



V1 CANOPY DESIGN CONCEPT

HADID E1

The canopy's primary purpose is to create a new structure that flows over the gaps between buildings, defining a contrast between itself and the cubic facade of V1. To achieve this, inspiration was taken from BIG's Serpentine Pavilion's use of the same modular component to create a curved form. The canopy focuses on durability, sustainability and visual attraction. With the use of cor-10 steel, the final design is aimed to be incredibly long-lasting with minimal maintenance.

"9C6241"

Serpentine Gallery Pavilion 2016 - Bjarke Ingels Group



Serpentine Gallery Pavilion 2016 (Frearson, 2016)



Serpentine Gallery Pavilion 2016 (Frearson, 2016)

The 2016 Serpentine Pavilion's design concept became a starting point for our design. We really enjoyed the simpleness of repeating patterns yet it's complexed simultaneously when looked from afar. The Serpentine was created from pultruded fiberglass "bricks," which let in light and views to the interior of the pavilion through each wall. This inspired us to incorporate passive design in creating a canopy that creates a sense of "openness" to all users. Its design for structural integrity and the architect's way of making structure becoming gesture was another brilliant touch that got us inspired of using metallic extrusions as structural connections between each blocks.

DUO Towers - Buro Ole Scheeren



DUO Towers (Block, 2018)



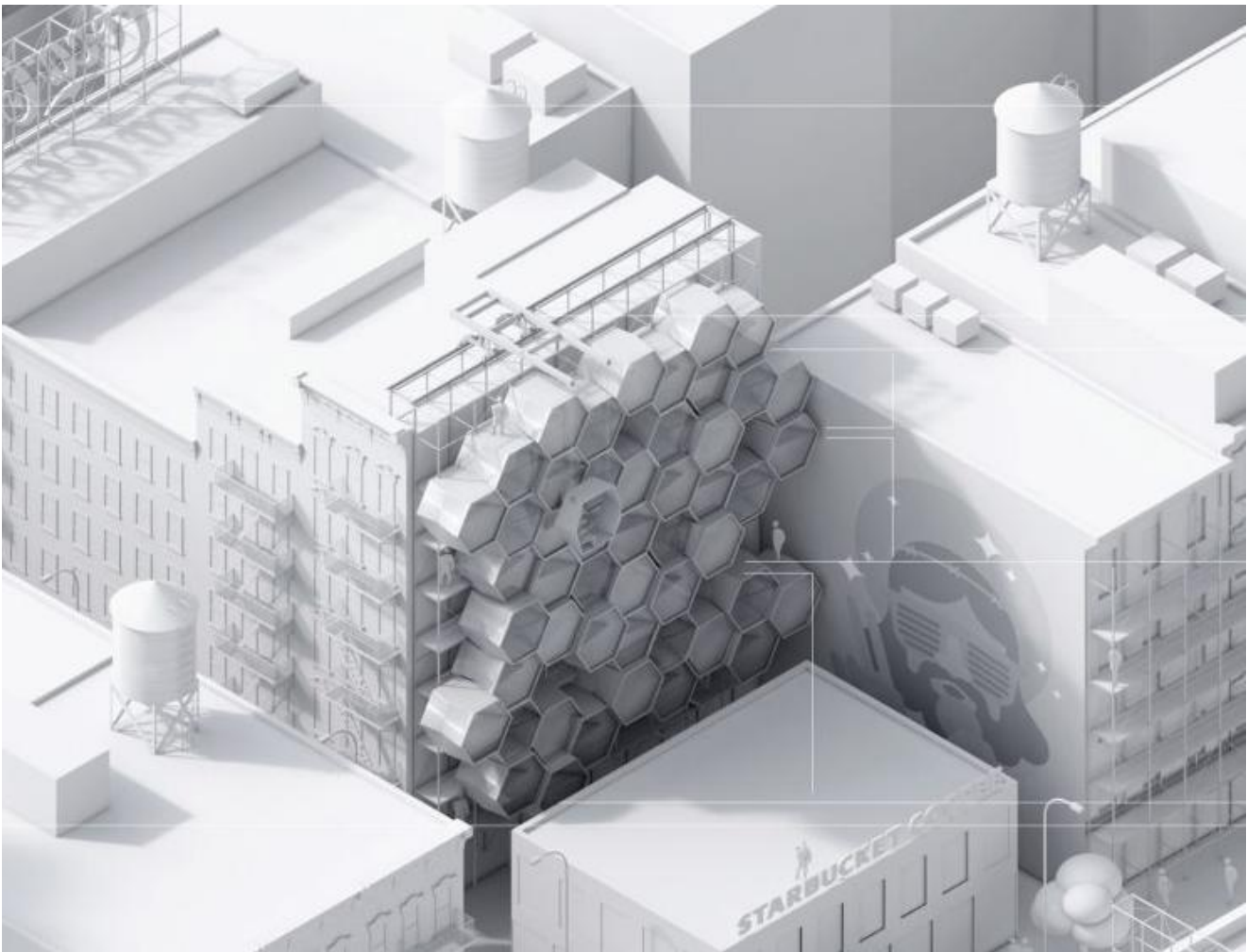
DUO Towers (Buro, 2021)

The DUO Towers located in Singapore inspired our design because of its hexagonal pattern throughout the entire envelope. As seen from the image on the left, the hexagons fit perfectly with each other as it creates an uniform layer. While giving the building visual identity, the hexagonal frames also provided shading from the sun. As a result, we were inspired to incorporate hexagonal designs into our canopy both as an architectural definition and as a passive method for shading/rain protection.

Homed - Framlab



Homed (Gibson, 2017)



Homed Rendered View (Lusiardi, 2018)

The building, Homed, designed by Framlab in New York is another precedent we referred to due to its hexagonal design. The perfection in fitting hexagons together was a factor we really enjoyed. Furthermore, the placements of hexagon units with varying depths inspired us to perhaps include this as a passive design in our canopy to provide maximum shading/rain protection for the users. In fact, the extrusions of hexagons added more definition to the building facade in comparison to adjacent buildings as seen in the image on the right.

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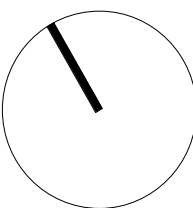
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REV.	ISSUE	DATE
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Jeffery Li
#20829422
Mathew Song
#20822363



V1 Canopy Project
200 University Ave W., Waterloo, ON N2J 4B6

Title:

Precedents/Inspirations

Project No.	0001	Scale	N / A
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Drawing No.

A200

Owl Creek Residence - Skylab Architecture



Owl Creek Residence (Ho, 2021)



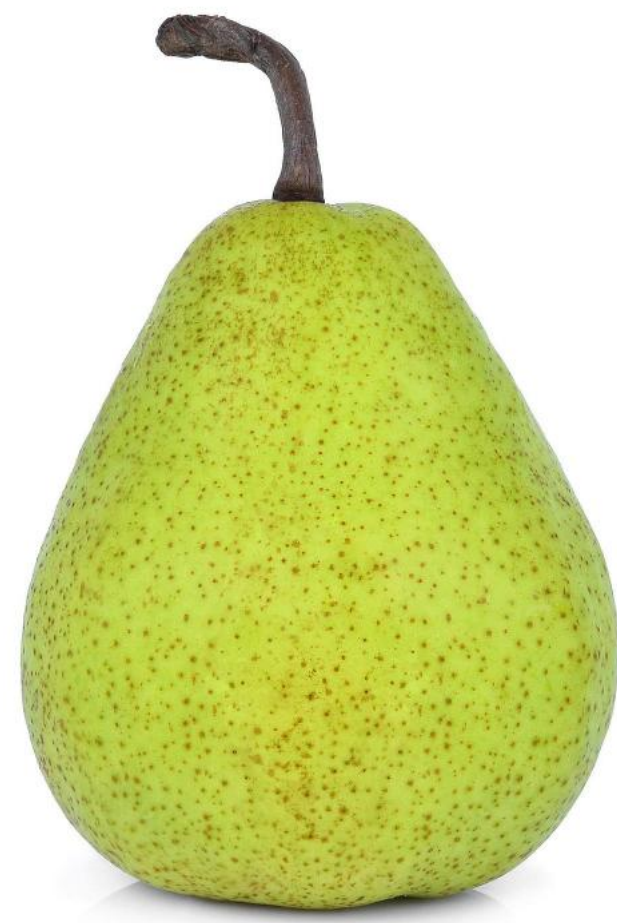
Owl Creek Residence (Brillon, 2018)

While searching for material inspirations, we stumbled across this beautiful resort house in Colorado: the Owl Creek Residence. The material choice of combining corten steel and wood together in this design inspired us to take a similar approach. We were struggling to find durable materials that match the canopy with the overpass as it consists of wooden louvres. Our initial approach was to use Glass Fiber Reinforced Polymer (GFRP) but we were afraid its artificial appearance may create a huge contrast with the adjacent wooden louvres. However, this precedent showed us the pleasant and natural interaction between wood and corten steel and thus influenced our material choice away from using GFRP.

