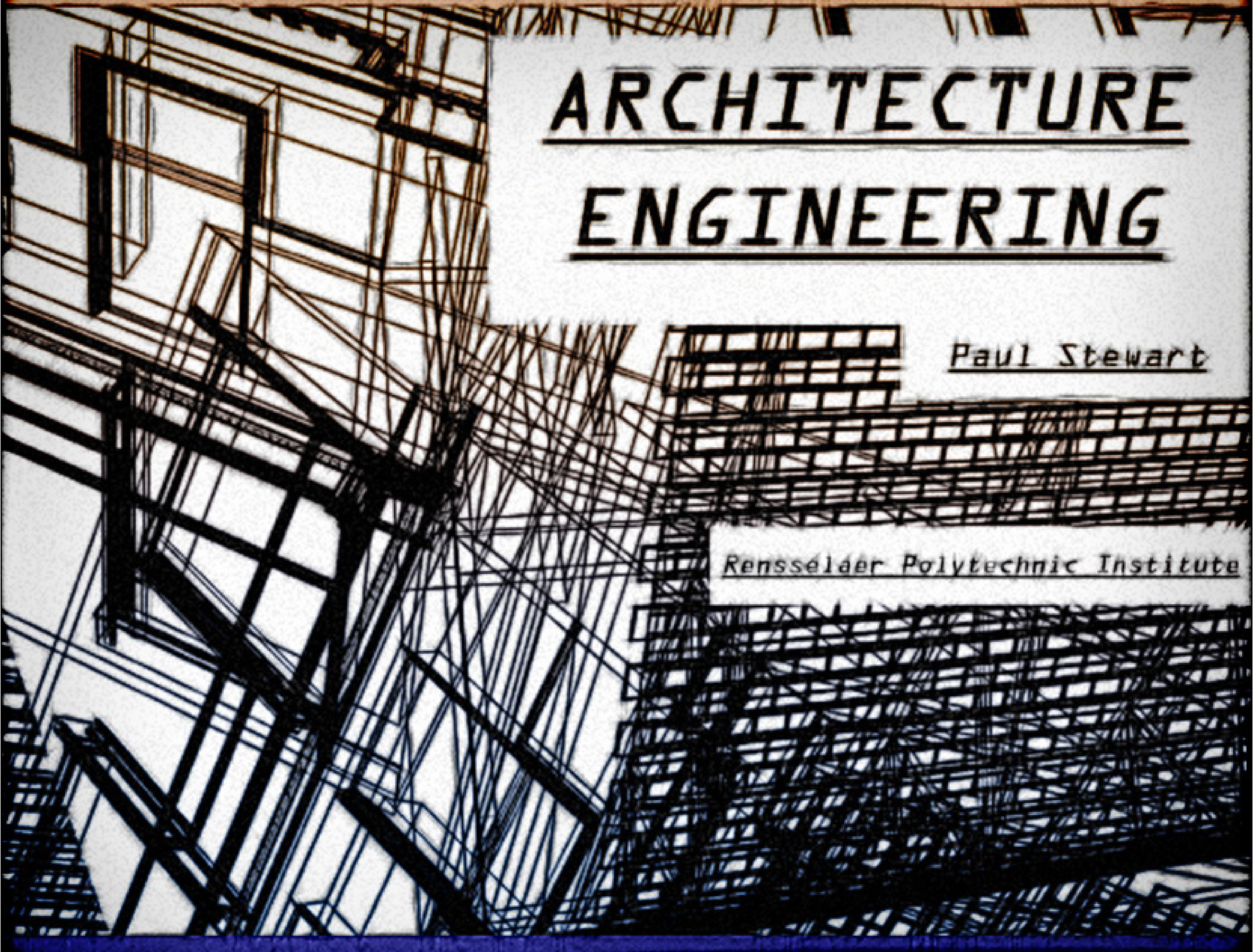
# ARCHITECTURE ENGINEERING

Paul Stewart

Rensselaer Polytechnic Institute

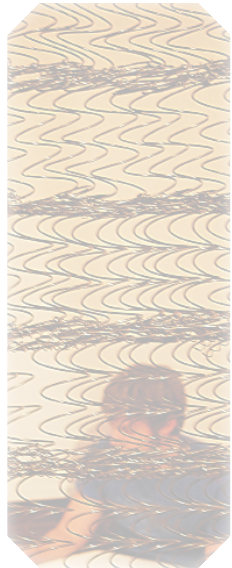


REVIT RISA RHINO ROBOT

ADOBE STAAD CAD MAPLE OFFICE














# Preface

“Form follows function.” - Horatio Greenough

I never wanted to be an engineer. Engineers crunch numbers and record data. They are bound by equation sheets and TI-89’s. That’s no fun. Where’s the art in that? I was always driven by my hunger to create and my thirst for imagination. It was this demiurgic zeal that led me to architecture. My desire for inventiveness was, however, stifled by dictation; My competencies in physics and scientific analysis seemed to break my fall. I became an engineer after all.

The aforementioned quote, the idea of beauty resulting from functionality, has governed modern architecture at the turn of the 20th century. If form truly follows function, then architects and engineers are one in the same. Design is universal. What once seemed like a fallback plan has become a passion. I’m a structural engineer and I’m proud to present the following pages as a creative portfolio.

The rules were meant to be broken.

Push the envelope.

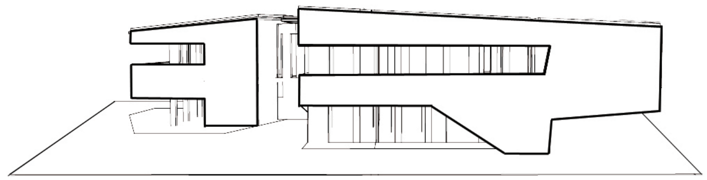
Watch it *bend.*

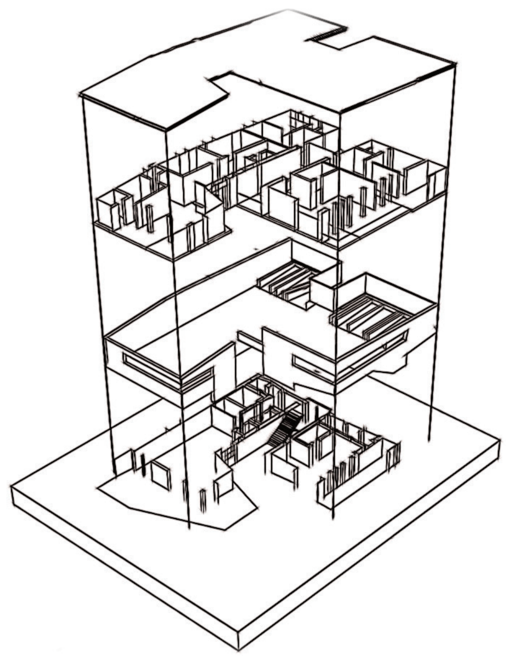
# Tetris House

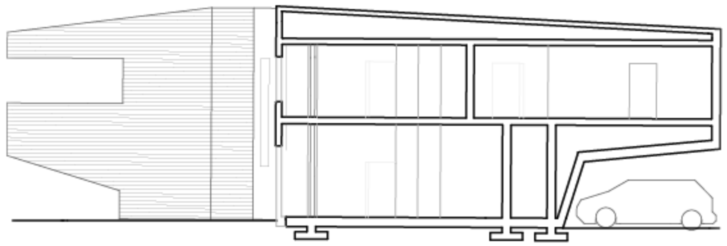
## Case Study

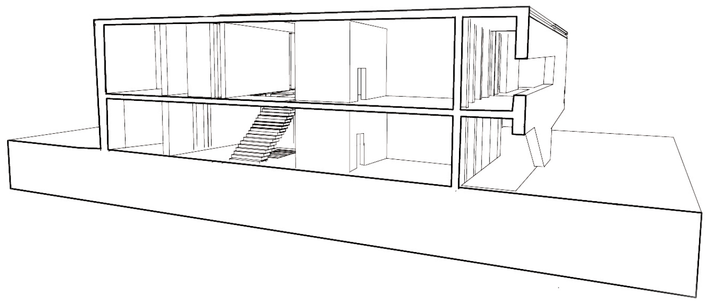
"Tetris House is derived from turning very pragmatic parameters into a spatially engaging concept: multiple programmatic demands (five self-contained units, parking space and other covered exterior areas) have initiated two volumes. L-shaped in plan and section they are spatially interwoven as to produce a range of dynamic in-between spaces."

