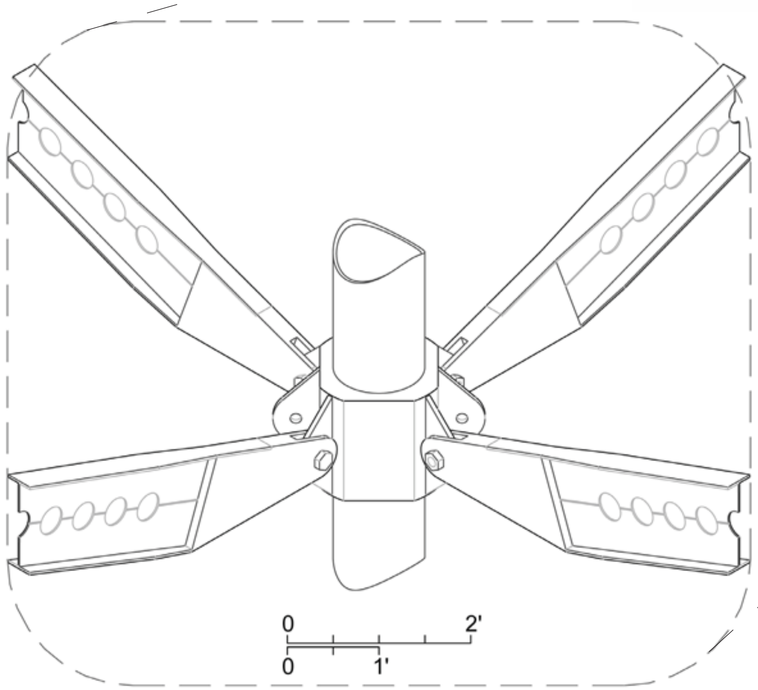


Figure 6.8a Exlarged isometric of column sleeve with tapered cellular beam attached. Source: Author

TYPICAL INTERIOR COLUMN ISOMETRIC

Enlarged details of the tension rod connections to the structural members.

ASSEMBLY & JOINTURE: A TECTONICS OF PLACE & STRUCTURE IN THE MISSISSIPPI HEARTLAND DELTA

BY: MATTHEW J. PICA

FIGURE 6.8

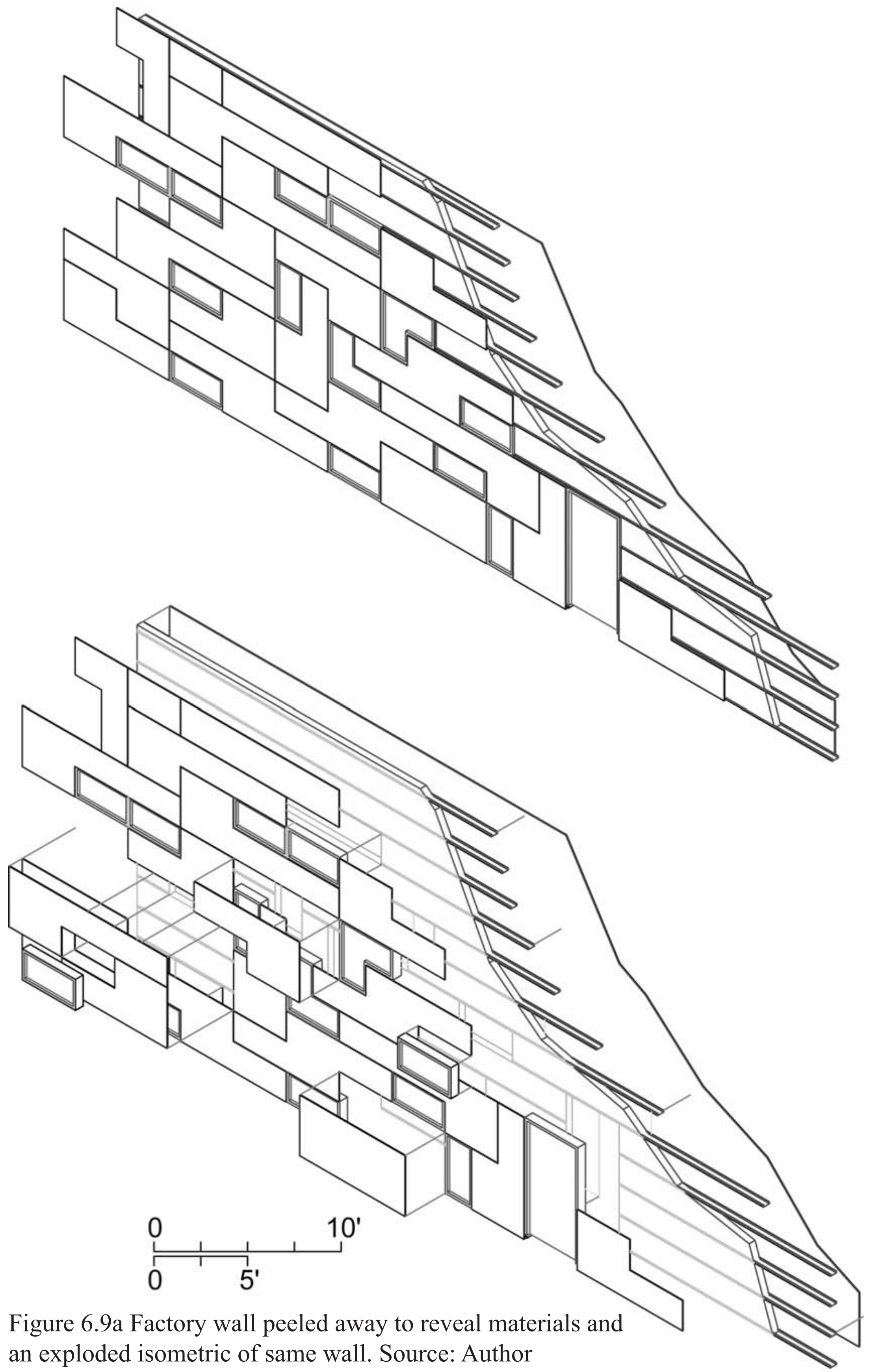


Figure 6.9a Factory wall peeled away to reveal materials and an exploded isometric of same wall. Source: Author

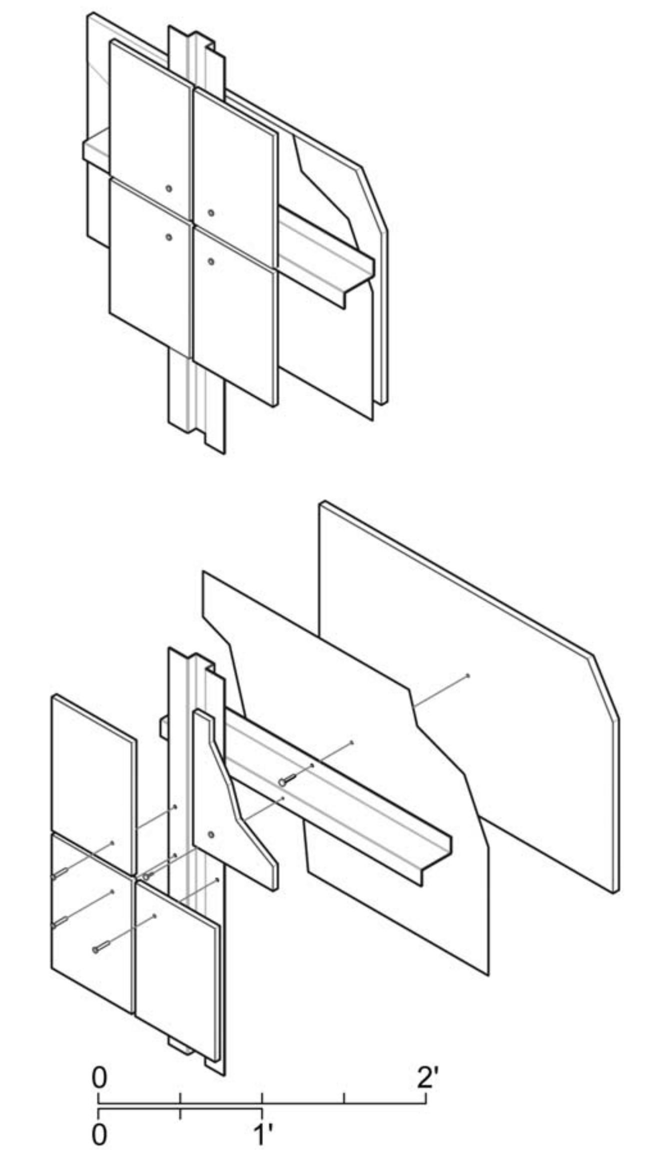


Figure 6.9b Exploded isometric of assembly method of the fibre-C panel system. Source: Author

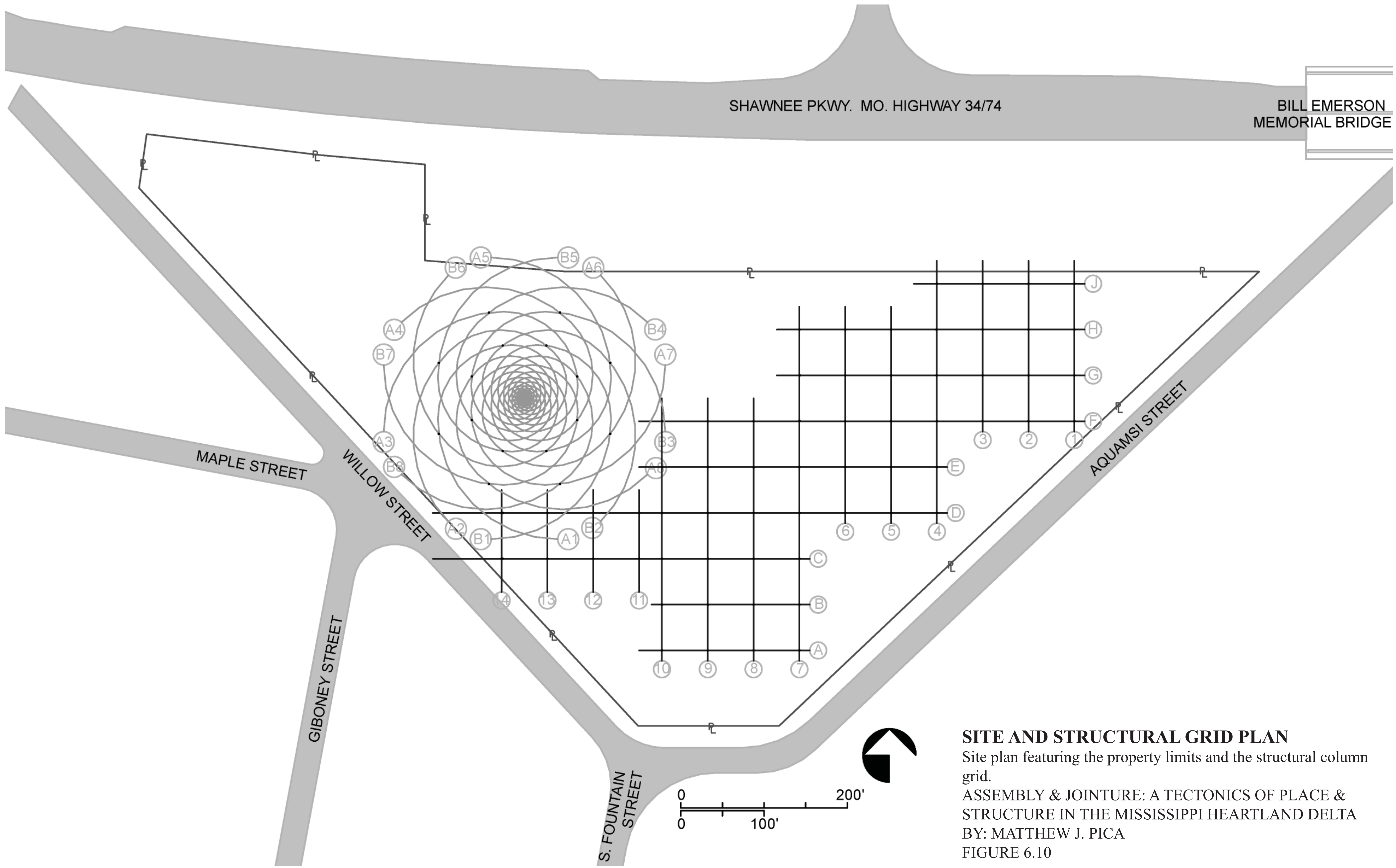
EXPLODED WALL ISOMETRIC

Isometric details of wall construction using the fibre-C panel system for the factory space.

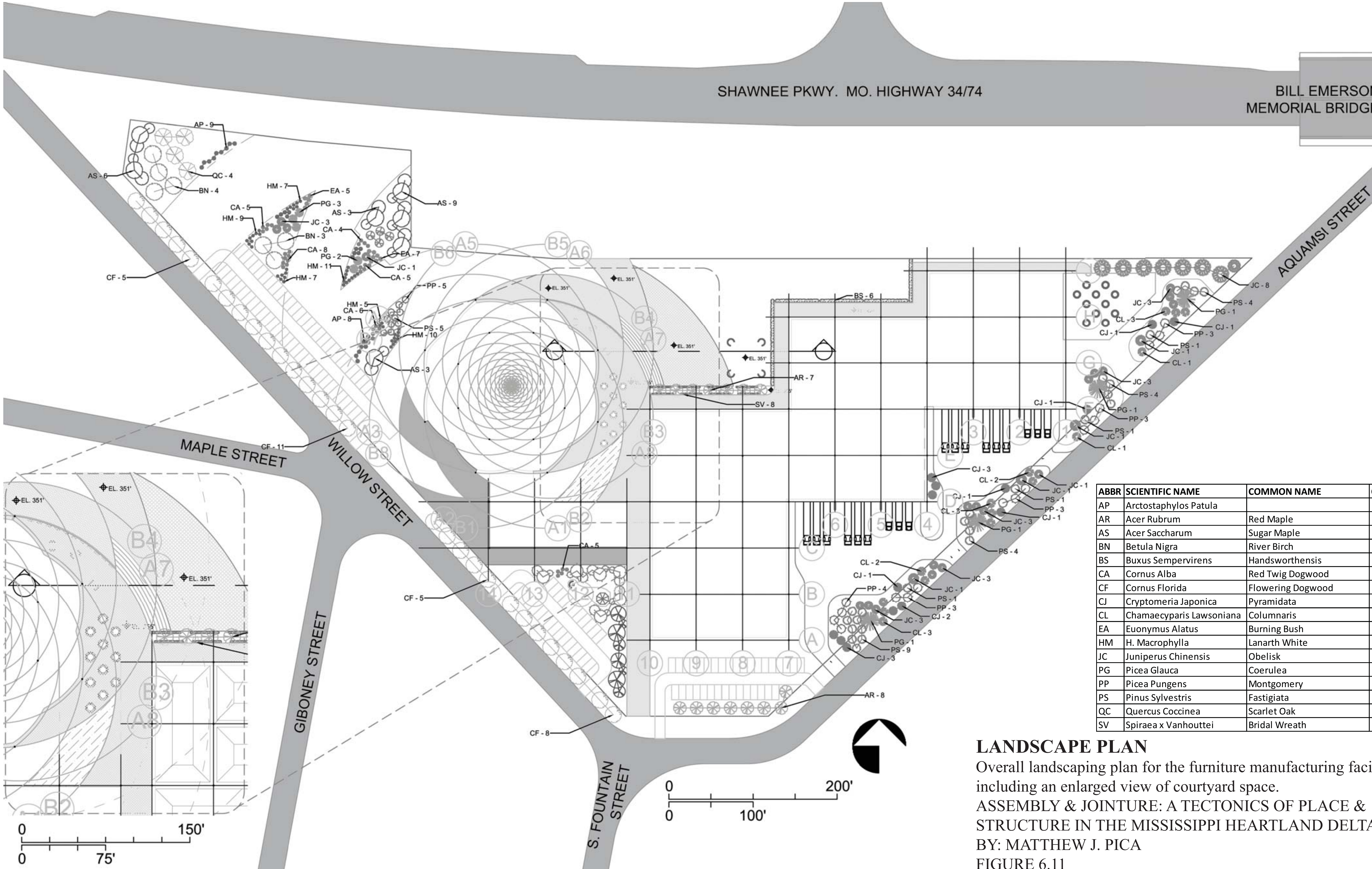
ASSEMBLY & JOINTURE: A TECTONICS OF PLACE & STRUCTURE IN THE MISSISSIPPI HEARTLAND DELTA

