PARAMETRIC SKINS

Shanghai Art Center

Institute for advanced architecture of Catalonia

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Shanghai Art Center
Foster + partners & Heatherwick Studio

Inspired by traditional Chinese theatres, the three-storey building features a curtain-like facade of bronze tubes. These tubes hang in three layers, creating semi-transparent screens in front of windows and balconies.
When the design was first announced, the architects described this facade as "a moving veil, which adapts to the changing use of the building, and reveals the stage on the balcony and views towards Pudong". As well as the main theatre auditorium, the 4,000-square-metre building also contains a series of exhibition and events halls, including one on the roof.



Fig 1 :Main 3D Shot of the Art Center

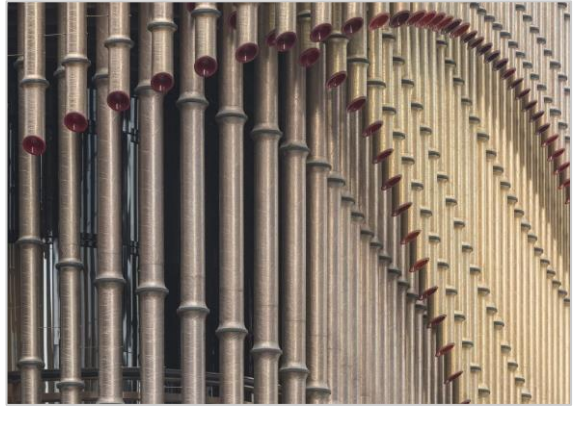


Fig 2: Bronze Moving Veils zoomed in.

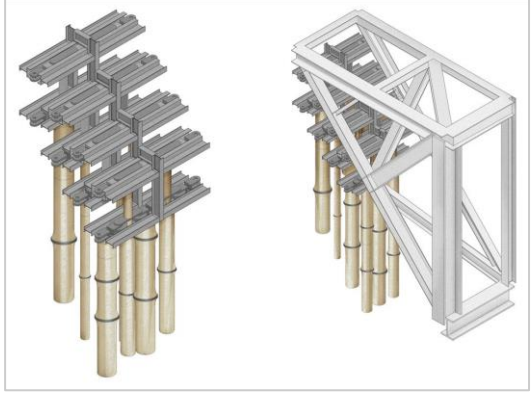


Fig 3:Moving Veils relation with the track

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Decomposing the logic of the facade:

- First of all the hanging tubes are divided into three layers and each layer is placed on a different track
- Second point is that the tubes take a waveform while rotating around the building
- Third point is that the first and third layer move on the same direction were as the second layer move in the opposite direction
- Fourth point each tube contain joints with the same wave shape.

