VISUAL PROGRAMMING BASICS 23/24 WS

SAGE GATESHEAD DESIGN

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individualized production | RWTH AACHEN UNIVERSITY

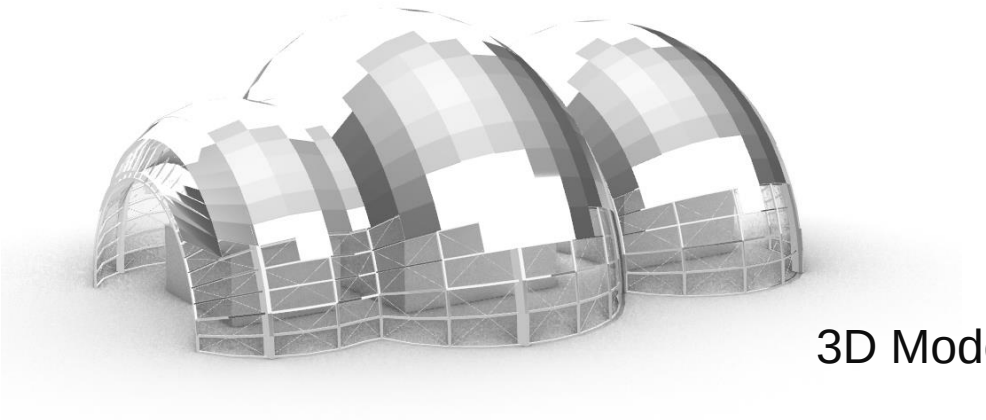
Introduction and Overview

The Sage Gateshead, crafted by the renowned architect Norman Foster, showcases an enchanting curved roof made of glass and stainless steel, resulting in a visually striking and iconic edifice. Its elegant and contemporary architectural style effortlessly harmonizes with the natural environment, establishing it as a notable landmark along the River Tyne's shores.

Referemce: https://divisare.com/projects/286961-foster-partners-nigel-young-the-sage-gateshead

Analysis

- Consists of 3 concert halls whose position and size can be adjusted parametrically
- 1 Shell structure that covers the 3 concert halls. The structure has:
  - Main beams, secondary beams diagonal braces, glass and stainless stell panels and horizontal beams
- Shape changes based on the shape of the concert hall