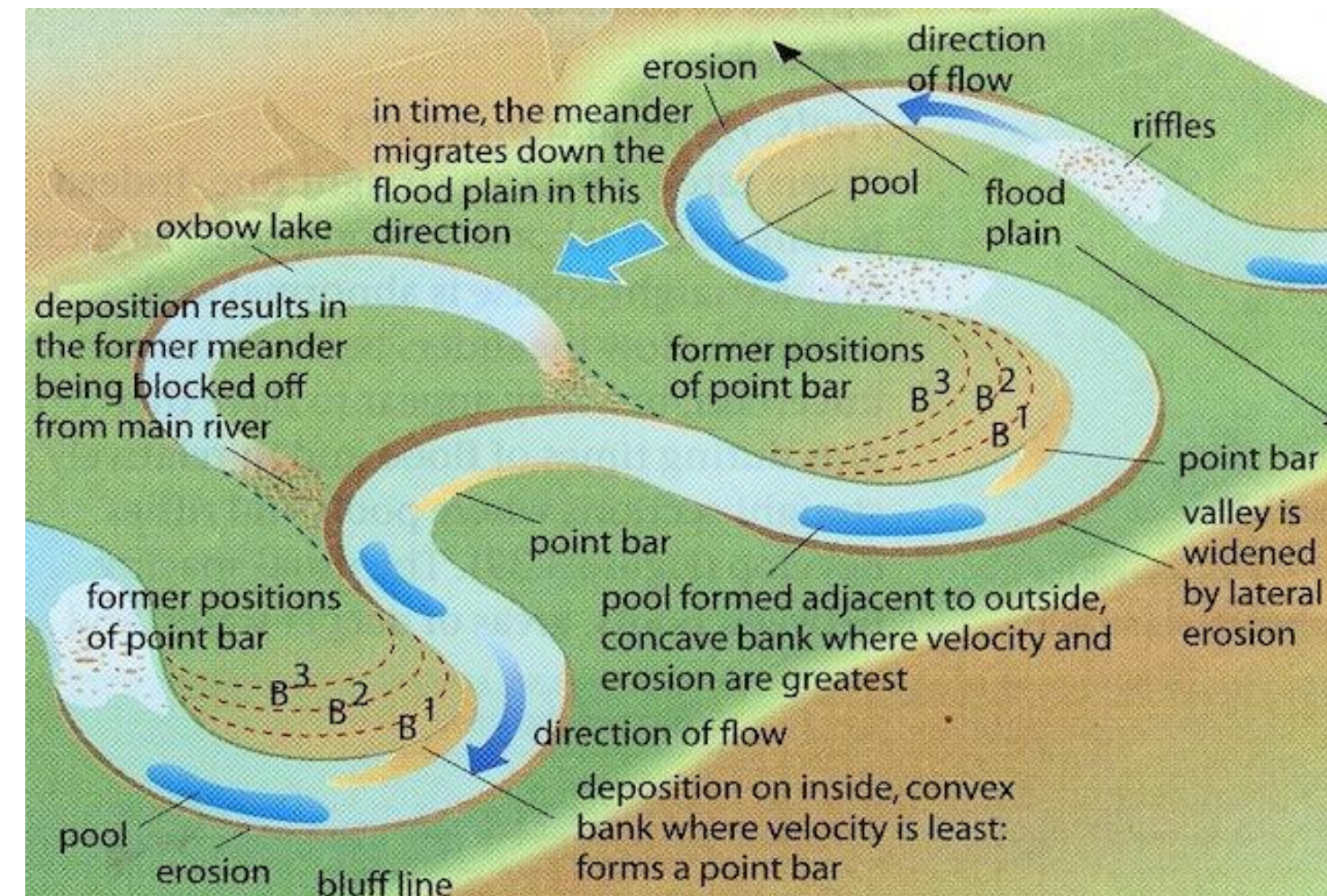
Precedents for Canopy's Overall Shape



Light-bulb (Shutterstock, 2019)



William Pear (Purohit, 2019)

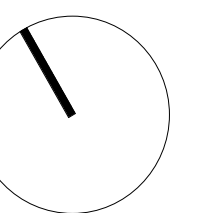


Streams Diagram (Lemke, 2021)

The organic shape of a light-bulb or a pear was something we were looking into as the shape of the canopy. Due to design for structural integrity, the top of the canopy has to be connected to the roof. Rather than merely having the hexagonal patterned canopy go down in a straight slope, we decided to add an organic curve similar to the ones seen here by extruding the hexagon blocks of our design in varying depths.

Another precedent we referred to when deciding the overall shape of our canopy is the curved nature of streams as seen in the left image. We tried to imitate in having a shape that guides water down from the canopy to the ground smoothly and the stream curve is a perfect example we found that use curves to naturally direct water flow. As a result, we decided to have the hexagons a little sloped downwards so water can be directed downwards by a "curve-like" shape.

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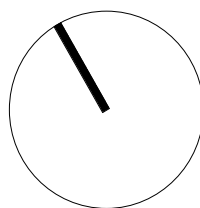
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Drawing No.

A202



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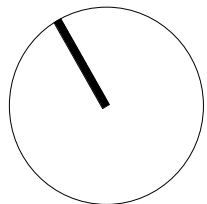
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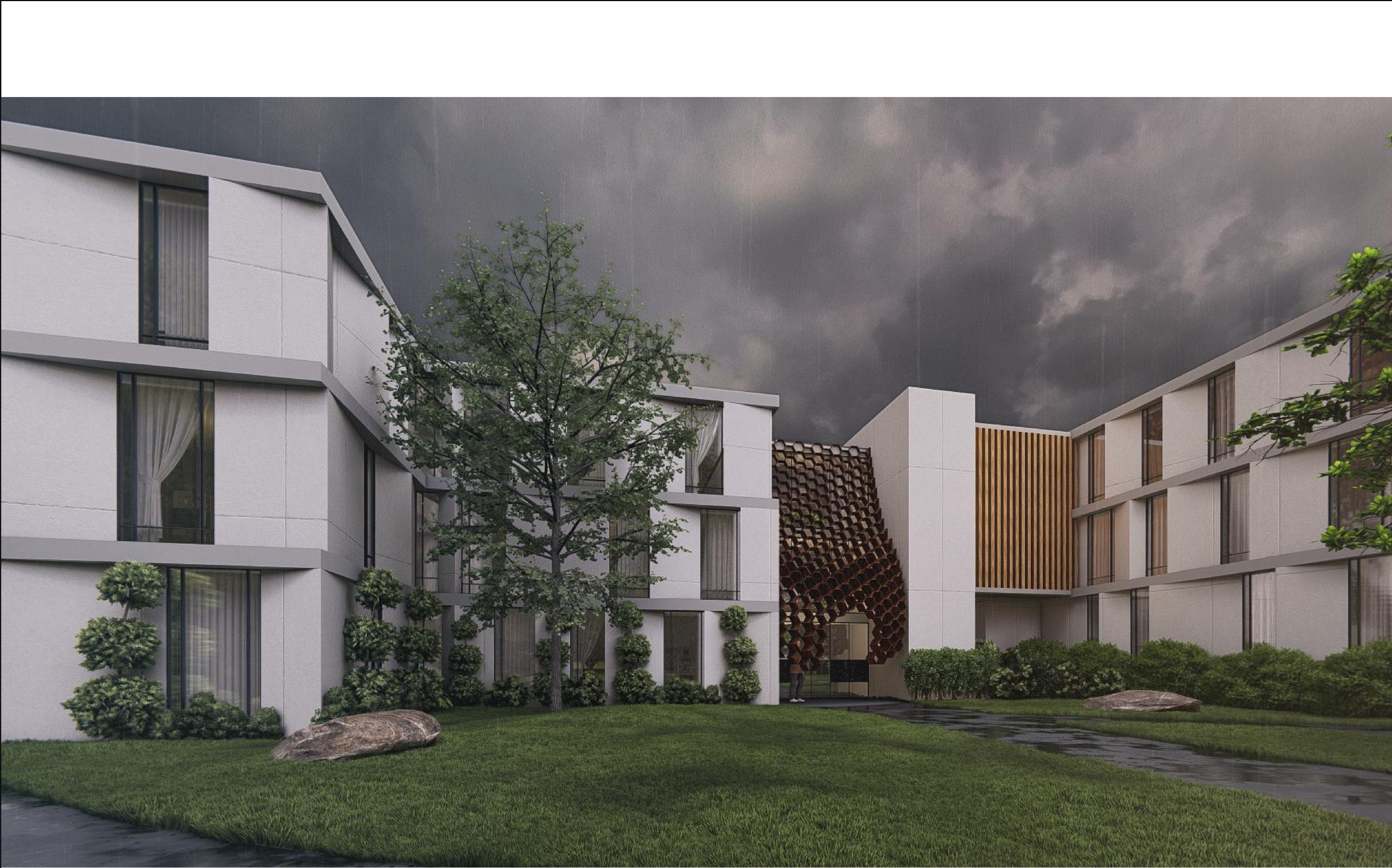
Title:

Canopy 3D Sunny
Rendered View

Project No.	0001	Scale	N / A
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Drawing No.

A203



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HADID E1

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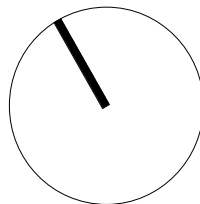
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V1 Canopy Project

200 University Ave W., Waterloo, ON N2J 4B6

Title:

Canopy 3D Rainy
Rendered View

Project No.	0001	Scale	N / A
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Drawing No.

A204



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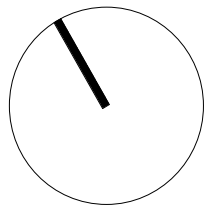
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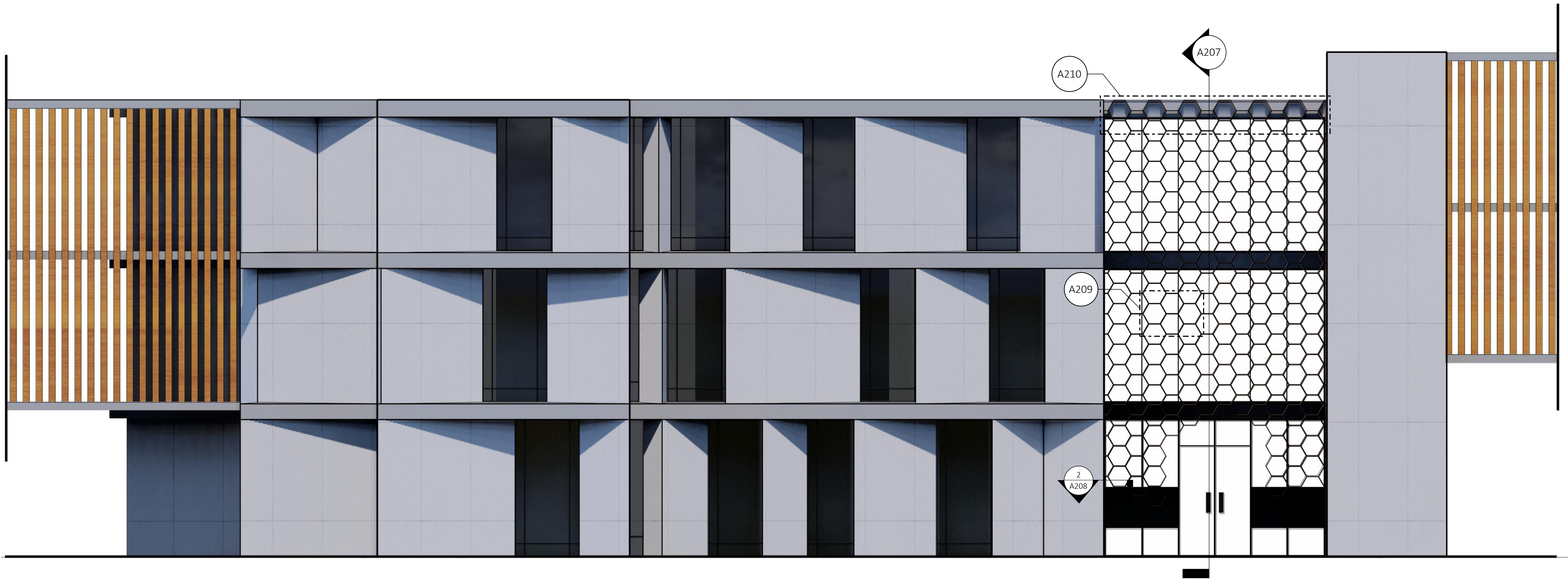
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Vestibule 3D Rendered View

Project No.	0001	Scale	N / A
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Drawing No.