BY: MATTHEW J. PICA

FIGURE 6.9



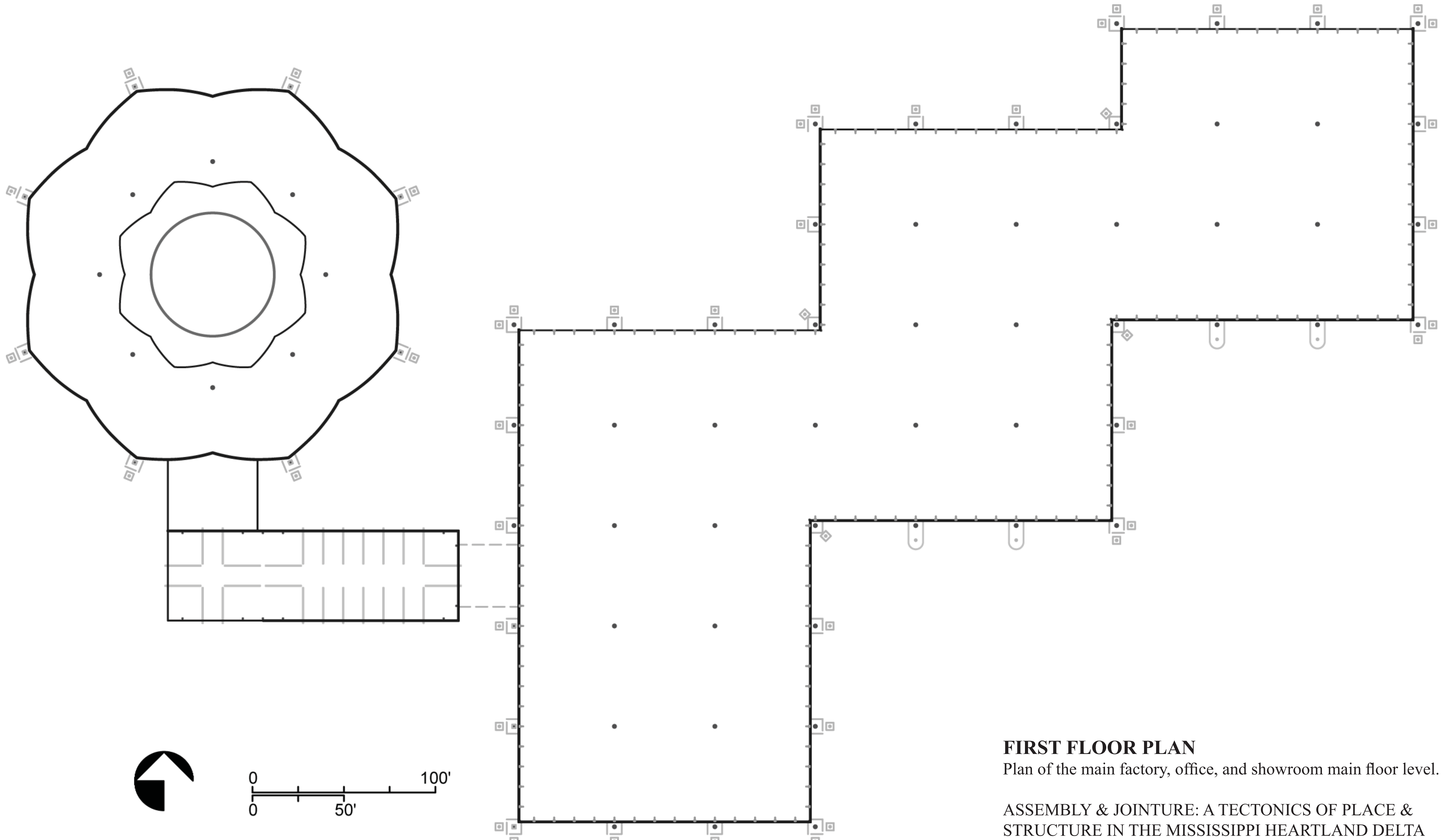
SITE AND STRUCTURAL GRID PLAN
Site plan featuring the property limits and the structural column grid.
ASSEMBLY & JOINTURE: A TECTONICS OF PLACE & STRUCTURE IN THE MISSISSIPPI HEARTLAND DELTA
BY: MATTHEW J. PICA
FIGURE 6.10



ABBR	SCIENTIFIC NAME	COMMON NAME	QTY
AP	Arctostaphylos Patula		17
AR	Acer Rubrum	Red Maple	15
AS	Acer Saccharum	Sugar Maple	21
BN	Betula Nigra	River Birch	7
BS	Buxus Sempervirens	Handsworthensis	6
CA	Cornus Alba	Red Twig Dogwood	33
CF	Cornus Florida	Flowering Dogwood	29
CJ	Cryptomeria Japonica	Pyramidata	14
CL	Chamaecyparis Lawsoniana	Columnaris	15
EA	Euonymus Alatus	Burning Bush	12
HM	H. Macrophylla	Lanarth White	49
JC	Juniperus Chinensis	Obelisk	32
PG	Picea Glauca	Coerulea	9
PP	Picea Pungens	Montgomery	21
PS	Pinus Sylvestris	Fastigiata	30
QC	Quercus Coccinea	Scarlet Oak	4
SV	Spiraea x Vanhouttei	Bridal Wreath	8

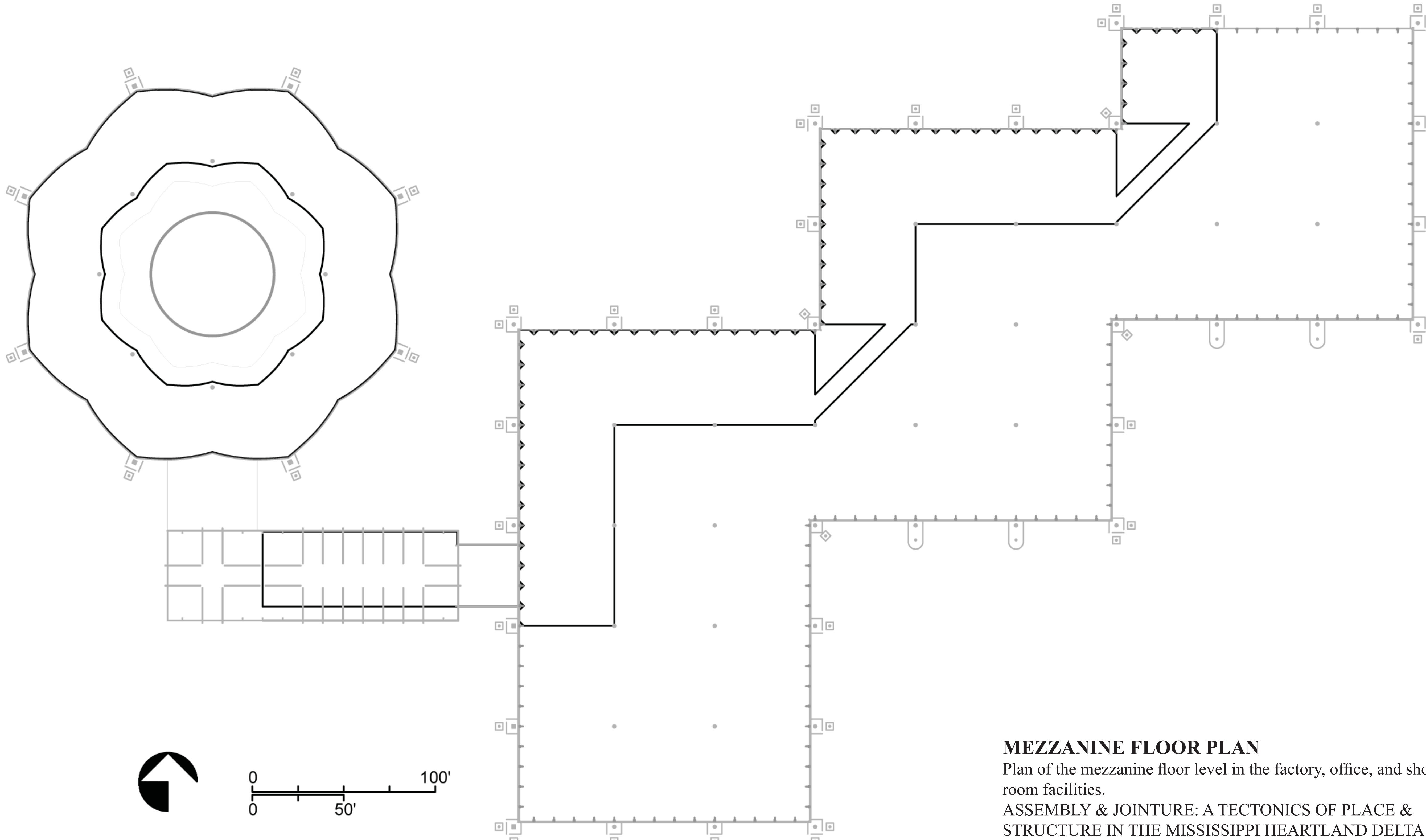
LANDSCAPE PLAN

Overall landscaping plan for the furniture manufacturing facility including an enlarged view of courtyard space.
ASSEMBLY & JOINTURE: A TECTONICS OF PLACE & STRUCTURE IN THE MISSISSIPPI HEARTLAND DELTA
BY: MATTHEW J. PICA
FIGURE 6.11

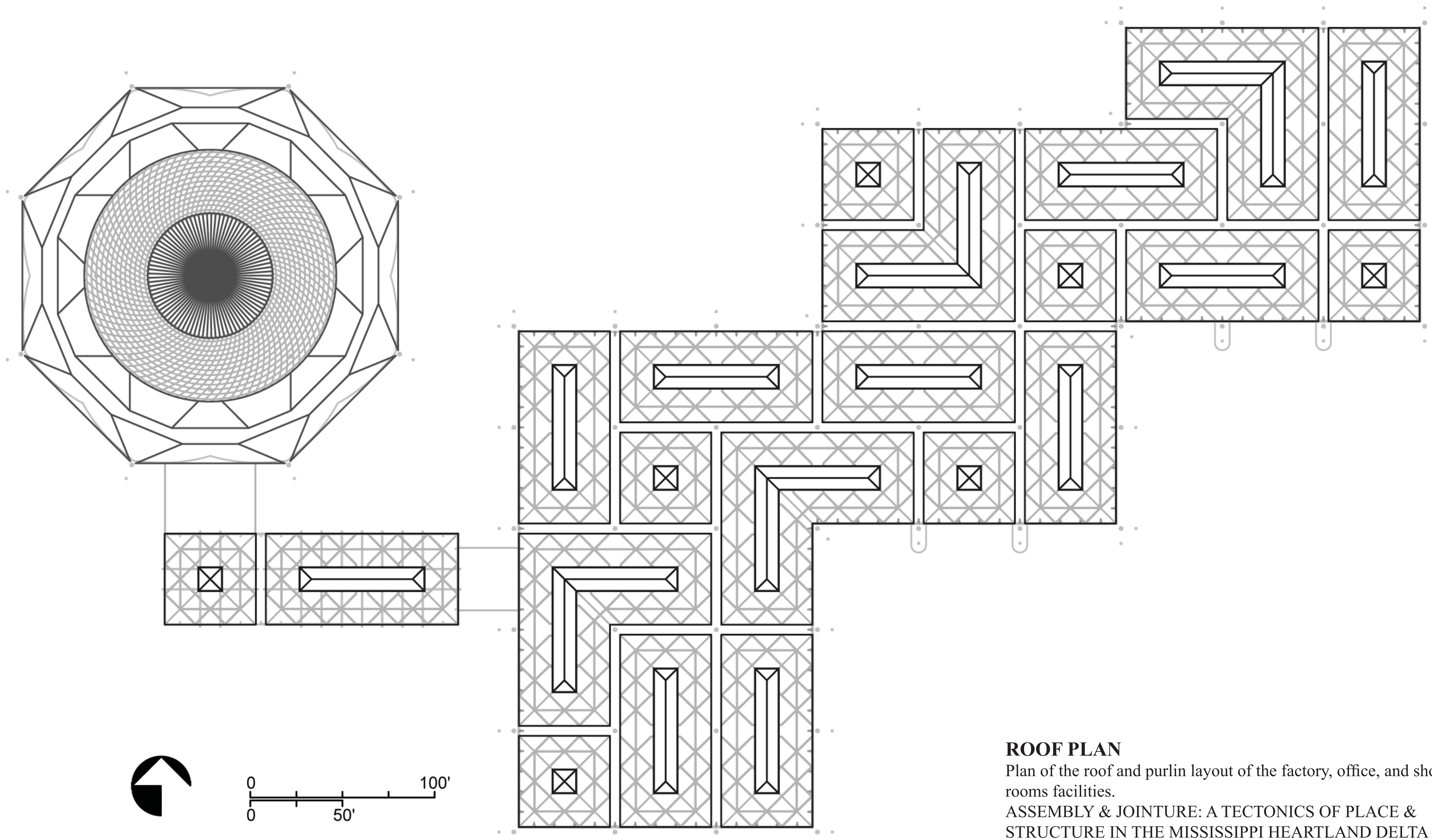


FIRST FLOOR PLAN
Plan of the main factory, office, and showroom main floor level.

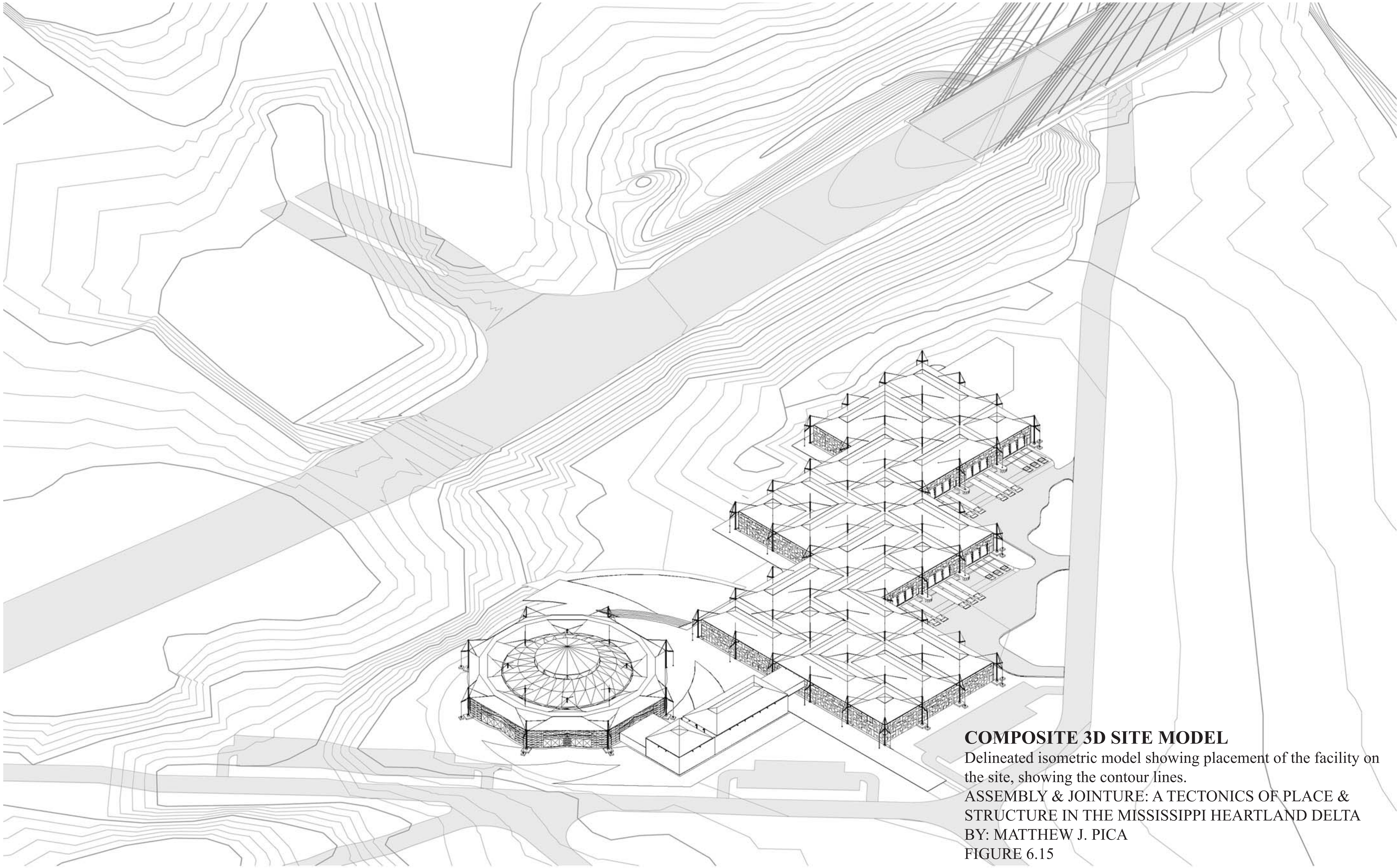
ASSEMBLY & JOINTURE: A TECTONICS OF PLACE & STRUCTURE IN THE MISSISSIPPI HEARTLAND DELTA
BY: MATTHEW J. PICA
FIGURE 6.12



