[TECH]nology in Architecture

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ABSTRACT

With the use of technology architects can break the pattern of the dangerous orthogonal building. Technology in architecture is starting to eliminate the fallacy that non-orthogonal buildings are too costly and too complex to be built. This is happening by connecting the 3 - dimensional model directly to the construction phase and architects are also learning from other industries such as the ship and auto industry that have formed methods to keep designers connected to the fabrication process. With the help of technology it is also helping the architect gain more control of the project bringing him closer to a new age master builder. Technology is also opening up a whole new method of designing that is creating new and innovative forms. The process of designing is being influenced by the computer and if watched and used correctly the forms will benefit the architecture.

PROJECT SUMMARY

Currently there is a predominance of simple orthogonal forms in the built landscape of North America, which has a tendency to be a self-perpetuating condition. Designers (and their clients) may assume that because of the public's familiarity with simple orthogonal forms, more complex or non-orthogonal spaces should not be considered. This predisposition may even be unconsciously reflected in new designs.

The architect used to be considered the "Master Builder." This term referred to the fact that architects had control of the project from design through construction; a "one stop shop" so to speak. It was easy for them to do this because they built the project and designed it, in a manner that is similar to a "Design-Build" firm of today. Now we have lost this ability to control the construction phase of the project.

It is time for architects to learn from other industries such as the ship and auto industry that have formed methods to keep designers connected to the fabrication process. For example, once a ship's 3-D model is completed, that model is used throughout the entire construction process. In the auto industry a car's motor is put together at one plant, the body at another and so on. Finally when all the pieces of a car reach a final destination they are assembled. If architects start using these techniques we can accomplish two things.

First of all, we can eliminate the fallacy that non-orthogonal buildings are too costly and too complex to be built. The connection of digital models to new forms of digital manufacturing means that unique parts ("mass customization") which may be necessary to create complex forms, are just as feasible to construct and just as economical to produce as simple orthogonal parts though not as economical to assemble in many cases. Although they are still much more costly to assemble. Secondly, we can bring architects back to the status of a modern day "master builder." This can be done with the connection of the 3-D model and the manufacturing phase of the building's beams, skin, walls, etc... Information such as the exact radius of a curvilinear piece can be sent directly from the 3-D model to the manufacturers.

Architecture has been influenced by these new technological advances pioneered by these other industries. These two things have created changes in the way architecture is being designed and buildings are being constructed. The technology of today and tomorrow along with what we learn from other industries will cause architecture to be transformed in ways that we can not imagine. These new technological advances and the knowledge from other industries have caused a serge of new forms in the architectural world. Are these new tools going to bring the construction phase of the project closer to the architect? The thesis project hopes to demonstrate that these new technologies are allowing us to actually propose more complicated and dynamic forms which would be impractical without these new forms of technology. The project also hopes to illustrate a renewed sense of the importance of the tectonics of construction by re-connecting the designer to the making of buildings through the filter of digital design and construction.

2. THESIS PAPER 8

This thesis seeks to investigate dynamic spaces through the use of mass customization and other forms of digitally based design, modeling , and fabrication technology. There are techniques and software that sister industries use that architects can use as well that will help in the designing and building of dynamic spaces; this will make them easier to be assembled and designed. The title "architect" used to mean "master builder", now the word holds a much different meaning. The use of mass customization technology is bringing us closer to gaining the control architects used to have over the construction of their projects no matter how dynamic the spaces are. Are dynamic spaces really more feasible with the use of cutting edge technology and mass customization?

When an architect sits down with a client and they start discussing a design process, often times an orthogonal form is already a preconceived notion from the start. Most of the time the use of these basic forms happen sub-consciously and tends to address what the client wants quickly. The use of orthogonal forms is dangerously taking over architecture more and more every day. This has continued to occur for years but with the use of technology it is starting to become broken. Technology is beginning to help us overcome the routine manner in which architects are choosing to design orthogonally; architects can now access a wider range of formal possibilities during the design process more easily. Architecture runs the risk of becoming routine and static over time, not capable or able to be creative and innovative if buildings become routine. **1**. If a building becomes routine can you really consider this architecture? Architecture is supposed to be innovative and creative. In schools across the nation students are told this and their studying lies along these lines as well. "Techniques are behaviors and procedures that are systematic, repeatable, and communicable." **2**. Most architects have now been using software such as CAD (computer aided design) as a design and construction tool for so long they have become very familiar with the techniques used to make the software perform to its limits. Once this happens new techniques are found by either experimenting and testing the program or sometimes rewriting the underling code of the entire program. This is how architects can harness and direct the powerful potential of new technologies in architectural design, research and manufacturing. 3. With the use of digital technology architects can explore non-orthogonal forms with their computer. This type of technology addresses architecture in an entirely new way. By using animation software that was originally created for movies the architect can create a walk through of a non-orthogonal space. This will give the client a better feel of what that space may look and feel like. Technological advancements are measured by their effectiveness. These advancements are usually measured by new patterns of behaviors and performance the technology is able to create in its users. If it is a good technical advancement there will be one of the following happening or in some cases all of these things happening; "efficiency with less material, fewer parts, and less resistance." 4. Architects that are using state of the art technological advances are taking the profession back in time bringing it closer to what it used to mean to be an architect.

To be an architect used to mean that you were a "master builder." The master builder was a person who combined the roles of an architect, a builder, a engineer, and a scientist. Most buildings both modest and aspiring , were designed and erected by master builders until only a few hundred years ago. **5**. Architects used to work in the same way

as a design build firm of today. Master builder meant that the architect would design and build the project himself; this gave the architect complete control of the project from start to finish. The architect was able to decide what materials, process, and what tools would be used to construct the project. This has not been seen in the architecture community since the early renaissance time period. **6.** Architects today do not have this same control over their projects. For example, once the design phase and the construction documents are produced the architect then sends the documents out to the project manager. Once this occurs the architect is not in close control over what materials or what construction process creates the building he has designed. He is supposed to, but sometimes the contractor and the owner of the building want the architect to make decisions about these things based on price. Wheather it is the price of the material or the price of labor. Many decisions that go along with the building process are never discussed with the architect. When an architect creates a design they have certain ideas in mind that make the building what it is intended to be. However, if a certain material is up in cost that month the contractor may decide to go with a material that does not cost as much. To sum it up the architect and the tradespeople just had a much greater common understanding about how the building was intended to be built. The architect drew a lot less because there was a more common understanding about the construction of this building. Today technology is bridging the gap between the architect, design, and the construction phase of the building. Architects are learning from sister industries to connect the design phase of the project to the manufacturing of the buildings pieces at an early point in the process, giving them more control and bringing them closer to the construction phase of the project. **7.** This ability to connect themselves to their projects is giving more of the responsibility back to the architect. More responsibility and more control of the project brought back to the architect is the direct link in attempting to make the architect become the "master builder" he once was.

We will never get back to what it used to mean to be a master builder, but we are getting closer with the new advances that are happening everyday in architecture. The designer is becoming connected to the construction of the project at the conceptual phase of the design. This is leading to virtual testing of models under simulated stresses. "As architects become more accustomed to working directly with construction manufacturers at the inception of a design, the potential benefits of integrating manufacturing processes into the design generation will become more evident and more widely adopted." **8.** This is something that is happening in sister industries such as aerospace, maritime and automotive engineering. The wear and fatigue of the product can be simulated early in the conceptual design phase of the product. We as architects are learning how to use other industry's methods in design and construction. Architects are starting to use the techniques they are learning and the information they are gaining in their own projects daily in search of results. Architects are using animation software from the film industries, techniques from aerospace, auto, and ship engineering, and their software is also beginning to be used by the avant-guard architectural firms around the world.

Aerospace engineers and the auto industry have been using software called CATIA for many years now. Gehry Associates uses this specific program on its projects because his forms are so complex and dynamic this program is able to handle complex information in three dimensions. Gehry Associates is an advocate for three-dimensional rather than only two-dimensional information to develop building requirements. This helps the architectural design, mechanical, electrical and structural engineering, cost estimation, and fabrication of

the building all to be integrated or managed from the same model. The first project on which Gehry Associates used CATIA was called the Guggenheim museum located in Balboa Spain. Gehry Associates uses techniques from the shipbuilding industry as well; the 3-D model is used all the way through the construction of the building making it so constuction documents never have to be produced, nearly a paperless project. The pieces of the skin were made into molds that were CNC machined and then sent to the site. Once they reached the site they were scanned and the CATIA model was able to show where each piece was expected to go. After the Guggenheim project Gehry Associates and IBM formed a separate consultant firm called Gehry Technologies that developed a new version of CATIA. They worked on CATIAs' formal design, curvature analysis, integration of engineering and other building systems and manufacturing techniques. **9.** This is an example of a firm learning a software program, pushing it to its limits and having to invent new techniques and rewrite some of the software so it can better be used by architects. Some of the same things are happening with software that is used by the film industry. There is always room for advancements in many types of software designs and architecture based programs leave much room for research and development.

The film industry uses software programs that let them develop animations, and special effects in movies and television. One of the widest used programs in architecture today is 3-D studio Viz and 3-D studio Max. Alias Wavefront's 3-D modeler Maya is another software used by the film industry that is starting to be used by a few architectural firms. Some of the firms that are beginning to use this program are Emergent Architecture, Contemporary Architecture Practice, and AEDS just to name a few. This software is very advanced; so advanced in fact that it was used in movies such as Lord of the Rings. These architecture firms are learning how to use it and then pushing the program to its limits in search of new developments. One of the latest developments for this program is a plug in called Genr8. A plug-in is a program that is written and then added to the program to make it do things more creatively and dynamically that it originally was designed to do. This plug in "uses a population-based adaptation akin to evolution and a generative algorithm akin to growth. The exploration is enabled by an evolutionary module that produces populations of surfaces in many generations, and the development is governed by an algorithm that mimics organic growth." **10.** The outcome is unpredictable and the edges of the algorithm can be changed to alter the outcome of the skin.

Mass customization is used by many industries such as the bike, and clothing industry just to name two. Once a bike is produced, such as Lance Armstrong's, it is very easy for the bike manufacturing company to change the length of certain parts and mass produce the bike. Mass customization, a computer numerical controled (CNC) machine, and dynamic forms go hand-in-hand. Without mass customization and the CNC machine, dynamic forms would not be as buildable as they are today. The CNC machine has been directly linked to the conceptual design stage in many ways. As the design starts the architect and the material engineers start testing pieces of the material that are cut out with the CNC machine. There are several virtual and real tests that occur on the material before the final piece is actually made. Once the final mold or piece is made with the CNC machine it is very easy to change just a few numbers to create the next piece. This is an example of mass customization. This is just another example of how technology and methods from other industries are being used in architecture.

The ability to use digital design technology at every stage of an architectural project

from conception to fabrication allows for contemporary technological practices to seamlessly operate between scales, preserving complexity through all levels of design. **11.** As time goes on architects learn more about new software and more techniques from other industries which is bringing new dynamic forms into the architectural community. Without new technology the production of dynamic spaces using mass customization would not be possible.

Notes

1. Rahim , Ali. pg. 45

2. "IBID"

3. "IBID"

4. Rahim , Ali. pg. 47

5. Kieran, Stephen pg. 22

6. Kieran, Stephen pg. 56

7. Weinstock, Michael, and Nikoaos Stathopoulos. pg. 55

8. "IBID"

9. Rahim , Ali. pg. 61

10. O'Reilly, Dr. Una-May, Martin Hemberg, and Achim Menges. pg. 51

11.Rahim, Ail pg 41

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Pretty Good Life Showroom Stockholm, Sweden

Construction: 1999-2000

Architectural Firm: Greg Lynn FORM Lead Designer Greg Lynn

Client PrettyGoodLife.com AG Stockholm, Sweden
Concept for PrettyGoodLife.com the need for different displays in a fairly easy way.

Greg Lynn FORM handles smaller projects, but still uses technology in the design process and in the construction of the project. Greg Lynn defines 10 form types that guide his spatial explorations: teeth, bleb, blob, flower, fold, strand, skin, shred, branch, and lattice.

The Pretty Good Life Showroom is derived from two categories; blob, and skins. BLOBs are binaries of large objects. The main idea behind the blob is a modeling technique that uses polygon spheres which are given a zone of influence and a zone of deflection. These two interact with each other fusing and pulling to create different meshes. Skin is defined as a smooth shinny appearance. Earlier in his Gregg Lynns career he would let the computer make happy errors to create form. 1. This happened when Greg Lynn FORM used a program called Maya. They would input data and then use fields over certain points in the data creating form. "We write custom computer software so that we can control the design better and better. I stopped letting software make happy accidents awhile ago and now I just try to be as expert as possible. The corrugations and pattern on the walls were designed by us by intervening on the step between taking a surface model and translating it into a tool path for a CNC router. 2." (Lynn) In this project they use a CNC (computer numerically controled) router to create this appearance.

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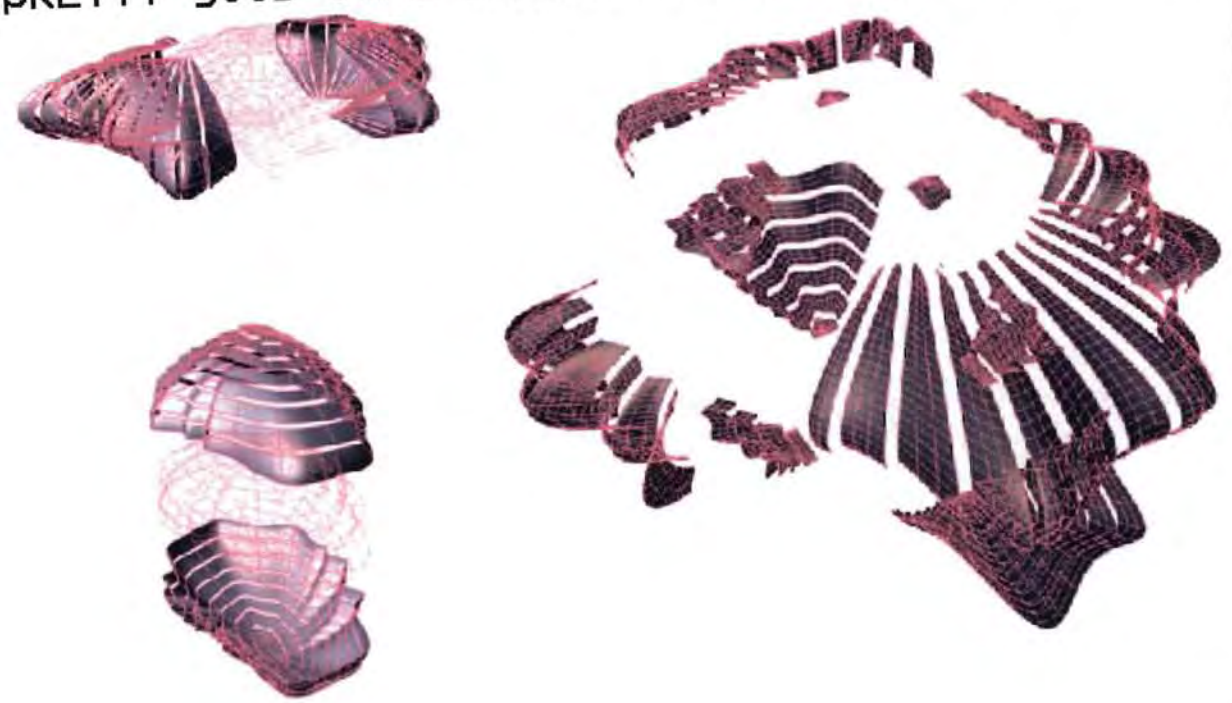

Pretty Good Life Showroom Stockholm, Sweden

Construction: 1999-2000

Architectural Firm: Greg Lynn FORM Lead Designer Greg Lynn

With the same design technique and with high degrees of variation he can produce showrooms all over the world no matter how big or small they are. With the technology driven techniques of the CNC machine he can either mass produce and/or create customized showrooms at the same time. 3.

This is a great advantage to the CNC machine. Simply by changing a few numbers in the computer he can create a showroom that is similar to the previous one but yet in its own way it is unique. The CNC machine gives you high craftsman ship and uniqueness, but ellements can be mass produced as well. 4.

One of the problems they had to over come in this project was the fact that this company has everything from vacuum cleaners to cups on display. So the shelving units themselves will have to be extremely flexible. The reversible glass shelves have two different curved profiles so that they can be aligned to at least two different positions on the wall. This helps create a very versatile design. The stainless steel display pegs can be inserted in the CNC carved wooden blocks of the display wall in many different locations across the wall. 5. This is another way that the design is versatile. Things like this help the showroom wall becomes unique in every location without having to change the milling pattern of the CNC machine. This is very helpful in creating flexible and unique configurations of many different shapes and sizes with the one single design and construction strategy. 6.

This technology creates a highly crafted project that has a high complexity level as well. Complicated projects such as this one would not of been able to be created with such a high level of accuracy with out the use of a CNC machine. Another accomplishment of this project is the versatility of the project to be unique with a limited number of parts. With the need to be able to adapt to different locations through out the world its parts need to be able to be relocated on the display wall. This project can be mass produced at a high level of quality, but be unique for every show room.7.

pRETTY gOOD
lIFE
sHOWROOM

Work by Garofalo Architects Chicago, Illinois

Construction: 2000

Architectural Firm: Garofalo Architects Lead Designer Doug Garofal

Client Museum of Contemporary Art Chicago.
Exhibit: "Material Evidence: Chicago Architecture at 2000

Garofalo Architects are located in Chicago Illinois. This is a small firm that has 3-4 employes. 8. This firm has a collection of diverse projects. Just to name a few there is the fireorb, the INFORMant.system, and the Tibet carpet design. The fireorb hangs from any ceiling by the chimney stack. The fireorb can also rotate 360 degrees. They were also asked by Elson & Company to design carpet for the Tibetan people. For this design they were asked to translate their impression of the Tibet. The result was a translation of cultural, geographic, abstract, philosophical, or ethereal aspects of Tibet. The 3d model of the carpet is located below. This next project is a little more theoritically based; the "museum of time" at the museum of science and industry Chicago Illinois. This was an exhibit at the museum in January 2001. This exhibition associates notions of Space/Time and the comprehensive integration of the collection with the interior architecture. Just like Einstein they wanted to demonstrate that neither time nor space is absolute, this is why they designed an exhibit that surrounds and wraps the collection to demonstrate that neither time nor space is absolute. Their strategy weaved time and space into a continuous experience that smoothly merges the two within the overall context of the museum. "Space-time is curved, dynamic, and expanding, we have chosen to employ a topological strategy of surface and enclosure to integrate disparate and distant elements into a coherent yet manifold experience." 9.

The final project is his IN.FORMant.system. It is a built response to a set of questions raised by the Museum of contemporary Art in Chicago for the exhibit "Material Evidence: Chicago Architecture at 2000." This project is more directly related to my these than the previous examples because their current work attempts to translate the flexibility and complexity of contemporary technologies into built form. "This commission offered a unique opportunity to employ and project digital technology into the public realm through a new prototype." The IN.FORMant.system refers to a future "micro-urbanism" of many structures dispensing information in variable ways. This system operates as a swarm of protective enclosures that each house various time-sensitive, information-based programs. 10.

iNFORMant.system

IN.FORMant.system Chicago, Illinois

Construction: 2000

Architectural Firm: Garofalo Architects Lead Designer Doug Garofalo

Doug Garofalo transforms the conventional with dynamic forms. Throughout Garofalo's work, complex geometries fold and bend, departing decisively from the orthogonal. As he puts it, "we're trying to push the envelope of what architecture is formally."11. One thing one is sure to notice in Garofalo's work is the expressive dynamic forms and loud colors. It is surprising to read that his work is complex in form and considered edgy, it would appear to be easy to inhabit and responsive to ethnically complex community settings.

Garfalo's architecture is often compared to Frank Gehry. Garfalo is definitely considered a cutting edge architect. His designs are conceptually based. Some of his designs don't make it to the actual construction phase. 12. Those are the designs that are more experimental. These projects can be more creative. One project that has not made it to construction yet is the recasting of the Loop L. This project envisions grass and animals on top of the elevated train line that loops through downtown Chicago. His firm even goes as far as locating a place where the farm equipment required for the project could be stored. One more way Garofalo shares some of the same traits as Frank Gehry is how he is all about movement. He likes to incorporate movement into his projects as does Gehry. 13.

Garofalo and his staff have aggressively exploited several different kinds of computer software, including animation programs used in Hollywood filmmaking to make their ideas come to life. For the Manilow project, for example, the house's curvilinear cladding was created by an animation program that fed the design specifications directly into a milling machine, with no drawings required. 14. This is an example of connecting the design model directly to the manufacturing phase of the project. This leaves less chance for marginal air, and brings the architect one step closer to the construction process.

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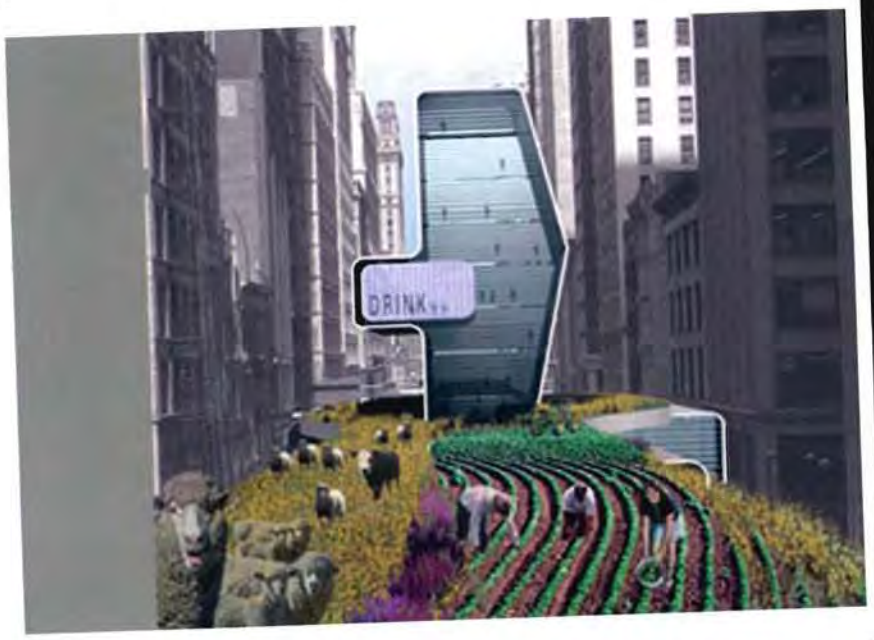


Guggenheim Museum Bilboa, Spain

Construction: 1991-1997

Architectural Firm: Gehry Partners LLC. Lead Designer Frank Gehry

Program: Museum of contemporary art, including permanent collection and temporary exhibition spaces, administrative offices, three hundred-seat auditorium, restaurant, retail, public plaza and water garden.
Budget: 10,859 million pesetas
Area: 265,000 square feet (6 acres)

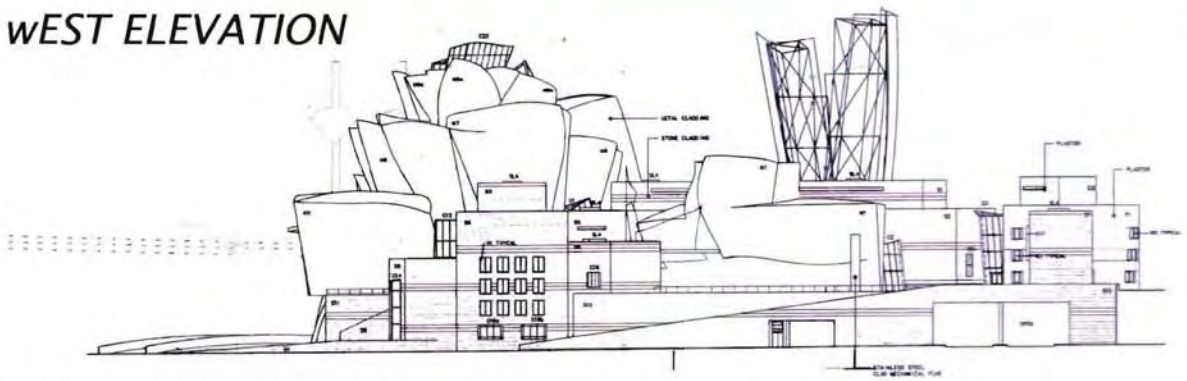
The Guggenheim museum in Bilboa, Spain uses technology to regain control over the entire project from design to constuction. Gehry Partners uses the 3d model, which was created in a program called CATIA, in ways that architects have never used a 3d model before. This project uses technology in ways that prior to this project were only used in sister industries such as the ship building industry, and the car industry. The advanced technology that was used on this project allowed it to be built without one tape measure on site. For Gehry Partners this project was very important. It needed to go smoothly so they could prove that a project of this size and complexity could be created paperless, on a limited timed schedule, and still stay within their budget. This would not have been possible without advanced technology. 15.

Guggenheim Museum Bilboa, Spain

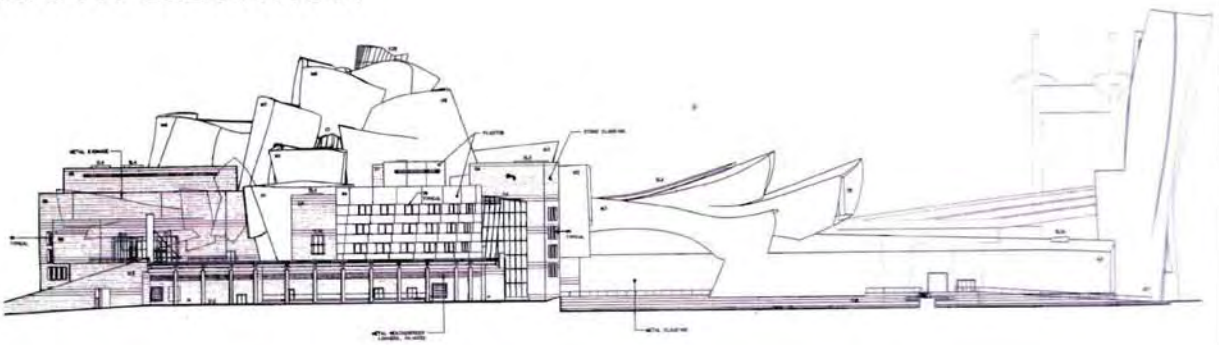
Construction: 1991-1997

Architectural Firm: Gehry Partners LLC. Lead Designer Frank Gehry

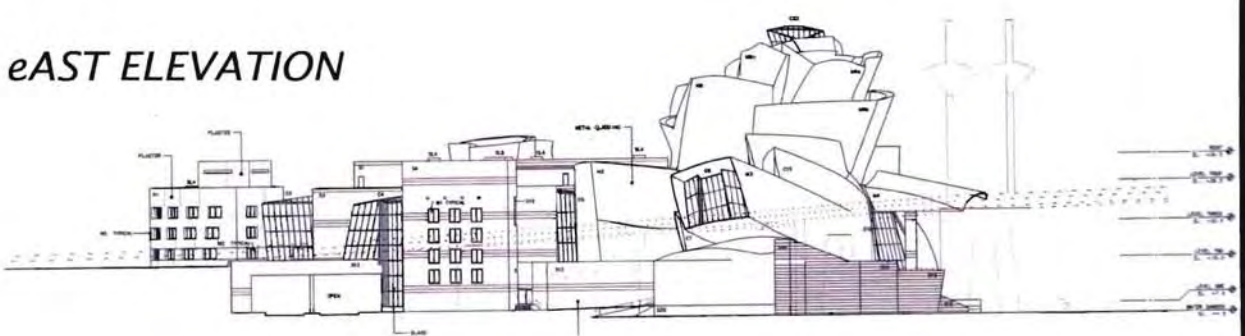
wEST ELEVATION



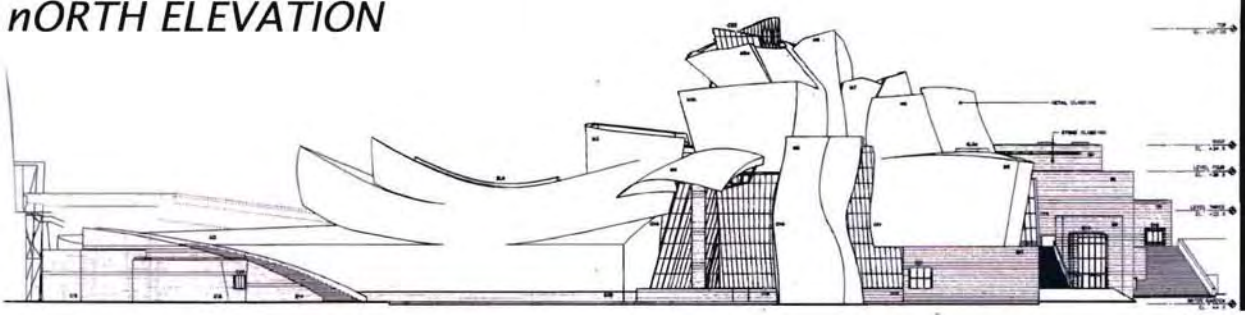
sOUTH ELEVATION



eAST ELEVATION



nORTH ELEVATION



Guggenheim Museum Bilboa, Spain

Construction: 1991-1997

Architectural Firm: Gehry Partners LLC. Lead Designer Frank Gehry

Gehry Partners LLP created a 3d model of the Guggenheim Museum with a program called CATIA. The 3d model was not just used to sell the project to the client with extravagant renderings of the building. This 3d model of the Museum played a big role in the production of the project. Data from the model was extracted and used to create the different pieces of the building at different locations. These pieces were then shipped to the site to be assembled. Each piece that was shipped to the site had a bar code on it. The barcode was scanned once it got to the site. The bar code would then match up with the CATIA model to show the builders where it went. The cladding being assembled off site, and put together on site is an example of architects using another industries principles, (the auto industry.) Each part of the car is made at a different plant. Some parts are made overseas. When all the chunks of the automobile reach the final plant it is then assembled. 16.

This idea is going to work very well for architects. This is something good that Frank Gehry is doing for architecture. The entire process of linking the 3-D design model to the manufacturing phase is very intelligent. It is giving the architect more control over the construction of the project, which is something we have lost as a profession over the years. In this example we are gaining control over the construction process in a couple different ways.

First of all we are in control of the data that is being added to the model. More importantly though, the information that is being taken out of the model is being used directly to fabricate the parts of the building. The builders on site are not responsible for laying out the walls. All of the parts are coming to the site all ready measured and preassembled. 17.

Secondly the builders are no longer cutting corners because this way is quicker to build then the way it was designed, or cheaper then the way it was designed. They no longer have the ability to change what the architect has designed. The way it is designed is the way the architect wants it built. They don't want it built like the last building they built. This is a different building with different ideas.

Technology is helping architects take over. This will lead to more buildings being built the way they were designed. The level of control and influence that an architect has over the construction process has slowly eroded over time since the days when the architect was understood to be "the master builder." Using digital modeling to create the design as well as the digital instructions for the fabrication and assembly of the building has the potential to restore some of this control over the construction process. 18.

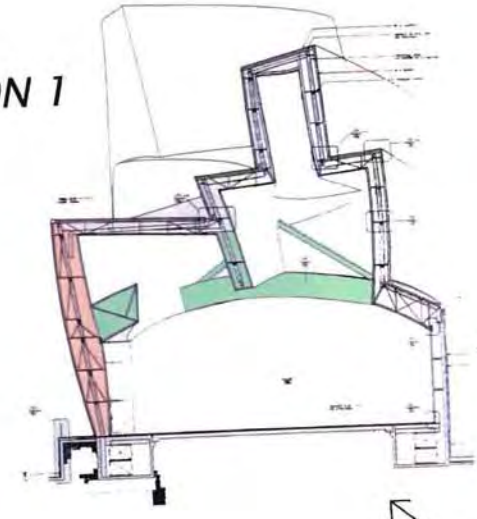
Guggenheim Museum Bilboa, Spain

Construction: 1991-1997

Architectural Firm: Gehry Partners LLC. Lead Designer Frank Gehry

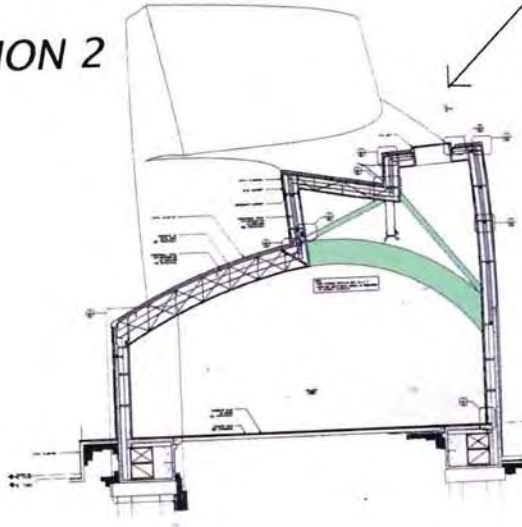
The Guggenheim Museum in Bilboa spain was also created without paper. This is another example of architects learning from another industry, the ship building industry has been doing this for years now. By creating a project paperlessly it cuts out some of the middle men, and brings the architect closer to the construction process. This is one of the biggest things Gehrys' firm is trying achieve. The level of control that technology is bringing back to architects over the construction process is going to help revive architecture.19.

sECTION 1



As you can see from the sections at left the structure that supports the skin is very complex just as the form of the building is. The structure does not keep the same thickness all the way through the section. This should be expected. Forms that involve such complex curves will have greater moments in some areas. At these areas is where the structure will need to be thicker.

sECTION 2



The envelope that encloses th structure is just as complex as the rest of the building. As you can see in the two sections the skin does not always follow the structure. Instead of there being columns in the middle of the museum floor the curve will continue to the other side of the room. That curve will then have braces that come off it to hold the structure above it. This is a great concept that they used to keep maximum floor space usable.

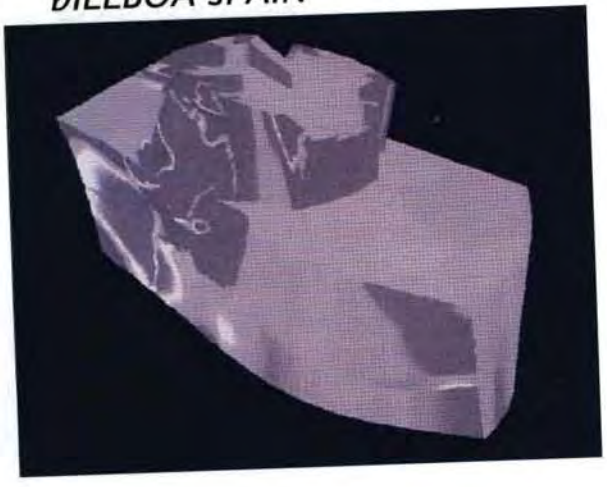
Guggenheim Museum Bilboa, Spain

Construction: 1991-1997

Architectural Firm: Gehry Partners LLC. Lead Designer Frank Gehry

Another example of technology being interrogated with architecture is the Gaussian analysis. The Gaussian analysis evaluates the degree of curvature in complexly shaped elements and produces a colored image that indicates, through various colors, the extent of the surface curvature. This analysis was used on the Guggenheim Museum in Bilboa, Spain, the Disney Concert Hall in Las Angeles California, and the Experience Music Project in Seattle, Washington. Along with many other projects. By using this analysis you can determine if a certain part of the building needs to be reworked. This is helpful in keeping the cost of the building down, and it also helps make sure the building is buildable. 20.

gAUSSIAN aNALYSIS oF tHE gUGGENHEIM mUSEUM bILLBOA sPAIN



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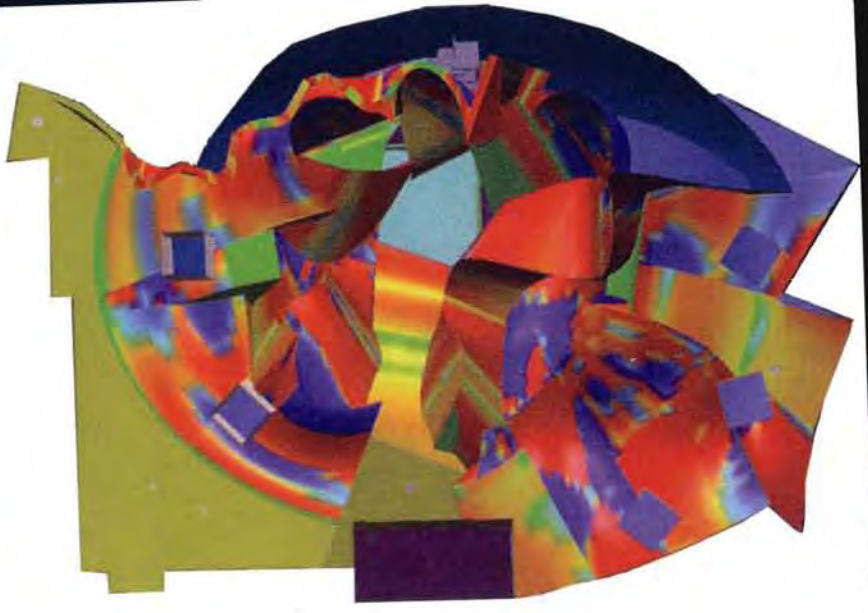
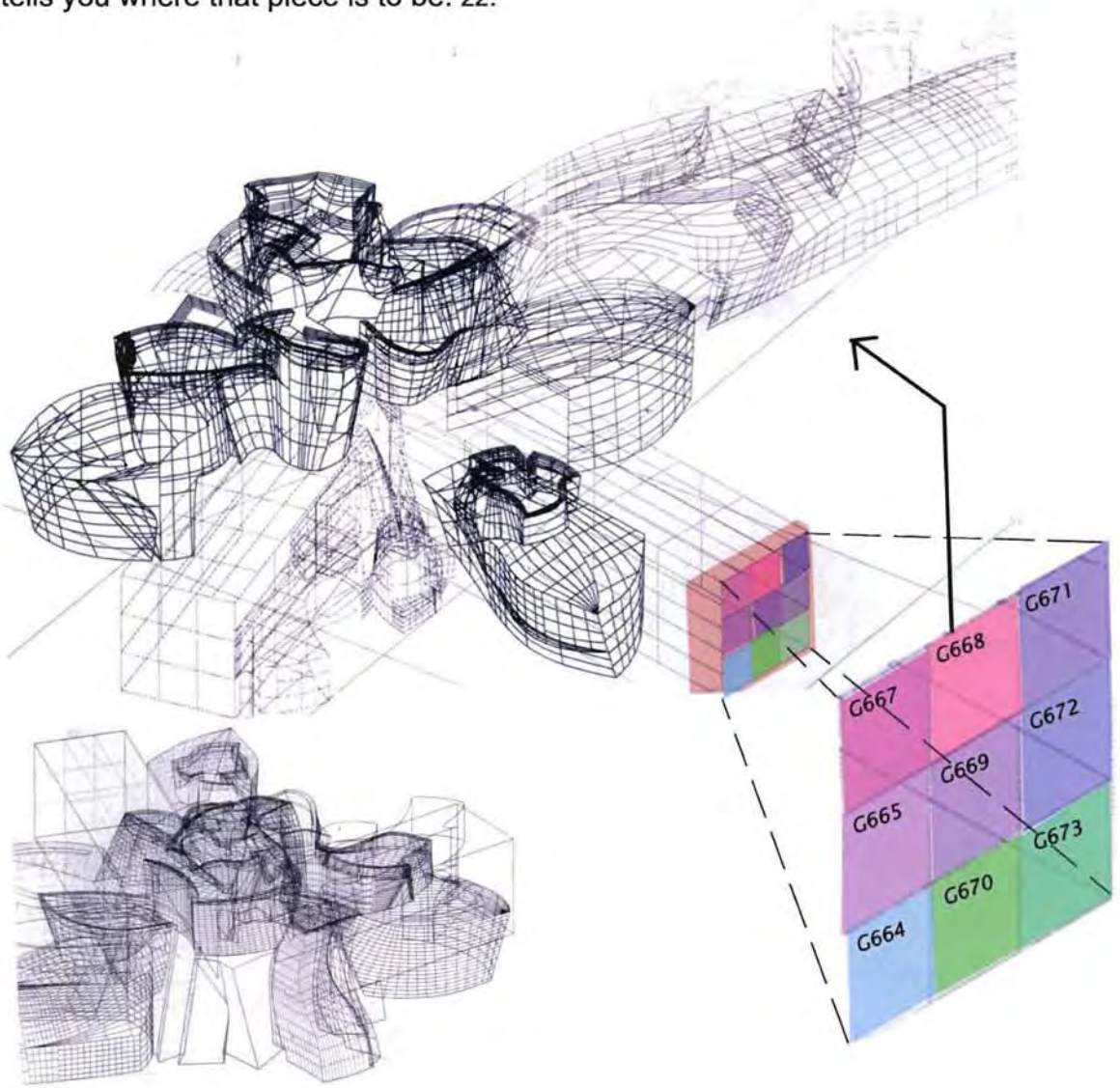


3D CATIA MODELS

These are actual models that were extracted from the 3d CATIA model to create the cladding. 21. Once the model is created at Gehrys' firm it is sent to an agency that handles the request to have data extracted from the model. The agency is then responsible to get the data from the 3d model to the companies that are producing the acutal chunks of the project. At this agency is also were information can be added to the projec as well. This is a great way to gather all the information in one location. Since each piece is different it takes a high technological approach to make sure that each piece when it arrives at the location of assembly is in the right spot. For instance when the metal cladding arrives at the site there is a bar code attached to it. The bar code is then scanned. The scanned data is then processed with the CATIA model. The model then tells you where that piece is to be. 22.

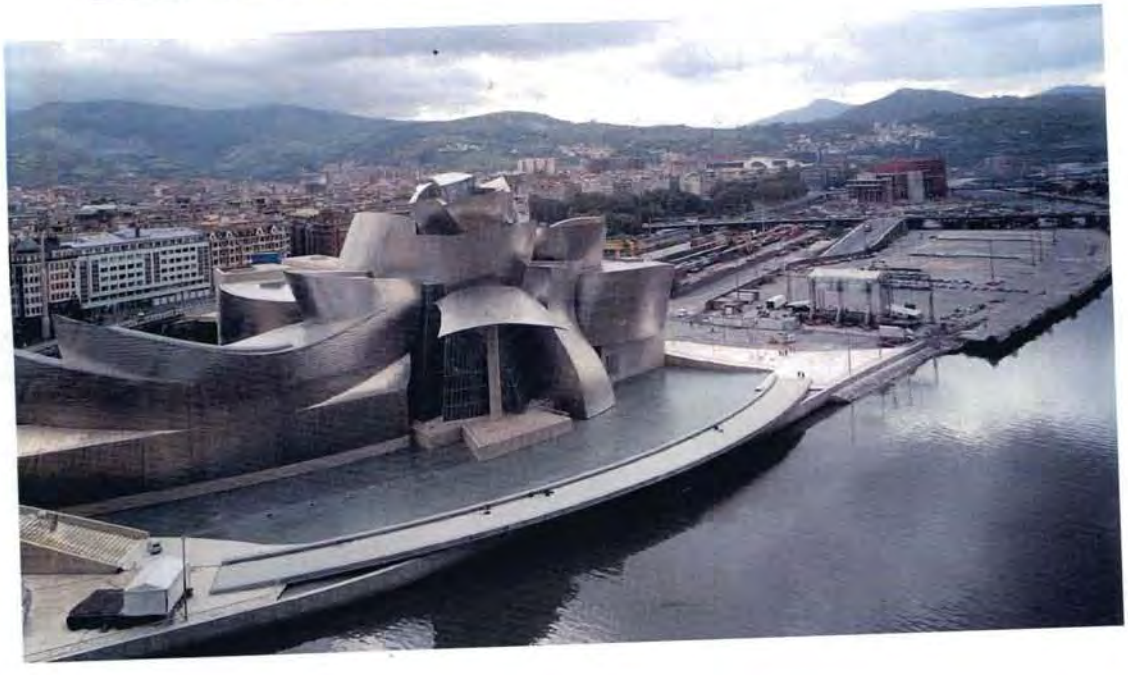


Guggenheim Museum Bilboa, Spain

Construction: 1991-1997

Architectural Firm: Gehry Partners LLC. Lead Designer Frank Gehry

One question that you hear asked frequently is what is Frank Gehry doing with his designs? There are two responses to this quesiton. Through his readings and his lectures you will find that he tries to encorporate motion into his designs. You will also hear him say that he designs buildings that look this way because life is chaotic. So he believes that architecture should express this is some way. The third reason is he believes that architects need to take more control of the construction process, "return to the master builder." (Gehry) Through technology he is accomplishing this.



NOTES:

1.Lynn, Greg. E-mail to author.09 Oct. 2006.

2. "IBID"

3. 4. Patteeuw, Veronique. , ed. pg. 30.

4. "IBID"

5. Lynn, Greg. <http://www.glform.com/>

6."IBID"

7. Patteeuw, Veronique. , ed. pg. 27.

8. Garofalo, Doug. <http://www.garofaloarchitects.com/>.

9. "IBID"

10. "IBID"

11. Amelar, Sarah. pg. 83.

12.Nance, Kevin. pg. 45.

13.Nance, Kevin. pg. 48.

14. "IBID"

15. Kolarevic, Branko. , ed pg. 46.

16. Kieran, Stephen , and James Timberlake. pg. 17.

17. Kolarevic, Branko. , ed pg. 46

18. Kolarevic, Branko. , ed pg. 60.

19. Kolarevic, Branko. , ed pg. 38.

20. Kolarevic, Branko. , ed pg. 48

21. Nance, Kevin. pg. 48.

22. Kolarevic, Branko. , ed pg. 38.

4. PROGRAM PRECEDENT S 26
Ultra Performance Nanotechnolgy 27
Kowloon Station, Hong Kong, China 30
Notes 32

Building Ultra Performance Nanotechnolgy Center Birck Nanotecnology Center
Maximum Planned Building Occupancy
Total Staff 300
Location: Purdue University Discovery Park, West Lafayette, IN

Design Consultants:
Architectural - Lead: HDR Architecture, Inc.
Architectural - Second: - MEP

Project Size:

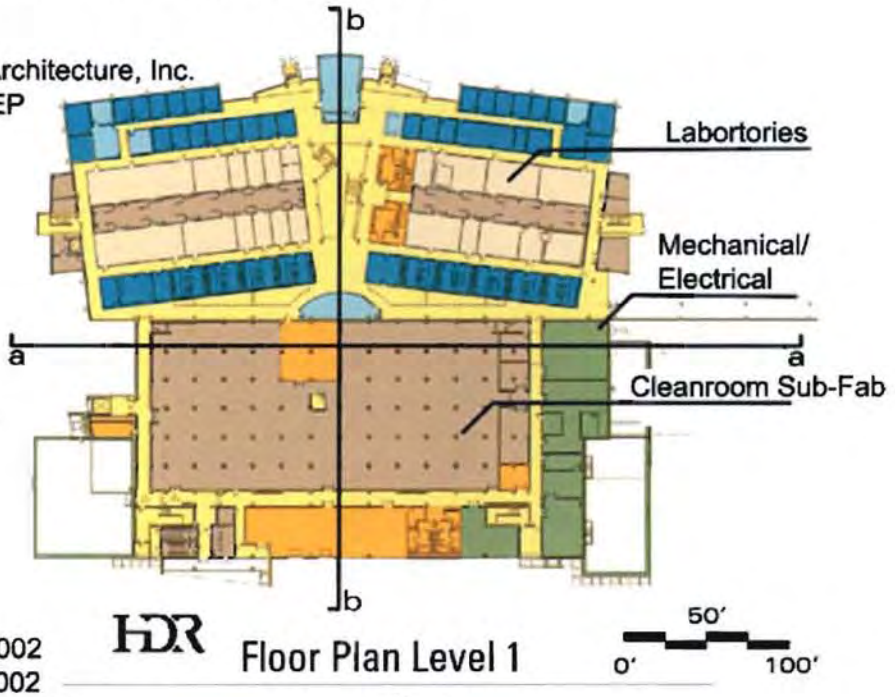
Size (GSF): 215,000
Site: 50 Acres

Project Cost Data:

Project Cost: $ 58,300,000
Construction Cost
$ 47,420,000
(excludes hookup):

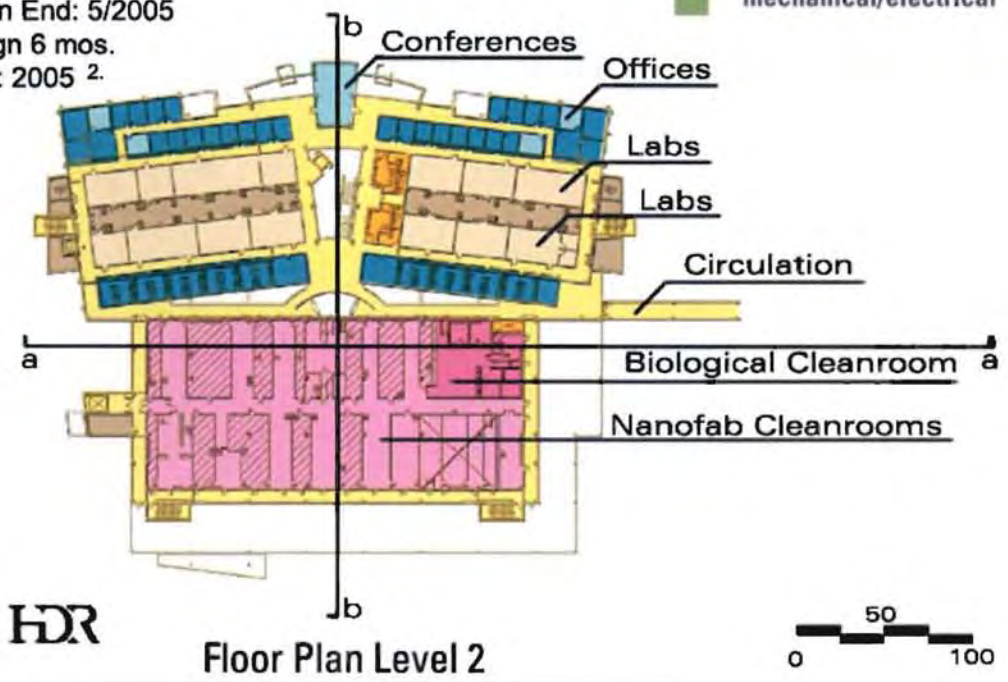
Project Schedule:

Schematic Design Start: 1/2002
Schematic Design End: 3/2002
Design Development Start: 3/2002
Design Development End: 6/2002
Construction Documents Start: 6/2002
Construction Documents End: 3/2003
Review / Permitting 1 mo.
Bidding / Negotiating 2 mos.
Construction Start: 7/2003
Construction End: 5/2005
Fit-up Design 6 mos.
Occupancy: 2005 [2.]



Key

circulation	conference rooms
building support	cleanroom/sub-fab support
laboratories	nanofabrication cleanrooms
offices	molecular cleanroom
	mechanical/electrical



The research that is taking place at the Nanotechnolgy Center is on the cutting edge. The prefix "nano" means one-billionth. A nanosecond is one-billionth of a second and a nanometer is one-billionth of a meter – approximately 10 atoms wide. These miniscule measurements, at almost incomprehensible scales, have opened a whole new world of scientific research. By enabling scientists and engineers to build electronic and mechanical structures literally atom-by-atom, nanotechnology is expected to revolutionize business, medical treatment, communications and other fields in everything from tiny computers, spacecraft and microscopic machines to microscopic life-saving medical devices.

The new facility is a prime example of a trend in thinking among the scientific community that diverse disciplines collaborate and work side-by-side, according
to Ahmad Soueid, RA, HDR project principal for the new facility. Nanotechnology is bringing together different disciplines such as physics, biology, chemistry,
pharmaceuticals, microelectronics, and manufacturing under one roof or to collaborate on research programs at the nano scale.