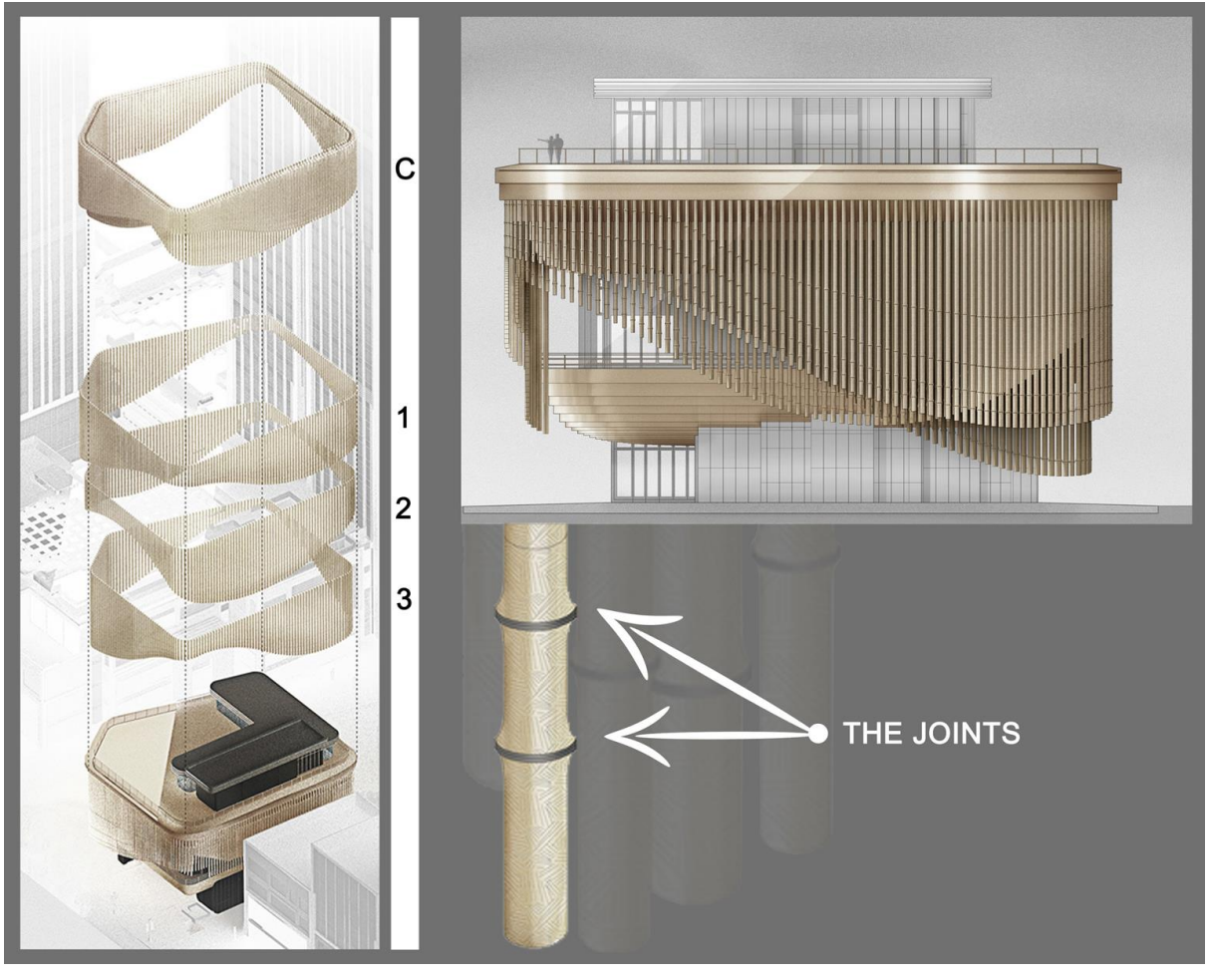


Fig 4: Decomposing the logic of the facade

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The main criteria of the design,
and thus the main focus of this exercise,
was to create rotating tubes along a path
moving around the building.

- The form is composed of three different curves
- each curve has different parameter
- Curve 1 and 3 move in the same direction were as curve 2 move in the inverse direction
- There is 250 tube per curve
- The diameter of the curve is 30 cm
- The length of the tube is related to the sign wave