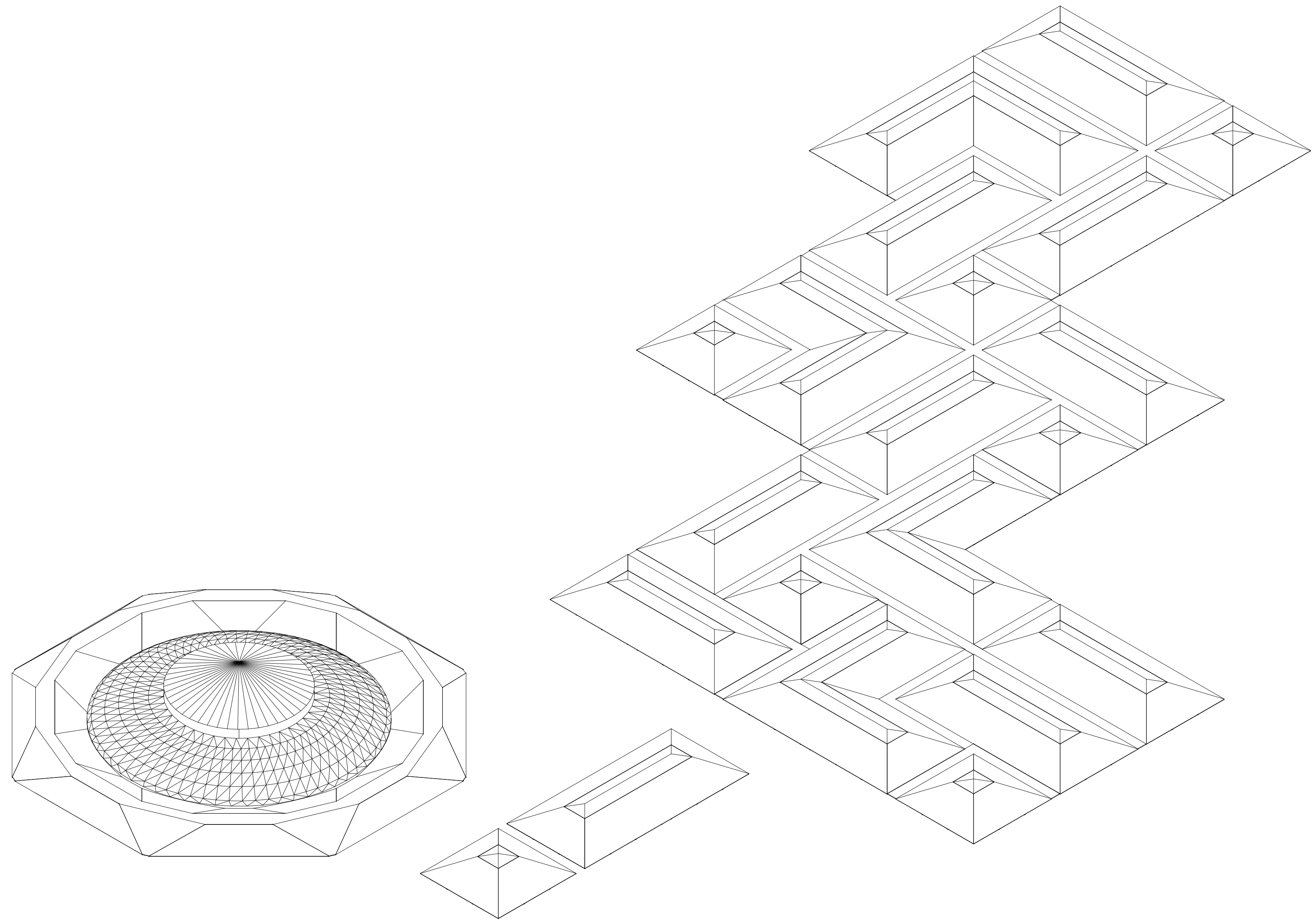
MEZZANINE FLOOR PLAN
Plan of the mezzanine floor level in the factory, office, and show-room facilities.
ASSEMBLY & JOINTURE: A TECTONICS OF PLACE & STRUCTURE IN THE MISSISSIPPI HEARTLAND DELTA
BY: MATTHEW J. PICA
FIGURE 6.13



ROOF PLAN
Plan of the roof and purlin layout of the factory, office, and show-rooms facilities.
ASSEMBLY & JOINTURE: A TECTONICS OF PLACE & STRUCTURE IN THE MISSISSIPPI HEARTLAND DELTA
BY: MATTHEW J. PICA
FIGURE 6.14

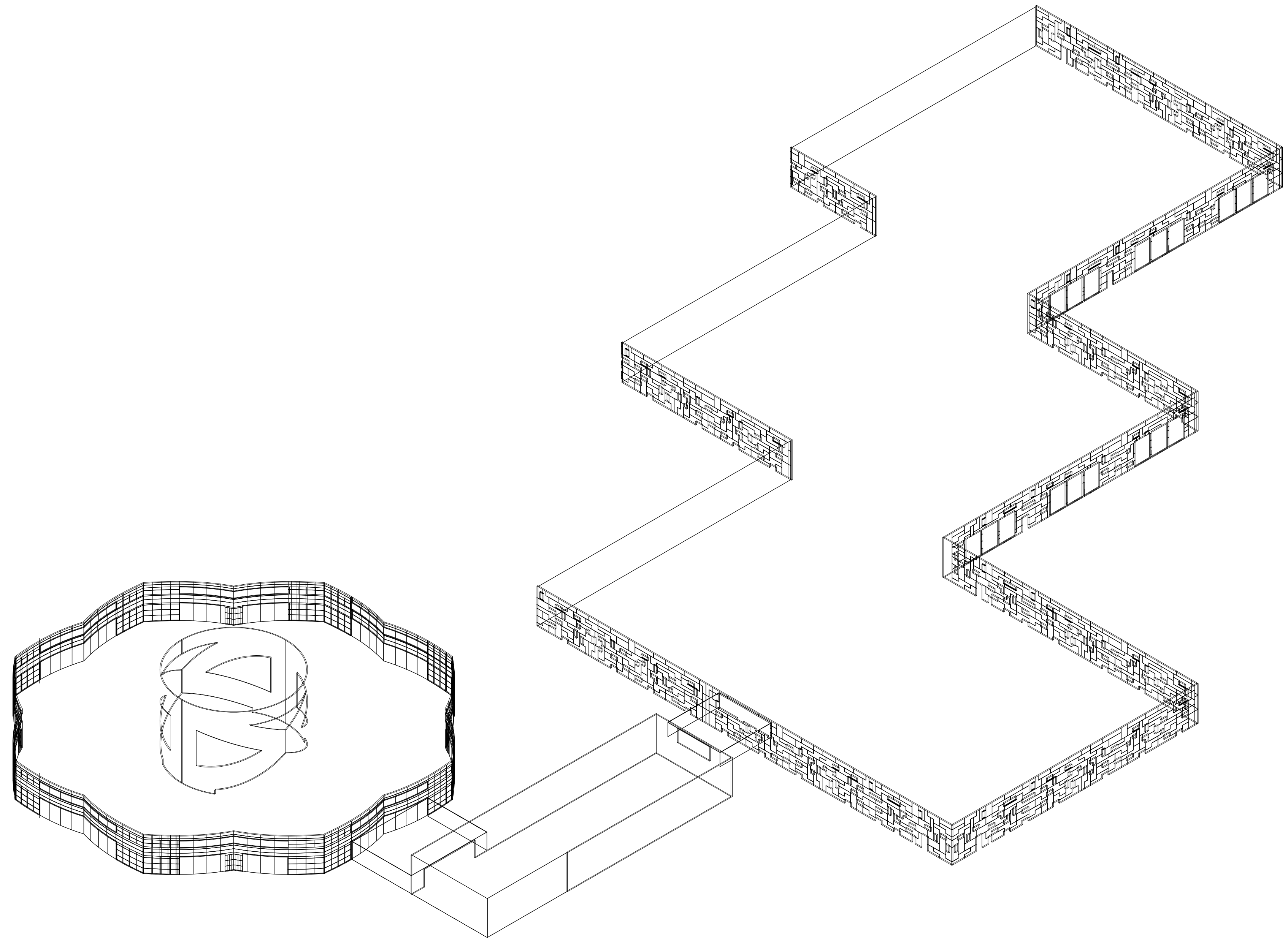


COMPOSITE 3D SITE MODEL
Delineated isometric model showing placement of the facility on the site, showing the contour lines.
ASSEMBLY & JOINTURE: A TECTONICS OF PLACE & STRUCTURE IN THE MISSISSIPPI HEARTLAND DELTA
BY: MATTHEW J. PICA
FIGURE 6.15



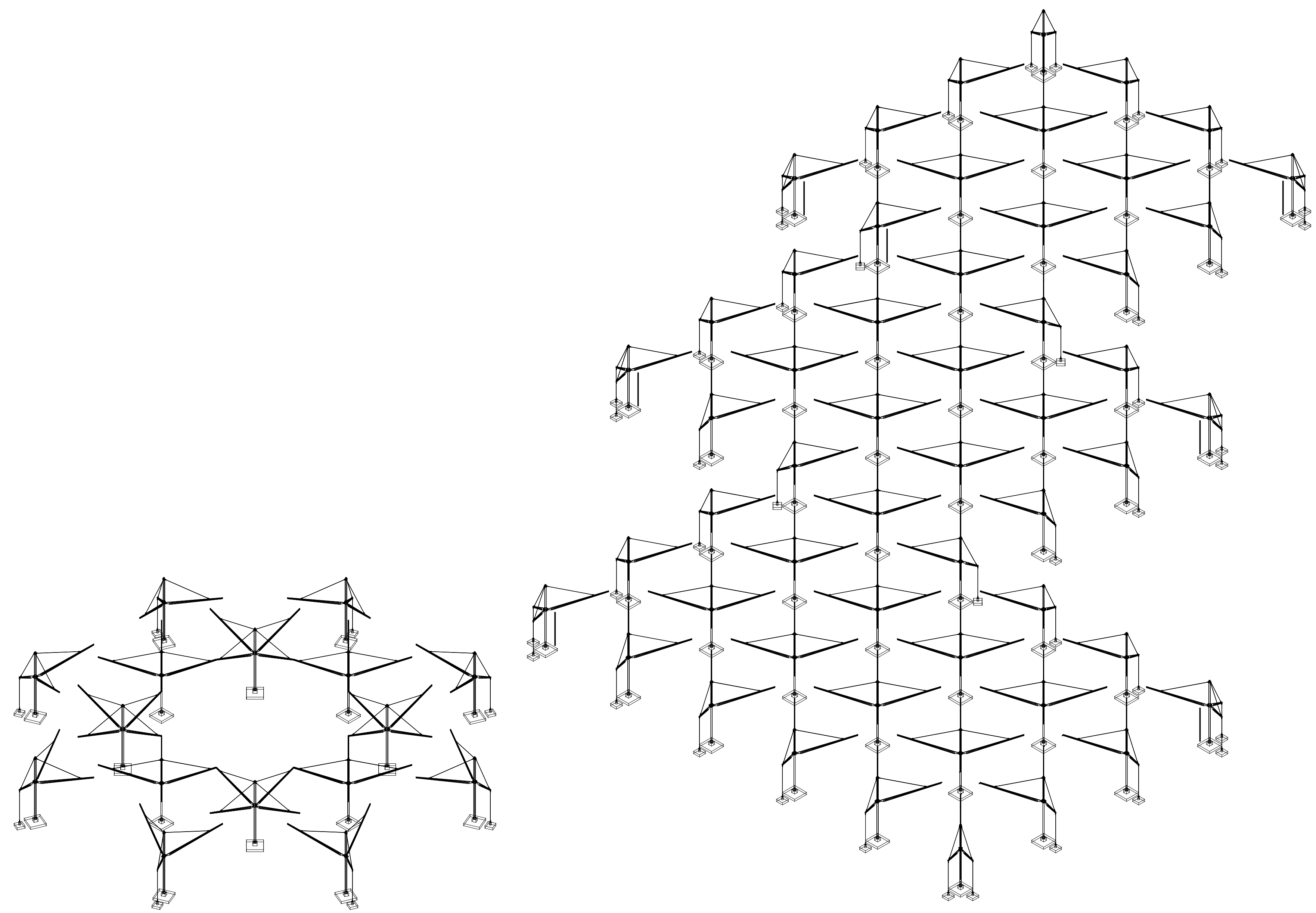
EXPLODED 3D ISOMETRIC OF BUILDING
ROOF LAYER

ASSEMBLY & JOINTURE: A TECTONICS OF PLACE &
STRUCTURE IN THE MISSISSIPPI HEARTLAND DELTA
BY: MATTHEW J. PICA
FIGURE 6.16a



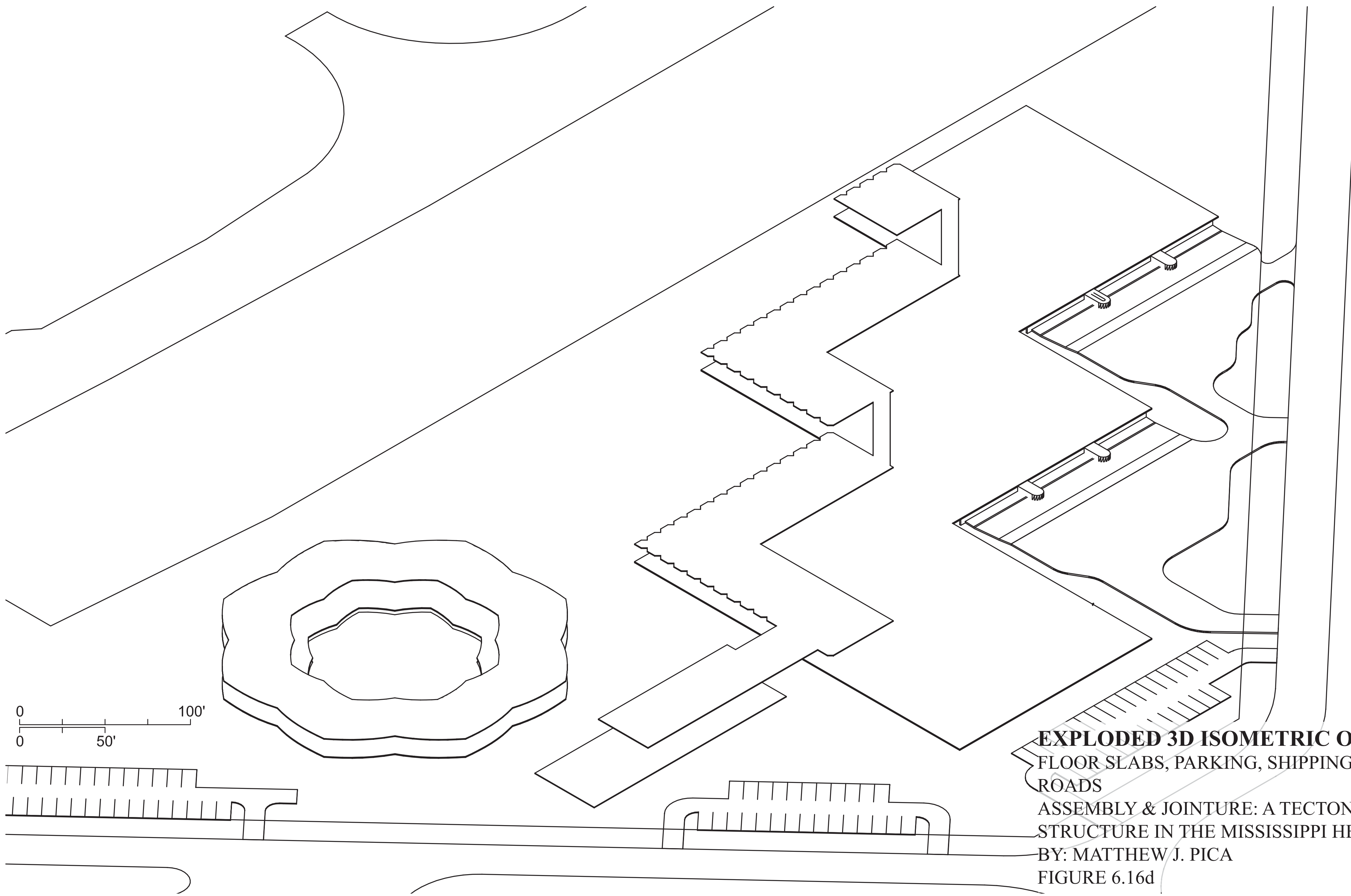
EXPLODED 3D ISOMETRIC OF BUILDING
FACADE LAYER