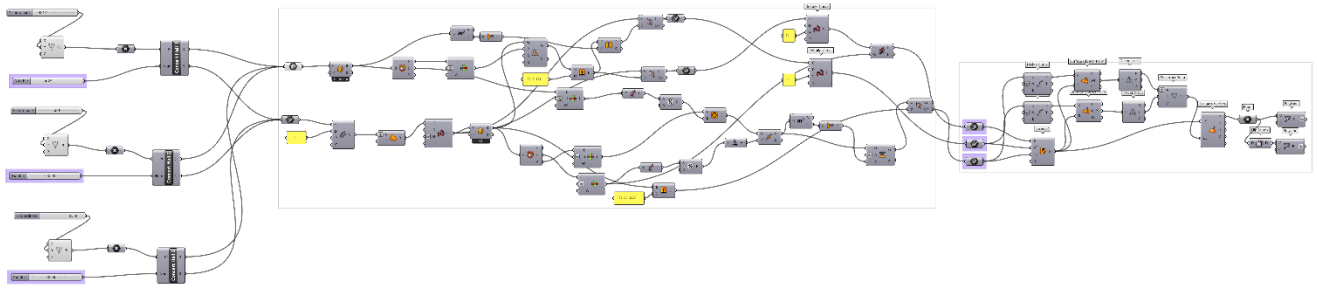


3D Model in Rhino

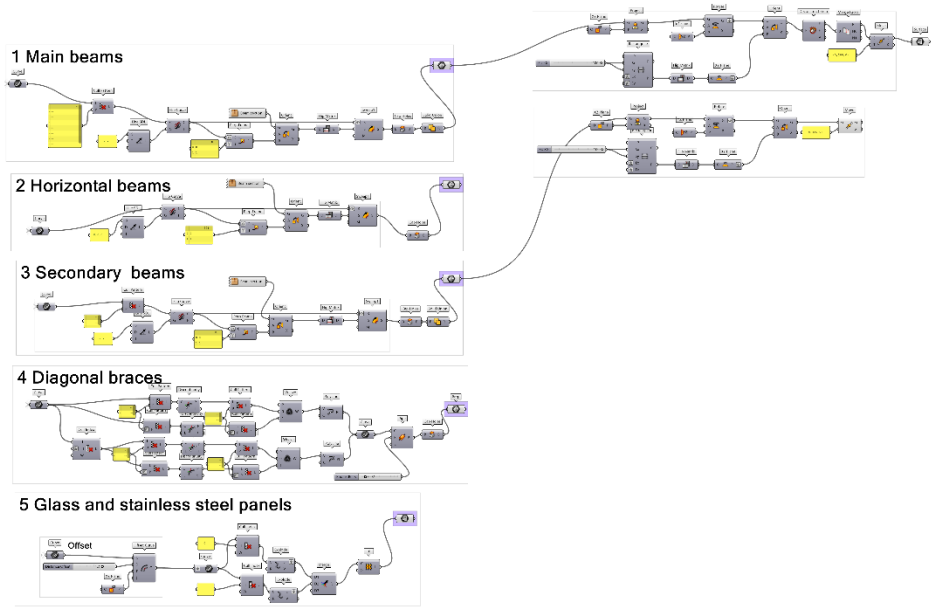
Overview of the Grasshopper script

1.Input Parameters

2. Parametric 3D-modeling



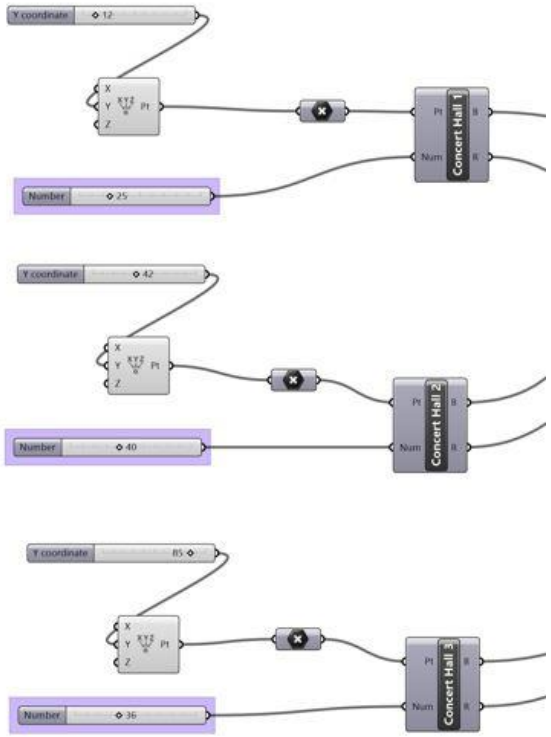
3. 2D fabrication plans



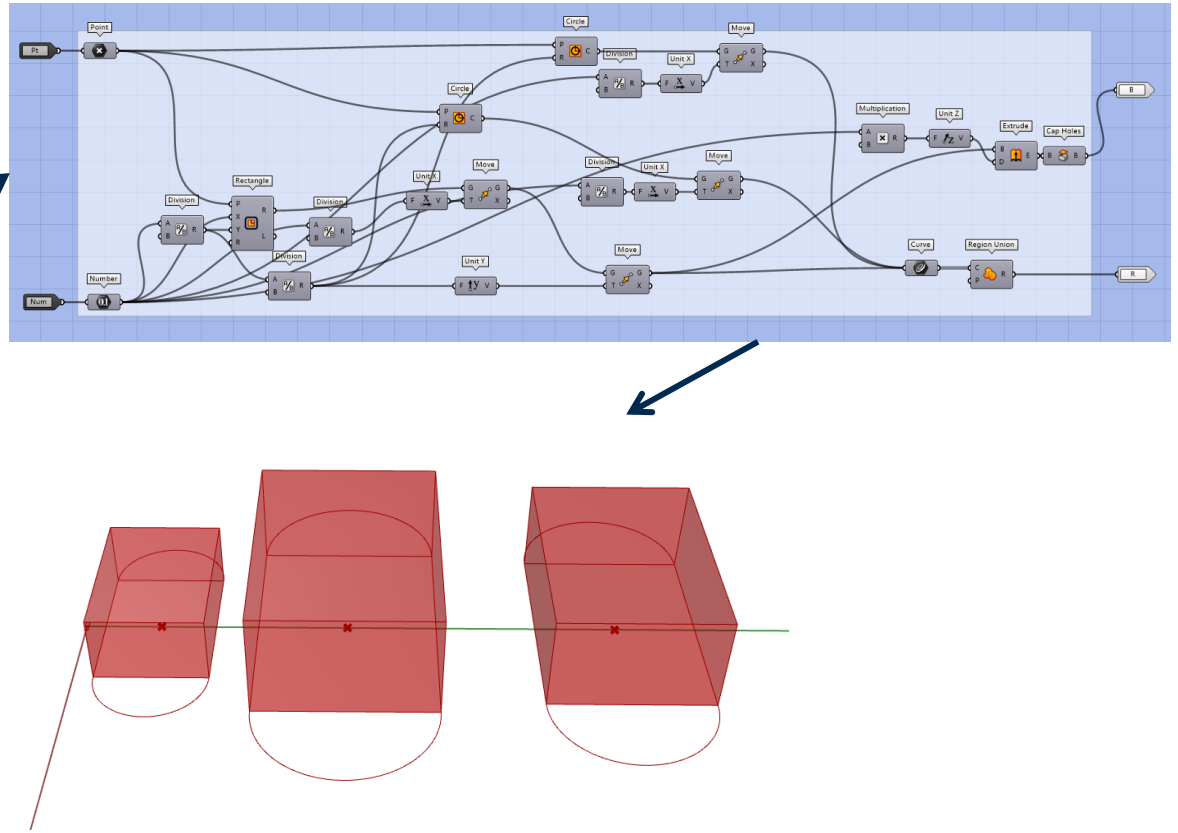
There are 3 main parts in the script:

- The editable input parameters(Concert halls)
- Parametric 3D model of the shell structure
- And the 2D fabrication data

Parametric Design Process: Input parameters

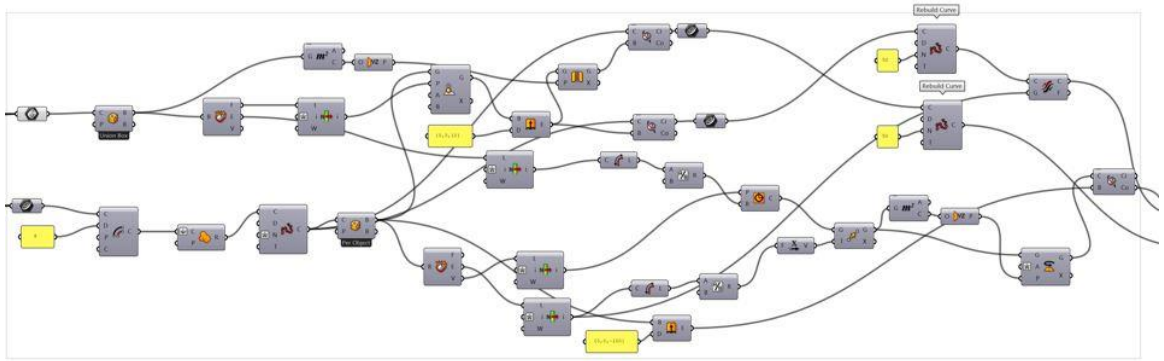


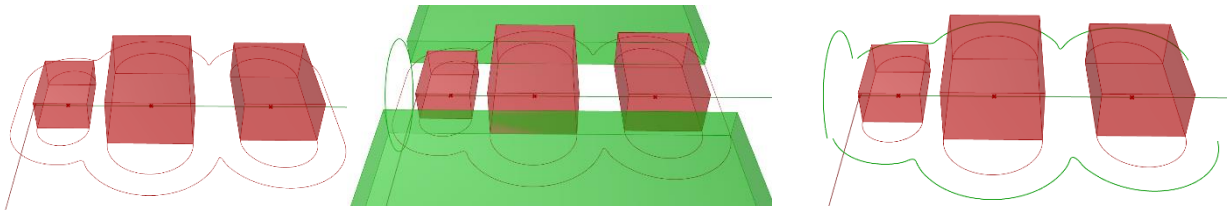
Has input size data and Position data and generate 3 points based on the Y-axis



- Concert halls are generated based on the points
- Outer bottom edges will be used to generate shell contour lines

Parametric Design Process: Modelling the shell





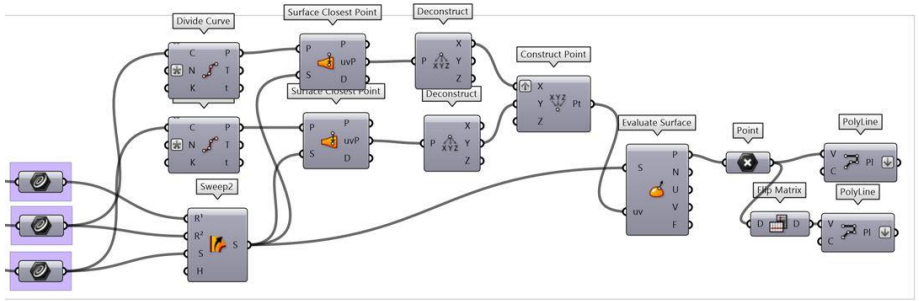
Expanding Cutting Picking up

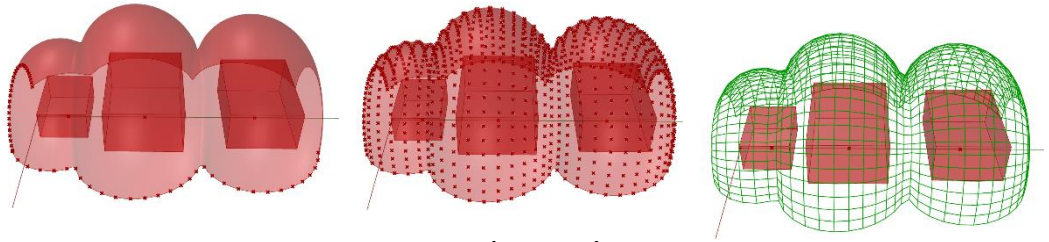
To generate the shell contour lines we:

- Expand the bottom edge line of the concert halls
- Cut line edges
- Pick up the relevant lines to get outer contour lines of the shells

To generate the shell frame, we:

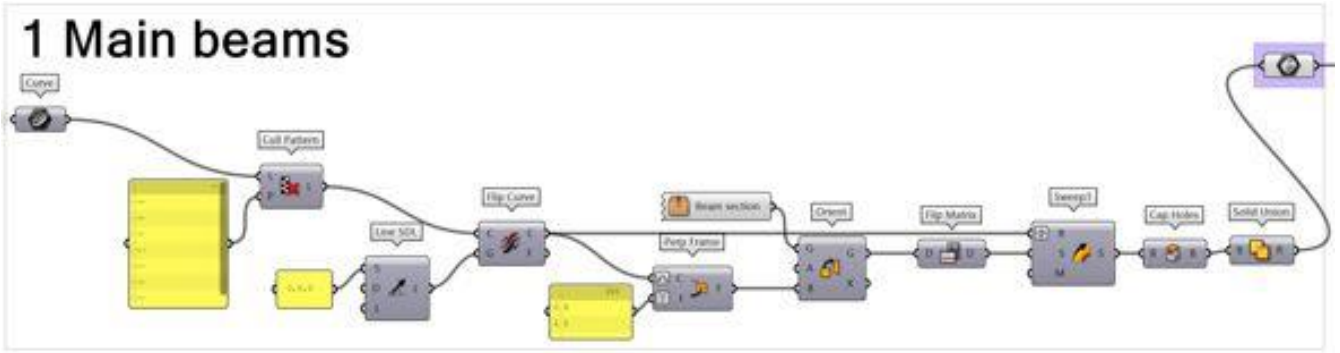
- Rotate the bottom edge to generate a curved and reference points
- Generate intersection points based on the reference points
- Connect the points to form the outer frame of the shell

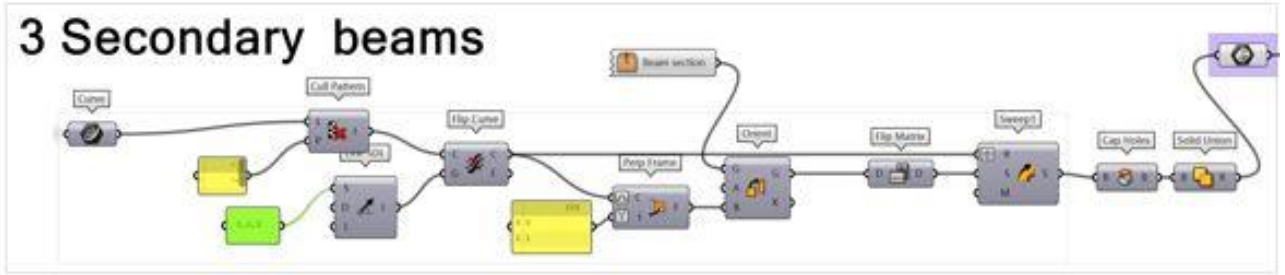




Curved surface & reference points Intersections points Shell frame

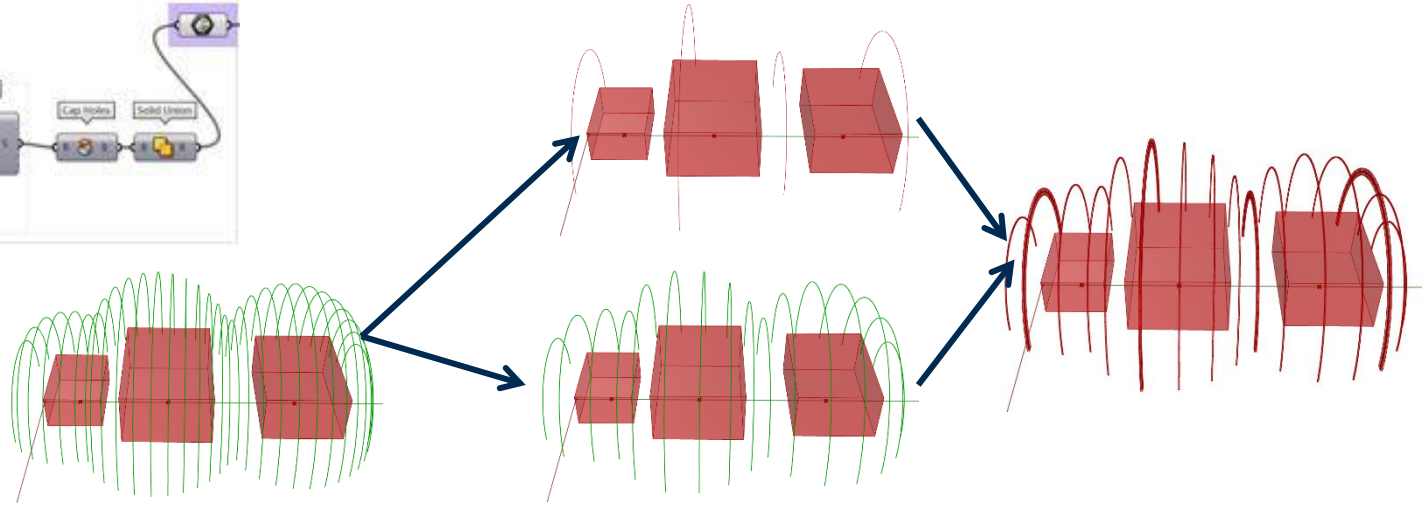
Parametric Design Process: Arch beams and secondary arch beams