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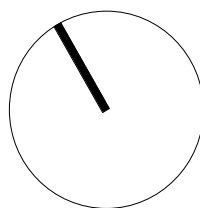
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Title:

Elevation Drawing

Project No. 0001	Scale	1 : 20
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Drawing No.

A206



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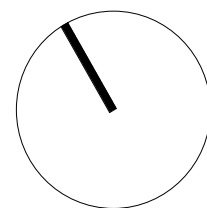
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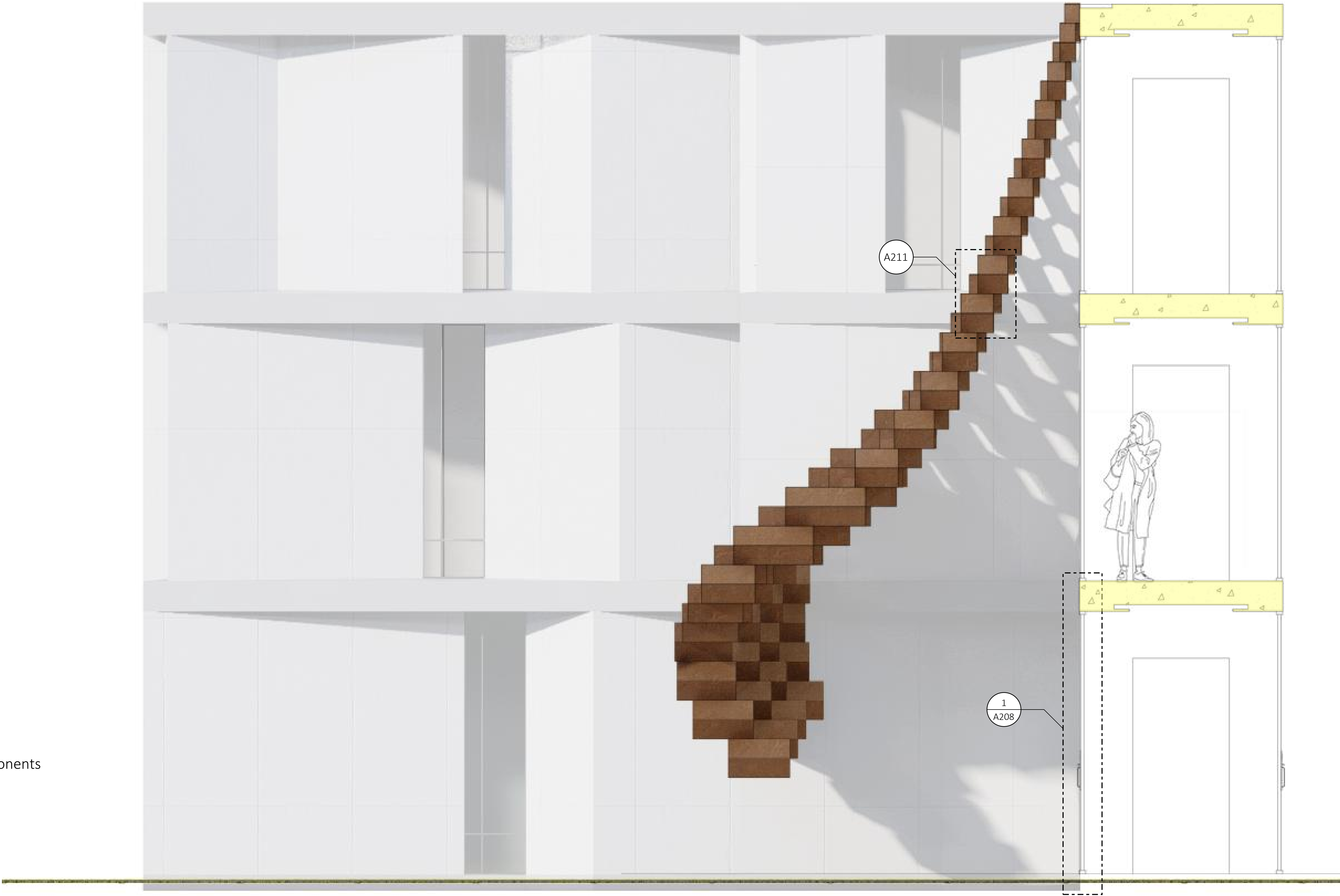
Section Drawing

Project No. 0001	Scale	1 : 10
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Drawing No.

A207

Existing Building Components



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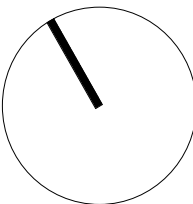
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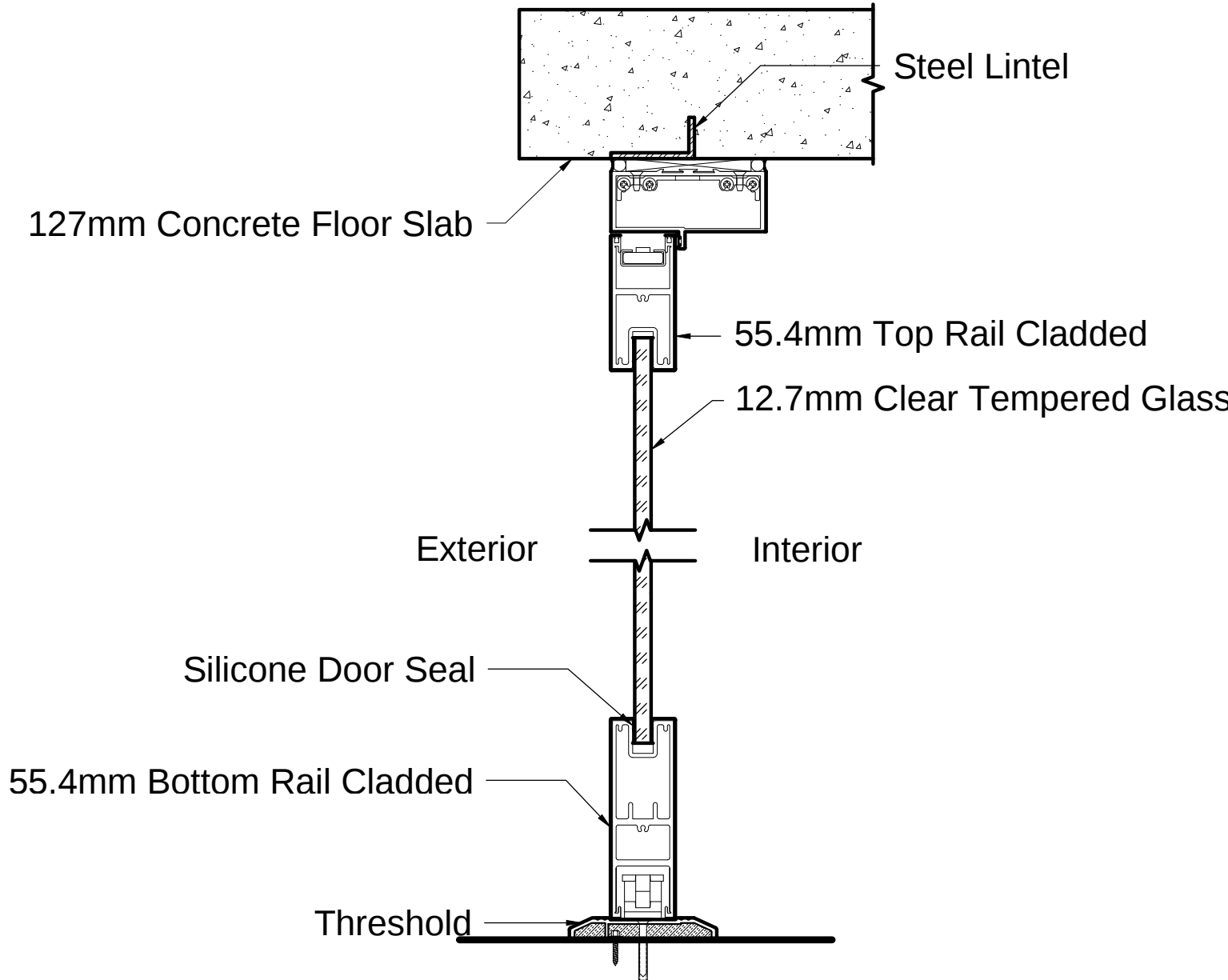
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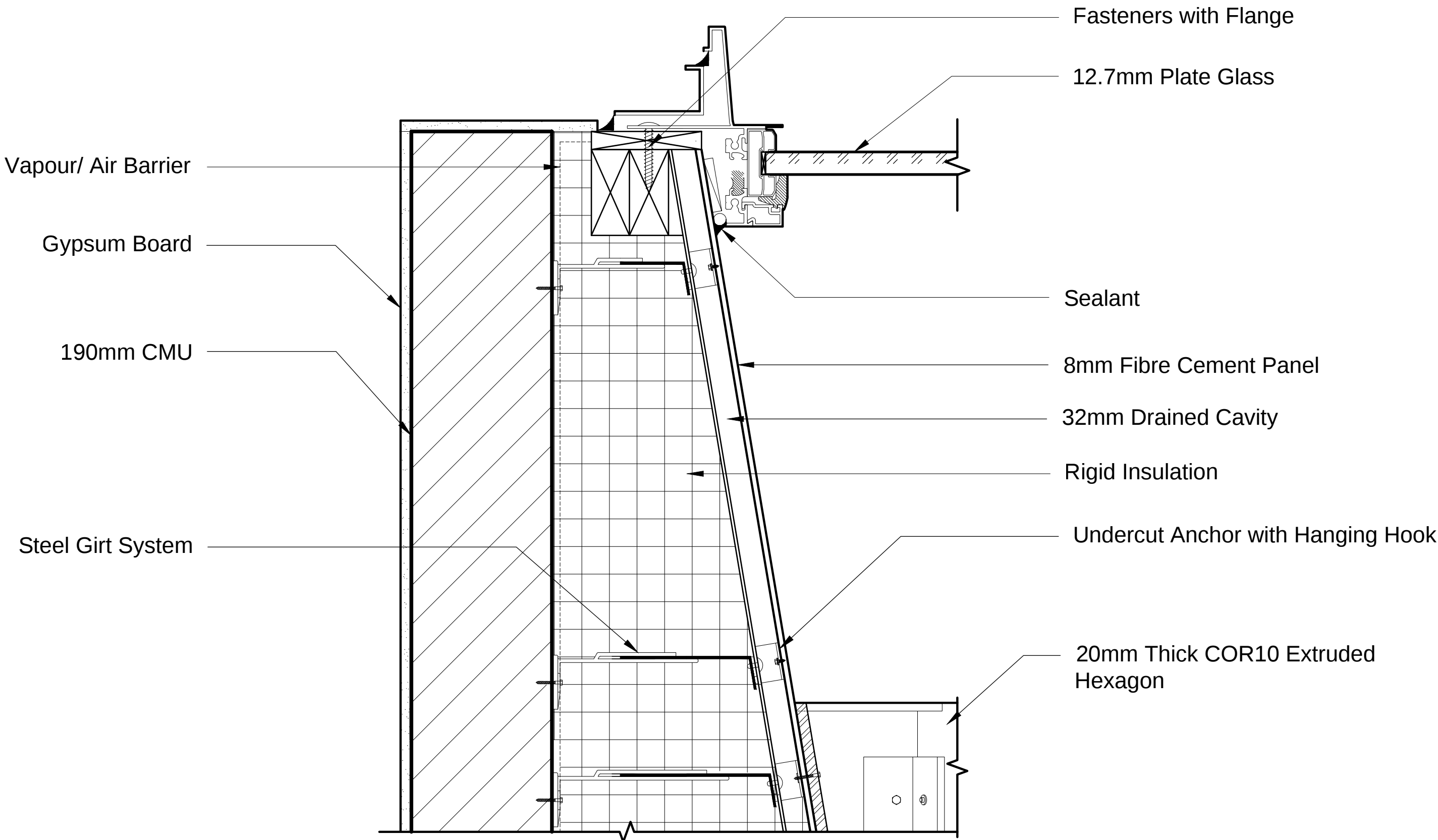
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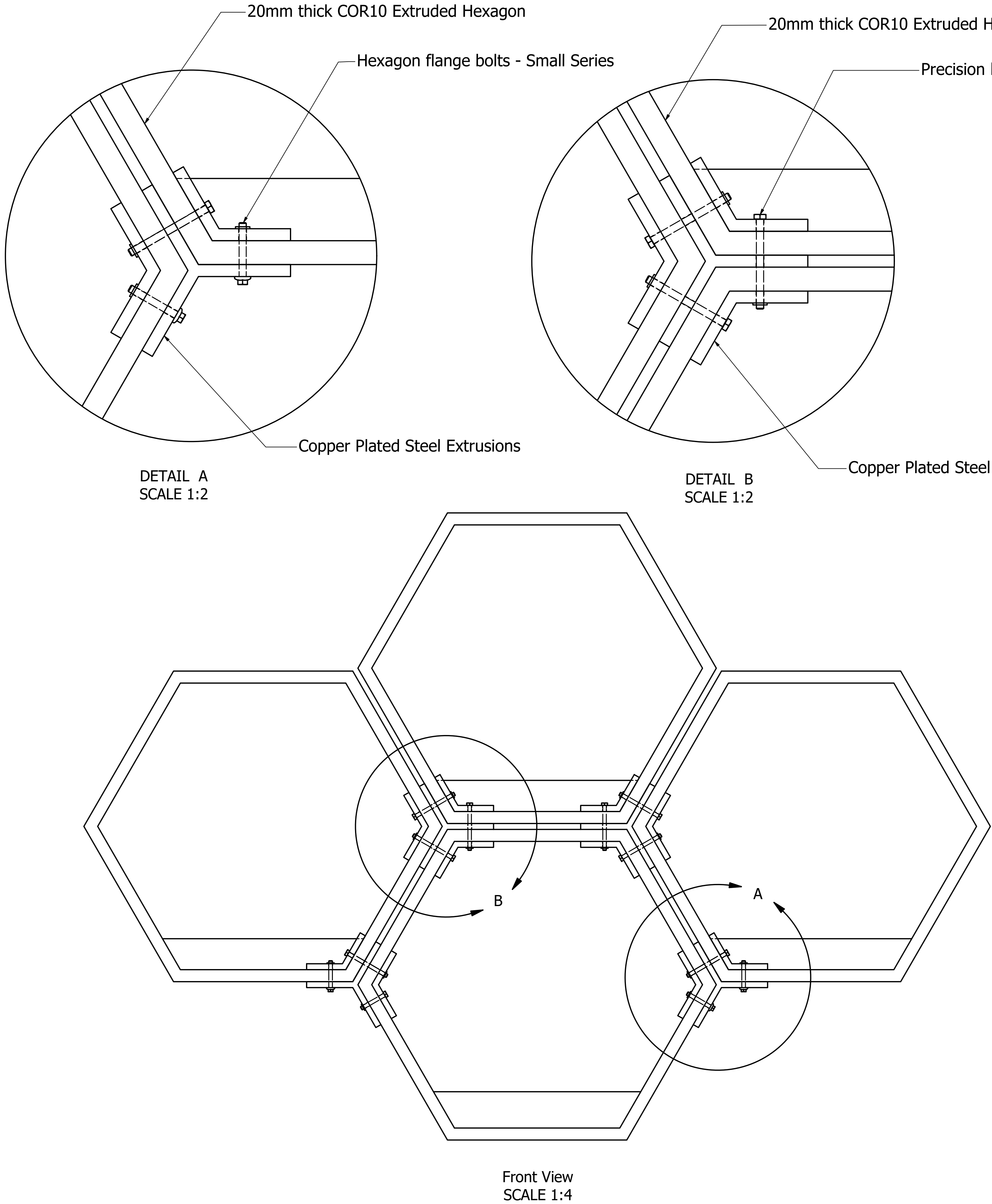
1