HDR

Section a-a

0' 50' 100'

Key

- circulation
- building support
- laboratories
- offices
- conference rooms
- cleanroom/sub-fab support
- nanofabrication cleanrooms
- molecular cleanroom
- mechanical/electrical

HDR

Section b-b

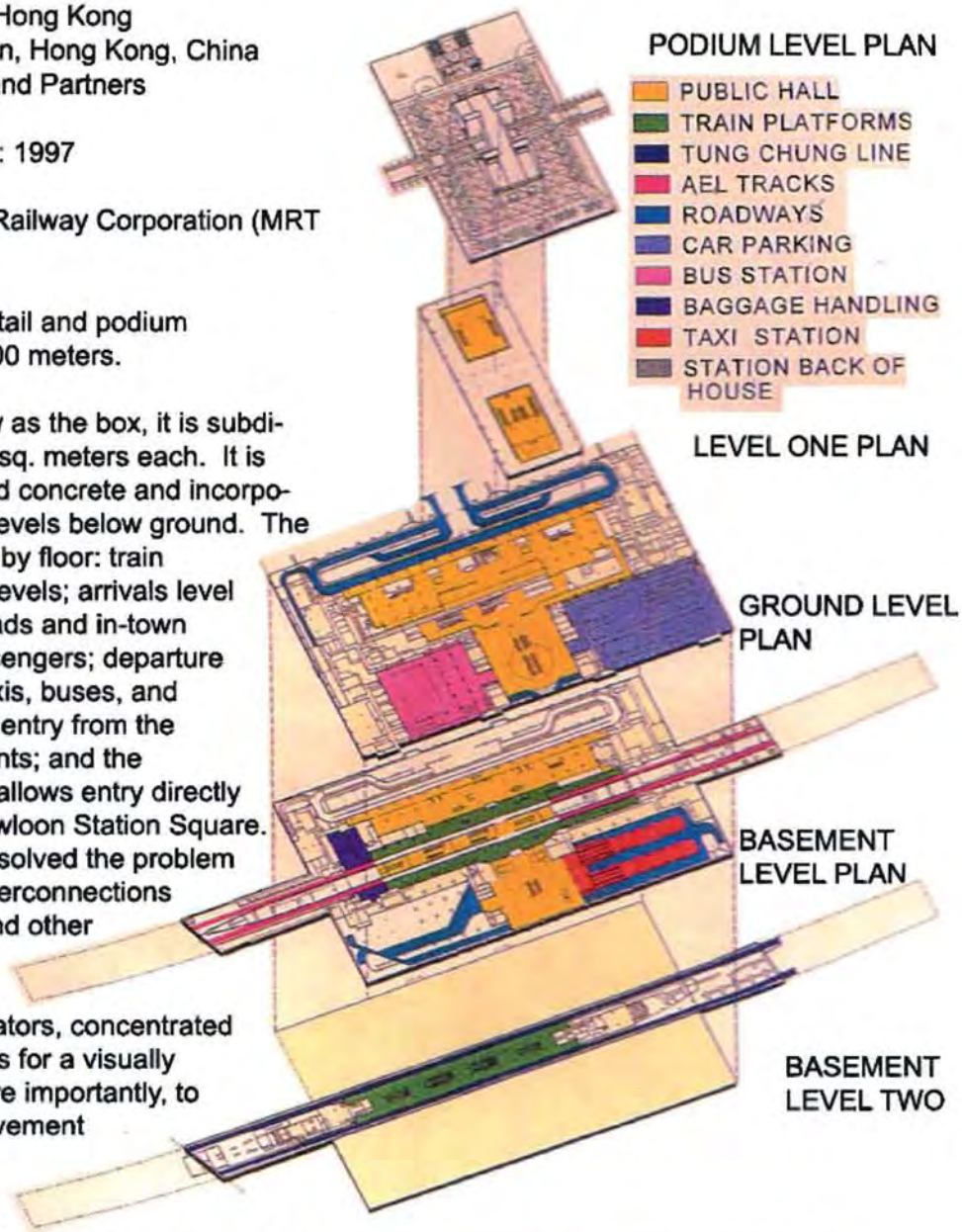
0' 50' 100'

After looking over the layout of this facility it is easy for me to say that the rooms are layed out in a way that is conveient for the poeple using the facility. All the labs, offices, mechnical areas, and ect. are located near each other. One critque I have about this layout is that all rooms are orthagonal. The buildings layout does not responde to the fluidity of movement that is happening inside. The thesis challenges the misconception people have about orthagonal rooms and the thesis project will show that non orthgonal rooms can work in layout just as easily as orthogonal forms. Sense the research that is taking place here is on the cutting edge the buildings exterior should of showed this as well. The forms of the future will be dynamic. They say that this research is going to shape the future. 1. Then the arguement that I have about this building is so should the building.

LOCATION: Kowloon, Hong Kong
Building Kowloon Station, Hong Kong, China
Architect: Terry Farrell and Partners
Engineers: Arup
Construction completed: 1997

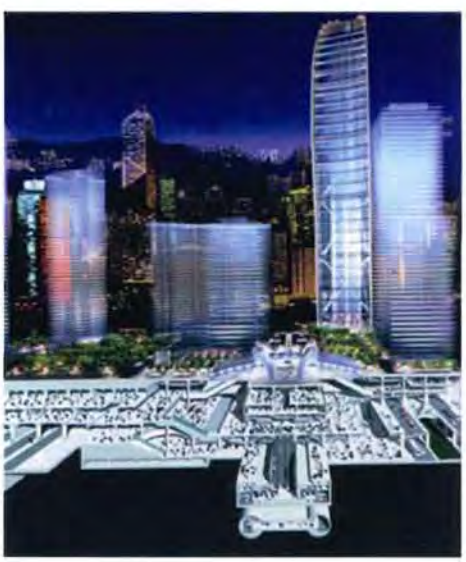
CLIENT: Mass Transit Railway Corporation (MRT Corp.)

:SIZE: 1,000,000 SF retail and podium
180 meters x 300 meters.



This project is know as the box, it is subdivided by modules of 12 sq. meters each. It is constructed of reinforced concrete and incorporates three suspended levels below ground. The functions are organized by floor: train platforms at the lowest levels; arrivals level with internal drop-off roads and in-town check-in for airport passengers; departure level associated with taxis, buses, and private car park; station entry from the surrounding developments; and the uppermost level, which allows entry directly from the area called Kowloon Station Square. A central concourse resolved the problem of providing complex interconnections between the rail lines and other modes of transport. The station uses an abundance of escalators, concentrated in the central open areas for a visually dynamic effect, but, more importantly, to concentrate vertical movement in a single volume, thereby contributing to the easy understanding of the organization of the space. The extreme use of glass allows an extreme amount of light to penetrate into the lower levels. 3.

This transit hub is the first and largest stop on the new rail line connecting Hong Kong to the new airport on Lantau Island. Kowloon Center doubles as a 12 million square foot mixed-use project featuring housing, hotels, office towers and retail. The design creates a retail/entertainment destination within the spatial labyrinth that forms the infrastructure of the transit system bringing clarity with a separate identity for each of the complex uses and creating a civic space rare in crowded Hong Kong. 4.



This program study is very close to the program of the thesis program. How the problem is handle between the rail lines and other means of transportation is a problem that will be occuring in the theisis project and it is interesting to see how they handled it.They mention that the use of escalators adds to the dynamacy to the space. This adds to the degree of movement. This is not expspressed anywhere elese in the design. The use of natural lite into the lower spaces of the structure is a nice design decesion that may appear in the final design of the train station.

NOTES:

1.Schlautman, Dee. "Pioneering Design for the Nano World." vol. 1 issue 3 Dec. 200308Nov.2006<http://www.nanobuildings.com/news/PreviousIssues/Vol1Issue3/images Current/NanoFrontierVol1Iss3.pdf>

2. "NANOBuildings.com." Projects. Oct. 2004. Nano Buildings. 9 Nov 2006 <http://www. nanobuildings.com/default.asp>.

3. Thorne, Martha. pg. 68

4. Thorne, Martha. pg. 69

5. PROGRAM

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Space Detail Summaries 39
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pROGRAM

[TECH]nology and Architecture

Technology and architecture have always gone side by side. The rate at which technology advances is hard to keep up with. Technology has made it possible for architects to create things on the computer which are more difficult to build than the orthogonal buildings of the past. At the same time, architects are beginning to see how technology is also making it so we can build what we can produce on the computer as stated earlier.

Technology is also advancing in other industries at a fast pace, such as the transportation industry. More specifically the train industry. There is now a train in Japan that can reach speeds of 321 mph. Trains will become a more economical way of traveling in the future. As oil prices go up transportation is one of the hardest hit industries. The program for this thesis project will be a light rail station, along with a bus station.

This station will have places to sleep, eat, exercise, and a place to have conferences, a place where one person can meet with people that are in other parts of the world, and a place to use the internet (internet cafes.) At times there will be a tremendous amount of people flowing through the station from high speed light rail trains that have just pulled into the station.

There will be two programs in the thesis project. One will consist of a high tech transit hub. The second program in the thesis will be a conference meeting center. Both programs provide the vehicles necessary to test the thesis. This program complements the thesis because just as a light rail moves at incredible speeds into the future so does the technology with which buildings are designed and constructed. This program gives the ability to imagine what is going to be available in the future and incorporate it into the project. The transit hub was also chosen because train travel is one of the fastest technological means of transportation.

Major Components of Program

Transportation hub & Conference Center

There will be two light rails being serviced by this transportation hub. One light rail will be running from Detroit to Ann Arbor, Metro airport to Toledo Ohio, and Metro airport to Port Huron. The other light rail will run from the transit hub to the airport. The transportation hub that is going to be located on the light rail line will also include a conference center. People arriving at the airport may conduct business at the transportation hub, or may take a transit line directly from the airport to the transportation hub. The transportation hub will get people there safely and efficiently, and at high speeds. Some of the major areas of these two buildings will be: a cafeteria that serves both the transit hub and the conference center; a restaurant; and an area to hold conferences.

Enumeration of Actions

Transportation Hub

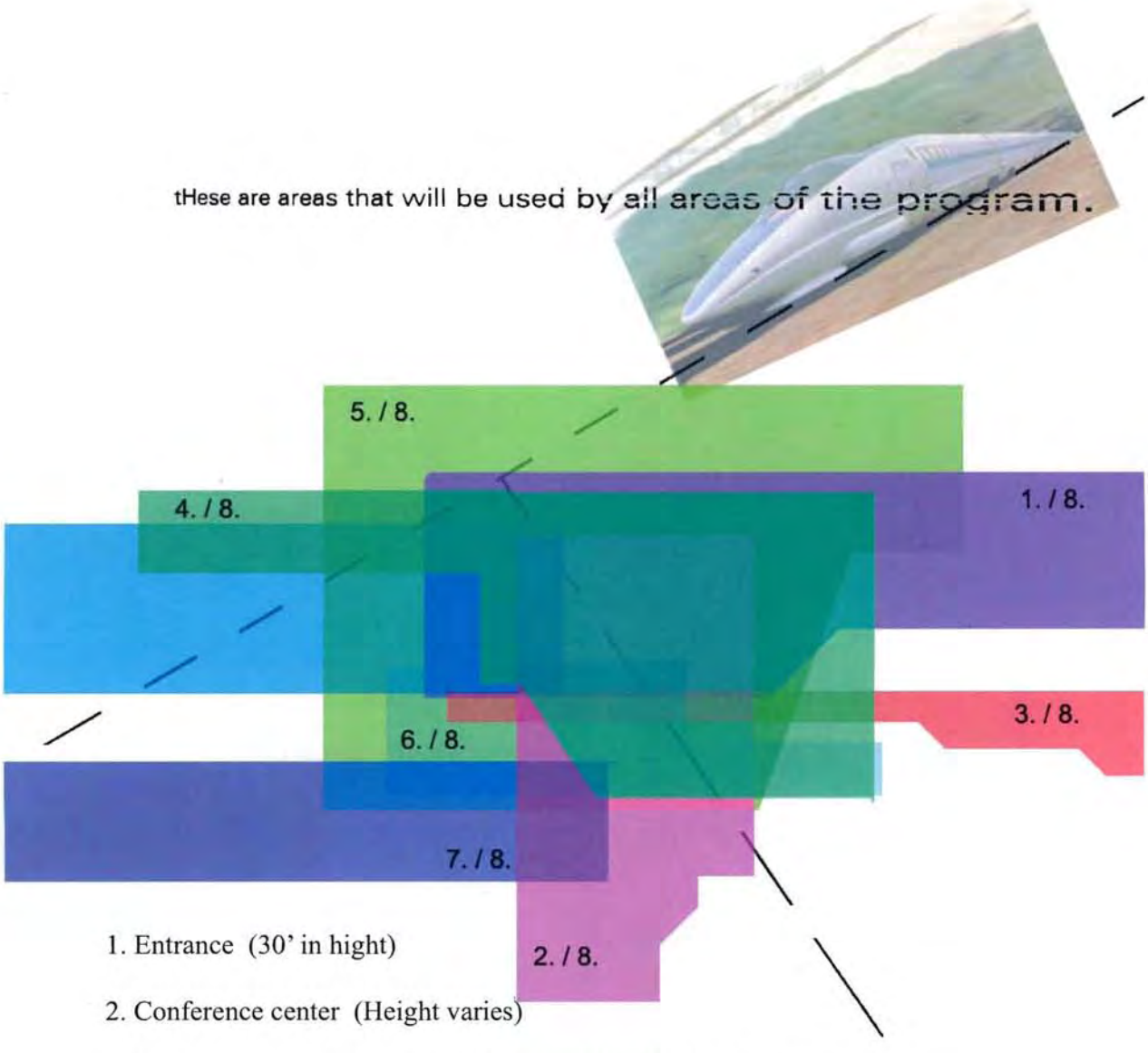
Showering
Sleeping
Collecting data (offices)
The selling of tickets
Baggage check-in if traveling to the airport.
Monitor the people entering the light rail platform
Passengers pick up and drop off area
Information center
Customer service area
Security offices
Waiting for trains, busses, taxi cabs, flights, conferences.
Conferences
Eating in a bar and in a fine restaurant
Dish washing
cooking
Retail / Shopping
Bathrooms
Monitoring room for trains
Car rental offices with counter tops
Bus offices
Taxi cab offices
Light rail offices

The following areas are shared by the high tech transportation hub and the conference center.

An entrance that services all major activities
A conference center
Short term sleeping components
A main security office with multiple places for security agents along with one holding cell
A cafeteria where workers and people that are traveling will be able to eat.
A fine dinning restaurant
Bathrooms that serve all major components
The exchange of information will be integrated into the building's envelope in as many ways as possible, both inside and outside the facility. For instance a wall that you are walking by could have several things happening on it from showing you cars waiting out side to pick up passengers, the local weather, the stock market, a view of the light rail track, anything is possible.

Actions taking place outside of the transit hub / conference center.
Parking of cars
Sleeping in hotels
Planes landing and taking off
Passengers being picked up
Eating
The sun rising in the east and setting in the west
Renting of cars
Retail area

tHese are areas that will be used by all areas of the program.



1. Entrance (30' in hight)
2. Conference center (Height varies)
3. A series of high tech mini hotel rooms (8'-10' in high ceiling)
4. Security offices (Height varies on location.)
5. Cafeteria (15' in height)
6. A fine dinning establishment (Height varies 10' to 20')
7. Rest rooms (8' in height)
8. The walls will be high tech. They will operate like a T.V. Screen / computer screens.

Transportation Hub

				TOTALS
I.	Ticketing Facilities			9,975 S.F.
a.	Ticket Queuing Area	3 @ 350 sq. ft. each =	1,050 sq. ft.	
b.	Fare Collection	3 @ 350 sq. ft. each =	1,050 sq. ft.	
c.	Accounting		350 sq. ft.	
d.	Cashiers		150 sq. ft.	
e.	Supervisor		150 sq. ft.	
f.	Storage		100 sq. ft.	
g.	Ticket Storage		50 sq. ft.	
h.	Staff Toilet		75 sq. ft.	
i.	Tour Office		200 sq. ft.	
j.	Equipment Room		100 sq. ft.	
k.	Small Ticket Offices	3 @ 600 sq. ft. each =	1,800 sq. ft.	
m.	Small Queuing Areas	3 @ 300 sq. ft. each =	900 sq. ft.	
n.	Open Seating Area		4,000 sq. ft.	
II.	Taxi			1,200 S.F.
a.	Taxi Cab Offices	4 @ 300 sq. ft. each =	1,200 sq. ft.	
III.	Baggage Claim			18,600 S.F.
a.	Baggage claim devices	2 @ 7,000 sq. ft. each =	14,000 sq. ft.	
b.	Baggage claim offices	2 @ 300 sq. ft. each =	600 sq. ft.	
c.	Baggage claim make up areas	2 @ 2,000 sq. ft. each =	4,000 sq. ft.	
IV.	Rental Car			3,200 S.F.
a.	Rental Car Company Offices	4 @ 200 sq. ft. each =	800 sq. ft.	
b.	Rental Car Counters	4 @ 200 sq. ft. each =	800 sq. ft.	
c.	Rental Car Queuing Areas	4 @ 400 sq. ft. each =	1,600 sq. ft.	

Bus Services & Operations Areas

Coaches will service the station at a maximum of six at one time. Following are assumed coach information: Width 96", Length 40', Wheel base 279" (23' 3"), Turning radius 44', Seating for 44\ passengers with room for 22 standees, and has a wheelchair lift.

V.	Bus Total			2,650 S.F.
a.	Bus ticket office		200 sq. ft.	
b.	Bus ticketing counter		1,000 sq. ft.	
c.	Bus Queuing Area		1,000 sq. ft.	
d.	Information Center/Desk		150 sq. ft.	
e.	Bus Offices	3 @ 100 sq. ft. each =	300 sq. ft.	

				TOTALS

Passenger Train Services & Operations Areas
Trains will approach the station on 2 tracks, which are served by one center platform elevated to approximately 48", thus allowing passengers to enter and exit trains without steps. The platform must be a minimum of 24' wide and 800' long.

VI.	Station Services			850 S.F.
a.	Passenger Train Offices		200 sq. ft.	
b.	Managers Office		150 sq. ft.	
c.	Office Reception		200 sq. ft.	
d.	Train Crew Check-in Office		150 sq. ft.	
e.	Information Center/Desk		150 sq. ft.	
f.	Control Center		300 sq. ft.	
VII.	Waiting & Queuing Areas			27,200 S.F.
a.	Platform Area		19,200 sq. ft.	
b.	Waiting Areas		5,000 sq. ft.	
c.	Security Check points		3,000 sq. ft.	

Light Rail Services & Operations Areas
Light Rail will approach the station on 2 tracks, which are served by one center platform elevated to approximately 48", thus allowing passengers to enter and exit trains without steps. The platforms must be a minimum of 24' wide and 600' long.

VIII.	Light Rail Total			15,650 S.F.
a.	Waiting & Queuing Areas		15,000 sq. ft.	
b.	Information Center/Desk		150 sq. ft.	
c.	Light Rail Offices		200 sq. ft.	
d.	Security check point		300 sq. ft.	

Shared Services

I.	Sleeping / Private spaces			9,000 S.F.
a.	Sleeping compartments	30 @ 200 sq. ft. each =	6,000 sq. ft.	
b.	Area to shower	15 @ 100 sq. ft. each =	3,000 sq. ft.	
II.	Conference (meetings)			21,800 S.F.
a.	Conference rooms	8 rooms =	15,000 sq. ft.	
b.	Kitchen		2,000 sq. ft.	
c.	Banquet Hall		4,000 sq. ft.	
d.	Bathrooms		800 sq. ft.	

				TOTALS
III.	Security	3 @ 1350 sq. ft. each =		4,050 S.F.
a.	Reception	3	200 sq. ft.	
b.	Workroom (camera booth)	3	200 sq. ft.	
c.	Holding Room	1	100 sq. ft.	
d.	Security Office	3	150 sq. ft.	
e.	Interrogation Room	3	100 sq. ft.	
f.	Training & Assembly Room	2	250 sq. ft.	
g.	Storage Room	3	150 sq. ft.	
h.	restroom	3	200 sq. ft.	
IV.	Employee Facilities			1,900 S.F.
a.	Lockers & Toilets		1,400 sq. ft.	
b.	Employee Lounge		500 sq. ft	
V.	Retail			10,500 S.F.
a.	Retail shops	7 @ 1000 sq. ft. each =	7,000 sq. ft.	
b.	Storage for shops	7 @ 500 sq. ft. each =	3,500 sq. ft.	
VI.	Entry			800 S.F.
VII.	Cafeteria (Upper)			15,900 S.F.
a.	Eating Area		12,500 sq. ft.	
b.	Kitchen		3,400 sq. ft.	
VIII.	Cafeteria (Lower)			15,900 S.F.
a.	Eating Area		12,500 sq. ft.	
b.	Kitchen		3,400 sq. ft.	
IX.	Fine restaurant / Bar			17,500 S.F.
a.	Fine restaurant		8,000 sq. ft.	
b.	Kitchen		2,500 sq. ft.	
c.	Bar		5,000 sq. ft.	
d.	Back of Bar		2,000 sq. ft.	
X.	Shipping and Receiving			5,000 S.F.

Total		***181,675 S. F.***
Factoring of 30 % for Mechinical and circulation area	***+ 54,502 sq. ft***	***236,177 S. F.***

				TOTALS
Outside Spaces				424,000 S.F.
Parking garage		1800 parking spaces	400,000 sq. ft.	
Park			10,000 sq. ft.	
Outside eating area			5,000 sq. ft.	
Passenger drop off			1,000 sq. ft	
Passenger pick up			1,000 sq. ft	
Buss Station				
Waiting & Queuing Areas			4,000 sq. ft.	
Taxi				
Taxi Cab pick up Area		2 @ 1,5000 sq. ft. each =	3,000 sq. ft.	
Gross Total	***424,000 S.F.***	+	236,177	***660,177 S.F.***

SPACE NAME	CAPACITY	NO. UNITS	NSF / UNIT	TOTAL NET AREA
Ticketing area	100		11,225	11,225

A Purpose / Functions
This area provides an area for the purchasing of tickets and the checking in of baggage if the passenger is taking a flight or if they are checking baggage for a longer train trip.

B. Activities
Standing, waiting in line, watching what is going on around them such as the projections on the walls.

C. Spatial Relationships
Most of this space is going to be public while some will be for employees only. This space needs to be accessible to all public spaces. Close to the entrance as well.

D. Equipment / furnishings
Computers, built in seats and tables, counter tops that are on a slant.

E. Special Considerations
As much natural light as possible. People need to be able to move comfortably in this area as some people will be purchasing tickets as others will be moving on to there destination.

F. Behavioral Considerations

G. Structural Systems
Steel Framing.

H. Mechanical / Electrical Systems
The space will need to be ventilated and electrical service provided to meet Michigan electrical code.

I. Site / Exterior Environmental Considerations
Direct access to main building eatry / passenger pick-up and drop off.

J. Form
The form is under the peel off of the main tublar section that covers the main platforms.

SPACE NAME	CAPACITY	NO. UNITS	NSF / UNIT	TOTAL NET AREA
Taxi	10		4,200	4,200

A. Purpose / Functions
This area provides an area for passengers to get a taxi and be dropped off. This area is also a space for a taxi cab office.

B. Activities
Standing, waiting, a place of action, and a little sitting.

C. Spatial Relationships
This area needs to be accessible to the main entrance and exit of the transportation hub.

D. Equipment / furnishings
There needs to be a counter in every office for customers that need and taxi and customer relationship and a few seats for sitting.

E. Special Considerations
As much natural light as possible. People need to be able to move comfortably in this area as some people will be standing and talking while others will be putting their bags into the taxi cab.

F. Behavioral Considerations

G. Structural Systems
Steel Framing.

H. Mechanical / Electrical Systems
The space will need to be ventilated and electrical service provided to meet Michigan electrical code.

I. Site / Exterior Environmental Considerations
Plants and trees. Located at the main point of drop off for passengers.

J. Form
This is its own form with sloping roofs and walls that appear to come out of the ground.

SPACE NAME	CAPACITY	NO. UNITS	NSF / UNIT	TOTAL NET AREA
Baggage Claim	100		18,600	18,600

A. Purpose / Functions
This area provides an area for passengers to pick up there baggage once they arrive at the transportation hub from the airport.

B. Activities
Standing, walking, waiting

C. Spatial Relationships
This area needs to be accessible to the exit. This space should be accessible to the bus station and the taxi cab pick up area, and the car rental area as well.

D. Equipment / furnishings
There needs to be 2 baggage carousel and seats.

E. Special Considerations
As much natural light as possible. People need to be able to move comfortably in this area as some people will be standing and talking while others will be picking up their bags.

F. Behavioral Considerations

G. Structural Systems
Steel Framing.

H. Mechanical / Electrical Systems
The space will need to be ventilated and electrical service provided to meet Michigan electrical code.

I. Site / Exterior Environmental Considerations

J. Form
The form of this area was meant to appear as a net that is pulling the main tublar shape to the ground.

SPACE NAME	CAPACITY	NO. UNITS	NSF / UNIT	TOTAL NET AREA
Rental Car	20		3,200	3,200

A. Purpose / Functions
This area provides an area for customers to pick up a rental car.

B. Activities
People that are not picking up a car may just be walking through the area to get to an adjacent area.

C. Spatial Relationships
This area needs to be accessible to all other public spaces.

D. Equipment / furnishings
There needs to be 3 counter tops for customers that need a rental.

E. Special Considerations
As much natural light as possible. People need to be able to move comfortably in this area as some people will be standing and talking while others will be picking up their bags. One area will be a u-check out counter. You will be able to input your name and pay and keys will then be unlocked to you.

F. Behavioral Considerations

G. Structural Systems
Steel Framing.

H. Mechanical / Electrical Systems
The space will need to be ventilated and electrical service provided to meet Michigan electrical code.

I. Site / Exterior Environmental Considerations

J. Form

SPACE NAME	CAPACITY	NO. UNITS	NSF / UNIT	TOTAL NET AREA
Bus area	60		6,650	6,650

A. Purpose / Functions
This area provides an area for customers to get on and off of busses along with bus station offices with counter tops.

B. Activities
This area will see a lot of motion at one time and at others it will be almost vacant. People will be waiting to catch a bus along with getting off of busses and walking to there next destination.

C. Spatial Relationships
This area needs to be accessible to to the train ticketing area along with the rental car area and the taxi cab area as well.

D. Equipment / furnishings
There needs to be counter tops and seats for brief sitting while waiting for a bus and a u-check place to pick up your ticket.

E. Special Considerations
As much natural light as possible. People need to be able to move comfortably in this area as some people will be standing and talking while others will be picking up their bags from the bus and moving on.

F. Behavioral Considerations

G. Structural Systems
Steel Framing.

H. Mechanical / Electrical Systems
The space were you the busses are will need to be well ventilated and electrical service provided to meet Michigan electrical code.

I. Site / Exterior Environmental Considerations

J. Form
This is its own form that is located 230' away from the main building. This form appears to come out of the form.

SPACE NAME	CAPACITY	NO. UNITS	NSF / UNIT	TOTAL NET AREA
Main Train Platform	600			28,050

A. Purpose / Functions
This area provides space for passengers to get on and off the light rail trains and a place to wait for passengers. There are two platforms that are located one on top of the other with the light rails approaching on the sides of the platforms. This platfrom serves the trains that transfer passengers from the light rail station to Toledo Ohio and the opposite side the light rail runs from Detroit to Chelsea Michigan stopping at the light rail station.

B. Activities
This area will see a lot of motion at one time and at others will be almost vacant. People will be waiting to catch a train.

C. Spatial Relationships
This area needs to be accessible to all other public spaces. And security needs to be able to get to it. Light rail tracks.

D. Equipment / furnishings
There needs to be 1 platform along with area for standing and sitting.

E. Special Considerations
As much natural light as possible. People need to be able to move comfortably in this area as some people will be standing and talking. Need to have the ability to keep people busy while waiting for trains to come in such as projections of the planes landing and taking off and other projections on the wall as well.

F. Behavioral Considerations

G. Structural Systems
Steel Framing for the tublar shape with structural columns that take the load of the tracks and platforms.

H. Mechanical / Electrical Systems
The space will need to be ventilated and electrical service provided to meet Michigan electrical code.

I. Site / Exterior Environmental Considerations
Elevated 30 to 40' in the air.

J. Form
This form is a sleek tublar form that flows from north east to south west on the site.

SPACE NAME	CAPACITY	NO. UNITS	NSF / UNIT	TOTAL NET AREA
Light Rail Platform	1500		15,650	15,650

A. Purpose / Functions

This area provides space for passengers to get on and off the light rail trains and a place to wait for passengers. There are two platforms that are located one on top of the other with the light rails approaching on the sides of the platforms. This platforms serves the trains that transfer passengers from Detroit Metro Airport to the lightrail station to Willow Run Airport.

B. Activities

This area will see a lot of motion at one time and at others will be almost vacant. People will be waiting to catch a train and moving to there next destination once they get off.

C. Spatial Relationships

This area needs to be accessible to all other public spaces. And security needs to be able to get to it This area also need to be accessible to the waiting area.

D. Equipment / furnishings

There needs to be 1 platforms along with area for standing and sitting.

E. Special Considerations

As much natural light as possible. People need to be able to move comfortably in this area as some people will be standing and talking. Need to have the ability to keep people busy while waiting for trains to come in such as projections of the planes landing and taking off and other projections on the wall as well.

F. Behavioral Considerations

G. Structural Systems

Steel Framing for the tublar shape with structural columns that take the load of the tracks and platforms.

H. Mechanical / Electrical Systems

The space will need to be ventilated and electrical service provided to meet Michigan electrical code.

I. Site / Exterior Environmental Considerations

Light rail tracks

J. Form

This form is a sleek tublar form that flows from north east to south west on the site.

SPACE NAME	CAPACITY	NO. UNITS	NSF / UNIT	TOTAL NET AREA
Sleeping areas	35	30	200	6,000

A. Purpose / Functions
This area provides an area for passengers who need to stay the night at the station.

B. Activities
This area will have people sleeping in it for short stays, also people will be coming here just to have a private space between trains, conferences, or even between flights.

C. Spatial Relationships
This area needs to be accessible to all other public spaces. And security needs to be able to get to it.

D. Equipment / furnishings
There needs to be 1 pull out bed plus an area to store personel belongings, a few areas will have room for 2 pull out beds. There will also be common restrooms that include showers.

E. Special Considerations
Limited natural light to create areas of easy rest during the middle of the day. People need to be able to be comfortable here.

F. Behavioral Considerations

G. Structural Systems
Steel Framing.

H. Mechanical / Electrical Systems
The space will need to be ventilated and electrical service provided to meet Michigan electrical code. Bathrooms will be provided with its own ventilation systems with exhaust fans.

I. Site / Exterior Environmental Considerations
Elevated in the air away from noisy areas

J. Form
This form is a flowing form that flows off the main tublar form of the platforms. The flowing form creates a nice sleek transition from one form to the next.

SPACE NAME	CAPACITY	NO. UNITS	NSF / UNIT	TOTAL NET AREA
Conference	805	8	2,725 sq. ft. avg.	21,800

A. Purpose / Functions
This area functions as a samll conference center including several meeting rooms of various scales, restrooms storage and support spaces, and a kitchen to suppport food services.

B. Activities
This area will have people sitting for a range of an hour to two hours at a time. There also could be several different kinds of events happening from a banquet in the banquet hall to a dance in a room that doesn't have permanent seats.

C. Spatial Relationships
This area needs to be accessible to all other public spaces. And security needs to be able to get to it.

D. Equipment / furnishings
Some conference areas will have stages while others will just have conference tables. All rooms need to be furnished with seats.

E. Special Considerations
As much natural light as possible. People need to be able to be comfortable here some people will be sleeping while others may be talking to someone across the country.

F. Behavioral Considerations

G. Structural Systems
Steel Framing. A thicker membrane on the side that is nearest to the light rail for noise control. This is a special condition

H. Mechanical / Electrical Systems
The space will need to be ventilated and electrical service provided to meet Michigan electrical code.

I. Site / Exterior Environmental Considerations
Elevated in the air away from noisy areas

J. Form
The form is a flowing tublar shape that appears to come out of the ground on the south side and dives back into the ground on the north east side of the site.

SPACE NAME	CAPACITY	NO. UNITS	NSF / UNIT	TOTAL NET AREA
Security Area	35	3	1,350	4,050

A. Purpose / Functions
This area provides offices for security personal, small meetings and a place to hold people for the police.

B. Activities
This area will have people doing surveillance work, talking, sitting, and standing and at times there needs to be enough space to move at a fast pace.

C. Spatial Relationships
This area needs to be accessible to all other public spaces, and it still needs to be accessible to other security areas on other floors.

D. Equipment / furnishings
There needs to be surveillance television monitors along with 4 desks on each floor with the main floor having a holding cell.

E. Special Considerations
As much natural light as possible. People need to be able to be comfortable here some people will be doing work.

F. Behavioral Considerations

G. Structural Systems
A thicker steel framing system to resits explosive blast.

H. Mechanical / Electrical Systems
The space will need to be ventilated and electrical service provided to meet Michigan electrical code.

I. Site / Exterior Environmental Considerations

J. Form

SPACE NAME	CAPACITY	NO. UNITS	NSF / UNIT	TOTAL NET AREA
Employee Facilities	50		24,400	24,400

A. Purpose / Functions
This area provides an area for employees to take breaks and change from their work cloths.

B. Activities
This area will have employees interchanging in conversation, eating and showering and changing while others will be relaxing looking for a space to be alone.

C. Spatial Relationships
This area needs to be accessible to all other public spaces, and it still needs to be accessible to the security.

D. Equipment / furnishings
There needs to be lockers, tables for sitting and bathrooms for the employees to use as well and a showering area as well.

E. Special Considerations
As much natural light as possible. People need to be able to be comfortable here some people some people will be relaxing on break here.

F. Behavioral Considerations

G. Structural Systems
Steel frame

H. Mechanical / Electrical Systems
The space will need to be ventilated and electrical service provided to meet Michigan electrical code.

I. Site / Exterior Environmental Considerations

SPACE NAME	CAPACITY	NO. UNITS	NSF / UNIT	TOTAL NET AREA
Retail shops	65	8	1,000	10,500

A. Purpose / Functions
This area provides areas for shopping. It will be split into a lower retail area along with an upper retail area.

B. Activities
This area will have people in it all day shopping some areas will need to be open 24 / 7.

C. Spatial Relationships
This area needs to be accessible to all other public spaces, and it still needs to be accessible to security.

D. Equipment / furnishings
There needs to be an area to check out.

E. Special Considerations
As much natural light as possible. People will be shopping here grabbing last minute things to head to there destination.

F. Behavioral Considerations

G. Structural Systems
Steel frame

H. Mechanical / Electrical Systems
The space will need to be ventilated each retail shop should be on its own zone while the main storage area can be on the normal zone. The electrical service will need to meet Michigan electrical code.

I. Site / Exterior Environmental Considerations

J. Form

SPACE NAME	CAPACITY	NO. UNITS	NSF / UNIT	TOTAL NET AREA
Entry	10	1	800	800

A. Purpose / Functions
This area provides an entrance into the building.

B. Activities
This area will have people coming into the building and leaving.

C. Spatial Relationships
This area needs to be accessible to the main floor that connects to all other areas.

D. Equipment / furnishings
There needs to be 2 sets of doors to create an air lock helping the cold air stay out during the winter and the warm air in the summer.

E. Special Considerations
As much natural light as possible.

F. Behavioral Considerations

G. Structural Systems
Steel frame

H. Mechanical / Electrical Systems
The space will need to be ventilated with an expected loss of heat in the winter and a loss of cool air in the summer. The electrical service will need to meet Michigan electrical code.

I. Site / Exterior Environmental Considerations

J. Form
This form flows off the main tublar platform appear as a net that comes down to the ground.

SPACE NAME	CAPACITY	NO. UNITS	NSF / UNIT	TOTAL NET AREA
Cafeteria lower & upper	300		31,800	31,800

A. Purpose / Functions
This area provides an area for people to get something to eat before they move on or they can sit down and enjoy a meal.

B. Activities
This area will have people engaged in conversation making it a loud space at times and at other times it will be quiet.

C. Spatial Relationships
This area needs to be accessible to all other public spaces, and it still needs to be accessible to security.

D. Equipment / furnishings
There needs to be seating for 300 people to eat. Outside of the lower cafeteria there will also need to be space outside to eat and drink.

E. Special Considerations
As much natural light as possible. People need to be able to be comfortable here some people some eating with others while some will just be grabbing it to go.

F. Behavioral Considerations

G. Structural Systems
Steel frame

H. Mechanical / Electrical Systems
The space will need to be ventilated. This area will not only have to have its own mechanical but this area will have to have three zones to it for a smoking / non smoking areas and for the kitchen area. The electrical service provided to meet Michigan electrical code.

I. Site / Exterior Environmental Considerations

J. Form

SPACE NAME	CAPACITY	NO. UNITS	NSF / UNIT	TOTAL NET AREA
Restaurant / Bar	150		17,500	17,500

A. Purpose / Functions
This area provides an area for people to sit down and have a nice meal and people will be able sit and drink socially.

B. Activities
This area will have people engaged in conversation making it a loud space at times.

C. Spatial Relationships
This area needs to be accessible to all other public spaces, and it still needs to be accessible to security.

D. Equipment / furnishings
There needs to be seating for 150 people to eat, a hostess stand, a coat check, and a bar, an area to display alcohol, a place for people to sit, and a dance floor. In the kitchen there will need to be an area for cooking along with an area to keep things refigerated. There will also need to be space outside to eat and drink.

E. Special Considerations
As much natural light as possible. People need to be able to be comfortable here some people some people will be relaxing on break here.

F. Behavioral Considerations

G. Structural Systems
Steel frame

H. Mechanical / Electrical Systems
The space will need to be ventilated. This area will not only have to have its own mechanical but this area will have to have two zones to it for a smoking and non smoking area and electrical provided to meet Michigan electrical code.

I. Site / Exterior Environmental Considerations

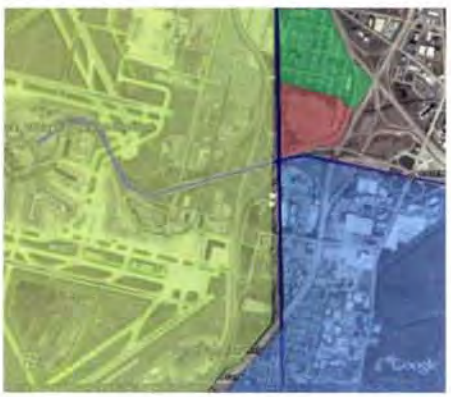
J. Form
This is form is a sleek tublar form that flows from the north west to the south east side of the site, with the south east side of the form being glass that comes back towards the people eating giving them a good view of the sky at night and allowing you to see the plans flying over you along with the light rails pulling into the station.

6. SITE ANALYSIS
Site Factors 62 61

The criterea that I used to select the site were as follows. The area needed to be preparing for the future. The site didn't necessarly need to be something that was going to be built tomarrow because the building is also something of the future. There also needed to be a high population of people in the surrounding area. Another criterea that needed to be filled to be considered as a possible site was there needed to be a need for this type of building. There were three cities that I looked at as possible matches. The first was Chicago Illinios because of its allready in place transit line and its high population. The next city that was considered was Boston Massachutes because of its population and there allready in place rail transit. The final city that was considered was Detroit Michigan. With all the talk about the new light rail that would connect Detroit to Chelsea Michigan and the talk of Aerotropolis at Detroit Metro Airport this site turned into a perfect match.

Chicago Illinois Site

The first site is located east of the Chicago International Airport. This site is located in a heavly populated area from commercial, to residential. There is a densly populated subdivision located to the north of the site. To the east and south the site there is commercial property. Near the site there are local restraunts, hotels, car rental agencies, and a parking lot for the airport employees. The area which my site is located is zoned for commercial use. At the location of the site there is a transit line which goes to the airport and a commercial rail road that cross. I am proposing a station at this location. This way it would be possible for a train like Amtrak to stop at this location along with the light rail that goes to the airport This would also be a good stop for the housing developments which are in the area as well. This site is 47 acres.



Boston Massachusetts Site

The second site is located south east of Fenway Way Park in Boston Massachusetts. This site is heavily populated with hotels, businesses, restaurants, a stadium, a hospital, and residential. The proposed site is a park by the name of Back Bay Fens. This site is limited to 47,000 square feet.

This site is also located near a Mbta stop, and there are two light rails that run on opposite sides of the near by the express way that currently do not stop near Fenway Park. My site would make it possible to connect all three. The stadium with the light rails and the bus stop all at one stop. The landscape is mostly flat with trees, and it has a river that runs to the east of it. Across the river is a commercial building.

Boston University has several buildings located near the site. These developments are marked with a D on the map below. To the north west of the site is where Fenway Park is located. Fenway park was opened in 1912 same year as the "Old Tiger Stadium." Once Tiger stadium closed Fenway Park was the oldest ballpark still used to day to play major league ball in. Sense the Boston Red Sox choose to stay there the city has been coming up with a plan to redevelop the area. This area is about to see a significant change. The area is about to several new high rises which Harvard has already chosen to the first one that goes up as theirs for housing. The Longwood Medical Hospital employees 37,000 people right now and it is about to go up to 47,000 people once the new renevation is done. This area is going to be hopping with new businesses, and new residences within the next few years.

This map shows how the area's buildings and streets will be developed (and by whom) in the coming years, based on current plans.
Key:
A - Red Sox D - Boston University
B - Fenway Ventures (Steven Samuels) E - Sage & Co.
C - Meredith (John Rosenthal) ? - in negotiation

Back Bay Fens Park

Detroit Site

The site is located on the north side of I-94 when passing Detroit Metro airport. This is one of the proposed stops for the new rail line that will be connecting Detroit, Ann Arbor, Dexter and Chelsea in the future. 1. This site does have the potential to become an airport city (areotropolis); an airport city is something of the future. This will mean that people will fly in or ride in to aerotropolis. Here they will be able to have a conference, gamble at the horse track or the casino, eat at a fine dinning establishment, stay the night and fly back out the very next day.

Wayne county is taking steps to create aerotropolis. The beginning steps in the creation this are under way. Such as Wayne Counties state of the art Facilities they are having built at Metro airport. In seven years, they will spend approximately 1.2 billion dollars. This will result in new terminals and four new parallel runways; plus there they will spend 0.5 billion dollars for full Smith/Davey Terminal Reconstruction. 2.

The landscape is mostly flat with few trees, and is currently occupied with corn. Near the site there are local restraunts, hotels, car rental agencies, and a parking lot for the airport employees. North of the proposed site there will soon be a horse track owned and operated by Michigan downs, this particular site is 212 acres.

SITE:

N

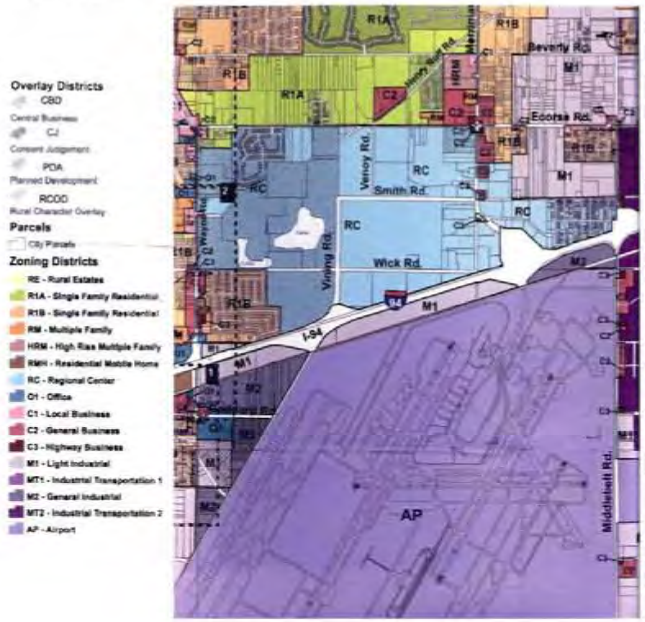
Michigan Downs Race Track

South of that site is the proposed 1,100 acre casino site for the Hannahville Tribe

Hannahville Tribe Casino

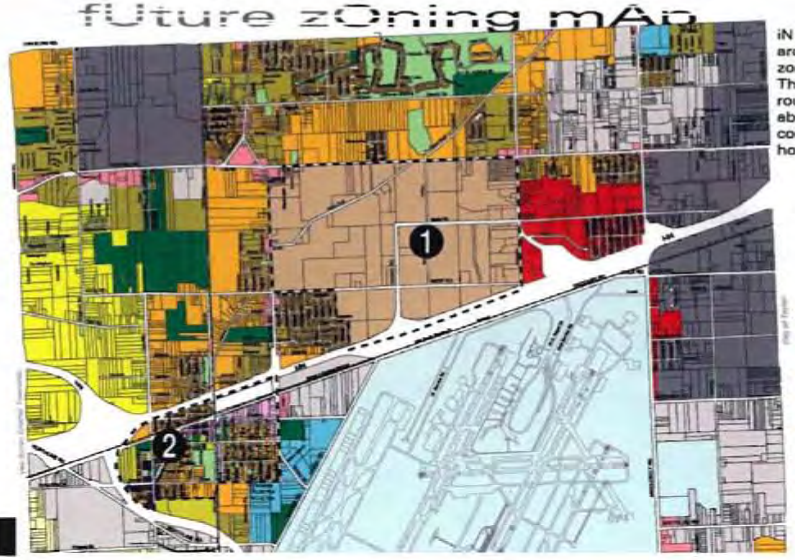
Technology is advancing every day. As technology advances we enter more of a digital era. The field of architecture benefits greatly from the advancement of technology in such ways as the creation and building of dynamic forms. This site could be considered in the same way, it has the potiental to advance into a piece of Metro Airport City. As we continue to make advancements in travel and technology this site will display those advancements as one of the major pieces of Airport City. Just like airport city is not there yet or the connector train from Detroit to Ann Arbor neither is this technologicaly advanced building. In the future we will have much to look forward to as the design and creation of this "city" occurs using the latest in these advancements.

cUrrent zOning mAp 2000



cUrrent area around the site is a RC (regional Center District.) tHis means that this area is zoned for large scale commercial and office developments which can take advantage of the potential trade of passengers, visitors and employments at the Metro Airport.

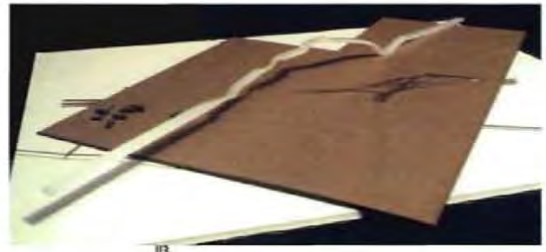
fUture zOning mAp



iN the future the area around my site will be zoned metro center. This means that the surrounding area will be able to have casinos, convention centers, hotels and restaurants.

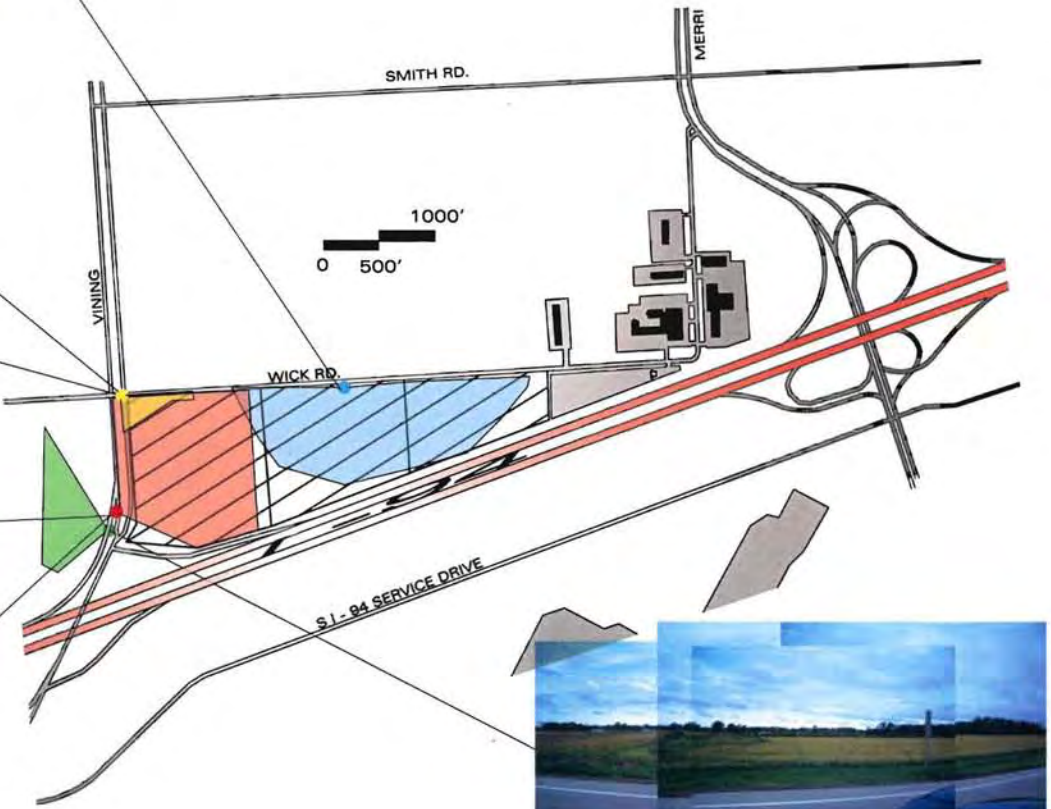
site maps

site models



site plans

panoramic views of site



PANORAMIC VIEWS

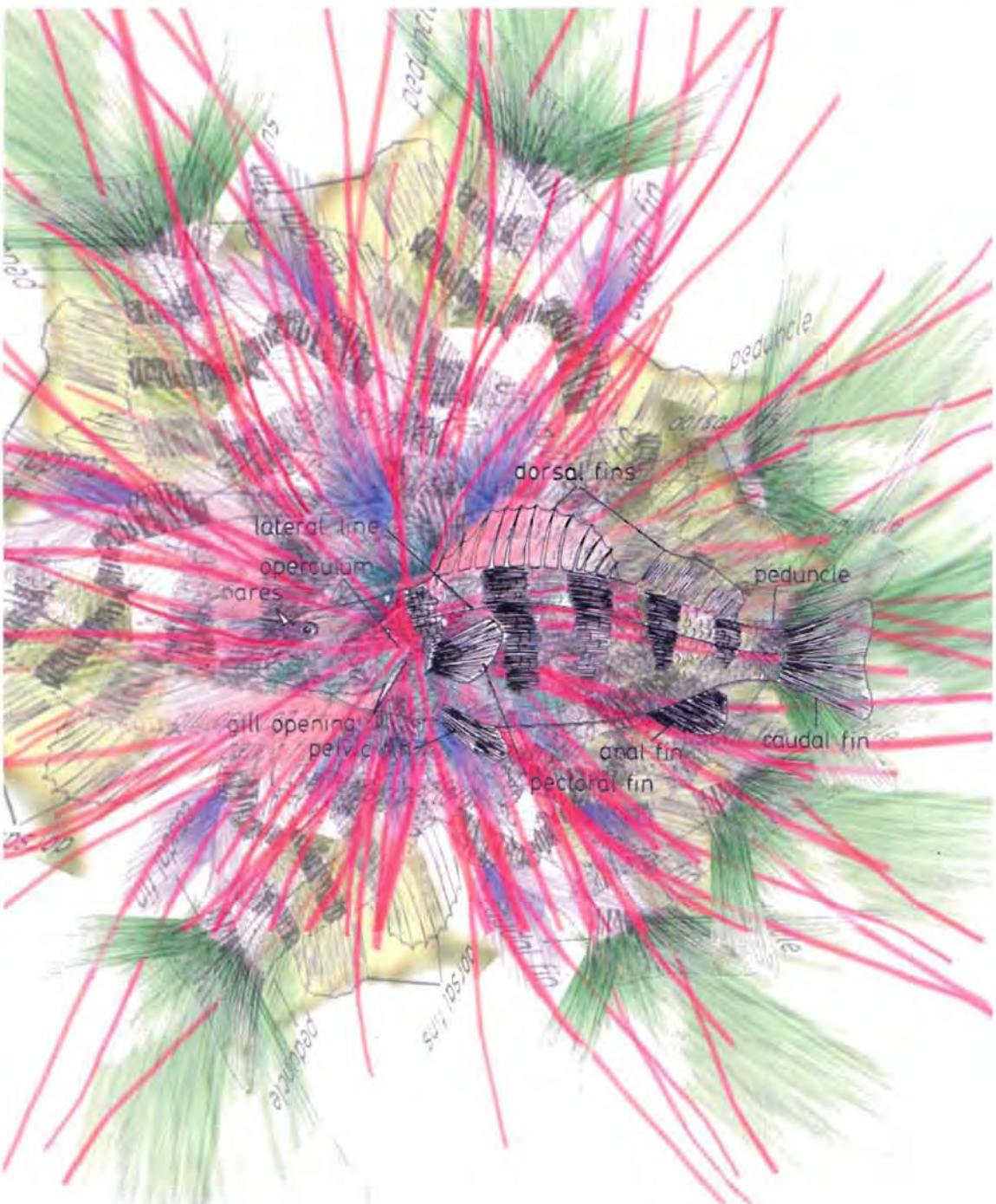
NOTES:

1."PRELIMINARY ALTERNATIVES MAP." Ann Arbor to Detroit. 27 Oct. 2003. Southeast Michigan Council of Governments. 9 Dec 2006 <http://www.ann arbordetroitrapidtransitstudy.com/study_alts/prelim_map.aspx>.