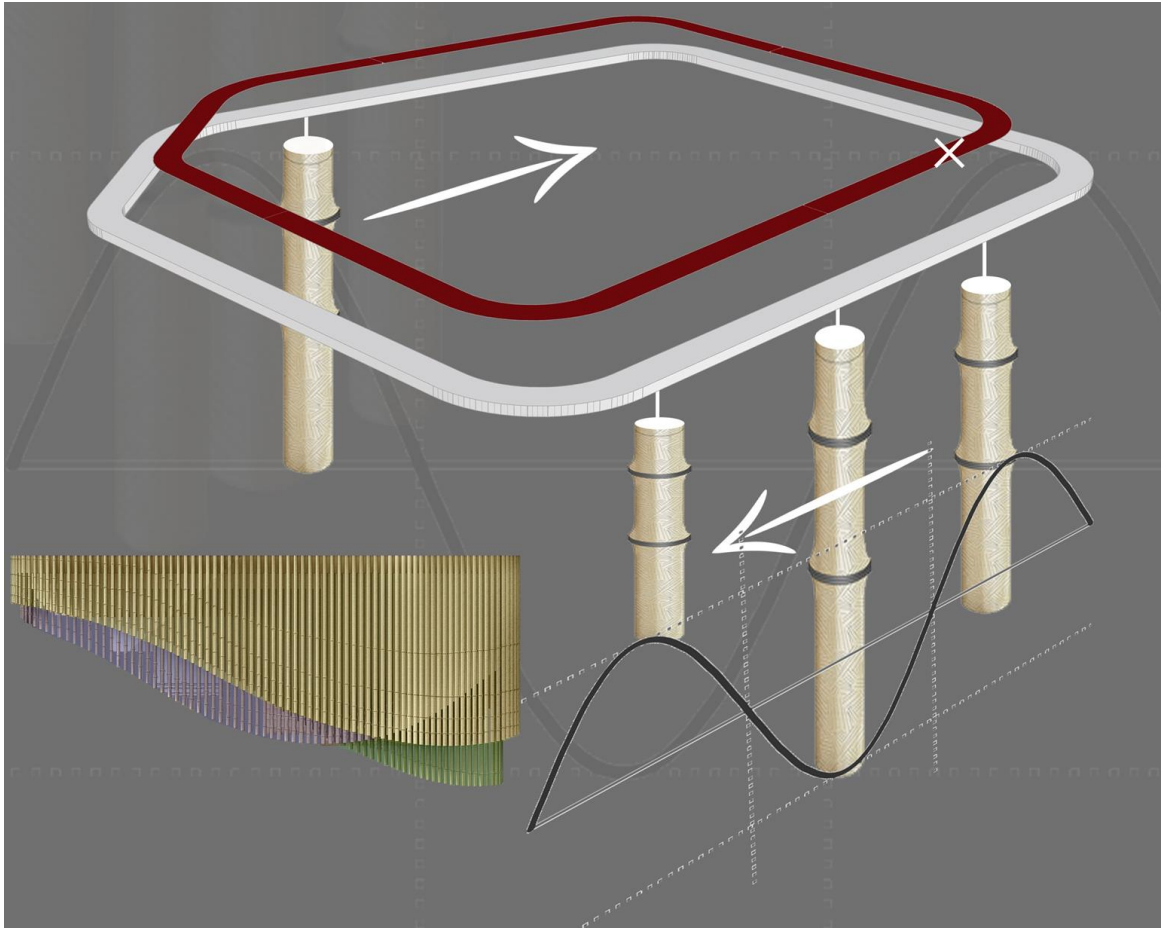
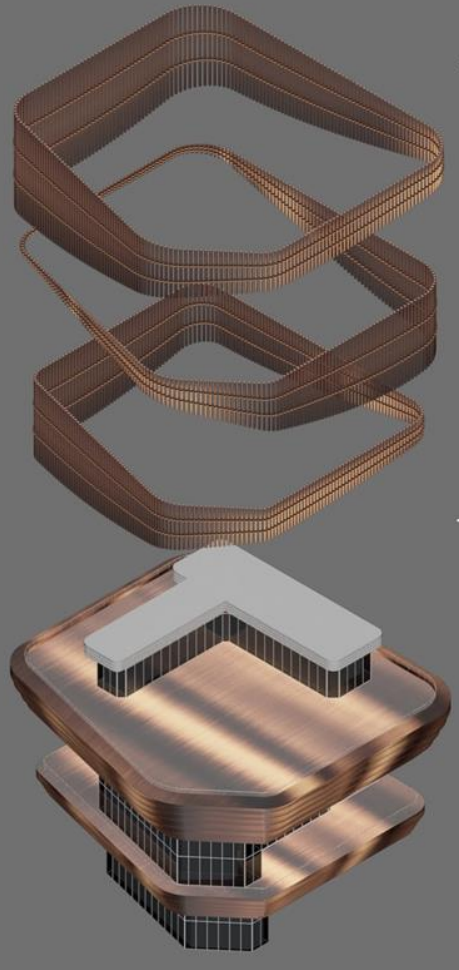