Door Detail



2

Jamb to Wall and Canopy to Wall Connection Plan View Detail



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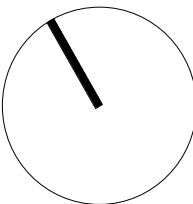
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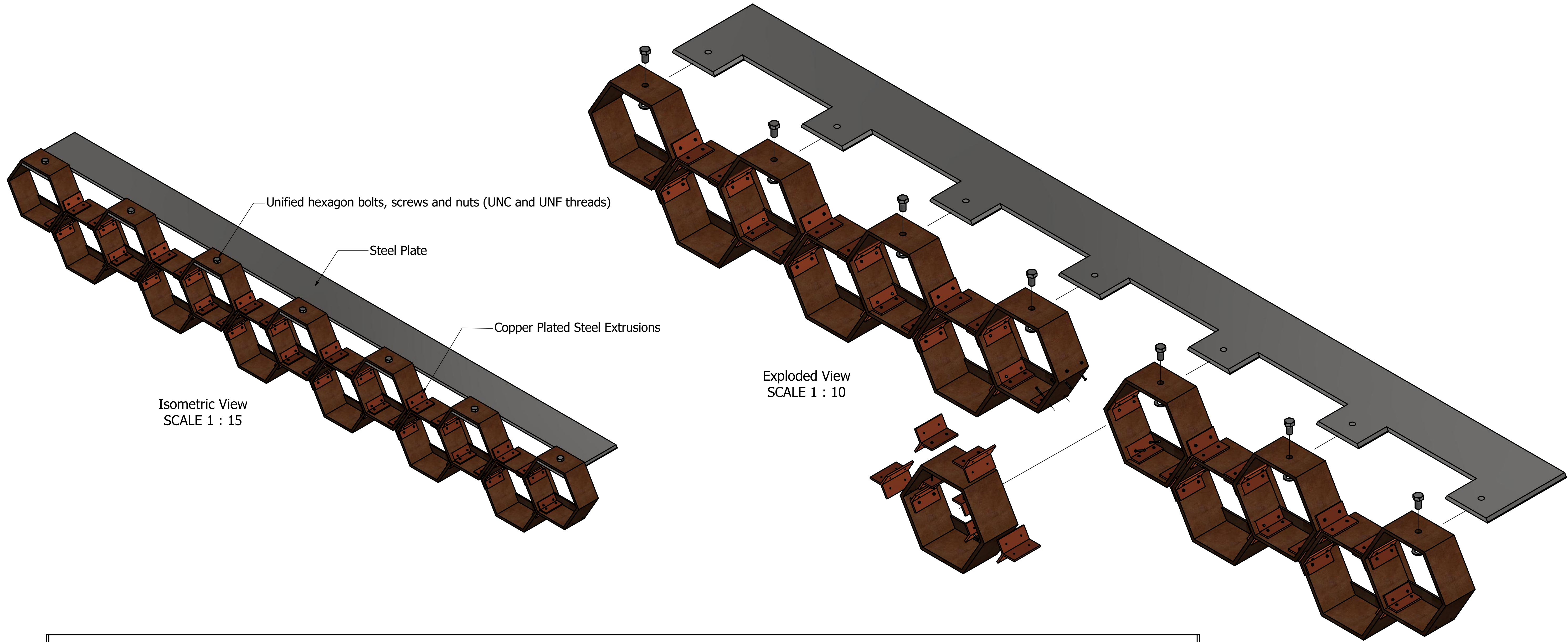
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Extruded Hexagon
Connection Detail

Project No.	0001	Scale	As Scaled
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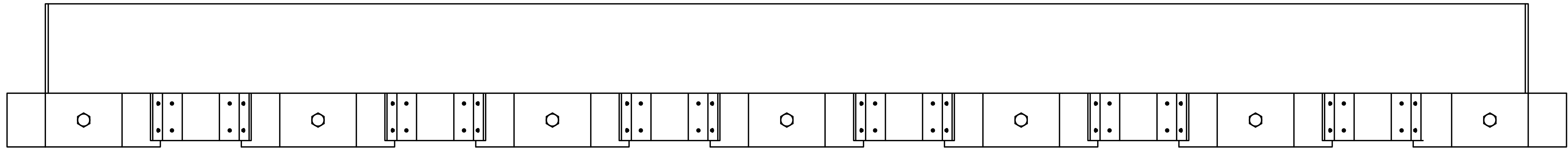
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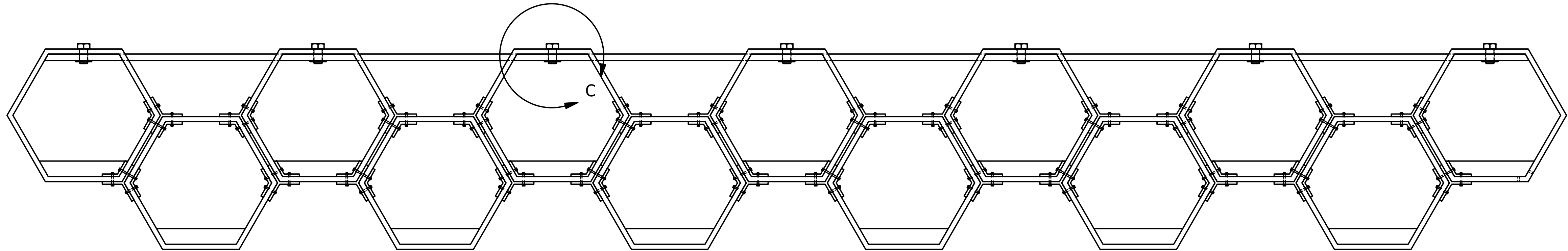