ASSEMBLY & JOINTURE: A TECTONICS OF PLACE & STRUCTURE IN THE MISSISSIPPI HEARTLAND DELTA
BY: MATTHEW J. PICA
FIGURE 6.16b

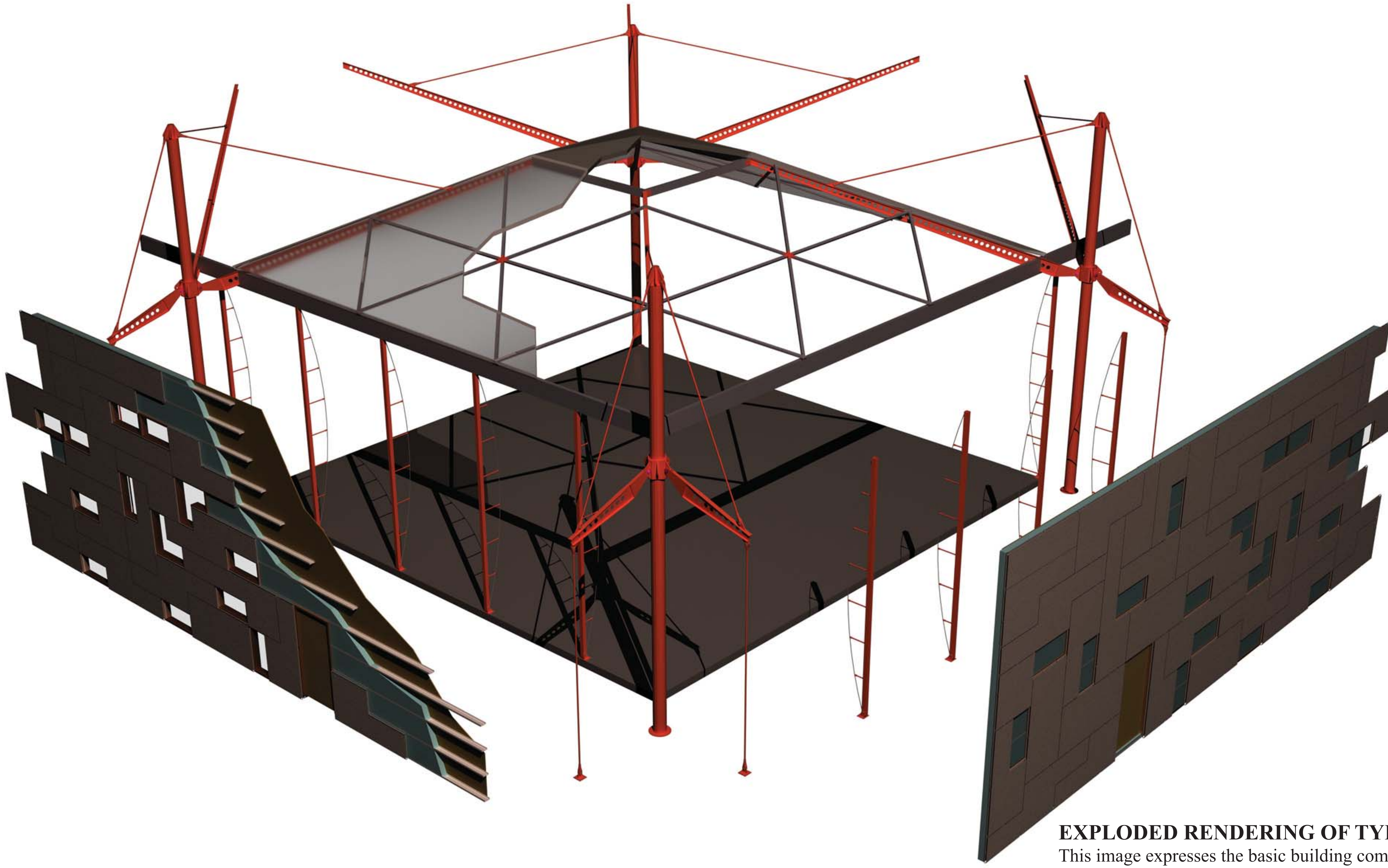


EXPLODED 3D ISOMETRIC OF BUILDING
STRUCTURAL LAYER

ASSEMBLY & JOINTURE: A TECTONICS OF PLACE & STRUCTURE IN THE MISSISSIPPI HEARTLAND DELTA
BY: MATTHEW J. PICA
FIGURE 6.16c



EXPLODED 3D ISOMETRIC OF BUILDING
FLOOR SLABS, PARKING, SHIPPING/RECEIVING, & ROADS
ASSEMBLY & JOINTURE: A TECTONICS OF PLACE & STRUCTURE IN THE MISSISSIPPI HEARTLAND DELTA
BY: MATTHEW J. PICA
FIGURE 6.16d



EXPLODED RENDERING OF TYPICAL BAY
This image expresses the basic building components reguired for construction a single typical bay.
ASSEMBLY & JOINTURE: A TECTONICS OF PLACE & STRUCTURE IN THE MISSISSIPPI HEARTLAND DELTA
BY: MATTHEW J. PICA
FIGURE 6.17

SOUTHEAST PERSPECTIVE RENDERING
Southeast perspective rendering looking north along Aguamsi St.in Cape Girardeau, MO with the ‘Iconic’ Bridge in background.
ASSEMBLY & JOINTURE: A TECTONICS OF PLACE & STRUCTURE IN THE MISSISSIPPI HEARTLAND DELTA
BY: MATTHEW J. PICA
FIGURE 6.18

RENDERING LOOKING FROM BRIDGE
View looking to the Southwest from the Bill Emerson Memorial Bridge
ASSEMBLY & JOINTURE: A TECTONICS OF PLACE & STRUCTURE IN THE MISSISSIPPI HEARTLAND DELTA
BY: MATTHEW J. PICA
FIGURE 6.19

RENDERING LOOKING TOWARDS THE RIVER
View looking across the rooftop of the facility towards the Mississippi River.
ASSEMBLY & JOINTURE: A TECTONICS OF PLACE & STRUCTURE IN THE MISSISSIPPI HEARTLAND DELTA
BY: MATTHEW J. PICA
FIGURE 6.20

PERSPECTIVE FROM THE COURTYARD
This perspective looks out across the north side of the complex towards the SouthEast Missouri State University River Campus.
ASSEMBLY & JOINTURE: A TECTONICS OF PLACE & STRUCTURE IN THE MISSISSIPPI HEARTLAND DELTA
BY: MATTHEW J. PICA
FIGURE 6.21

RENDERING LOOKING TOWARDS COURTYARD
View looking SouthWest, away from the bridge, towards the courtyard of the facility.
ASSEMBLY & JOINTURE: A TECTONICS OF PLACE & STRUCTURE IN THE MISSISSIPPI HEARTLAND DELTA
BY: MATTHEW J. PICA
FIGURE 6.22

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APPENDICES

APPENDIX A

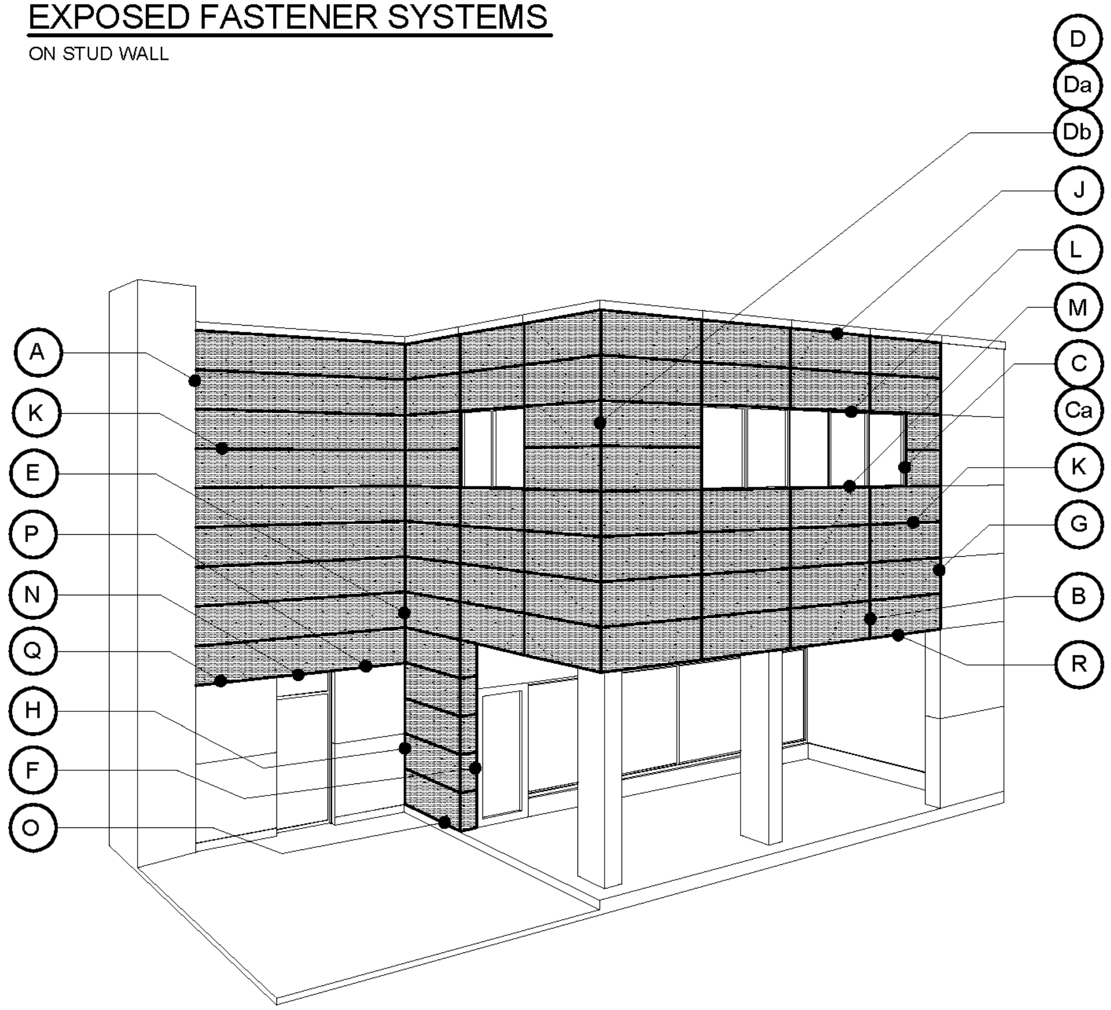
[Fibre C] CUT SHEETS – Façade for Factory & Office Space

BAMCO inc. CUT SHEETS – Façade for Showroom Space

NOVEMBER 2008

EXPOSED FASTENER SYSTEMS

ON STUD WALL



DETAIL LOCATOR

sound. solutions
Architectural Products

Sound Solutions (1997) Inc.
6817 Steeles Avenue West
Toronto, Ontario M9V 4R9
www.soundsolutions.ca

Telephone. 416 740 0303
Facsimile. 416 740 0696
Toll Free. 800 667 2776

Distributor of
fibre C North America
Toll Free. 877 740 0303
www.fibrec.us

[fibre C]
NORTH AMERICA

LEGEND DETAILS

fibre C North America Products Distributed by Sound Solutions:

(1) 1/2" [13mm] Thk. fibre C PANEL

Standard Sizes:

- 47 5/8" x 8' 2 27/64" x 1/2"
  [1210 x 2500 x 13mm]
- 47 5/8" x 11' 9 3/4" x 1/2"
  [1210 x 3600 x 13mm]

Other Products Available from Sound Solutions:

(2) POWDER COATED FINISHED fibre C FASTENERS

Miscellaneous & Accessories Items (By Others):

(3) HAT CHANNEL SUBGIRT (GALV.)
(4) Z-BAR SUBGIRT (GALV.)
(5) HORIZONTAL/VERTICAL SUBGIRT SUPPORT (GALV.)
(6) SEPARATION TAPE (IF REQ'D.)
(7) #14 x 3/4" TYPE AB FASTENERS (OR EQUIVALENT)
(8) INSULATION
(9) AIR/VAPOUR BARRIER
(10) #14 x 1 1/4" Lg. TYPE AB FASTENERS
(11) METAL TRIMS/FLASHING/CAP
(12) PERFORATED/VENT. METAL TRIMS

TABLE OF CONTENTS

EXPOSED FASTENER SYSTEMS
ON STUD WALL

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Architectural Products

Sound Solutions (1997) Inc.
6817 Steeles Avenue West
Toronto, Ontario M9V 4R9
www.soundsolutions.ca

Telephone. 416 740 0303
Facsimile. 416 740 0696
Toll Free. 800 667 2776

Distributor of
fibre C North America
Toll Free. 877 740 0303
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[fibre C]
NORTH AMERICA

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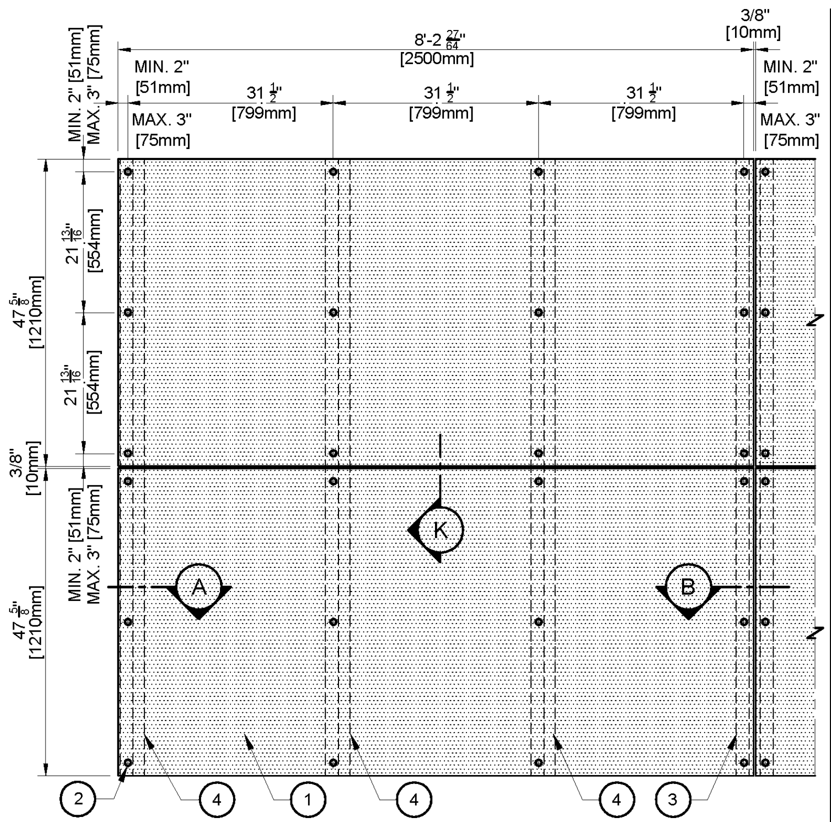
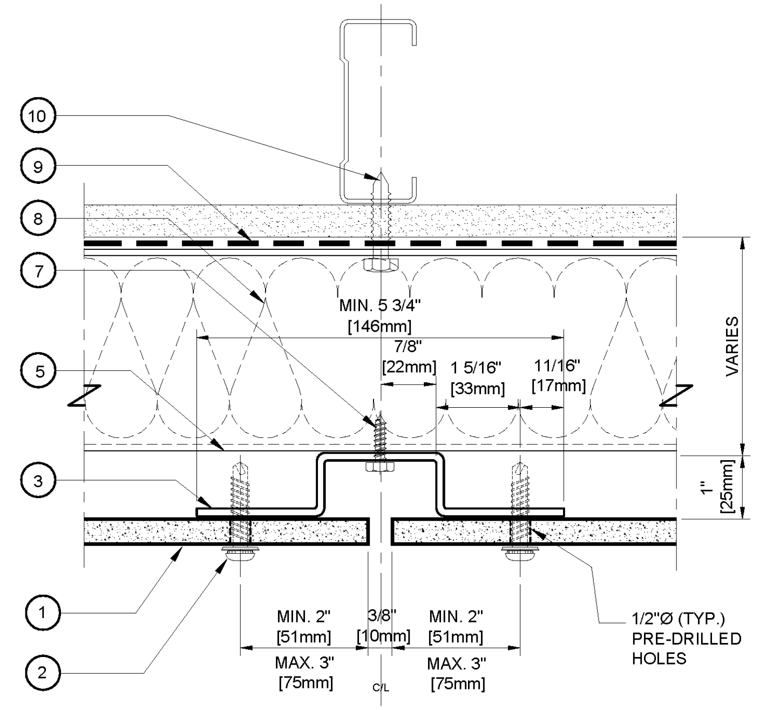