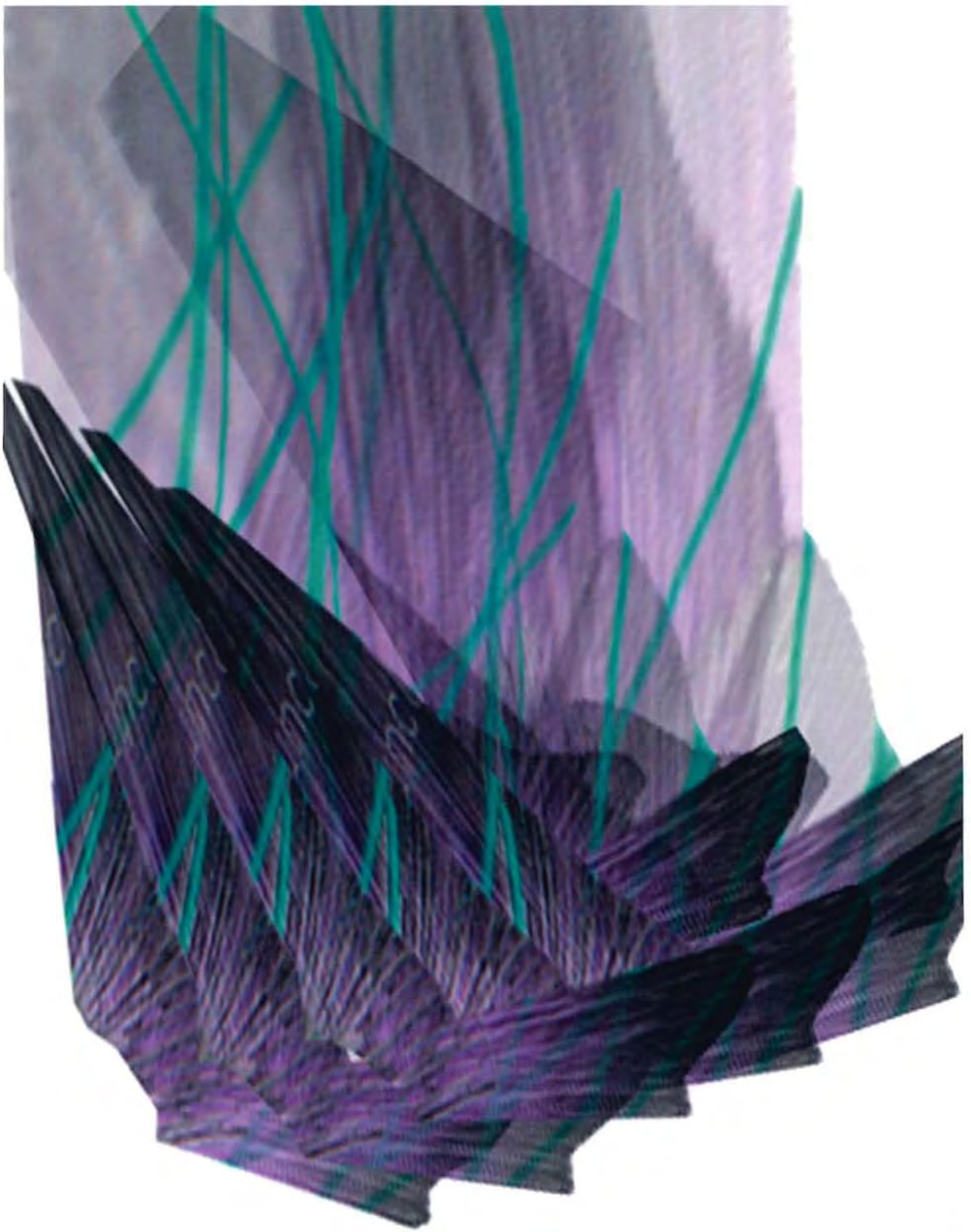
2."The Wayne County Aerotropolis." Wayne County Regional Development. 2006. Univer sity of Michigan. 10 Dec 2006 <http://www.tcaup.umich.edu/charrette/20 06/aerotropolis06_wayneco.pdf>.


8. SPRING BOARD
68

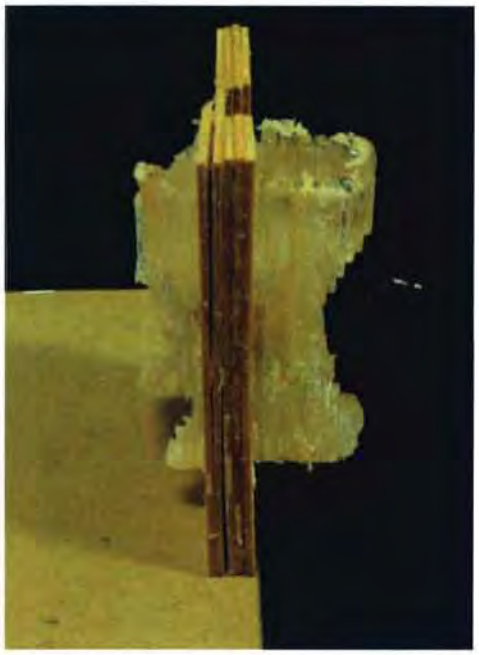
This project started out as a dissection of a fish. A typical fish is cold-blooded and has a streamlined body that allows it to swim rapidly through the water in a sleek and slick way. Their scales on there body are different for each type of fish. One thing they all have in common is they protect the fish and are usually a diamond shape. Each one has a thin layer over the hard protective layer that helps to stop bacteria from forming on the fish. This exploration of the fish quickly turned into a fun and exciting exploration. This study is about using a source image or form to create a new form through a process of disection and re-aggregation, or abstraction. This is similiar to what how I started my design process of my building that will be seen later in this chapter. Below is a picture that started with a fish. After dissecting the major parts of the fish and rotating them all around a common point this is what resulted; a very abstract drawing of a fish.



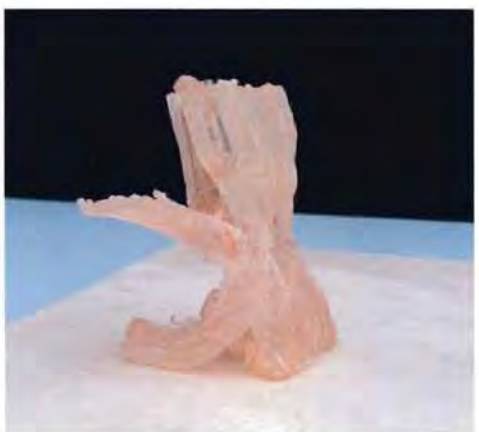
This is a reinterpretation of the previous drawing. There were certain parts of the previous drawing that stood out. These parts were taken and fit together to make the drawing below.



The next step in the process was to create a 3-D Viz model. The drawing on the previous page was imported into 3-D Viz and traced using nurb surfaces. Each arc that was created was raised at a increment of 6" each time, then connected with a nurb surface modifier, creating the model located below.



The next challenge was to try to get the computer model to a physical model. I started by scaling the object down from 3' -0" to 4" in height. I had to export the image from 3-D studio Viz to a program called BOA. This is a Macintosh based program that will open up .dwg files. I set up the file so it would cut through the object every 1/8" of an inch. Each time I cut through the form I exported that image as a .dwg file, giving me 48 separate files. I opened all the files up in auto CAD and made six .dxf files. These .dxf files were then sent to a laser cuter which cut the pattern out of bass wood. Once the patterns where cut I put paste wax on them and lined one on top of the other. Once this was done I then poured clear resin into the form. The resin hardened and was removed from the laser cut form. The end result was that the physical model ended up looking similar to the computer model but it was not an exact replica.



The top left image has the mold that was created by the laser cutter once the resin was removed from the mold. This was a learning experience. Mass customization was the first thing I thought of once I had a chance to look back at the experience. Now that I have the mold and the file for the laser cutter I could easily cut a piece and add it to the mold. I could also rearrange the pattern to create a new form. Either way these are examples of mass cutomization if this was at full scale.

For a while now there has been talk about 3-D printing. It is used by some of the best architecture firms in the world. These firms are considered to always be pushing the envelope. It is a way to get what is virtual into the physical. This was a way to produce a more precise model. The first technique that involved the laser cutter, auto CAD, 3-D studio Viz, and BOA was very labor intensive and still did not produce a high quality model. All 3-D printers use .stl files to print and almost all 3-D software will export to a .stl format. There was only a few steps in this method.

First there needed to be a .stl check done. This is a simple modifier that checks to make sure there are not any inverted nodes, and no open edges. There were a few of these present in my model. Once they were fixed the file was then exported as a .stl file and sent to the 3-D printer. There are several different types of 3-D printers.

Some 3-D printers will print in color and even represent textures, while others use corn starch to print. These models must be coated in a wax or they are very brittle and break easily. The 3-D printer that printed this model used plaster. Once it came out of the printer it also needed to be sealed with a epoxy to make it more stable.

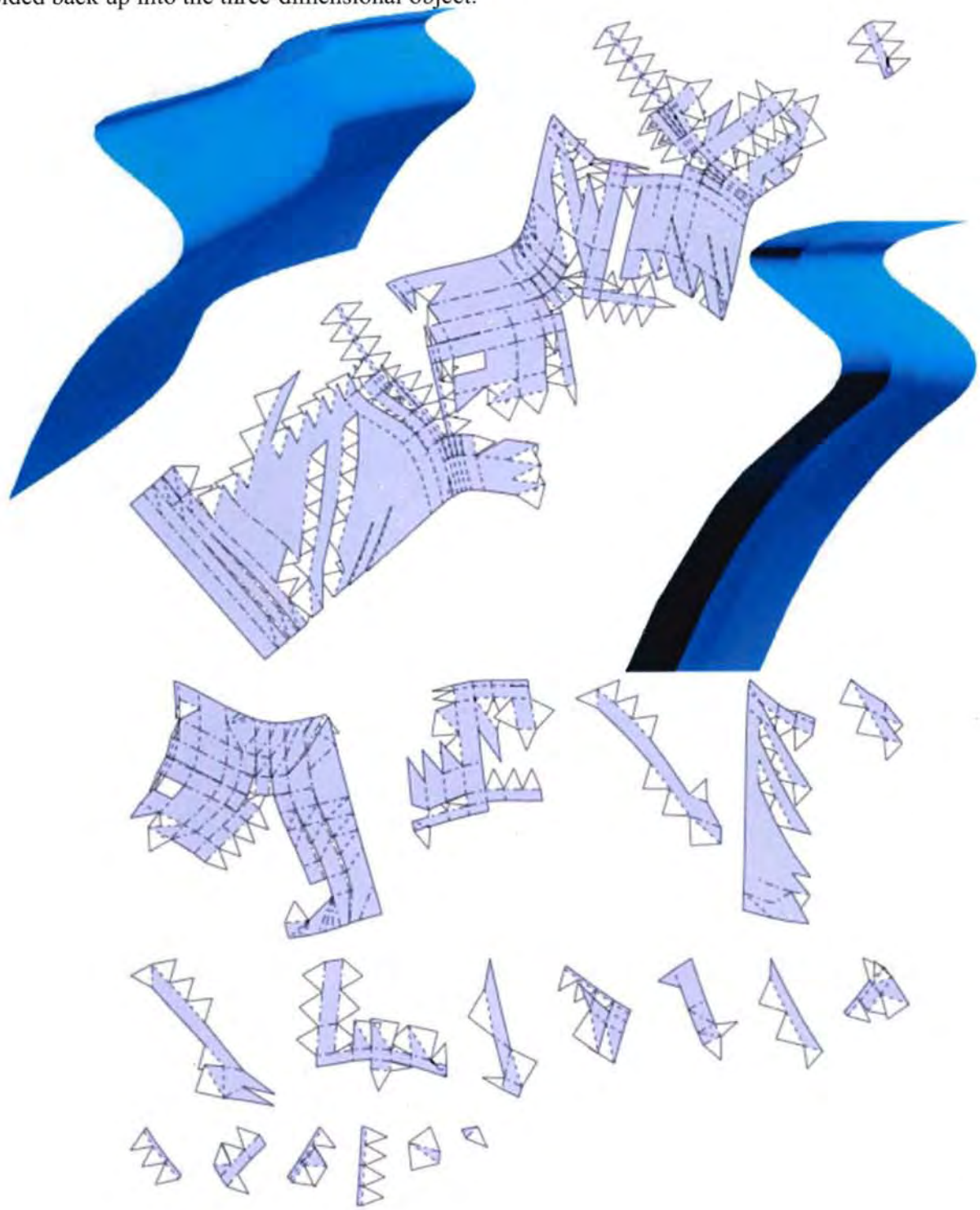
This model was more precise and was made 6" tall instead of only 4", and was created with fewer steps then the previous one. This file can easily be manipulated to get a different result now that the basic form is in the computer.

SKIN STUDY #1

This is a skin study were the pattern was cut out with the laser cutter and then the held together with a threaded rod that would need to be cut off after it was threaded through each hole. This is another example of mass customization. The file is all ready to be cut if it needs to curve a little less in one spot and more in another it can easily be done with a couple of changes to the file. The picture in the upper right hand corner is what the two pieces look like once they have been cut out. The pictures located bellow to the right and left are two different examples of what the skin could look like when it is assembled.

SKIN STUDY #2

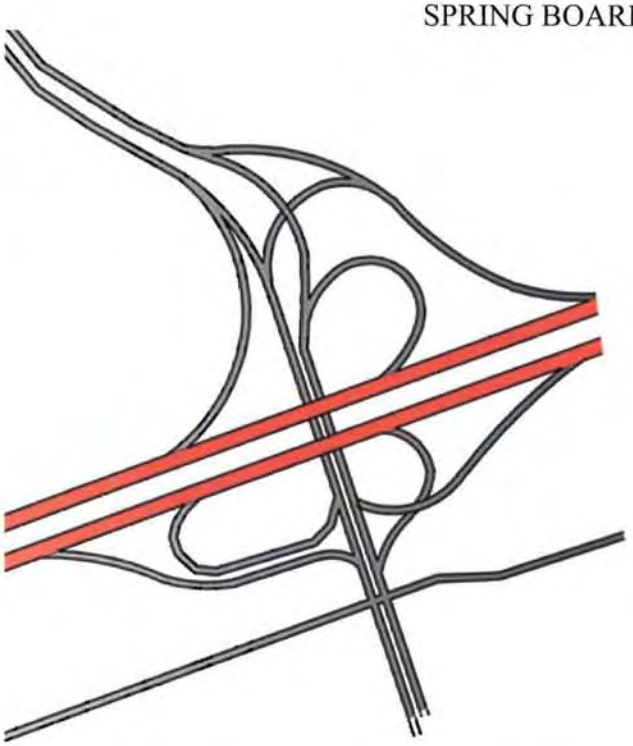
This study was done using 3-D Viz and a new software called Pepakura Designer 2. The 3-D image was created in 3-D studio Viz and then opened up in pepakura Designer 2. This software allows you to take a three-dimensional object and unfold it into a two-dimensional object. This object has all the fold lines along with flaps. It can then be folded back up into the three-dimensional object.



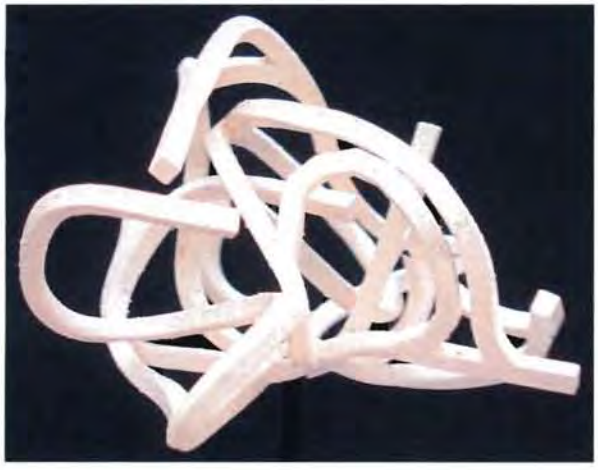
The image to the right,which is located near the project site, served as a generative image for the first step in the design process. The project has to do with high speed.

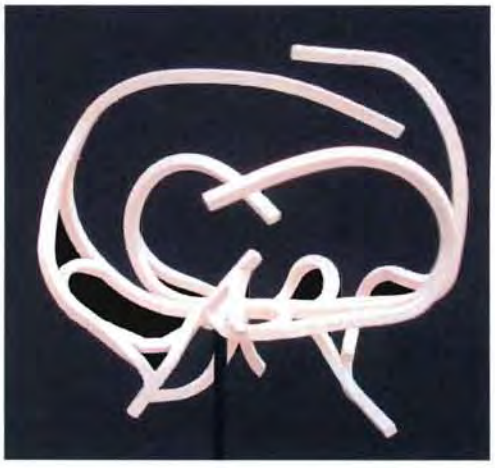
- Technology ● With the advancing of technology the production of dynamic spaces are becoming more feasible.
- Life ● The fact that life moves at such a fast pace especially around an airport. People always coming and going moving at speeds of up to 150 mph.
- Station ● This train station is going to be for high speed light rail trains. These trains are going to be moving people at speeds greater then 100 mph.
- Express way ● The cars moving past the site are moving at speeds of 55 mph and up.

This is why this is such an exquisite starting point for this design.

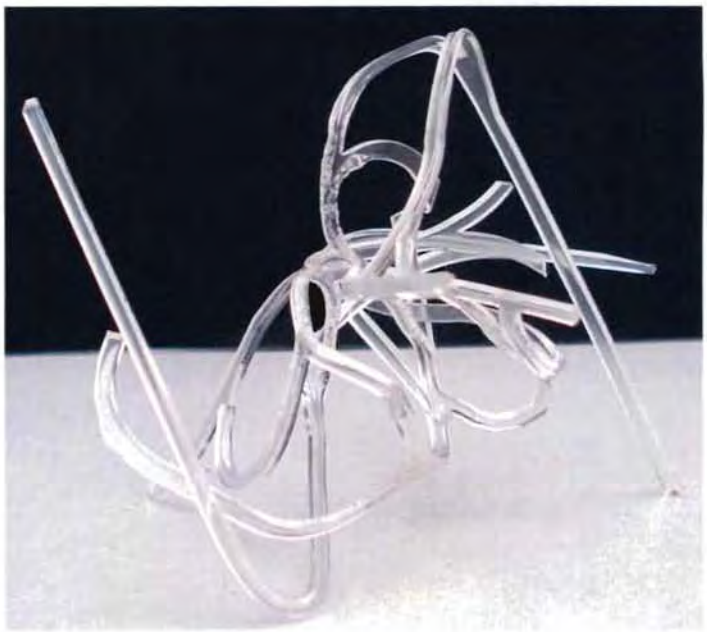


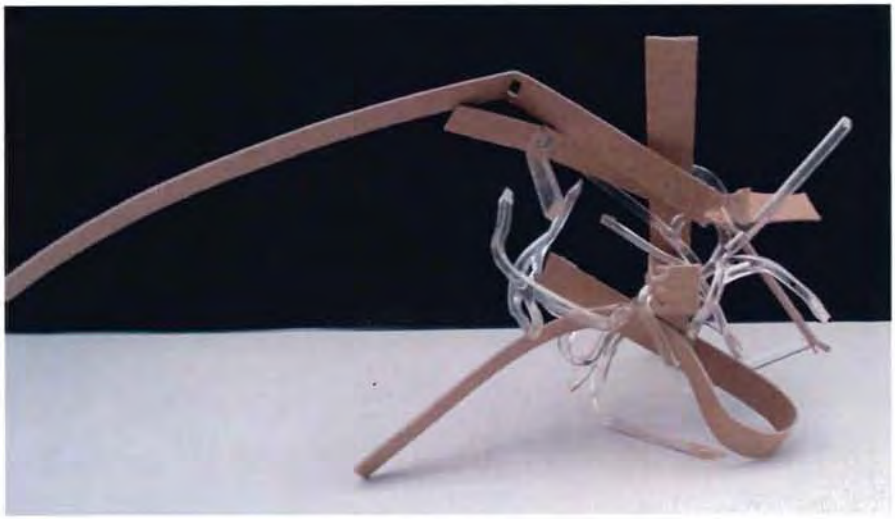
The pattern in the upper right hand corner was laser cut out of acrylic. The acrylic was then heated up and bent to create the forms located on the right hand side of this page and below. This was done several times, each time coming up with new variations.

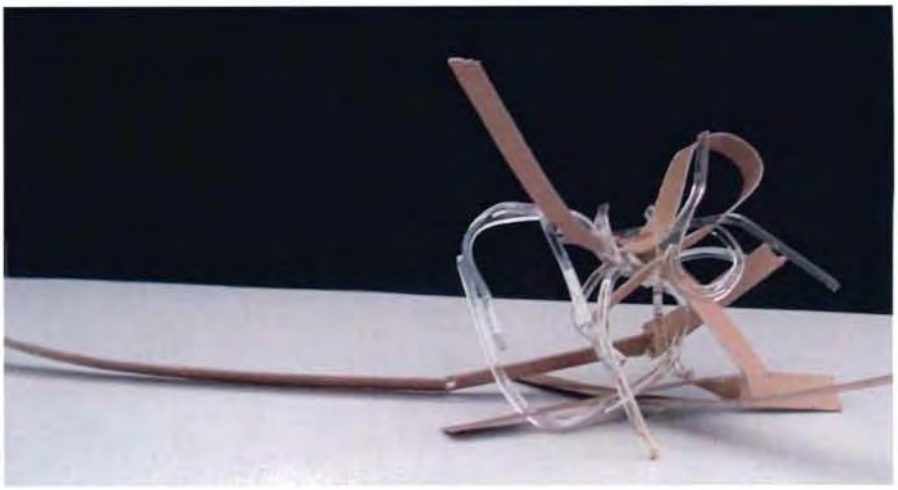




These are some more variations of the cloverleaf. In the bottom two images a secondary plane was injected. These turned out to be more of an interior form exploration instead of an outside form exploration.



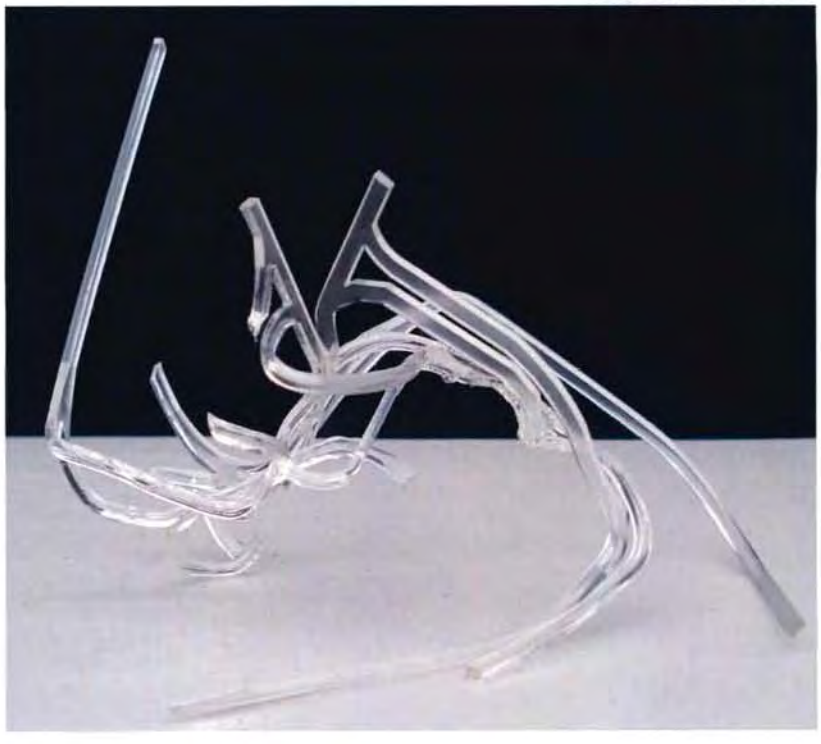


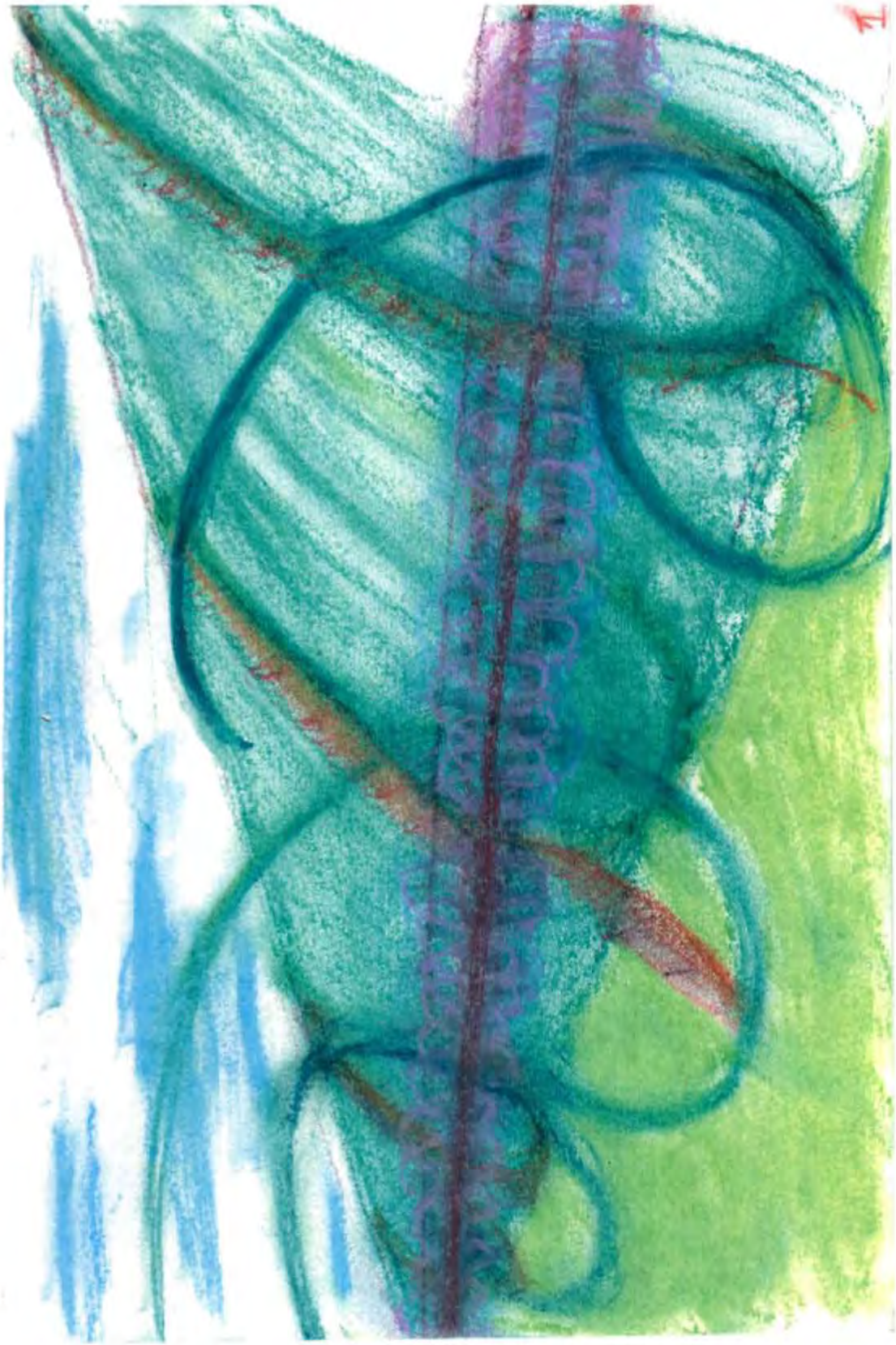


These drawings on the next couple of pages were done with pastels. They were done by looking at the models created in the previous step. I would look at the model like the one to the right and draw it like the drawing located below. Some of the drawings would just be drawn from one view. Other drawings would be created by drawing a piece that stood out and then turning the model and drawing another piece of the model that stood out to create one drawing.

These two pastel drawings were created separately, at separate times using the same technique, looking at one of the spatial models and reinterpreting it in a drawing.

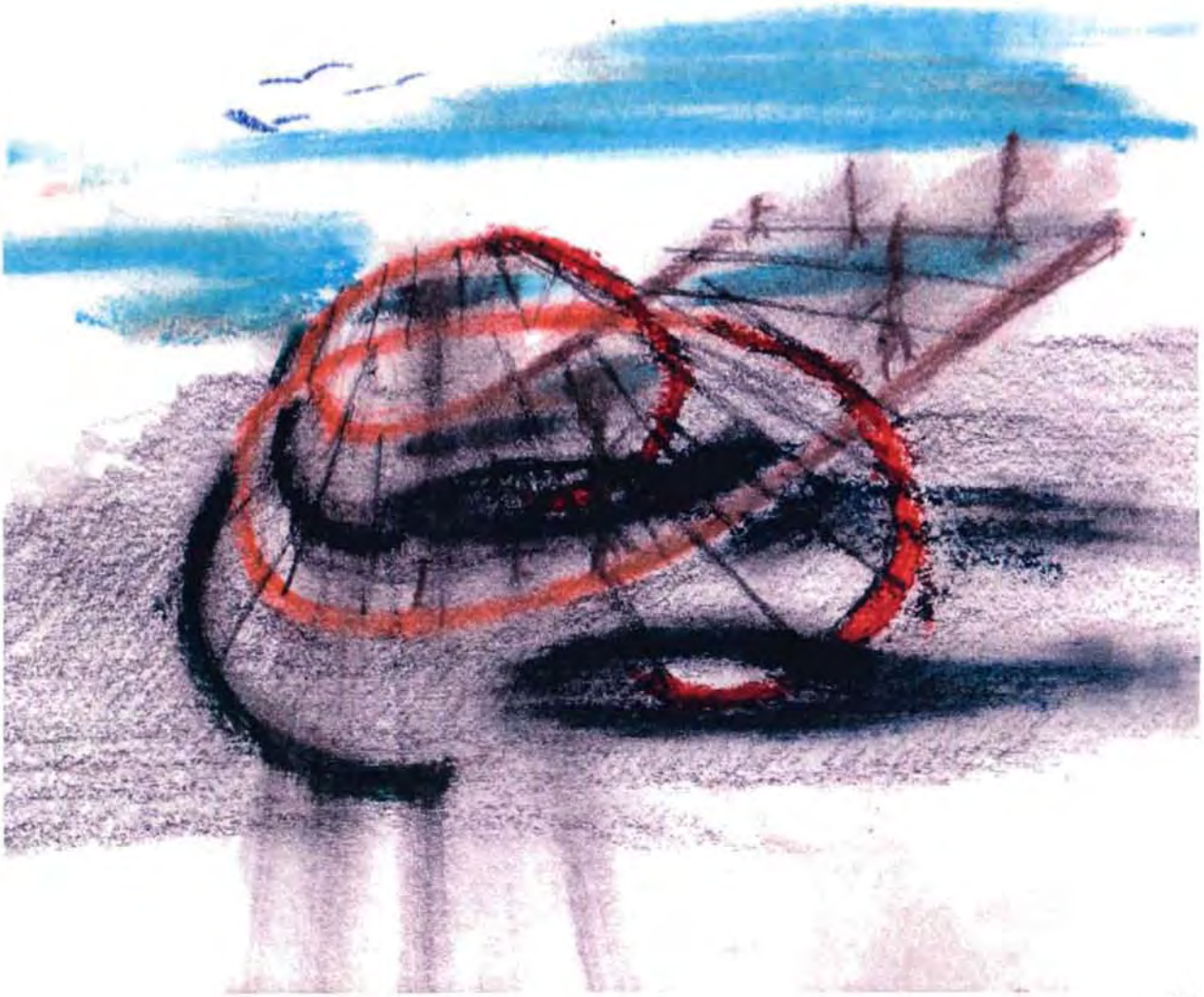
The drawing below was drawn by looking at the cloverleaf and pulling certain characteristics out of the position it was in and then repositioning the cloverleaf and drawing certain characteristics of that position.





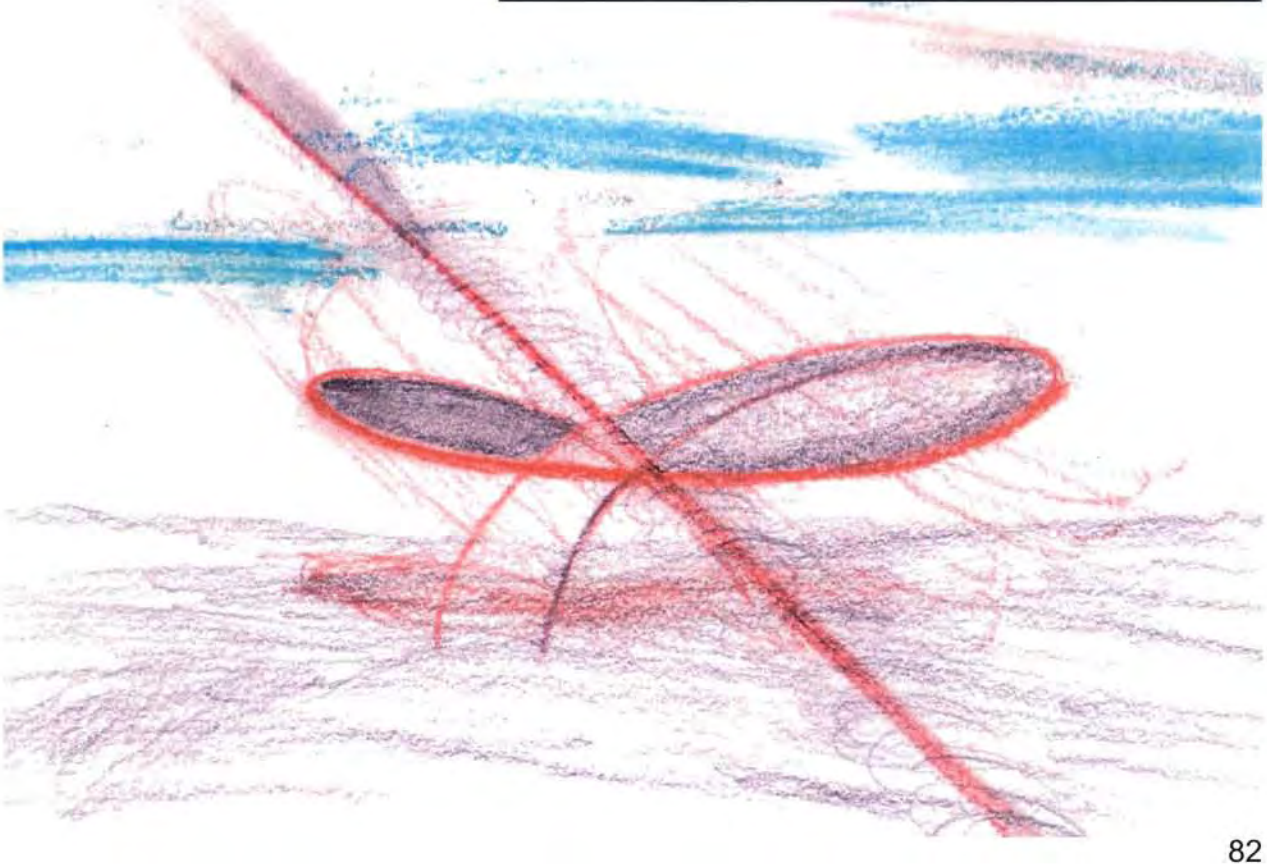
This drawing was developed from the previous drawing. This is a possible vision of the light rail with escalators (represented with the tan) that go over it.

I developed the drawing below by looking at the one to the right and imagining that it was a portion of the building. The drawing below is drawn in elevation. It is elevated above the ground to give the essence of floating. There are people coming outside to eat and to get some fresh air.

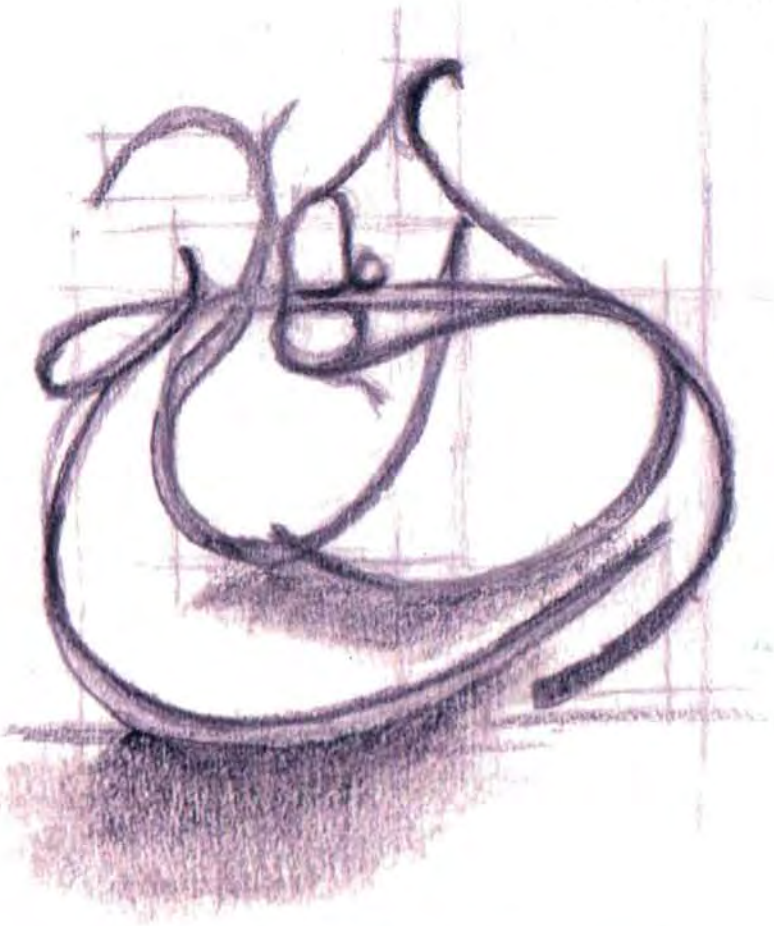


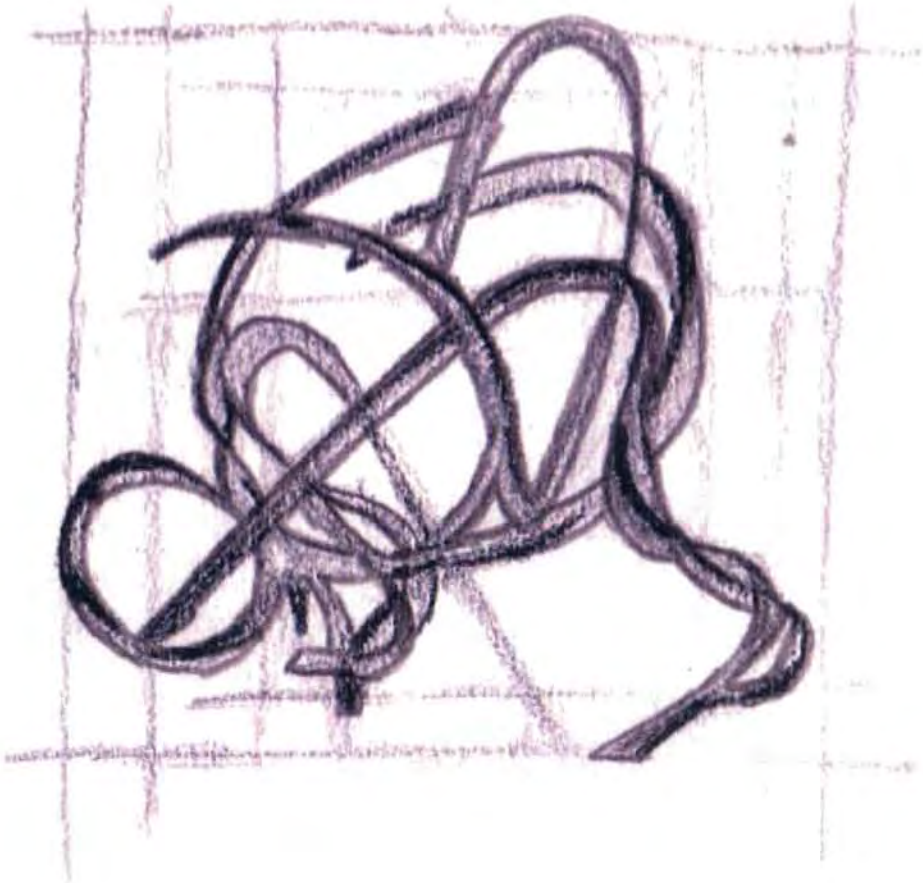
The drawing located to the right was produced in the same manner as the prvious ones. It was created with a different media; pastel pencils and black paper.

The drawing located below is a reinterpretation of the drawing on the right. The line that is through the middle is a representation of the light rail. This drawing makes the building appear as if it has a pair of wings.

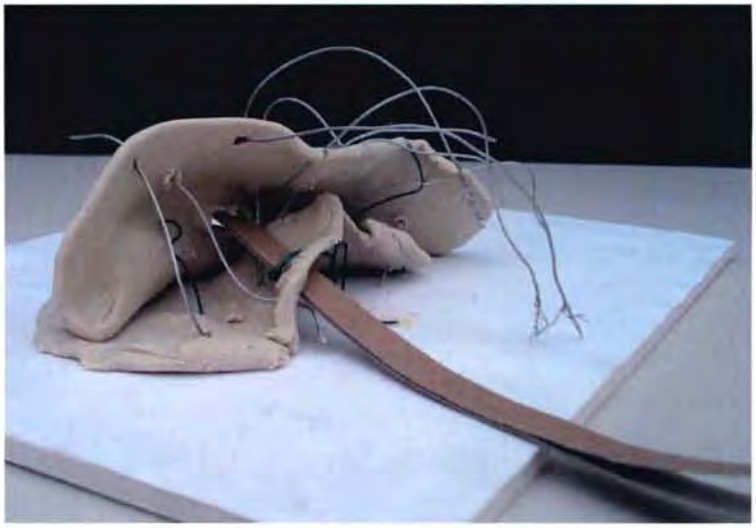


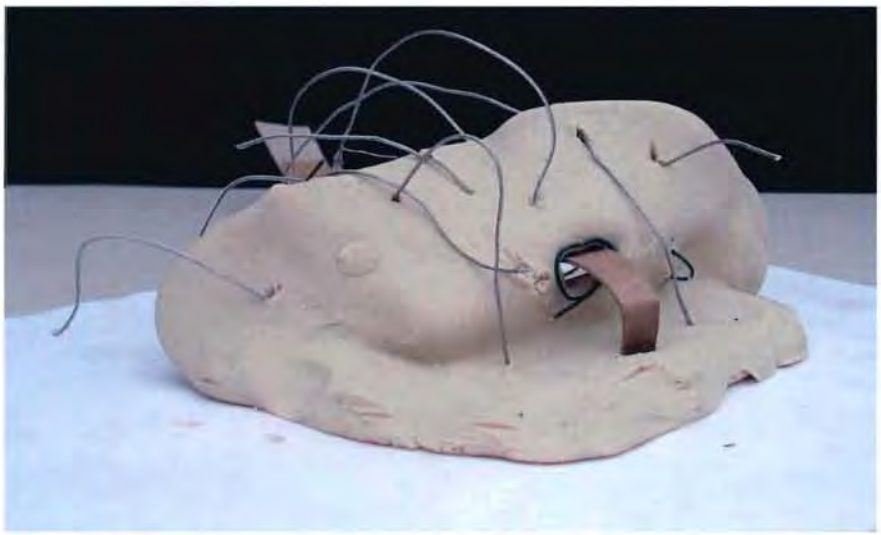
These next two drawings ended up being some of the most successful. They were created with charcoal and white paper. I looked at the cloverleaf and drew what I saw and then rotated the cloverleaf to a new position and then drew what I saw on top of the old one. This created an interesting reinterpretation of the cloverleaf model.

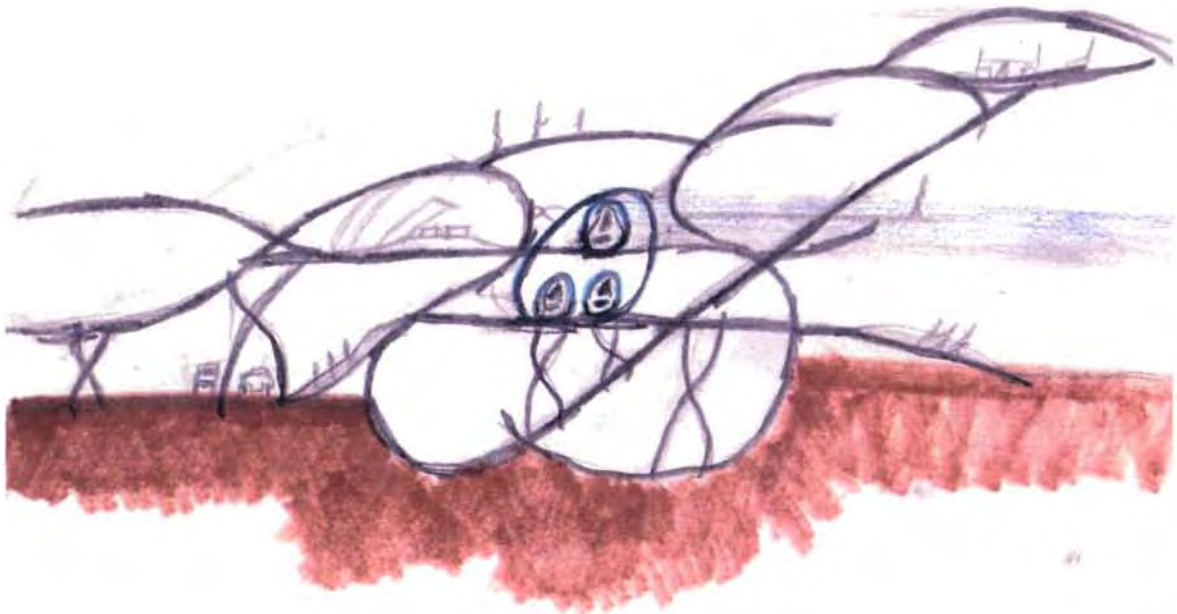




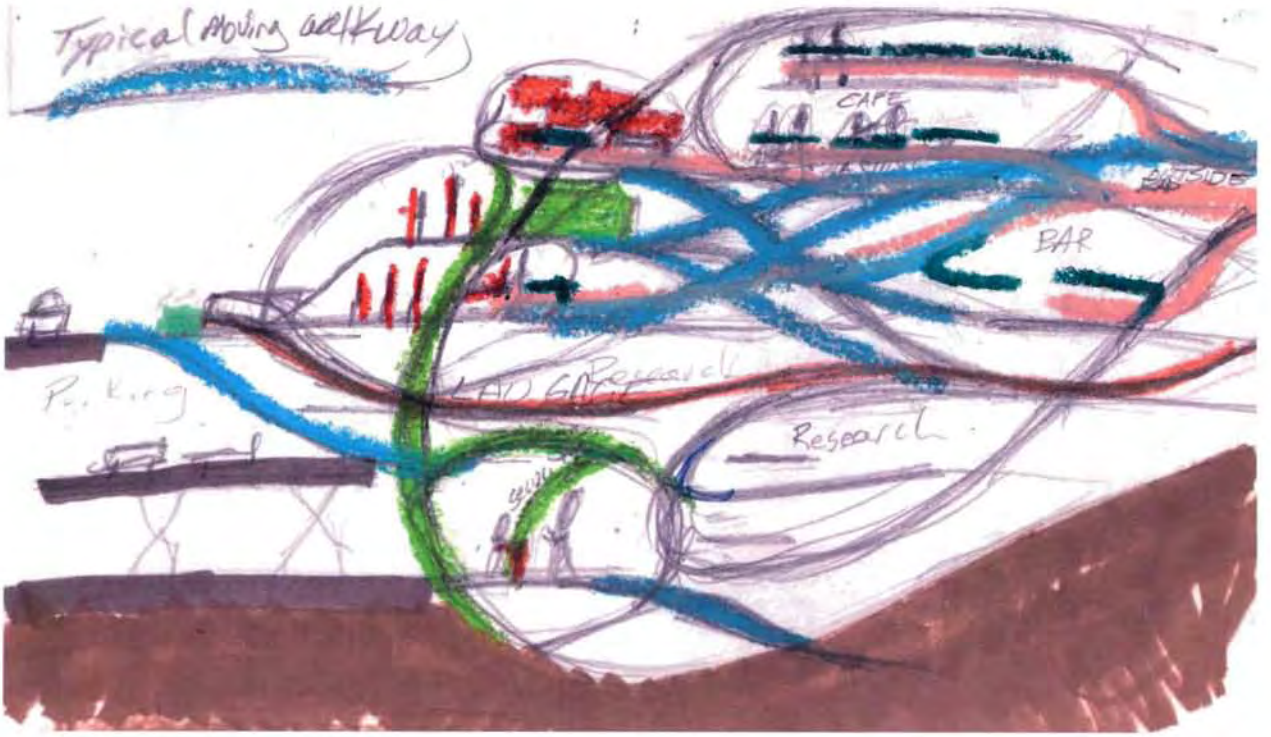
These next two pages have models and drawings on them that were created in a design charette that I did during a 5 hour studio session. The two models on this page are a reinterpretation of the drawing located below. The drawing below is a vision of what a section might look like through the building.

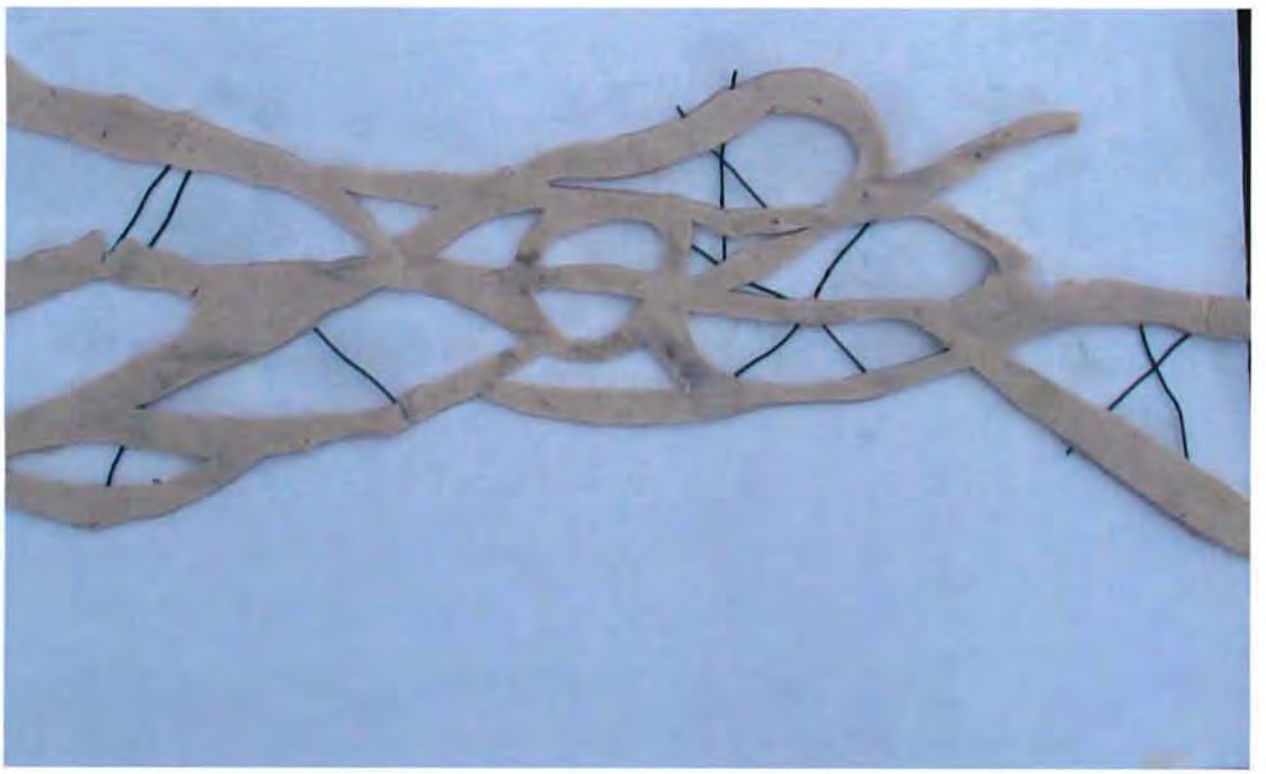






The model below is of the section drawing above.