Isometric View
SCALE 1 : 15

Exploded View
SCALE 1 : 10

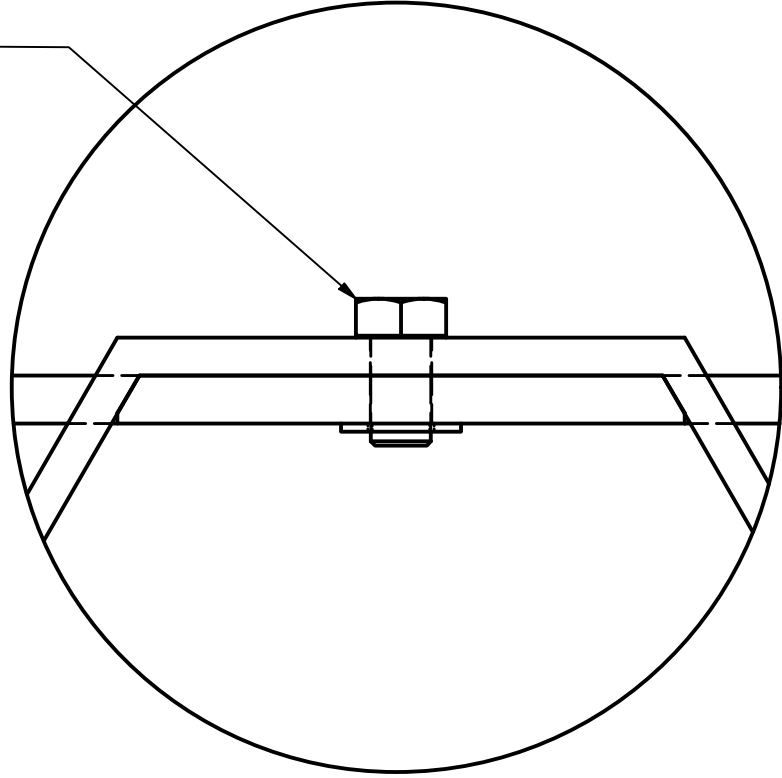


Top View
SCALE 1 : 10



Front View
SCALE 1 : 10

Unified hexagon bolts, screws and nuts (UNC and UNF threads)



DETAIL C
SCALE 1 : 4

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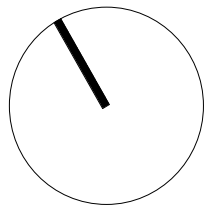
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V1 Canopy Project
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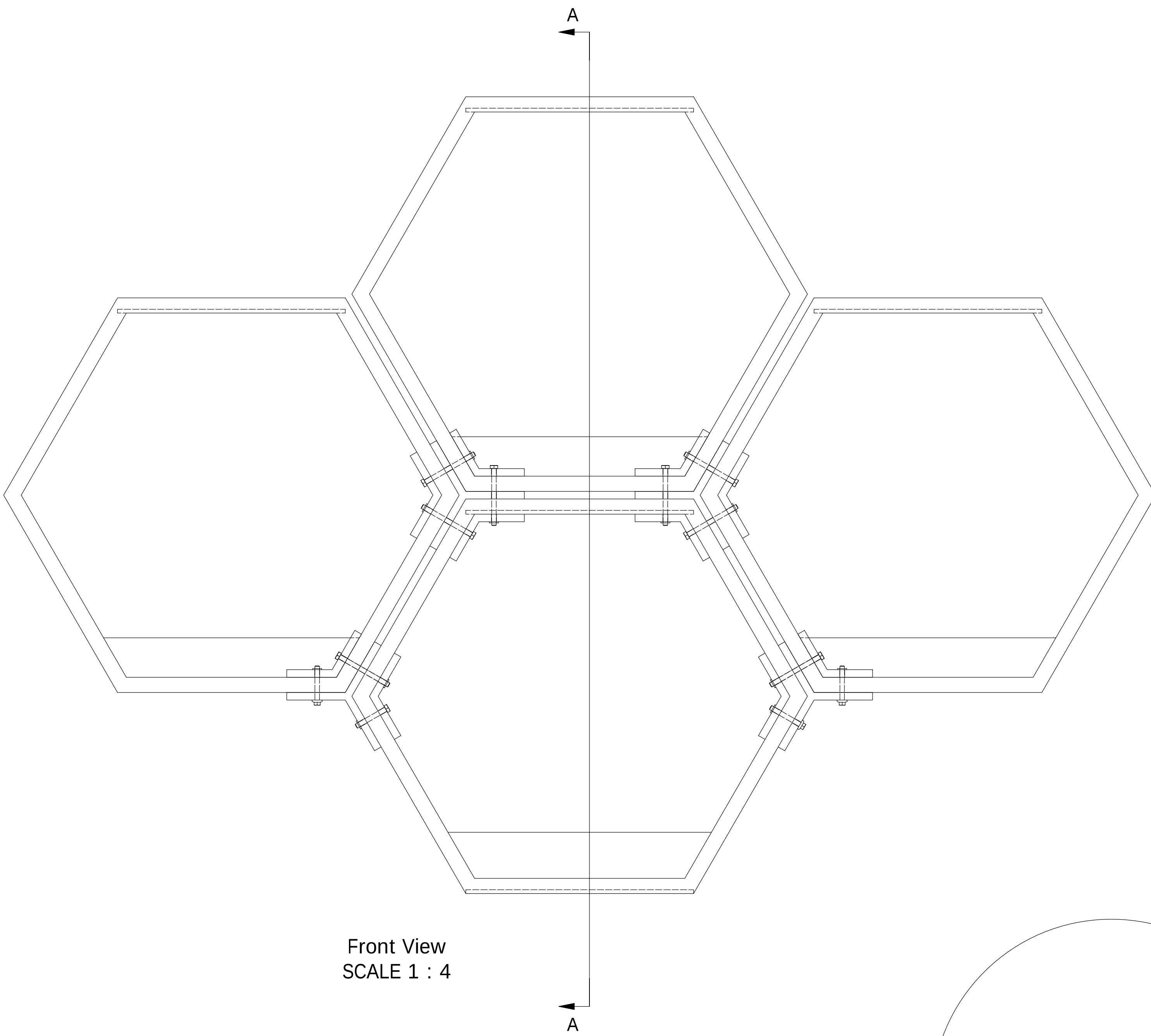
Title:

Canopy to Roof Connection
Detail

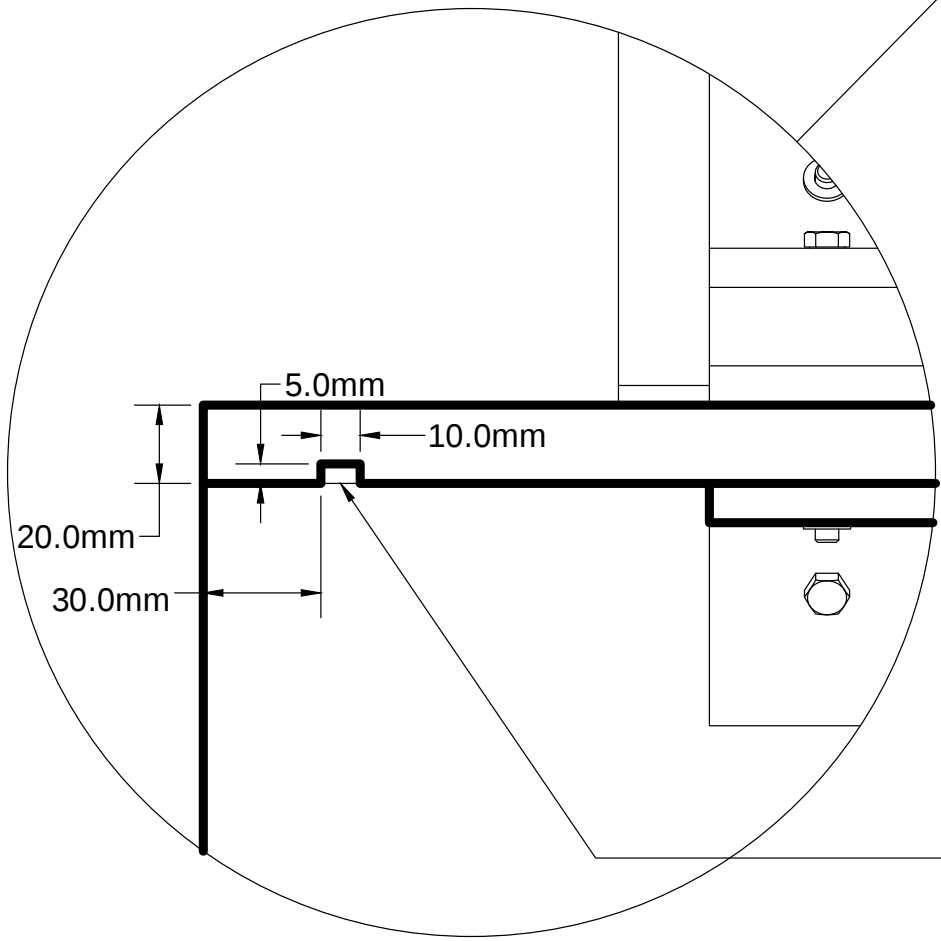
Project No. 0001 Scale As Scaled

Drawing No.