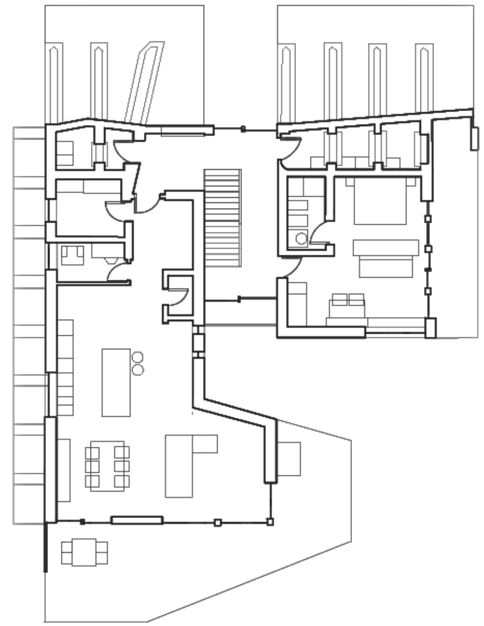
-Plasma Studio architects

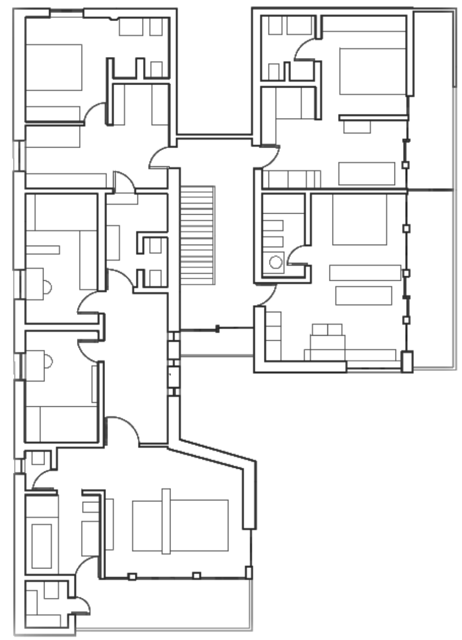


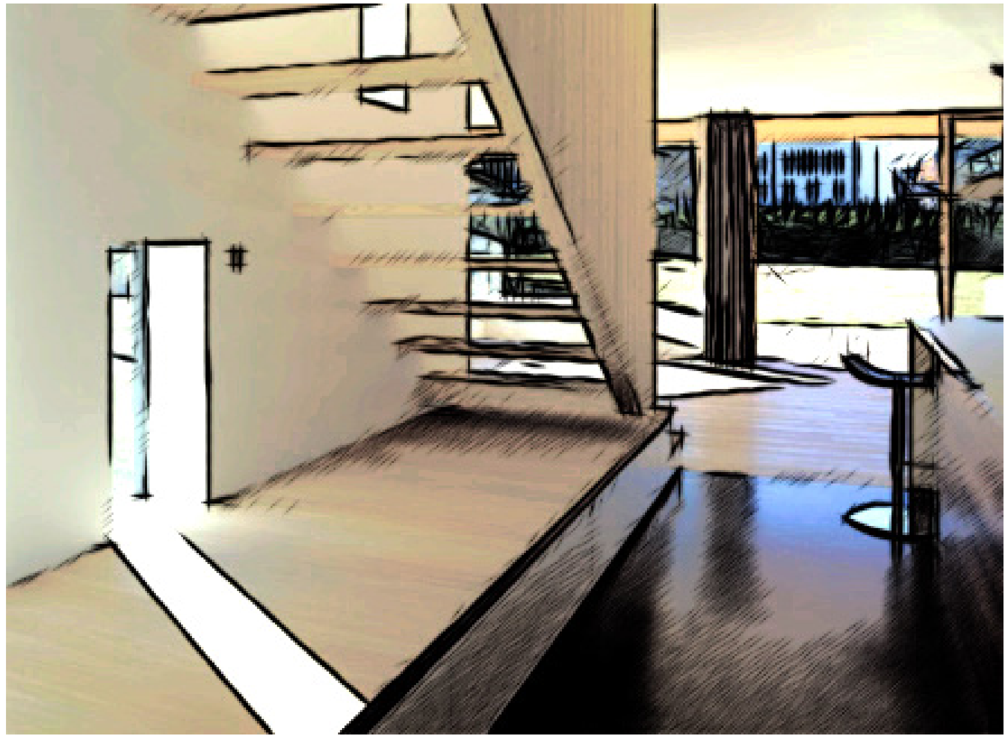


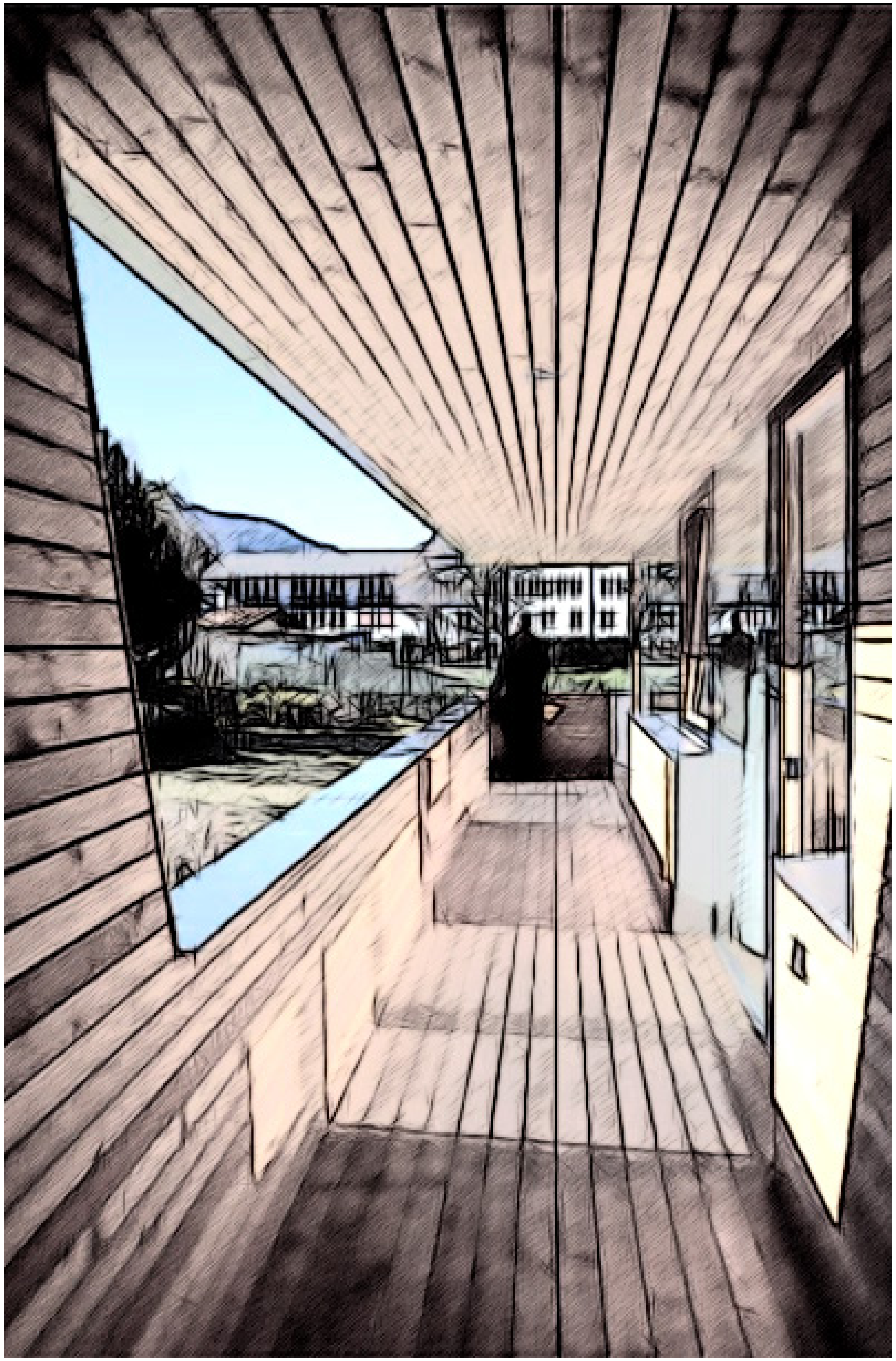


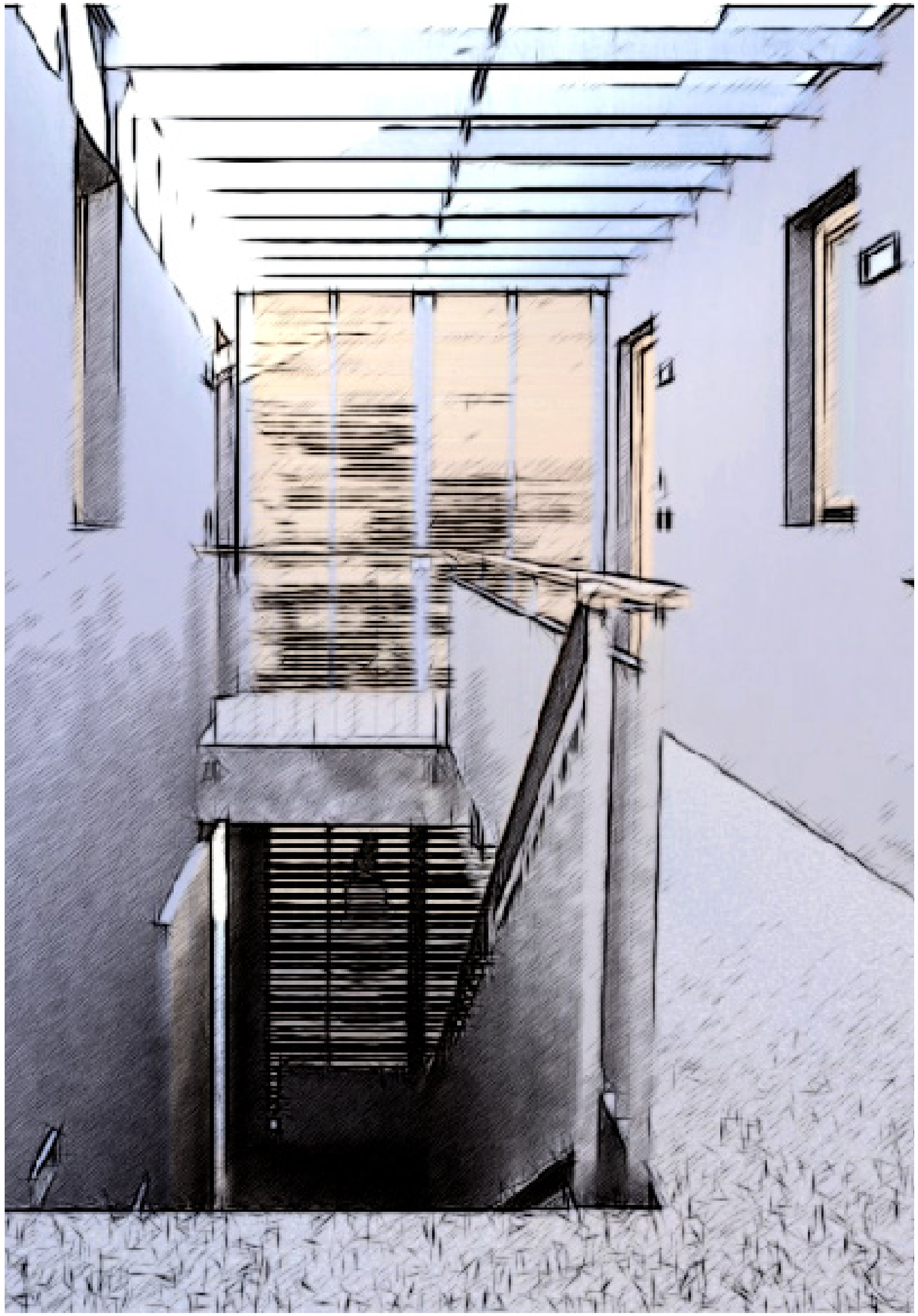


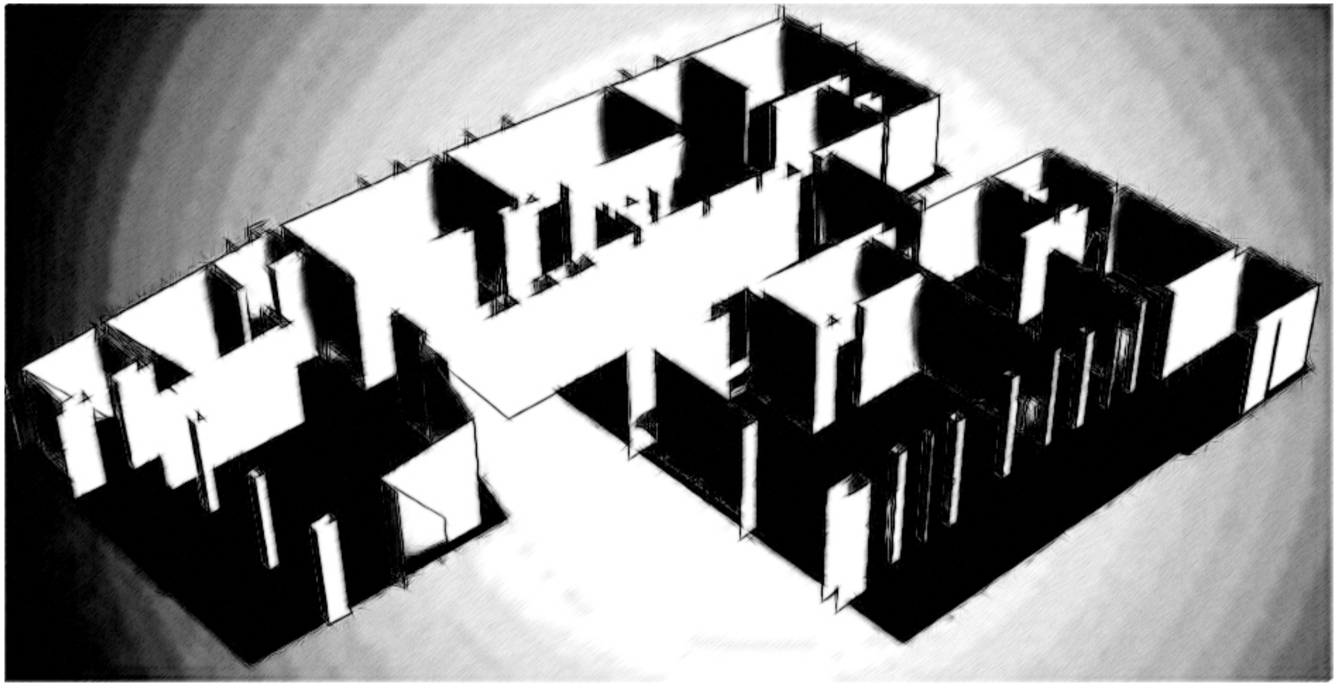
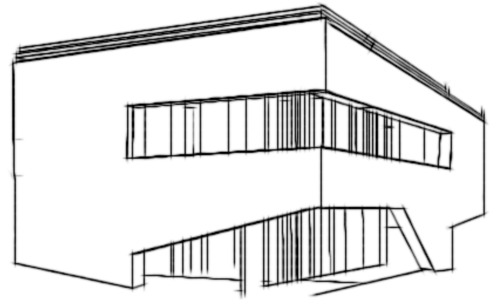
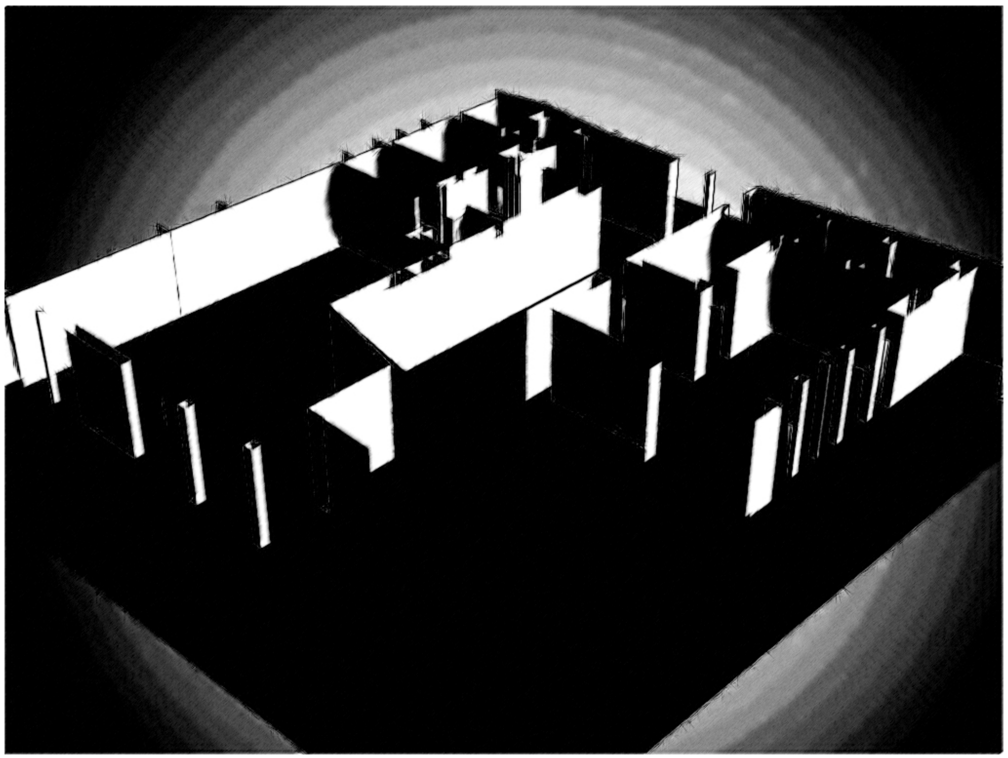
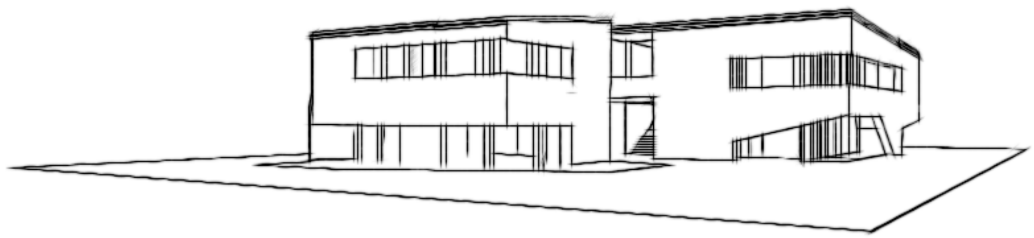
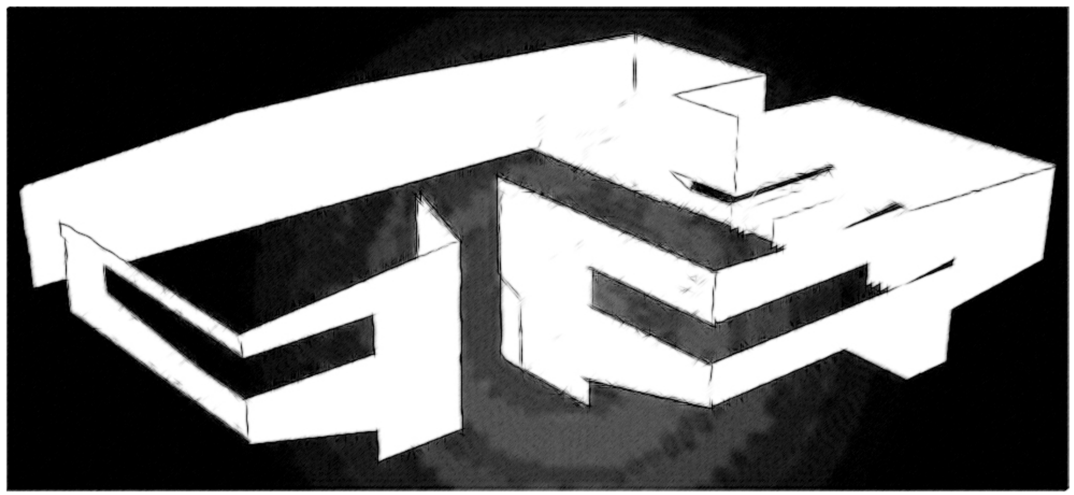
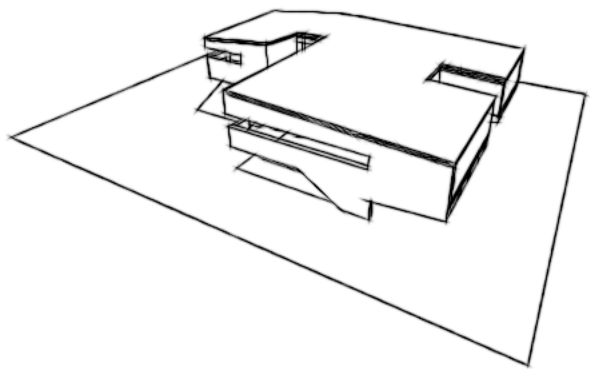


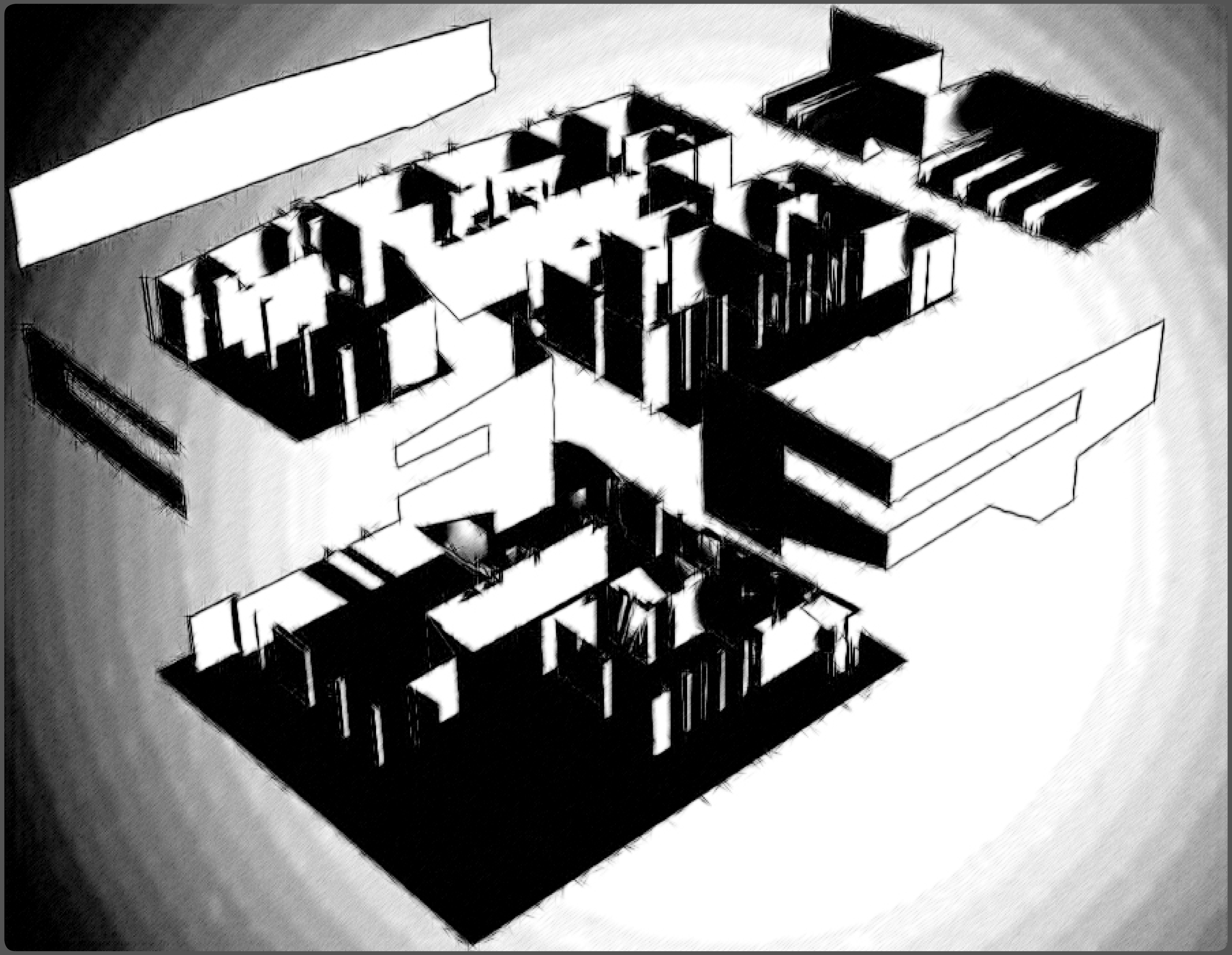


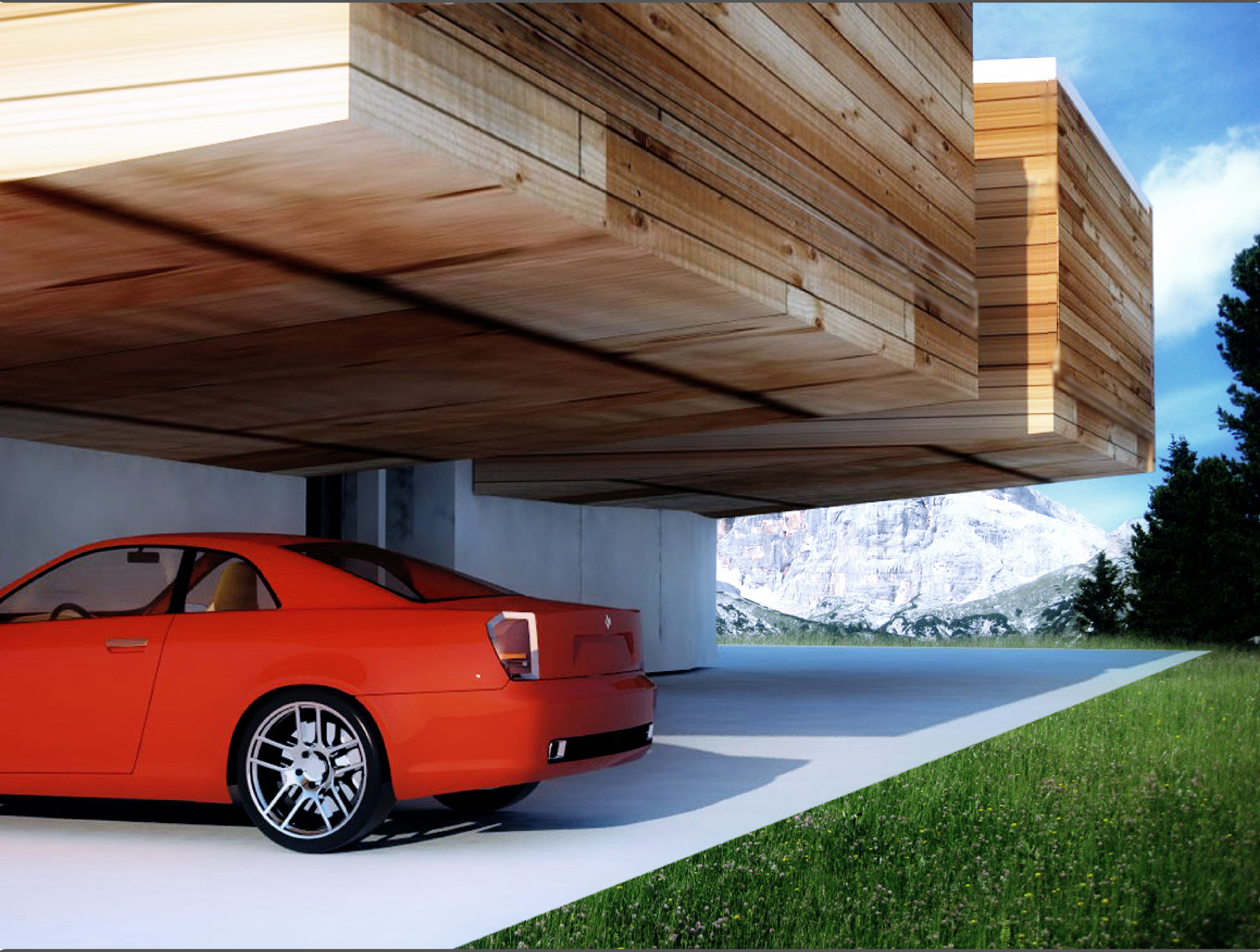


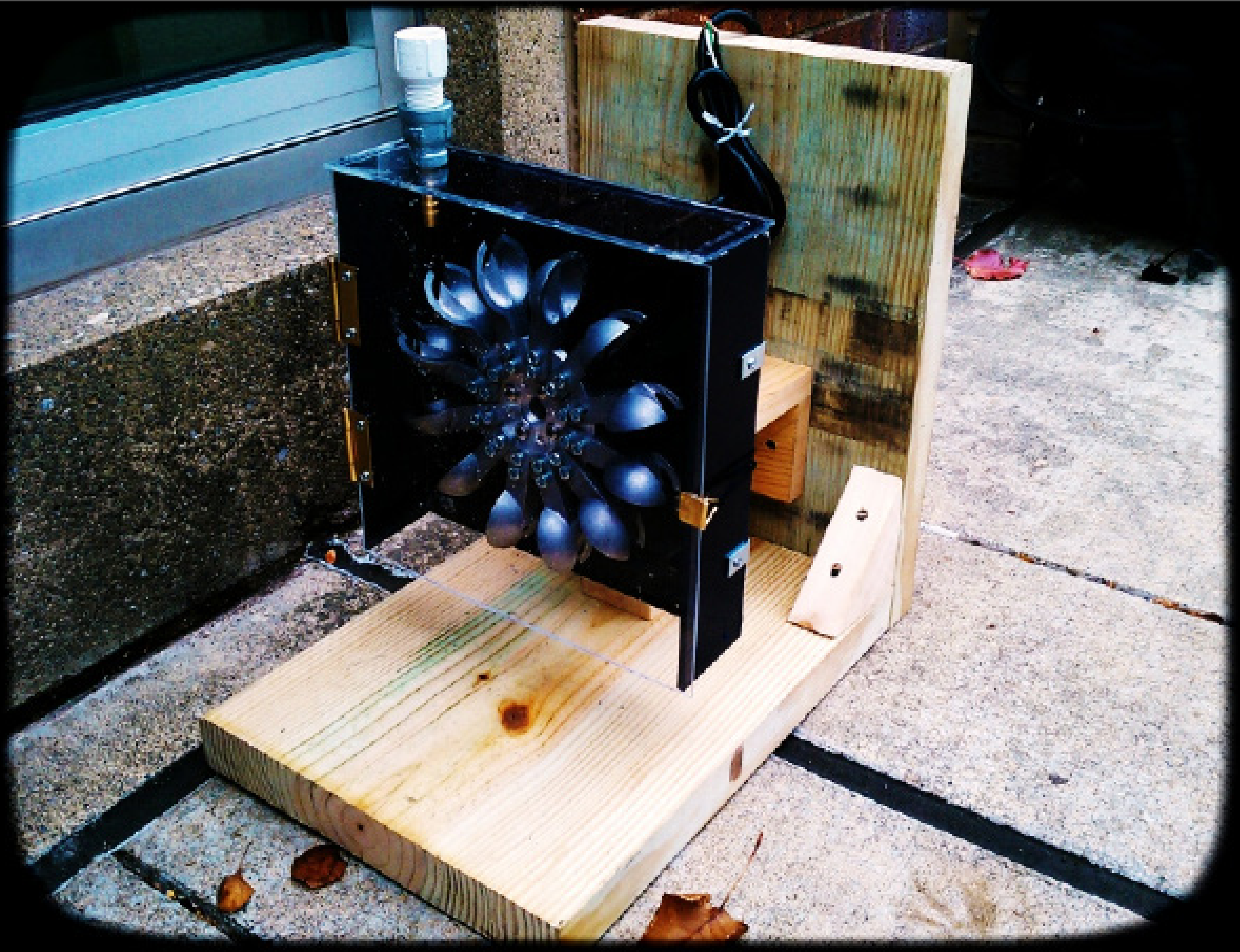




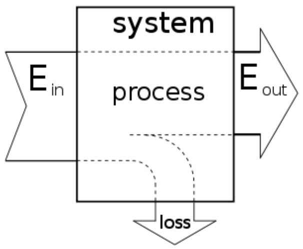


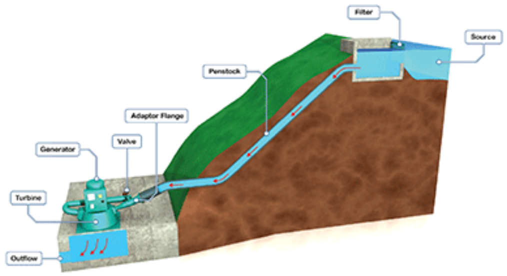




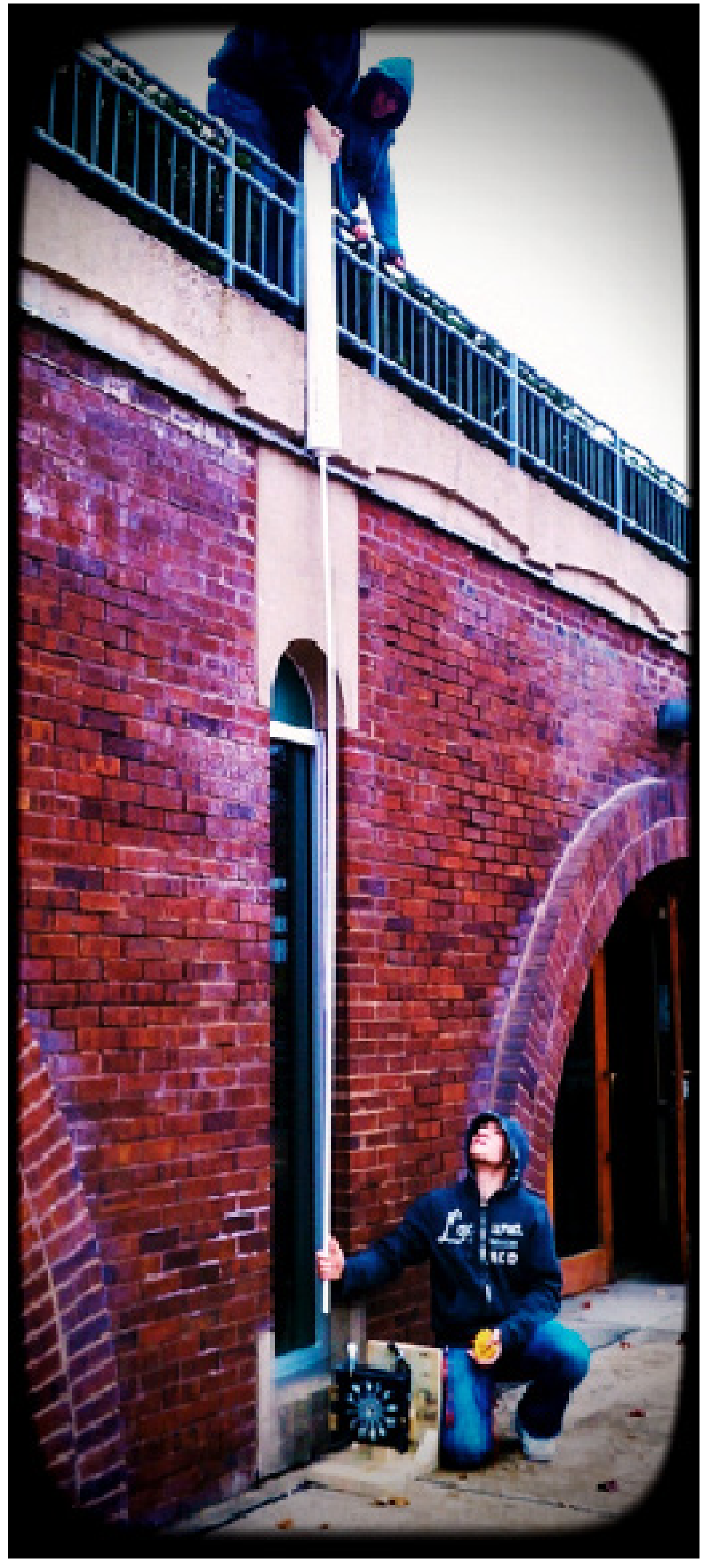
# Engineering Design

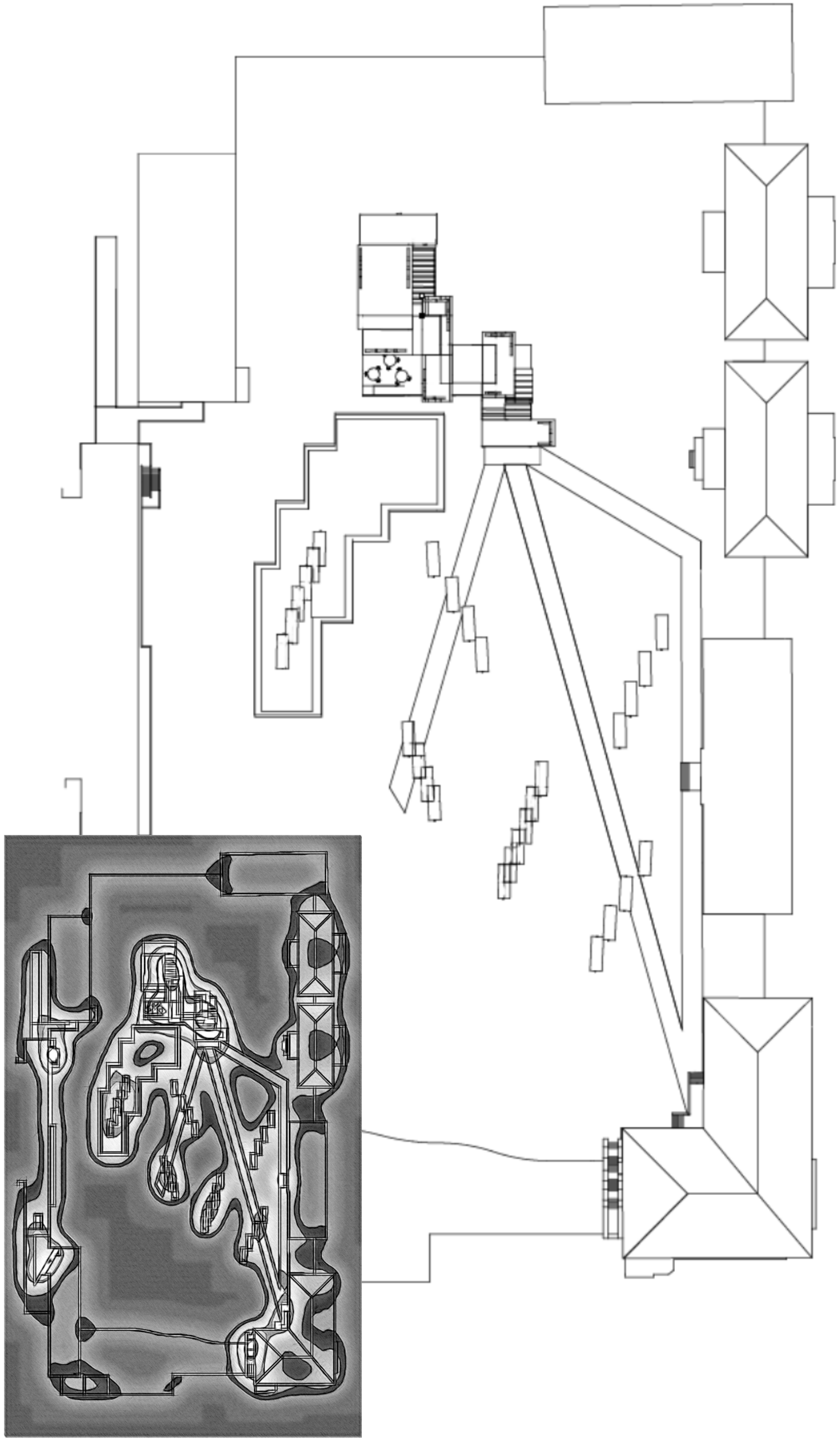
The main concept of this project was conservation. There were many example projects to choose from, but our group decided to develop a unit that locks into a gutter system of a house and turns running rainwater into mechanical energy by spinning a turbine and ultimately to electrical energy by powering an attached motor. The energy was then able to be stored in batteries and saved for later use.