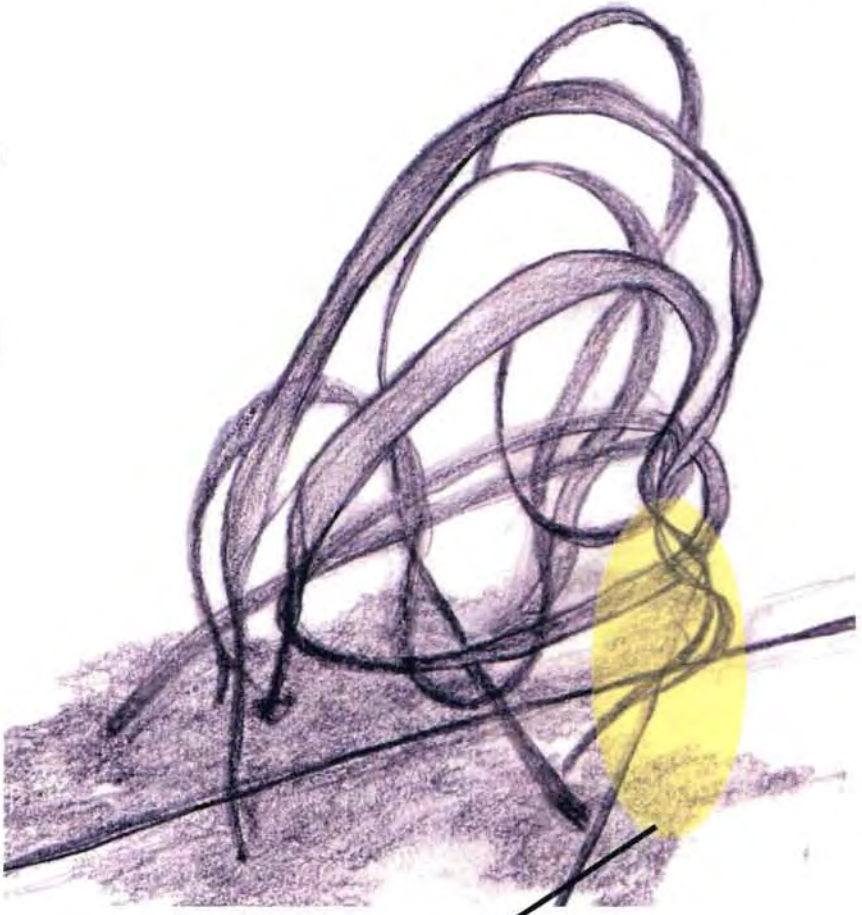


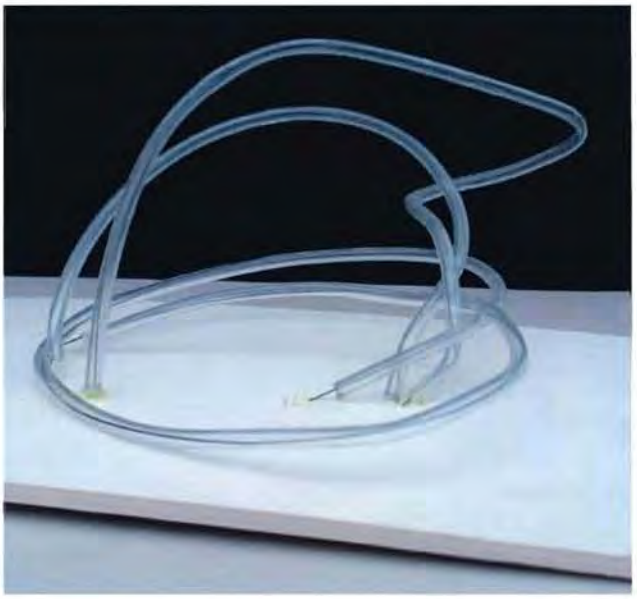


The drawing located to the right was drawn from the drawing located on the previous page.

The drawing located to the bottom left is a detail of the area highlighted on the drawing to the right. The tubular shaped object in the drawing is the tube that the light rail would run in once it got close to the station.

The model located to the bottom right is of the area located in the bottom left drawing.

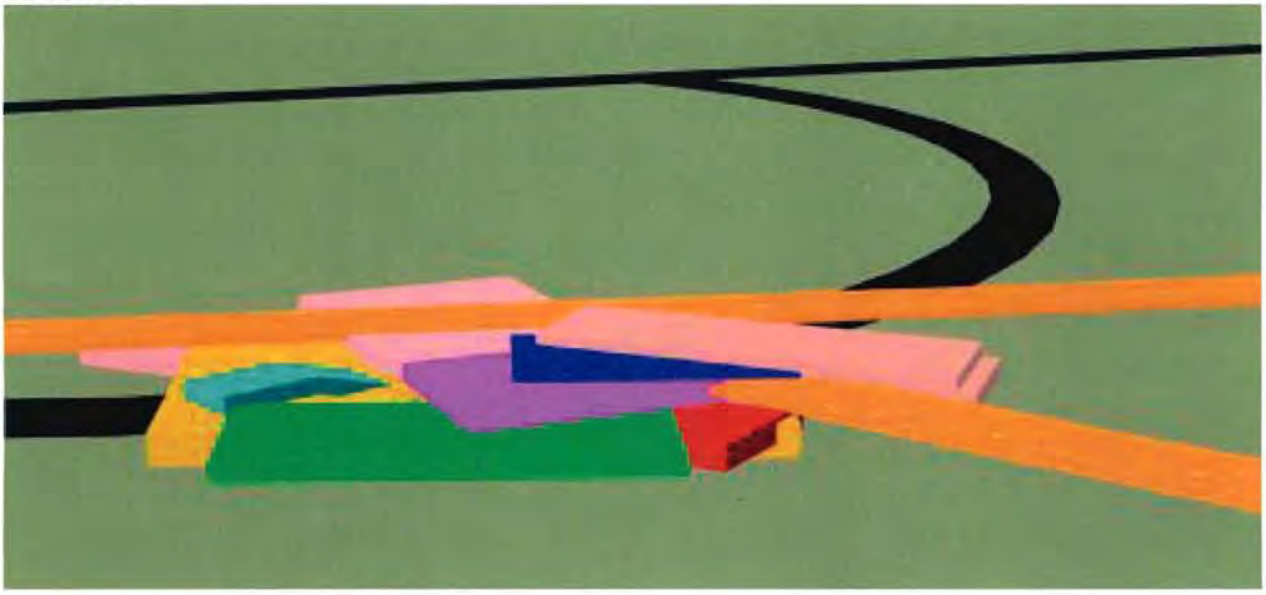




The next step in the process was to ensure that there would be enough space on the site for everything that was in the program. There was a small massing model that was created using 3-D Viz. This study showed that all three sites did not need to be used. So the site was cut down to just one plot of land.

Located in the upper right hand corner is the massing model in plan view sitting on the site.

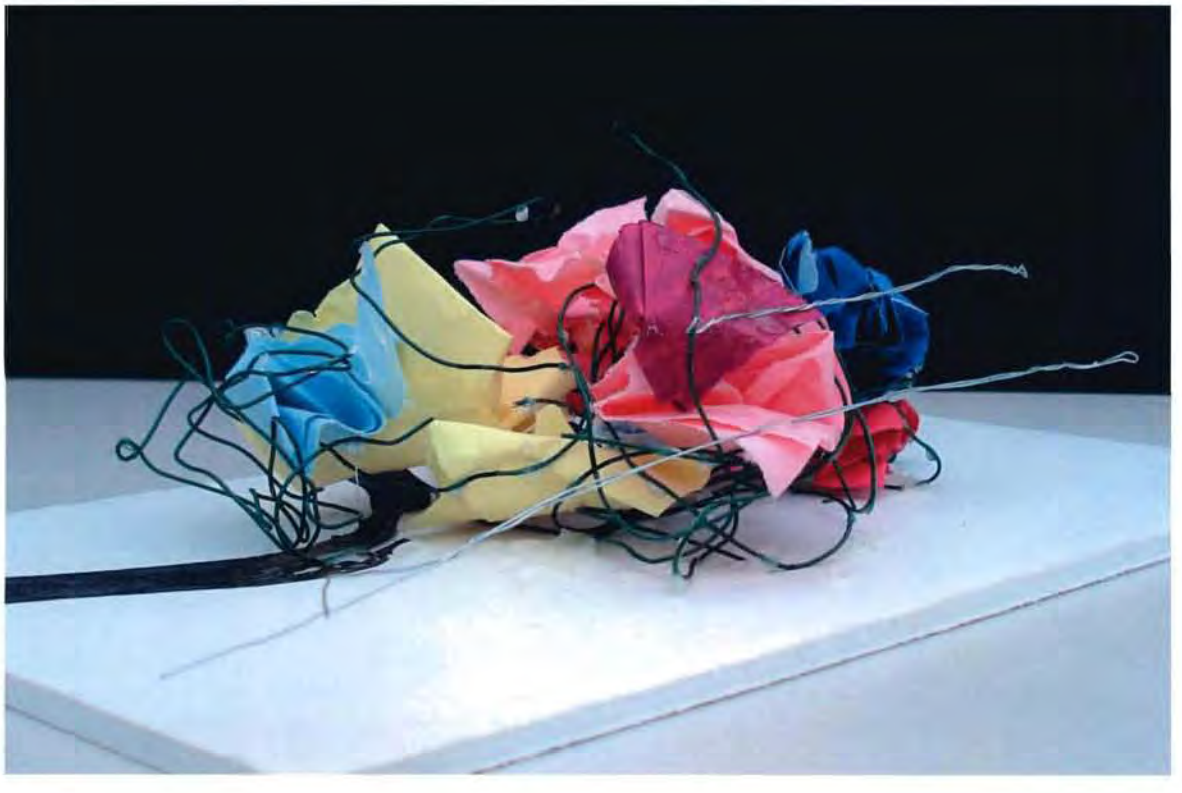
Directly below is a axonometric of the massing model sitting on the site.

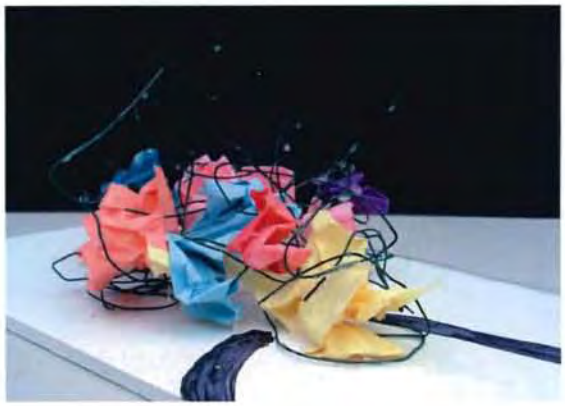


The two wire models here were created by looking at the massing model and reinterpreting what was seen.

These next three pages each have wire models that are reinterpretations of the massing model that was created in 3-D Viz, and shown on the previous page. The clored paper is inserted to indicate where each programatic space is located in the building.

KEY
RED = SECURITY
BLUE = MEETING AREAS
YELLOW IS TICKETING / ENTRY
LIGHT PINK = RESEARCH LAB
PURPLE = CAFETERIA
DARK PINK = LIGHT RAIL / BAR/ BAGGAGE PICKUP





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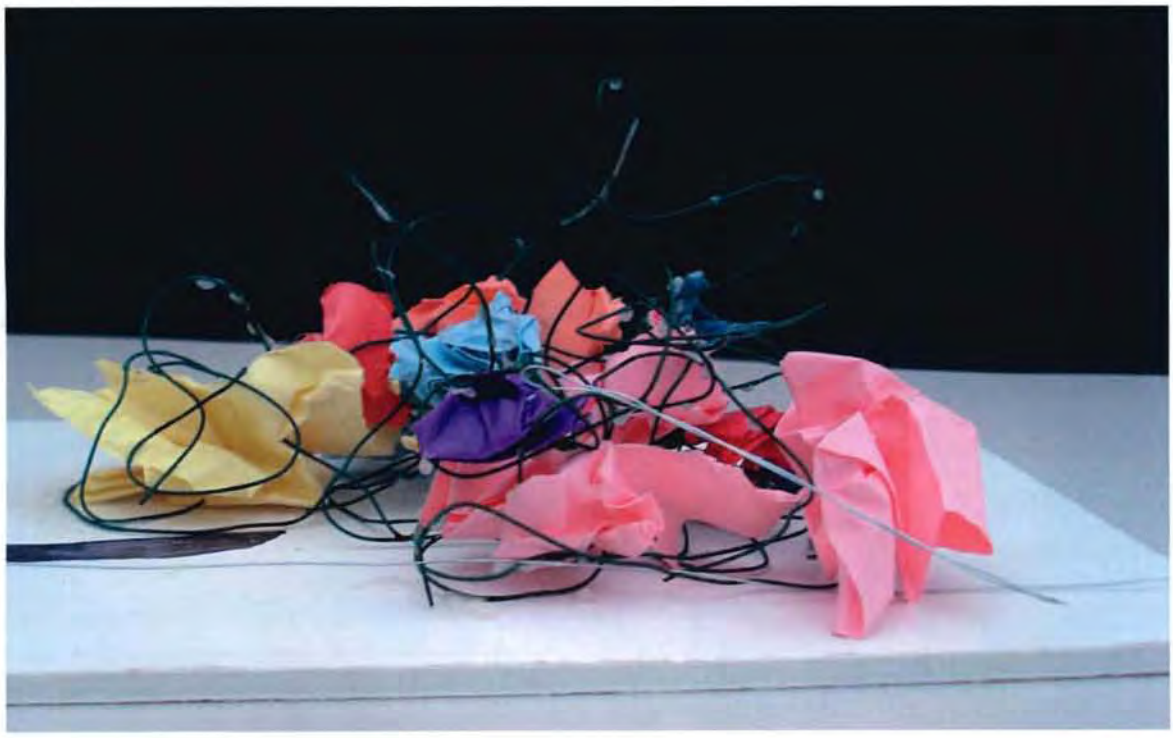
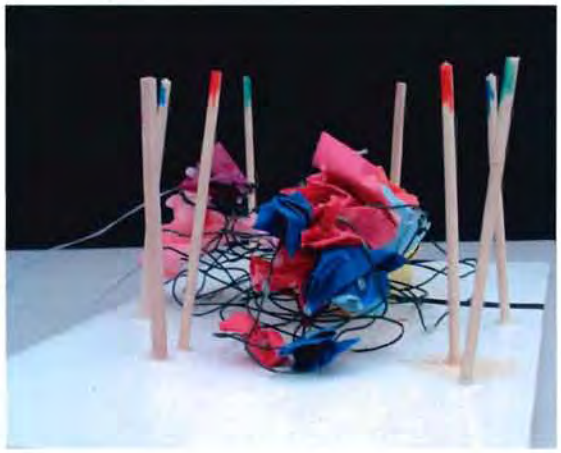
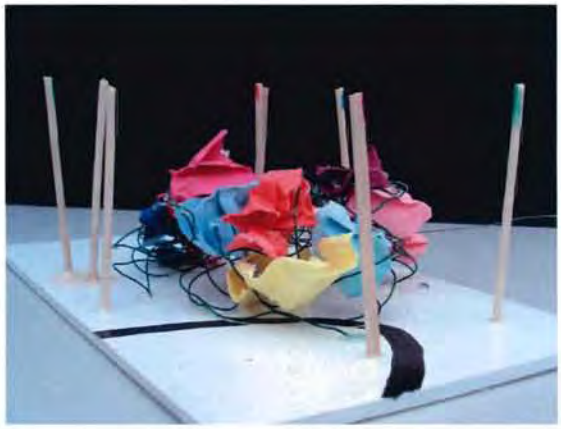
PURPLE = CAFETERIA
DARK PINK = LIGHT RAIL / BAR/
BAGGAGE PICKUP

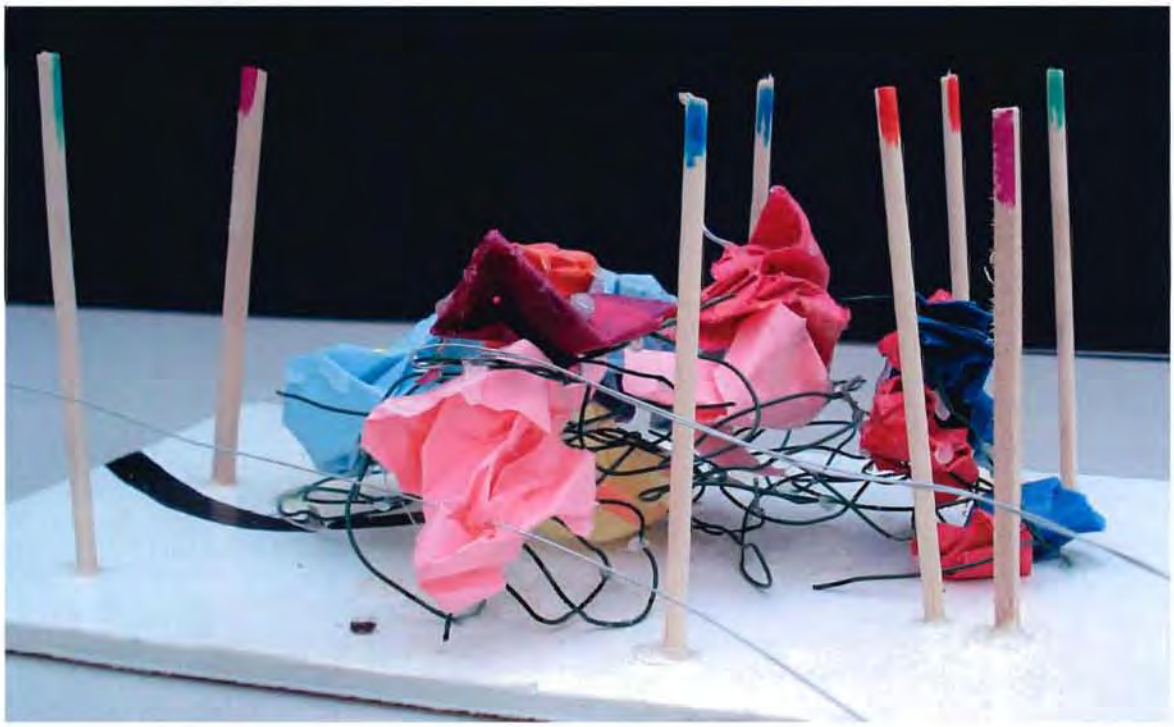


This model lead to the creation of sections and plans. Each section is coordinated with a colored stick to indicate where each section is being cut. Following this page are several pages with preliminary plans and sectons that are helping envision the spaces that will eventually be created.

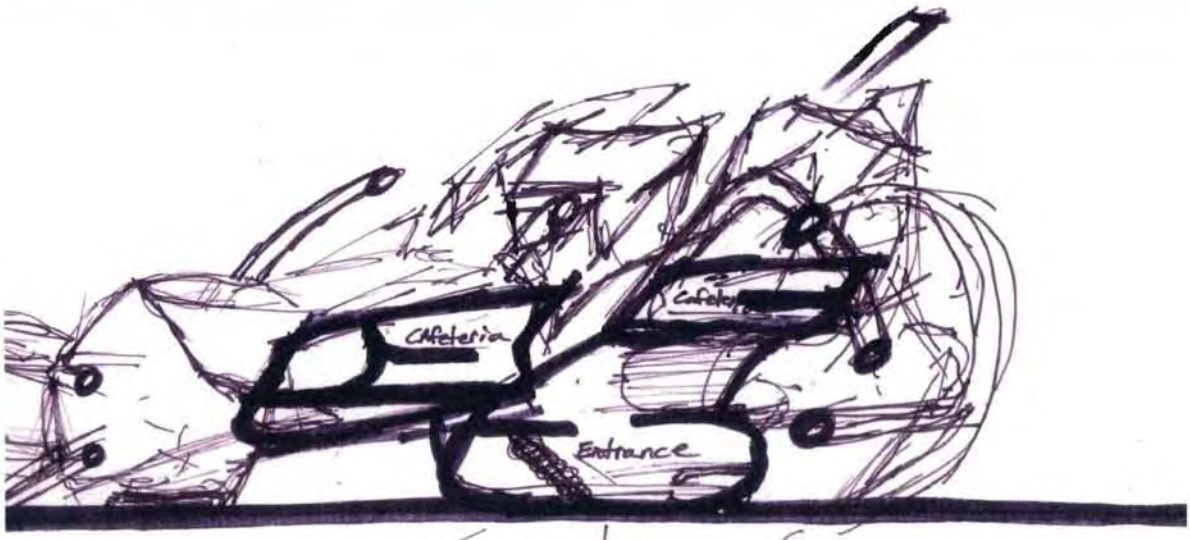


KEY
RED = SECURITY
BLUE = MEETING AREAS
YELLOW IS TICKETING / ENTRY
LIGHT PINK = RESEARCH LAB
PURPLE = CAFETERIA
DARK PINK = LIGHT RAIL / BAR/ BAGGAGE PICKUP





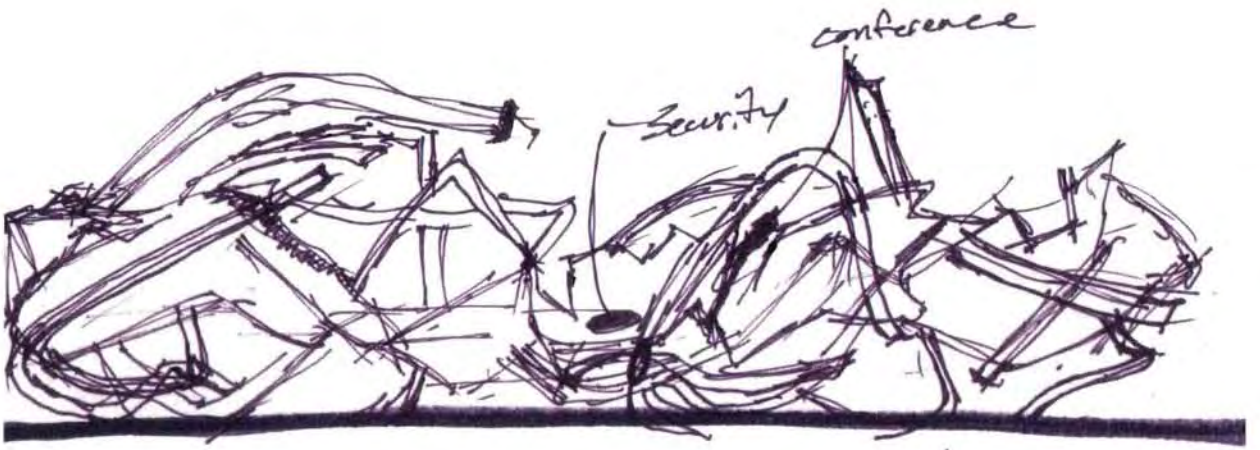
Section 1



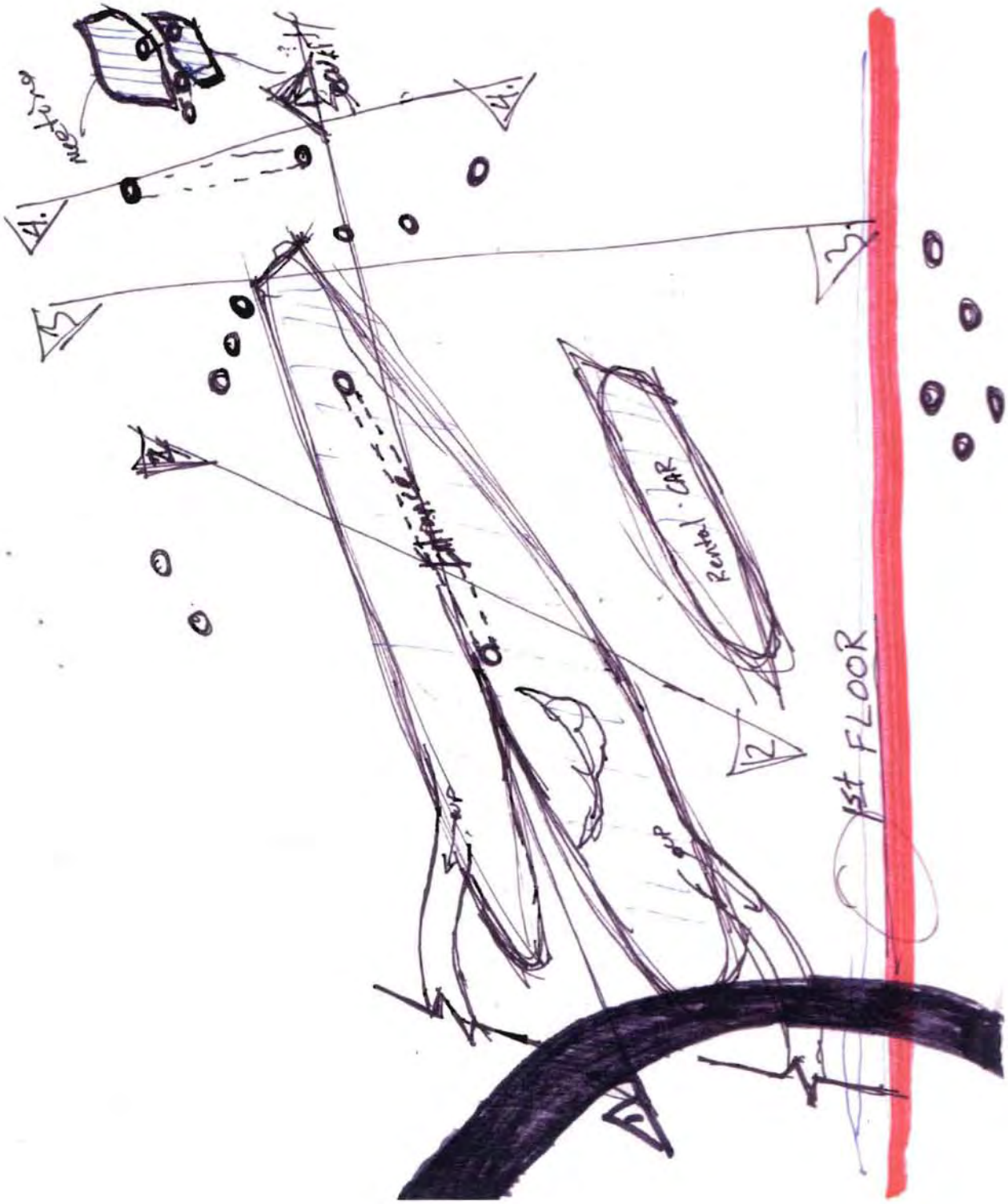
Section 2

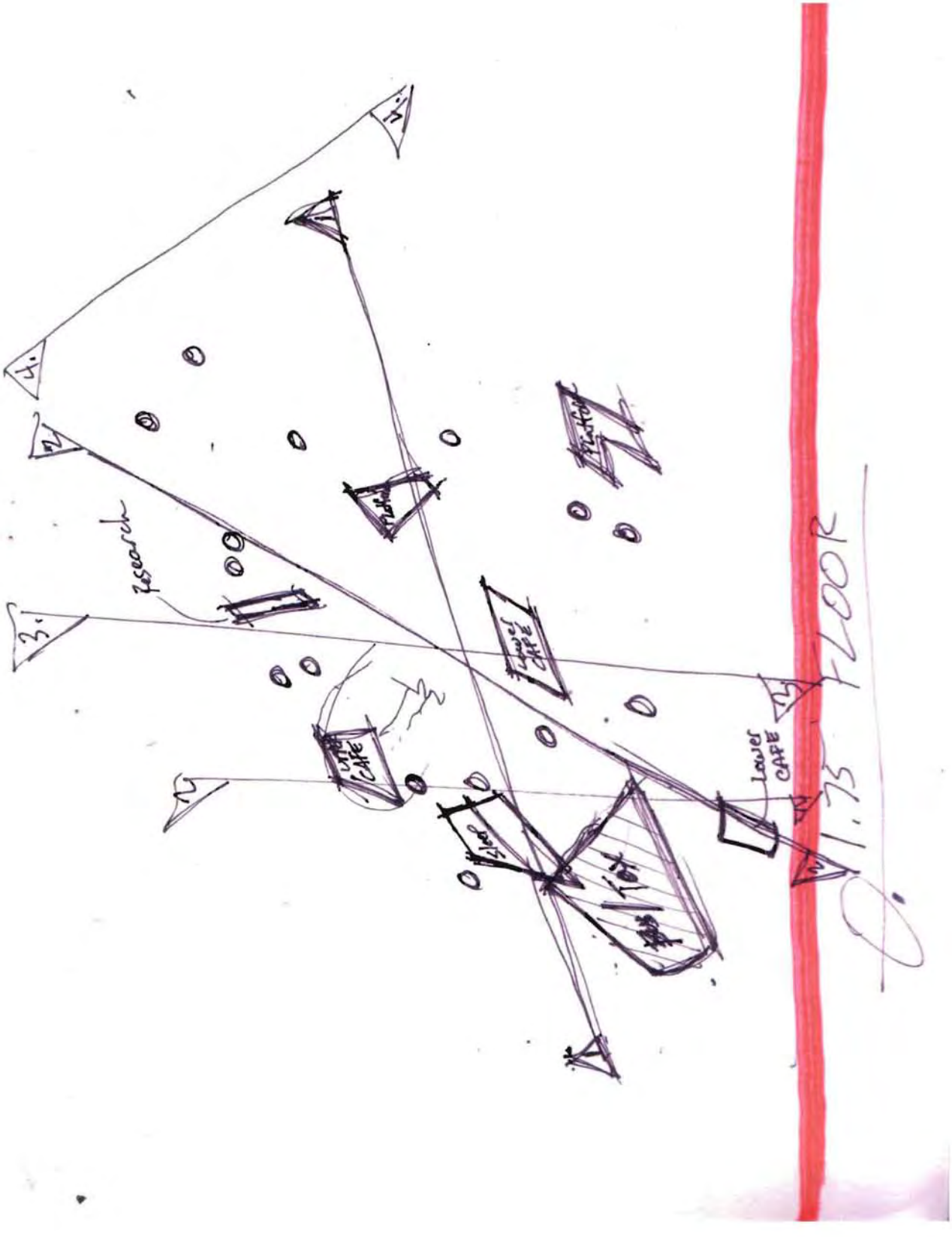
Section 3

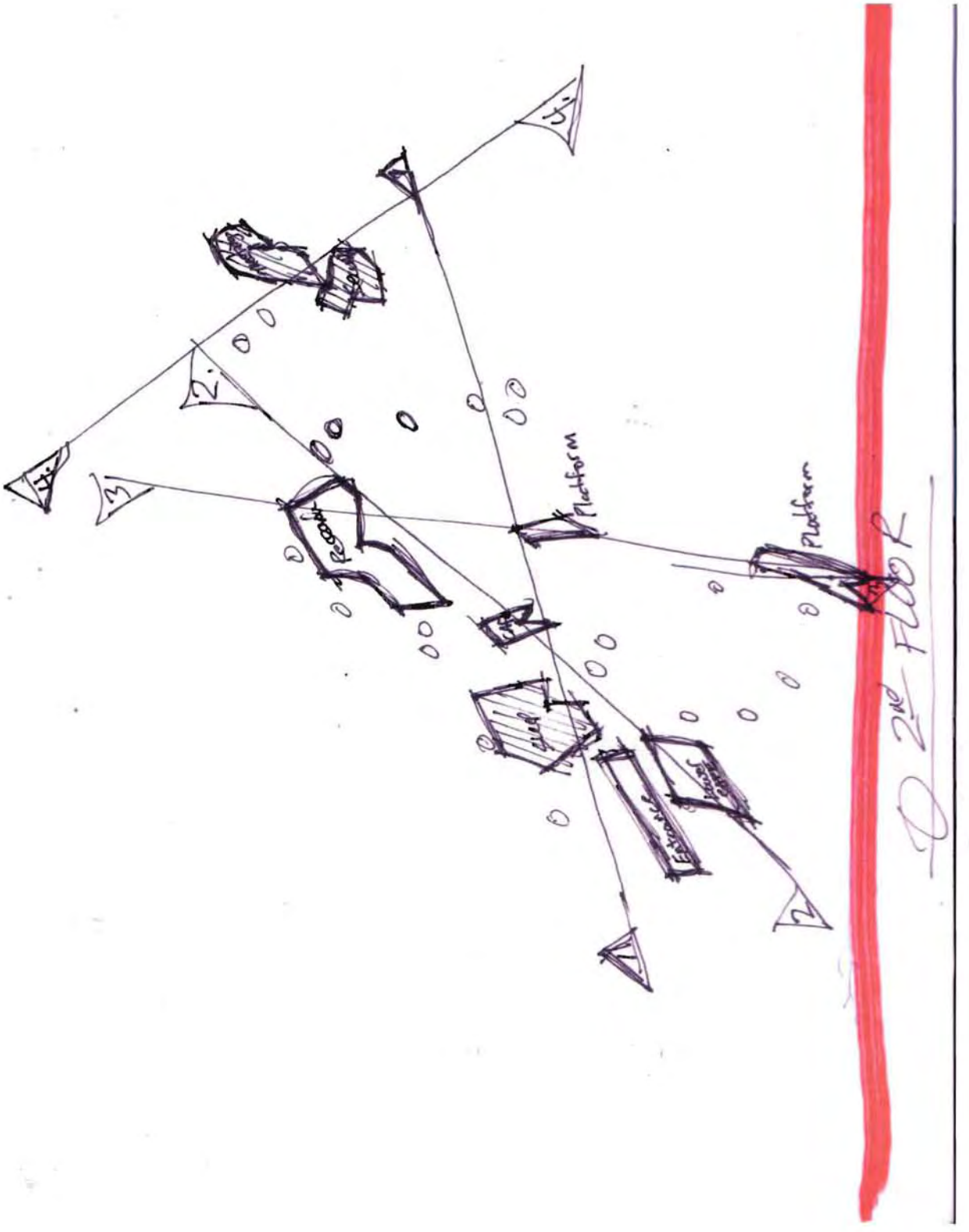
security

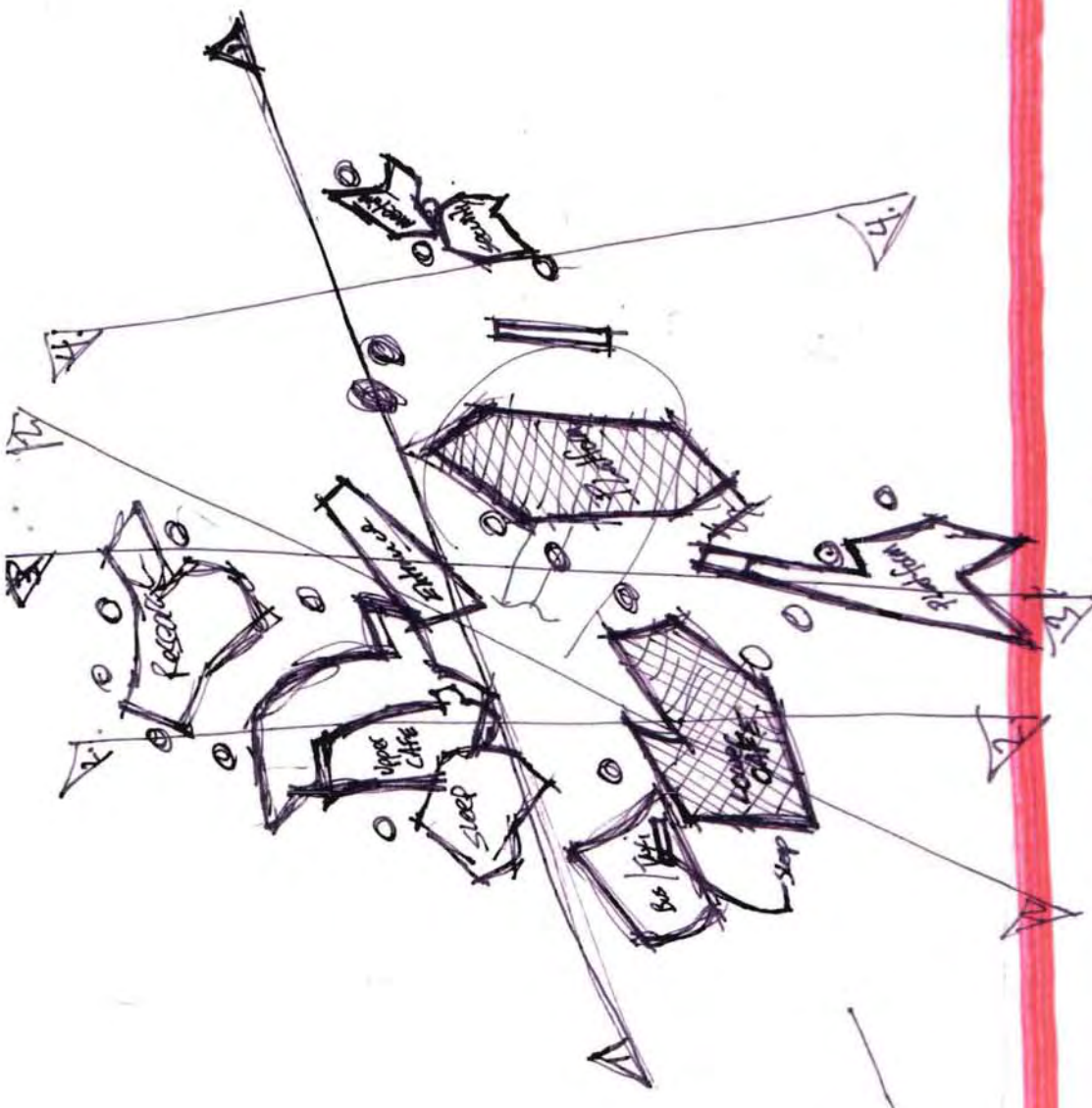


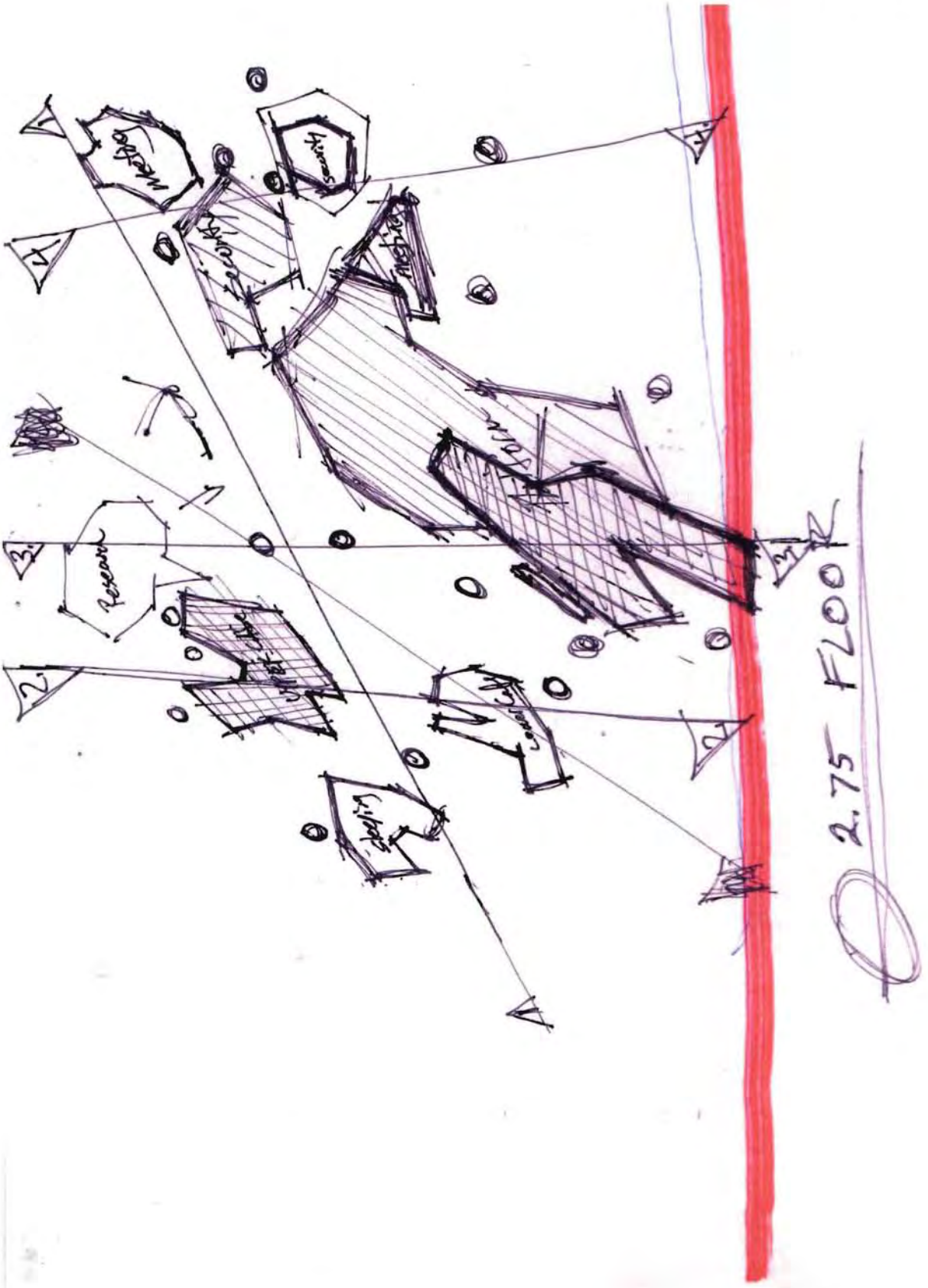
section 4

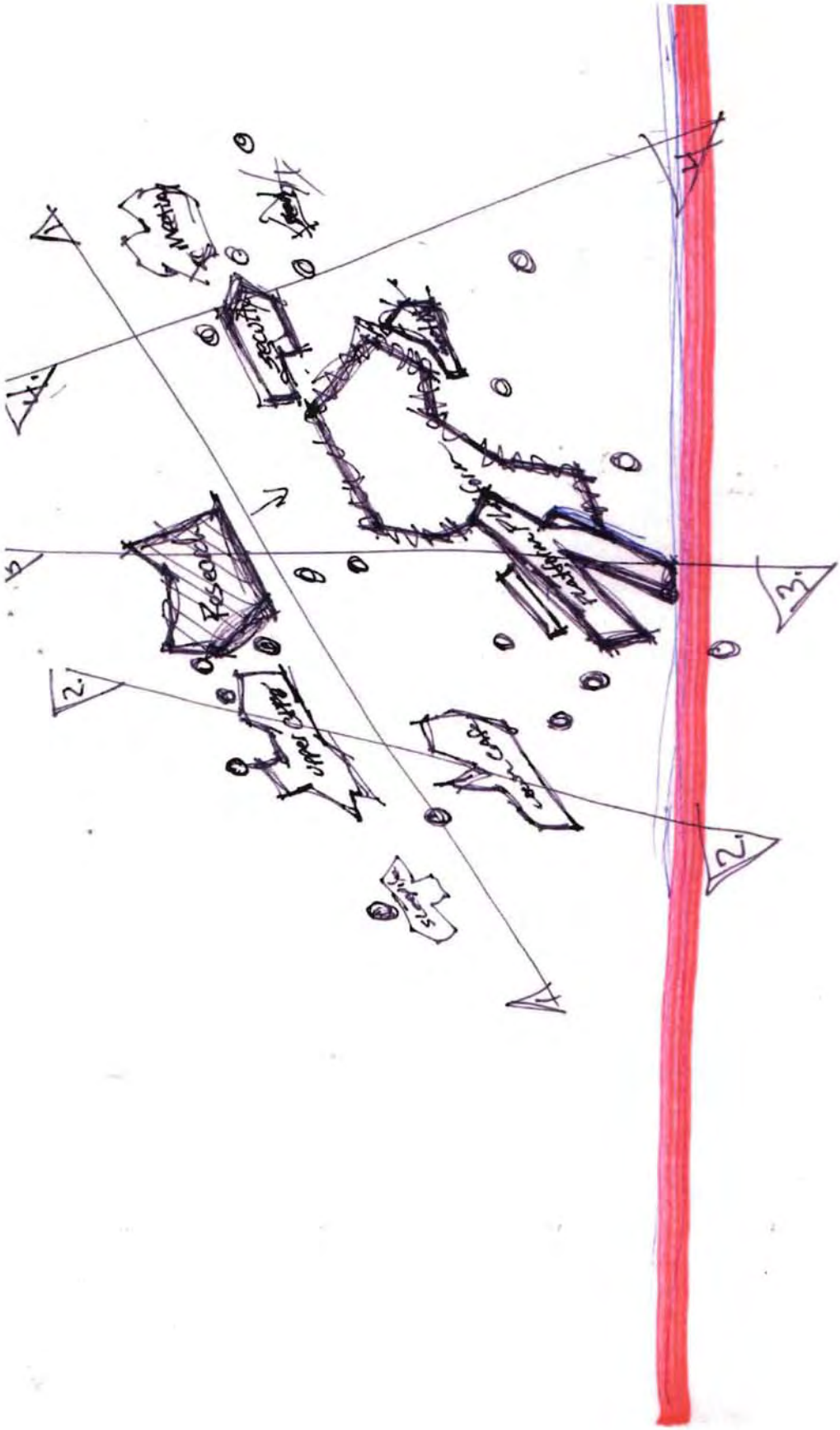

meeting
Rental · CAR
1st FLOOR


1.
4.
2.
3.
research
Upper CAFE
Lower CAFE
Lower CAFE
Lobby
Platform
Shop
1.75 FLOOR

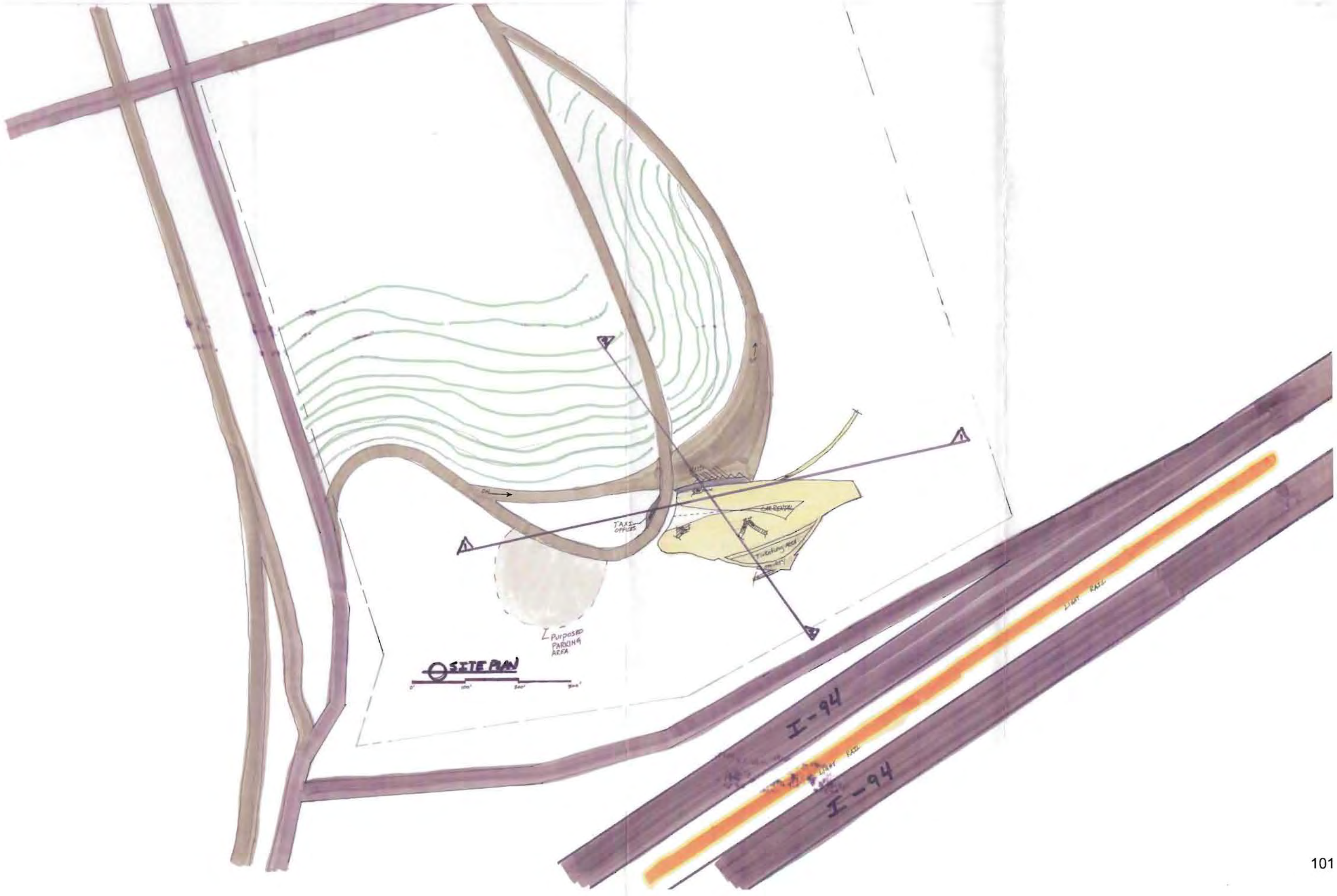

Platform
Platform
2nd FLOOR

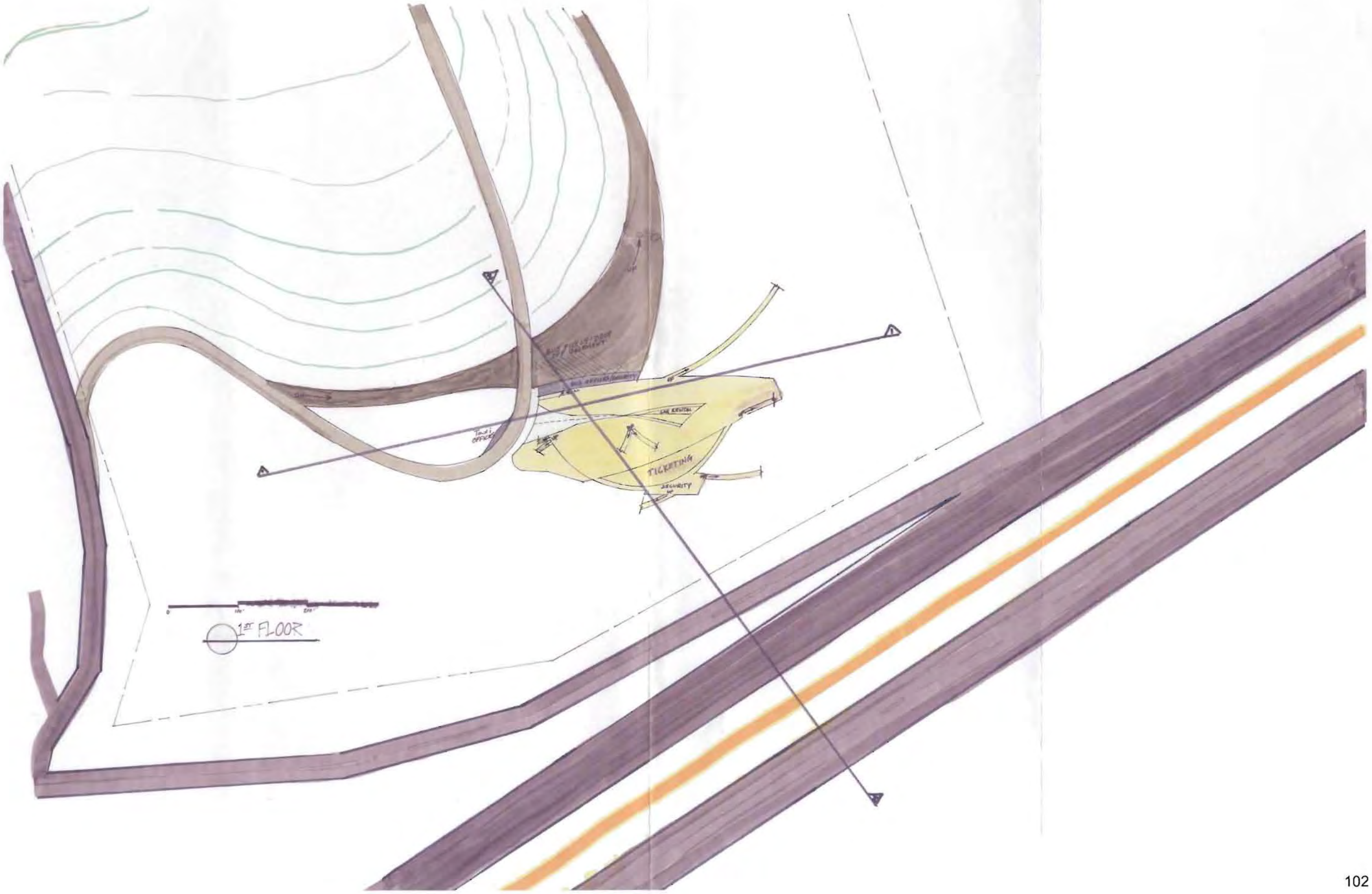

Recreation
Athletics
Upper Office
Stairs
Bar
Lower Office
Stairs
Auditorium
Auditorium
Recreation
Meeting
2.5 FLOOR