Fig 5: Decomposing the Mechanism of the tubes

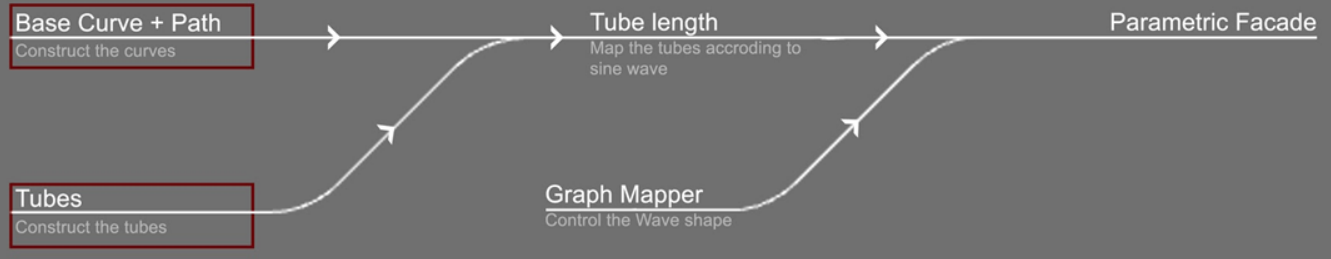


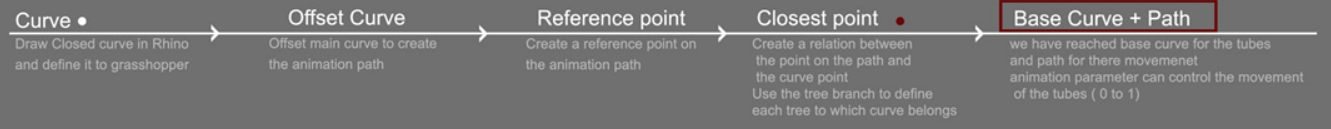
The Parametric Facade is made up of 3 different layers
Layer 1 and 3 move in the same direction
While layer 2 move in the inverse direction

The Tubes are connected to a track that control their movement

Pseudo Code

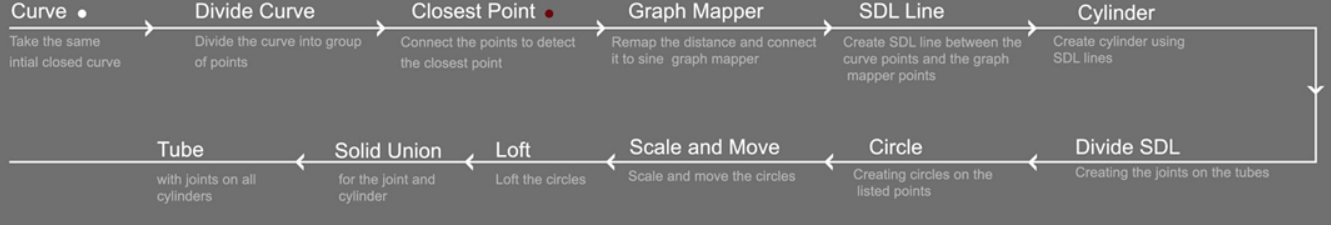
Base Curve + Tubes





Curve and Path Parameters

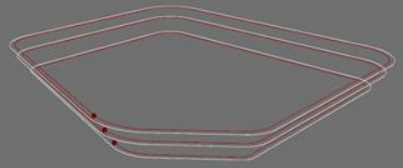
The curve is taken from the building profile in rhino so it dosn't have parameters , and the path parameter is the offset distance only