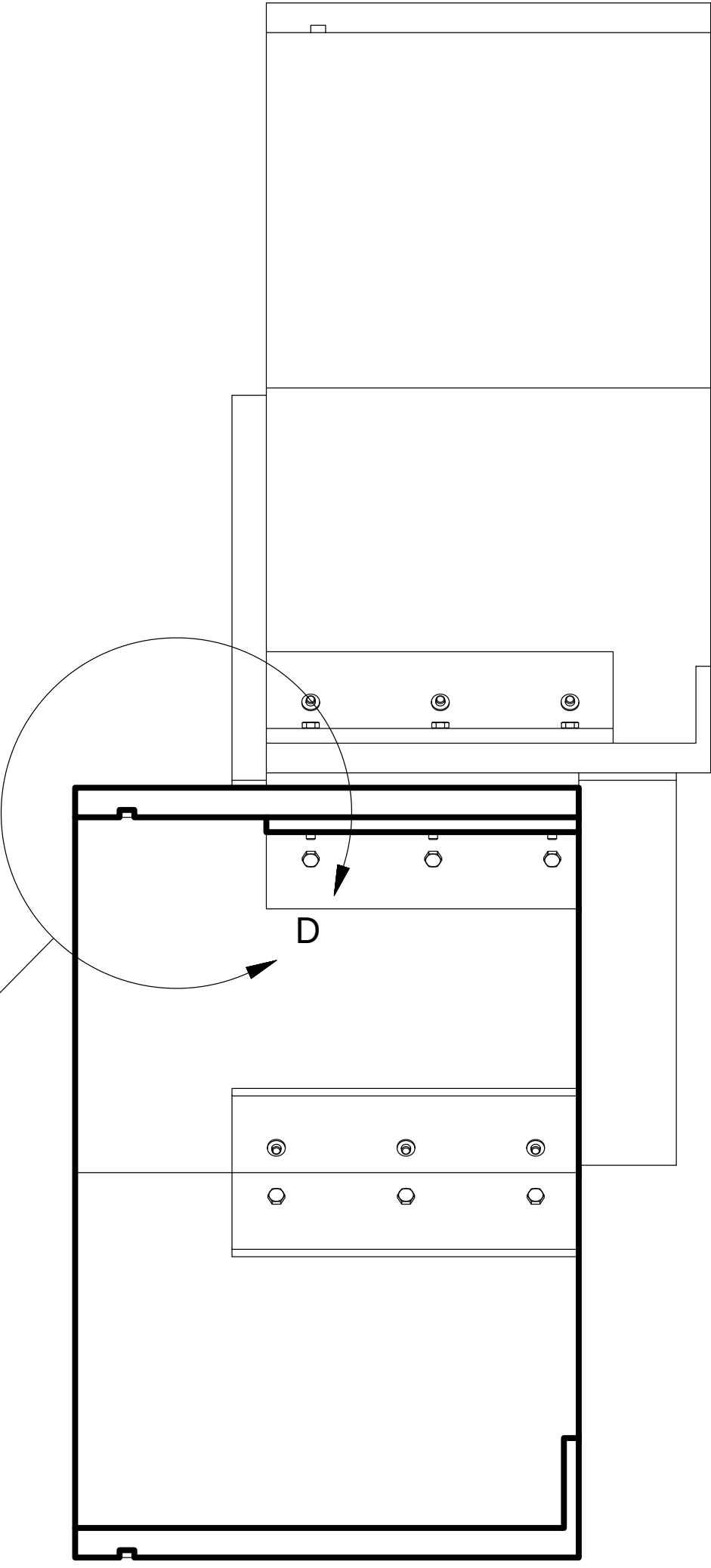
A210



Front View
SCALE 1 : 4



DETAIL D
SCALE 1 : 2



SECTION A-A
SCALE 1 : 4

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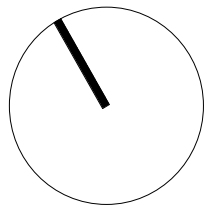
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REV.	ISSUE	DATE
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Jeffery Li
#20829422
Mathew Song
#20822363



V1 Canopy Project
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Title:

Drip Edge Detail

Project No. 0001 Scale As Scaled

Drawing No.

A211

Given that the canopy design consist of multiples of hollow COR-10 steel extruded hexagons, lack of rain/snow protection can be a concern for the users. However, we've added a few minor features which guarantees the canopy's resistance to rain and snow:

- 1. A drip groove is added on the top and bottom of the hexagon so water caused by rain or moisture can be stopped from running backwards and thus drip on the users below (Refer to A210)
- 2. The entire structure (including all hexagons) are sloped downwards with 1 degree angle. This angle is small enough to be not noticed visually while big enough to ensure water don't become stationary on the canopy
- 3. An extra cap is added at the end of each hexagon in prevention of slanted rain when the 1 degree slope is not sufficient enough to stop water from traveling backwards

In addition, we conducted a study to provide quantitative data in ensuring the three methods mentioned above are sufficient in rain/snow protection.

According to the statistics of the average wind speed in Waterloo done by Weather Spark, the maximum average wind speed for Waterloo annually is around 22.5km/h or 6.25m/s. Refer to Table 1 for the wind speed data in Waterloo.

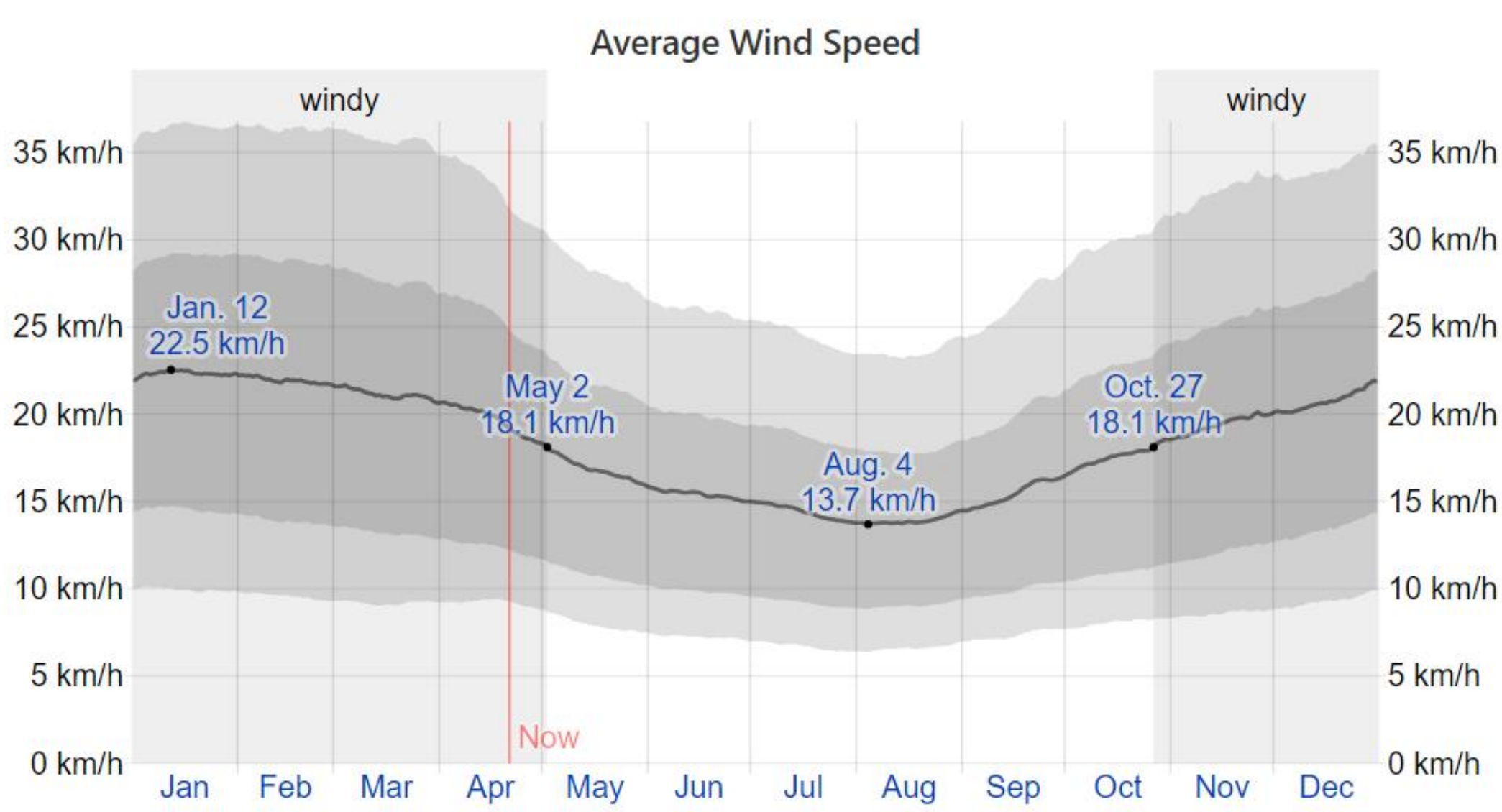
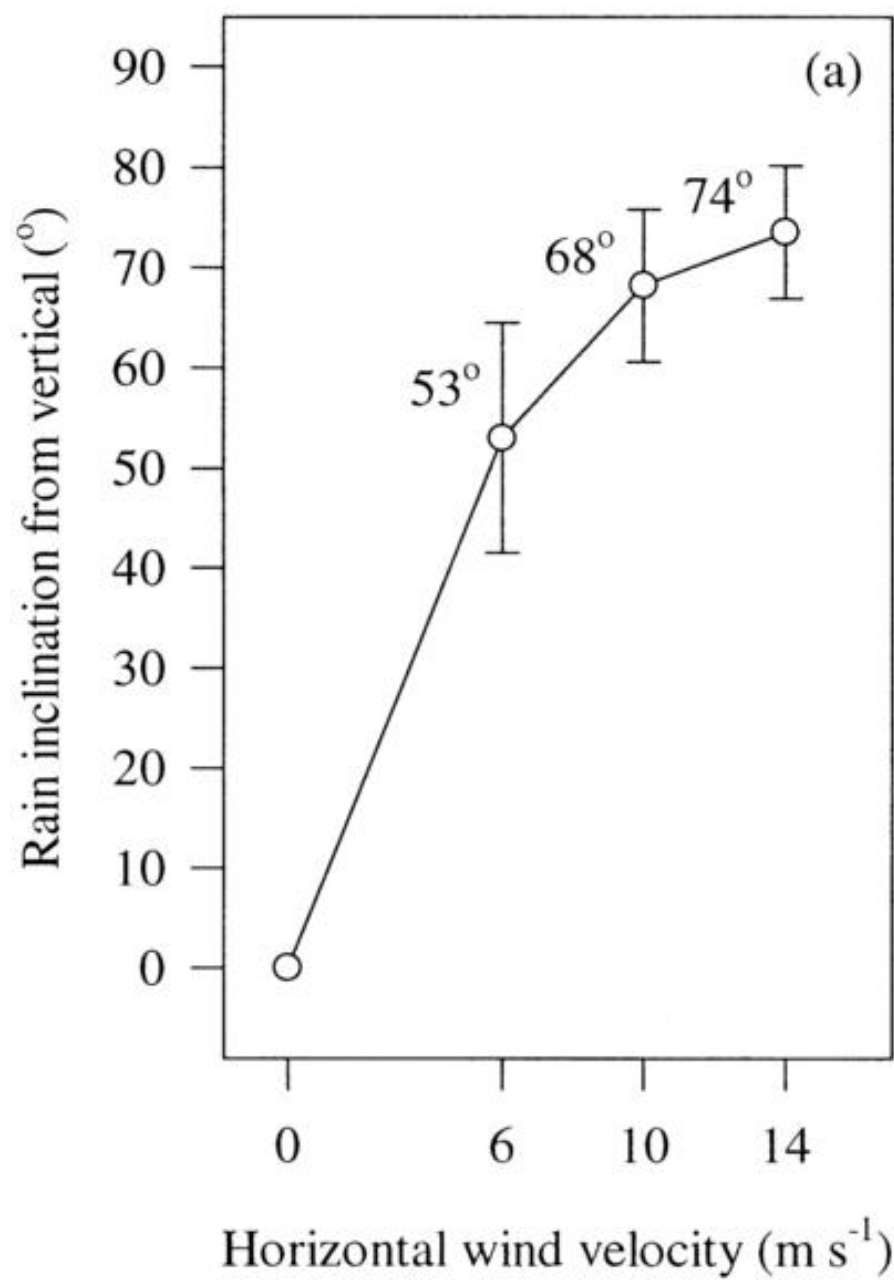