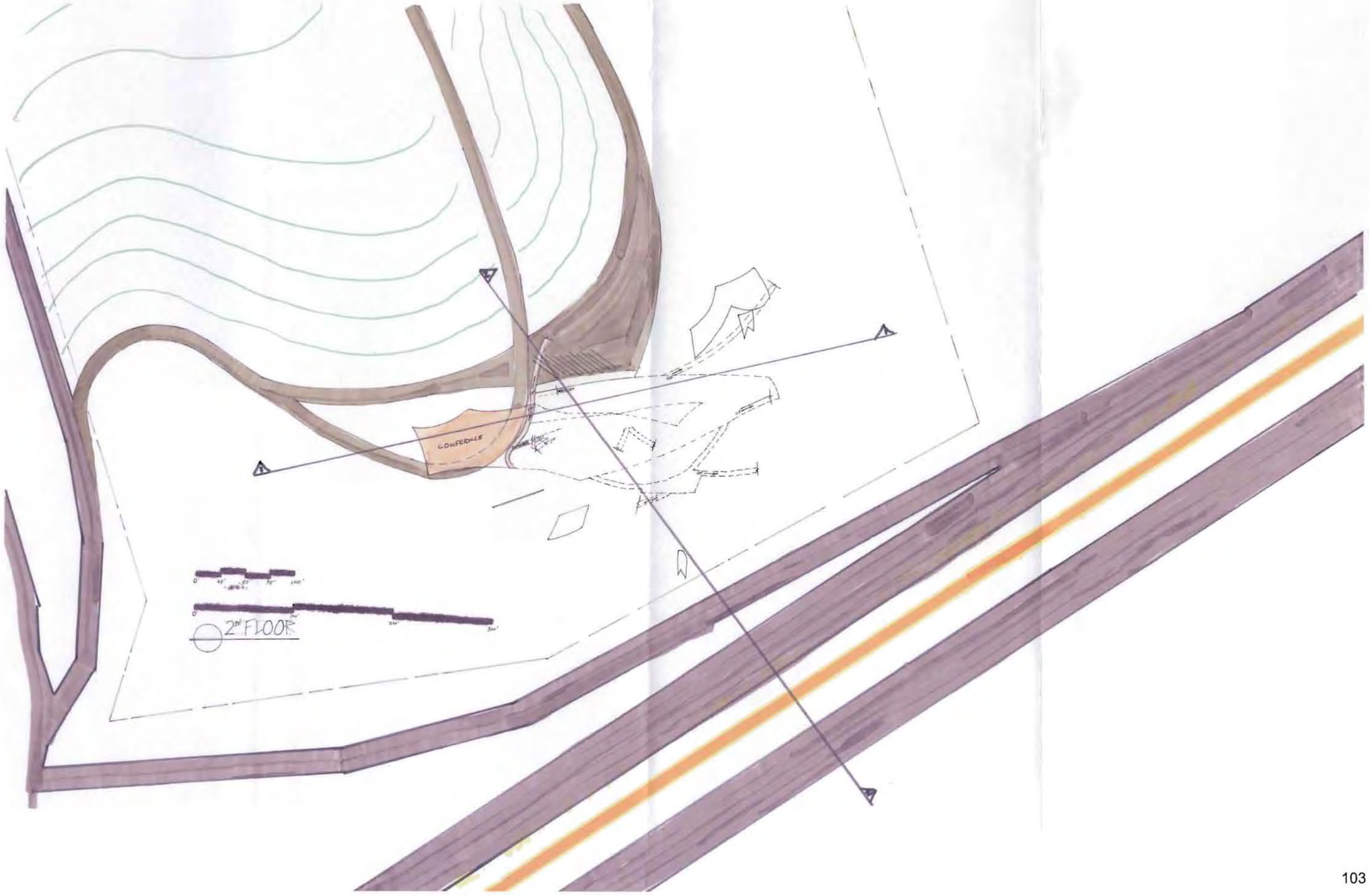

Meeting
Business
Reception
Meeting
Research
Staff
Conference
Reception
Gallery
2.
3.
2.75 FLOOR

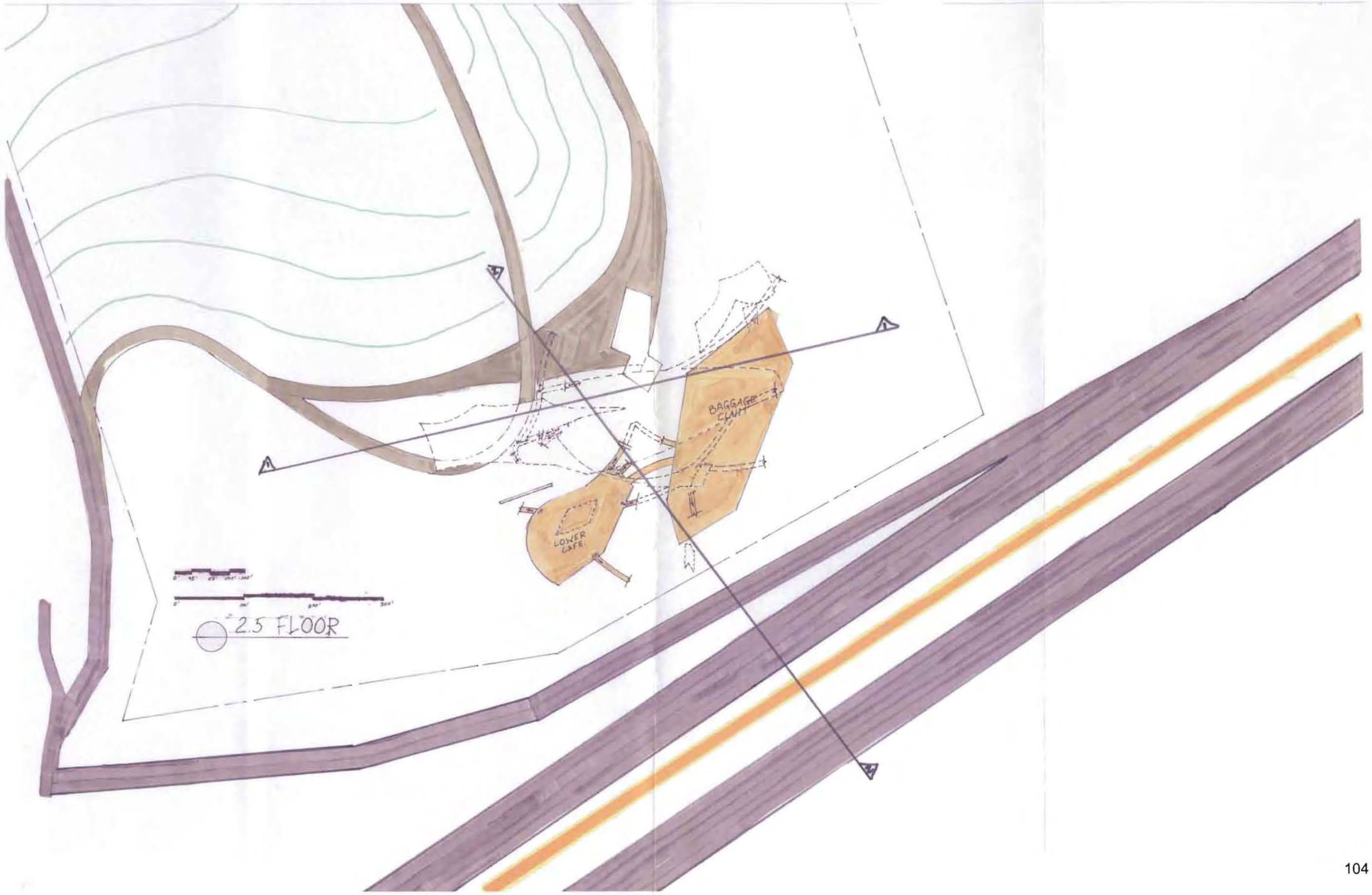

Weight
Resource
Fitness
Teaching Pit
Upper Gym
Lower Gym
Showers
2
3
2

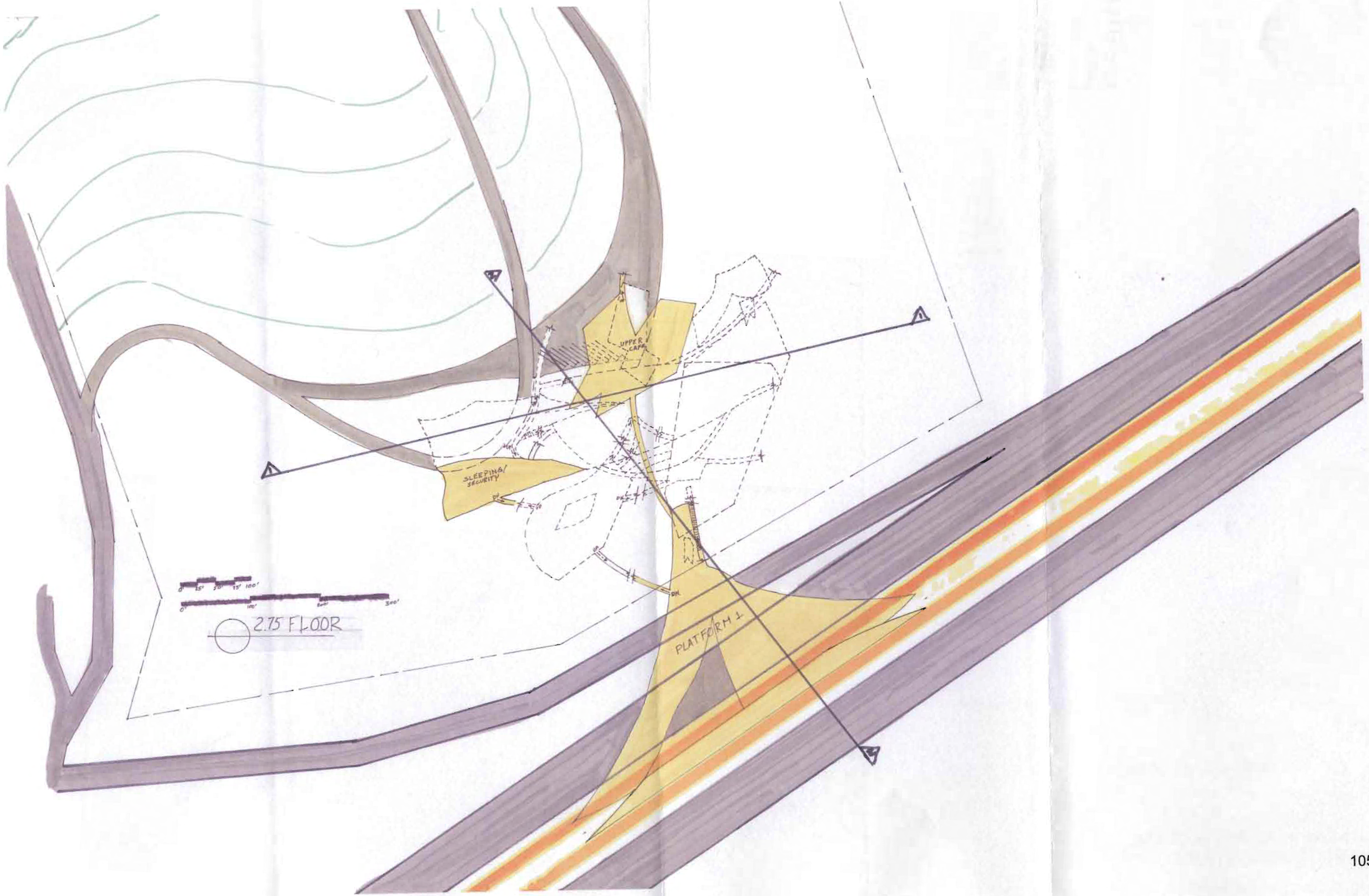
3rd FLOOR

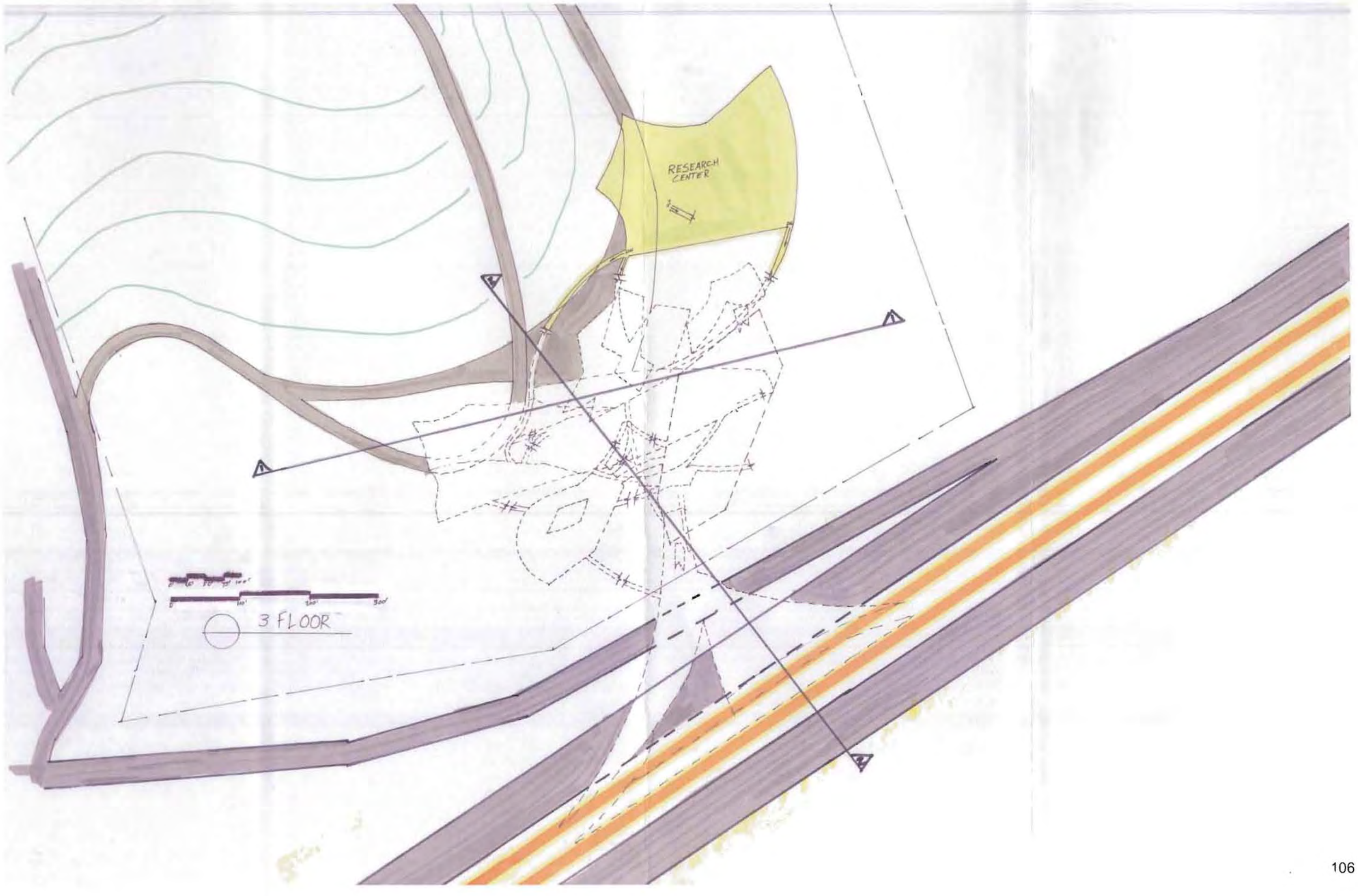

TAXI OFFICES
Purposed PARKING AREA
SITE PLAN
I-94
I-94


TICKETING
SECURITY
1ST FLOOR

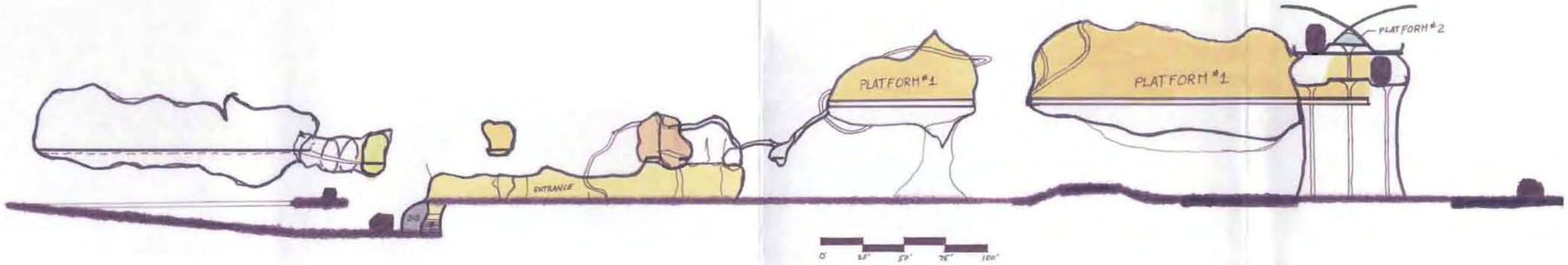

CONFERENCE
2nd FLOOR


BAGGAGE CLAIM
LOWER CAFE
2.5 FLOOR

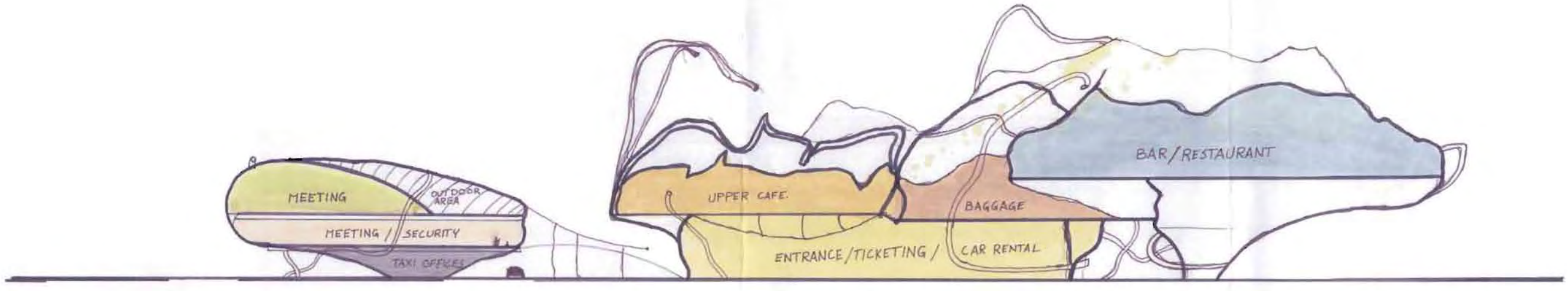

UPPER CAFE
SLEEPING/ SECURITY
PLATFORM 1
2.75 FLOOR


RESEARCH CENTER
3 FLOOR


RESEARCH
BAR / RESTAURANT
PLAT FORM #2
3.75 FLOOR



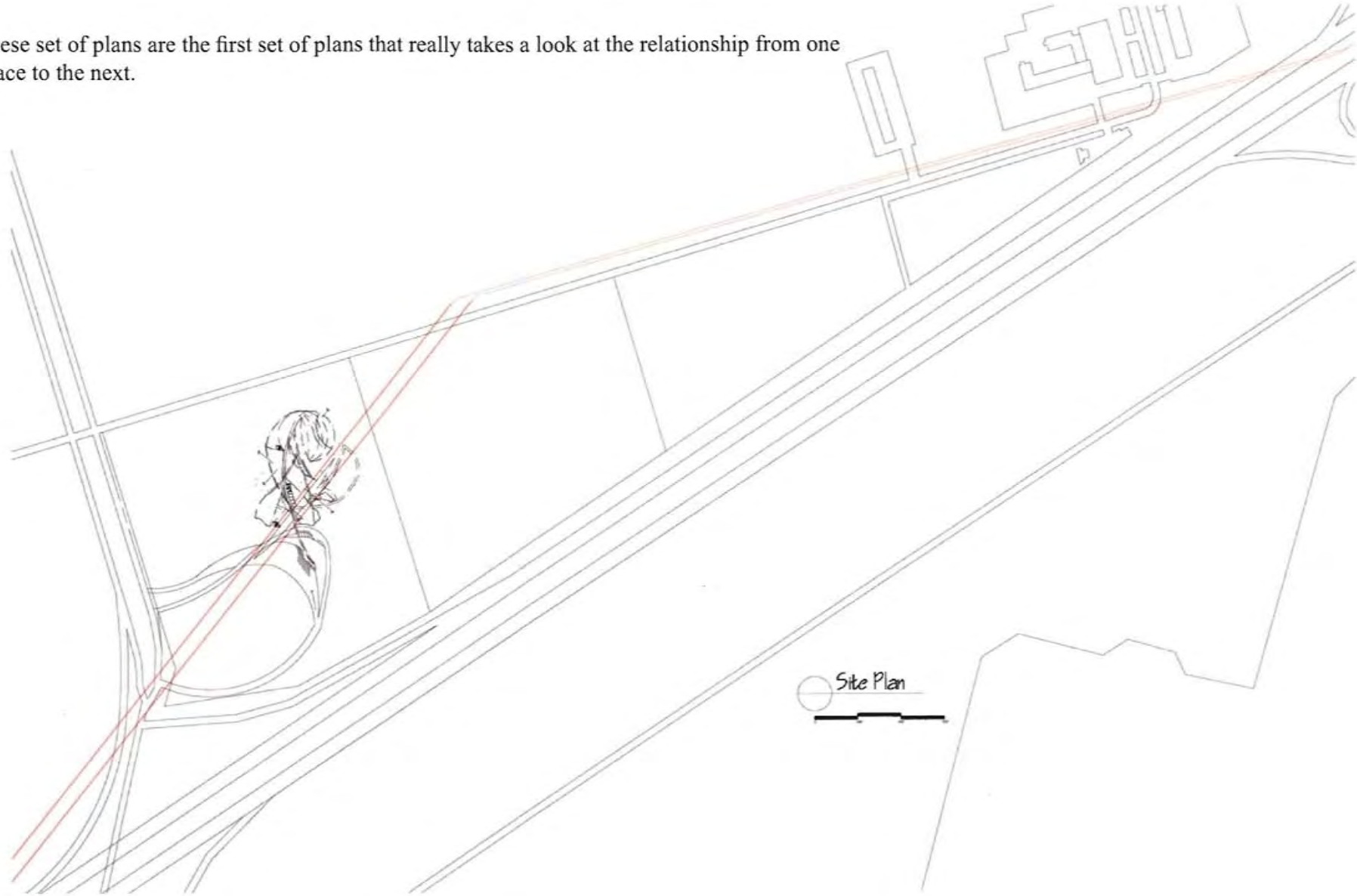
SECTION 2



SECTION 1

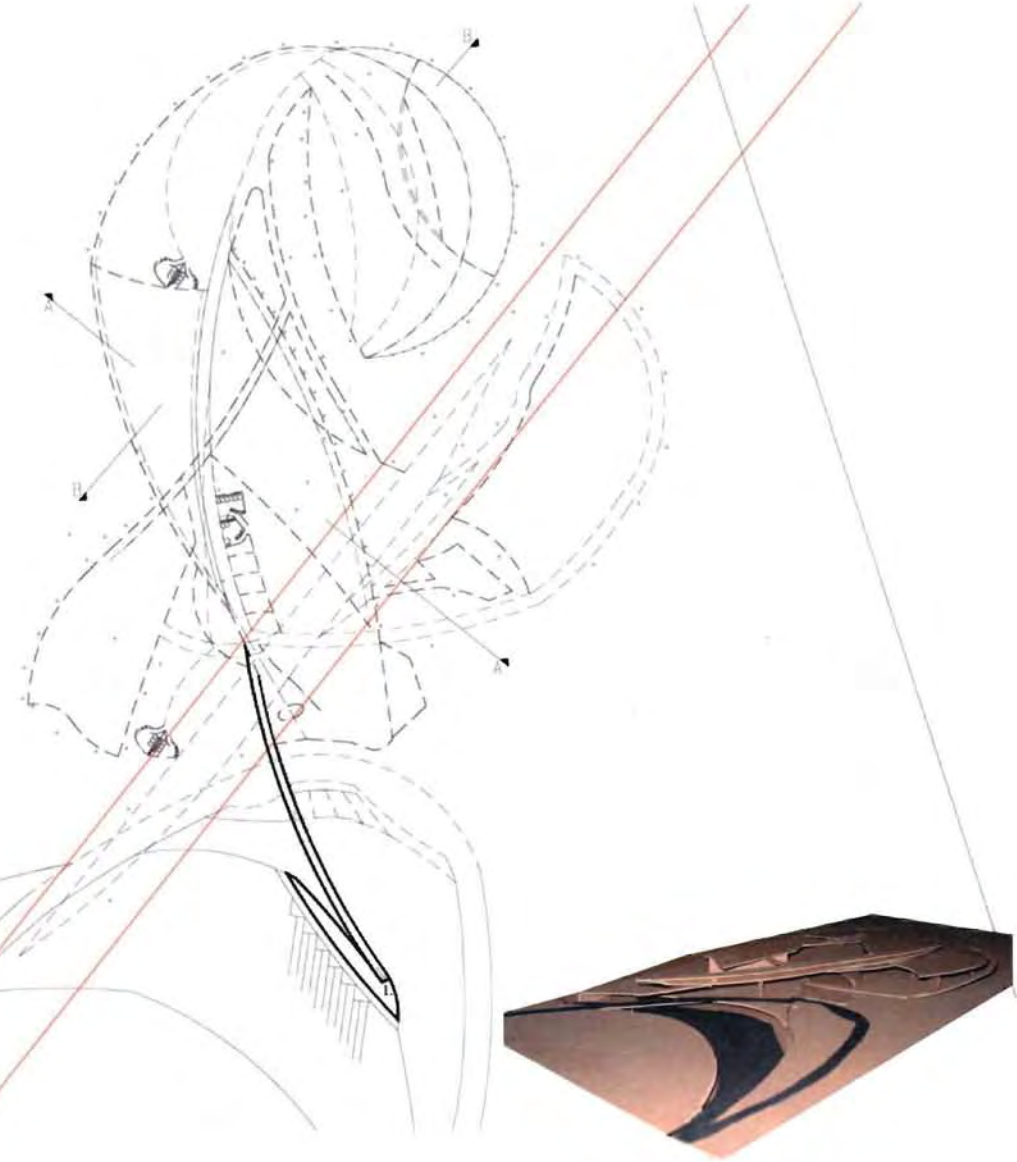
9. Building Design and Development 110

These set of plans are the first set of plans that really takes a look at the relationship from one space to the next.



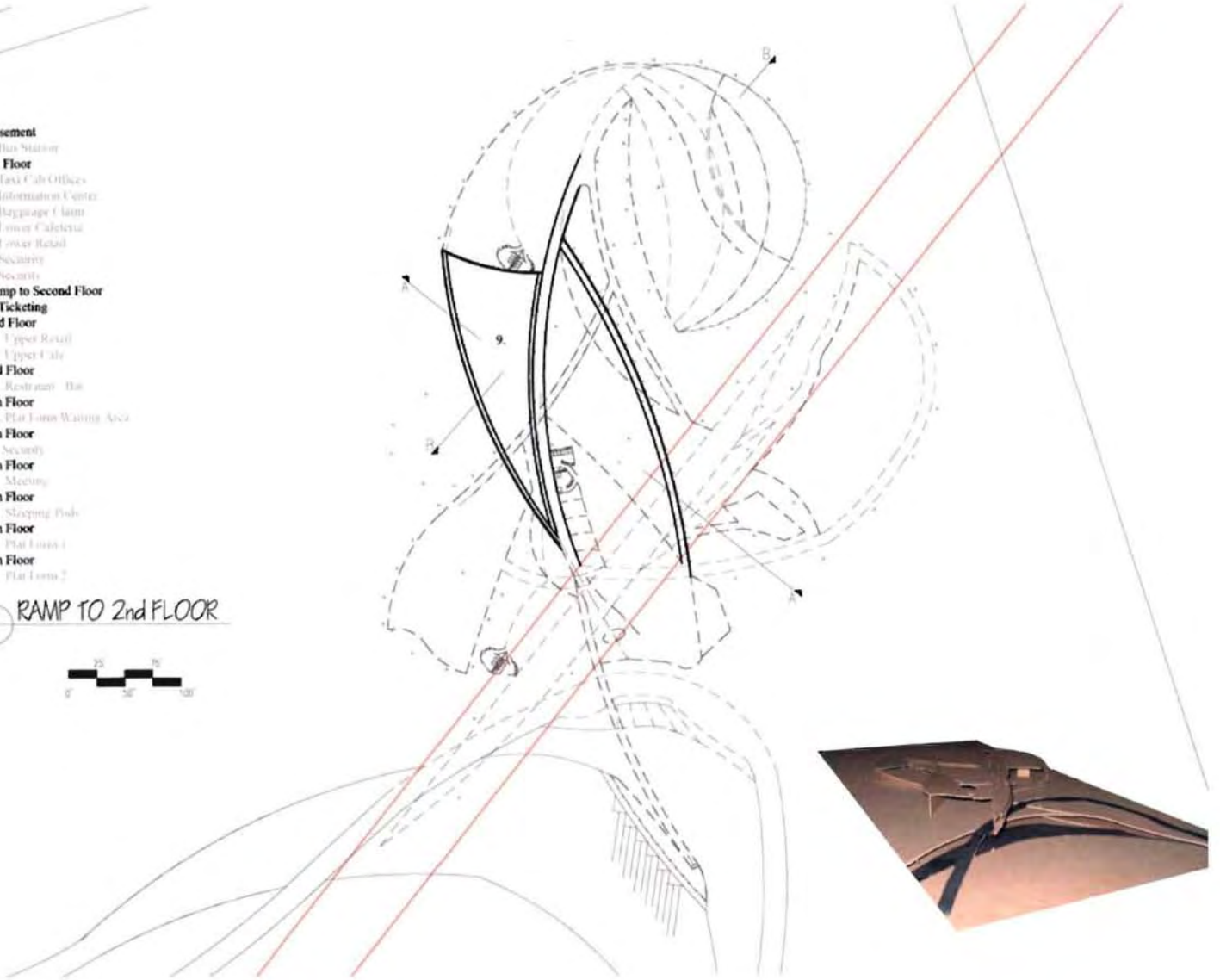
Basement
1. Bus Station
1st Floor
2. Taxi Cab Offices
3. Information Center
4. Baggage Claim
5. Lower Cafeteria
6. Lower Retail
7. Security
8. Security
Ramp to Second Floor
9. Ticketing
2nd Floor
10. Upper Retail
11. Upper Cafe
3rd Floor
12. Restaurant / Bar
4th Floor
13. Plat Form Waiting Area
5th Floor
14 Security
6th Floor
15 Meeting
7th Floor
16. Sleeping Pods
8th Floor
17. Plat Form 1
9th Floor
18. Plat Form 2

Basement FLOOR



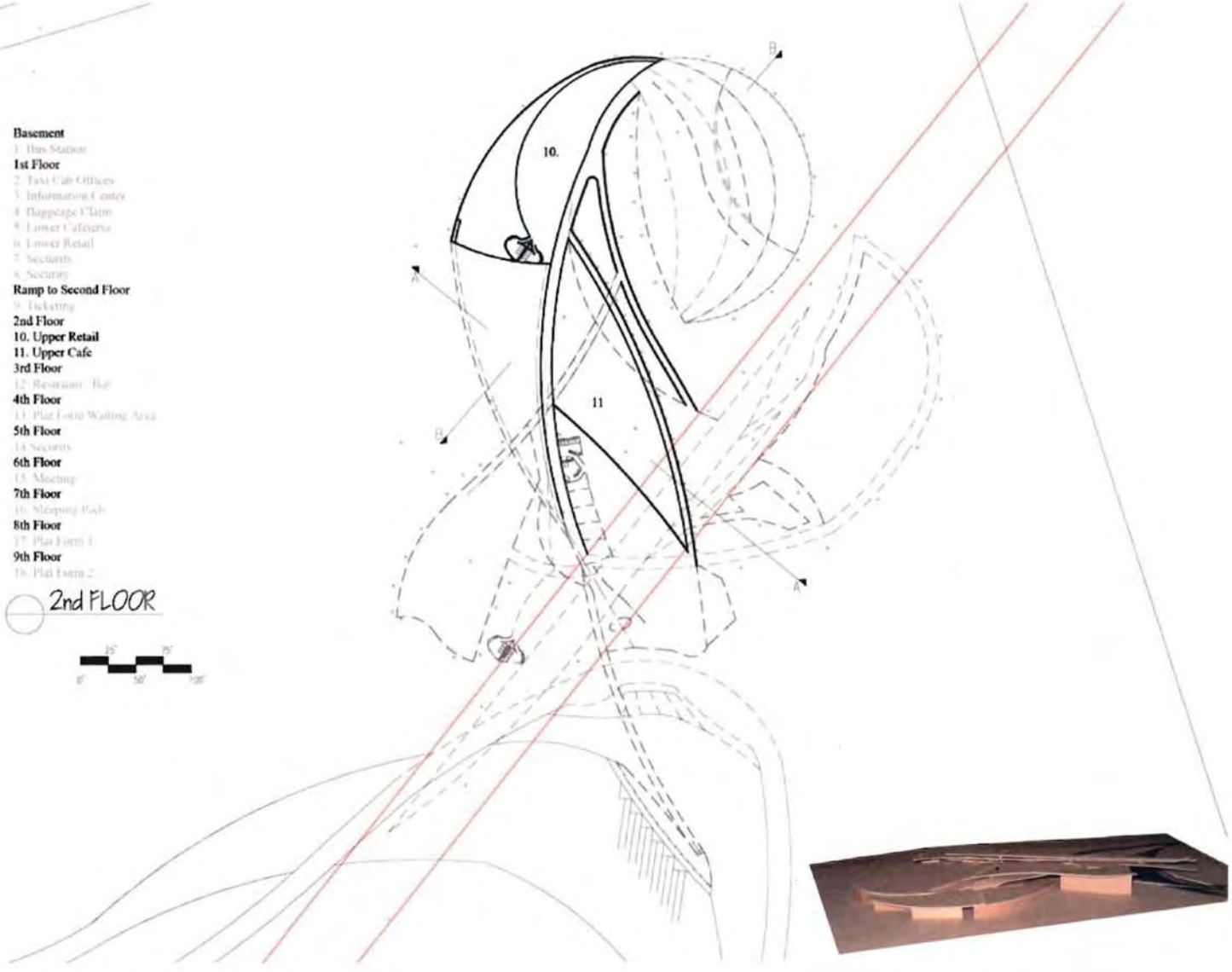
Basement
1. Bus Station
1st Floor
2. Taxi Cab Offices
3. Information Center
4. Baggage Claim
5. Lower Cafeteria
6. Lower Retail
7. Security
8. Security
Ramp to Second Floor
9. Ticketing
2nd Floor
10. Upper Retail
11. Upper Cafe
3rd Floor
12. Restrant / Bar
4th Floor
13. Plat Form Waiting Area
5th Floor
14 Security
6th Floor
15. Meeting
7th Floor
16. Sleeping Pods
8th Floor
17. Plat Form 1
9th Floor
18. Plat Form 2

RAMP TO 2nd FLOOR



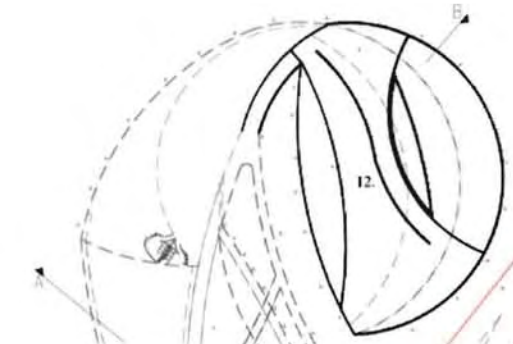
Basement
1. Bus Station
1st Floor
2. Taxi Cab Offices
3. Information Center
4. Baggage Claim
5. Lower Cafeteria
6. Lower Retail
7. Security
8. Security
Ramp to Second Floor
9. Ticketing
2nd Floor
10. Upper Retail
11. Upper Cafe
3rd Floor
12. Restaurant Bar
4th Floor
13. Plat Form Waiting Area
5th Floor
14. Security
6th Floor
15. Meeting
7th Floor
16. Sleeping Pods
8th Floor
17. Plat Form 1
9th Floor
18. Plat Form 2

2nd FLOOR



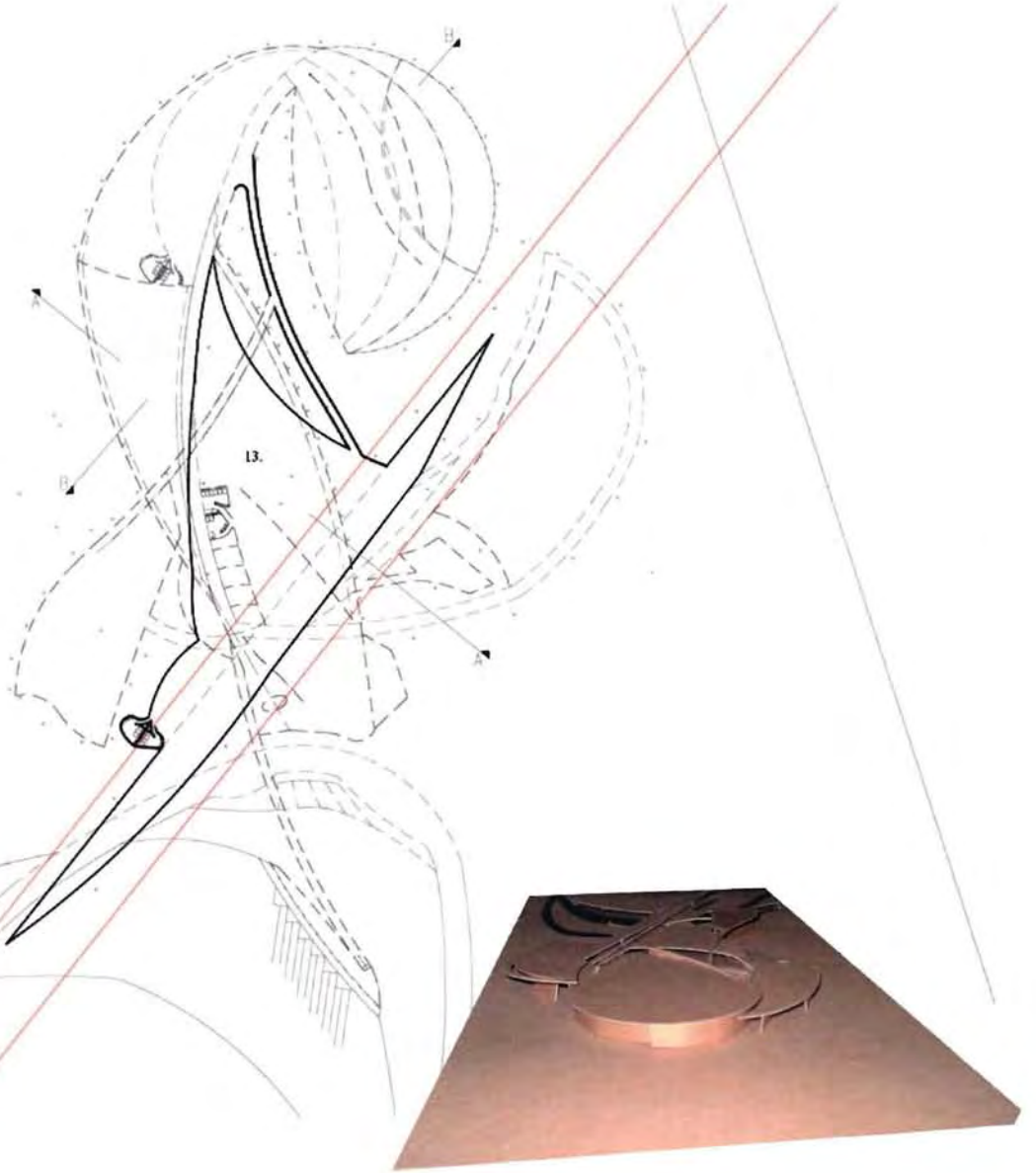
Basement
1. Bus Station
1st Floor
2. Taxi Cab Offices
3. Information Center
4. Baggagge Claim
5. Lower Cafeteria
6. Lower Retail
7. Sectority
8. Security
Ramp to Second Floor
9. Ticketing
2nd Floor
10. Upper Retail
11. Upper Cafe
3rd Floor
12. Restraunt / Bar
4th Floor
13. Plat Form Waiting Area
5th Floor
14 Security
6th Floor
15 Mosting
7th Floor
16. Sleeping Pods
8th Floor
17. Plat Form 1
9th Floor
18. Plat Form 2

3rd FLOOR



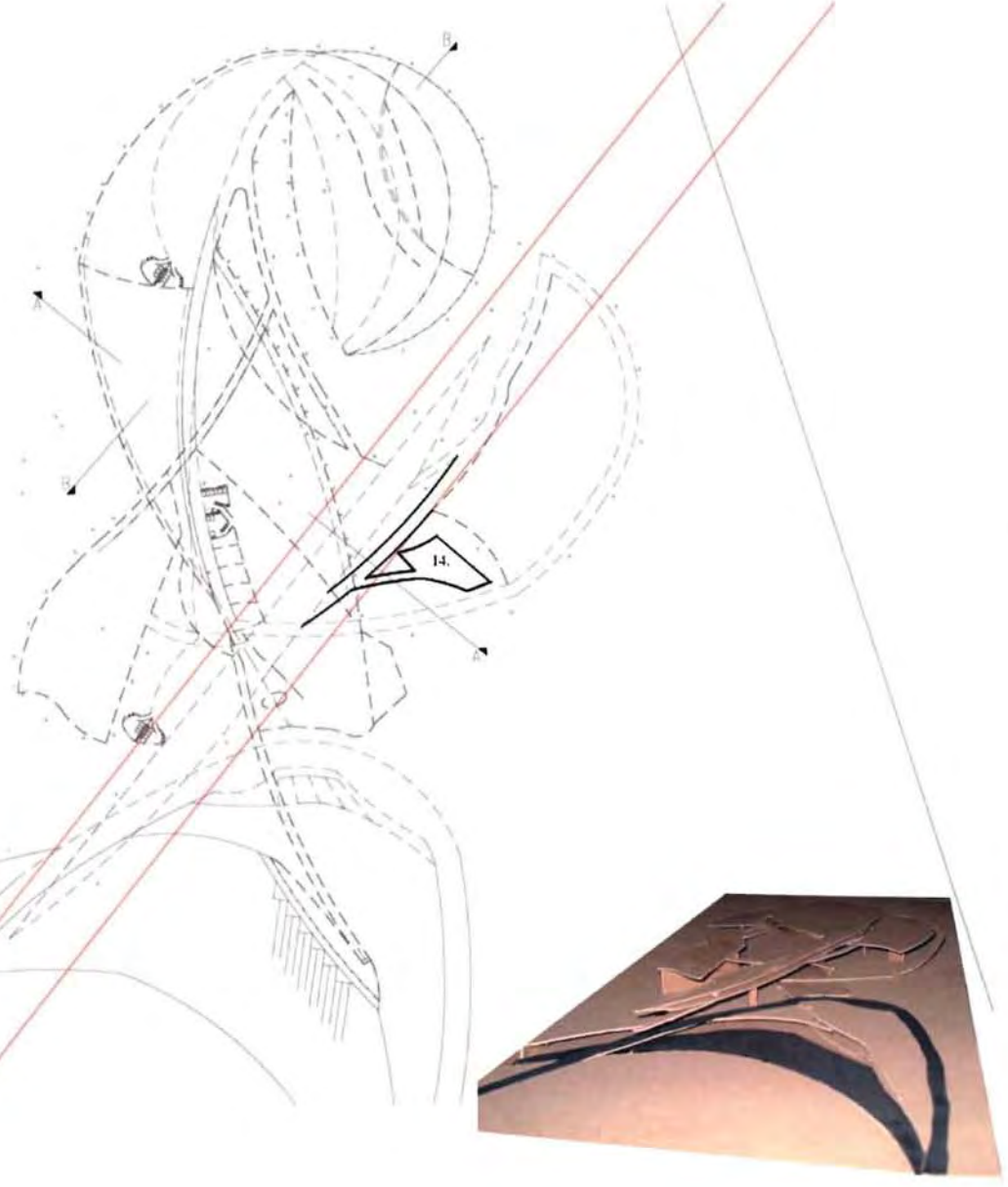
Basement
1. Bus Station
1st Floor
2. Taxi Cab Offices
3. Information Center
4. Baggarage Claim
5. Lower Cafeteria
6. Lower Retail
7. Secturity
8. Security
Ramp to Second Floor
9. Ticketing
2nd Floor
10. Upper Retail
11. Upper Cafe
3rd Floor
12. Restrauant - Bar
4th Floor
13. Plat Form Waiting Area
5th Floor
14. Security
6th Floor
15. Meeting
7th Floor
16. Sleeping Pods
8th Floor
17. Plat Form 1
9th Floor
18. Plat Form 2

4th FLOOR



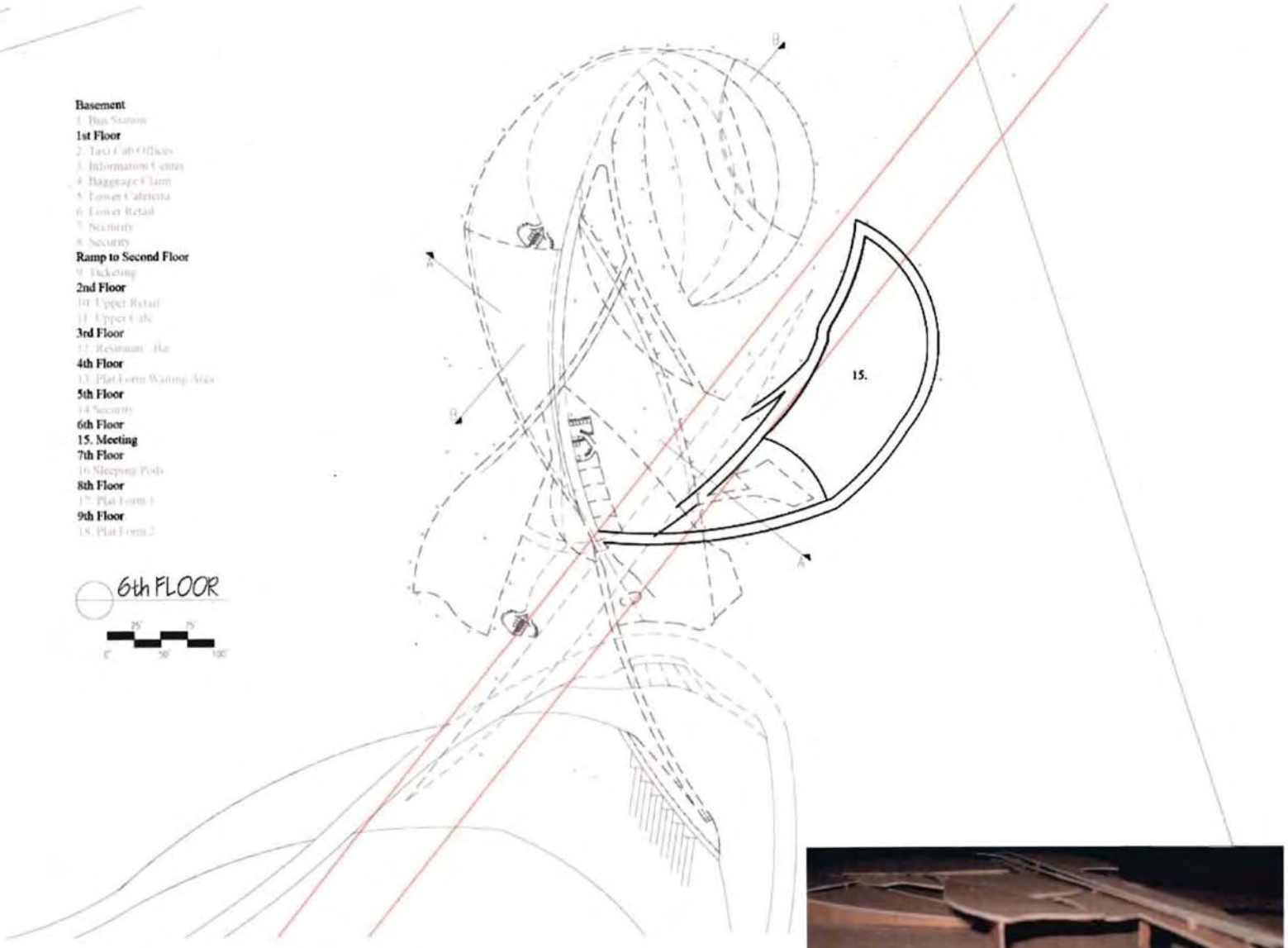
Basement
1. Bus Station
1st Floor
2. Taxi Cab Offices
3. Information Center
4. Baggage Claim
5. Lower Cafeteria
6. Lower Retail
7. Security
8. Security
Ramp to Second Floor
9. Ticketing
2nd Floor
10. Upper Retail
11. Upper Cafe
3rd Floor
12. Restaurant / Bar
4th Floor
13. Plat Form Waiting Area
5th Floor
14 Security
6th Floor
15. Meeting
7th Floor
16. Sleeping Pods
8th Floor
17. Plat Form 1
9th Floor
18. Plat Form 2

5th FLOOR



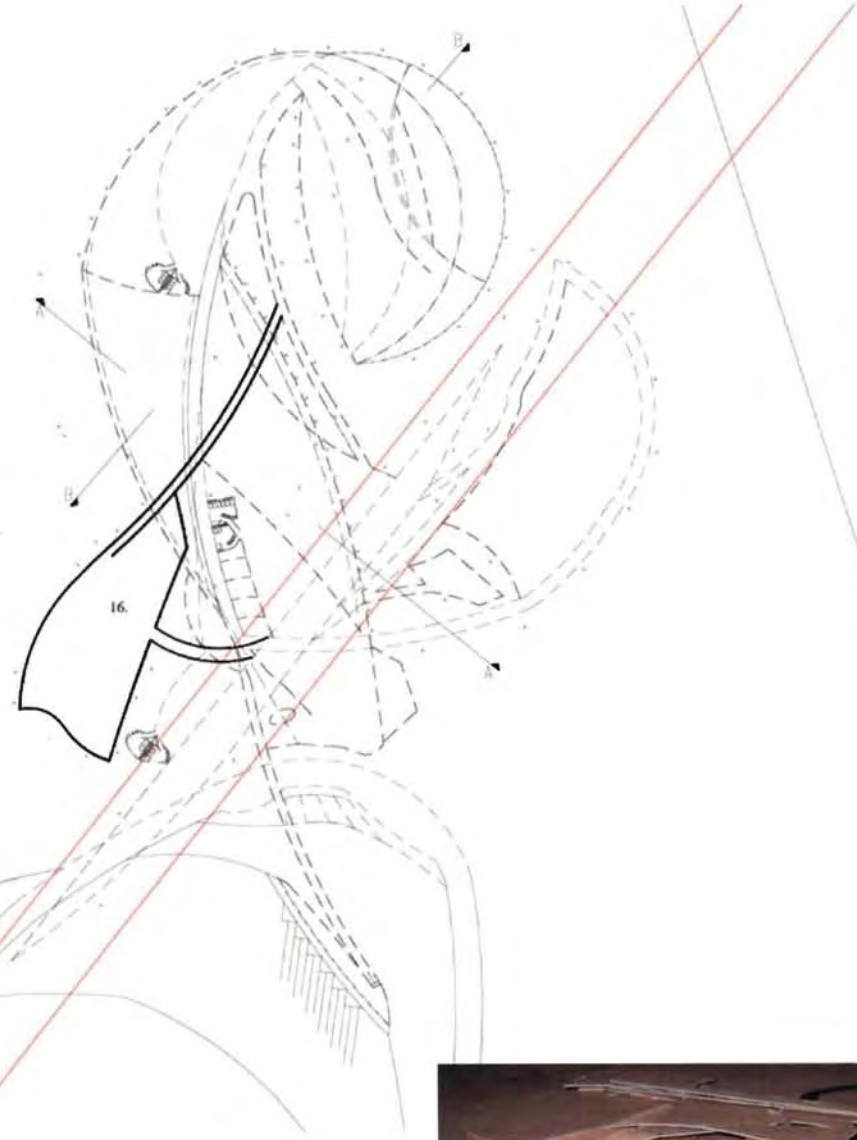
Basement
1. Bus Station
1st Floor
2. Taxi Cab Offices
3. Information Center
4. Baggage Claim
5. Lower Cafeteria
6. Lower Retail
7. Security
8. Security
Ramp to Second Floor
9. Ticketing
2nd Floor
10. Upper Retail
11. Upper Cafe
3rd Floor
12. Restaurant / Bar
4th Floor
13. Plat Form Waiting Area
5th Floor
14 Security
6th Floor
15. Meeting
7th Floor
16 Sleeping Pods
8th Floor
17. Plat Form 1
9th Floor
18. Plat Form 2