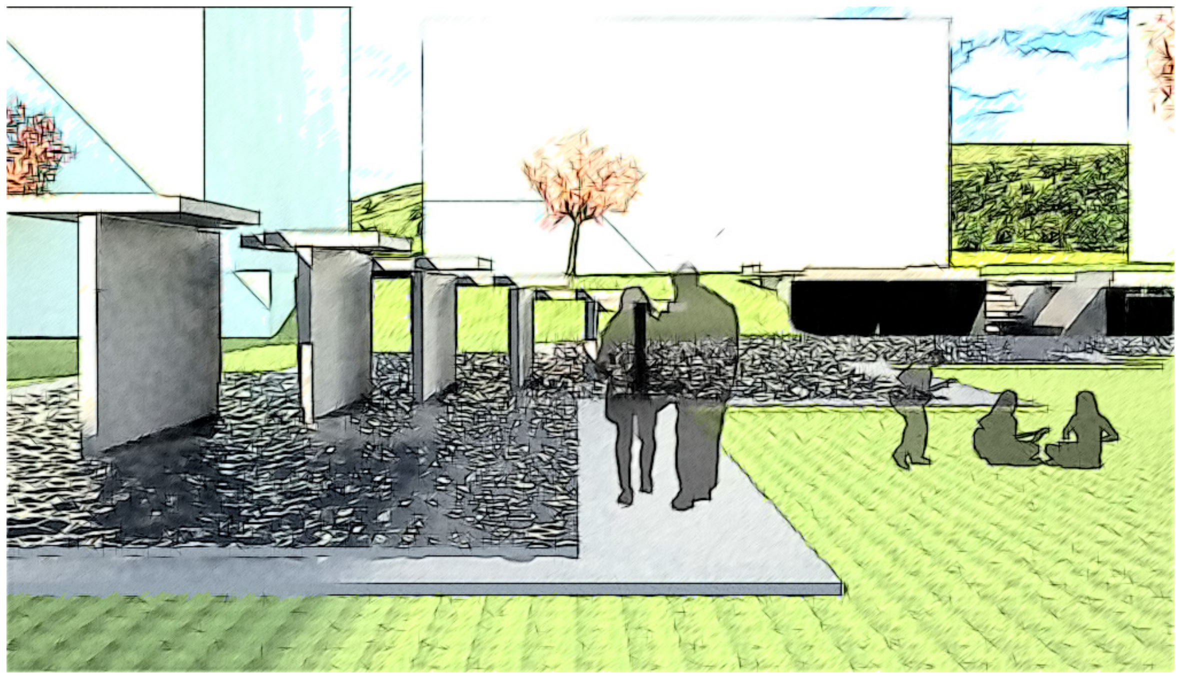


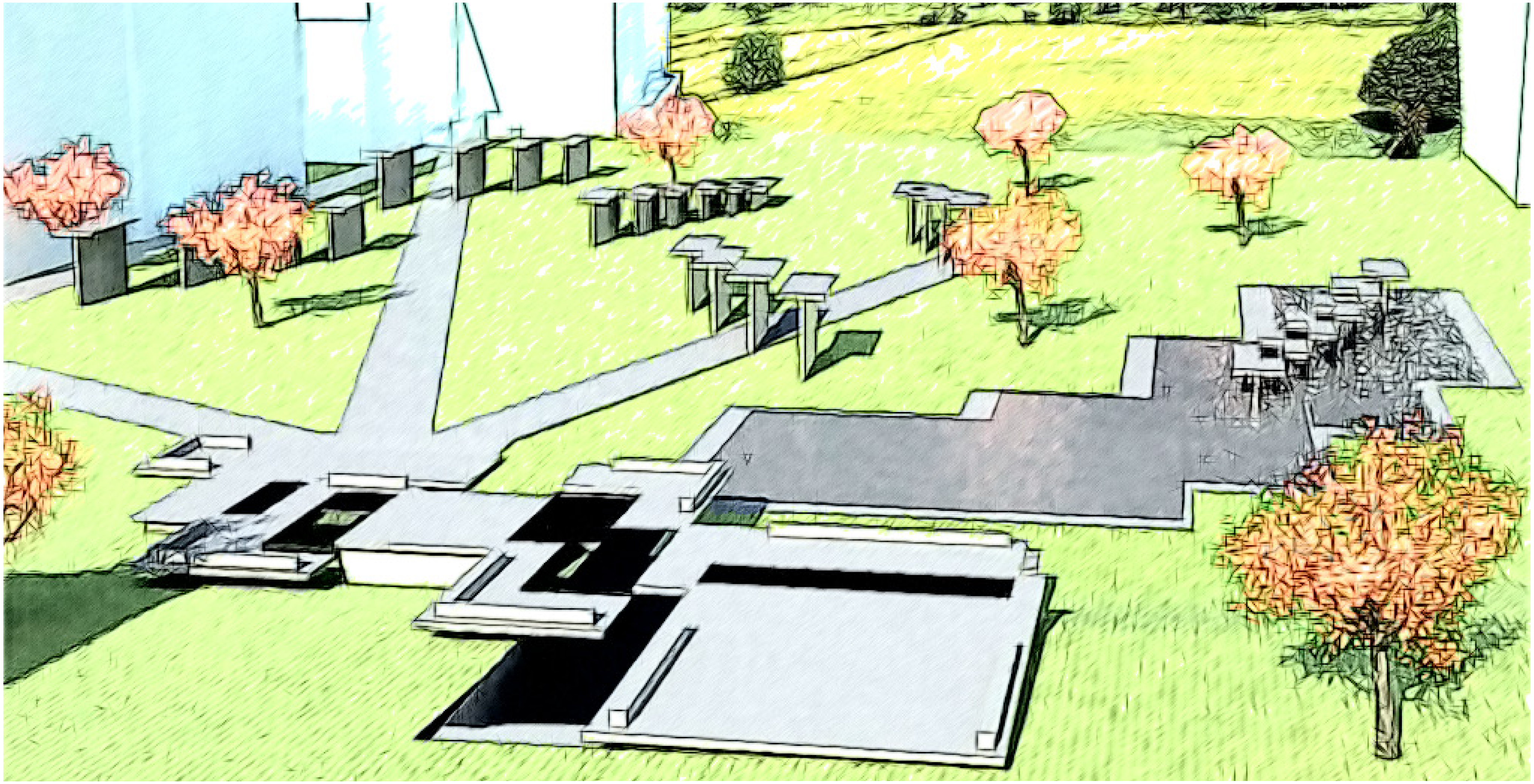


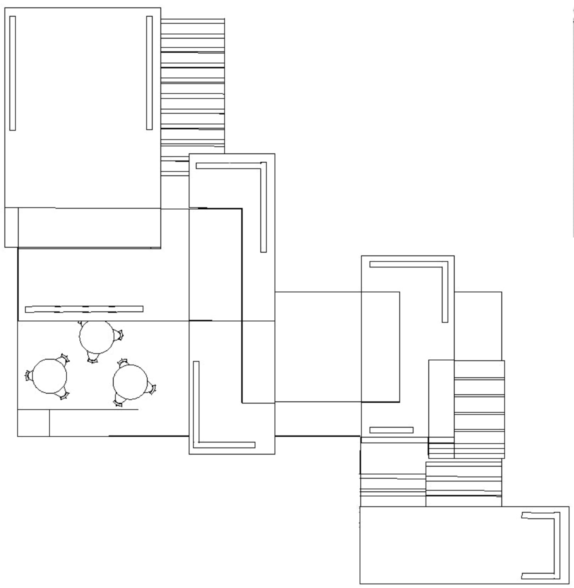
# Aleatory Fields

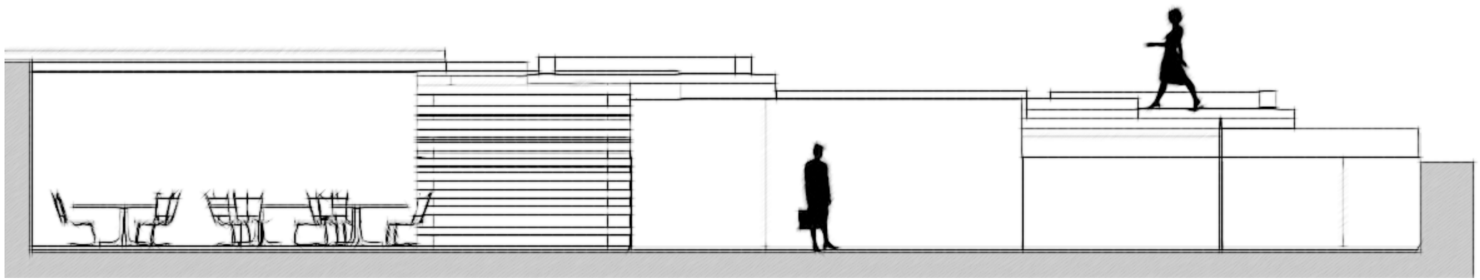
An aleatory condition is one that is random in nature - chance. This project explored using aleatory field conditions to reinvent the Rensselaer Polytechnic Institute '86 field via the design of a park. Pragmatically, the park needed to facilitate all of the major paths of circulation and needed to include a student center and a body of water. The methods of construction could only be concrete planes and the field could only be populated with trees and T or L-shaped sculptures. The trope of my design is the change of materiality from concrete to glass as the planes overlapped, which is evident in the design of the student center and the T-shaped sculptures. The sculptures all faced in one axial direction and forced aleatory human interaction as the paths of circulation intersected them at angles, creating perspectival interest. The geometry of the lake was also derived from the overlapping planes and harmoniously facilitates the concrete sculptures amidst it.

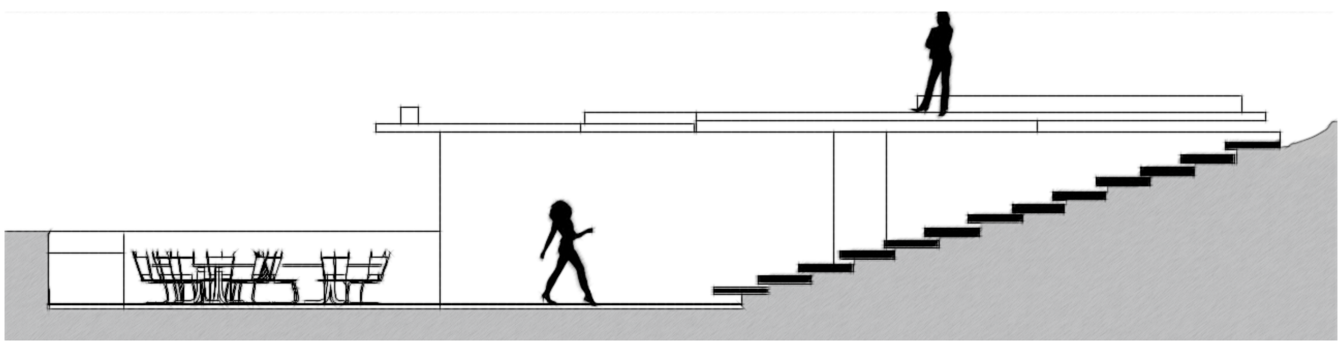
Aleatory - Depending on the throw of a die or on chance; random.