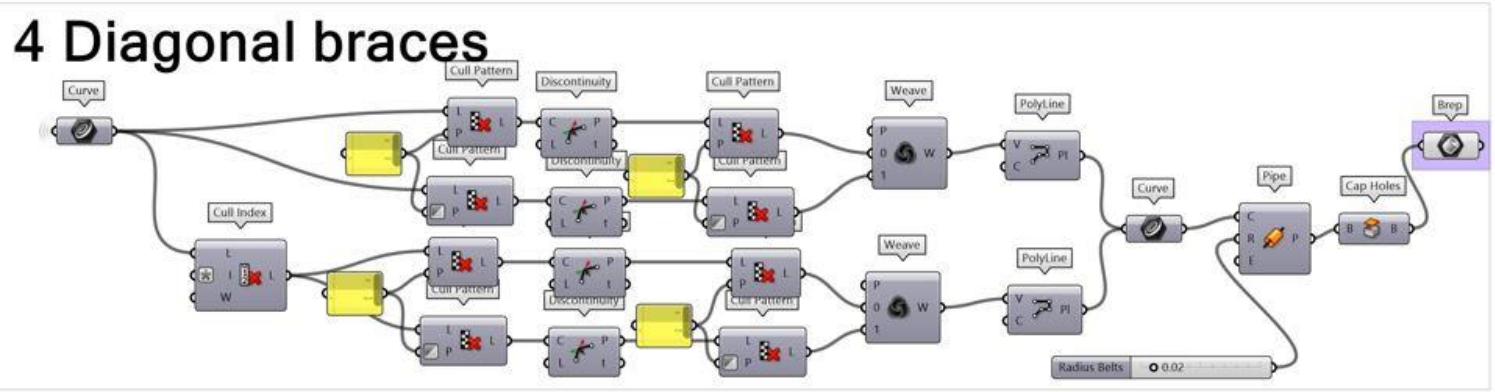


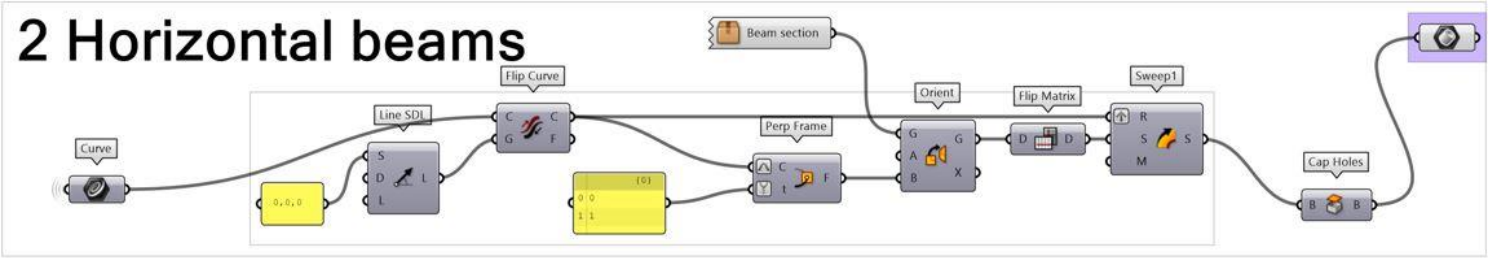
To generate the main and secondary beams:

- Filter the beams with Boolean operations
- Put the correct dimensions



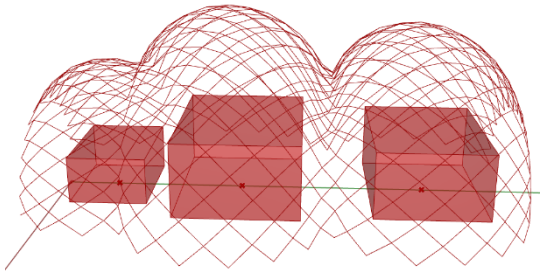
Parametric Design Process: Horizontal beams and diagonal braces





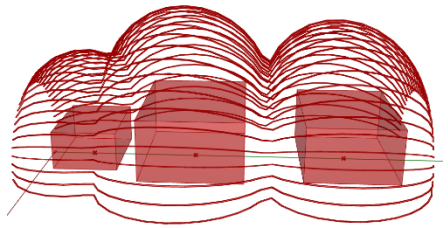
To generate diagonal braces:

- Diagonally link the intersections of the beams to form the diagonal frame
- Put the correct dimensions