Code Development



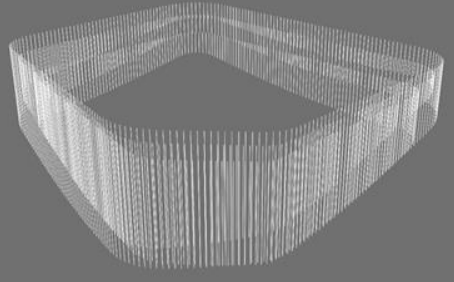
Draw the curves in rhino from the buildings floor and set the curve to grasshopper



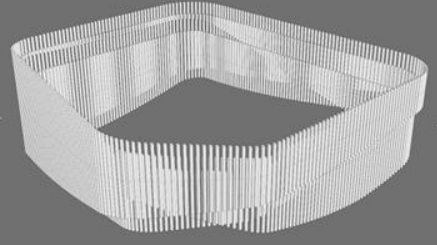
Offset the curves and specify the motion point , in relation with the closest point on the main curve



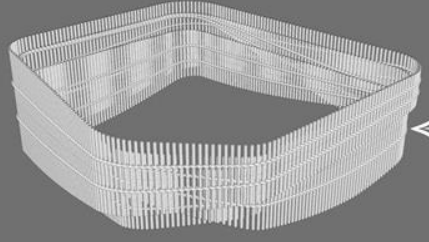
Devide the initial curve to number of points (corresponding to tubes number)



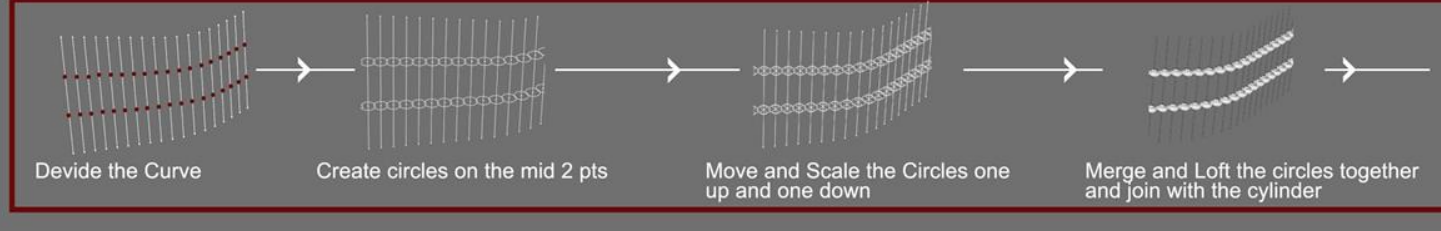
Create SDL lines using Graph mapper and by remaping the distance between the closest point and the curve points.



Create cylinders on each SDL line According to line length



Create the joints on each curve



Bronze Tubes

- The bronze tubes are the main element of the facade.
- These tubes contain different joints
- The tubes move on specific track to form different interlooking waves
- The tubes was made using SDL lines , cylinders and the joints were done using lofted circles
- The parameters that could be modified:

➔ The shape of the wave created
➔ The number of the tubes
➔ The radius of the tubes
➔ The length of the wave
➔ The animation path