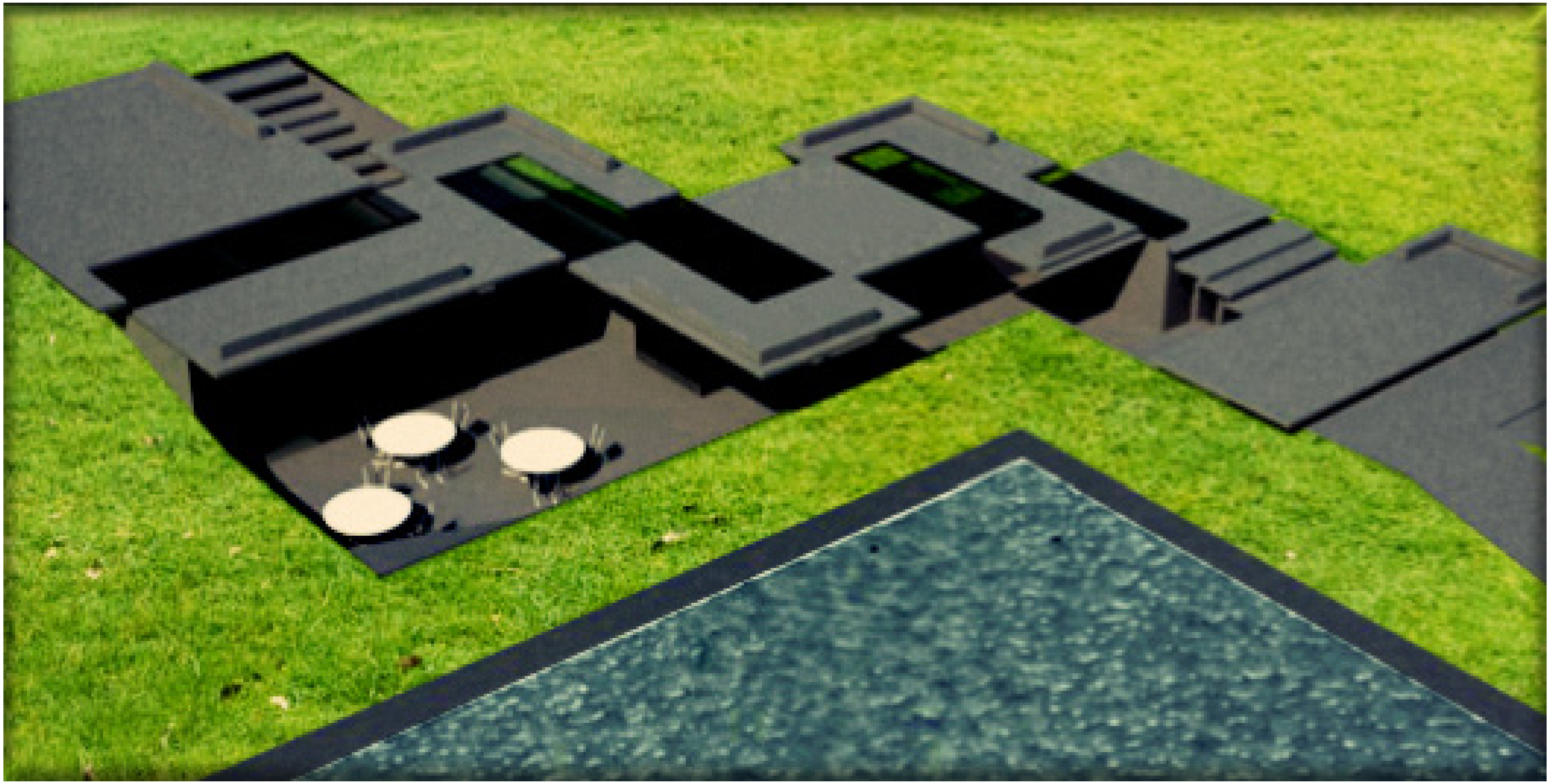


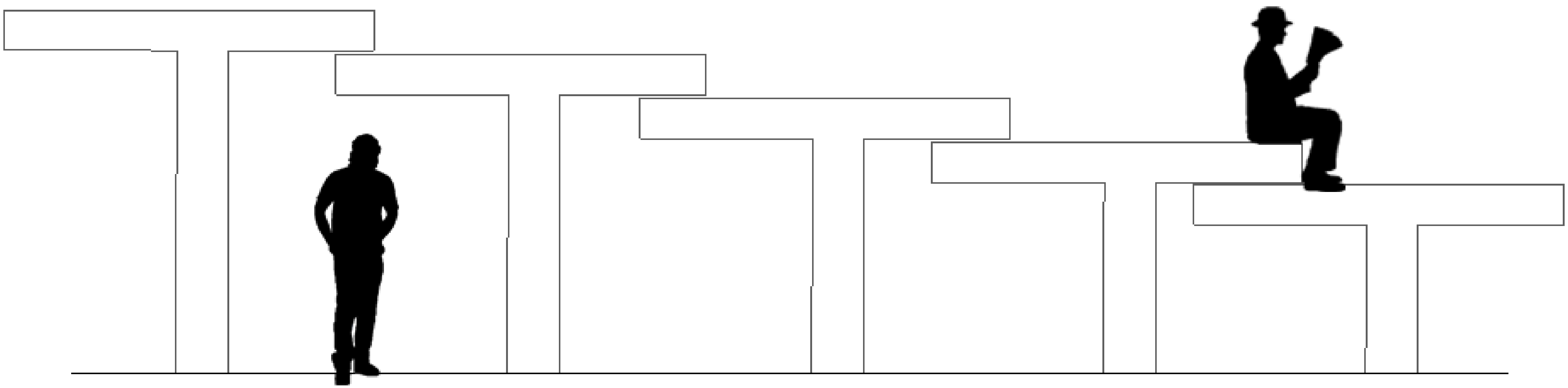


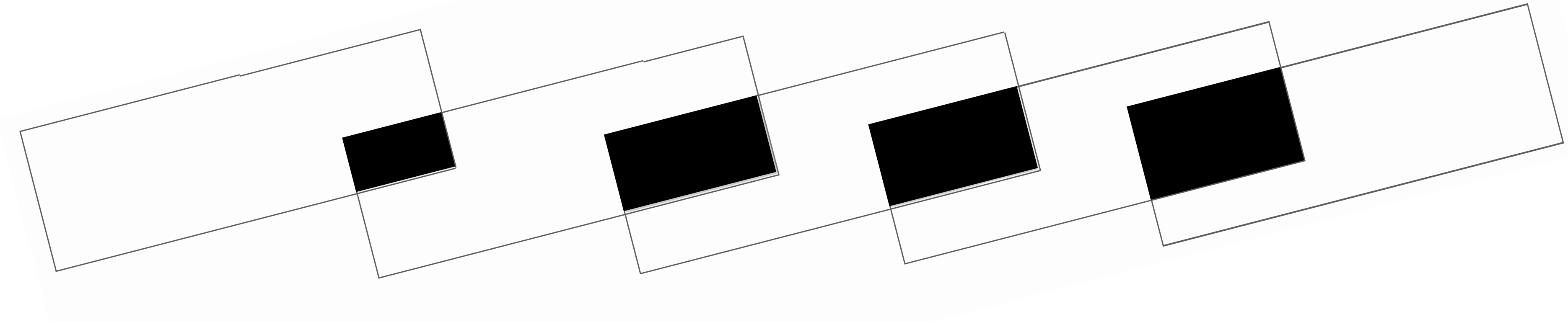




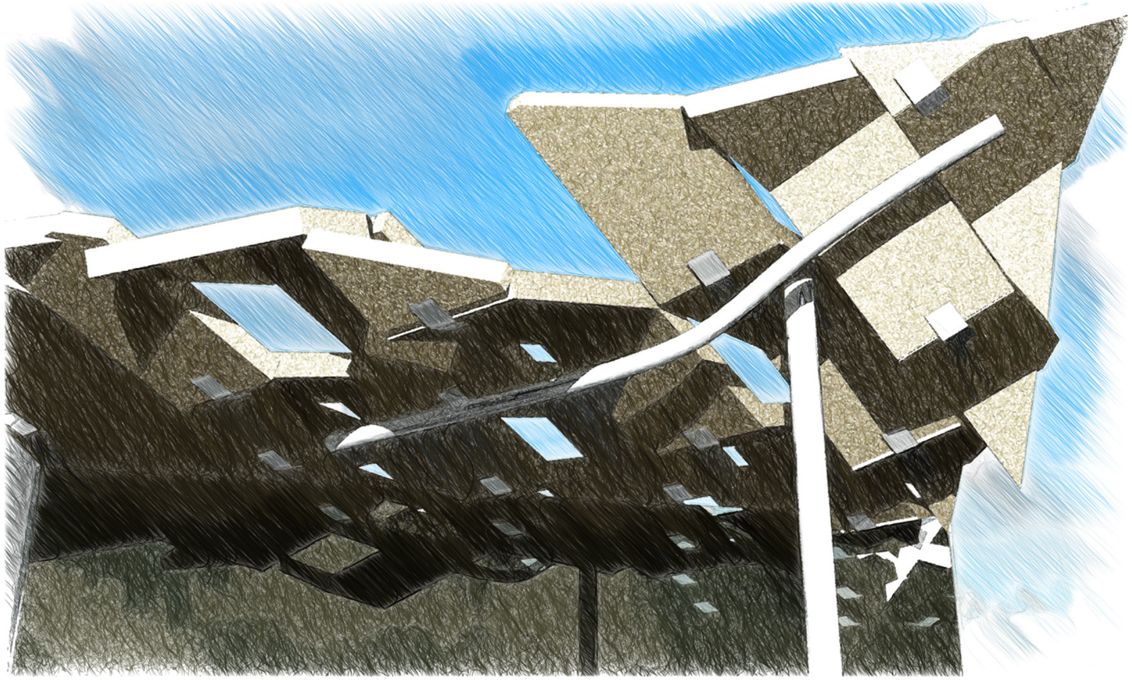




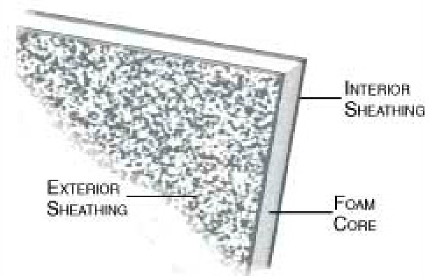


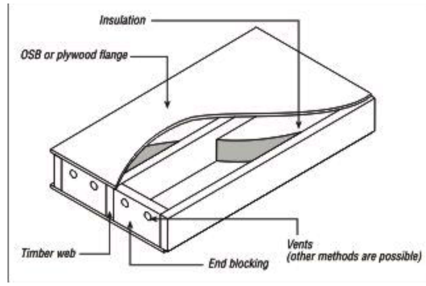


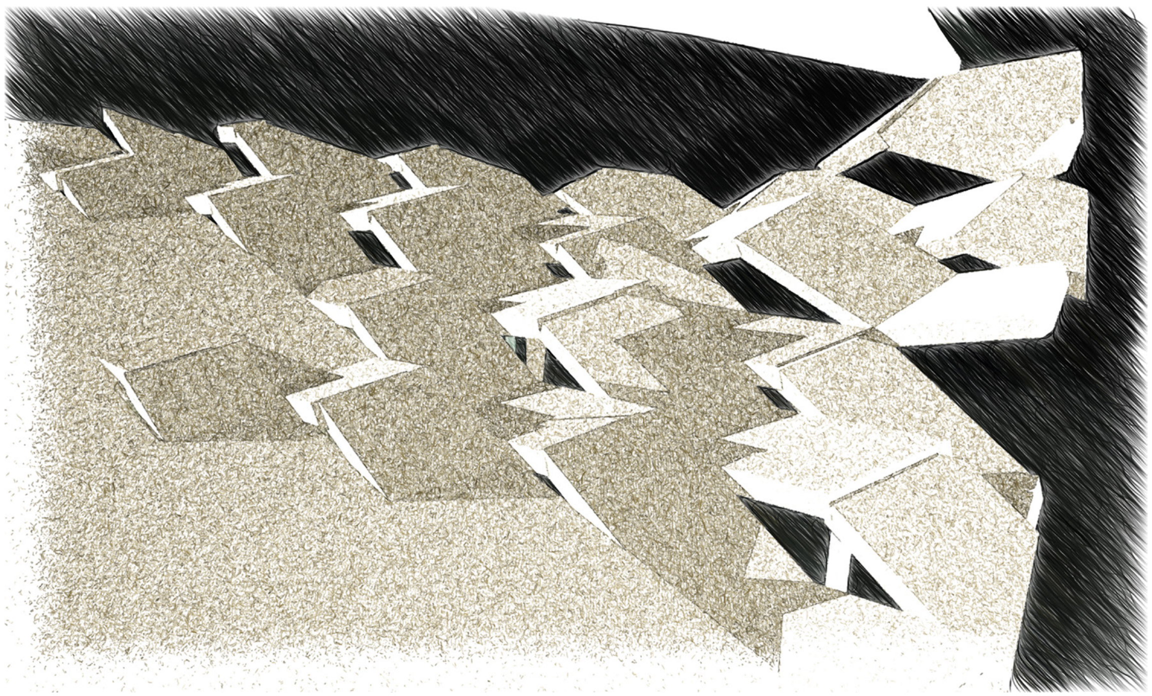
# Trellis Study

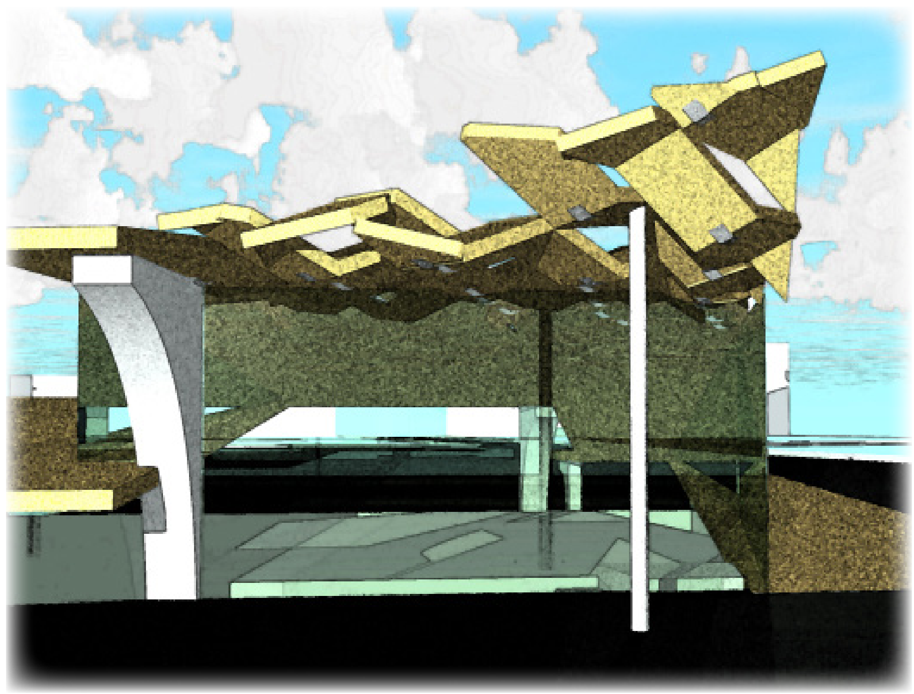


This project is based around the design of a trellis system on the edge of a solid plain. The trellis is constructed out of lightweight stress-skin panels. The stress-skin panels are constructed out of foam laminated wood. Each stress-skin panel acts as a single module and is attached at slowly increasing angles via an L-bracket and a steel dowel pin connection. The system of panels also slowly begins to bend upwards to exemplify it's lightweight nature. This allows light to filter through in an increasingly dramatic fashion. The trellis is supported by a solid steel column and a cambered steel beam.



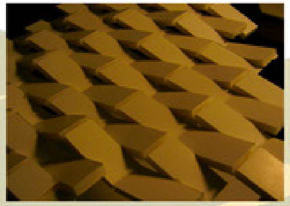



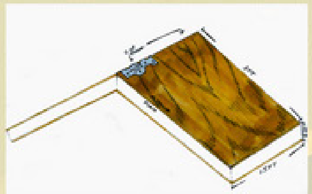


# STRUCTURE: SPAN + SUPPORT

Jeff Betts    Paul Stewart    Aaron Vinsel    Jenni Wilga

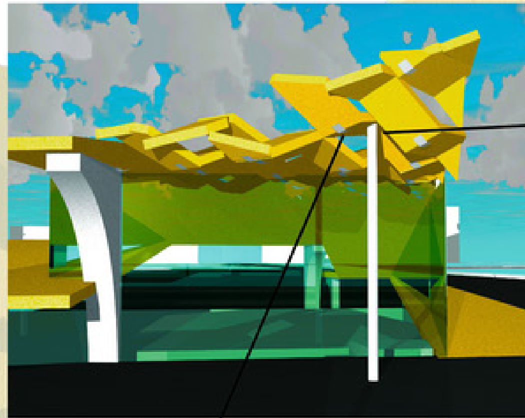
## INITIAL IDEAS

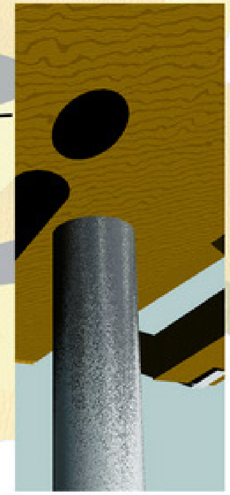


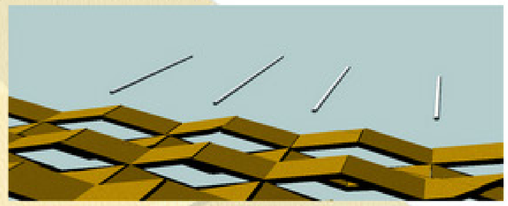


The Project is based on planes lifting up to allow light to filter through. This concept was carried over to the design of the trellis, which lifts out of the plane and becomes it's own entity. The plane appears to disintegrate, and then become the trellis.

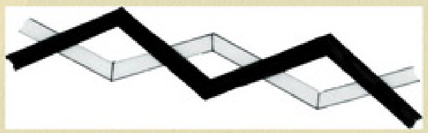
## ATTACHMENT SYSTEMS



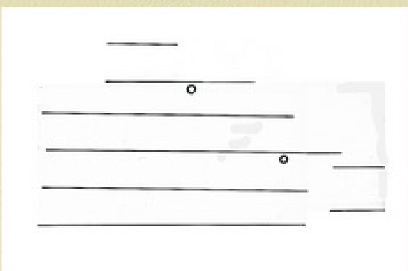




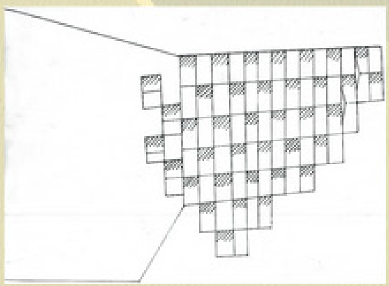
## PLAN AND SECTION



Section

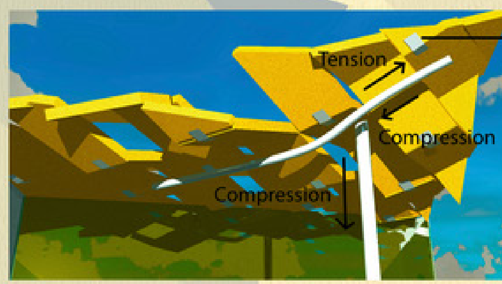


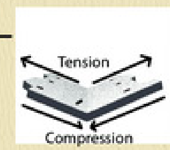
Structural Plan

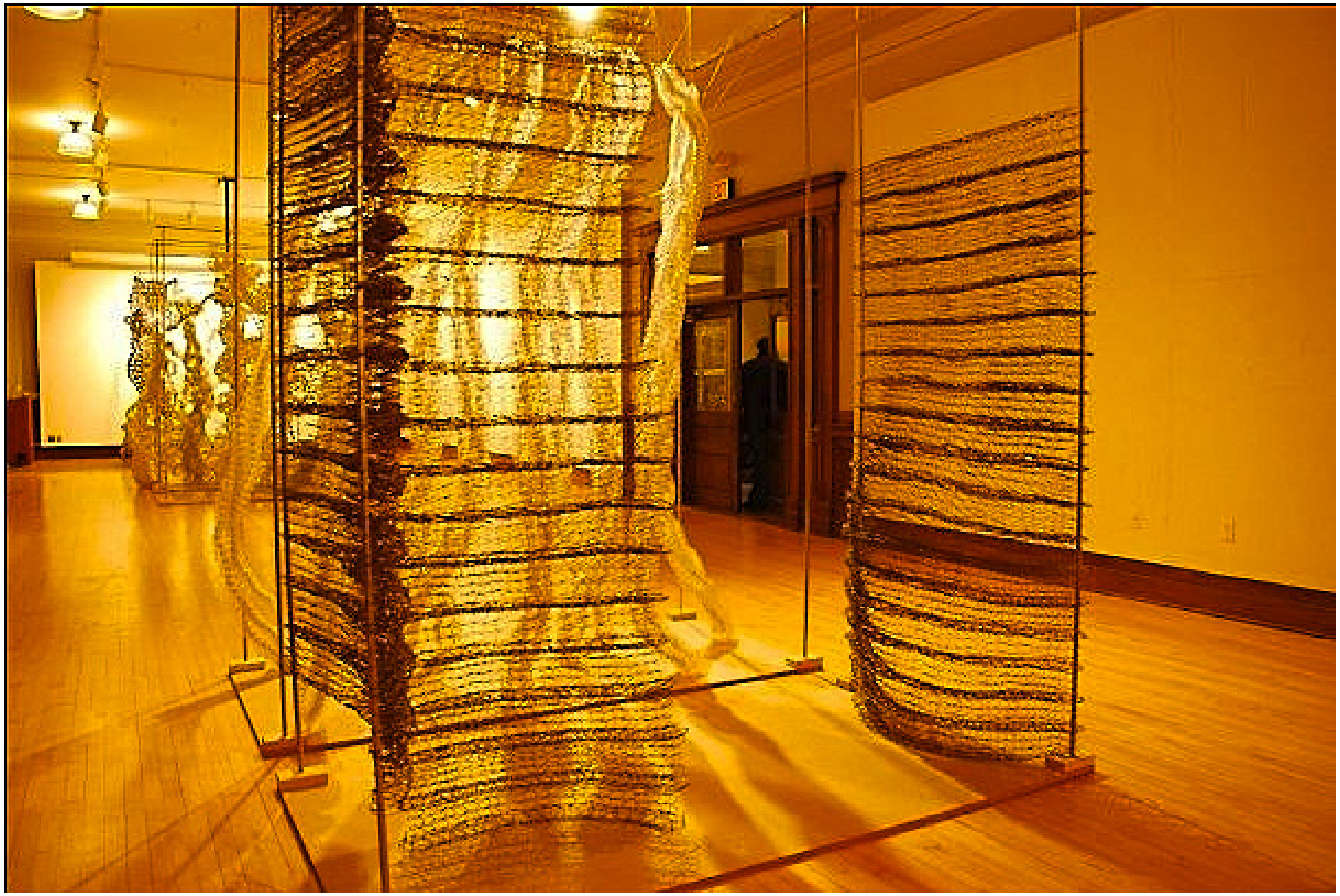


Plan

## STRUCTURAL SYSTEMS

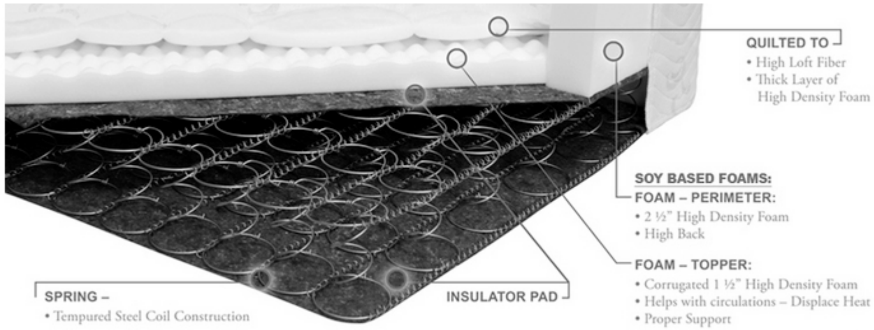


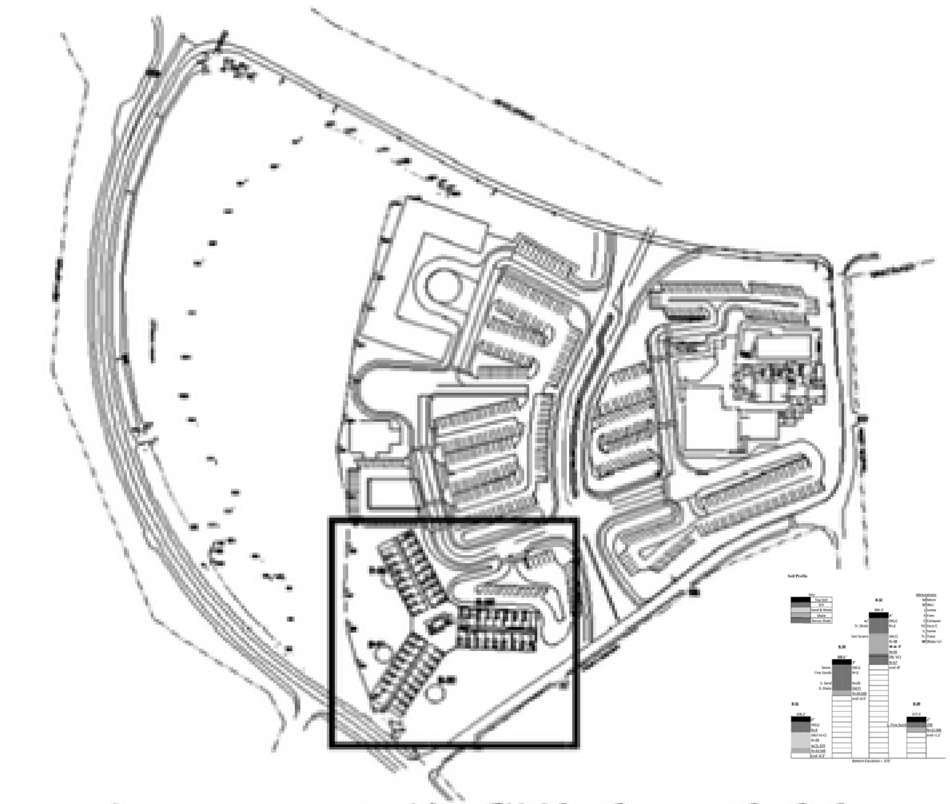



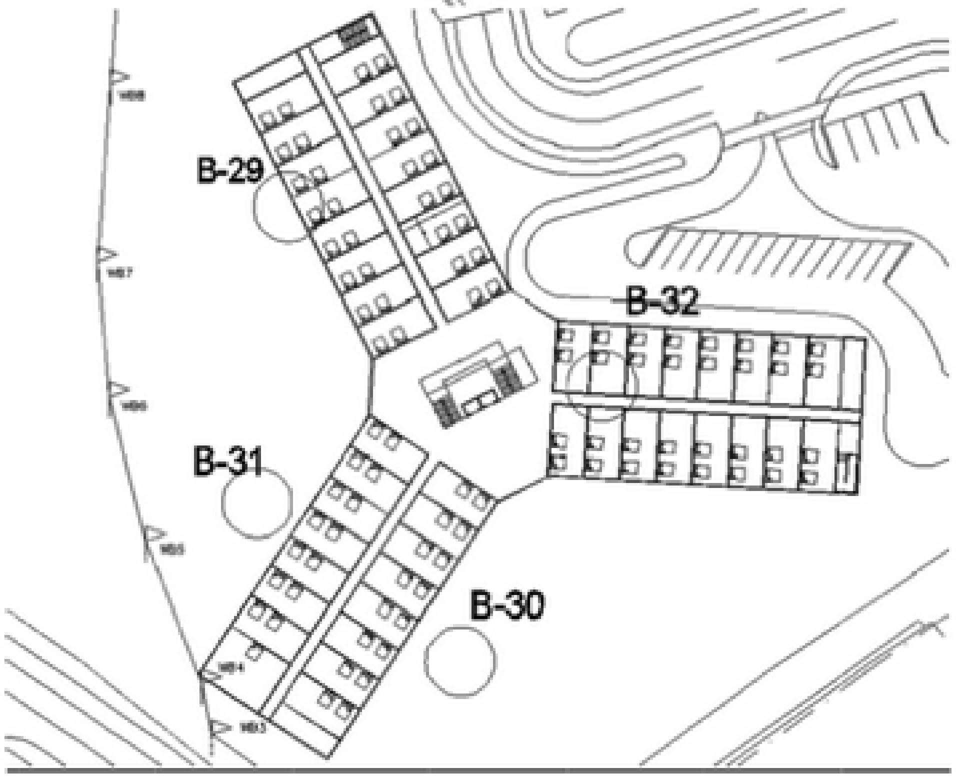



# Spring Construction

Without getting too architectural with the language, the project was simply about making secure connections. We were told to go dumpster diving and find old recycled materials and break them down into connectable modules. The recycled material I chose were bed mattresses. I cut them down until I just had the spring bed, and then further cut apart each individual spring. I found that these spring connect beautifully in sheets by intertwining them in each other and produce a lot of gradient visual qualities.






# Capstone Design

The Civil Engineering students are first broken into teams. There are building teams with structural engineers and geotechnical engineers and then there are teams of environmental engineers and transportation engineers. The goal of each building team is to develop a structure in its entirety, ours being a hotel. Analysis of zoning codes for our plot of land was the first element researched before even thinking about loads. A full analysis of the live and dead loads to be expected in a hotel were to be calculated and allowed us to find and locate where the steel skeleton beams and columns should go. This project required a lot of teamwork and cooperation as the transportation teams were designing the roads and parking lots for the hotel and the environmental team did site analysis. Finally, after the loads were known and the steel columns and beams had been sized, the geotechnical portion of our team developed the foundation. We utilized computer programs such as RISA 3D, Revit, and Robot Structural Analysis to aid us in the design.