Table 1 - Average Wind Speed in Waterloo [1]

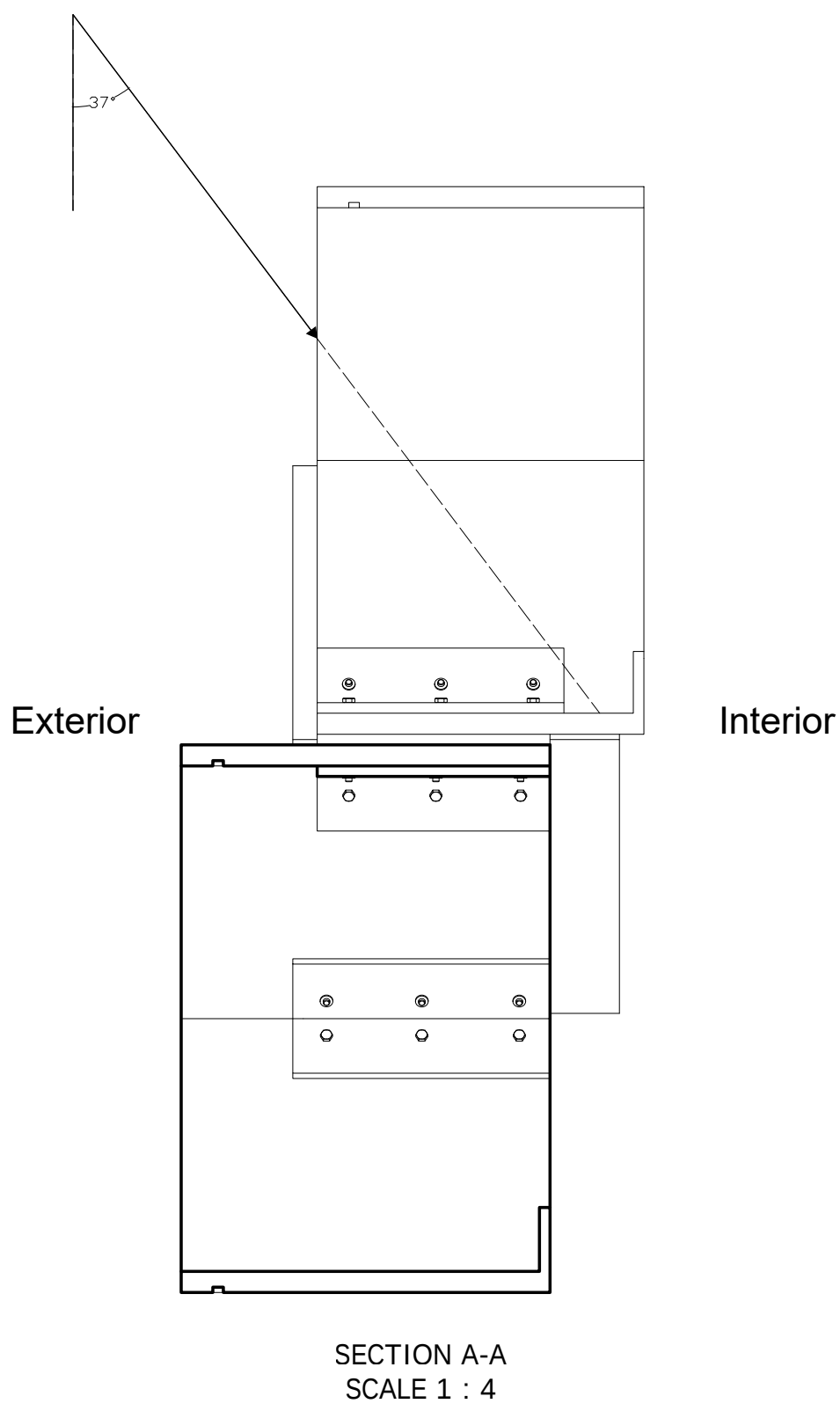
Of course, horizontal wind speed dictates the angle and direction of the rain and thus making slanted rain possible. According to a study on the correlation between horizontal wind velocity and rain inclination, professors in Ankara University have constructed their findings in graph 1.



Graph 1 - Rain Inclination vs Horizontal Wind Velocity [2]



Based on Graph 1, having a wind velocity of 6.25m/s corresponds to a rain inclination of approximately 53 degrees from the vertical. As seen below, slanted rain with 53 degrees is not angled too horizontally that it'll go directly though the hexagon and cause trouble for the users below. In the worse case scenario, the slanted rain will hit the cap at the end and be guided downwards to the exterior side of canopy by the 1 degree slope. Thus, we utilized passive design strategies to ensure the user is protection from rain and snow.



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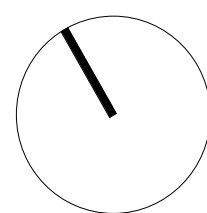
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Jeffery Li
#20829422
Mathew Song
#20822363



V1 Canopy Project
200 University Ave W, Waterloo, ON N2J 4B6

Title:

Rain and Snow
Protection Concept

Project No.	0001	Scale	N / A
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Drawing No.

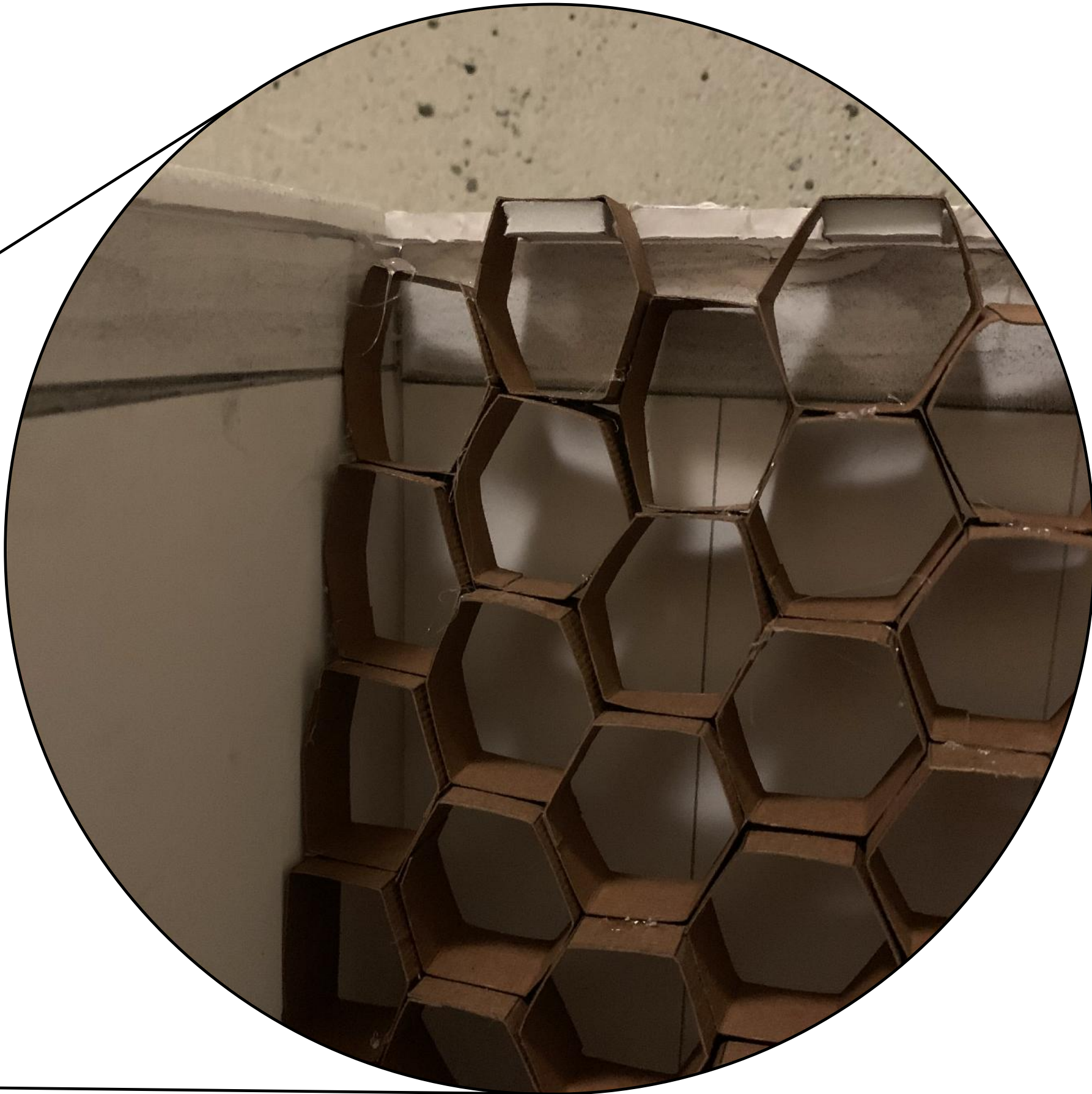
A212

[1] Erpul, G. & Darrell, Norton & Gabriels, Donald. (2003). The effect of wind on raindrop impact and rainsplash detachment. Transactions of the ASAE. 46. 10.13031/2013.12548.

[2] WeatherSpark. (2021). Average Weather in Waterloo, Canada. Average Weather in Waterloo, Canada, Year Round - Weather Spark.
<https://weatherspark.com/y/19227/Average-Weather-in-Waterloo-Canada-Year-Round#:~:text=The%20windier%20part%20of%20the,May%202%20to%20October%2027.>

"9C6241" 1 : 20 Paper Model

The paper model is an accurate replica of the V1 East 5 Building with the canopy in 1:20 scale. Its unique pattern of extruded hexagons at various depths are made out of card stock paper. It's essential to note that the canopy does not touch the floor at all. It's completed supported by the top and sides.