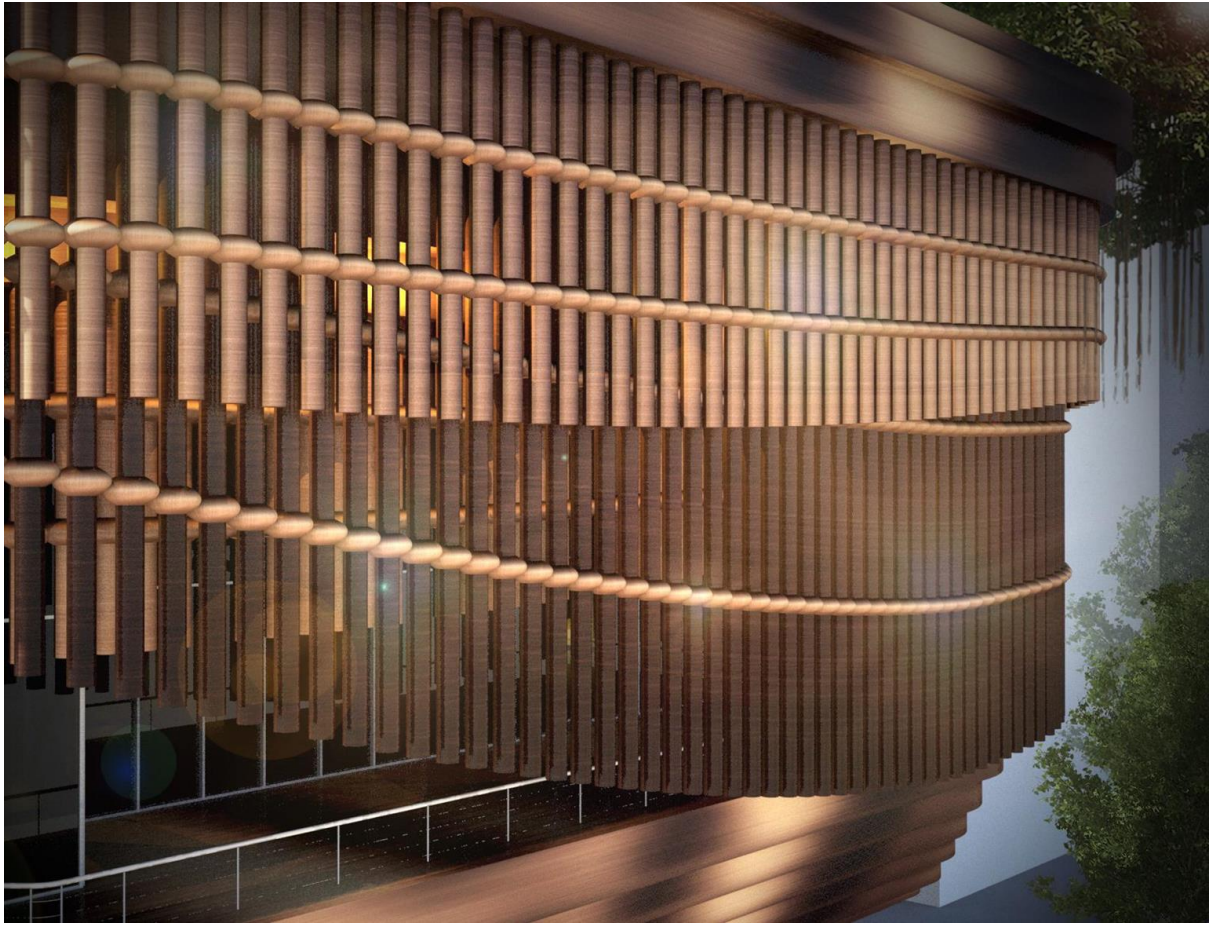
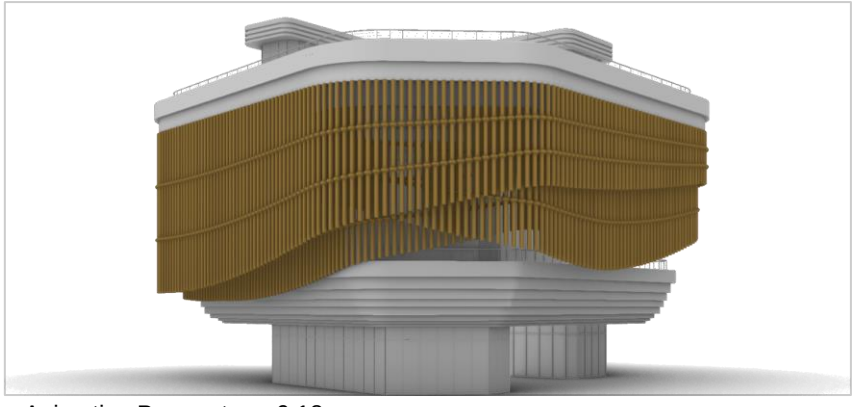