PARTIAL PANEL ELEVATION



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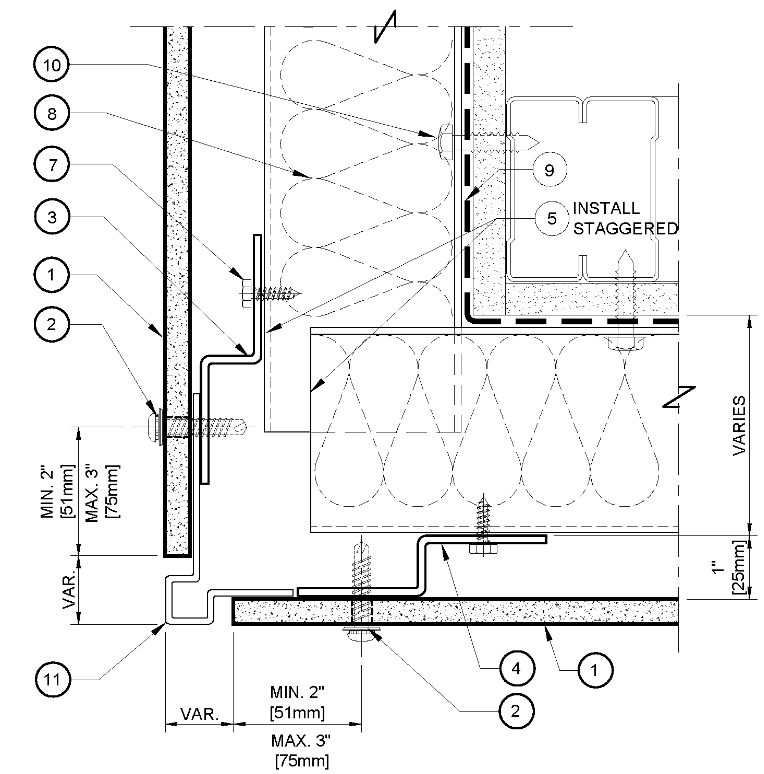

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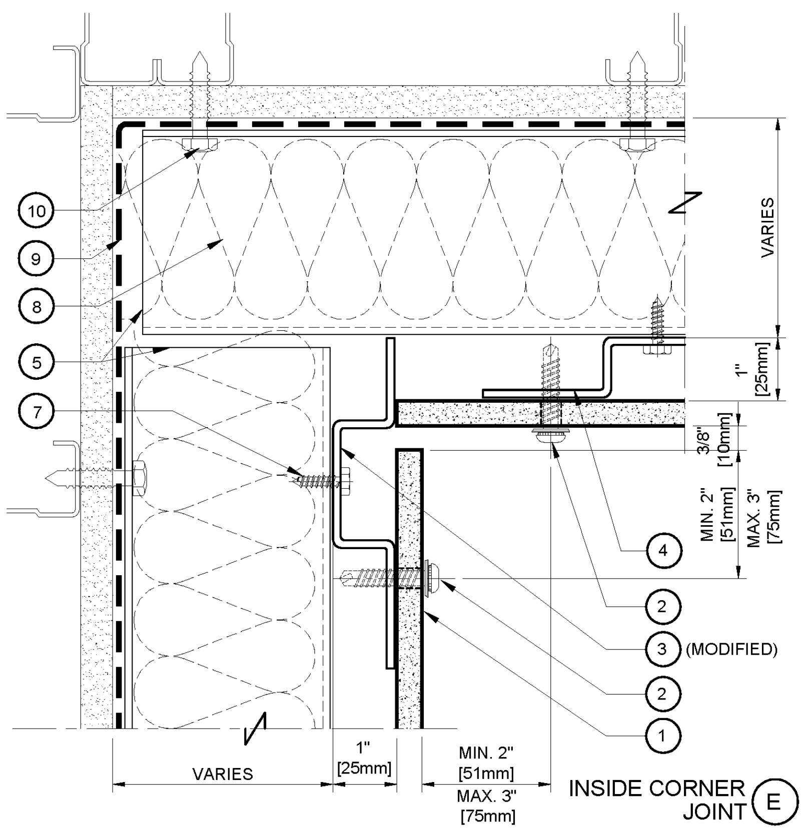

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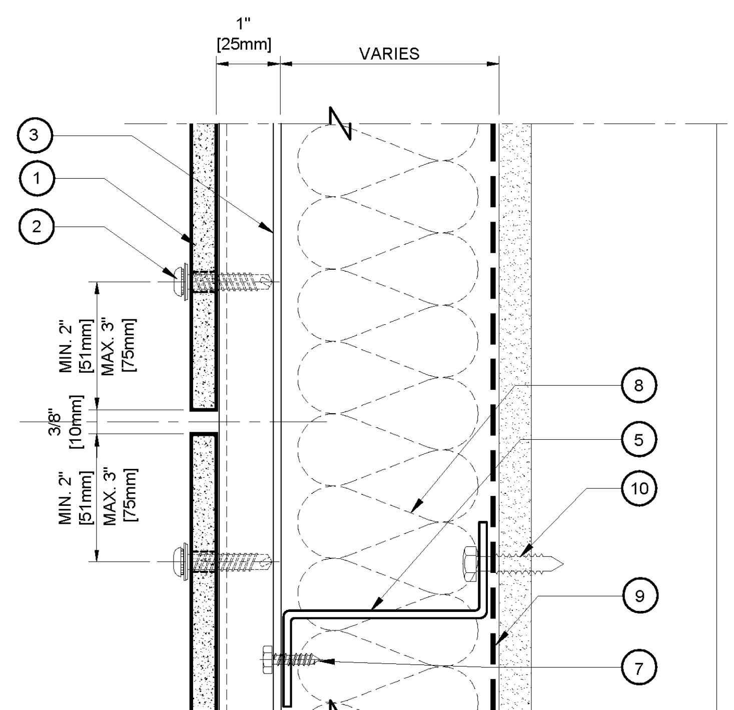

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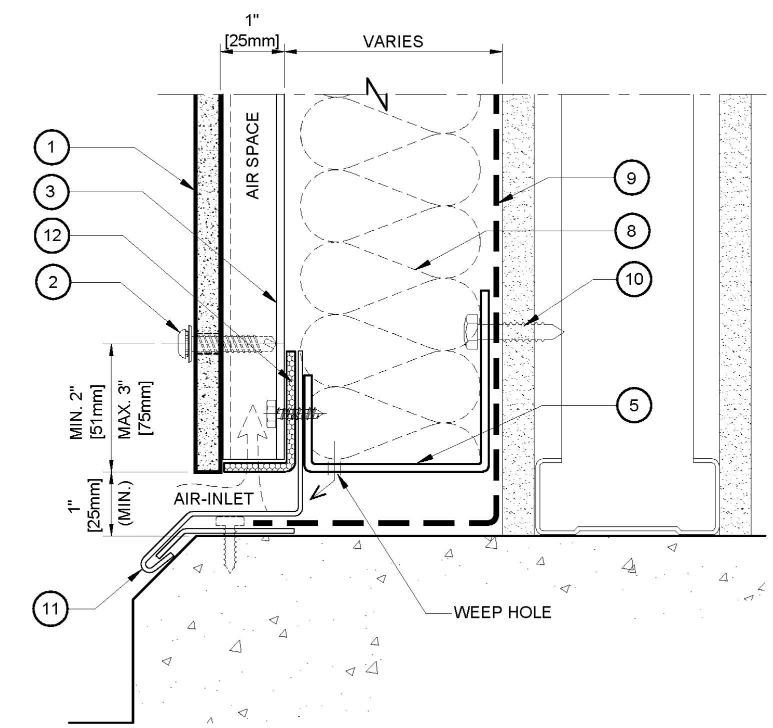

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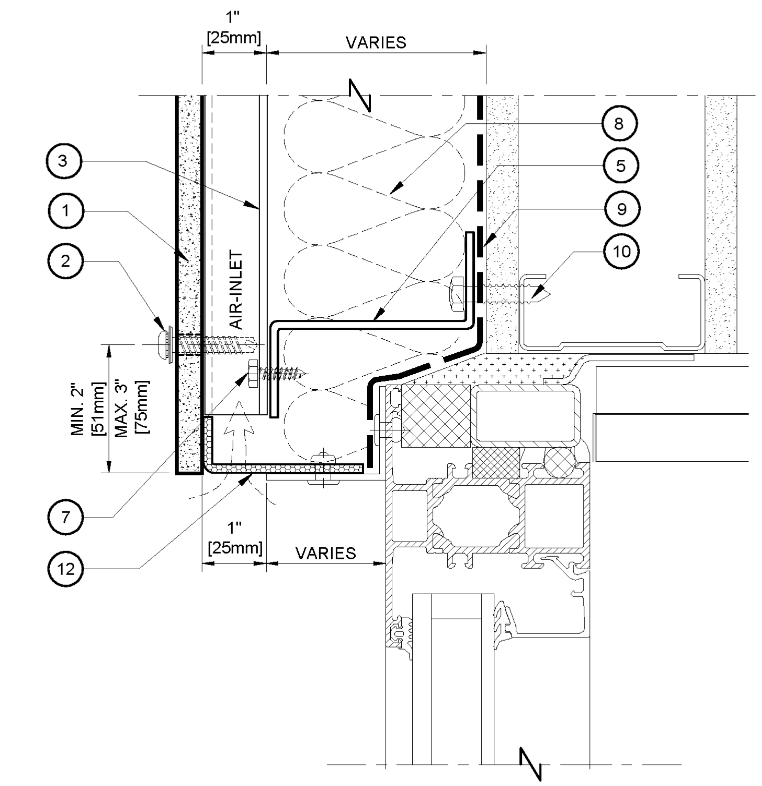

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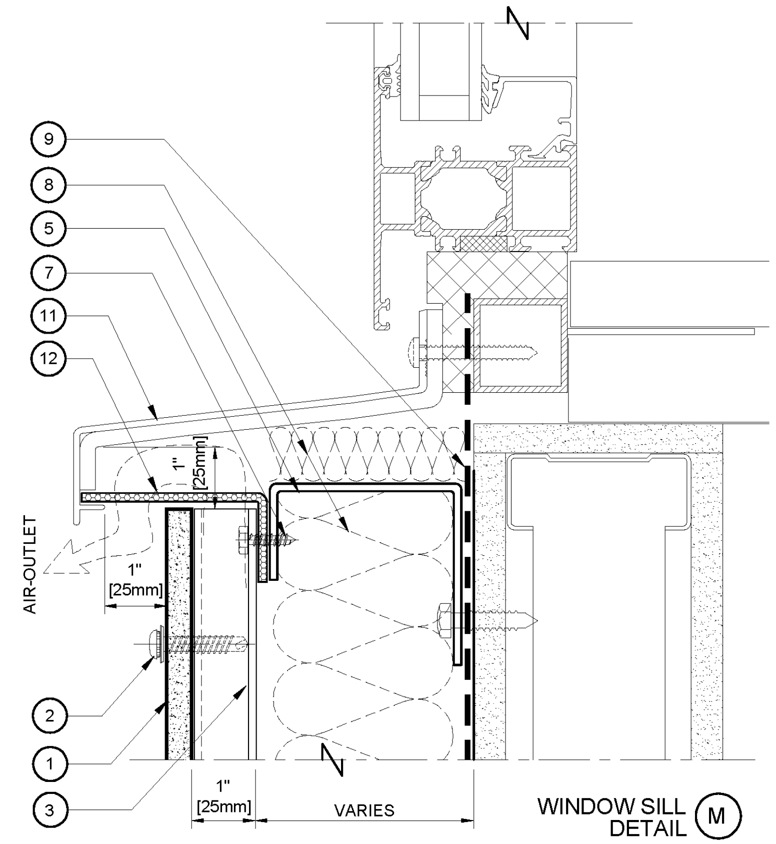

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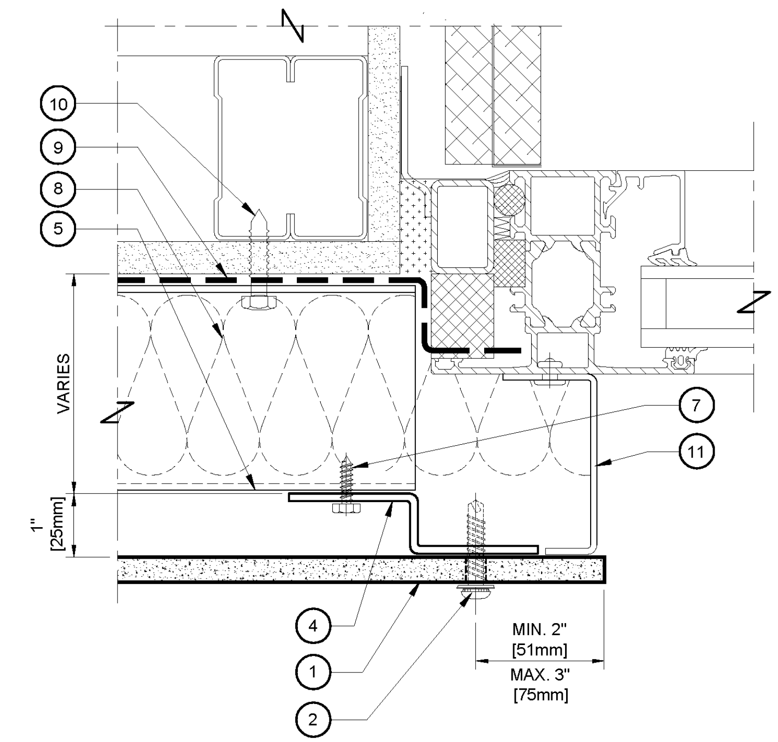

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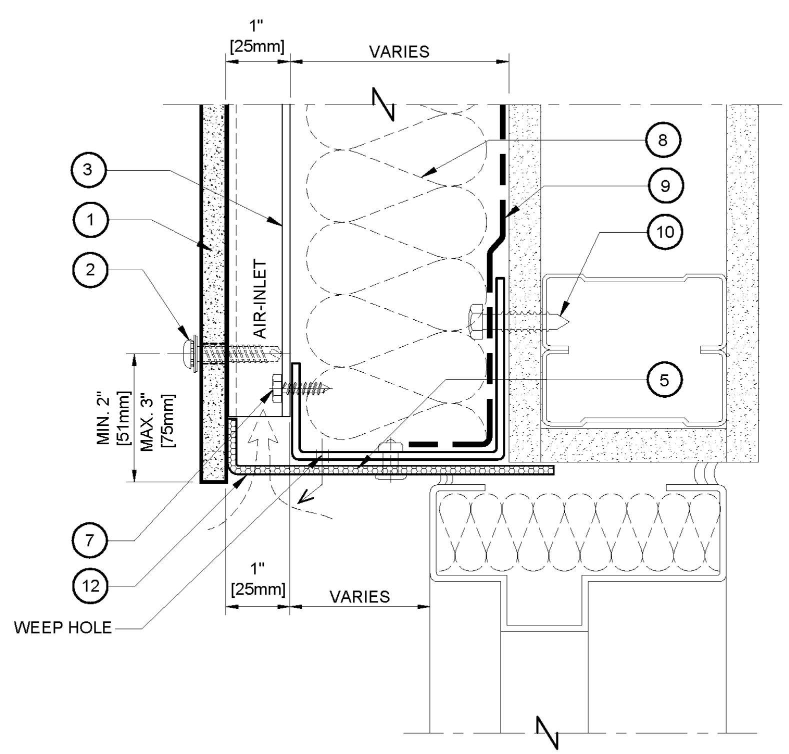

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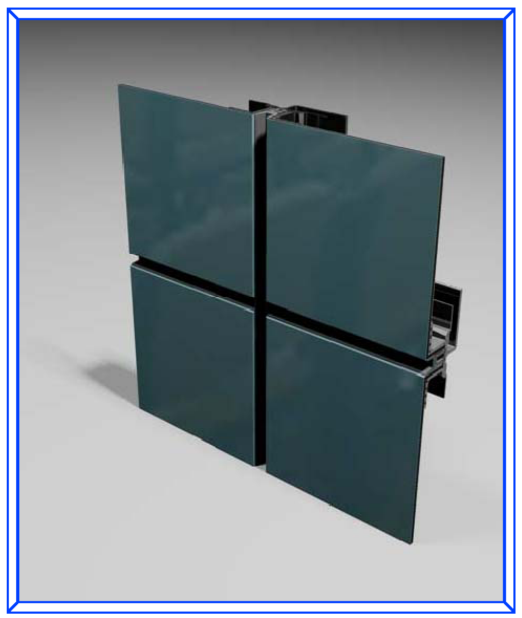
BAMCO inc.