Figure_: Concrete Structure With 12 in x 12 in Columns, 12 in x 24 in beams, and 3 ft Wide Pre-cast, Post-Tension Plank Floor System

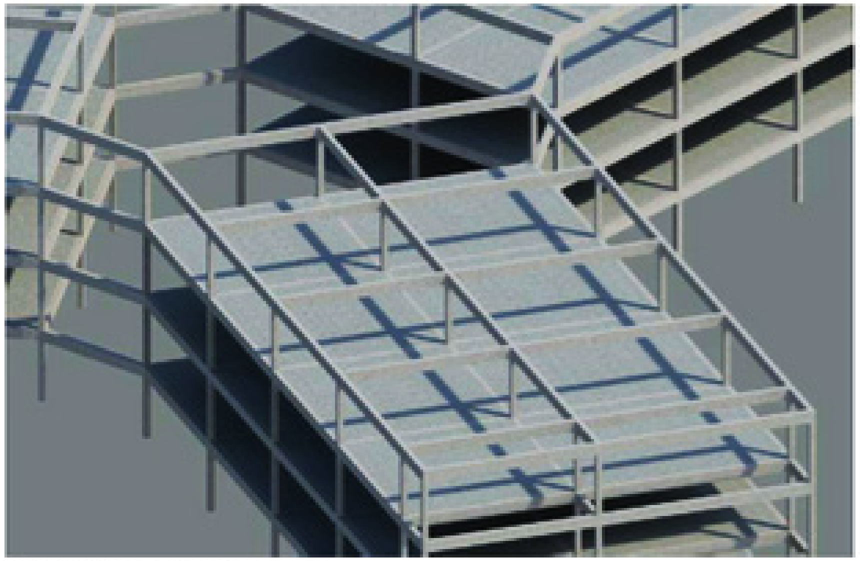


Figure_: Moments About the Local Y Axis for Beams and Girders (kip*ft)

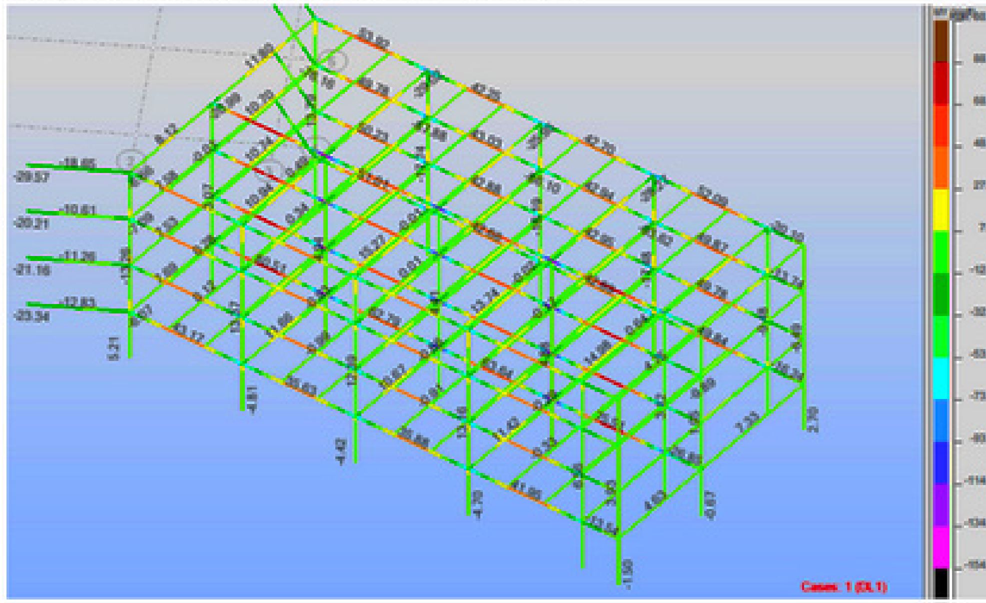
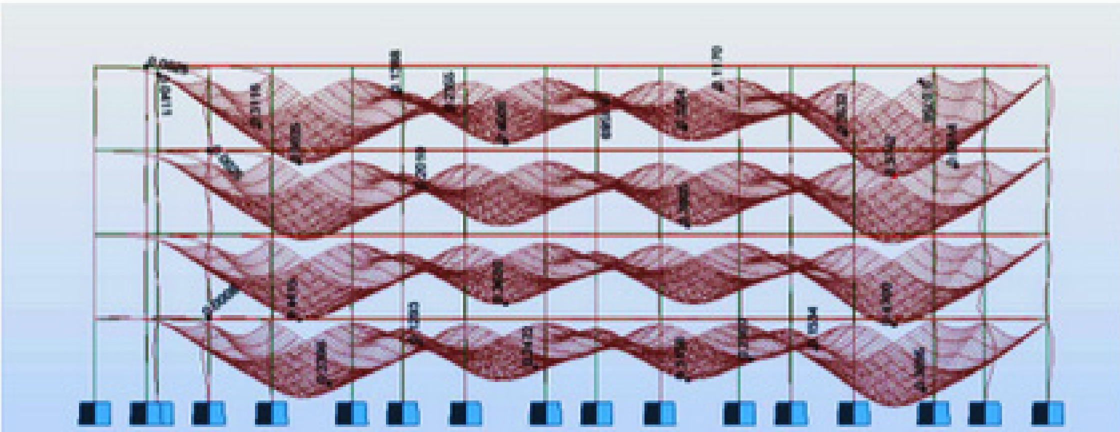


Figure_: Deflections Caused by Dead Load (in)



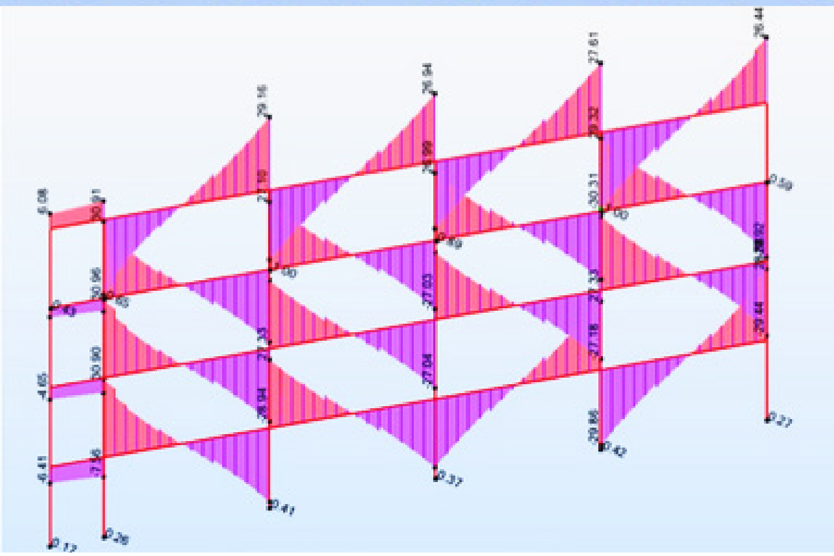


Figure_: Global Z Axis Reactions for Columns (kip)

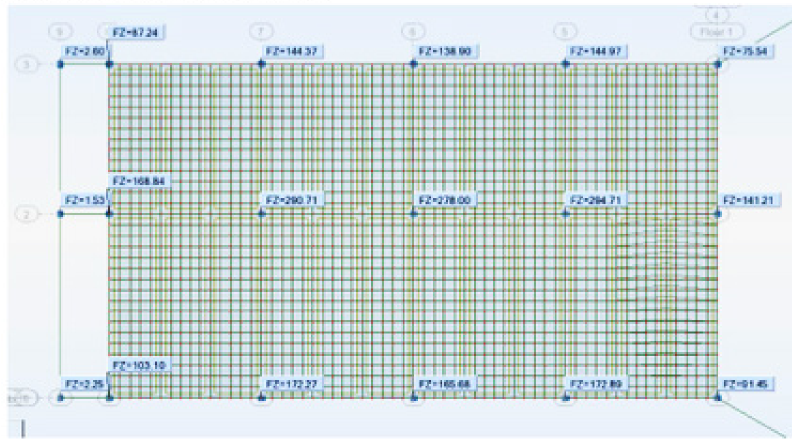
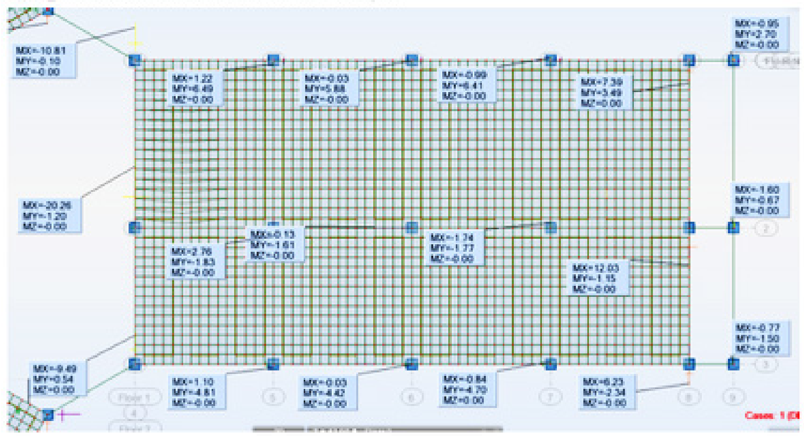
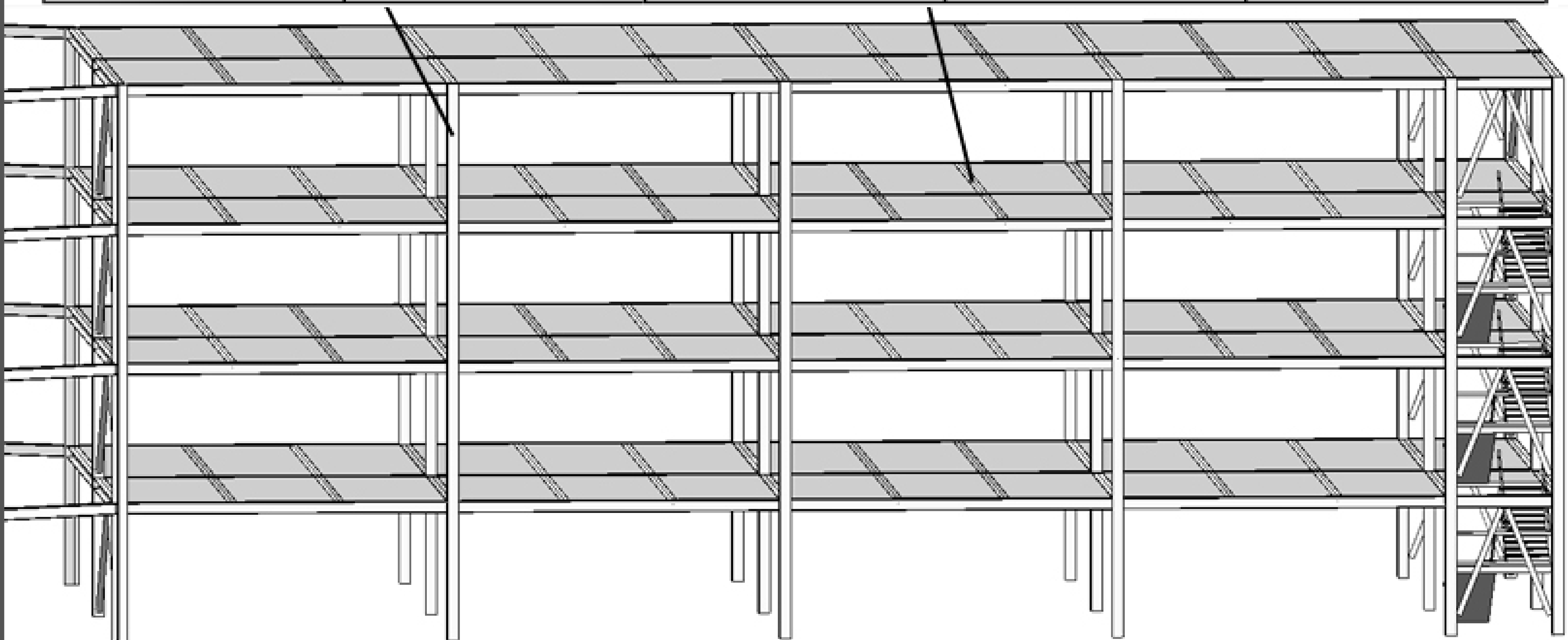


Figure_: Moment Reactions in Global X, Y, and Z Axes (kip*ft)

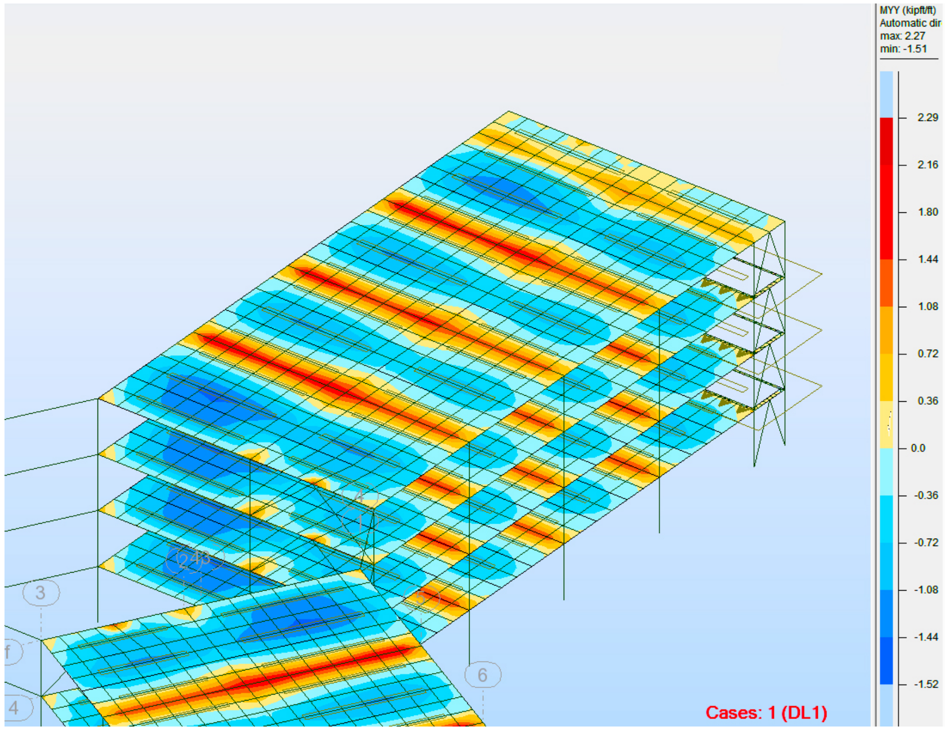


# Member Selection

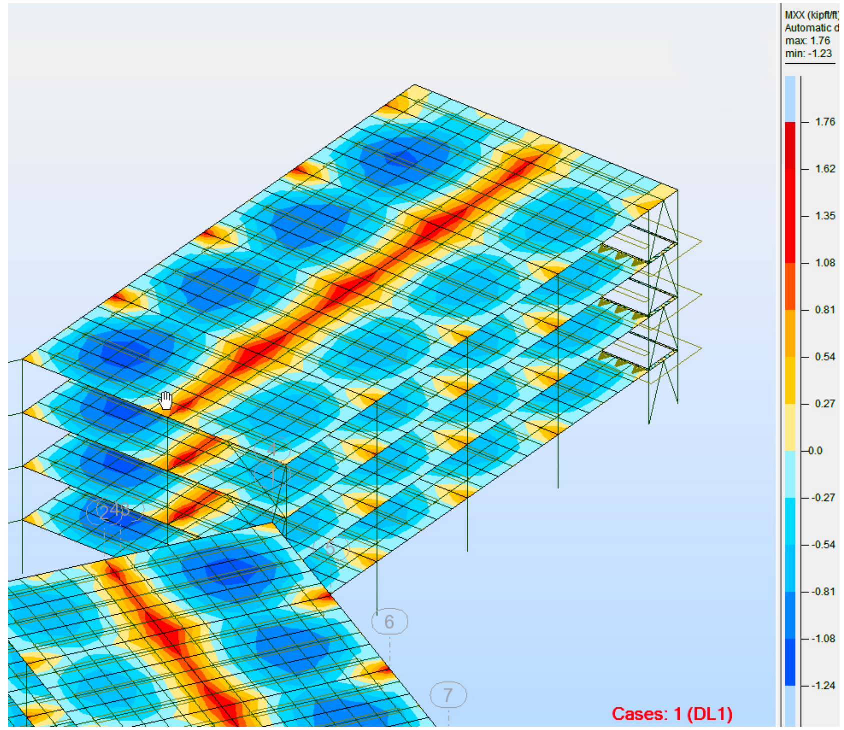
| Hot Rolled Steel | Size | Pieces | Length (ft) | Weight (k) |
|---|---|---|---|---|
| A36 Gr.36 | LL5X5X12X6 | 244 | 4491.2 | 212.4 |
| A992 | W12X106 | 240 | 3120 | 331.2 |
| A992 | W14X74 | 144 | 2623.5 | 194.6 |
| A992 | W14X82 | 408 | 8844 | 725.3 |
| A992 | W21X111 | 480 | 5172 | 575.5 |
| A992 | W27X178 | 333 | 3466.3 | 616.9 |
| Total HR Steel | | 1849 | 27716.9 | 2655.9 |