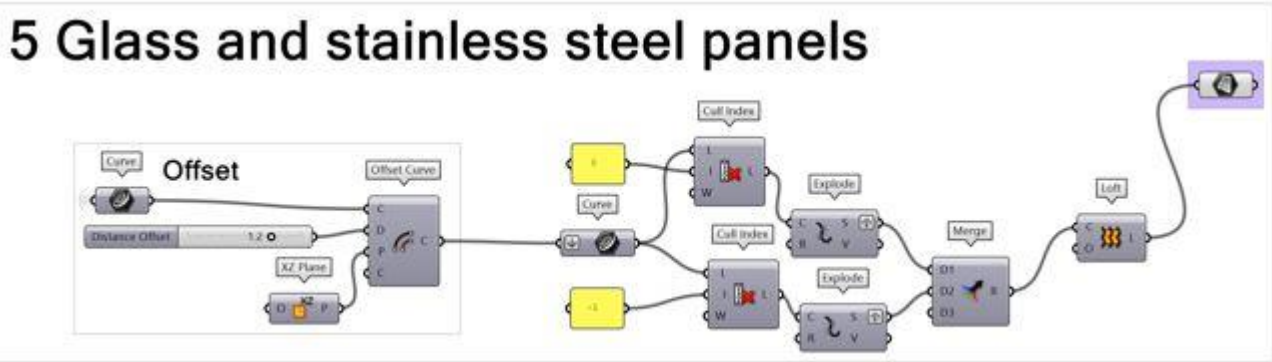


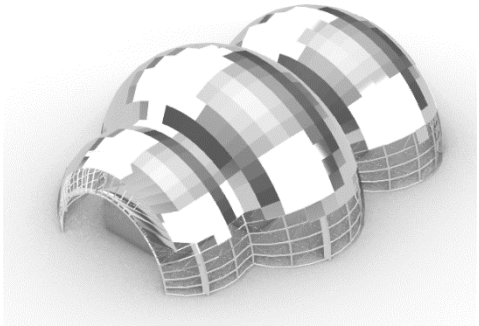
To generate horizontal beams:

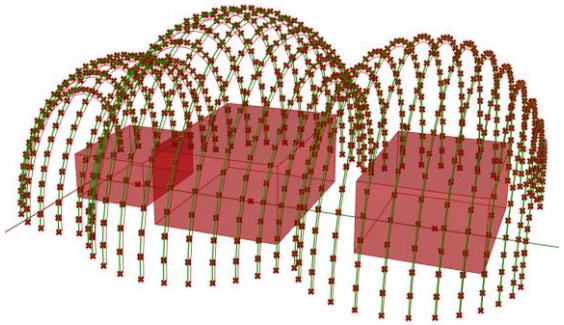
- Filter out the horizontal beams
- Put the correct dimensions

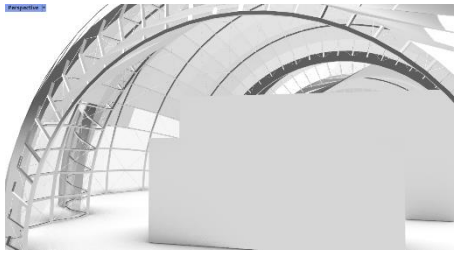


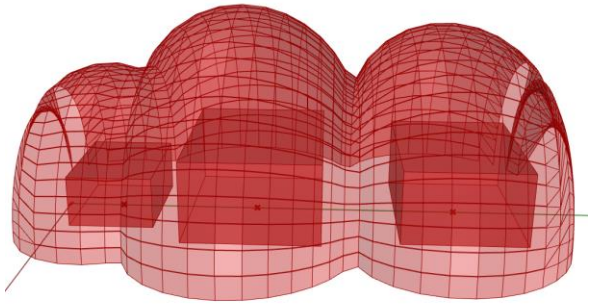
Parametric Design Process: 3D modelling, baking and rendering











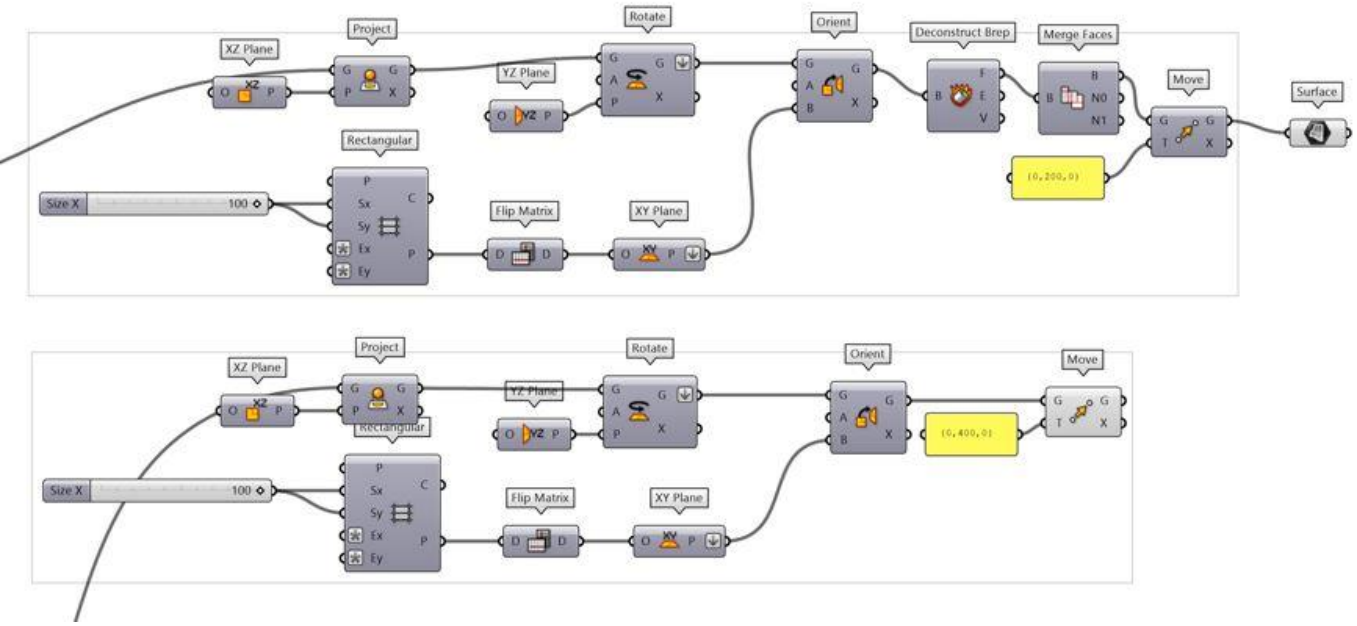
To generate the glass and stainless-steel panels:

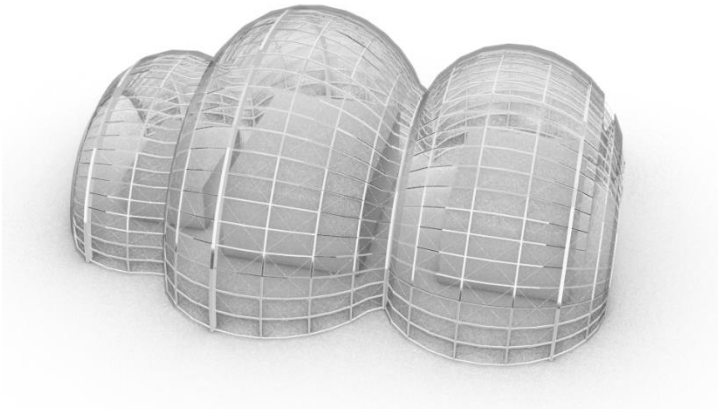
- Expand the arch frame and generate panels at corner points
- Link the corner points to form the panels frame
- Generate the panels entities

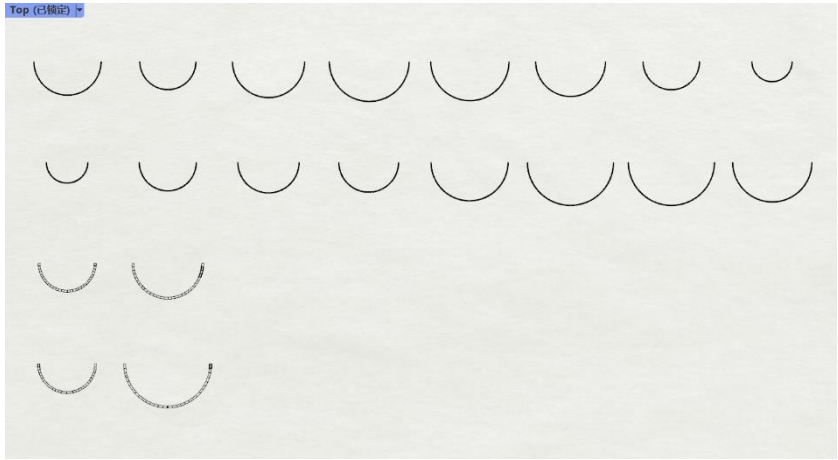
To render the material in Rhino:

- Bake the models in Rhino separating components into layers
- Define the material of each layer
- Render