6th FLOOR



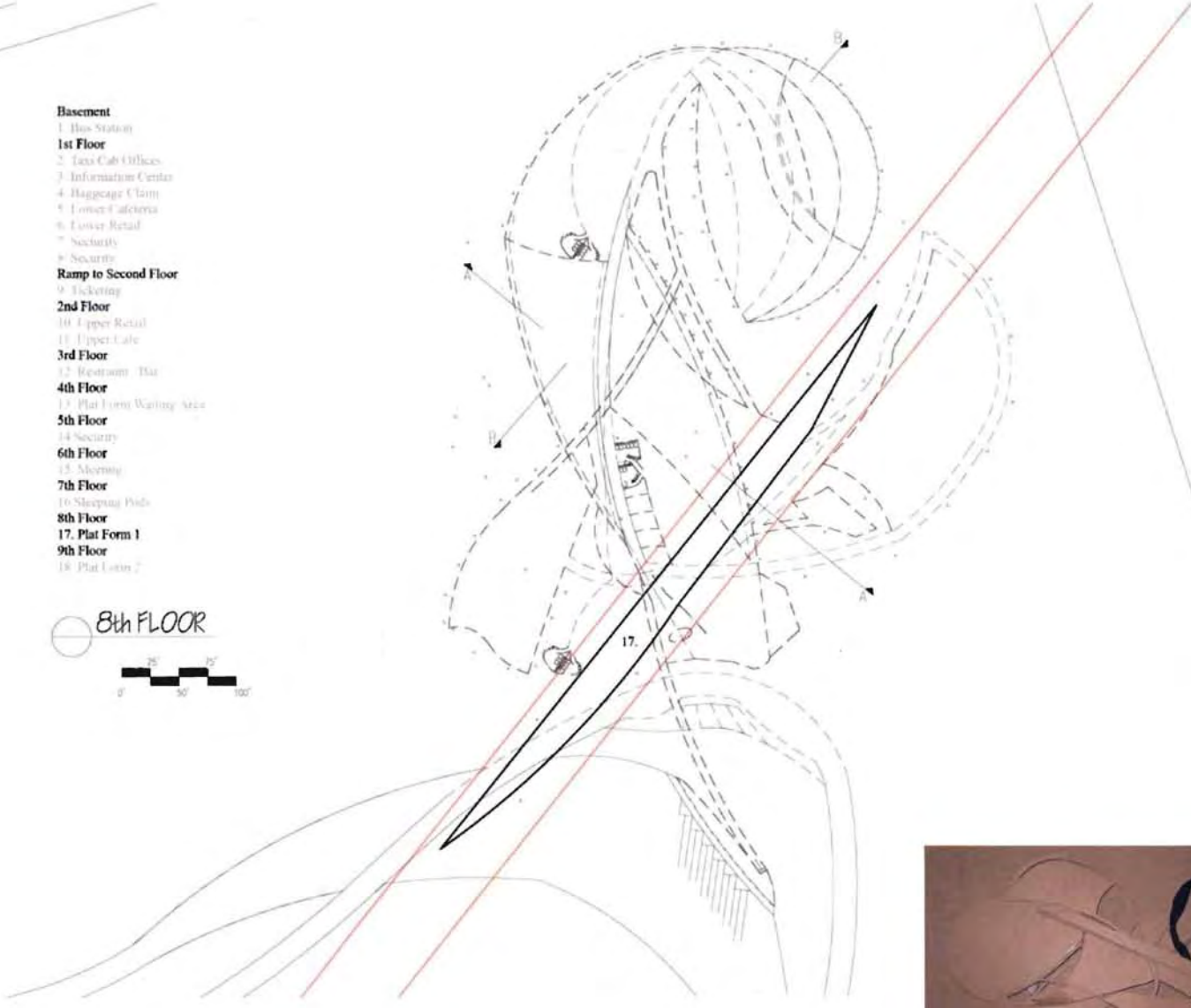
Basement
1. Bus Station
1st Floor
2. Taxi Cab Offices
3. Information Center
4. Baggage Claim
5. Lower Cafeteria
6. Lower Retail
7. Security
8. Security
Ramp to Second Floor
9. Ticketing
2nd Floor
10. Upper Retail
11. Upper Cafe
3rd Floor
12. Restaurant / Bar
4th Floor
13. Plat Form Waiting Area
5th Floor
14 Security
6th Floor
15. Meeting
7th Floor
16.Sleeping Pods
8th Floor
17. Plat Form 1
9th Floor
18. Plat Form 2

7th FLOOR



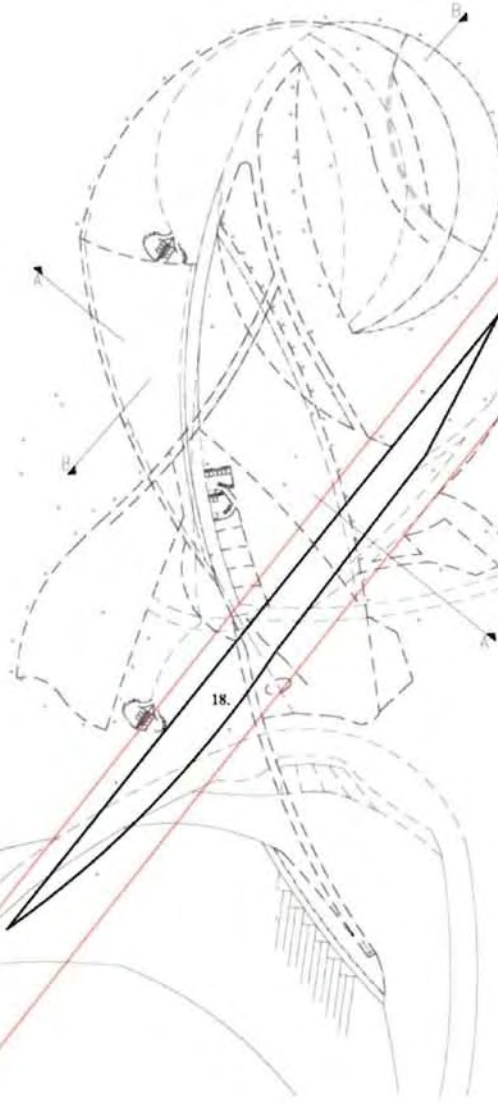
Basement
1. Bus Station
1st Floor
2. Taxi Cab Offices
3. Information Center
4. Baggeage Claim
5. Lower Cafeteria
6. Lower Retail
7. Security
8. Security
Ramp to Second Floor
9. Ticketing
2nd Floor
10. Upper Retail
11. Upper Cafe
3rd Floor
12. Restroom / Bar
4th Floor
13. Plat Form Waiting Area
5th Floor
14 Security
6th Floor
15. Meeting
7th Floor
16 Sleeping Pods
8th Floor
17. Plat Form 1
9th Floor
18. Plat Form 2

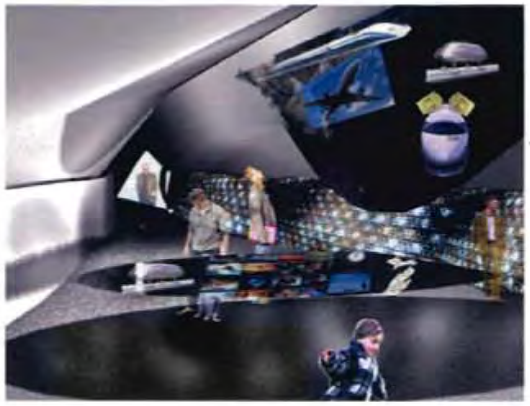
8th FLOOR



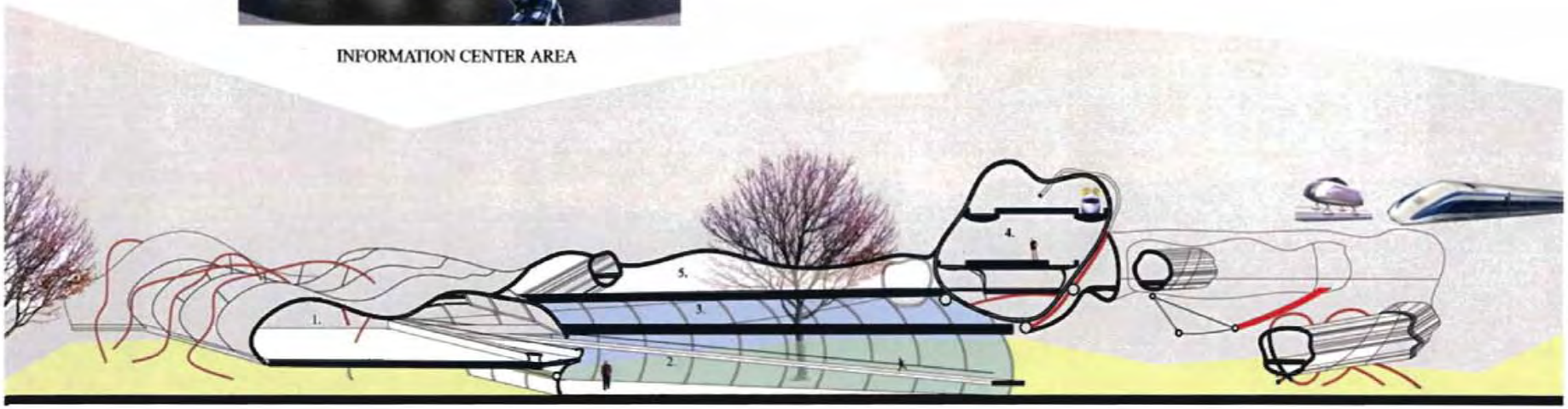
Basement
1. Bus Station
1st Floor
2. Taxi Cab Offices
3. Information Center
4. Baggage Claim
5. Lower Cafeteria
6. Lower Retail
7. Security
8. Security
Ramp to Second Floor
9. Ticketing
2nd Floor
10. Upper Retail
11. Upper Cafe
3rd Floor
12. Reservation Bar
4th Floor
13. Plat Form Waiting Area
5th Floor
14 Security
6th Floor
15. Meeting
7th Floor
16 Sleeping Pods
8th Floor
17. Plat Form 1
9th Floor
18. Plat Form 2

9th FLOOR





INFORMATION CENTER AREA



1. Ticketing
2. Lower Cafeteria
3. Upper Cafeteria
4. Platform loading and Unloading Area
5. Platform Waiting Area.

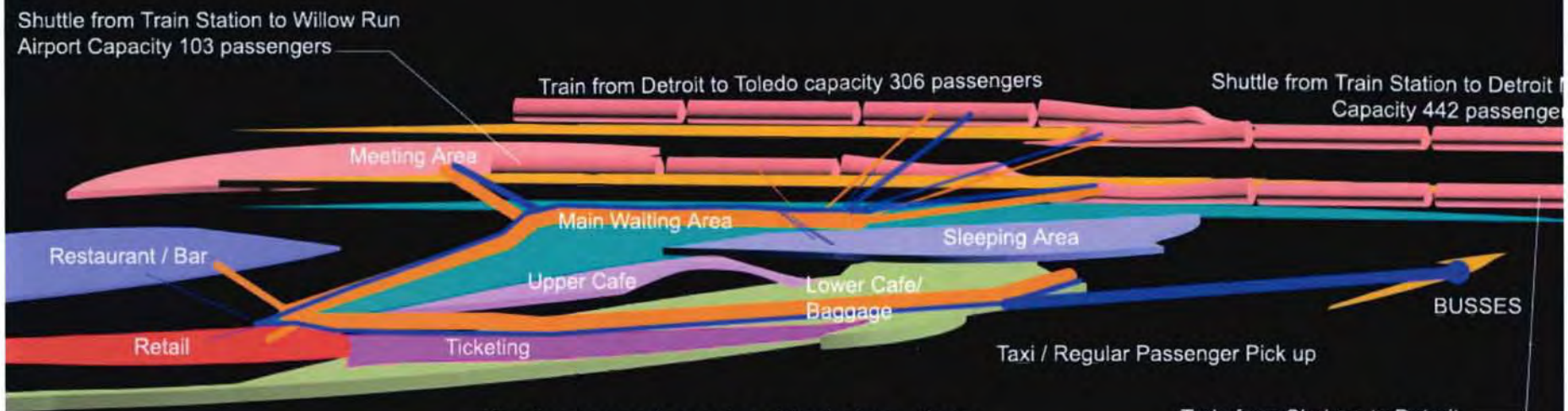
SECTION A-A

0' 10' 20'

UNIVERSITY OF DETROIT MERCY S.O.A.
FEB.. 5, 2007
JOHN KINNUNEN
PROFESSOR WILL WITTIG

FLOW DIAGRAM OF PASSENGERS BEING DROPPED OFF BY CARS AND BUSSES

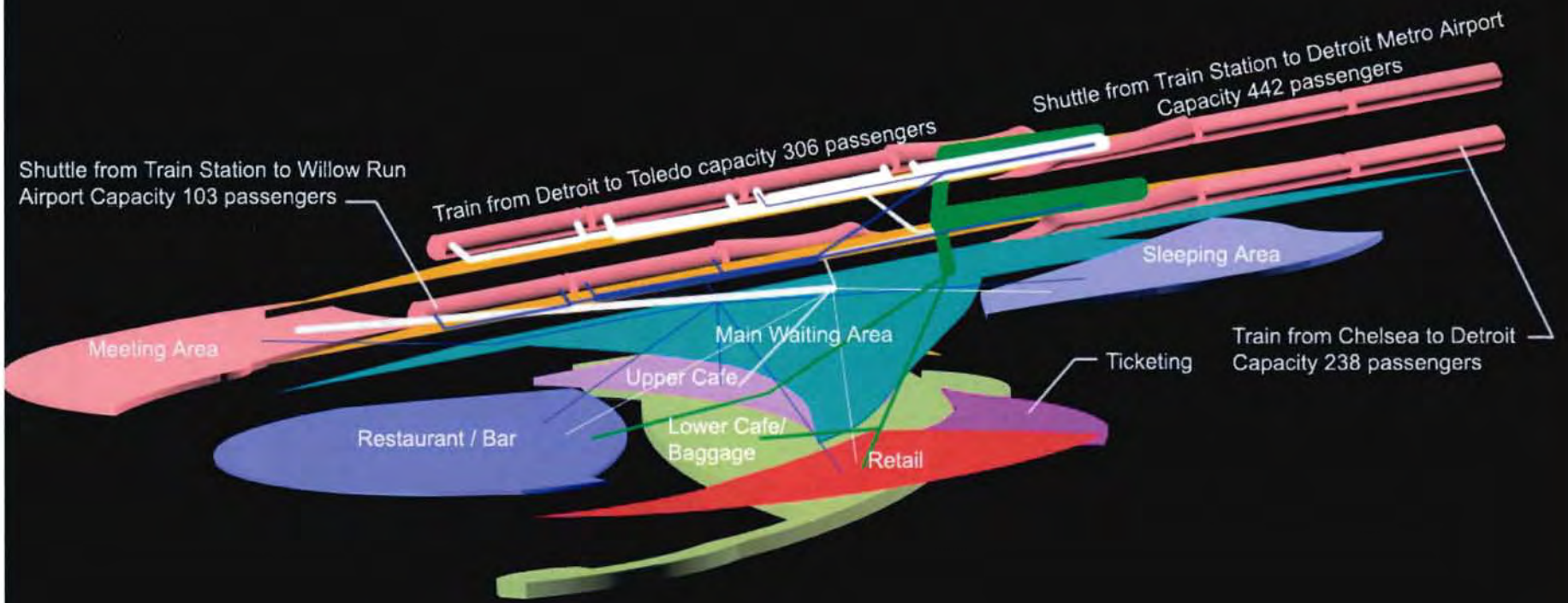
These diagrams on the next few pages were done to see where the flow of people would must likely be going. There were some design decissions made from these diagrams that you will see in the next set of plans.



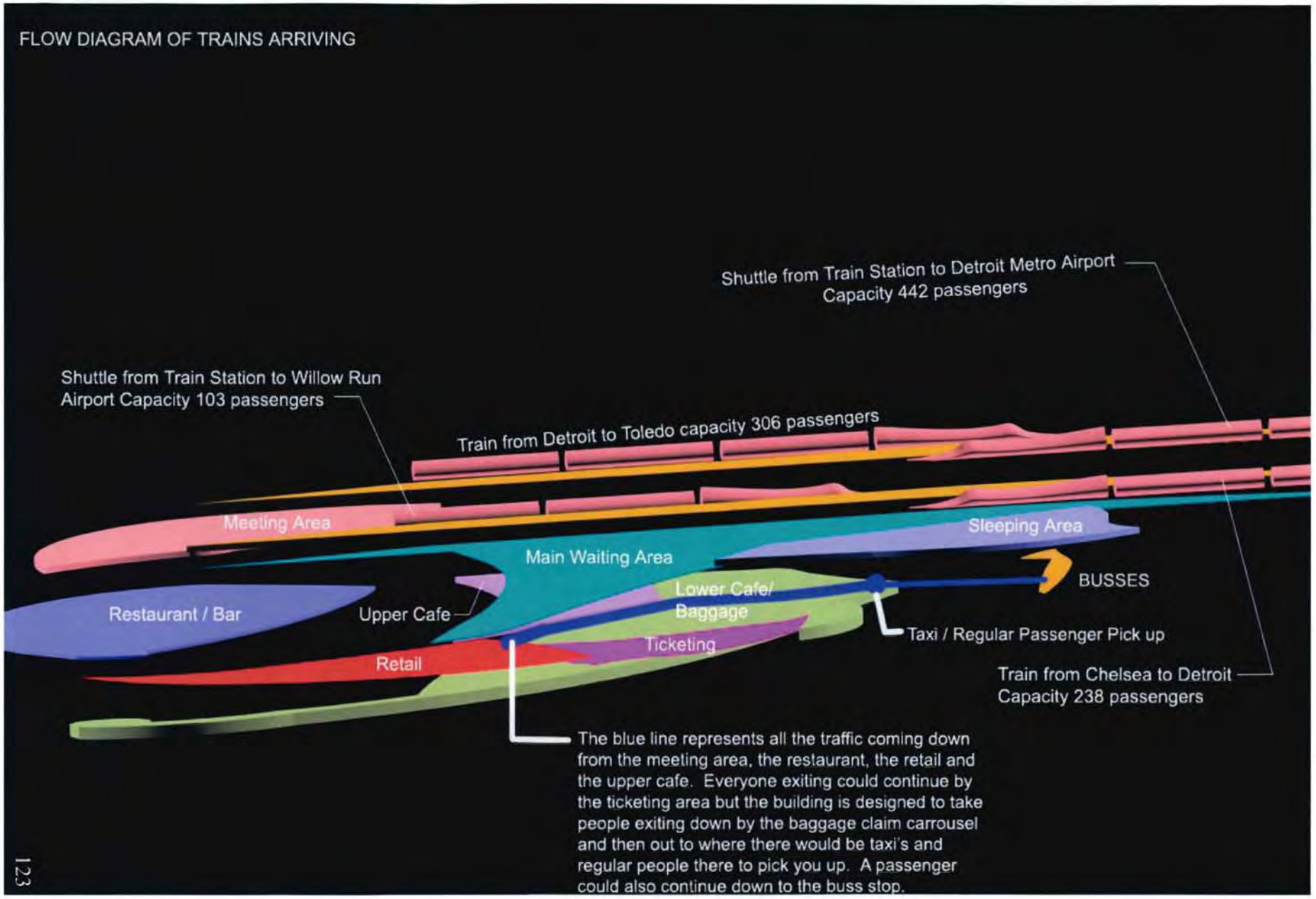
Blue line represents people arriving by buss. Some will transfer to a taxi or someone will pick them up or they will continue on by the ticketing offices up to retail, restaurant, meeting area, or the trains.

The orange line represents people being dropped off by either taxi's, another person or they may of drove themselves. See above for route they would take.

FLOW DIAGRAM OF TRAINS ARRIVING



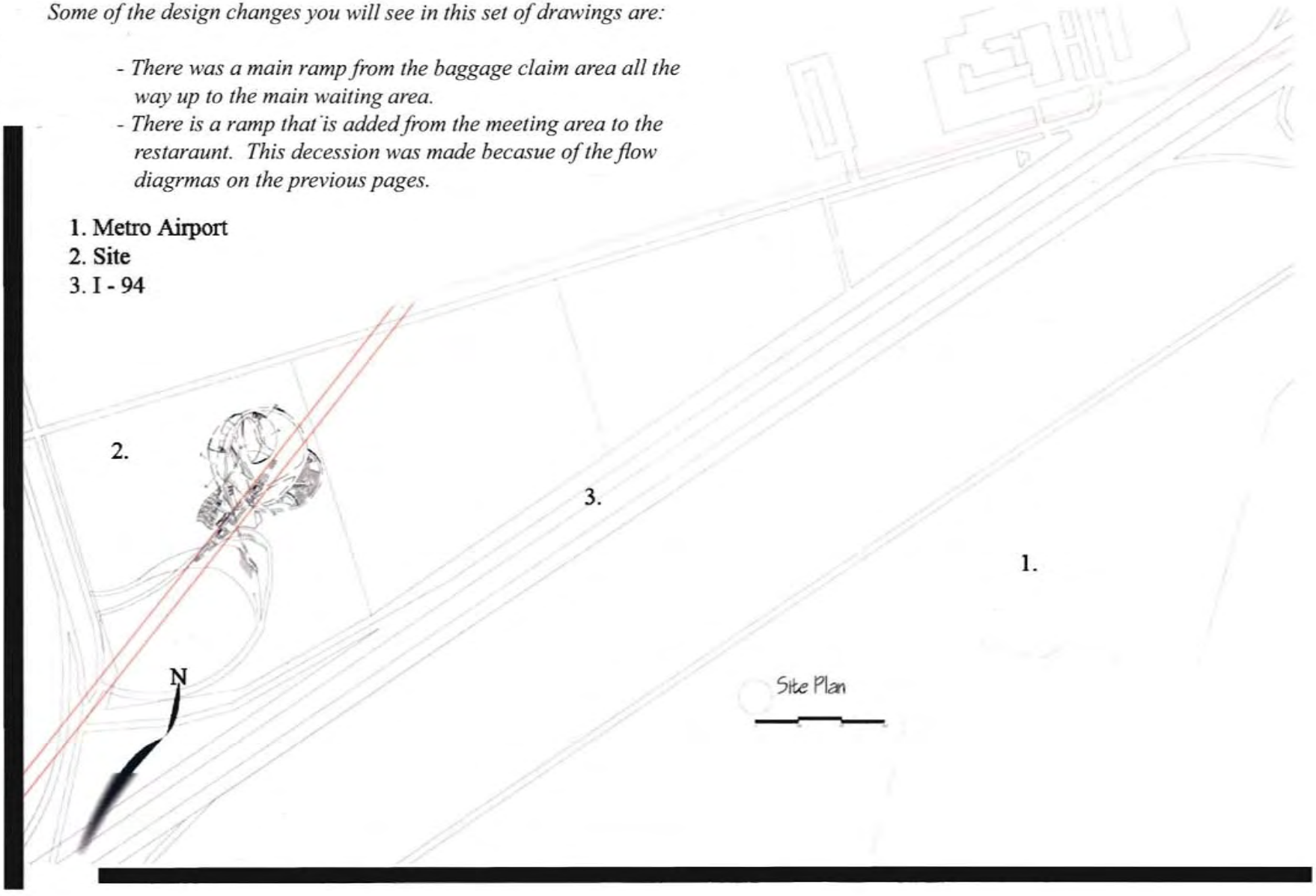
FLOW DIAGRAM OF TRAINS ARRIVING



Some of the design changes you will see in this set of drawings are:

- *There was a main ramp from the baggage claim area all the way up to the main waiting area.*
- *There is a ramp that is added from the meeting area to the restaraunt. This decession was made becasue of the flow diagrmas on the previous pages.*

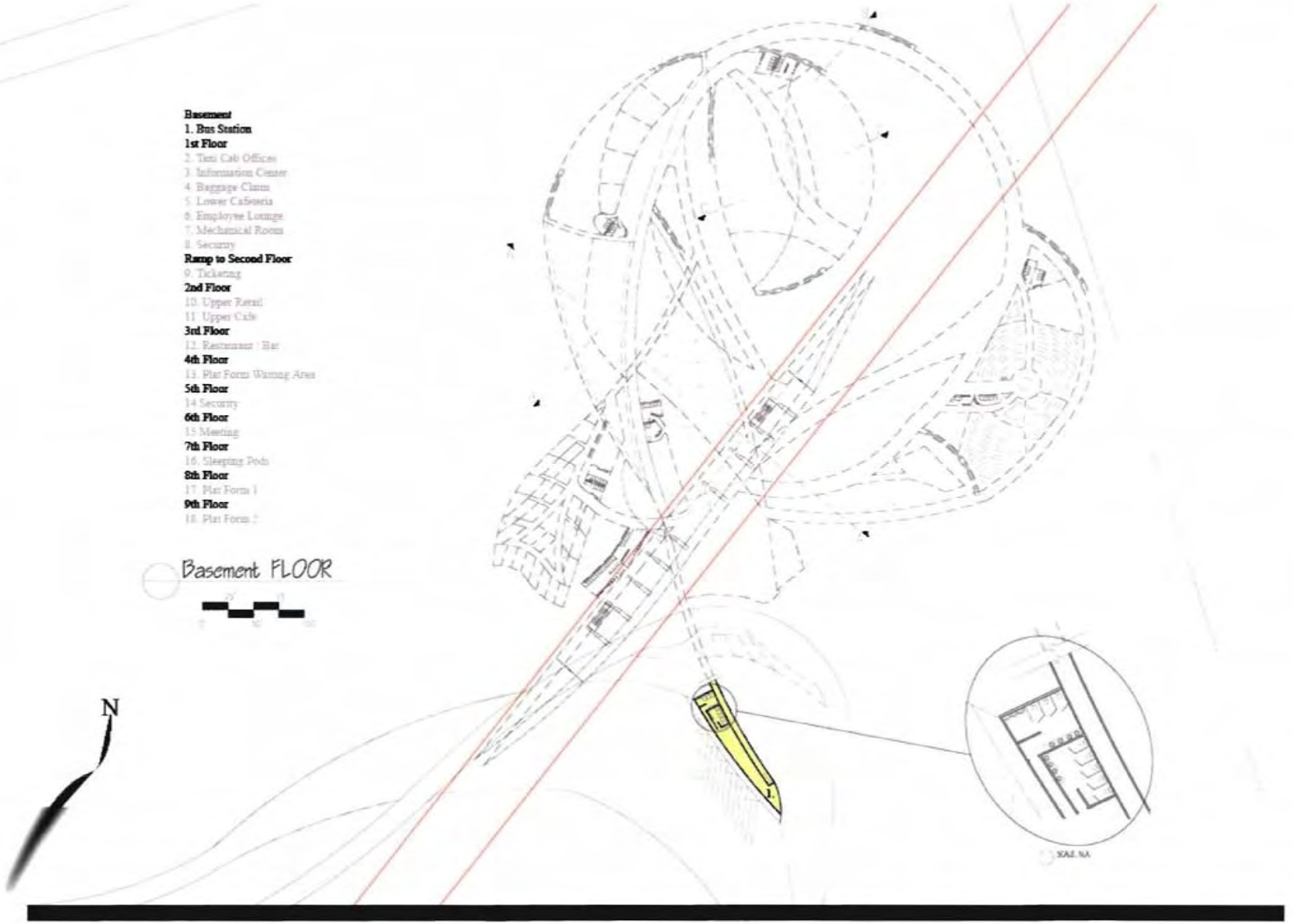
1. Metro Airport
2. Site
3. I - 94



HYBRID LIGHT RAIL STATION

Basement
1. Bus Station
1st Floor
2. Taxi Cab Offices
3. Information Center
4. Baggage Claim
5. Lower Cafeteria
6. Employee Lounge
7. Mechanical Room
8. Security
Ramp to Second Floor
9. Ticketing
2nd Floor
10. Upper Retail
11. Upper Cafe
3rd Floor
12. Restaurant / Bar
4th Floor
13. Plat Form Waiting Area
5th Floor
14 Security
6th Floor
15 Meeting
7th Floor
16. Sleeping Pods
8th Floor
17. Plat Form 1
9th Floor
18. Plat Form 2

Basement FLOOR



HYBRID LIGHT RAIL STATION

Basement
1. Bus Station
1st Floor
2. Taxi Cab Offices
3. Information Center
4. Baggage Claim
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6. Employee Lounge
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Ramp to Second Floor
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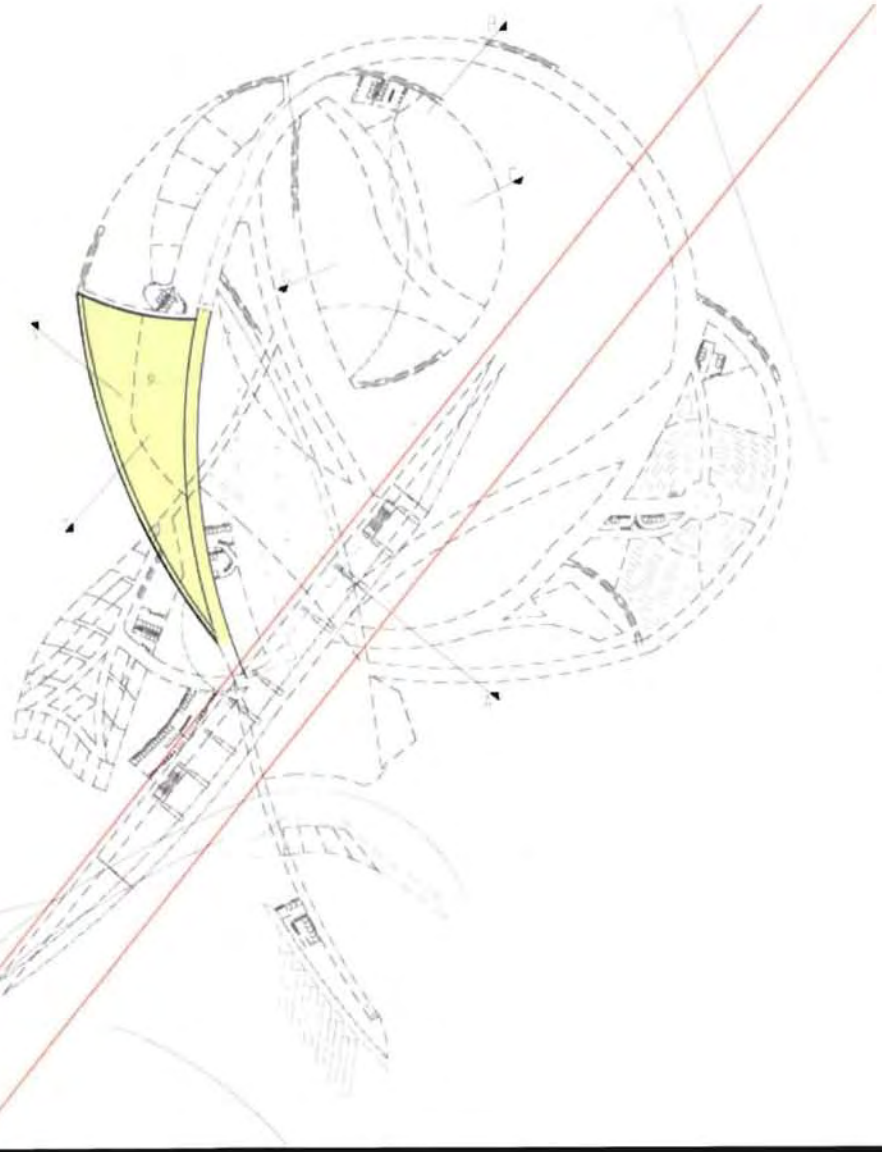
10. Upper Retail
11. Upper Cafe
3rd Floor
12. Restaurant / Bar
4th Floor
13. Plat Form Waiting Area
5th Floor
14. Security
6th Floor
15. Meeting
7th Floor
16. Sleeping Pods
8th Floor
17. Plat Form 1
9th Floor
18. Plat Form 2

1st FLOOR

HYBRID LIGHT RAIL STATION

Basement
1. Bus Station
1st Floor
2. Taxi Cab Offices
3. Information Center
4. Baggage Claim
5. Lower Cafeteria
6. Employee Lounge
7. Mechanical Rooms
8. Security
Ramp to Second Floor
9. Ticketing
2nd Floor
10. Upper Retail
11. Upper Cafe
3rd Floor
12. Restaurant / Bar
4th Floor
13. Plat Form Waiting Area
5th Floor
14 Security
6th Floor
15. Meeting
7th Floor
16. Sleeping Pods
8th Floor
17. Plat Form 1
9th Floor
18. Plat Form 2

RAMP TO 2nd FLOOR



HYBRID LIGHT RAIL STATION

Basement
1. Bus Station
1st Floor
2. Taxi Cab Offices
3. Information Center
4. Baggage Claim
5. Lower Cafeteria
6. Employee Lounge
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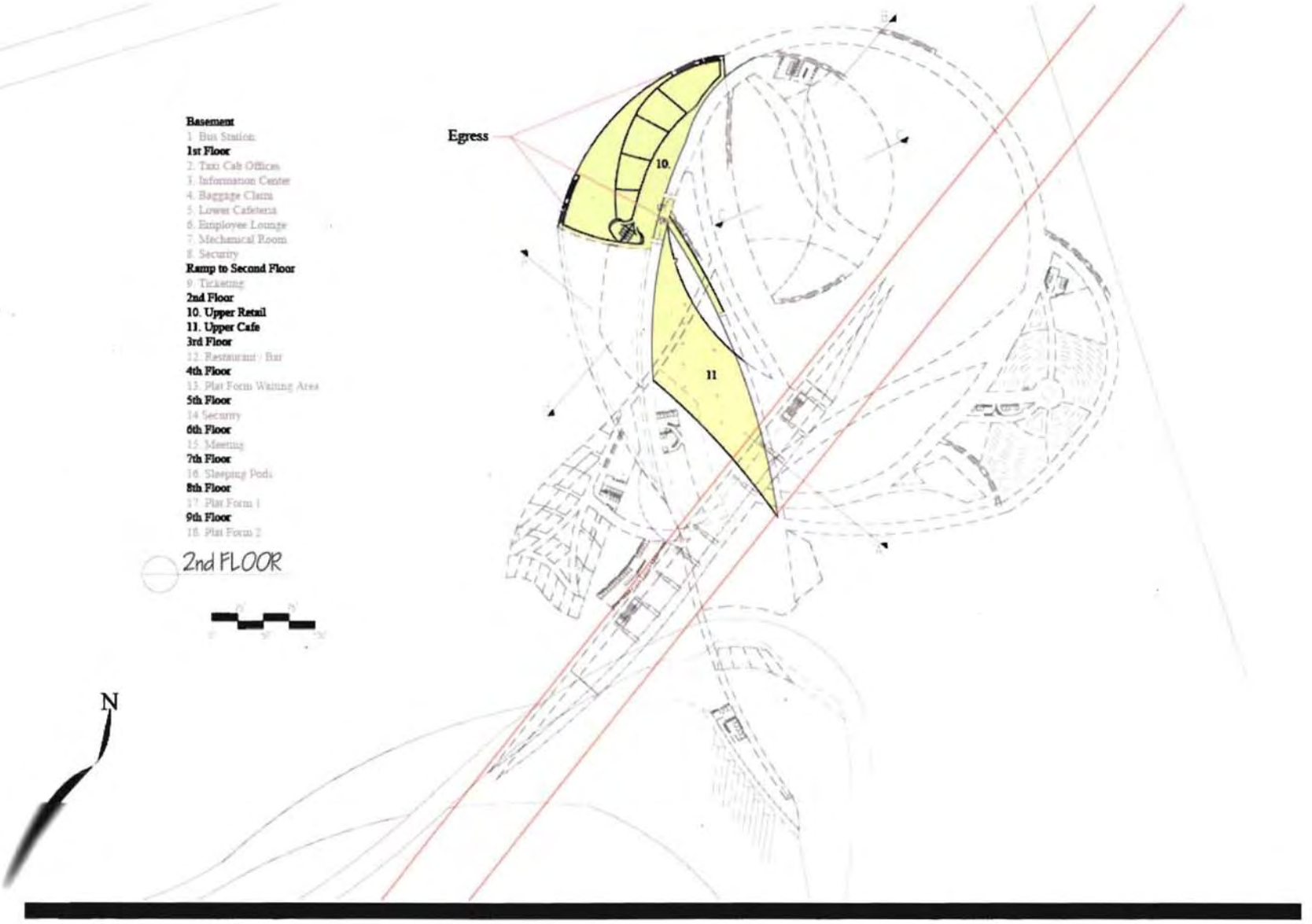
8. Security
Ramp to Second Floor
9. Ticketing
2nd Floor
10. Upper Retail
11. Upper Cafe
3rd Floor
12. Restaurant / Bar
4th Floor
13. Plat Form Waiting Area
5th Floor
14 Security
6th Floor
15. Meeting
7th Floor
16. Sleeping Pods
8th Floor
17. Plat Form 1
9th Floor
18. Plat Form 2

2nd FLOOR



Basement
1. Bus Station
1st Floor
2. Taxi Cab Offices
3. Information Center
4. Baggage Claim
5. Lower Cafeteria
6. Employee Lounge
7. Mechanical Room
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Ramp to Second Floor
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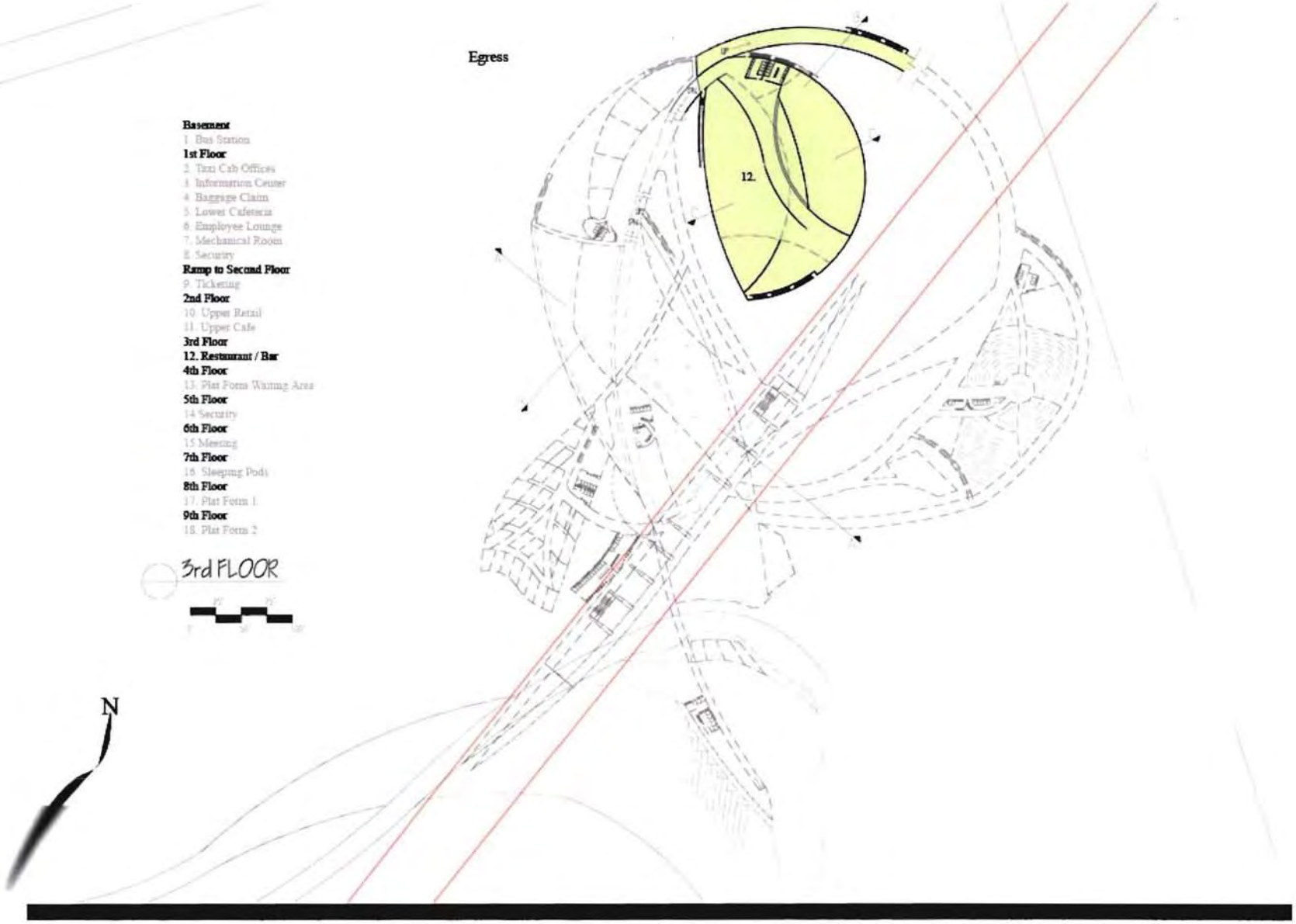
3rd Floor
12. Restaurant / Bar
4th Floor
13. Plat Form Waiting Area
5th Floor
14 Security
6th Floor
15 Meeting
7th Floor
16. Sleeping Pods
8th Floor
17. Plat Form 1
9th Floor
18. Plat Form 2

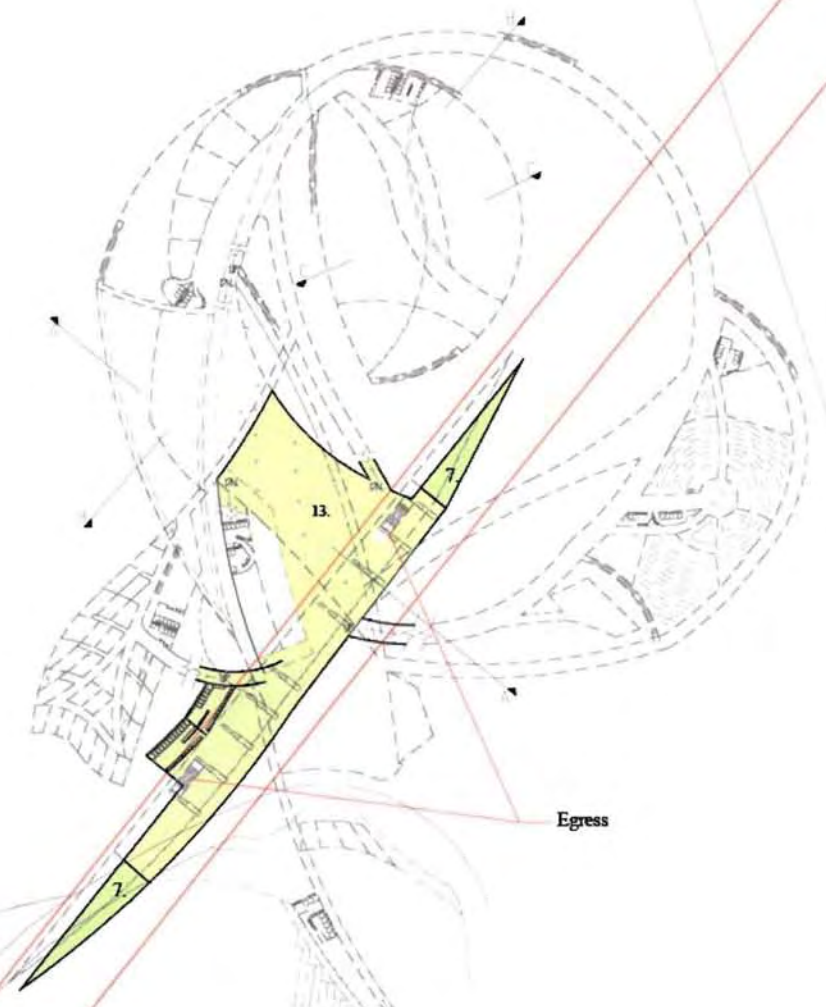
3rd FLOOR



HYBRID LIGHT RAIL STATION

Basement
1. Bus Station
1st Floor
2. Taxi Cab Offices
3. Information Center
4. Baggeage Claim
5. Lower Cafeteria
6. Employee Lounge
7. Mechinical Room
8. Security
Ramp to Second Floor
9. Ticketing
2nd Floor
10. Upper Retail
11. Upper Cafe
3rd Floor
12. Restraunt / Bar
4th Floor
13. Plat Form Waiting Area
5th Floor
14 Security
6th Floor
15. Meeting
7th Floor
16. Sleeping Pods
8th Floor
17. Plat Form 1
9th Floor
18. Plat Form 2

4th FLOOR



HYBRID LIGHT RAIL STATION

Basement
1. Bus Station
1st Floor
2. Taxi Cab Offices
3. Information Center
4. Baggeage Claim
5. Lower Cafeteria
6. Employee Lounge
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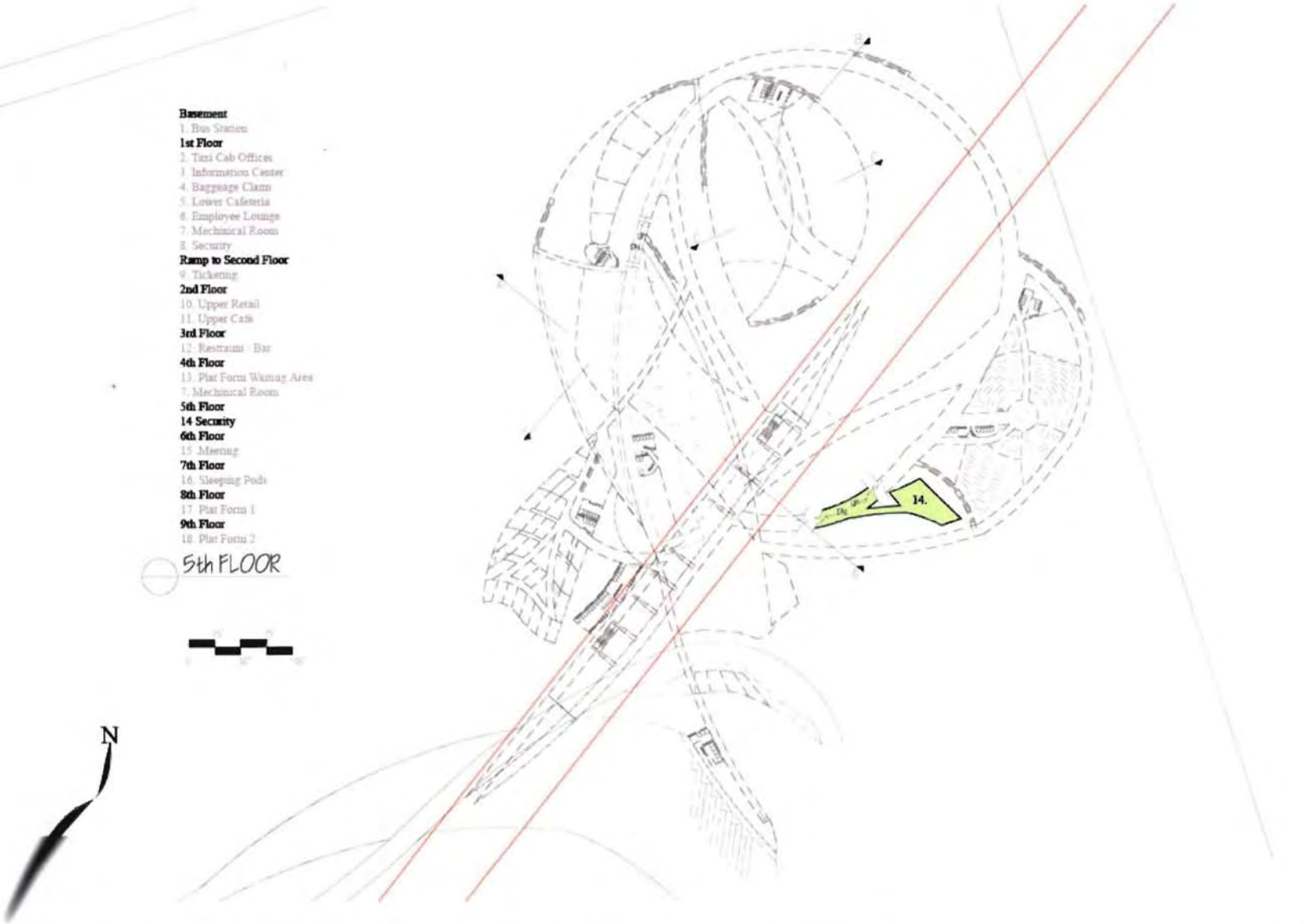
12. Restrant / Bar
4th Floor
13. Plat Form Waiting Area
7. Mechanical Room
5th Floor
14 Security
6th Floor
15. Meeting
7th Floor
16. Sleeping Pods
8th Floor
17. Plat Form 1
9th Floor
18. Plat Form 2

5th FLOOR



Basement
1. Bus Station
1st Floor
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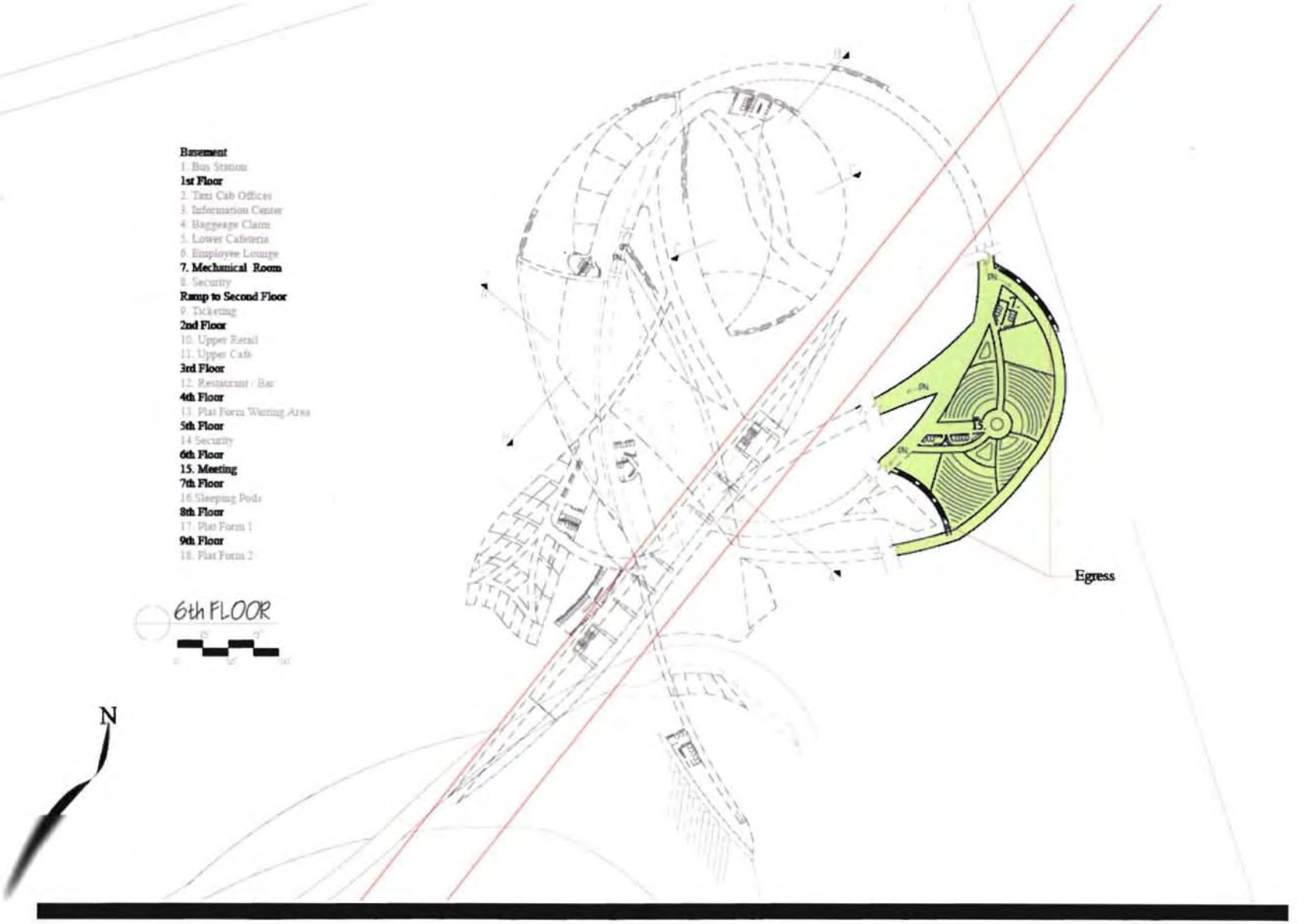
5th Floor
14 Security
6th Floor
15. Meeting
7th Floor
16 Sleeping Pods
8th Floor
17. Plat Form 1
9th Floor
18. Plat Form 2