Fig 7: Facade rendered view

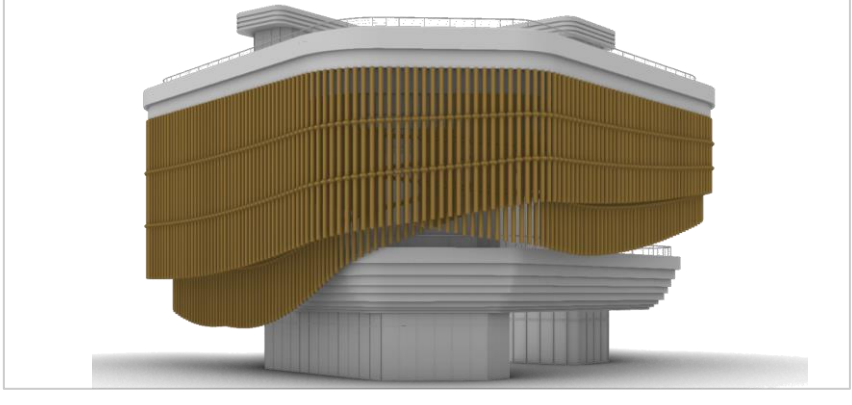
Facade iterations



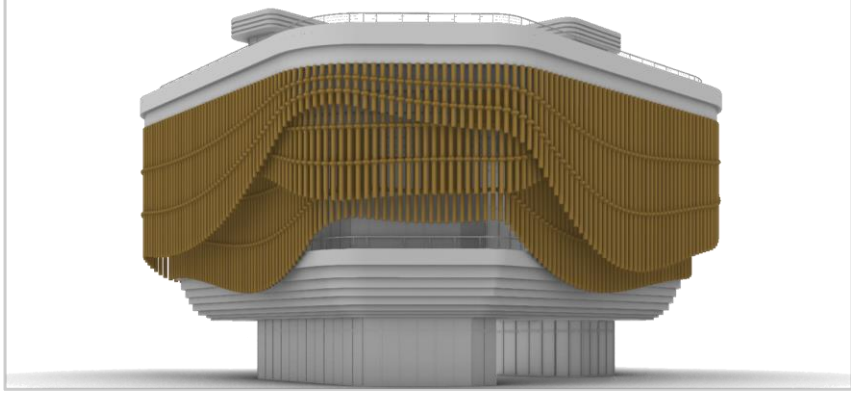
Animation Parameter = 0.18
Tubes Count = 250