Generating 2D fabrication plans



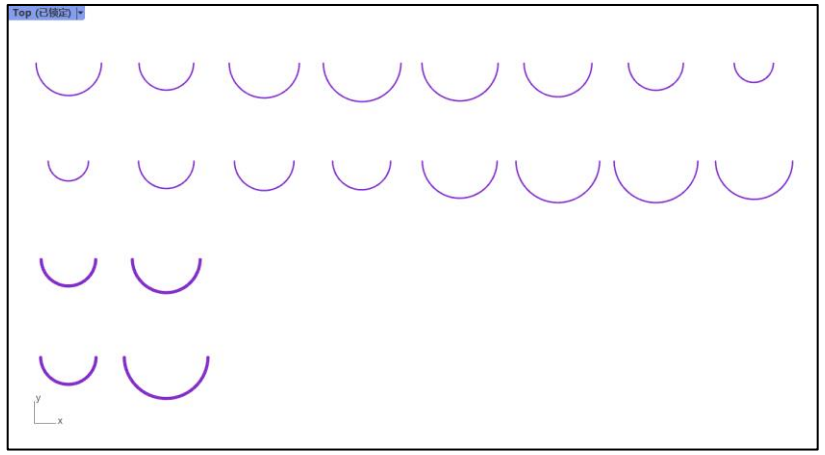




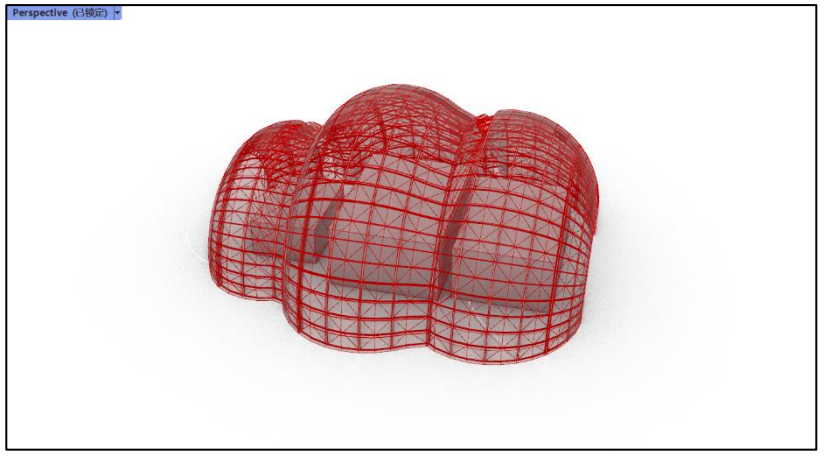
To generate the 2D fabrication plans:

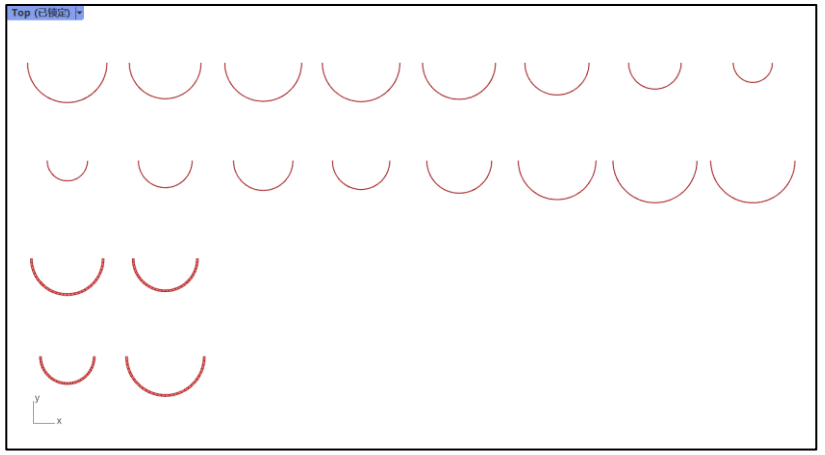
- Extract the data from the main beams and the secondary beams
- Layout to top view

The 3 types of design variations based on the 2D fabrication data



Type 1





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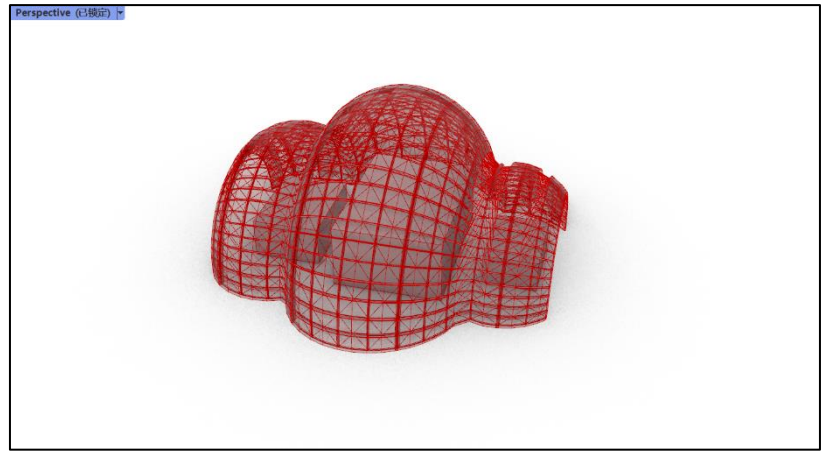

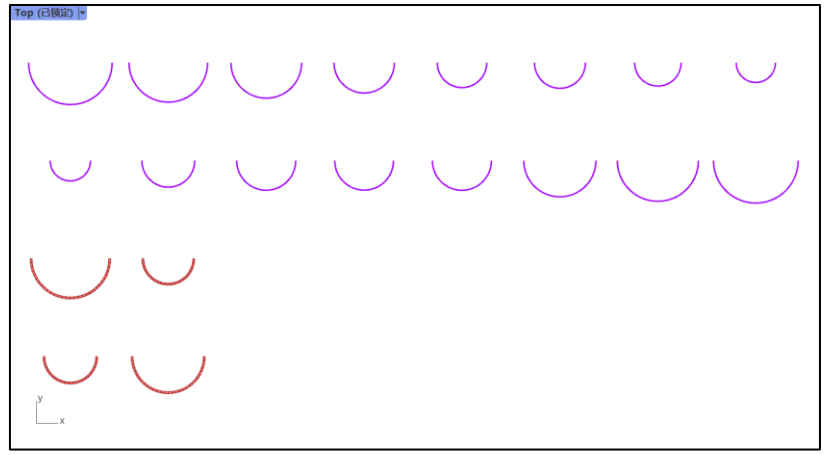

Type 3