6th FLOOR

N



Basement
1. Bus Station
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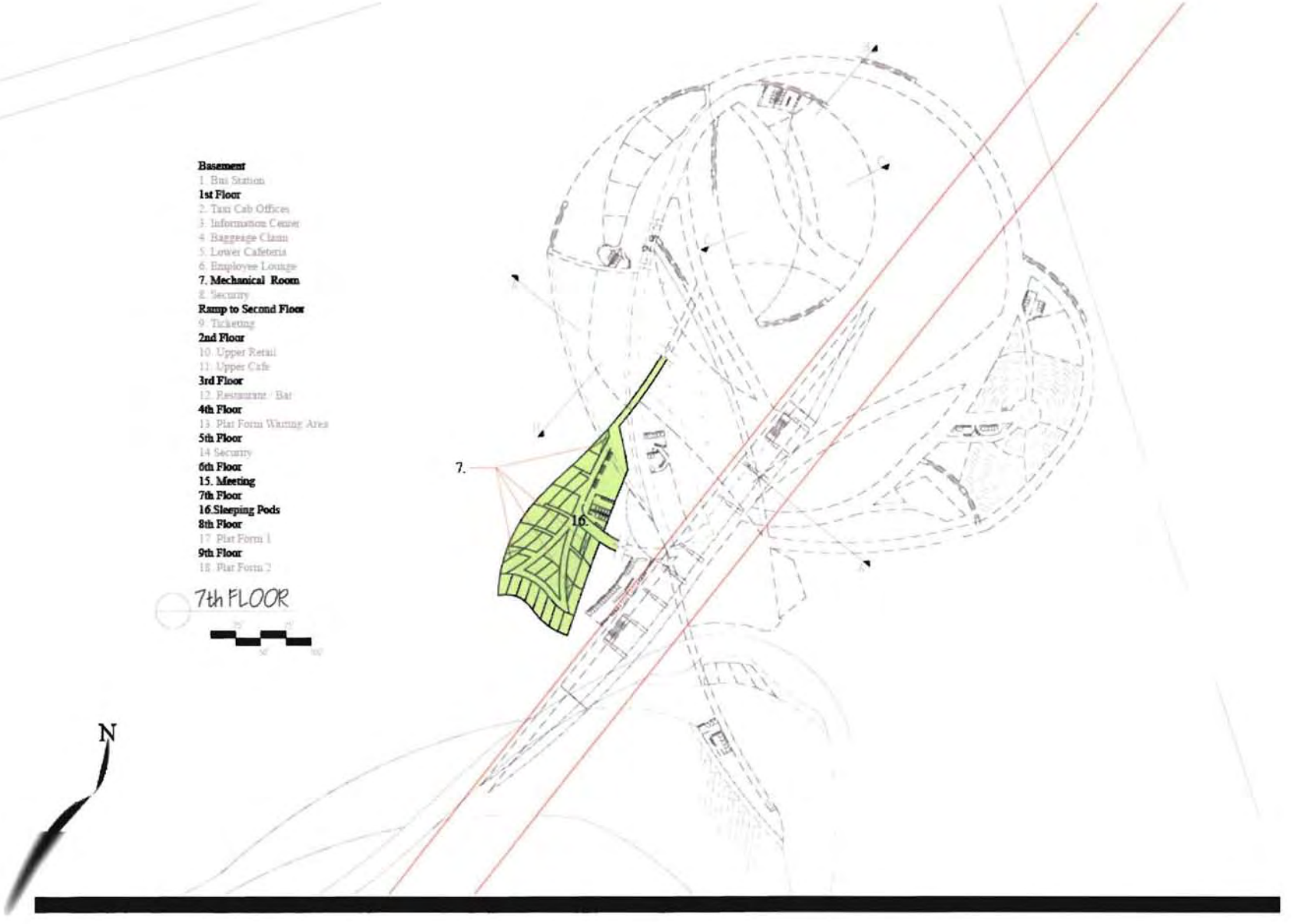
12. Restaurant / Bar
4th Floor
13. Plat Form Waiting Area
5th Floor
14 Security
6th Floor
15. Meeting
7th Floor
16.Sleeping Pods
8th Floor
17. Plat Form 1
9th Floor
18. Plat Form 2

7th FLOOR



HYBRID LIGHT RAIL STATION

Basement
1. Bus Station
1st Floor
2. Taxi Cab Offices
3. Information Centre
4. Baggage Claim
5. Lower Cafeteria
6. Employee Lounge
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9. Ticketing
2nd Floor
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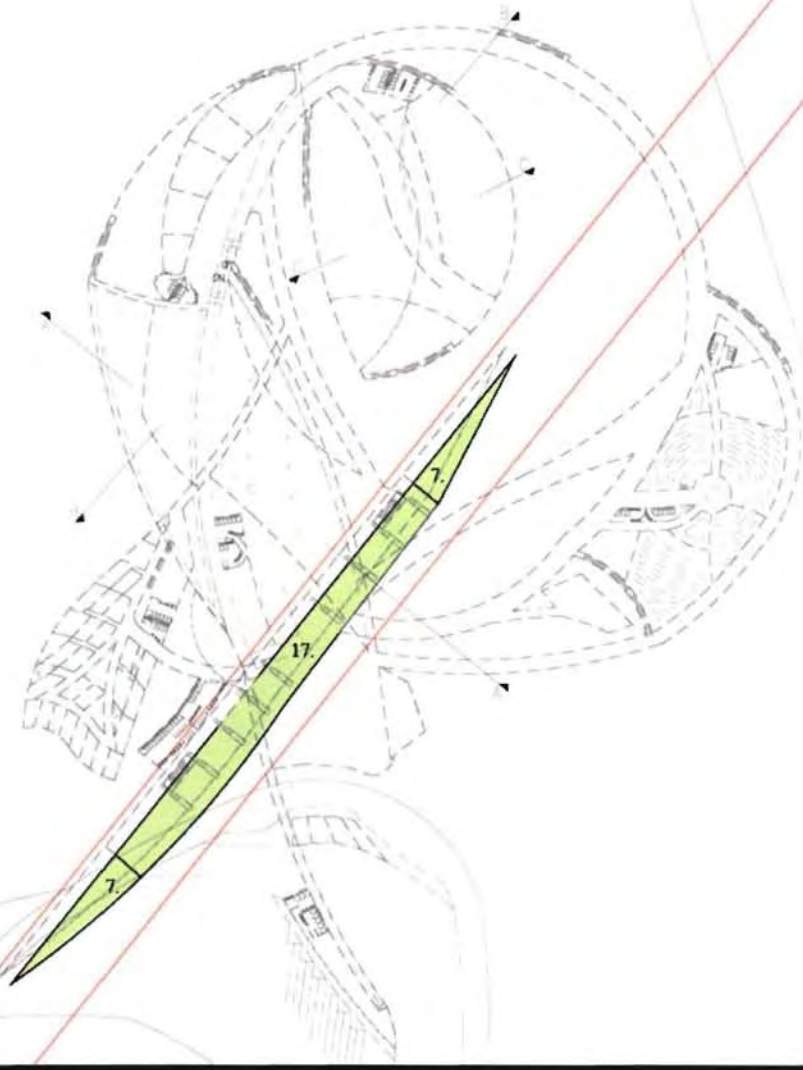
11. Upper Cafe
3rd Floor
12. Restaurant / Bar
4th Floor
13. Plat Form Waiting Area
5th Floor
14 Security
6th Floor
15 Meeting
7th Floor
16. Sleeping Pods
8th Floor
17. Plat Form 1
9th Floor
18. Plat Form 2

8th FLOOR



HYBRID LIGHT RAIL STATION

Basement
1. Bus Station
1st Floor
2. Taxi Cab Offices
3. Information Center
4. Baggage Claim
5. Lower Cafeteria
6. Employee Lounge
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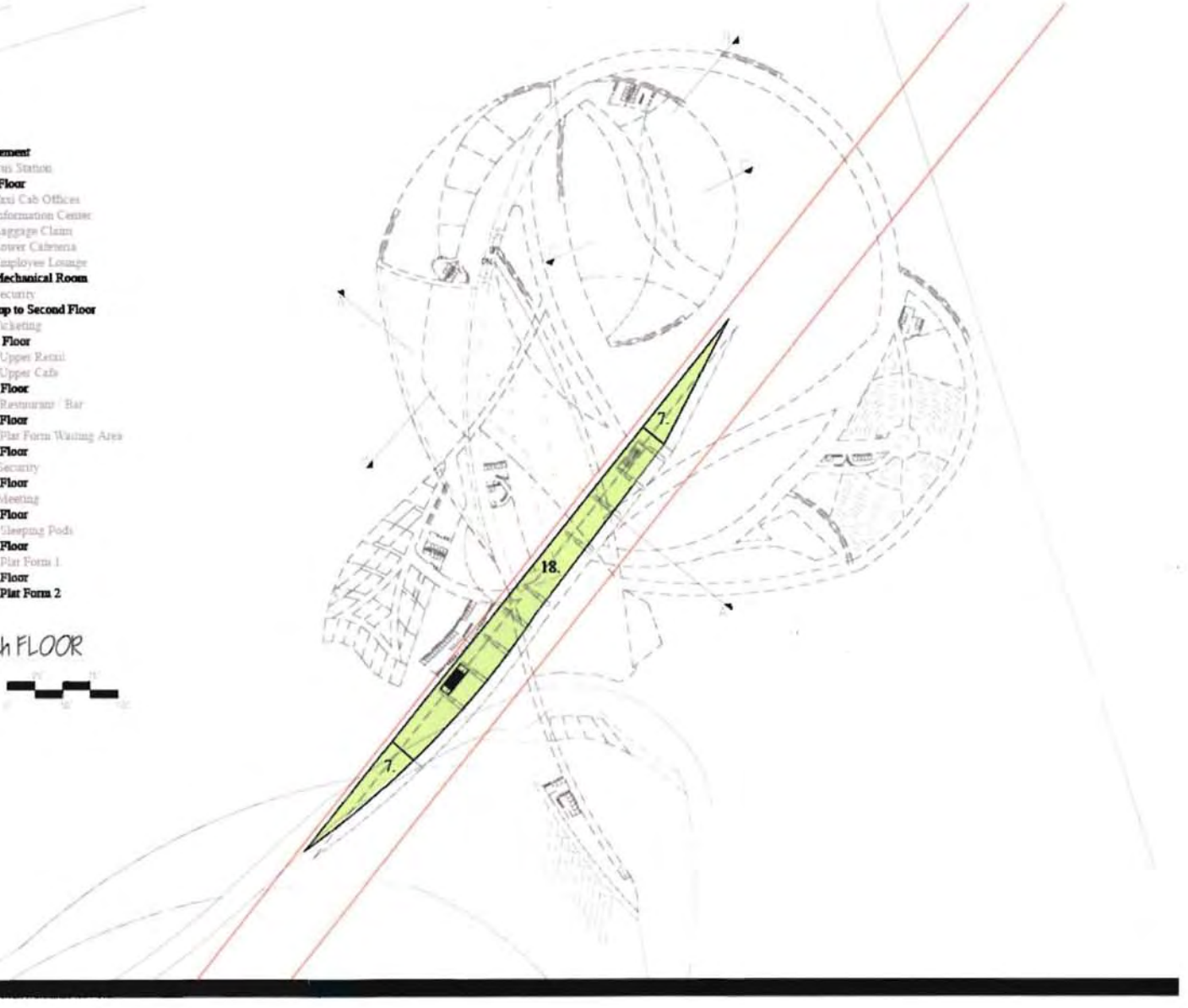
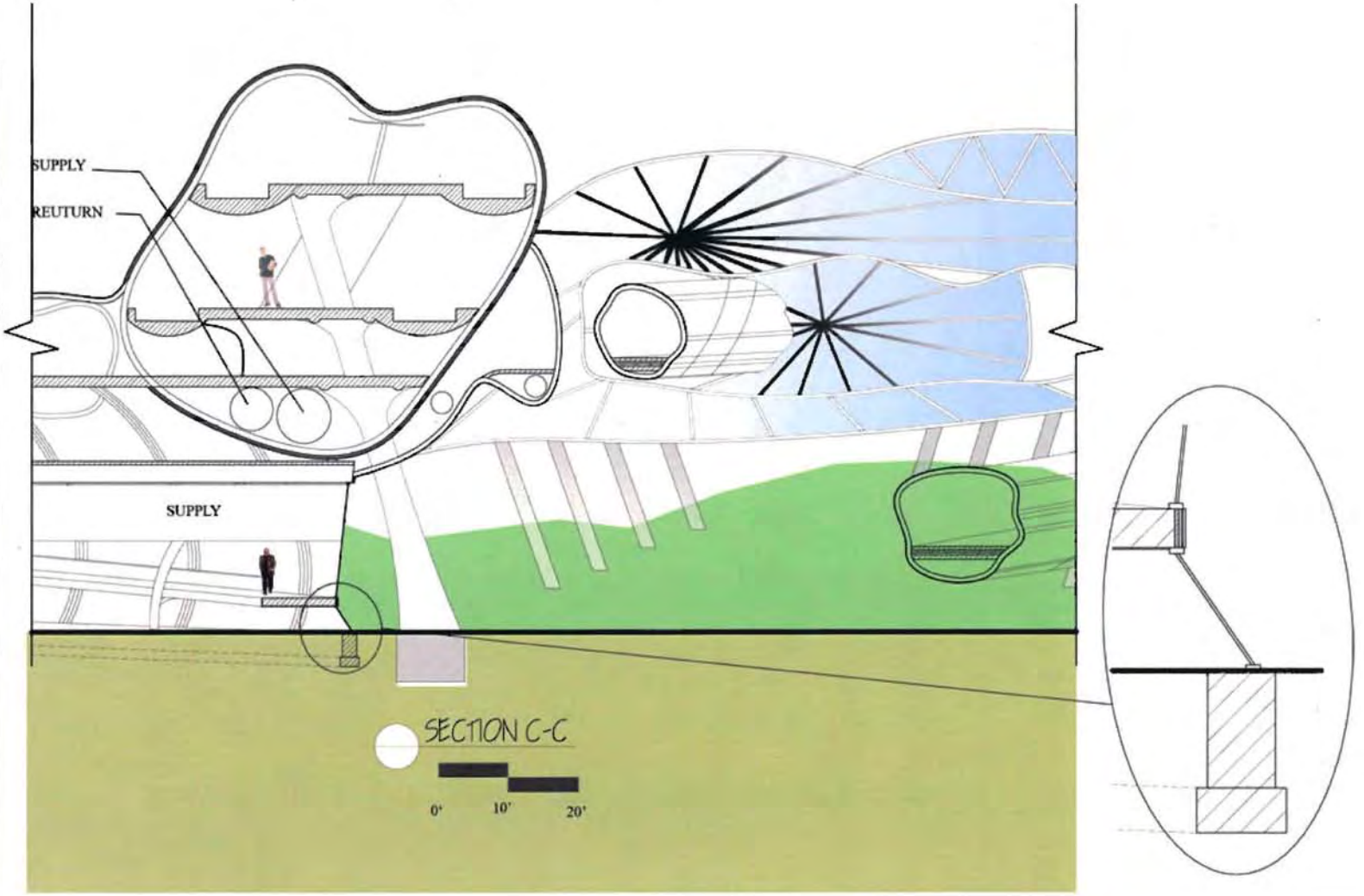
8. Security
Ramp to Second Floor
9. Ticketing
2nd Floor
10. Upper Retail
11. Upper Cafe
3rd Floor
12. Restaurant / Bar
4th Floor
13. Plat Form Waiting Area
5th Floor
14 Security
6th Floor
15 Meeting
7th Floor
16. Sleeping Pods
8th Floor
17. Plat Form 1
9th Floor
18. Plat Form 2

9th FLOOR




SUPPLY
REUTURN
SUPPLY
SECTION C-C
0'
10'
20'

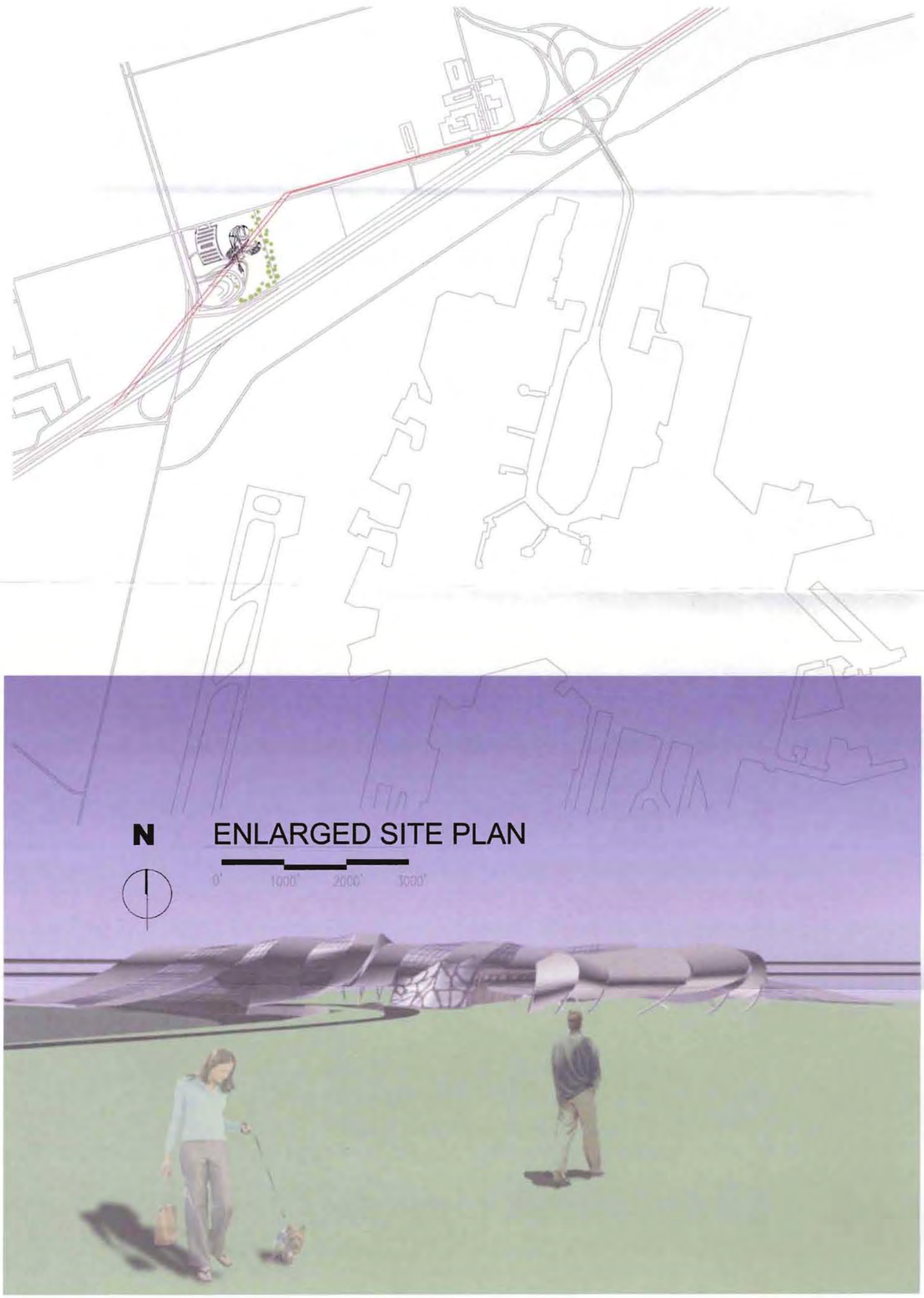
10. Final Presentation 140

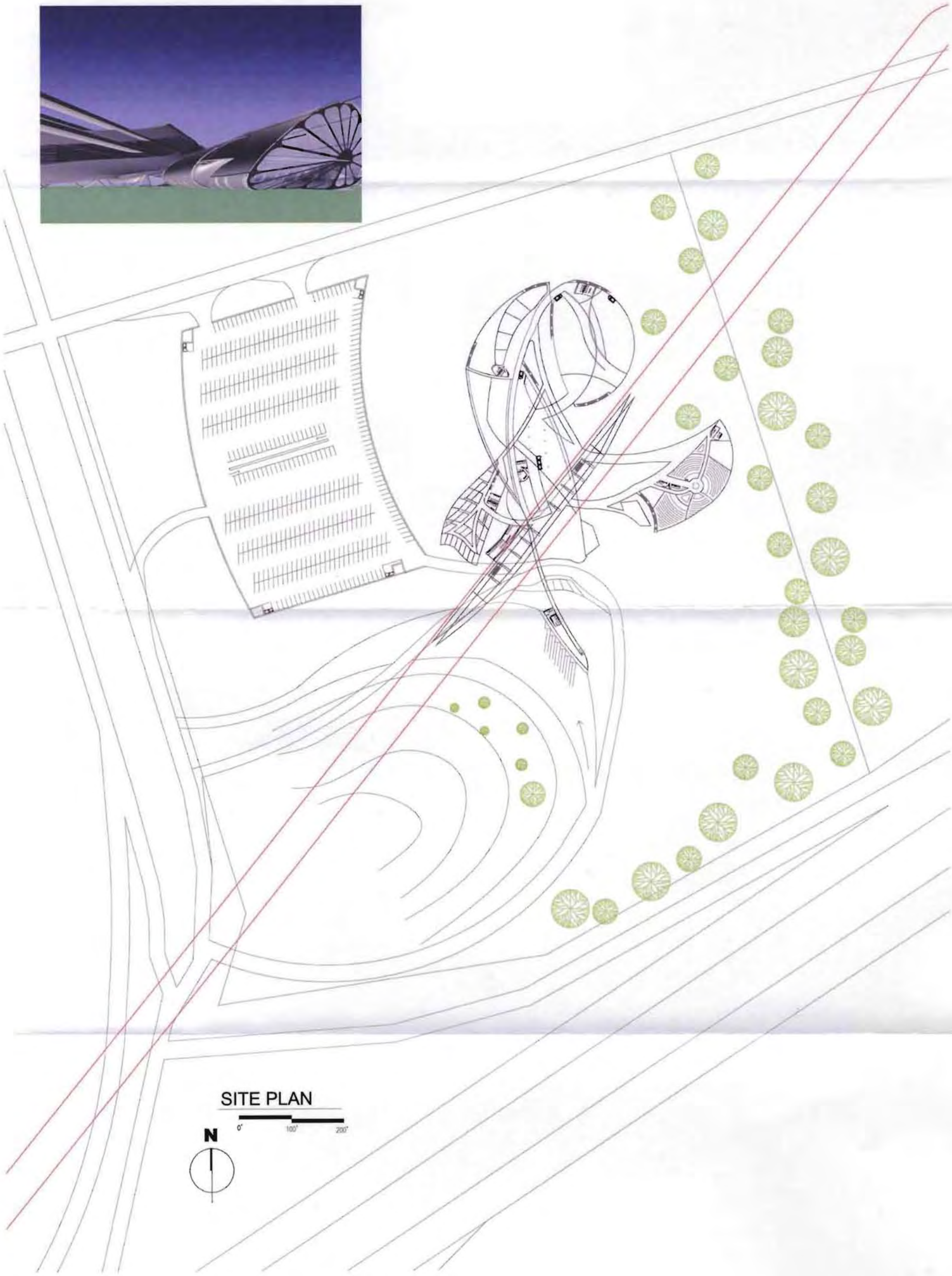
Some of the final changes that were made to the design were as follows:

- The ramp from the meeting center to the restraunt was taken out because of the length of travel.

- The ramp from the baggage claim to the meeting center was removed because the main ramp from the entrance area to the main waiting area links the entire building.

- A ramp was added from the main waiting area to the restraunt connecting the two areas.


N
ENLARGED SITE PLAN
0'
1000'
2000'
3000'


SITE PLAN
0'
100'
200'
N

1. Bus Station
2. Taxi Cab Offices
3. Information Center
4. Baggage Claim
5. Lower Cafeteria
6. Employee Lounge
7. Mechanical Room
8. Security
9. Ticketing
10. Upper Retail
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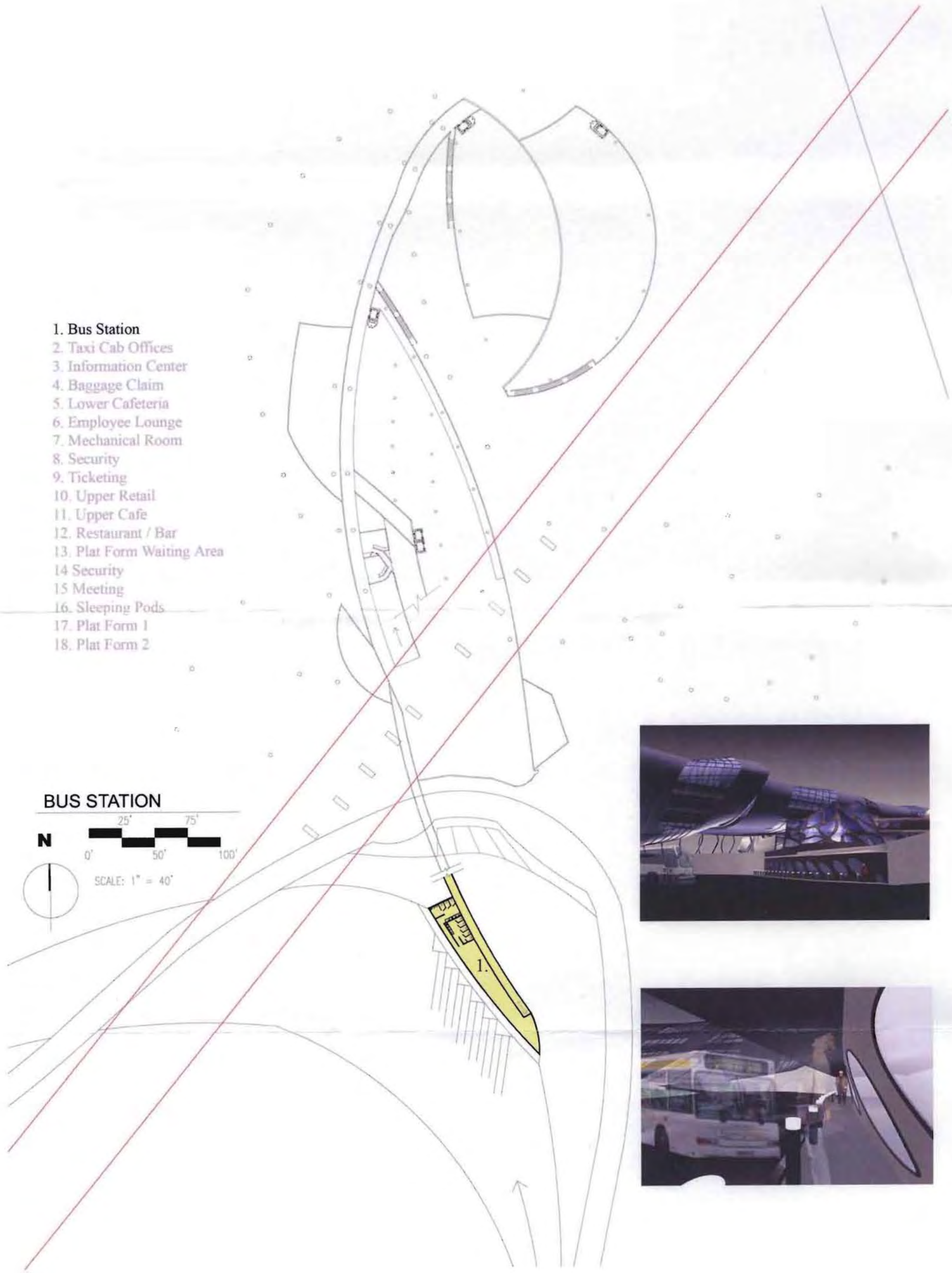
12. Restaurant / Bar
13. Plat Form Waiting Area
14 Security
15 Meeting
16. Sleeping Pods
17. Plat Form 1
18. Plat Form 2



1. Bus Station
2. Taxi Cab Offices
3. Information Center
4. Baggage Claim
5. Lower Cafeteria
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7. Mechanical Room
8. Security
9. Ticketing
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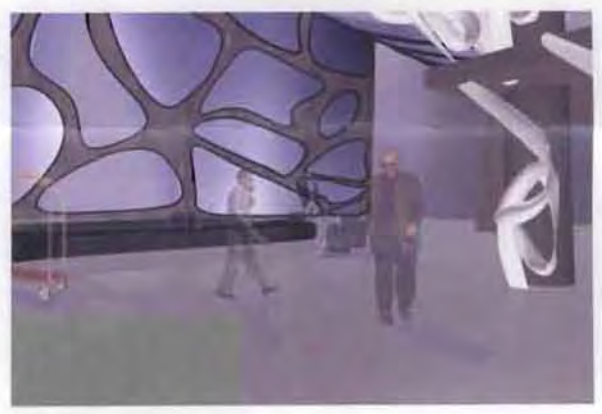
11. Upper Cafe
12. Restaurant / Bar
13. Plat Form Waiting Area
14 Security
15 Meeting
16. Sleeping Pods
17. Plat Form 1
18. Plat Form 2

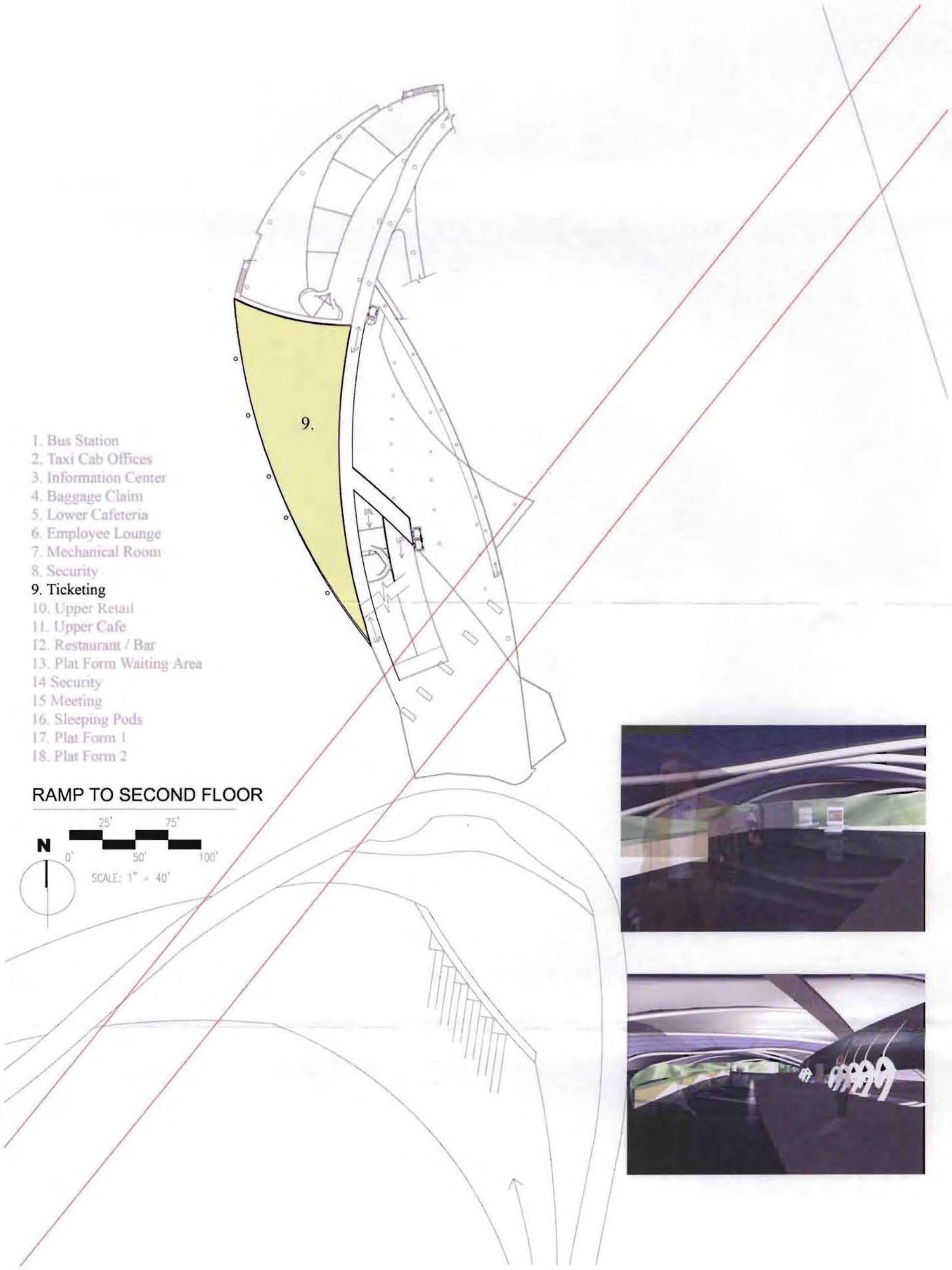
1st FLOOR

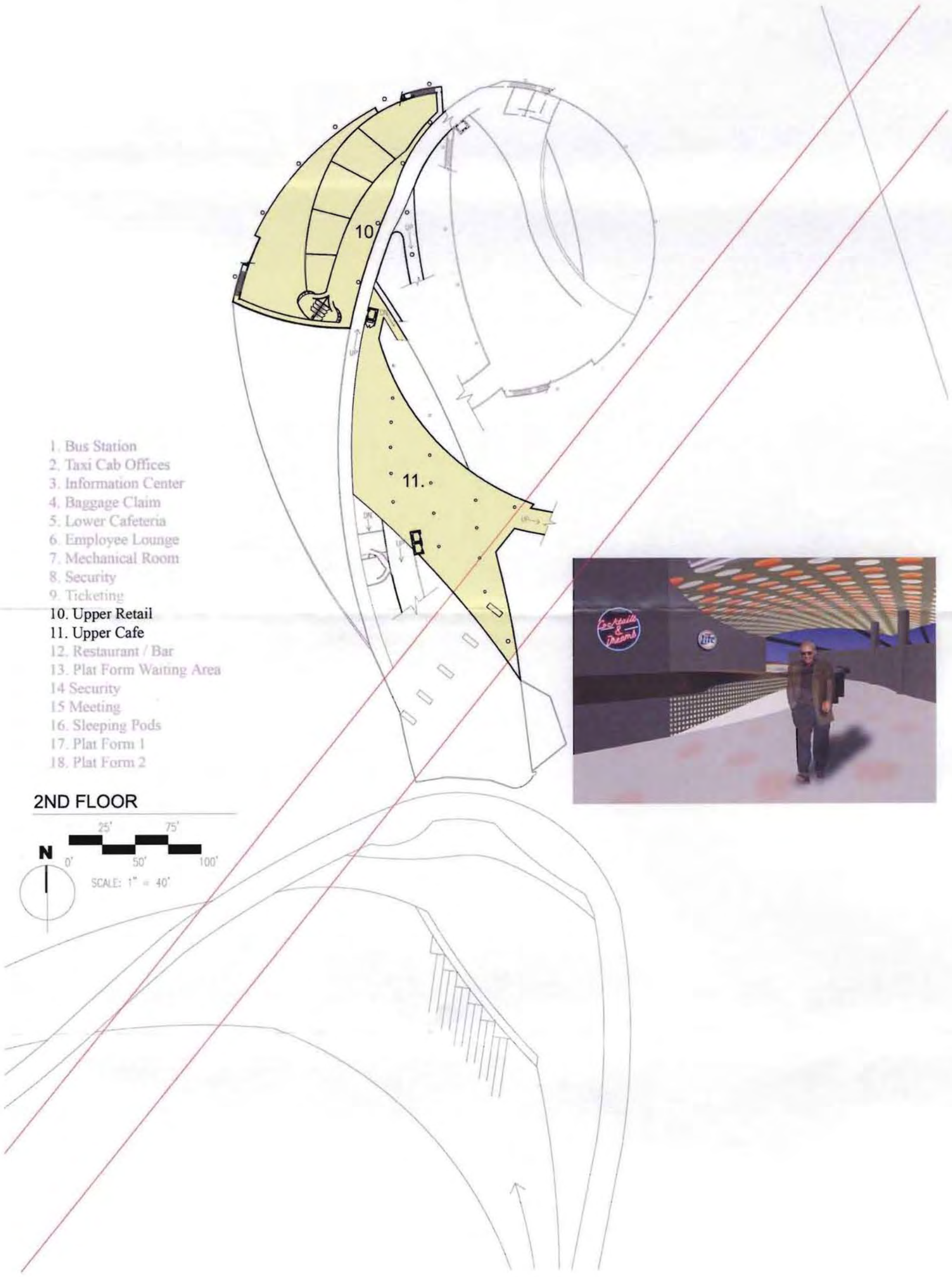
N

0' 25' 50' 75' 100'

SCALE: 1" = 40'




9.
1. Bus Station
2. Taxi Cab Offices
3. Information Center
4. Baggage Claim
5. Lower Cafeteria
6. Employee Lounge
7. Mechanical Room
8. Security
9. Ticketing
10. Upper Retail
11. Upper Cafe
12. Restaurant / Bar
13. Plat Form Waiting Area
14 Security
15 Meeting
16. Sleeping Pods
17. Plat Form 1
18. Plat Form 2
RAMP TO SECOND FLOOR
N
0'
25'
50'
75'
100'
SCALE: 1" = 40'



1. Bus Station
2. Taxi Cab Offices
3. Information Center
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5. Lower Cafeteria
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7. Mechanical Room
8. Security
9. Ticketing
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12. Restaurant / Bar
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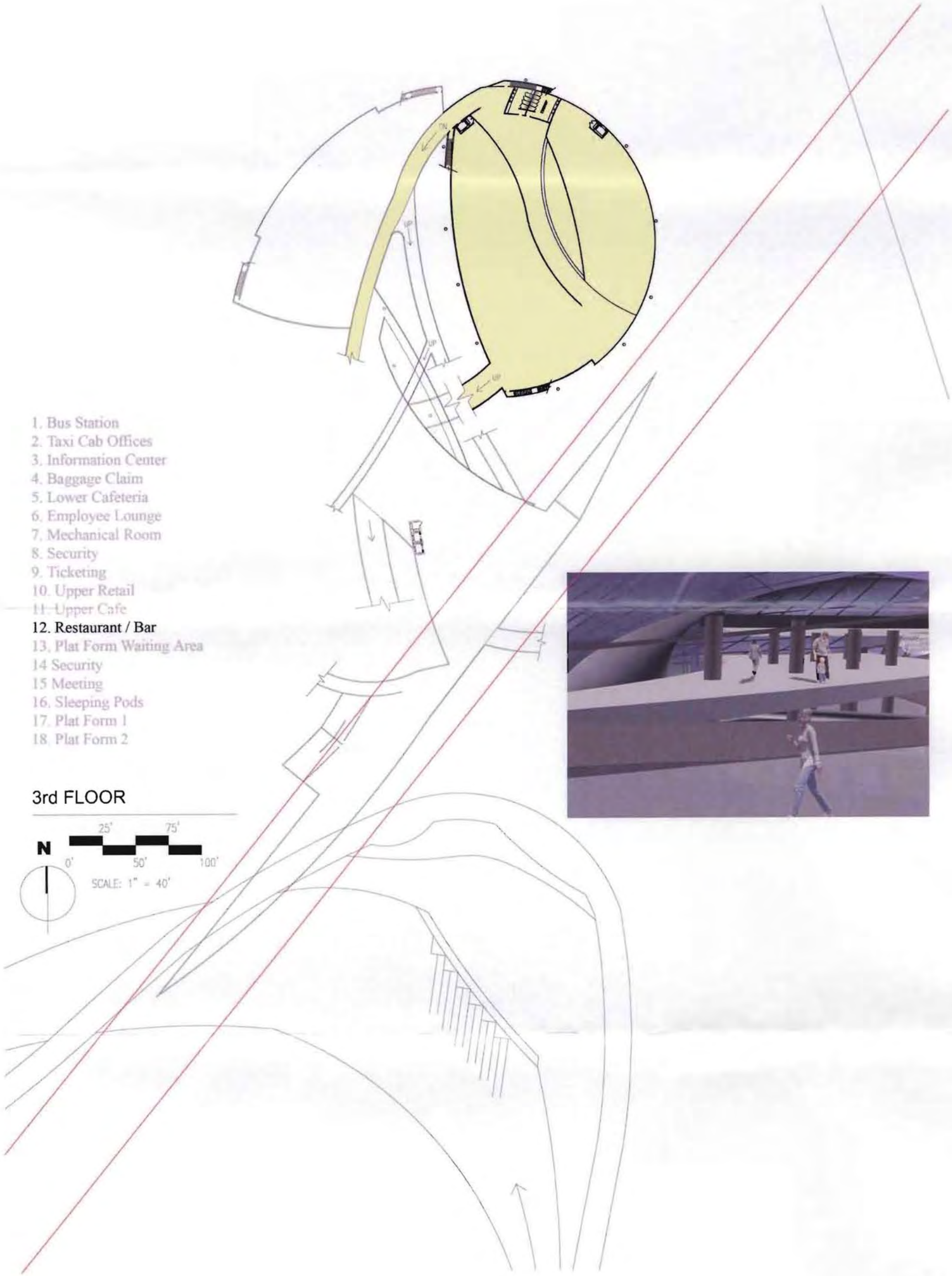
14 Security
15 Meeting
16. Sleeping Pods
17. Plat Form 1
18. Plat Form 2

2ND FLOOR


1. Bus Station
2. Taxi Cab Offices
3. Information Center
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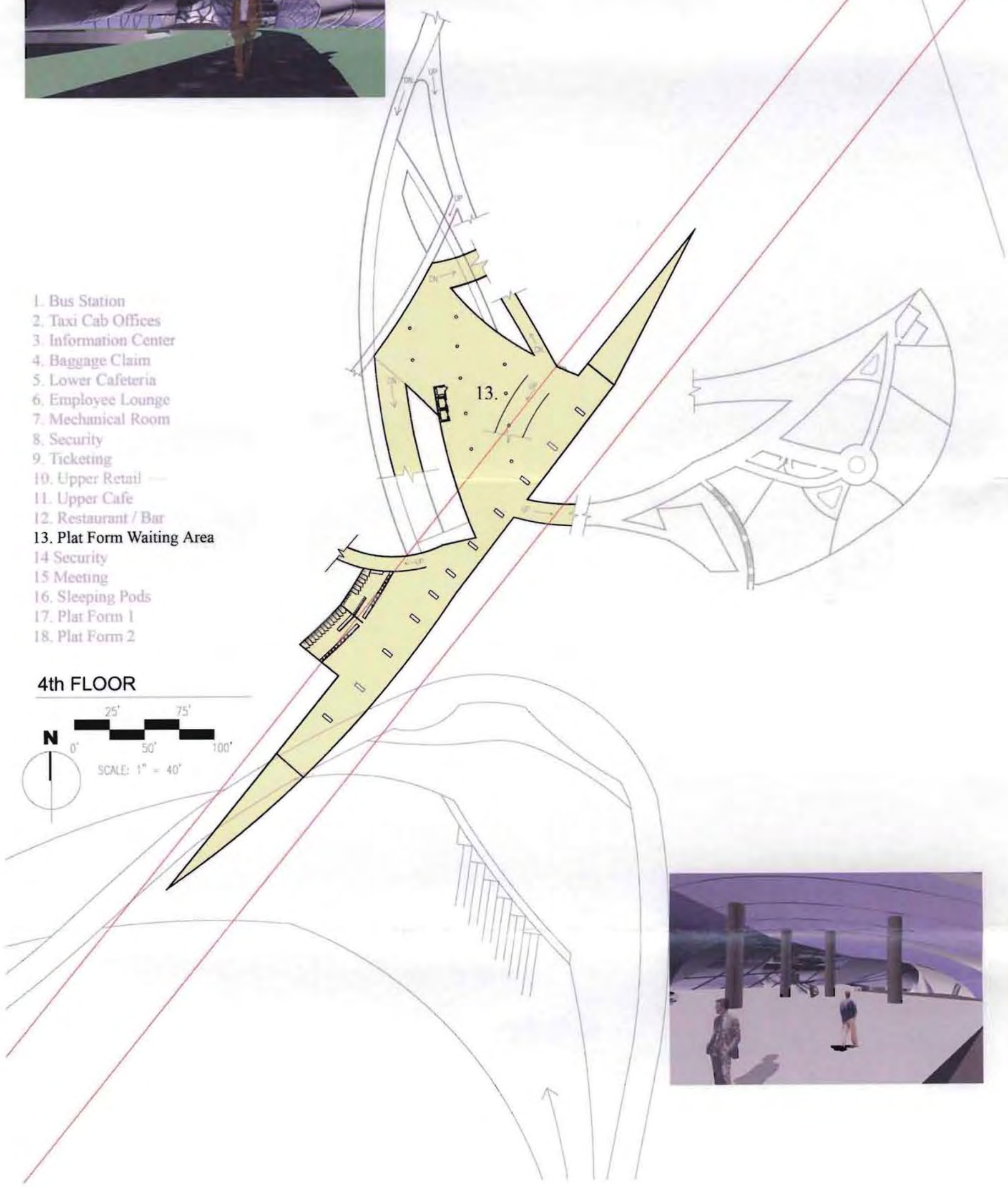
5. Lower Cafeteria
6. Employee Lounge
7. Mechanical Room
8. Security
9. Ticketing
10. Upper Retail
11. Upper Cafe
12. Restaurant / Bar
13. Plat Form Waiting Area
14 Security
15 Meeting
16. Sleeping Pods
17. Plat Form 1
18. Plat Form 2
3rd FLOOR
N
0'
25'
50'
75'
100'
SCALE: 1" = 40'



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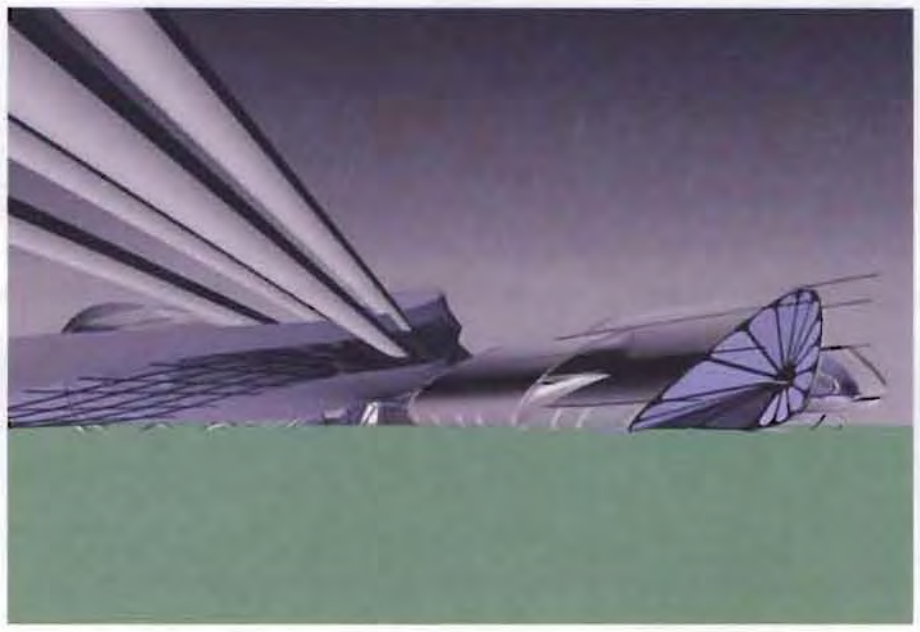
18. Plat Form 2

4th FLOOR



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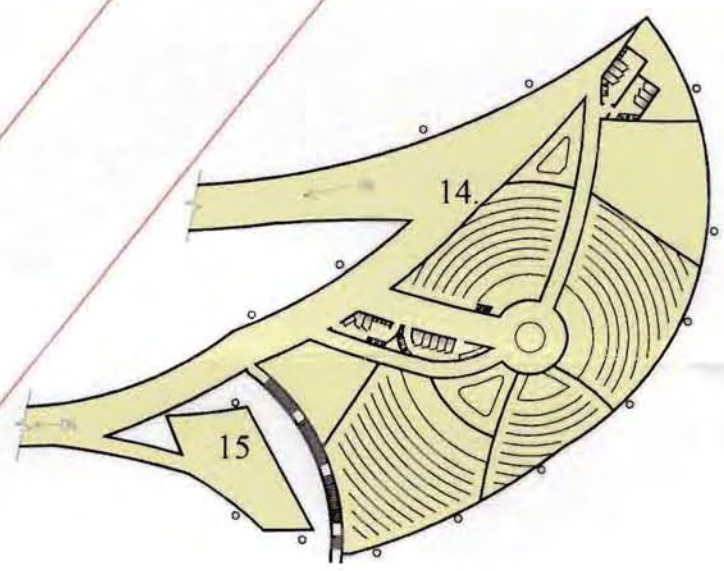

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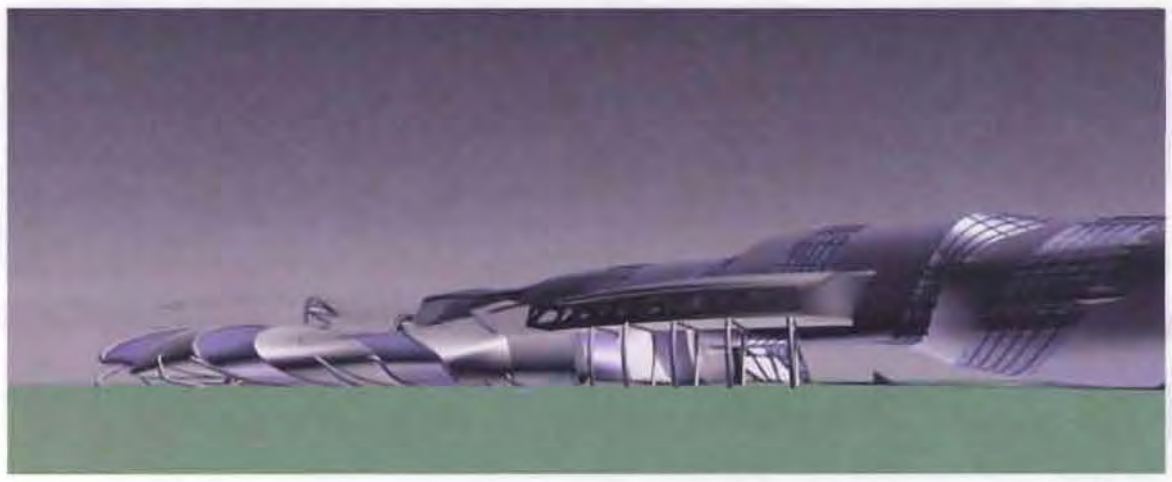

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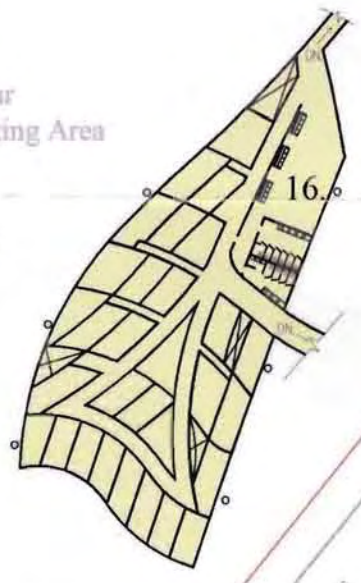