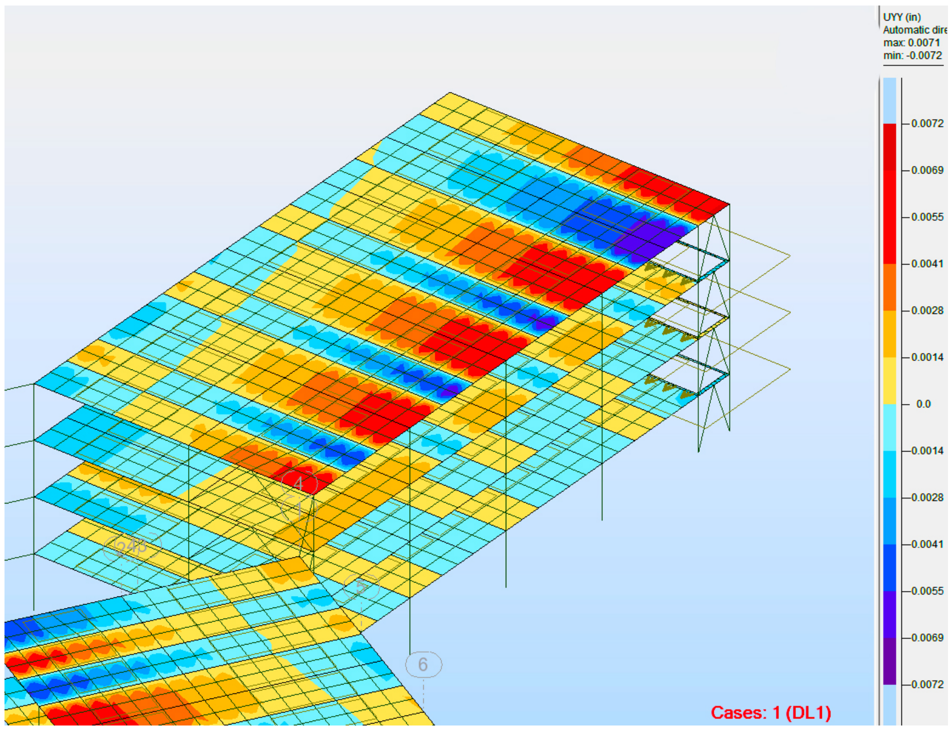
## Moments about Y axis



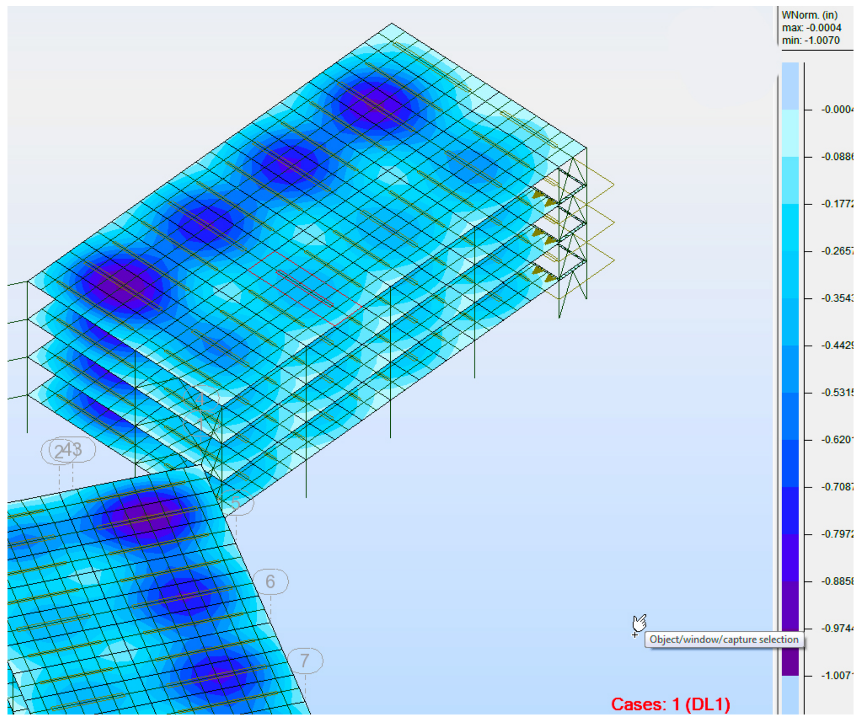

## Moments about X axis




## Deflections about Y axis

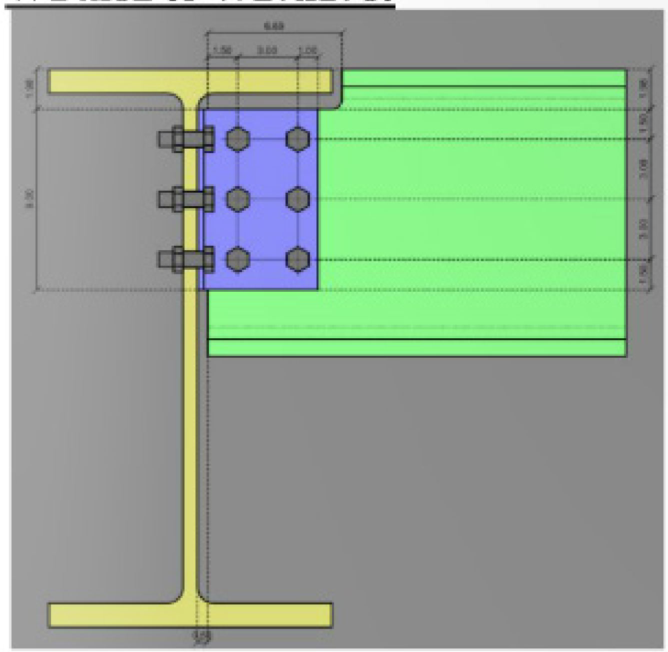


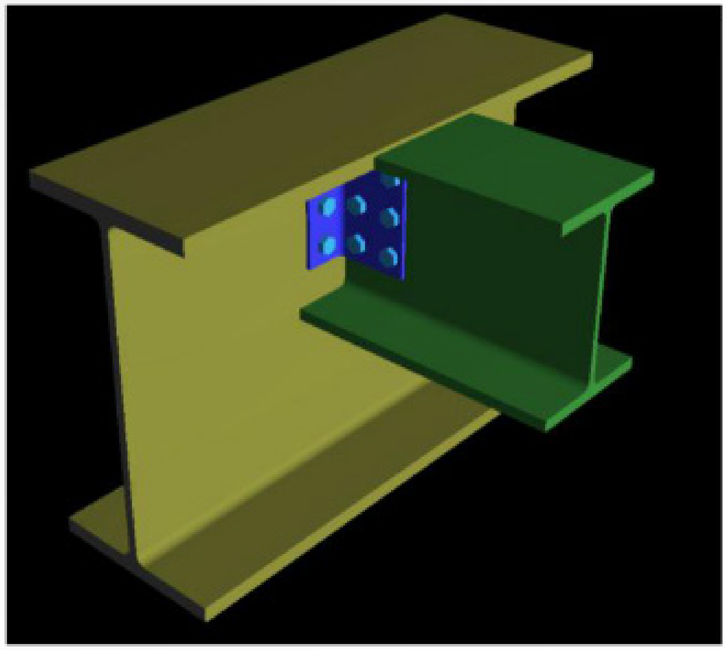

## Deflections about Z axis



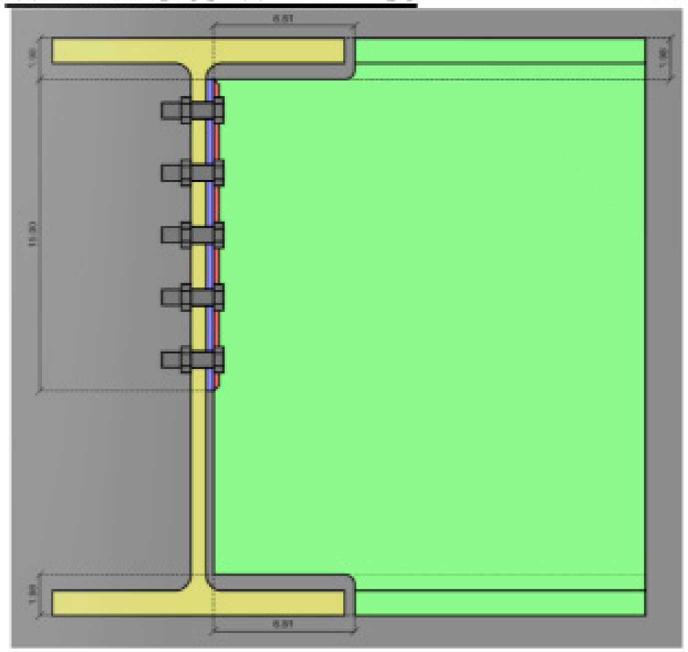
# Connections

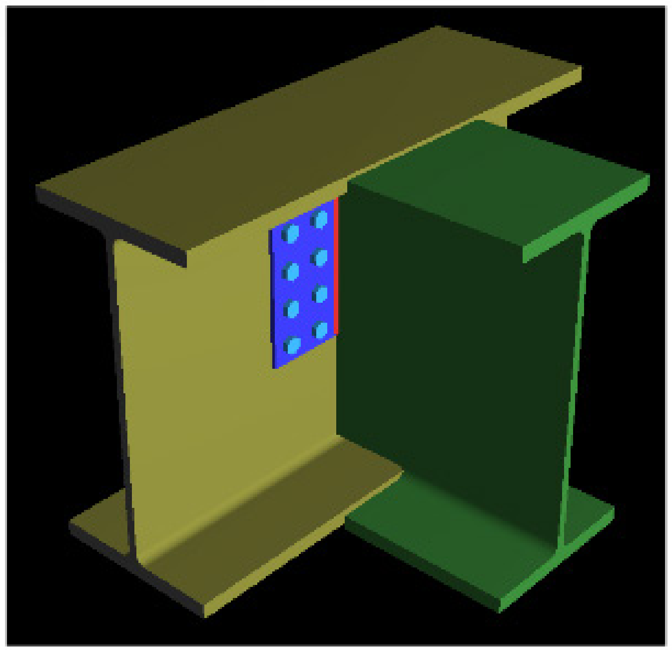
**W14x82 to W27x178:**



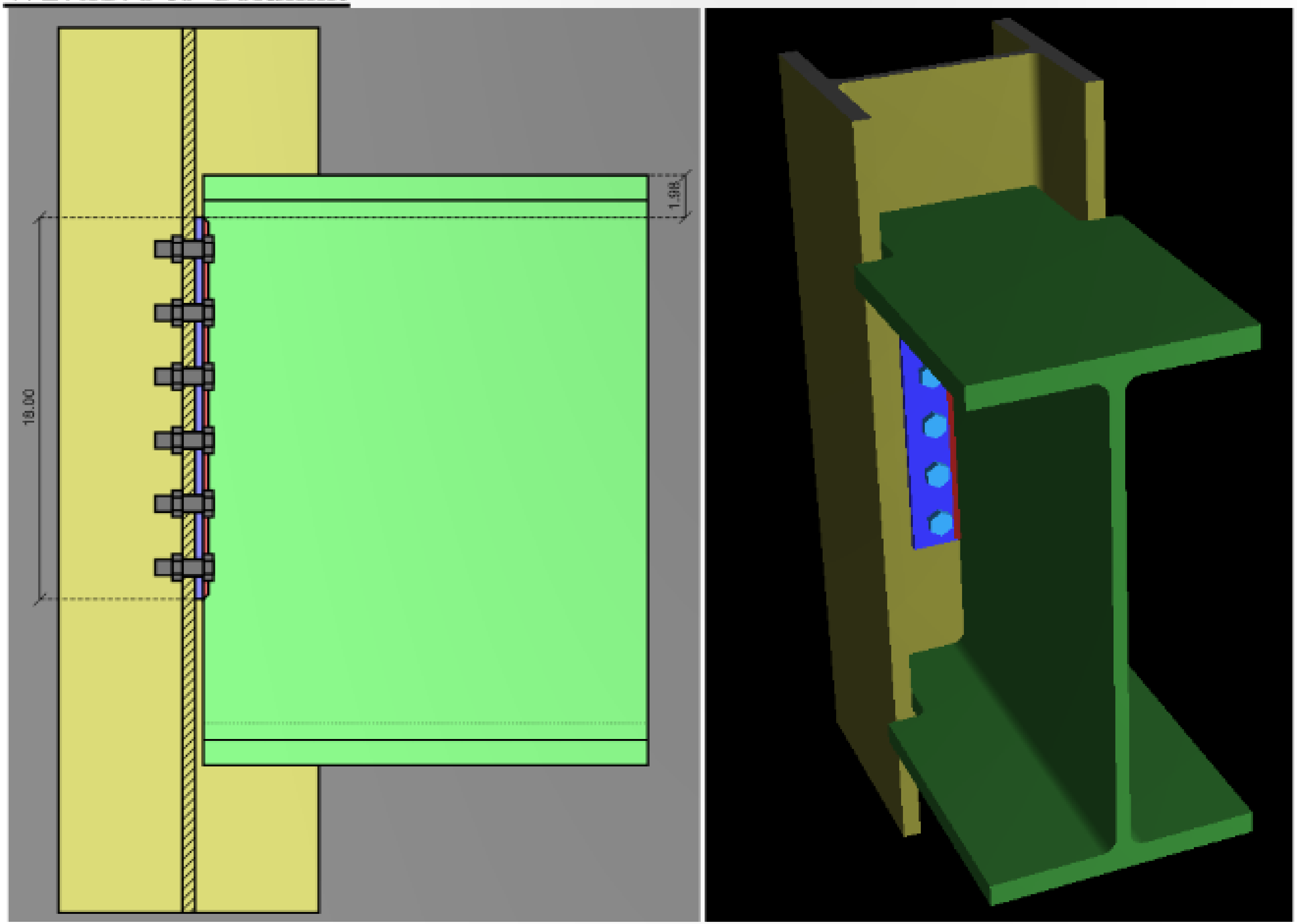


**W27x178 to W27x178:**



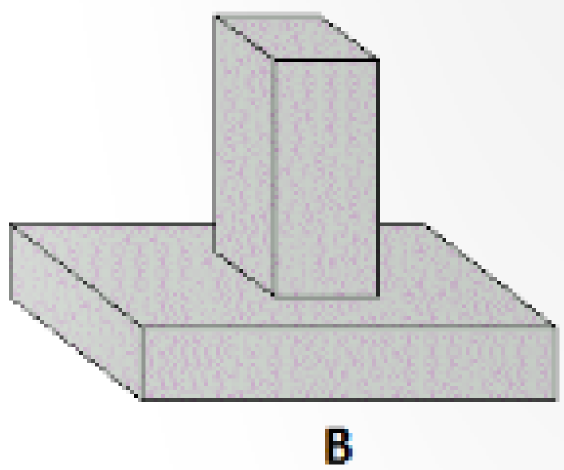


# W27x178 to Column:

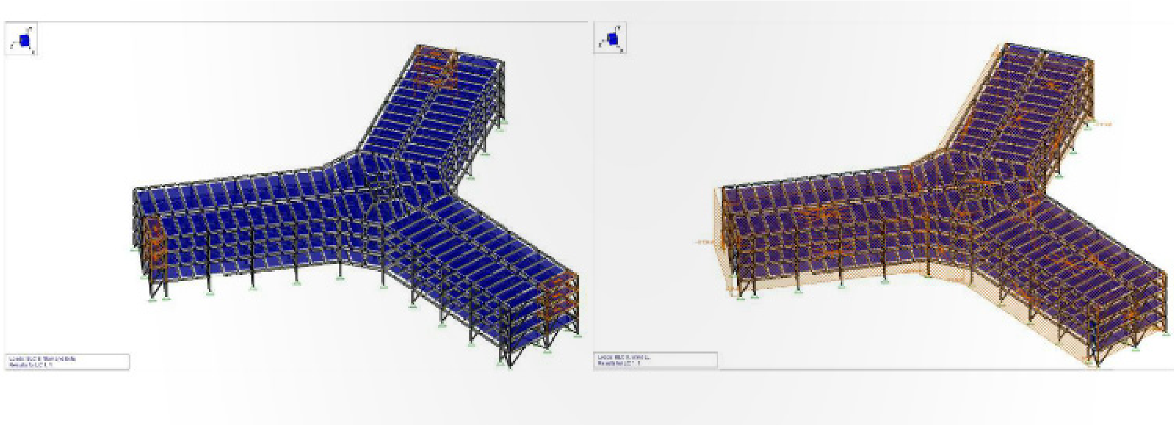


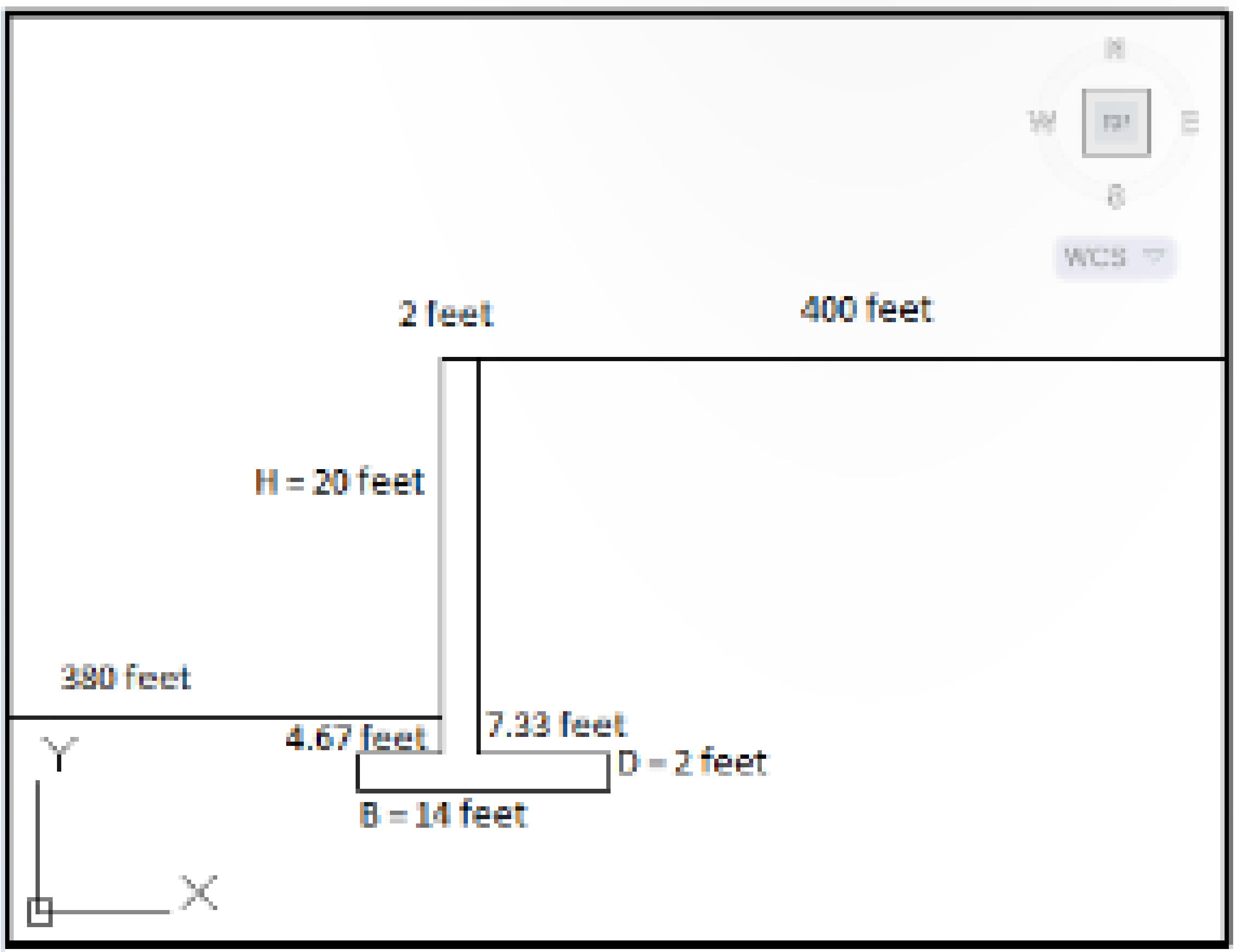
## Final Foundation Plan

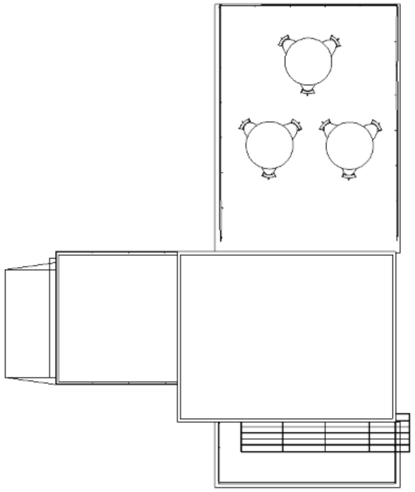
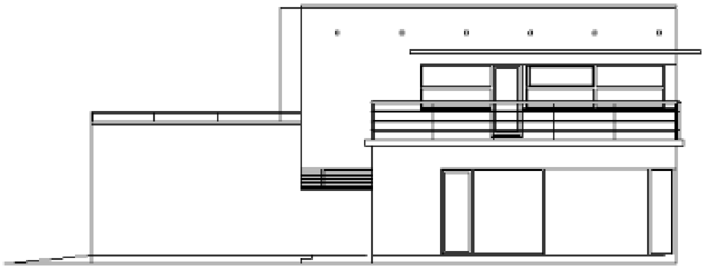
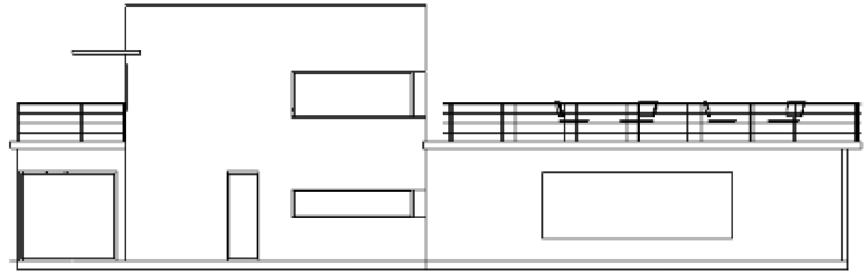
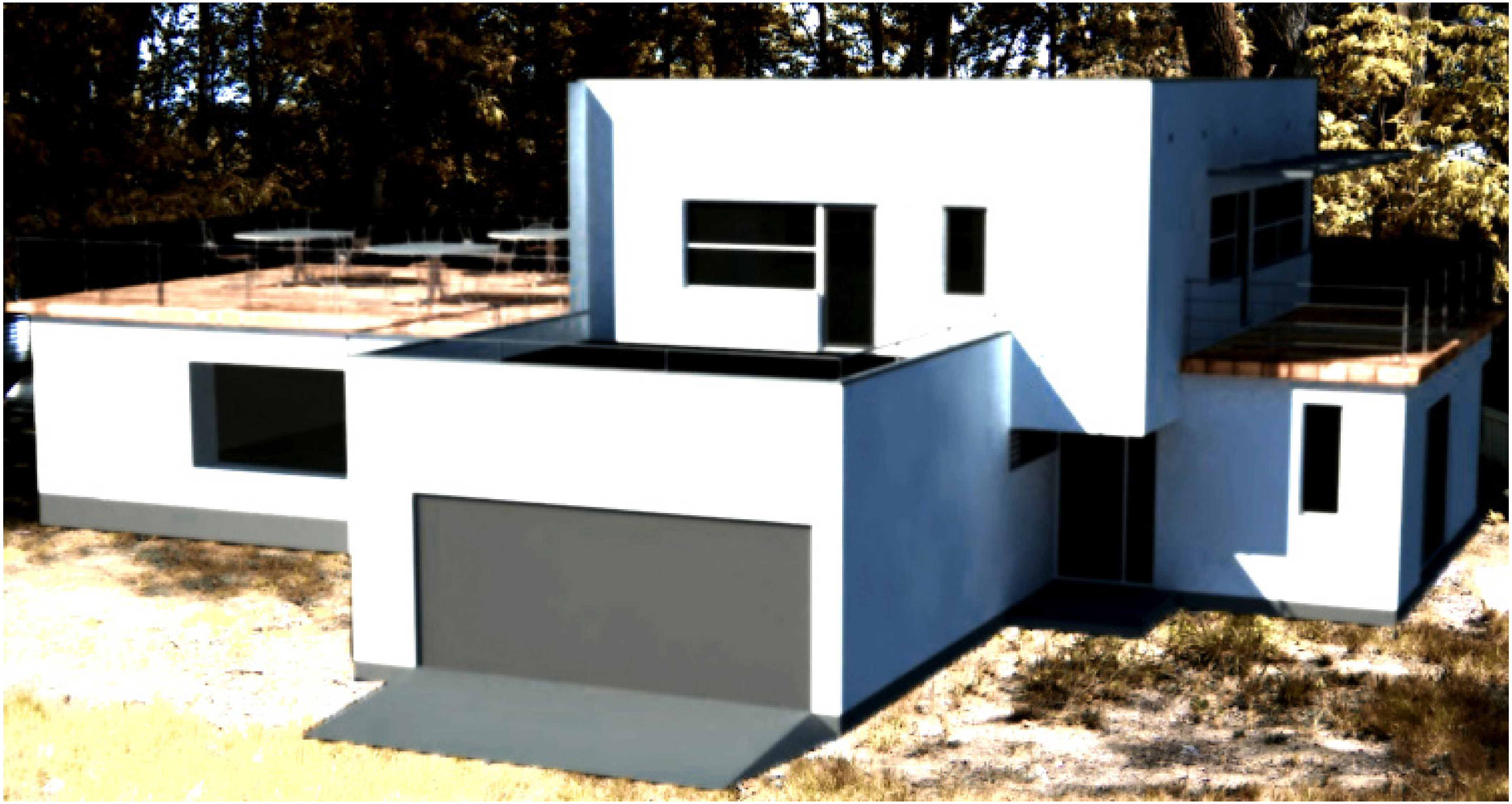
Each column will have its own square spread footing, which will be placed at a depth 4 feet below the surface. This depth will keep the footing stable and protect from frost penetration. From the three column loads, a footing was designed. The ACI code was used almost exclusively. The results of this analysis are shown in the table and diagram below.




| | 300 kip | 500 kip | 705 kip |
|---|---|---|---|
| B | 10 ft | 13 ft | 16 ft |
| d | 18 inch | 26 inch | 32 inch |
| h | 22 inch | 30 inch | 36 inch |
| Bar | No. 5 | No. 6 | No. 6 |
| As / ft | 0.49 in^2 / ft | 0.59 in^2 / ft | 0.71 in^2/ ft |
| s | 5 inch | 9 inch | 7.5 inch |

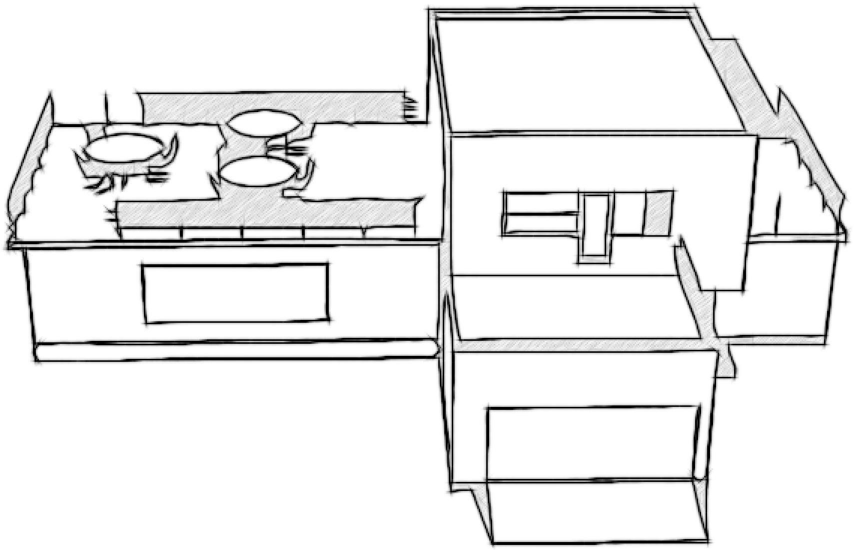


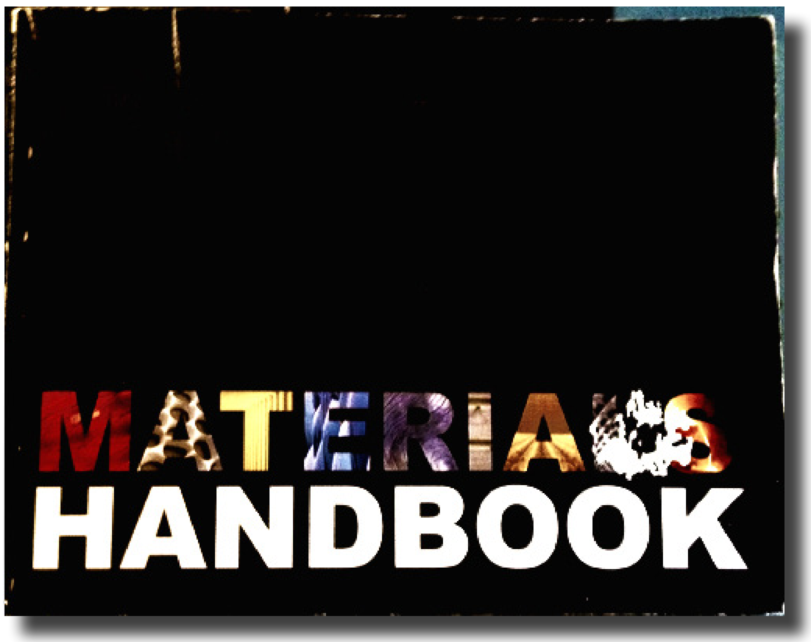

N
W
E
S
WCS
2 feet
400 feet
H = 20 feet
380 feet
4.67 feet
7.33 feet
D = 2 feet
B = 14 feet
Y
X

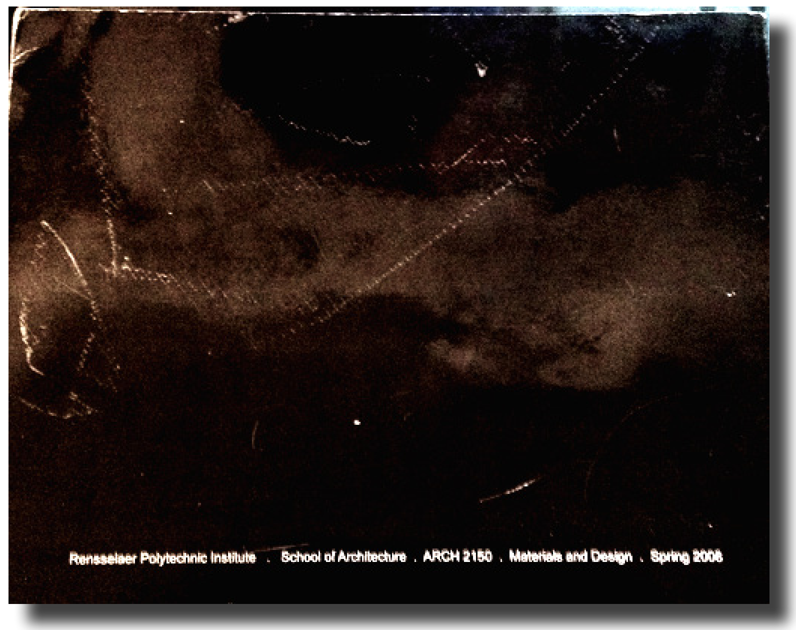





# Cubic Cabin

A modern house inspired by the famous, austere "cube" furniture and buildings of Le Corbusier.