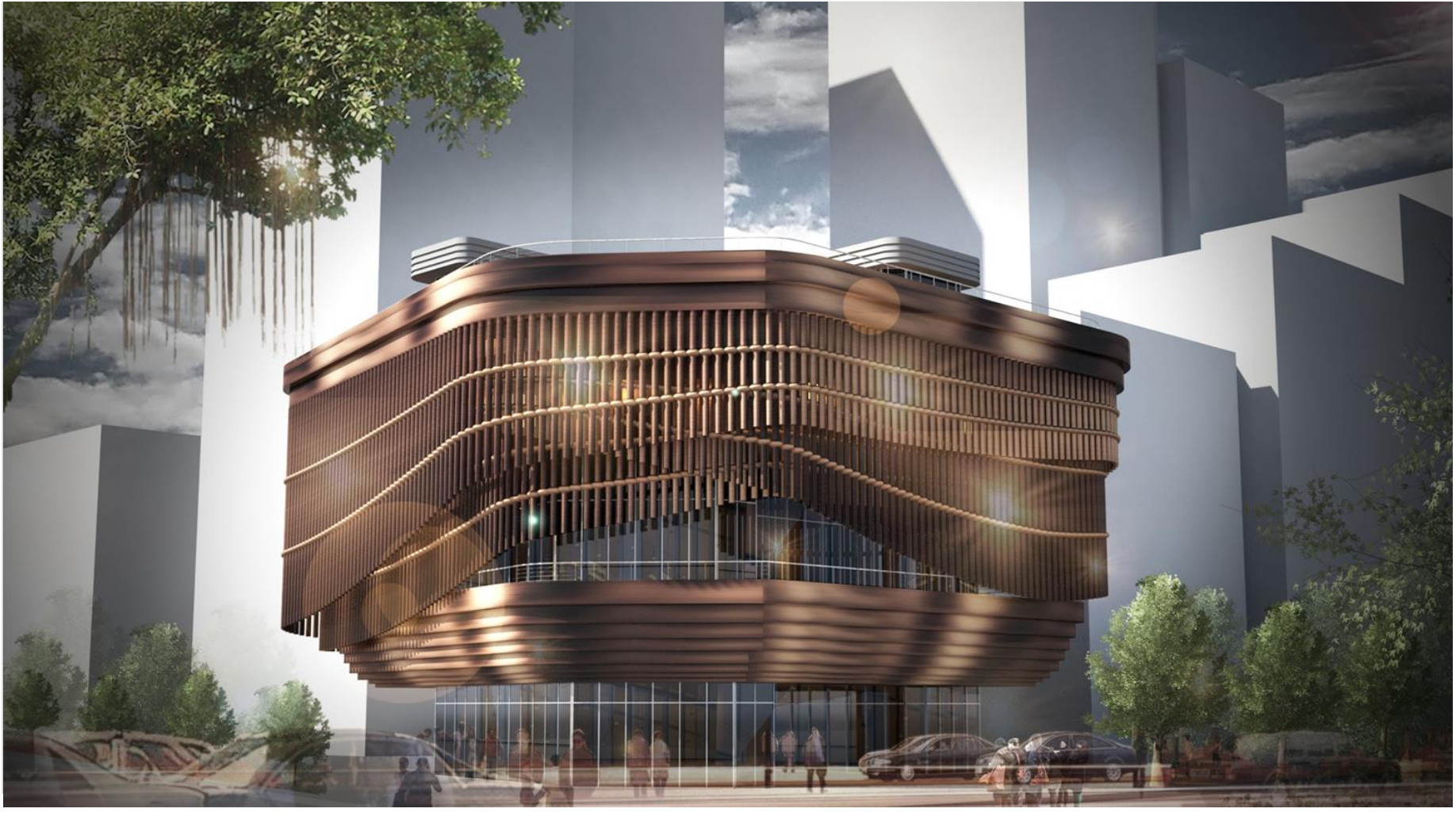
Animation Parameter = 0.51
Tubes Count = 250



Animation Parameter = 0.18
Graph mapper (change the curve)



Animation Parameter = 0.51
Graph mapper changed + Remaped value changed



Iaac

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References:

Text :
https://www.archdaily.com/881511/bund-finance-centre-foster-plus-partners-plus-heatherwick-studio?ad_medium=gallery
https://www.dezeen.com/2017/06/09/foster-heatherwick-complete-shanghai-arts-centre-curtain-like-facade-fosun-foundation-theatre-architecture/

Images:
Fig 1 - Fig 2 _ Fig 3 : https://www.archdaily.com/881511/bund-finance-centre-foster-plus-partners-plus-heatherwick-studio?ad_medium=gallery
Fig 4 and fig 5: Done by the author +
https://www.dezeen.com/2017/06/09/foster-heatherwick-complete-shanghai-arts-centre-curtain-like-facade-fosun-foundation-theatre-architecture/
Fig 7 : Done by the author