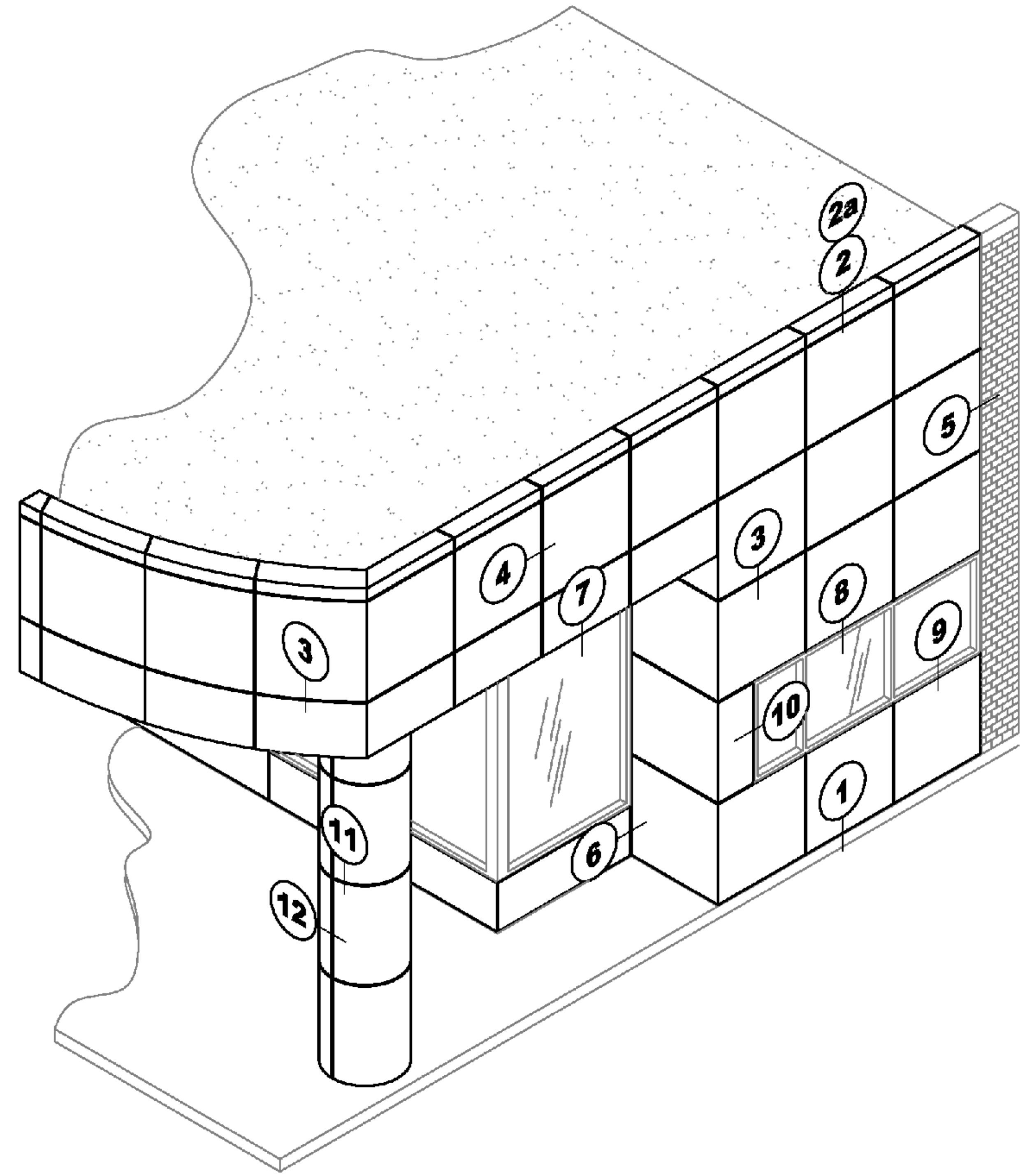
Composite Metal Wall Systems

G-500 ALUMINUM COMPOSITE PANEL SYSTEM



30 BAEKELAND AVENUE
MIDDLESEX, NEW JERSEY 08846
PHONE: (732) 302-0889 FAX: (732) 302-9456
WWW.BAMCOINC.ORG

NOVEMBER 2008



BAMCO inc. 30 Baekeland Avenue, Middlesex, NJ 08846	PHONE: (732) 302-0889 FAX : (732) 302-9456 www.bamcoinc.org	Detail Name: BAMCO G-500 SAMPLE BUILDING ISOMETRIC			Drawing No. G500
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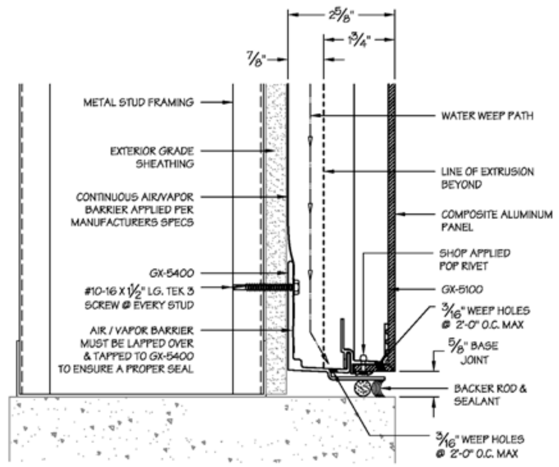

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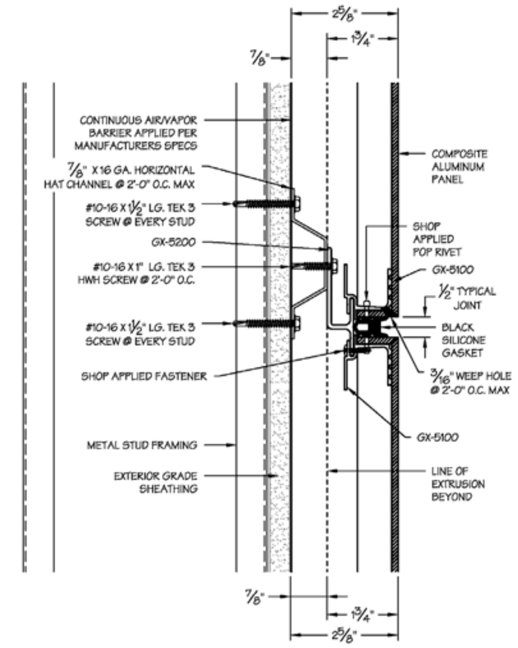

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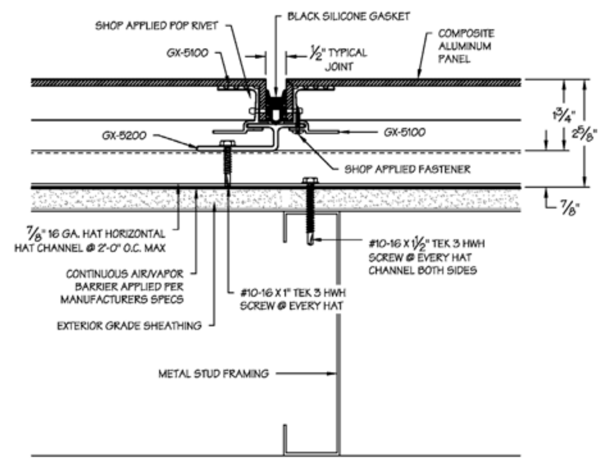

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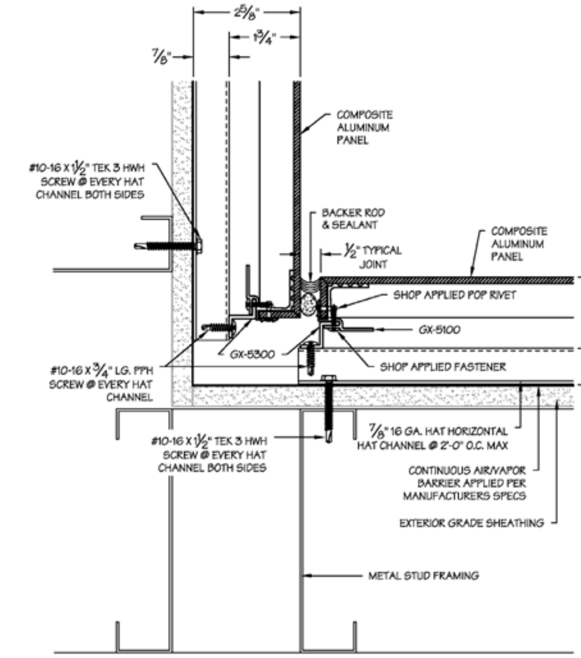

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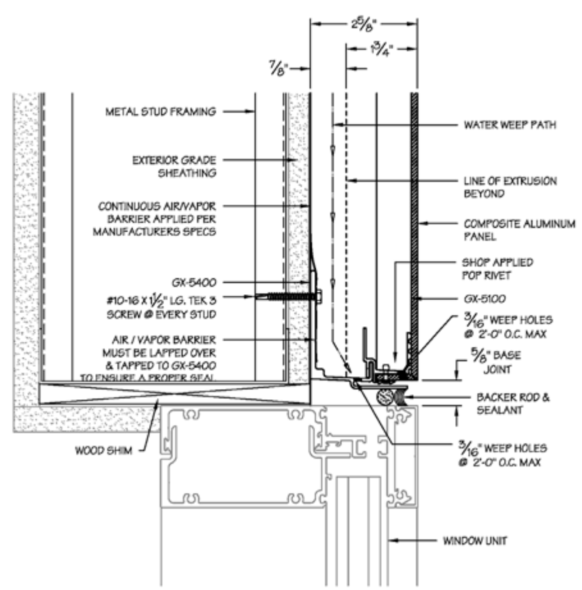

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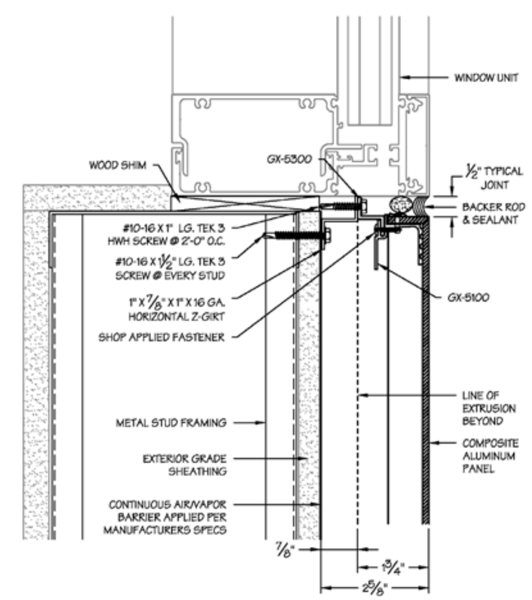

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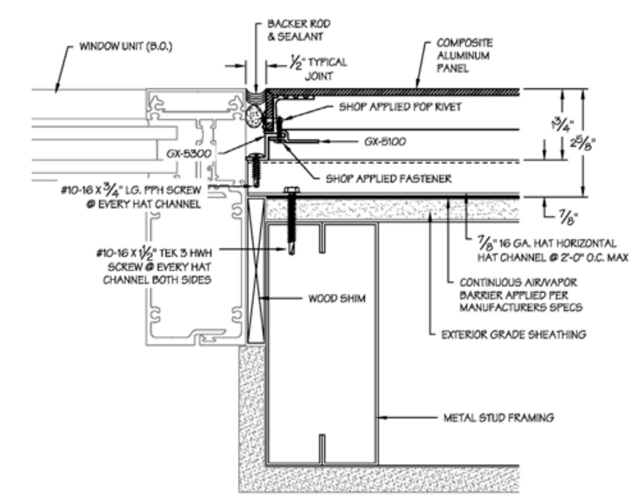
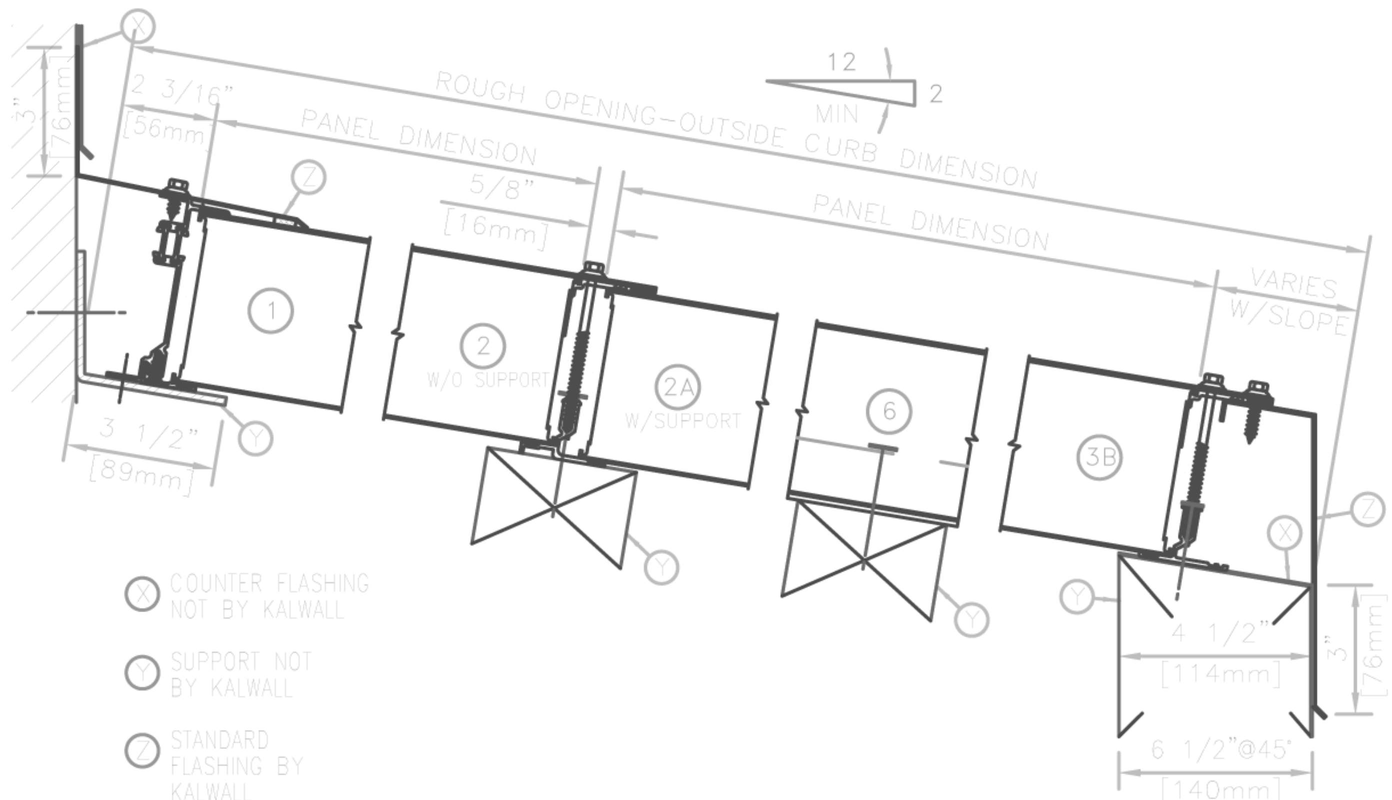