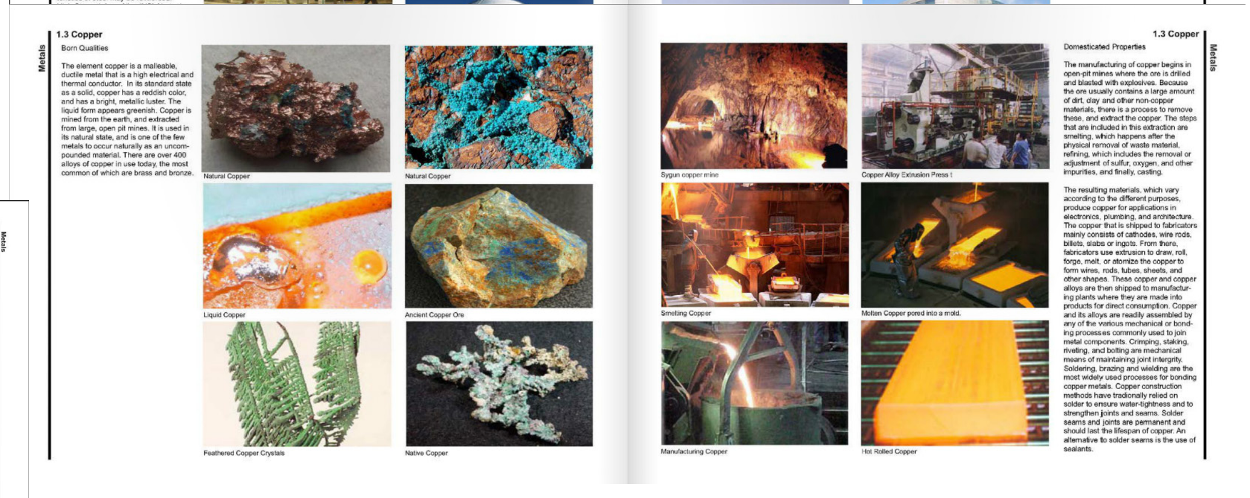


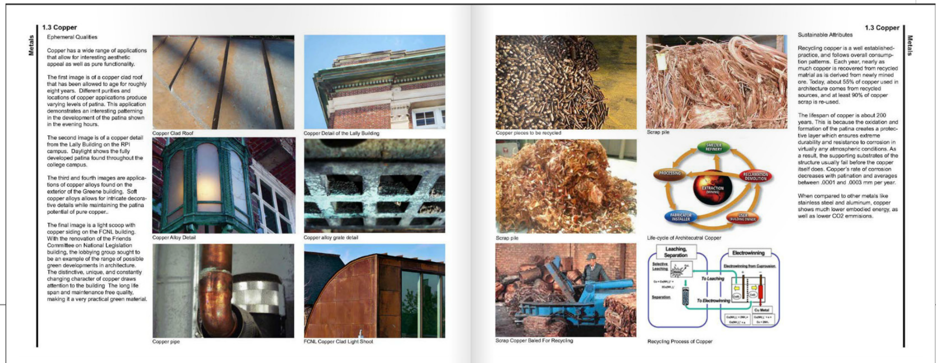

MATERIALS
HANDBOOK

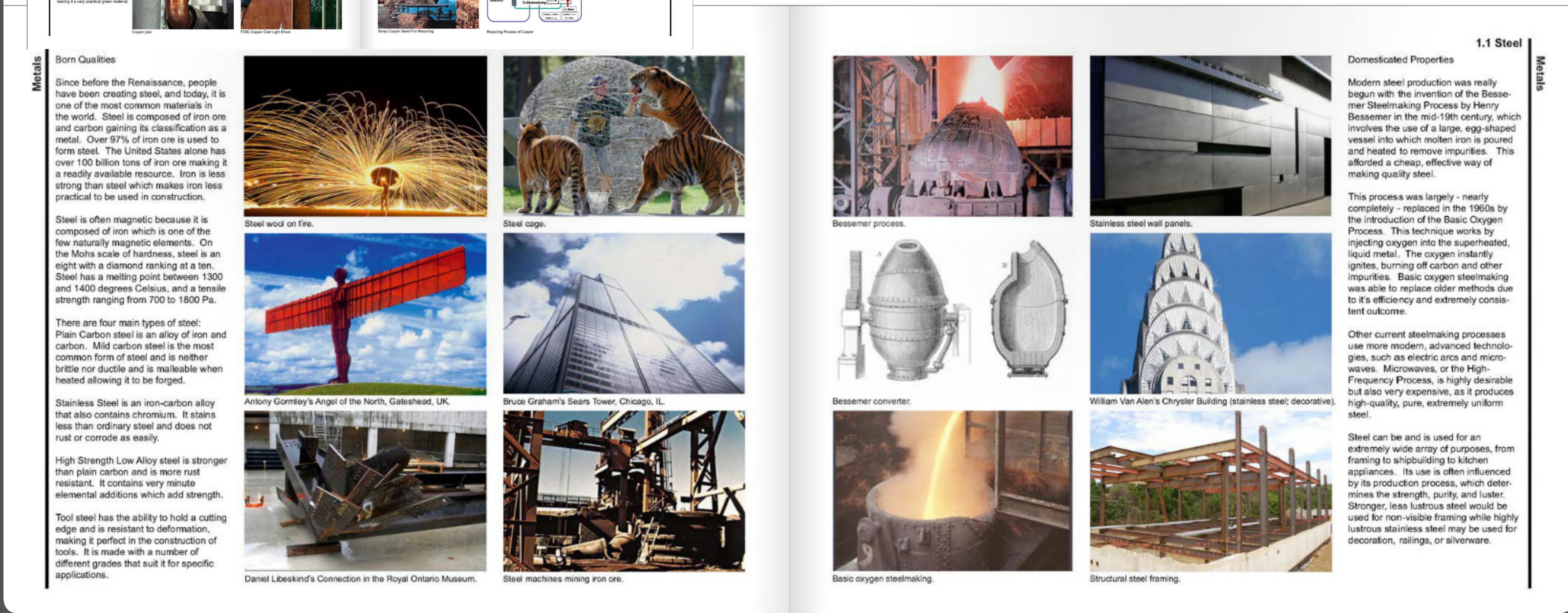

Rensselaer Polytechnic Institute . School of Architecture . ARCH 2150 . Materials and Design . Spring 2006

# Materials Book

This publishing is a compilation of materials research developed by the ARCH 2150, Materials and Design, Spring 2008 class at Rensselaer Polytechnic Institute, School of Architecture. It is intended to serve as a manual help early architecture students with the understanding of materials and their implementation in design. The 14 materials divided into 4 categories are formatted in a manner that would tell a designer everything they need to know to make informed decisions.







Metals

Born Qualities

Since before the Renaissance, people have been creating steel, and today, it is one of the most common materials in the world. Steel is composed of iron ore and carbon gaining its classification as a metal. Over 97% of iron ore is used to form steel. The United States alone has over 100 billion tons of iron ore making it a readily available resource. Iron is less strong than steel which makes iron less practical to be used in construction.

Steel is often magnetic because it is composed of iron which is one of the few naturally magnetic elements. On the Mohs scale of hardness, steel is an eight with a diamond ranking at a ten. Steel has a melting point between 1300 and 1400 degrees Celsius, and a tensile strength ranging from 700 to 1800 Pa.

There are four main types of steel:
Plain Carbon steel is an alloy of iron and carbon. Mild carbon steel is the most common form of steel and is neither brittle nor ductile and is malleable when heated allowing it to be forged.

Stainless Steel is an iron-carbon alloy that also contains chromium. It stains less than ordinary steel and does not rust or corrode as easily.

High Strength Low Alloy steel is stronger than plain carbon and is more rust resistant. It contains very minute elemental additions which add strength.

Tool steel has the ability to hold a cutting edge and is resistant to deformation, making it perfect in the construction of tools. It is made with a number of different grades that suit it for specific applications.

Steel wool on fire.

Steel cage.

Antony Gormley's Angel of the North, Gateshead, UK.

Bruce Graham's Sears Tower, Chicago, IL.

Daniel Libeskind's Connection in the Royal Ontario Museum.

Steel machines mining iron ore.

1.1 Steel

Bessemer process.

Stainless steel wall panels.

Bessemer converter.

William Van Alen's Chrysler Building (stainless steel; decorative).

Basic oxygen steelmaking.

Structural steel framing.

Domesticated Properties

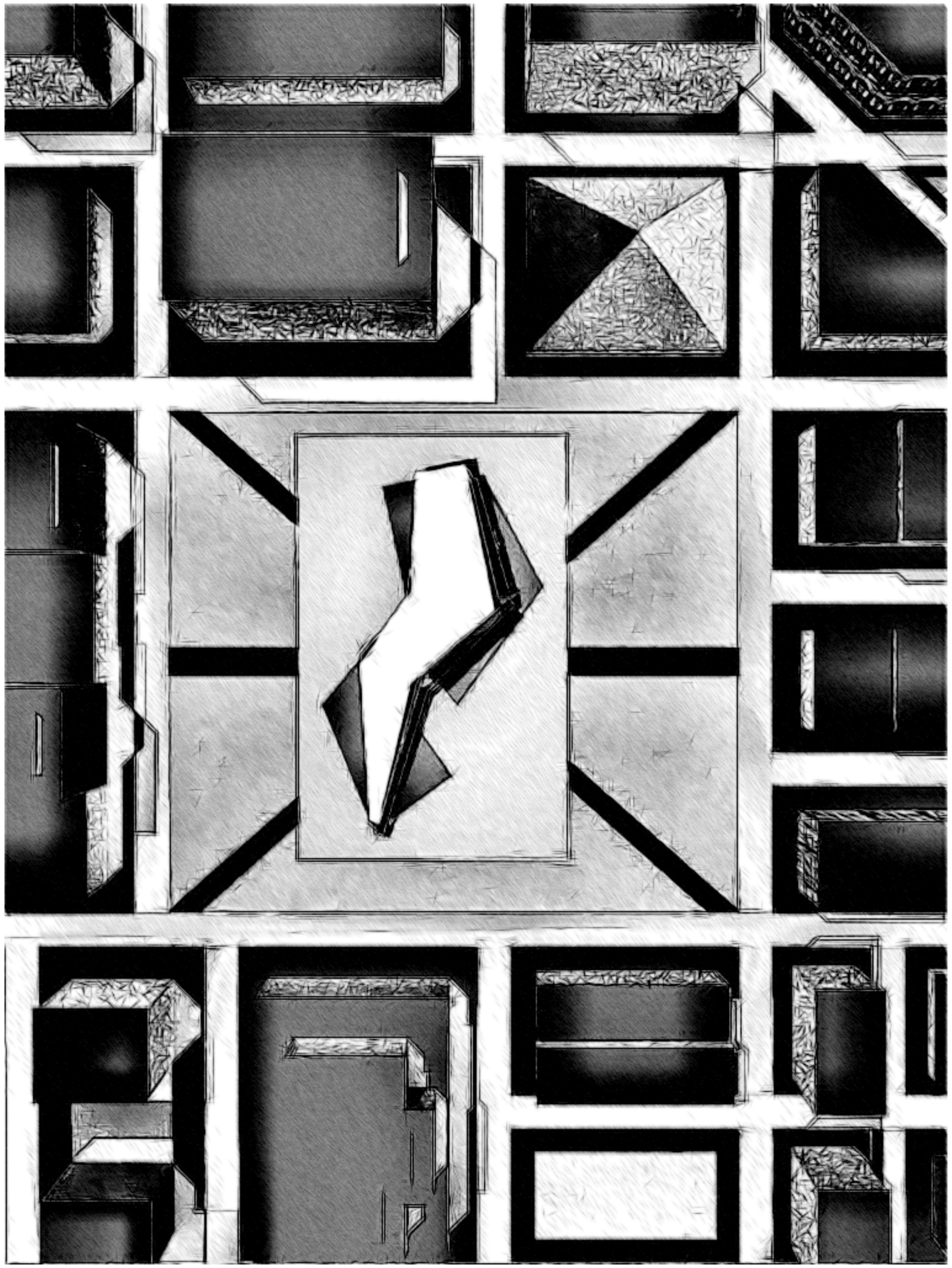
Modern steel production was really begun with the invention of the Bessemer Steelmaking Process by Henry Bessemer in the mid-19th century, which involves the use of a large, egg-shaped vessel into which molten iron is poured and heated to remove impurities. This afforded a cheap, effective way of making quality steel.

This process was largely - nearly completely - replaced in the 1960s by the introduction of the Basic Oxygen Process. This technique works by injecting oxygen into the superheated, liquid metal. The oxygen instantly ignites, burning off carbon and other impurities. Basic oxygen steelmaking was able to replace older methods due to it's efficiency and extremely consistent outcome.

Other current steelmaking processes use more modern, advanced technologies, such as electric arcs and microwaves. Microwaves, or the High-Frequency Process, is highly desirable but also very expensive, as it produces high-quality, pure, extremely uniform steel.

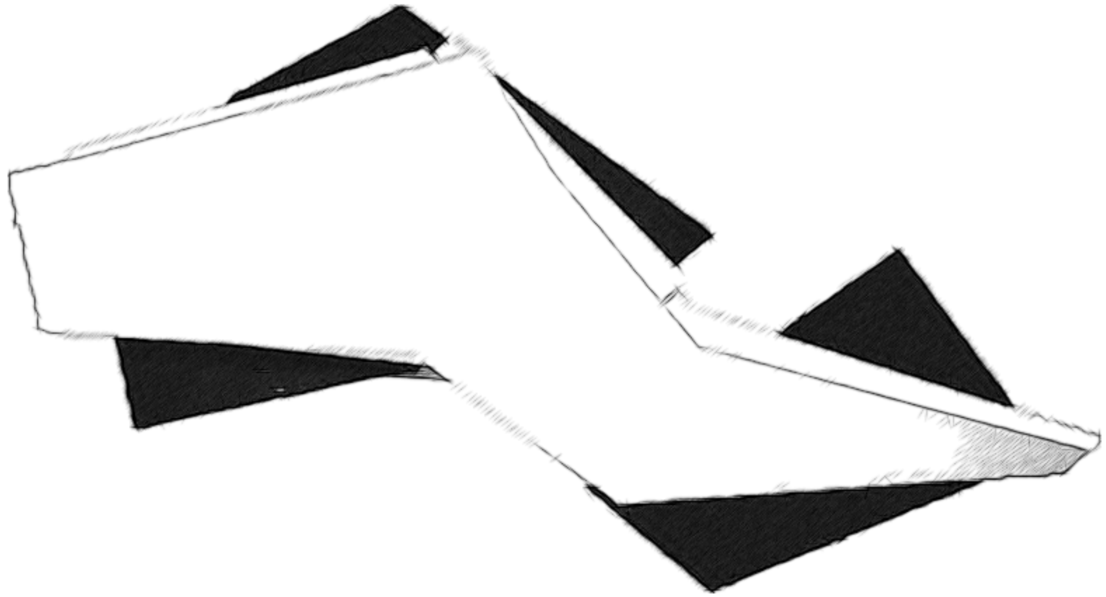
Steel can be and is used for an extremely wide array of purposes, from framing to shipbuilding to kitchen appliances. Its use is often influenced by its production process, which determines the strength, purity, and luster. Stronger, less lustrous steel would be used for non-visible framing while highly lustrous stainless steel may be used for decoration, railings, or silverware.

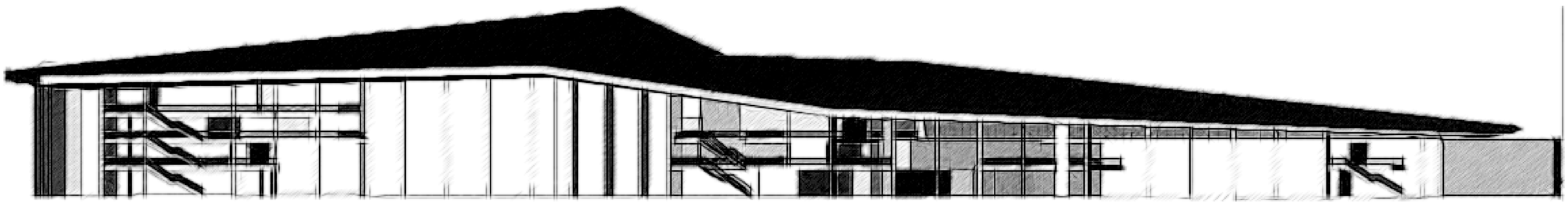
Metals

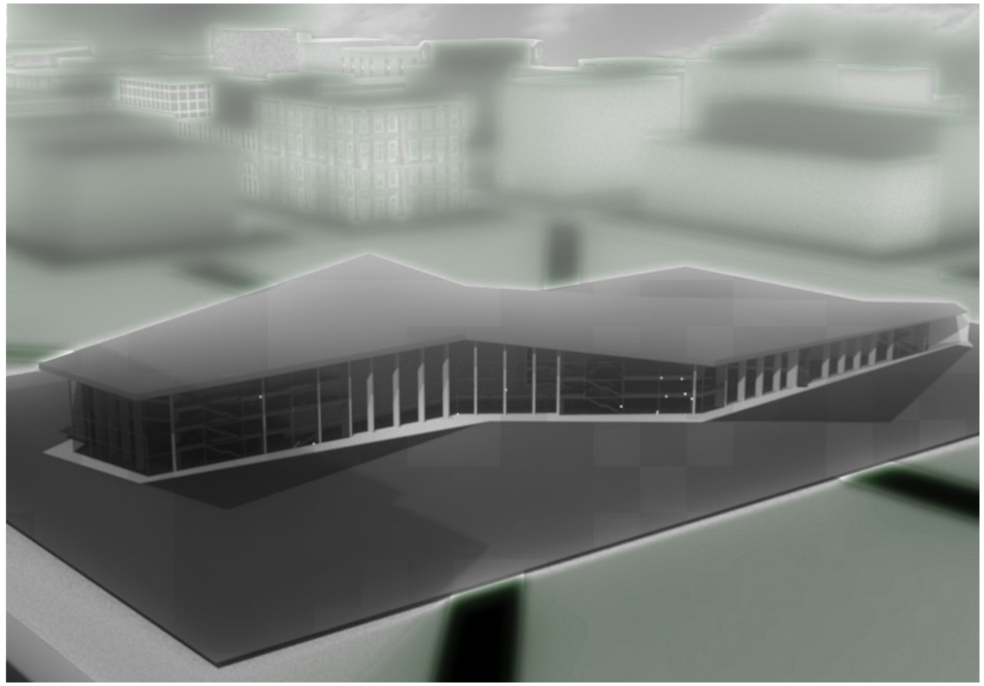
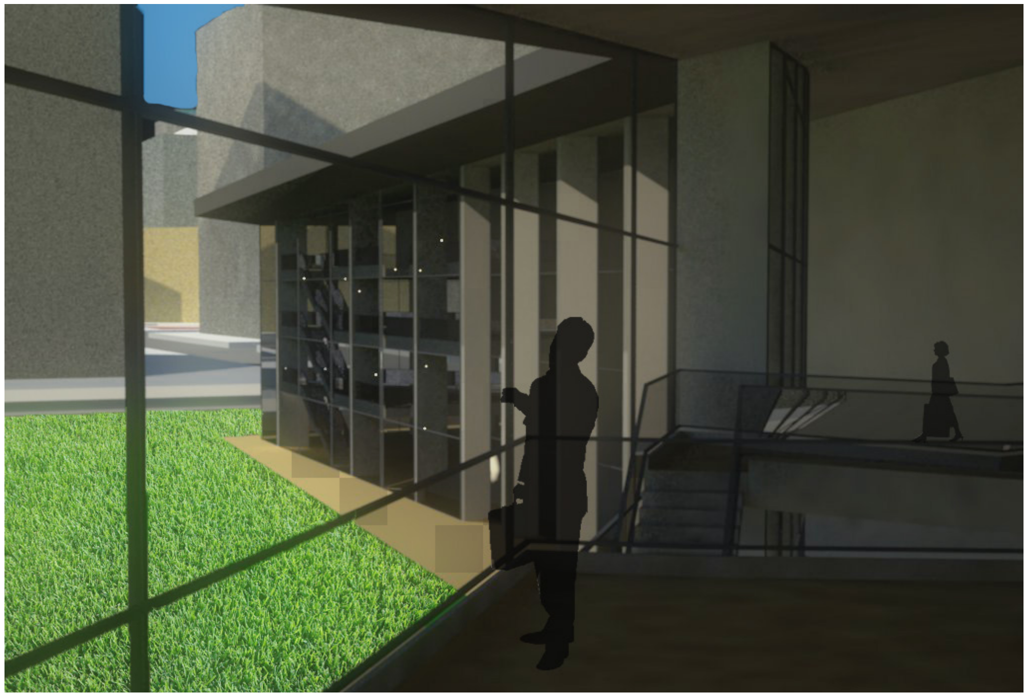
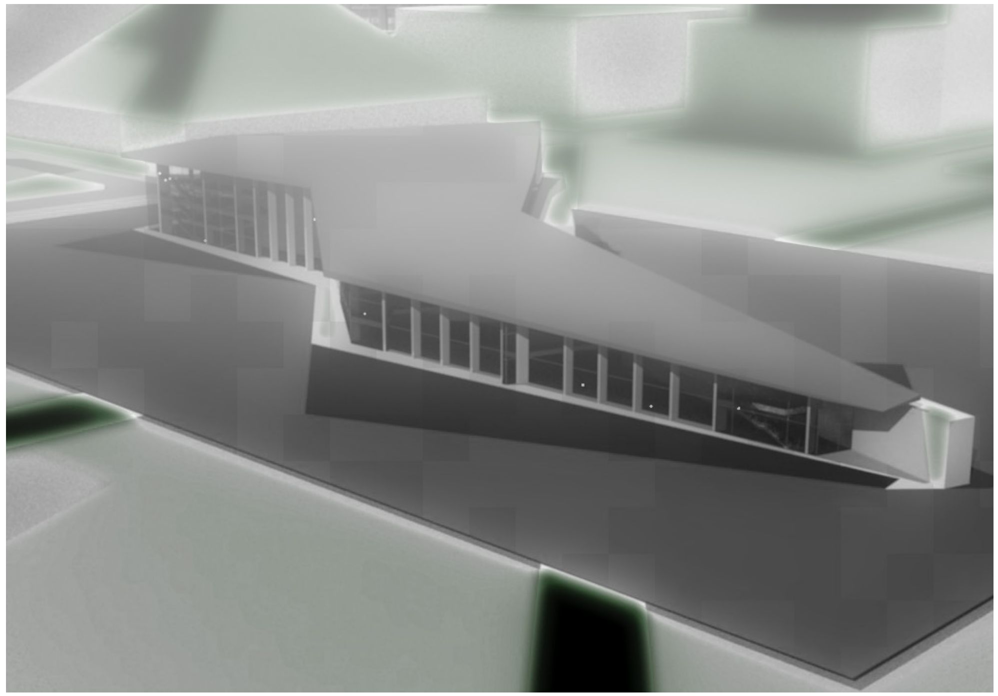


# Slither

This snake-like convention center was based around the interaction of depth and perception and was inspired by Zaha Hadid's Vitra Fire Station. The site is a central field within a city and therefore perspectival interest from every angle is imminent. In section and in plan the project consists of three dynamic shifts in direction to create false perceptions of depth which registers via a system of consistently varying column heights. Pragmatically, the structure facilitates various meeting rooms and features a glass phasod which grants visibility to and from the city, coinciding with its public nature.