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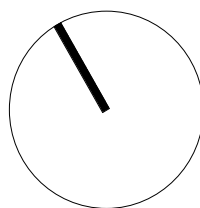
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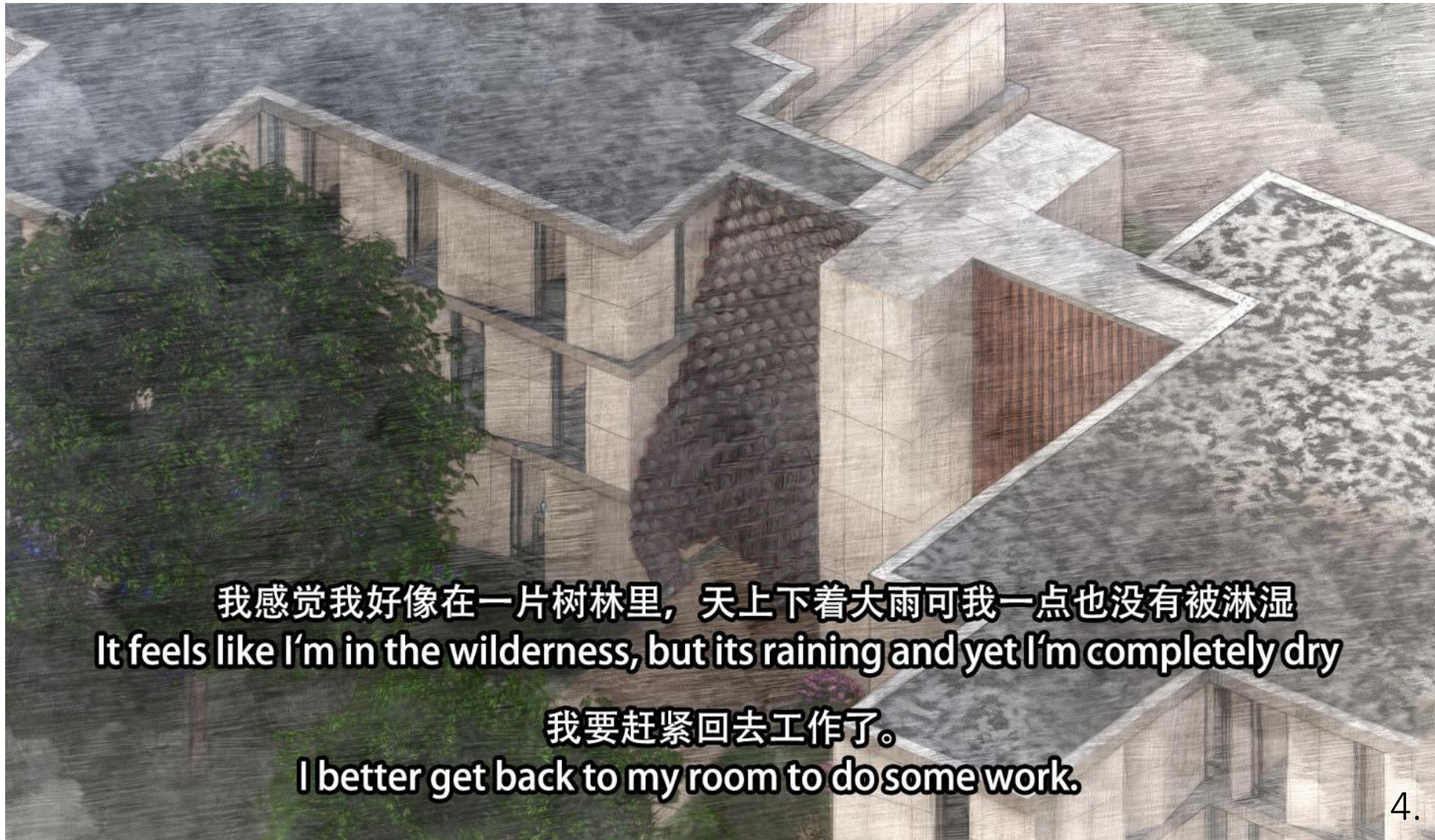
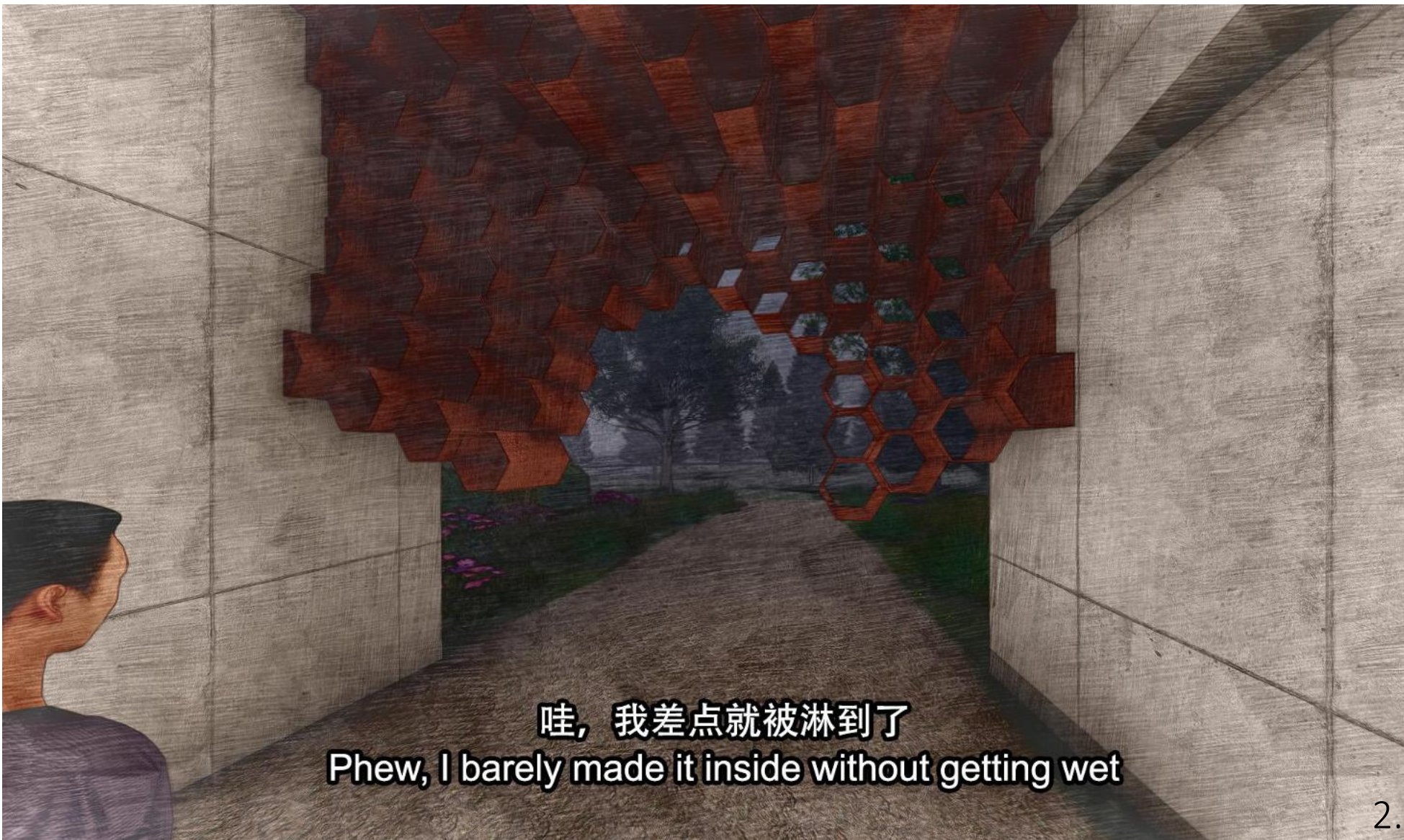
V1 Canopy Project
200 University Ave W, Waterloo, ON N2J 4B6

Title:

Paper Model

Project No. 0001	Scale	1 : 20
Drawing No.		

A213



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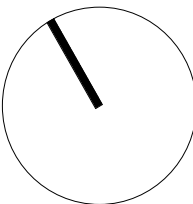
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Jeffery Li
#20829422
Mathew Song
#20822363



V1 Canopy Project
200 University Ave W, Waterloo, ON N2J 4B6

Title:

Use Scenario

Project No. 0001	Scale	N / A
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Drawing No.

A214

March 23rd (3 Main Ideas Presented)

Hadid E1

House Members:
Jeffery Li
Mathew Song

March 31th Desk Critique with Rania, Cory, Jon and Brian

Hadid E1

House Members:
Jeffery Li
Mathew Song

Priorities

- Connection to nature (Comfort)
- Rain Protection
- Connection to facade design

Structural Support Ideas

- Angled metallic (Steel or Aluminum) Extrusions
- Structural Beams (Hidden) (presumably at each floor slab???)
- Supported at roof (through bolts and nails?)

Rain Protection Idea

March 31 Notes:
(Structural Crit with Rania, Cory and Chris)
- No need for structural beams
- Might be concerned about warp
- find ways to avoid birds nesting on the hexagons
- there might be too much wind resistance if we add a cover for rain protection (Crit with Jon and Brian)
- consider using Corten as material
- no need to add spikes to keep birds out
- good idea of using end cap to keep water out

Paper Model Draft

March 24th Desk Critique with Chris and Marco

Hadid E1

House Members:
Jeffery Li
Mathew Song

Priorities

- Connection to nature (Comfort)
- Rain Protection
- Connection to facade design

Structural Support Ideas

- Angled metallic (Steel or Aluminum) Extrusions
- Structural Beams (Hidden) (presumably at each floor slab???)
- Supported at roof (through bolts and nails?)

Notes from Crit (March 24, 2021)

CHRIS:
- Structure Concern (potentially add tension cords vertically)
- maybe use Autodesk Fusion
- Add sun diagram and color to section and elevation
- Expand on comic strip
- Remove blocked windows
MARCO:
- Hanging from roof the stuff needs to be connected
- consider ways to make the beams hidden
- adding transparent sheet at back vs front
- Back sheet can be a concern for snow load
- Front sheet can be concern abt light reflection
- Hexagons at side walls spill at half so there are 2 connection points
- look for detail drawings from serpentine precedent

Elevation Drawing

April 7th Desk Critique with Brian and Marco

Hadid E1

House Members:
Jeffery Li
Mathew Song

Priorities

- Connection to nature (Comfort)
- Rain Protection
- Connection to facade design

Check out our logo

Questions

- Verify Drip Edge
- Check if exploded view necessary like that
- Jam to wall detail connection good?
- need a structural detail for the side and if just adding nail is enough?
- Rain Protection Analysis due 12th or 22nd?

April 7 Notes:

- positive feedback on the comic :)
- try adding an exploded view for the details
- elevation go for a coloured one with line weights in
- Modifications on door detail
- Cool logo

Paper Model Draft



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Mathew Song
#20822363

V1 Canopy Project
200 University Ave W, Waterloo, ON N2J 4B6

Title:

Process/Development

Project No. 0001 Scale N / A

Drawing No.

A215