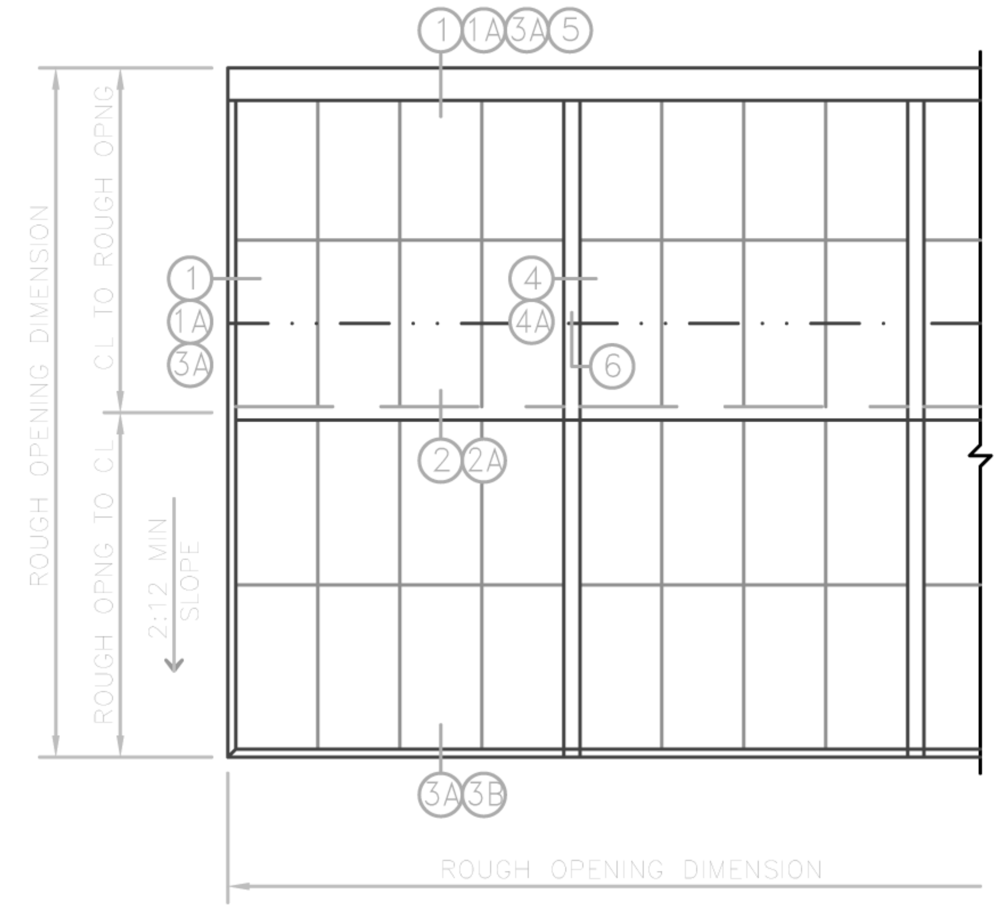
BAMCO G-500 TYPICAL WINDOW JAMB

APPENDIX B

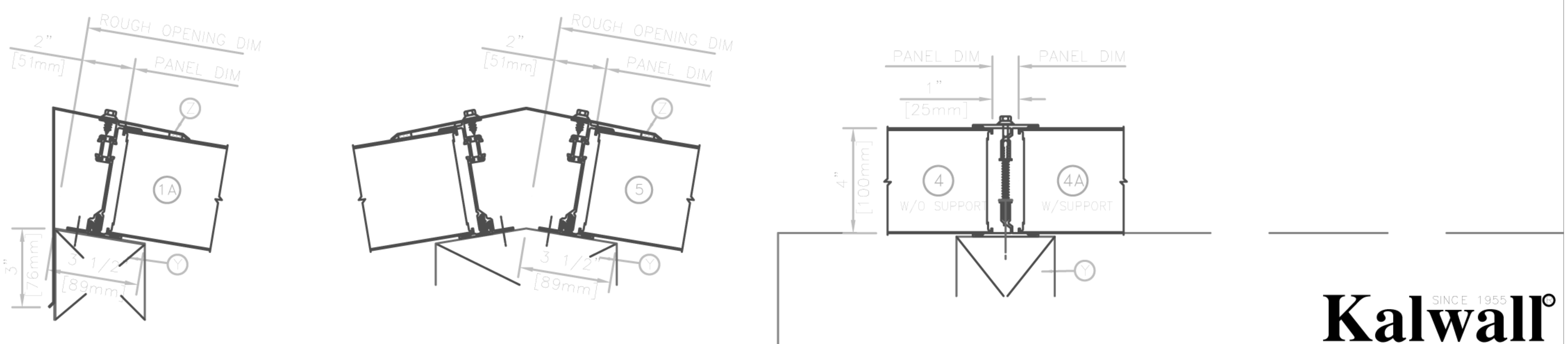
KALWALL SUPPORTED ROOF CUT SHEET

KALWALL 100 SUPPORTED ROOFS





ROOF PLAN

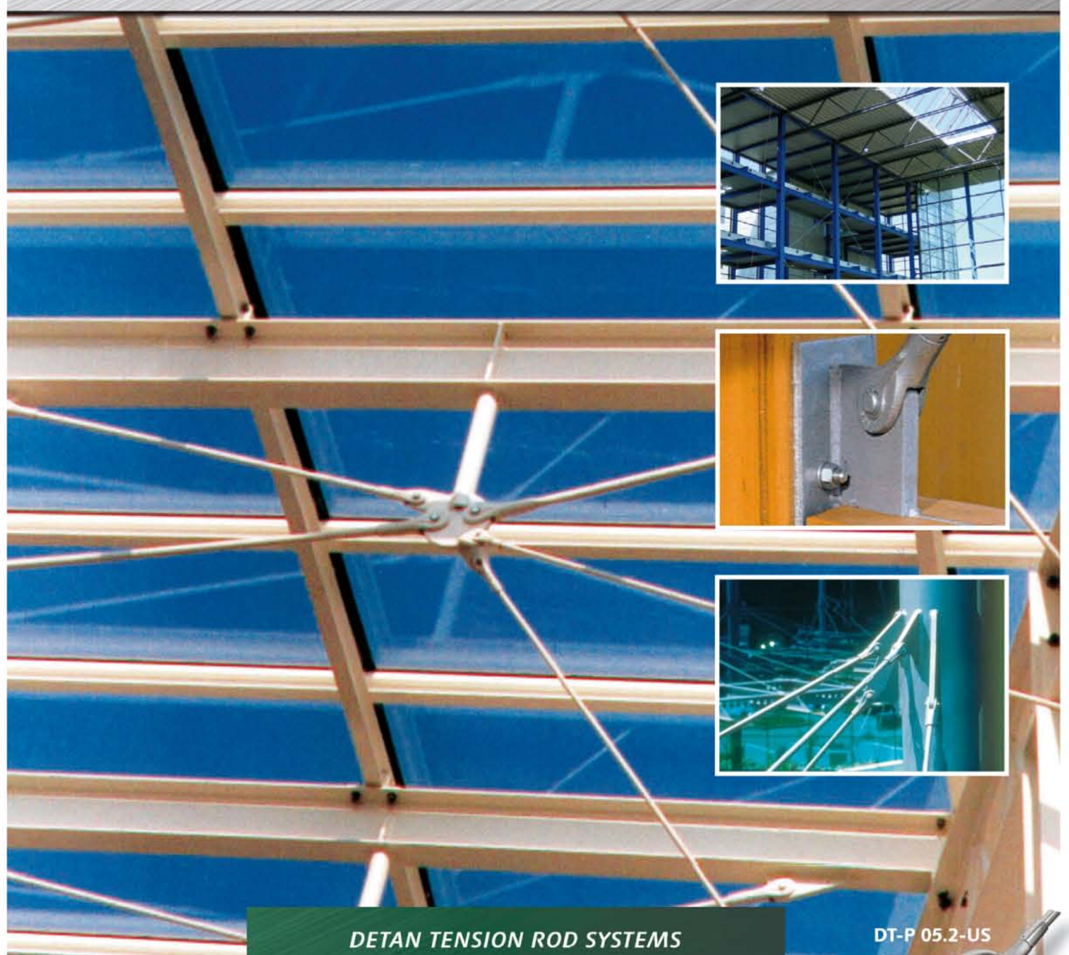


Kalwall SINCE 1955 CORPORATION

APPENDIX C

HALFAN TENSION ROD SYSTEMS PRODUCT INFORMATION

DETAN TENSION ROD SYSTEMS
PRODUCT INFORMATION



DETAN TENSION ROD SYSTEMS

FACADE

DT-P 05.2-US

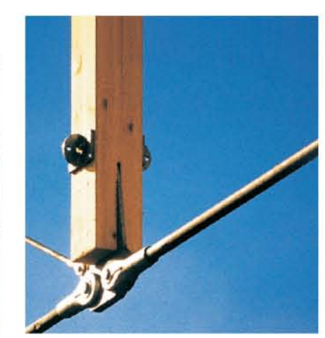
HALFEN® ANCHORING SYSTEMS

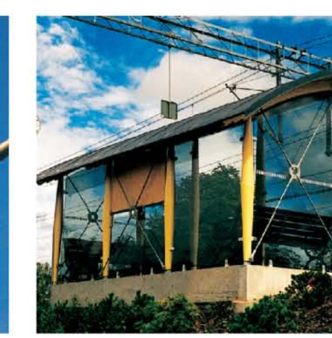
DETAN TENSION ROD SYSTEM
Introduction

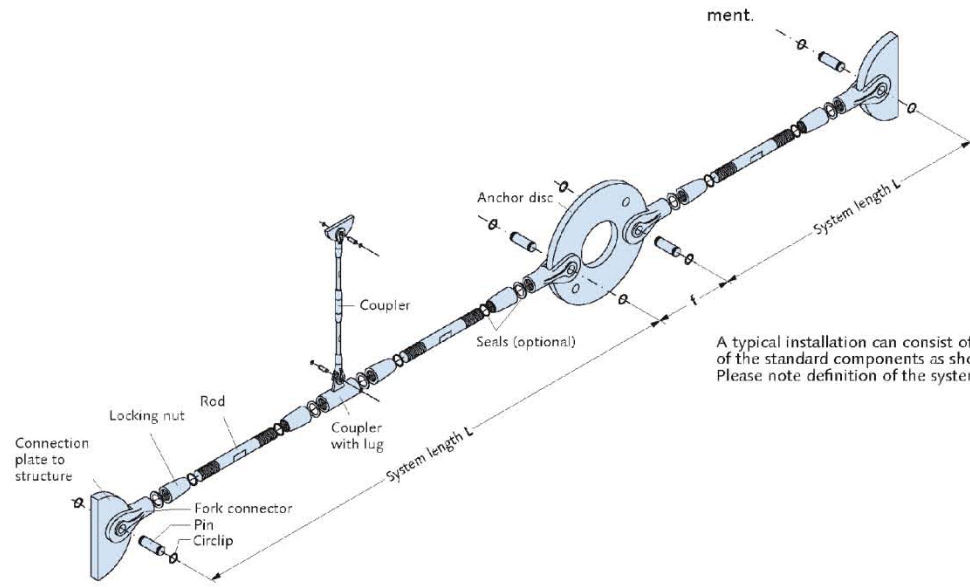
The DETAN Tension Rod System
The DETAN Tension Rod System is an aesthetically pleasing method of providing bracing or structural support. The DETAN system is manufactured from both carbon steel and stainless steel in a variety of sizes.
Adjustment for length is hidden within the system and is provided without the use of turnbuckles or unsightly exposed threads.

The manufacture of every component in the DETAN system is permanently controlled and fulfills the requirements of the HALFEN Quality Management System, certified according to ISO 9001. The DETAN System has been type approved by the Inspection Board for Building Engineering LGA, Bavaria, Germany.

Product features:
- Easily adjustable for length
- Available in carbon steel and stainless steel
- Variety of standard finishes
- Type approved
- Sealing of the threads for corrosion protection available (optional)
- System diameters from 6 mm to 95 mm (1/4 in. to 3-3/4 in.) in stainless steel up to 30 mm (1-1/4 in.)
- Load capacity up to 605.8 kips (2695 kN)





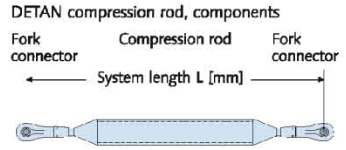


A typical installation can consist of some or of the standard components as shown. Please note definition of the system length l

SYSTEM SELECTIONS

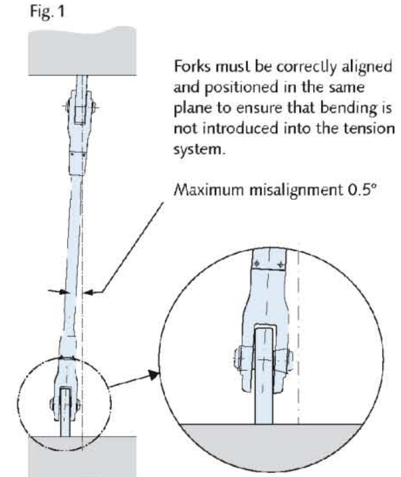
Material	Rod Ø [in.]	Components	Finish	System length L [mm]
Carbon Steel Stainless Steel	DT-S460: ds=1/4 to 3-3/4 DT-E: ds=1/4 to 1-1/4	Rod + Connection Set Anchor Disc 2 Rods + 1 Connection Set + 1 Coupler Set 2 Rods + 1 Connection Set + 1 Coupler Set with lug	Carbon Steel. **fv**=hot dip galv. Stainless Steel: **p**= polished	L If couplers are required their positions within the system length should be specified.

DETAN compression rod, components



Arrangement of connection plates

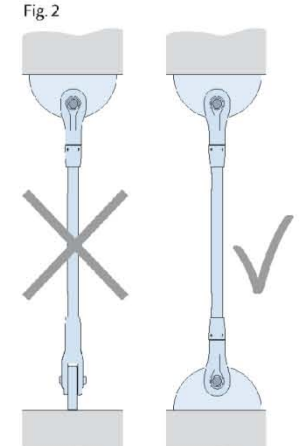
Fig. 1



Forks must be correctly aligned and positioned in the same plane to ensure that bending is not introduced into the tension system.