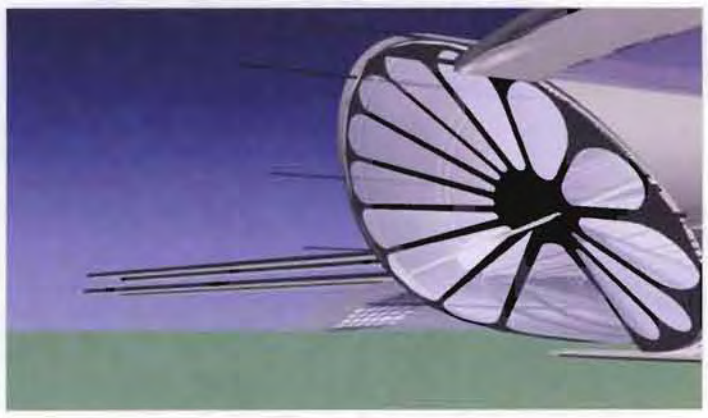

6th FLOOR

1. Bus Station
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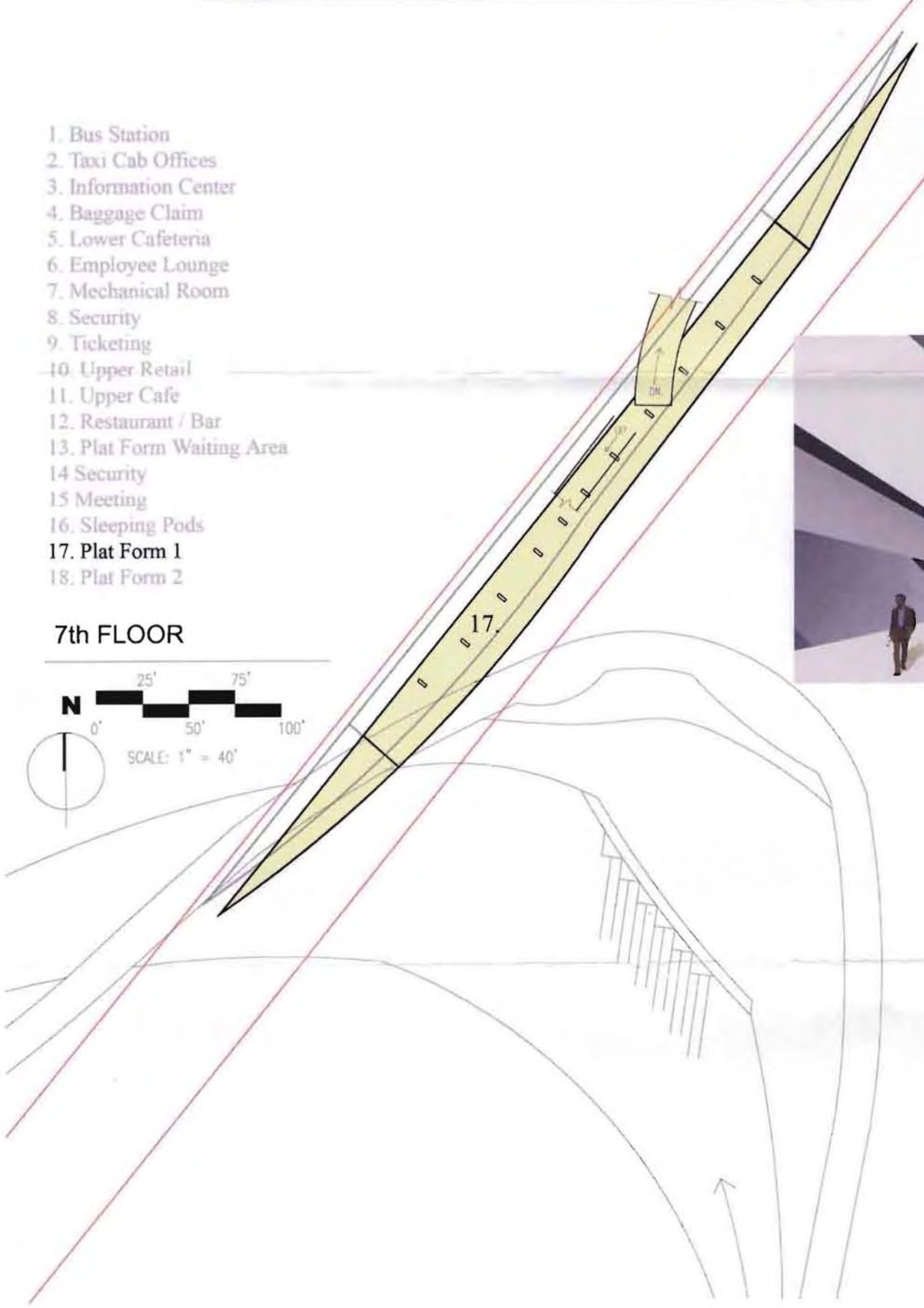
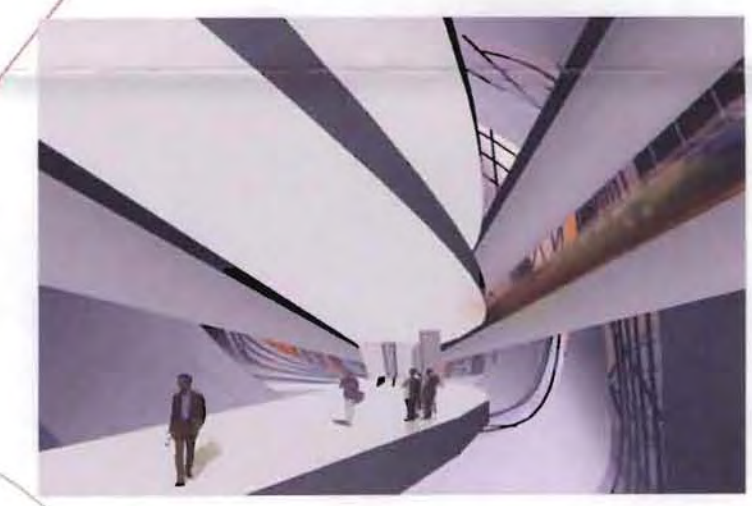
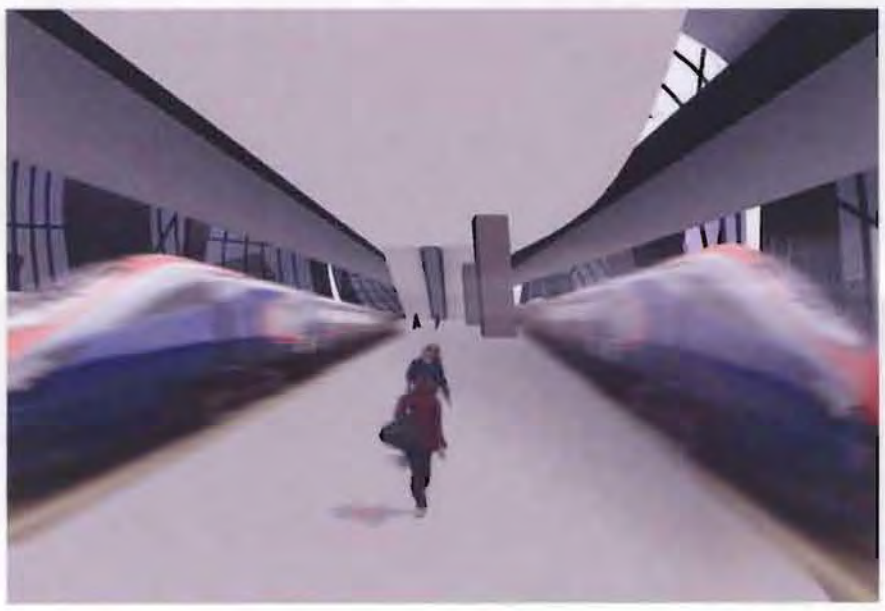
7th FLOOR







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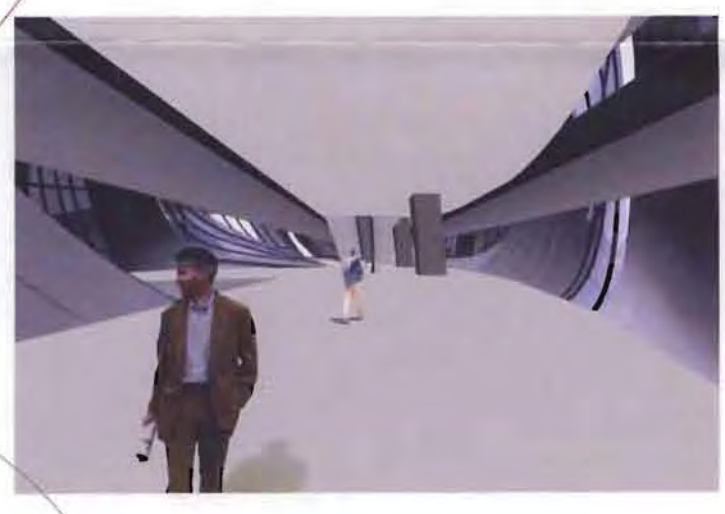

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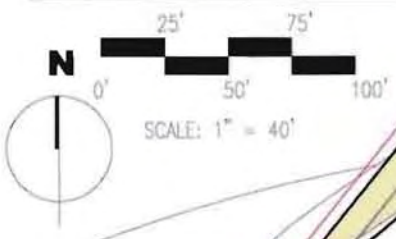
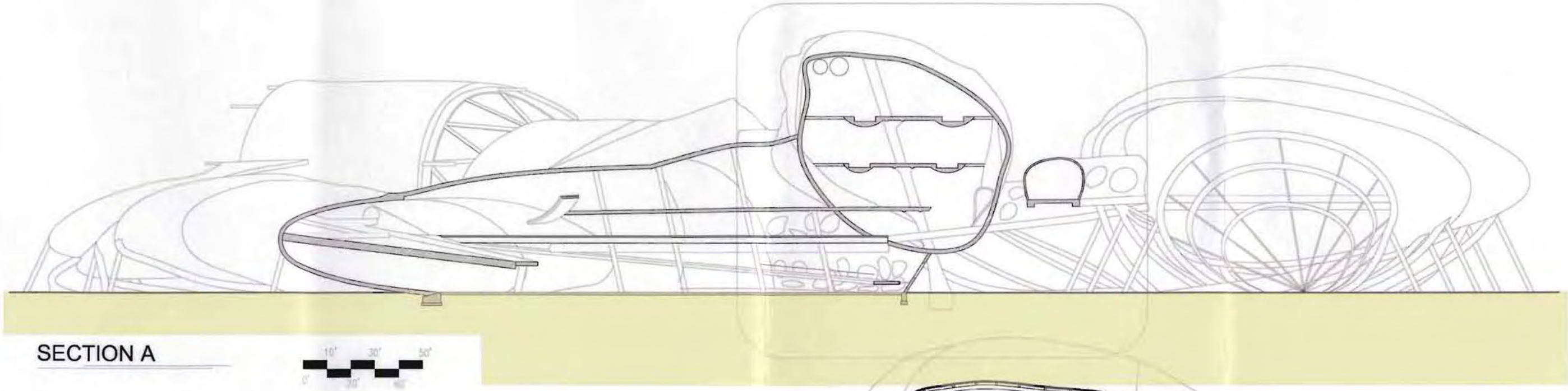
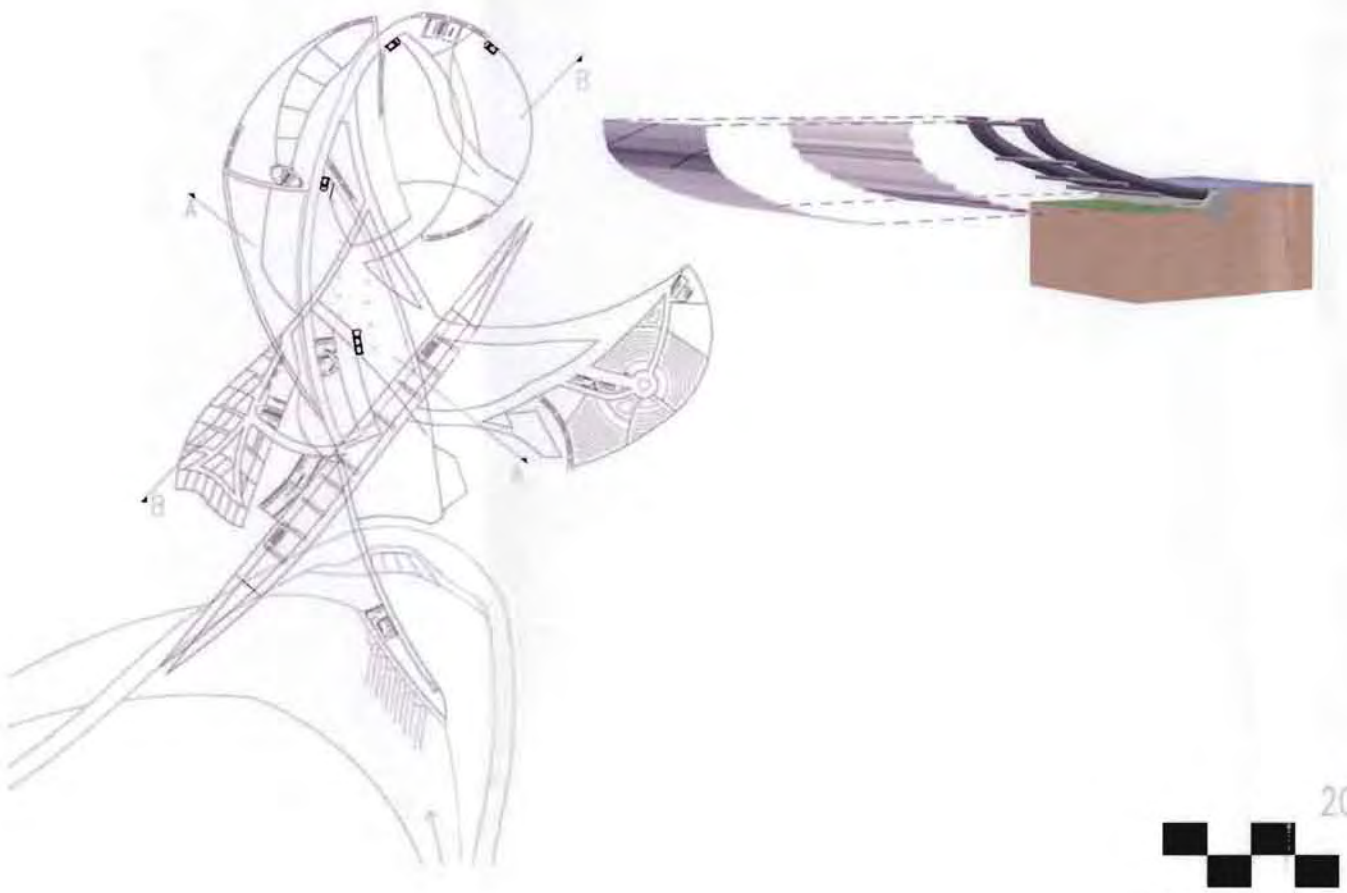
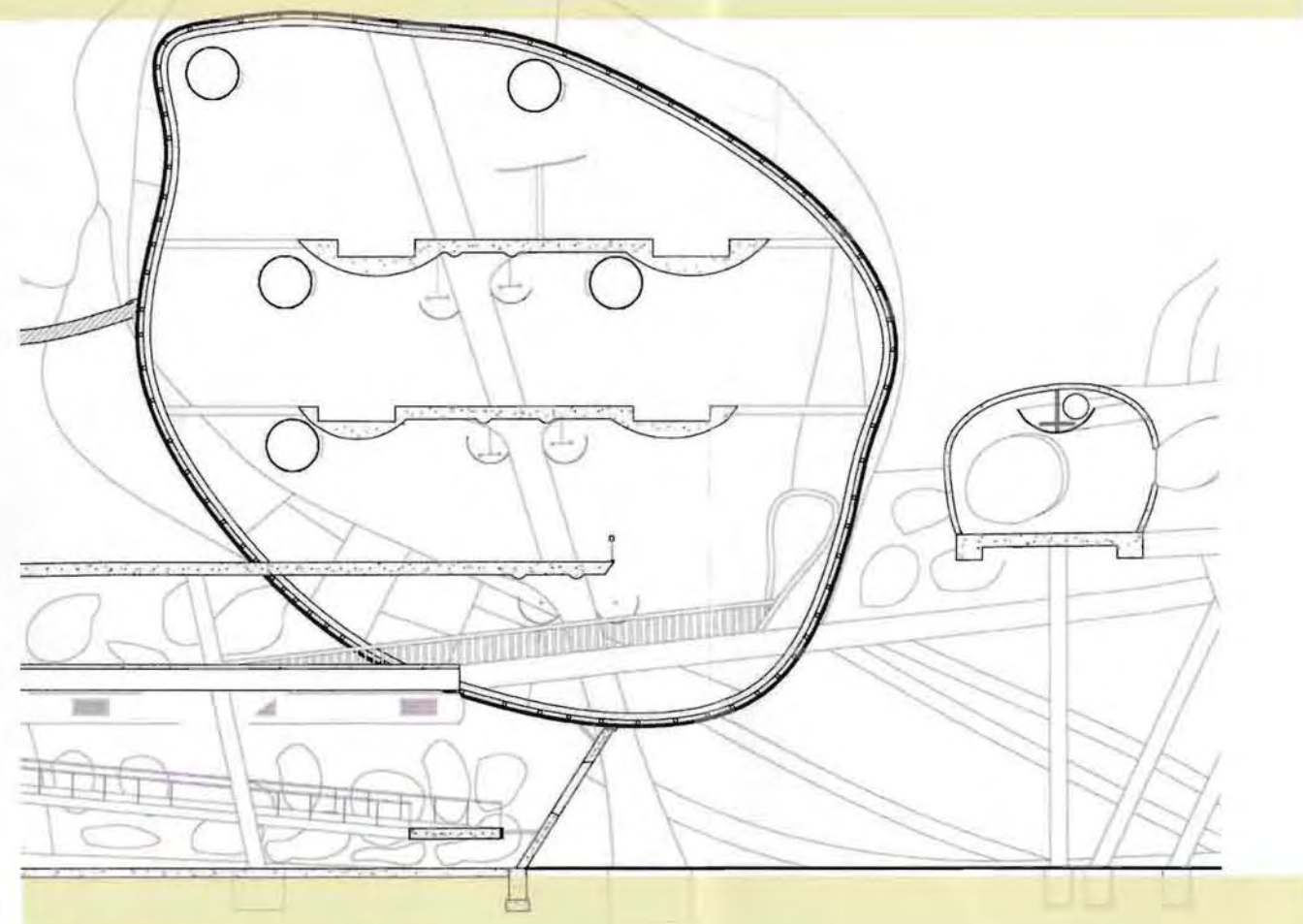




SECTION A





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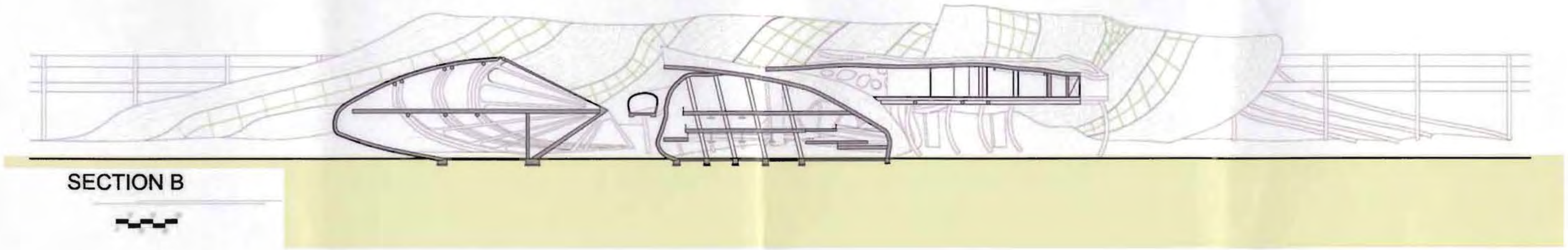
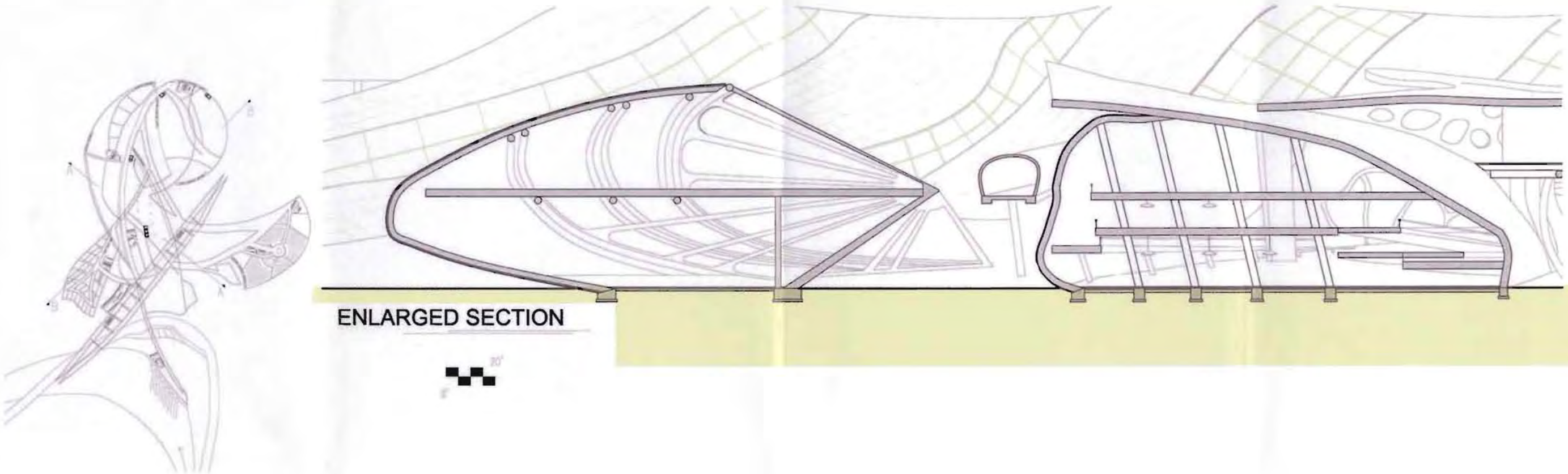


SECTION B



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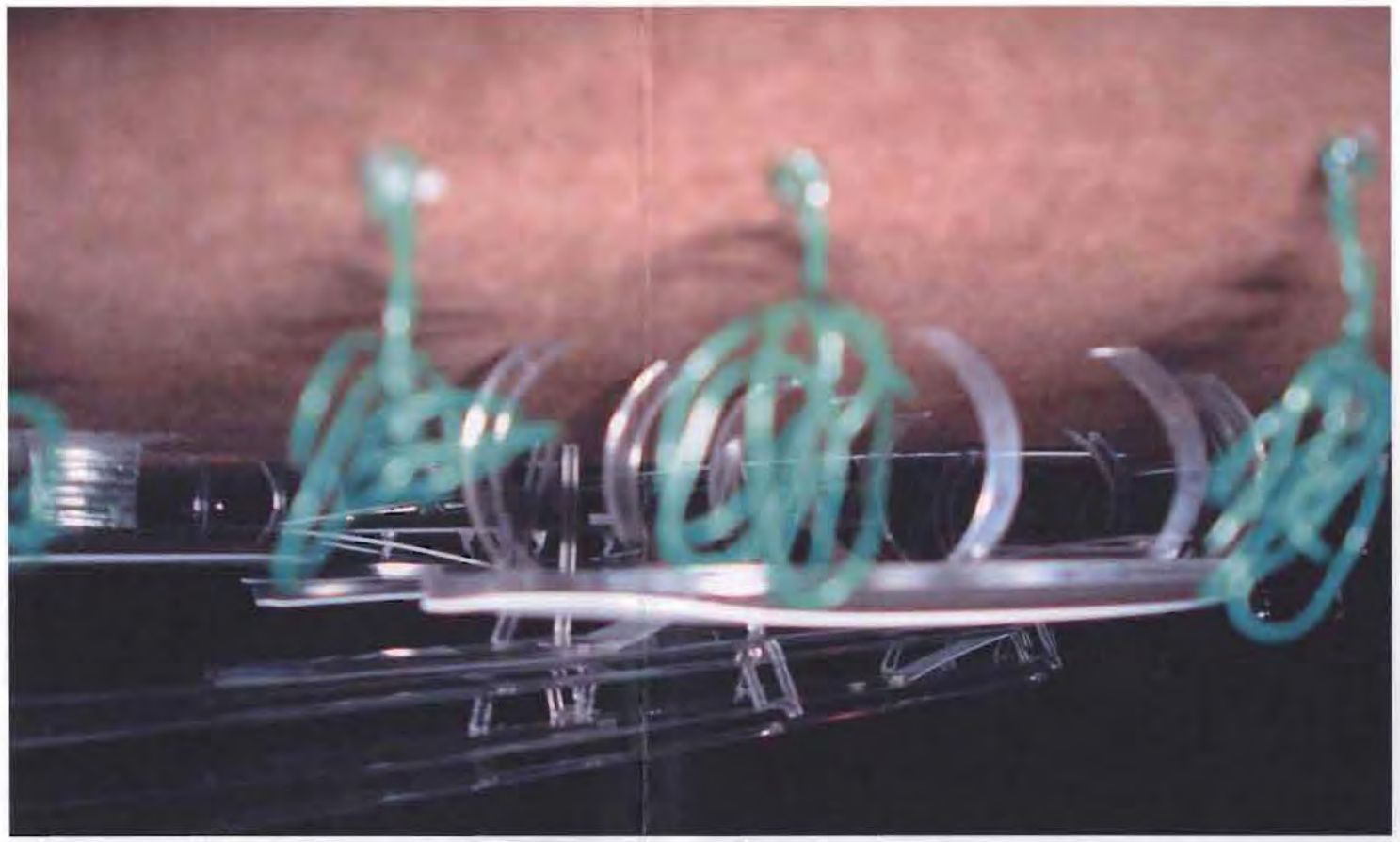
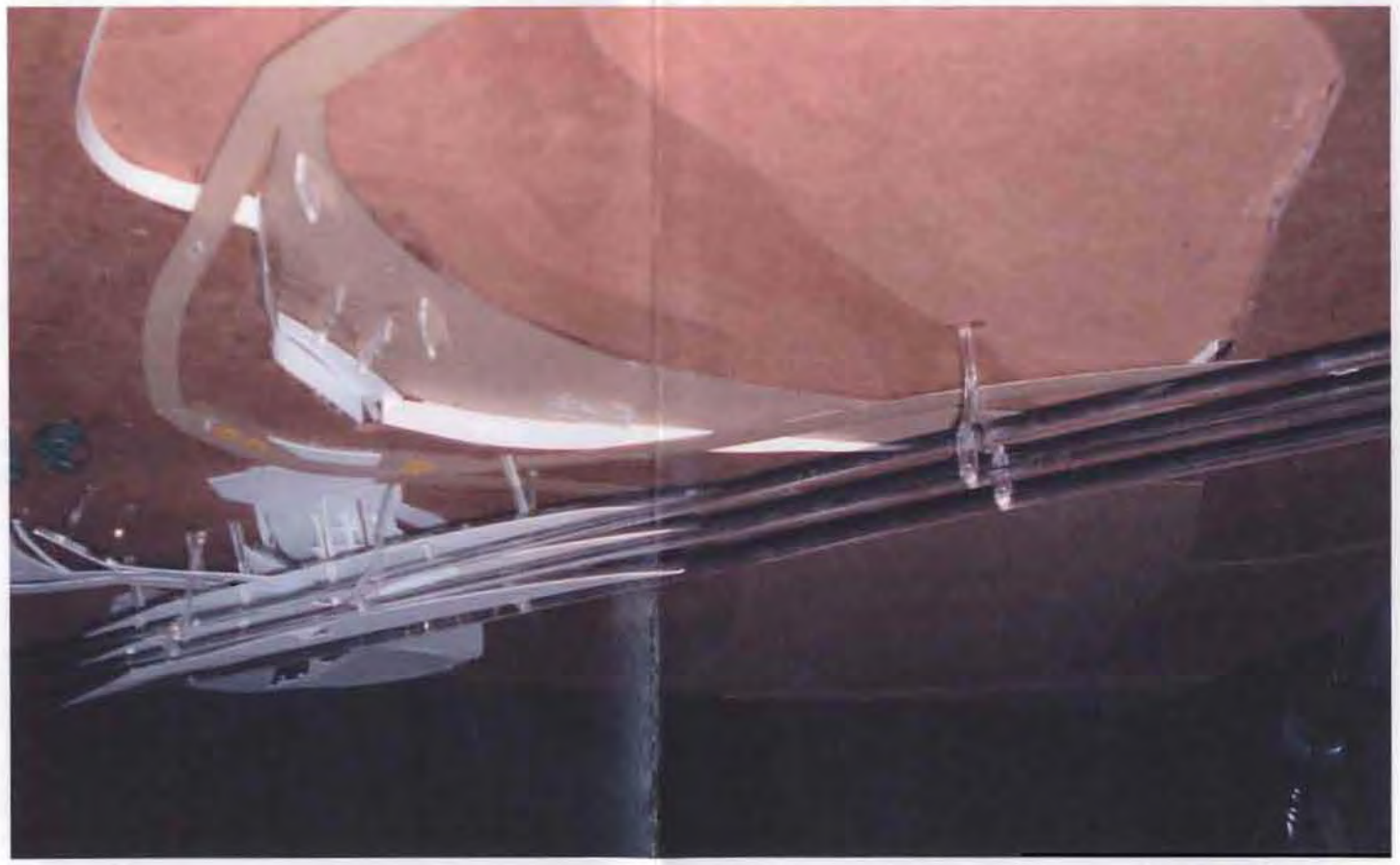
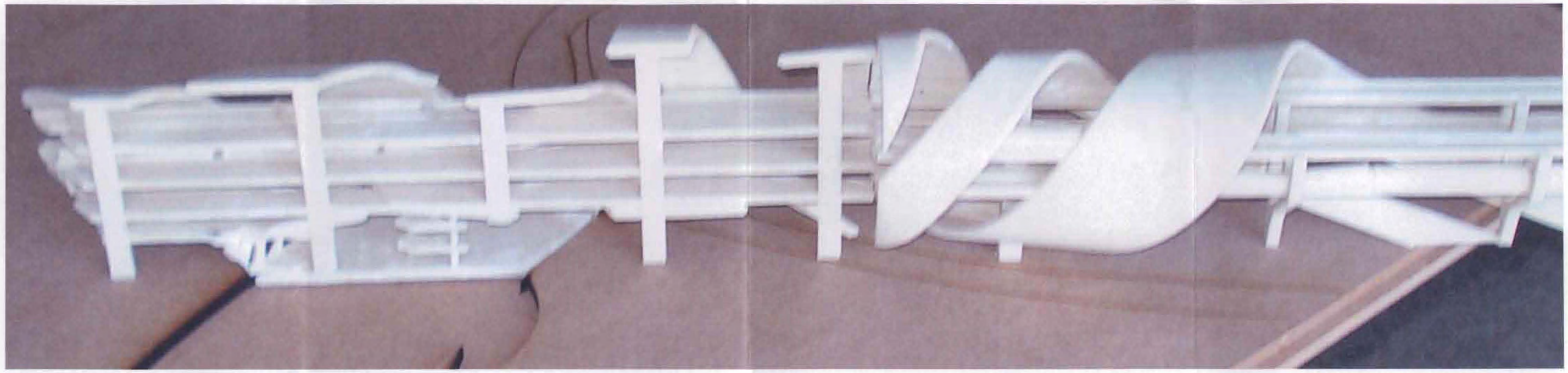
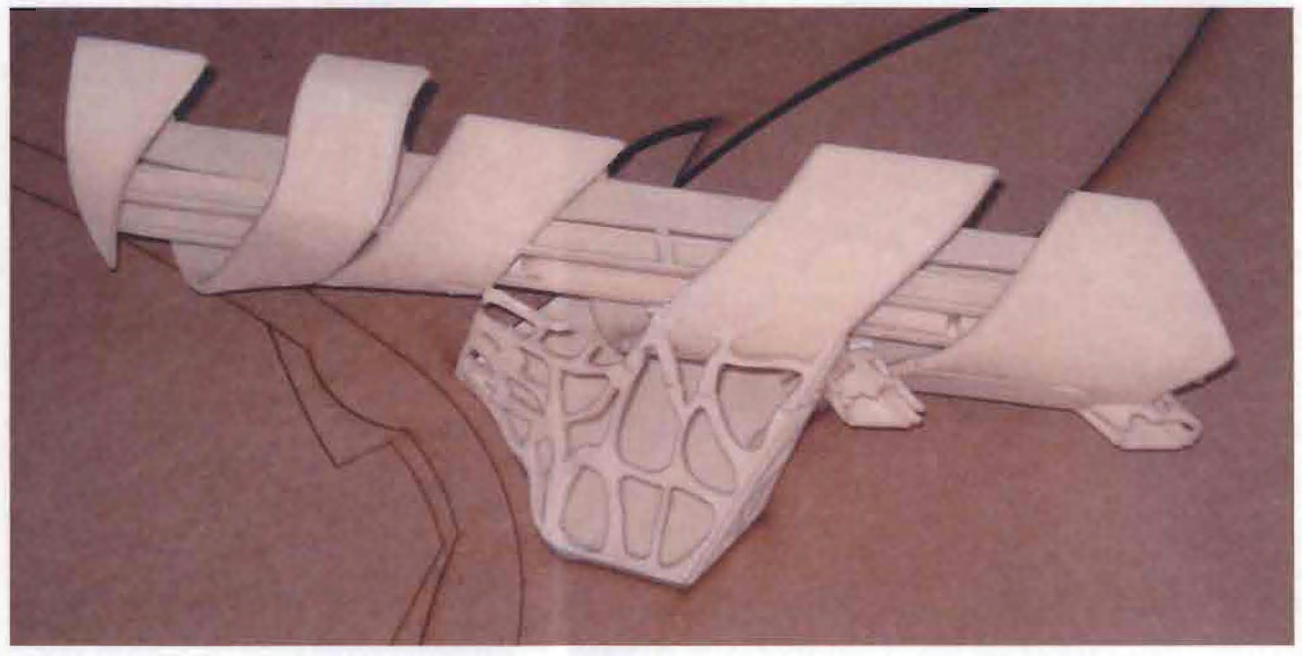
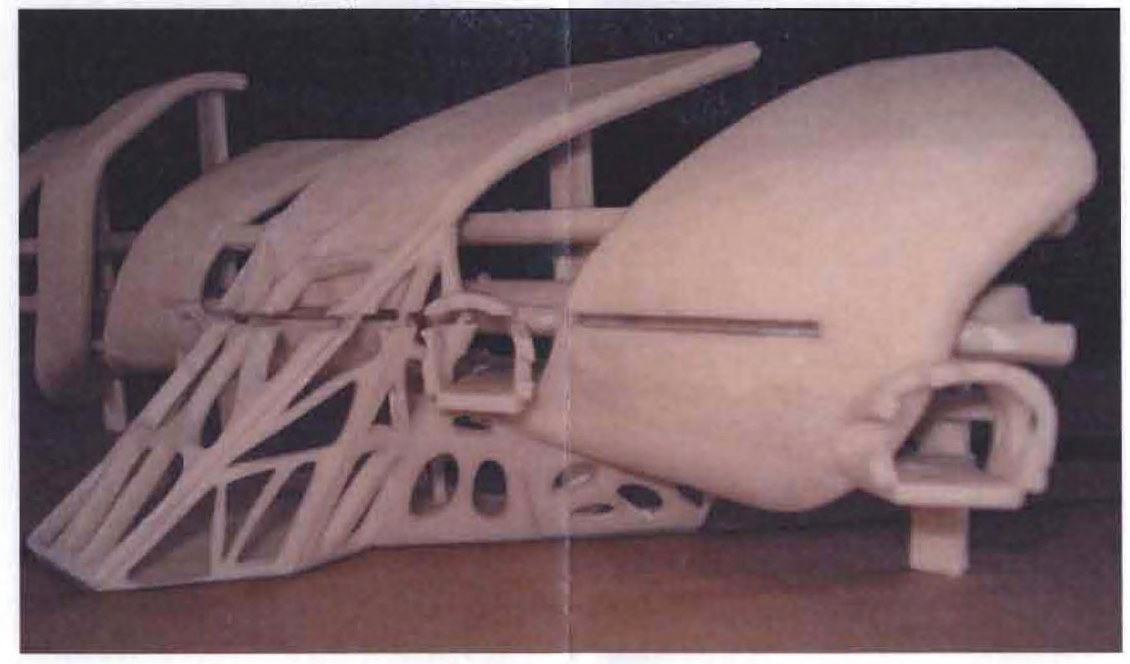


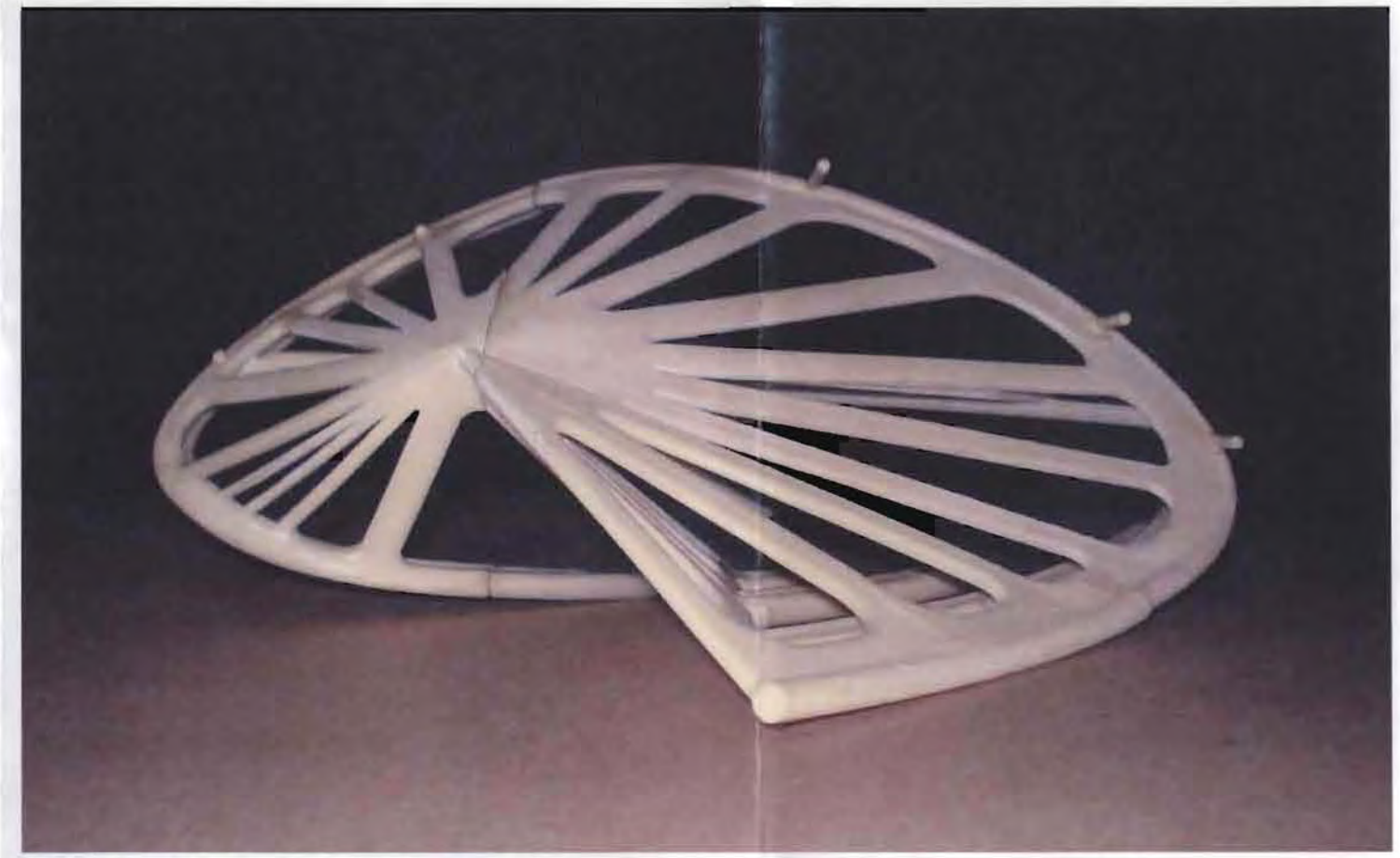


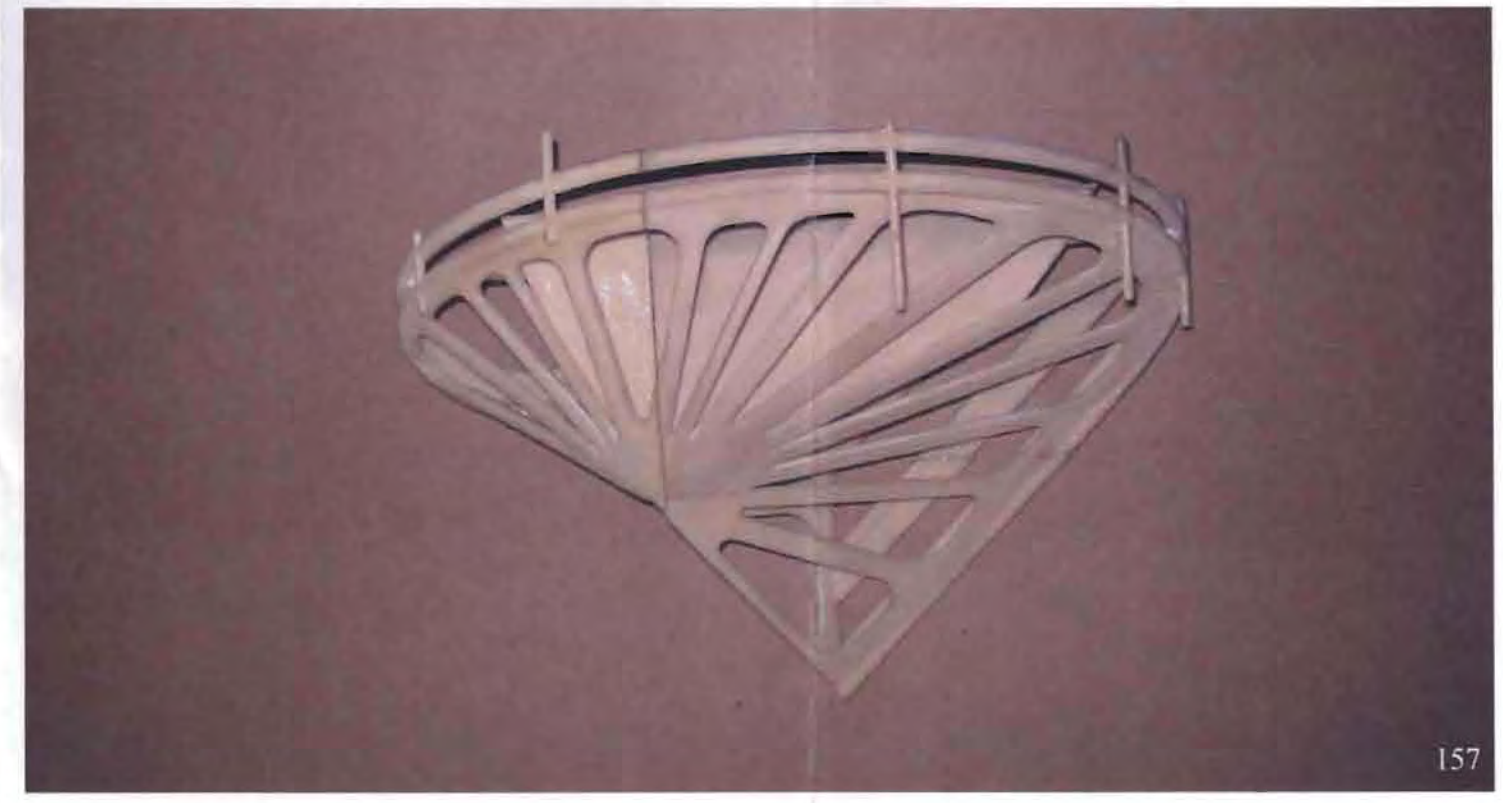
3 - D printed model. This is an example of how technology is making it possible to get what is produced with the computer into an actual precise model.











Conclusion

One of my investigating points in my thesis was to show how with the help of digital technology we can create shapes that would never be possible with out the computer. The project really capitalizes on this. After looking at the formal qualities that the form of this building maintains it is obvious that you would never be able to create this with out the computer. Even though the project sets out to prove this the process that is used to reach the goal is not all computerized. The process actually does not get into full force until after the site is chosen and the site plan has been drawn for the first time with no building. The process uses technology right from the get go. The clover leaf is spotted on the site plan. Than this shape is laser cut out of plastic and than that plastic is heated up and bent in a arbitral kind of way. The process bounces back and forth though. The process started out not using any technology in choosing the site, which was done just by analyzation, than technology was used in the next step with the laser cutter. This next step again bounces back to using no new age technology, by using oil pastels and paper as the medium. This is as basic as it gets with out using regular Crayola crayons. This part of the process was very successful because of how much work that was able to be produced in such a short amount of time. There were several drawings being produced every day. The next step in the process stayed in the same realm. The program was produced and than a massing model was produced in the computer. The process quickly jumped back however out of the computer and into physical models made of wire and paper. After these models were produced than a serious of floor plans were created on paper. Once the programmatic issues were taken care of there were than a series of floor plans produced in the computer. These floor plans were than taken into a program called 3 – D studio Viz were the project spent the rest of the second semester. There were 3 – dimensional printed models that were created from the 3 – D Viz model. This was one of the last steps used and was some of the highest technological methods used as well. There was one other piece of technology that was trying to be integrated into the project. That was a computer program named CATIA.

This program is being used by firms that are pushing the envelope. They are using it to produce 3 – dimensional models that are being used through out the construction phase of the project giving the architect more control. The CATIA model allows the building to be built without ever having to produce construction documents. It is able to achieve this first of all by sending the necessary information that is needed to produce the parts of the building at the manufactures factory. Once the data is transferred their and the pieces are sent to the site the bar code on that piece is than scanned and sent in to the computer model which than tells the construction crew where that piece goes. There were high hopes that this program was going to be

able to be implicated into the construction details of the project. It was very disappointing that the program was not understood well enough to exploit these characteristics of the program. This hurt the project because now it was not able to be proven that the project could be built with the help of the computer. Just by looking at the project it is understood that it could never of been built with out the help of the computer. CATIA was hoping to link the construction of the skin of the building to the manufacturing of the pieces that would need to be cut out using a CNC machine. This would of set the project on a whole other level. All of a sudden it would of went from a fictional building to one that was actually able to be created. One suggestion for anyone that is attempting to achieve a similar goal, is too learn the program the first semester if not a whole year of it first and than try to apply it to the project. It would produce a more exciting result. CATIA is such a large program that it was impossible to learn it in the same semester that it was needed to be applied. There are other capabilities this program has that were not talked about yet. It has the ability to analyze the structure once a material is assigned. This could help early in the design process of the project especially if it is a fast track project. The architect would know earlier on if that material was going to be able to handle that shape due to stresses applied to the material. This could save changes that may not of been caught until late in the design causing it to be more costly. Even though CATIA was not applied to the project in the way it was envisioned to be there was still a large amount of knowledge gained from the project.

The project did have its short comings, but it was nice to of challenged myself in such a way that it still leaves me wanting to know more. This is not a question that I do have all the answers for. This is something that I will continue learning about as my carrier in architecture continues.

Kolarevic, Branko. , ed. Architecture In The Digital Age : Design And Manufacturing. New York: Spon Press, 2003.

This book was the starting point of my research. Through reading it I have seen how architecture and technology are working together to gain the control of the building construction back.

Kieran, Stephen , and James Timberlake. refabricating Architecture How Manufacturing Methodologies Are Poised to Transform Building Construction. New York: McGraw-Hill Companies, Inc. , 2004.

This book has worked together with the previous book to make my thesis investigation stronger. The readings complement each other.

Francesco, Dal Co, and Kurt W. Forster. Frank O. Gehry: The Complete Works. New York: Phaidon Press, 2003. 480–497.

Through the use of this book I gained more information on the Guggenheim Museum in Bilboa Spain.

Caduto, Michael J., and Joseph Bruchac. Keepers Of The Animals Native American Stories And Wildlife Activities for Children. Golden: Fulcrum Publishing, 1991.

A drawing was used from this book to create an abstract drawing that will be used in the design process. 96–103.

Patteeuw, Veronique. , ed. Greg Lynn And Hani Rashid Architectural Laboratories. Rotterdam: NAi Publishers, 2002.

This book helped in a precedent study and also in the research into my thesis.

Lynn, Greg. "Greg Lynn FORM." Greg Lynn FORM. Greg Lynn FORM. 25 Sep 2006 <http://www.glform.com/>.

Lynn, Greg. Intricacy A Project by Greg Lynn FORM. Philadelphia: University of Pennsylvania, 2003.

This publication of intricacy helped me understand what Greg Lynn means by intricacy.

Buehrle, Sarah. "Greg Lynn and Fabian Marcaccio : Wexner Center for the Arts." New Art Examiner 28(2001): 94-95.

This article has helped in finding out a little more about who Greg Lynn is and what he is about.

Amelar, Sarah. "Doug Garofalo Transforms the Conventional with Dynamic Forms." Architectural Record 188(2000): 82-87.

Doug Garofalo is another architect that is being used as a precedent study along with his use of dynamic forms which is able to be produce with the technological advancements that have been made.

Giovannini, Joseph. "Computer Worship." Architecture 88(2000): 88-99.

This article is another article about Dough Garofalo which is relevant to the thesis because it talks about the use of technology in architecture.

"Doug Garofalo." Architectural Design 63(1993): 52-53.

This article touches more on Doug Garofalos' design process, and how he uses the computer to help in development of his ideas.

Nance, Kevin. Chicago architect Garofalo has fully arrived." Chicago Sun-Times 11 June 2006

This article was beneficial to my studies because it is directly linked to a precedent study.

Garofalo, Doug. "Garofalo Architects." Garofalo Architects. Garofalo Architects. 25 Sep 2006 <http://www.garofaloarchitects.com/>.

Schlautman, Dee. "Pioneering Design for the Nano World." vol. 1 issue 3Dec. 2003 08 Nov.2006<http://www.nanobuildings.com/news/PreviousIssues/Vol1Issue3/imagesCurrent/NanoFrontierVol1Iss3.pdf>.

"NANOBuildings.com." Projects. Oct. 2004. Nano Buildings. 9 Nov 2006 <http://www.nanobuildings.com/default.asp>.

Thorne, Martha. MODERN TRAINS and SPLENDID STATIONS Architecture, Design, and Rail Travel For The Twenty-First Century. London: Merrell Publishers Limited, 2001.

Lynn, Greg. "Master student, Thesis investigation." E-mail to author.09 Oct. 2006.

This was an e-mail sent from Gregg Lynn. Its intentions were to figure out more about his design process.

"The Wayne County Aerotropolis." Wayne County Regional Development. 2006. University of Michigan. 10 Dec 2006 <http://www.tcaup.umich.edu/charrette/2006/aerotropolis06_wayneco.pdf>.

This website helped gather information about Metro Cities Airport City.

"Preliminary Alternatives Map." Ann Arbor to Detroit. 27 Oct. 2003. Southeast Michigan Council of Governments. 9 Dec 2006 <http://www.annarbordetroitrapidtransitstudy.com/study_alts/prelim_map.aspx>.

This website helped gather information about the route that the transit from Detroit to Ann Arbor will be taking.

Rahim , Ali. Catalytic Formations. 1 edition. New York: Taylor & Francis, 2006.

This book helped in understanding how technological advances are helping in creating new dynamic forms.

Weinstock, Michael, and Nikoaos Stathopoulos. "Advanced Simulation in Design." Architectural Design Techniques and Technologies in Morphogenetic Design Mar. / Apr. 2006: 54-60.

This magazine is interesting to see how new technologies are advancing and connecting the design process to the manufacturing of the building.

O'Reilly, Dr. Una-May, Martin Hemberg, and Achim Menges. "Evolutionary Computation and Artificial Life in Architecture: Exploring the Potential of Generative and Genetic Algorithms as Operative Design Tools." Architectural Design Emergence: Morphogenetic Design Strategies May / June 2004: 49-53.