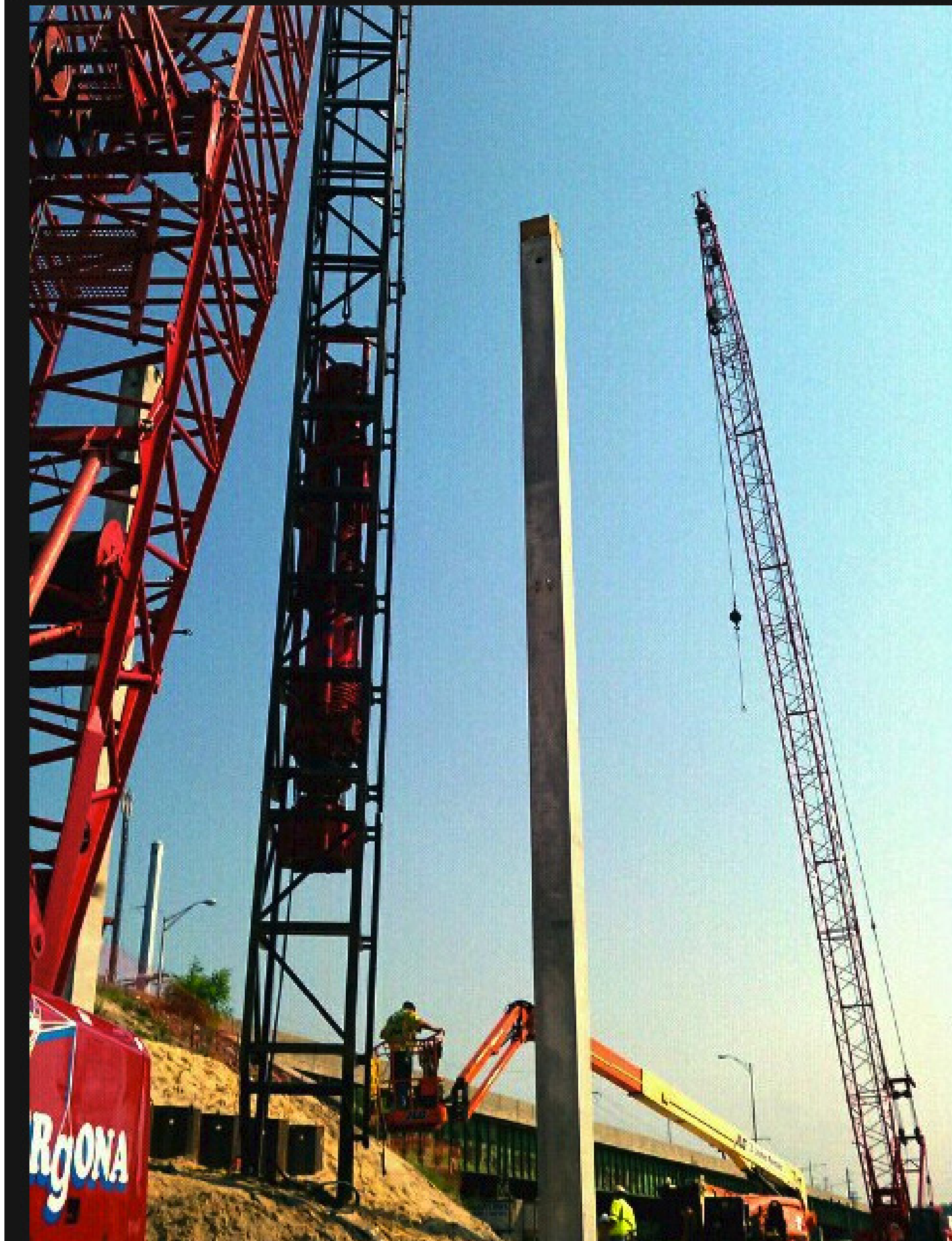





# Bass River

The New Jersey Turnpike Authority prepared a major Coastal Permit to widen nearly 50 miles of Garden State Parkway between Milepost 30 and Milepost 80. This includes replacement of the Bass River Bridge.

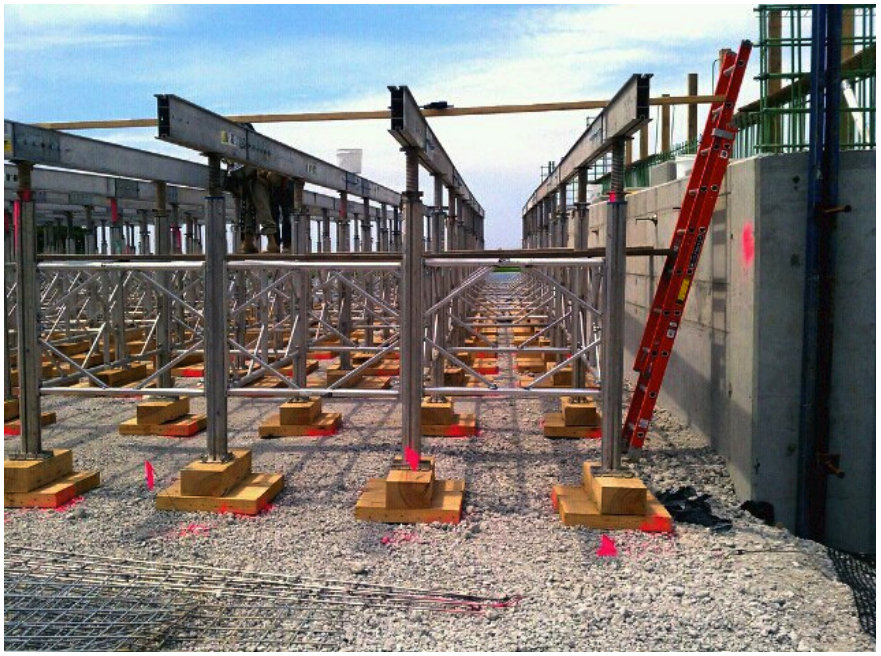
Pile Driving Analysis

Static Load Test



# Ocean City

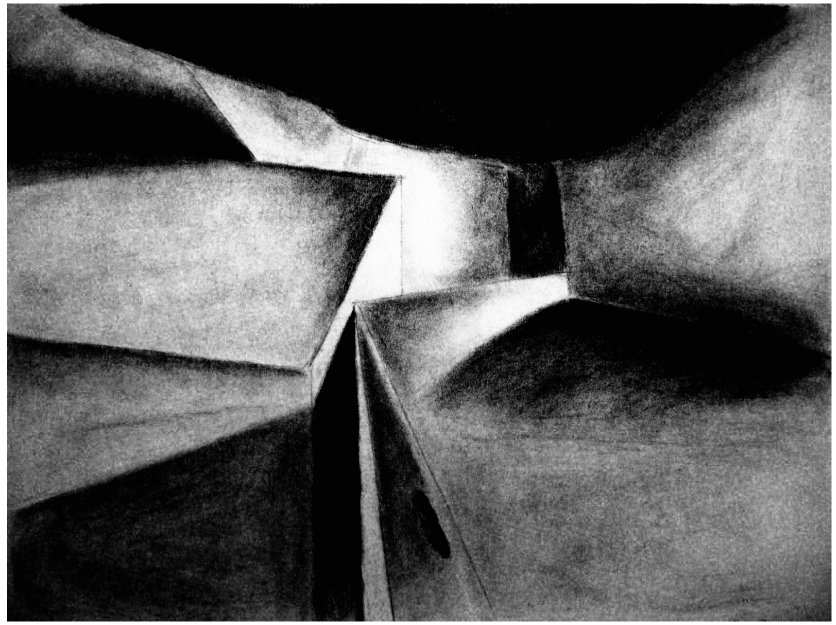
The Route 52 Causeway reconstruction project in Ocean City, NJ involves the replacement of existing bridges supported on combination of timber and pre-cast reinforced concrete piles.

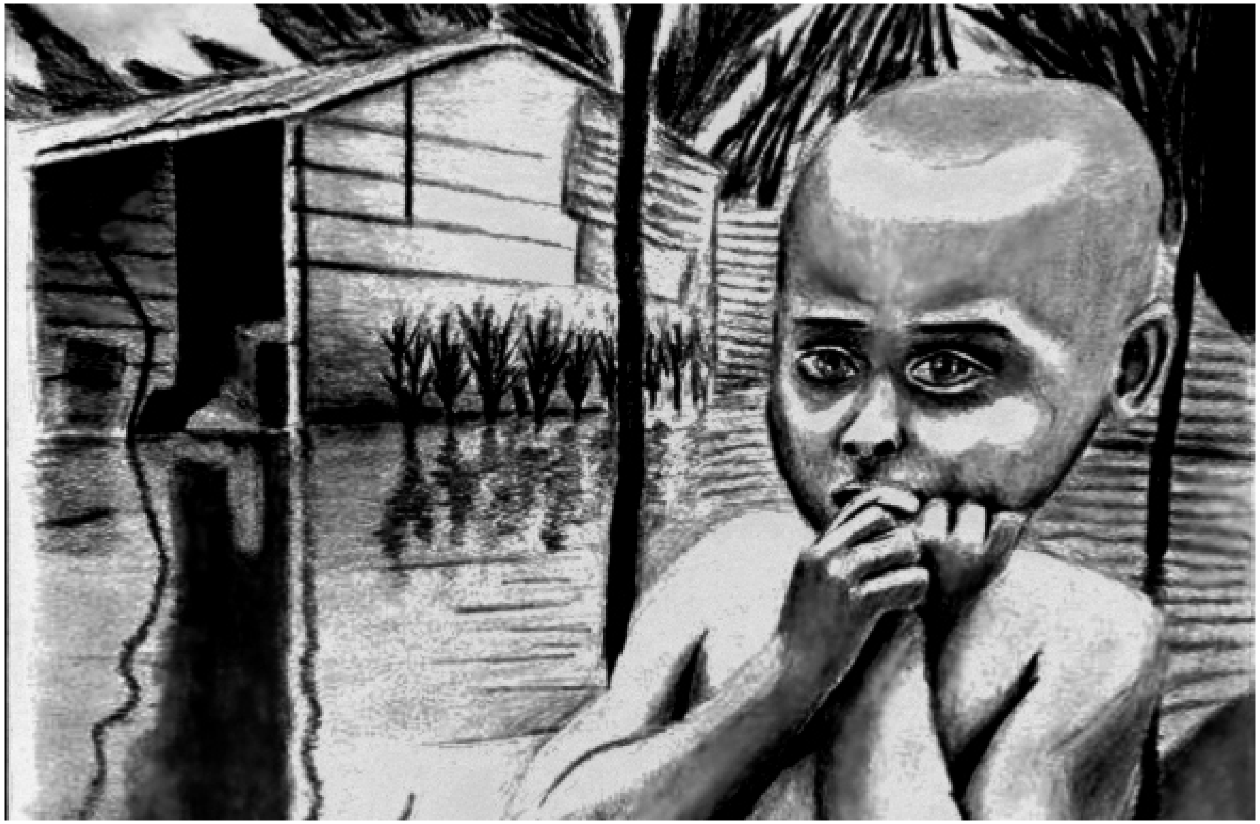


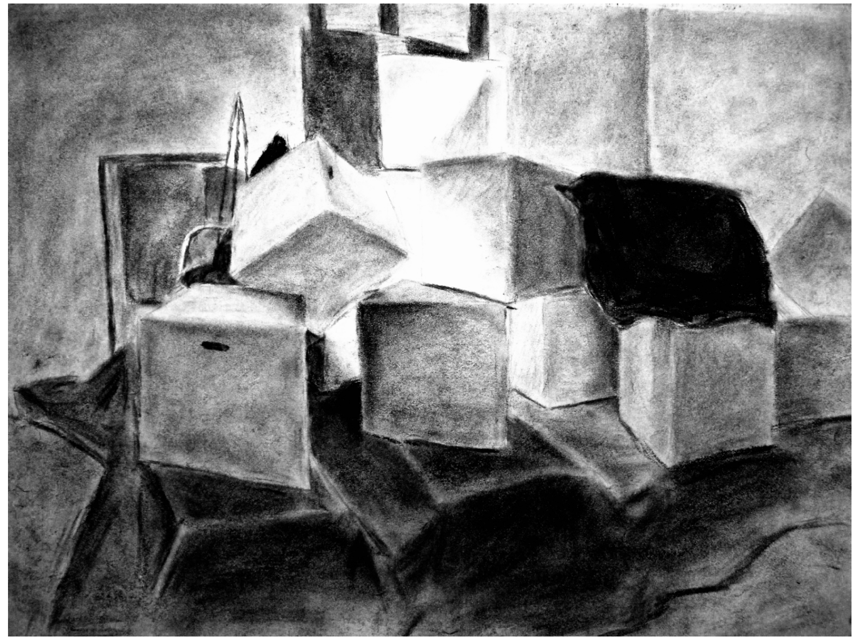
# Drawings

"Drawing is giving a performance; an artist is an actor who is not limited by the body, only by his ability and, perhaps, experience."

-Marc Davis

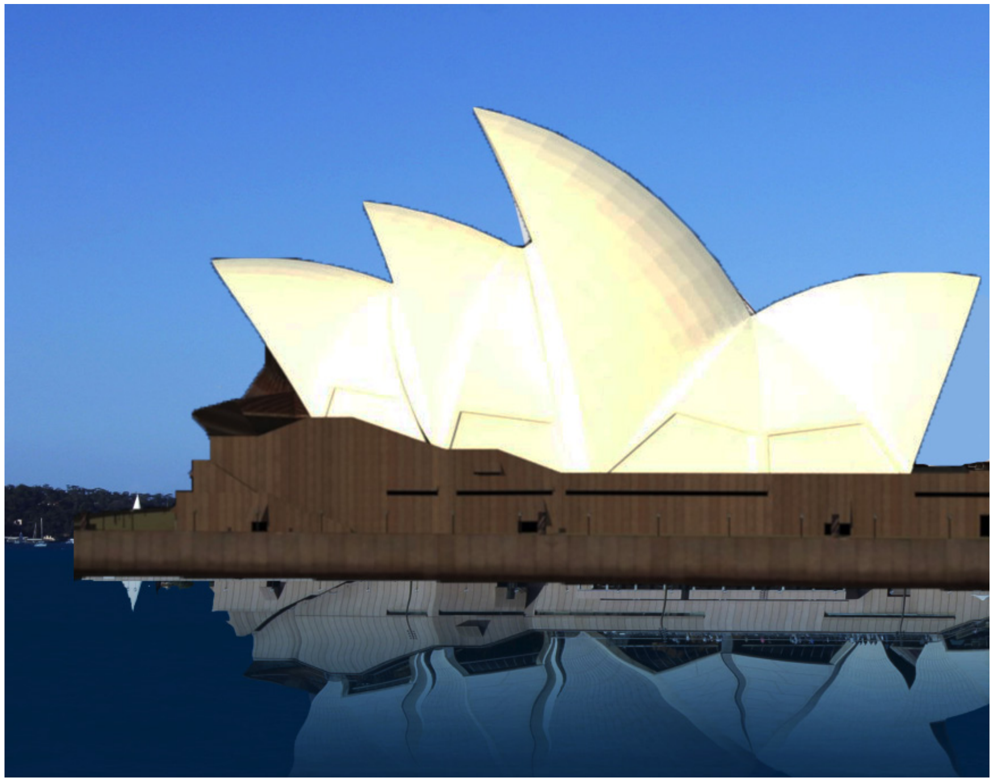






# Renders

A series of renders of famous works of architecture compiled using Rhinoceros, V-Ray and Photoshop. All 3D models were supplied by Google Sketchup 3D Warehouse.






# Guitars

John Frusciante uses his selection of Fender Stratocastors predomoninantly for live and studio recordings. The 1962 Tobacco Burst was received as a gift from Anthony Kiedis upon rejoining the band for the Californication album. Both the white stratocaster and the fiesta red stratocaster were recent acquirements during the Stadium Arcadium album.

## 1962 Fender Stratocaster (Tobacco Burst)

- Seymour Duncan Antiquity II Pickups
- Rosewood Thick C Shape Neck. 7.5 Radius
- Vintage Frets.
- 5-way pickup selector.
- Select Alder Body

## 1957 Fender Stratocaster (Sunburst)

- Seymour Duncan Antiquity I Pickups
- Maple V-shape neck 7.5 Radius
- 3-way pickup selector.
- Vintage Frets
- Alder body

## 1963 Fender Stratocaster (Fiesta Red)

- Seymour Duncan Antiquity II Pickups
- Rosewood Thick C Shape Neck 7.5 Radius
- Vintage frets.
- Alder body
- 5-way pickup selector.



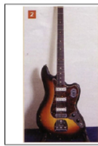
## Guitars

The Gibson SG is used for some heavy distortion portions on studio recordings. The Precision Bass has been widely used for bass parts on John's solo albums, such as "The Empyrean".

### 1961 Gibson SG/Les Paul Custom (Cherry)

- 3 Humbucking PAF pickups
- Rosewood thin taper neck 12" radius
- Medium-jumbo vintage frets.
- 3-way pickup selector
- Maestro Vibrato
- Can be seen in "Fortune Faded" video

### Fender Bass VI



- 3-way pickup selector
- Rosewood fingerboard 7.25" radius (30 length)
- Fender floating tremolo arm
- Three Single Coil Pickups
- Tuned 1 octave below guitar

### 1961 Fender Precision Bass (White)

- Single split coil pickup
- C shape rosewood 7.25" radius neck
- Vintage frets
- Alder body



## Guitars

The Telecaster was used widely between 2003-2005 and was featured on many songs on the "Live at Slane Castle" album. The main distortion tone for lead playing was acquired with use of the Boss DS-2 Turbo Distortion pedal. The Gretsch White Falcon is exclusively used for "Otherside" and "Californication" and is played through the Fender Showman amplifier.

### 1962 Fender Stratocaster (White)

- Seymour Duncan Antiquity II Pickups
- Rosewood Thick C Shape Neck. 7.5 radius.
- Vintage Frets
- 5-way pickup selector.
- Alder Body

### 1962 Fender Telecaster (Sunburst)

- Rosewood Thick C Shape Neck 7.5 radius
- Vintage Frets
- 3-way pickup selector.
- Double bound alder body
- Featured on "Live at Slane Castle"

### 1957 Gretsch White Falcon

- Hollowbody
- Arched laminated maple top
- Ebony Fretboard 12 radius
- Filter'tron pickups
- 3-way pickup selector
- Bigsby vibrato tailpiece
- Gold plated hardware
- Used exclusively on "Californication" and "Otherside"



## Guitars

The Fender Jaguar has been in John's possession longer than any other guitar in the collection.

### 1962 Fender Jaguar (Fiesta Red)

- C-Shape Maple neck
- Rosewood fretboard 7.25" radius
- Vintage Style Frets
- 2 single coil pickups
- 2-way pickup selector
- Alder Body
- Vintage Jazzmaster Tremolo Arm

### Gibson ES-175

- Fully hollow body construction
- Bound Rosewood Fingerboard
- Maple Thick Oval Shape Neck 12" radius
- Two humbucking pickups
- 3-way pickup selector.
- Left-Handed Vintage Tremolo.
- Floating rosewood bridge
- Medium-Jumbo frets

### Gibson ES-335

- Maple Semi-hollow body construction
- Bound Rosewood Fingerboard
- Maple Thick Oval Shape Neck 12" radius
- Two humbucking pickups
- 3-way pickup selector
- Bigsby vibrato tailpiece
- Medium-Jumbo frets



## Effects

**MXR Micro Amp**
- Gain 5/10

**Electro-Harmonix Big Muff**
- Volume 4/10
- Tone 10/10
- Sustain 10/10

**Electro-Harmonix English Muff'n**
- Output 6/10
- Input 8/10
- High 4.5/10
- Mid 5/10
- Low 7.5/10

**Boss DS-2 Turbo Distortion**
- Tone 10/10
- Level 10/10
- Distortion 8/10
- Mode II

**Ibanez WH-10 Wah Pedal**
- Guitar mode
- Sweep 10/10

**Boss Chorus Ensemble**
- Low Setting
- Level 4/10
- Intensity 6/10
- Depth 5/10
- Vibrato 7.5/10

**Electro-Harmonix Holy Grail Reverb**
- Spring Mode
- Mix 6/10

**Line 6 FN-4 Filter Modeler**
- Obi Wah
- Frequency 6.5/10
- Q 6.5/10
- Speed 6/10
- Mode 4/10
- Mix 3/10

**Line 6 DL-4 Delay Modeler**
- Used as a tap tempo multi delay
- Used as a tap tempo triplet delay

**Electro-Harmonix Electric Mistress**
- Color 4/10
- Range 7/10
- Rate 7/10

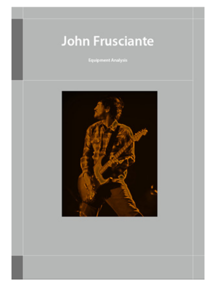
**Moog MuRF**

**Moog MF103 Phaser**

**Digitech PDS1002 Digital Delay**
- Time 5/10
- Regen 4/10
- Mix 5.5/10

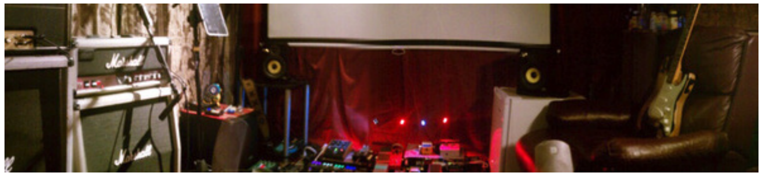
**Line 6 FN-4 Filter Modeler (alternate settings)**
- Seeker
- Frequency 4/10
- Q 4/10 Mode 6/10
- Speed 7/10 Mix 6/10
- Spin Cycle
- Frequency 7/10
- Q 6.5/10 Mode 5.5/10
- Speed 3/10 Mix 1010






# Music

Engineering specification meets creative expression - I have taken the time to catalog over 300 pages of information on the equipment and setups of my favorite guitarists and their respective settings and specifications. This was derived from an urge to be capable of reproducing exactly the same tones as can be heard on recordings. The full catalog of information can be viewed on my website at paulstew.prosite.com



architecture / engineering / design

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