Maximum misalignment 0.5°

Fig. 2



DETAN TENSION ROD SYSTEM

Typical Projects

❶ Cribbs Causeway, Bristol (UK)

❷ + ❸ Pedestrian bridge, Schwarza (GER)

❹ Central Station, Helsinki (SF)

❺ Hildegard-Forum, Bingen (GER)

❻ Bracing of a large glass facade

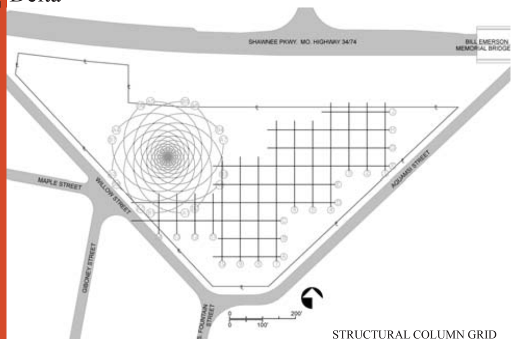
❼ Noise protection wall, Oberlaa (AT)

APPENDIX D

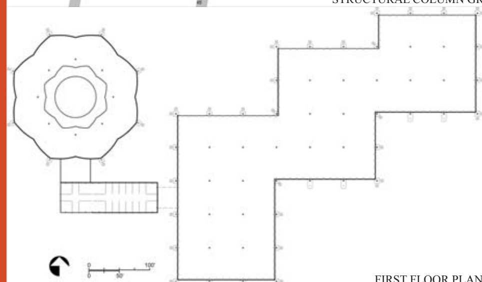
FINAL DESIGN BOARDS

ASSEMBLY & JOINTURE

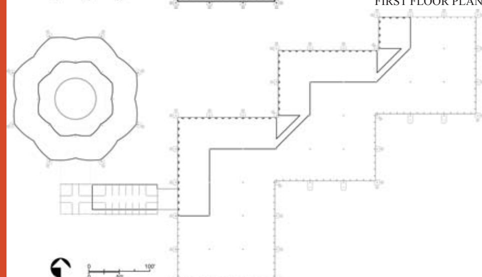
A Tectonics of Place & Structure in the Mississippi Heartland Delta



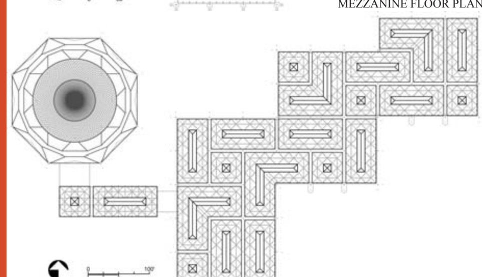
STRUCTURAL COLUMN GRID



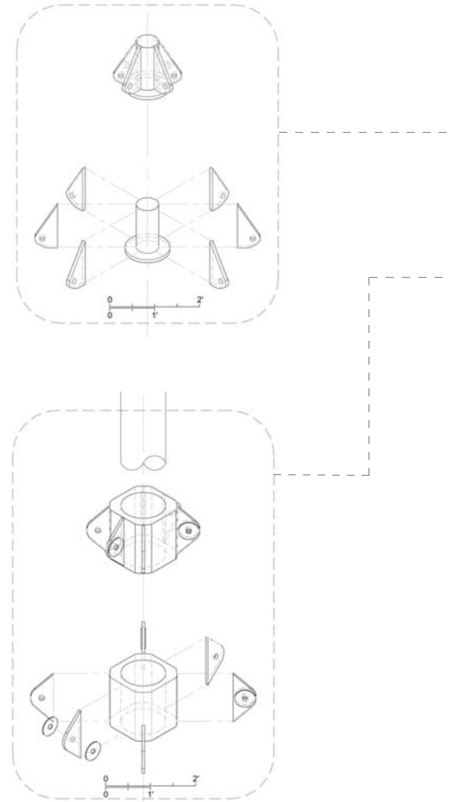
FIRST FLOOR PLAN



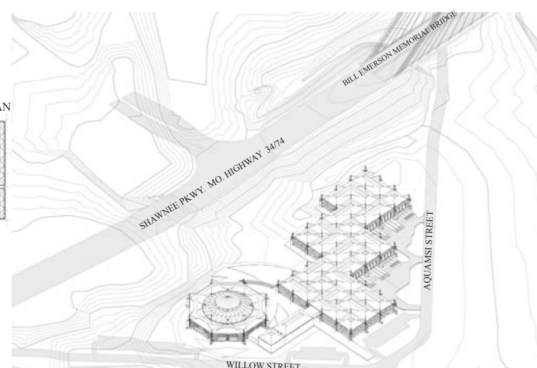
MEZZANINE FLOOR PLAN



ROOF PLAN

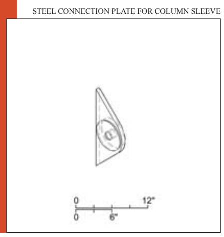


EXPLODED ASSEMBLY DIAGRAMS OF STRUCTURAL JOINTS

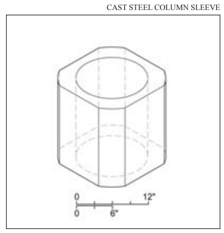


3D MODEL & SURROUNDING SITE CONTEXT

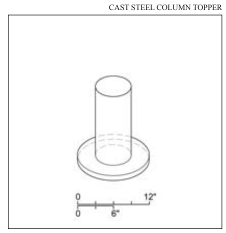
STEEL CONNECTION PLATE FOR COLUMN SLEEVE



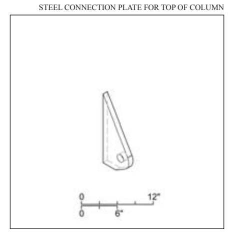
CAST STEEL COLUMN SLEEVE



CAST STEEL COLUMN TOPPER

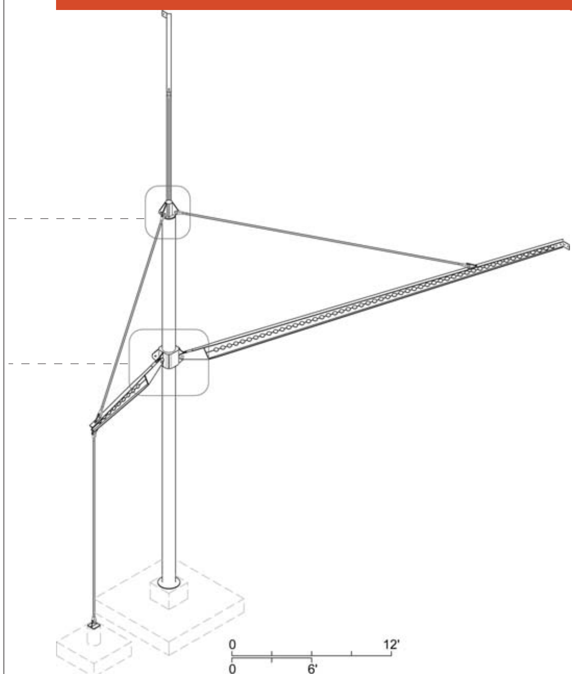


STEEL CONNECTION PLATE FOR TOP OF COLUMN

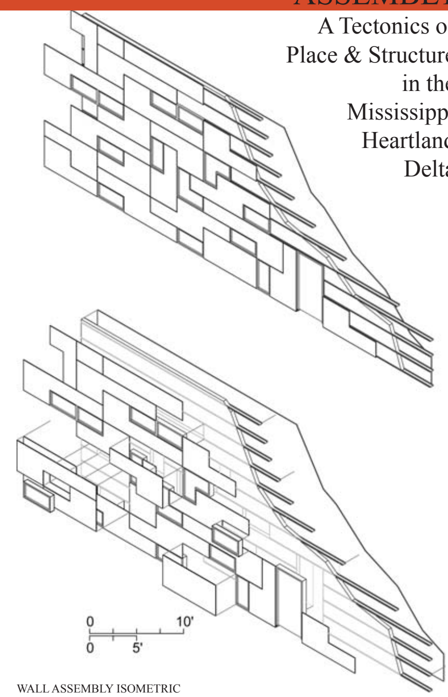


ASSEMBLY & JOINTURE

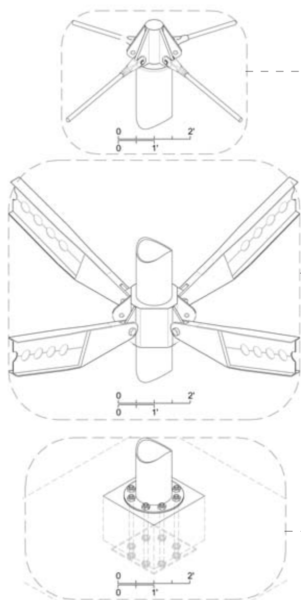
A Tectonics of Place & Structure in the Mississippi Heartland Delta



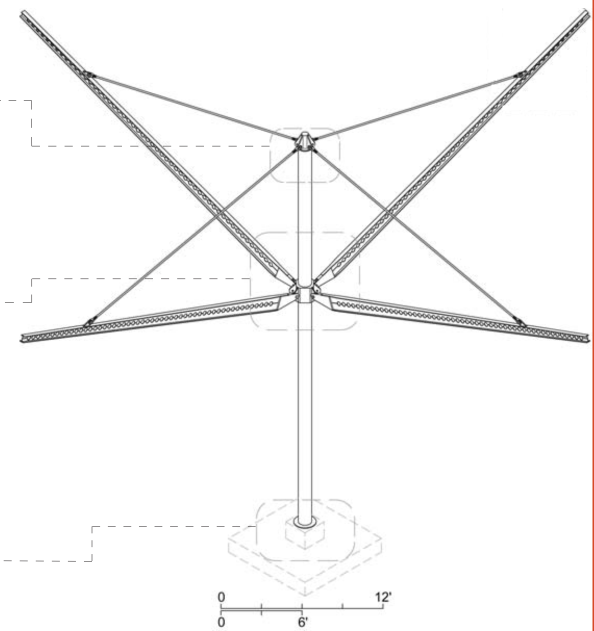
ISOMETRIC OF TYPICAL EXTERIOR COLUMN-BEAM



WALL ASSEMBLY ISOMETRIC

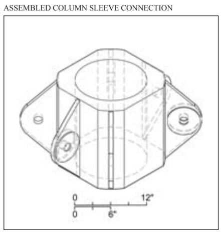


ENLARGED ISOMETRIC DIAGRAMS OF COLUMN ASSEMBLY

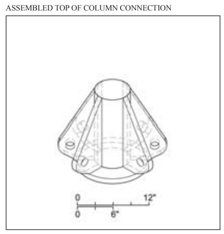


ISOMETRIC OF TYPICAL INTERIOR COLUMN-BEAM

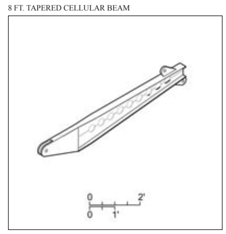
ASSEMBLED COLUMN SLEEVE CONNECTION



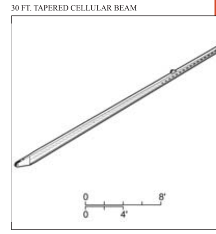
ASSEMBLED TOP OF COLUMN CONNECTION



8 FT. TAPERED CELLULAR BEAM

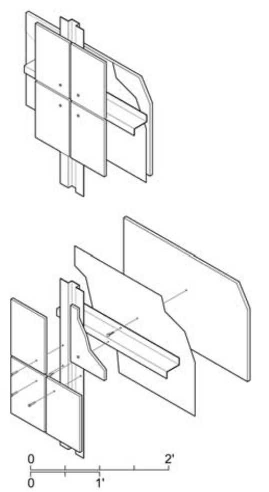


30 FT. TAPERED CELLULAR BEAM

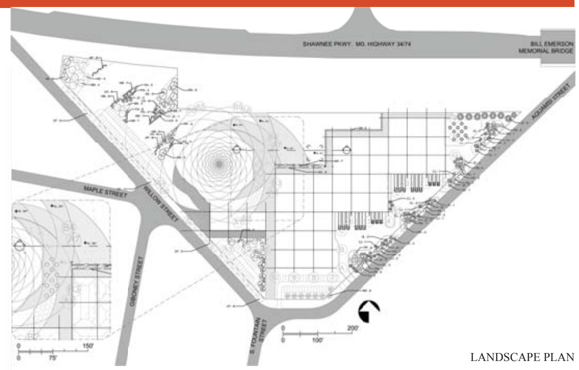


ASSEMBLY & JOINTURE

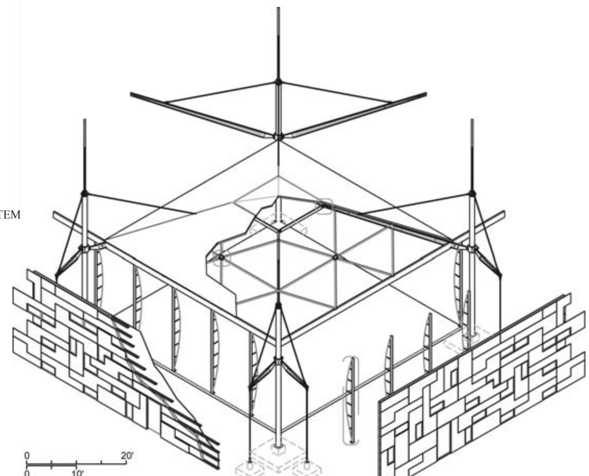
A Tectonics of Place & Structure in the Mississippi Heartland Delta



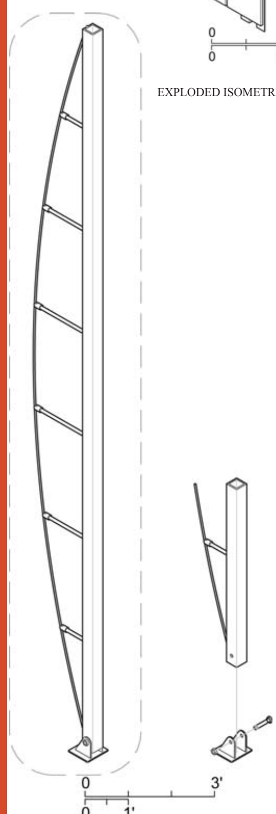
EXPLODED ISOMETRIC OF FIBRE-C FACADE SYSTEM



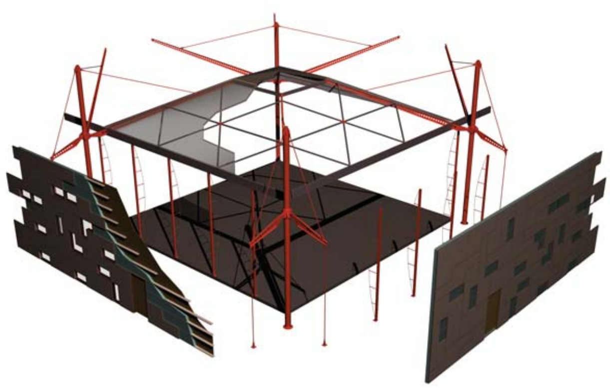
LANDSCAPE PLAN



EXPLODED ISOMETRIC ASSEMBLY DIAGRAM OF A SINGLE BAY

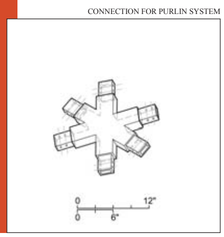


ENLARGED TENSIONED COLUMN TO SUPPORT FACEDE

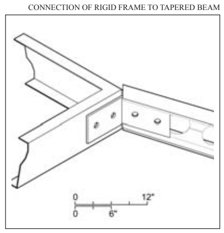


EXPLODED DIAGRAM RENDERING OF SINGLE STRUCTURAL BAY

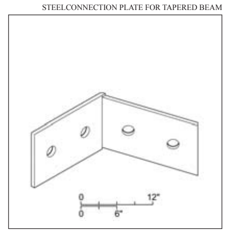
CONNECTION FOR PURLIN SYSTEM



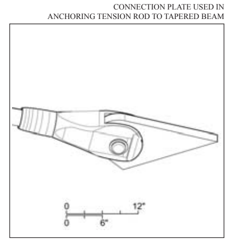
CONNECTION OF RIGID FRAME TO TAPERED BEAM



STEELCONNECTION PLATE FOR TAPERED BEAM



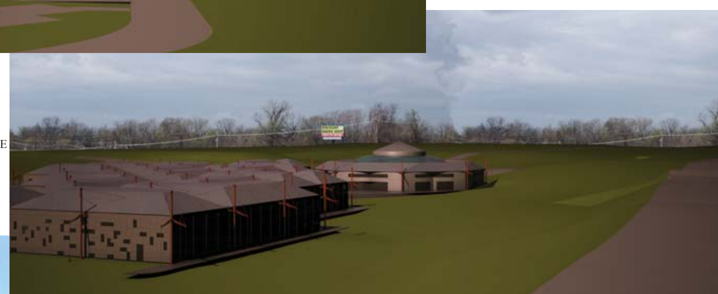
CONNECTION PLATE USED IN ANCHORING TENSION ROD TO TAPERED BEAM



ASSEMBLY & JOINTURE

A Tectonics of Place & Structure in the Mississippi Heartland Delta

VIEW LOOKING NORTHEAST TOWARDS BILL EMERSON MEMORIAL BRIDEGE



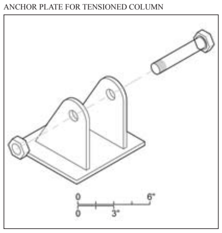
VIEW LOOKING FROM THE BRIDGE

VIEW LOOKING EAST TOWARDS MISSISSIPPI RIVER

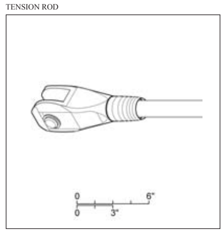
VIEW LOOKING NORTH FROM THE COURTYARD TOWARDS SEMO RIVER CAMPUS

VIEW LOOKING TOWARDS COURTYARD

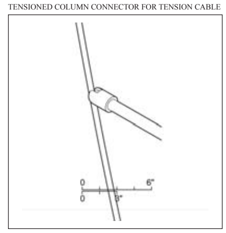
ANCHOR PLATE FOR TENSIONED COLUMN



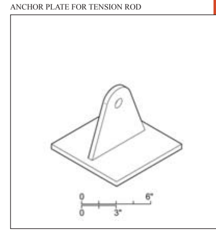
TENSION ROD



TENSIONED COLUMN CONNECTOR FOR TENSION CABLE



ANCHOR PLATE FOR TENSION ROD



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