# MSF11845
# Dynam(o)ite Your Design from Concept to Fabrication

Dieter Vermeulen MSc. Str. Eng.

Technical Specialist Structural Solutions, Autodesk EMEA NE

@BIM4Struc

# Class summary

This class will put some dynamite in your classic BIM workflows by introducing computational design in the whole BIM process, from concept to fabrication. You will see how Dynamo and Revit form the unbeatable duo in the design of structures. Discover how Dynamo can meet your requirements for rebar detailing, and get blown away by the ability of Dynamo to handle fabrication drawings of building-closure elements.

# Key learning objectives

At the end of this class, you will :

- understand the power of computational design in your BIM process
- know how to design complex steel structures with Dynamo and Revit
- be familiar with rebar modeling using Dynamo and Revit
- have learnt how to generate fabrication drawings of curved panel roofs

# About me

- Technical Specialist Structural Solutions @ Autodesk
- Working for EMEA NE region
- Structural Engineer based in Belgium
- +15 years experience in structural engineering
- “Revit Beyond BIM” & “BIM Toolbox”

# Get Connected

@BIM4Struc

www.linkedin.com/in/dietervermeulen

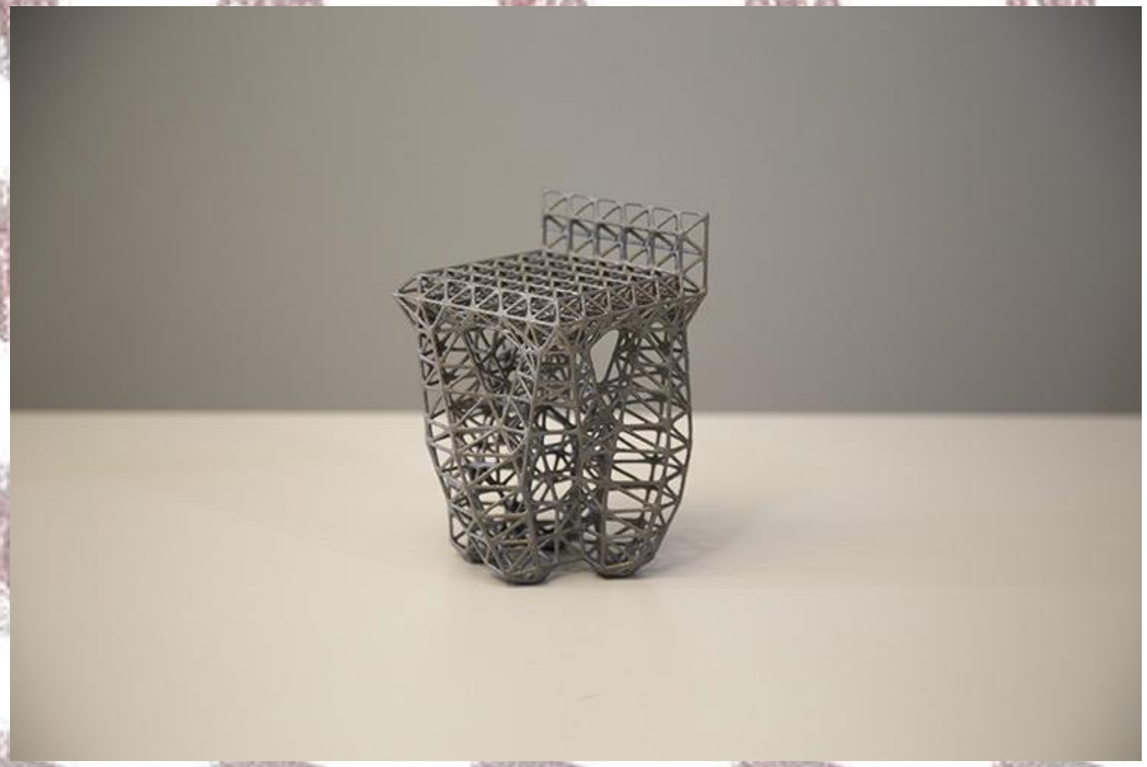
www.youtube.com/user/RevitbeyondBIM

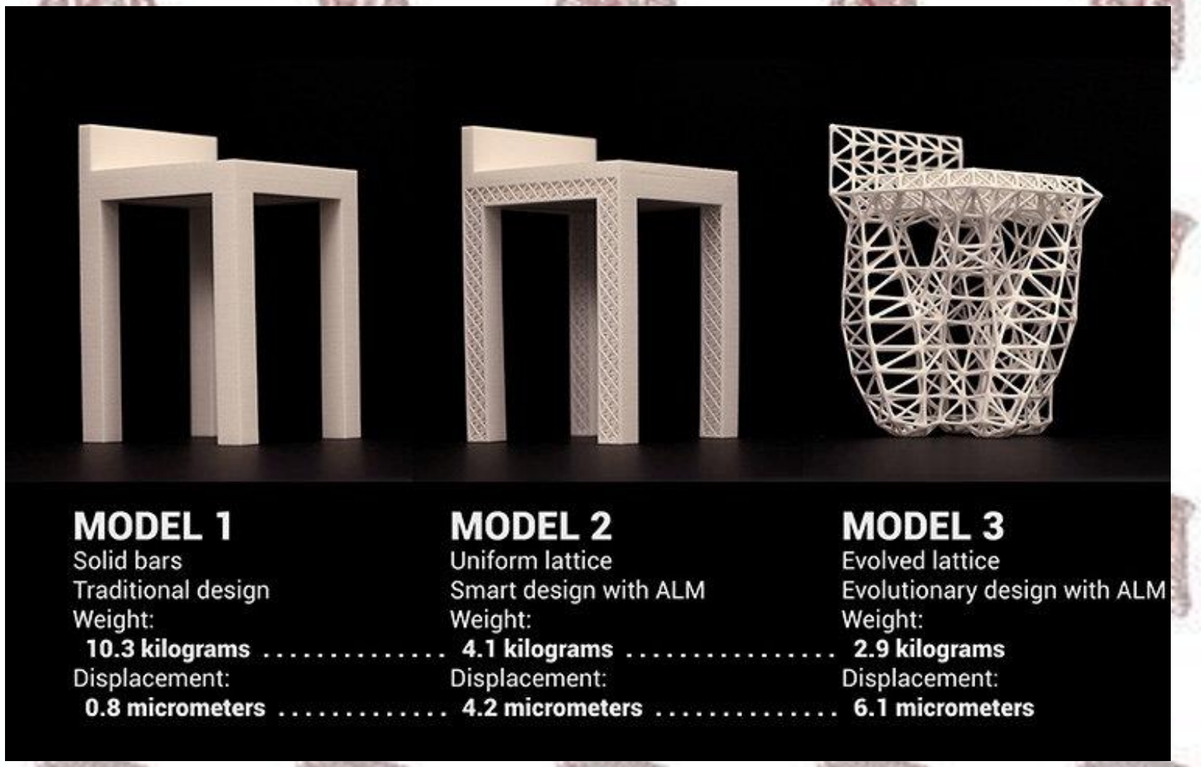
www.revitbeyondbim.wordpress.com

www.autodesk.typepad.com/bimtoolbox/

# Optimal Design ?

# Artificial Intelligence ?



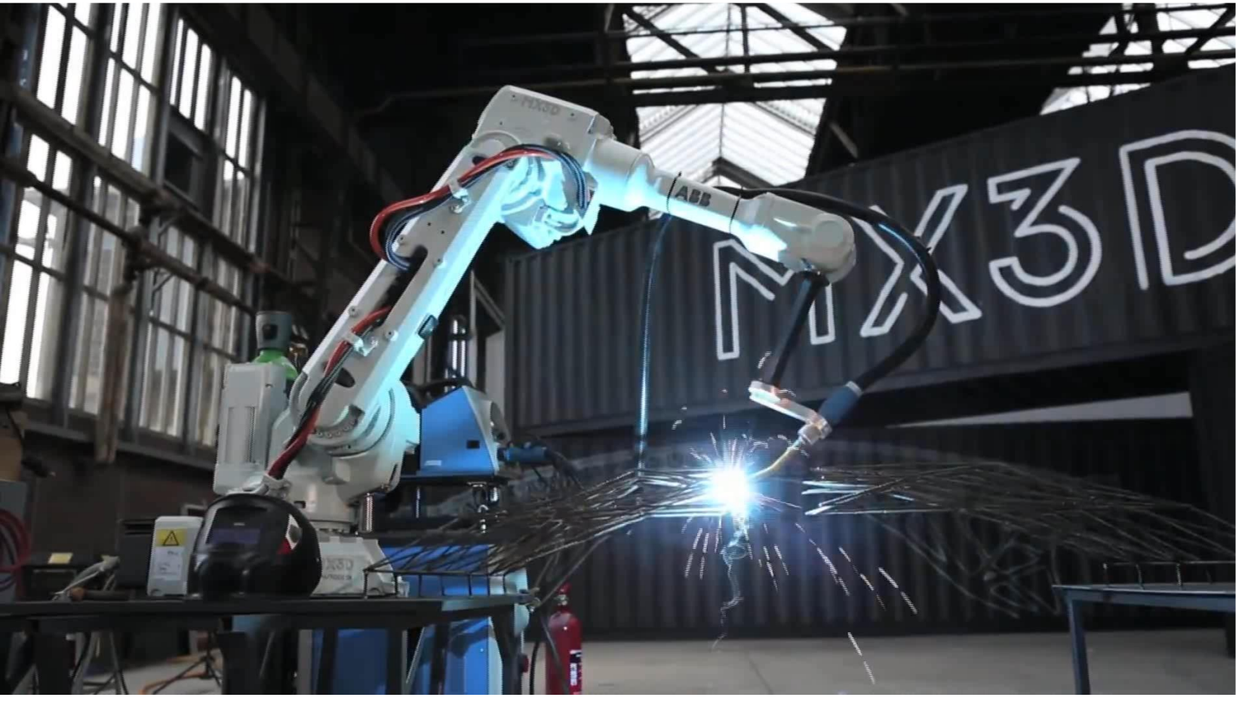


**MODEL 1**
Solid bars
Traditional design
Weight:
**10.3 kilograms**
Displacement:
**0.8 micrometers**

**MODEL 2**
Uniform lattice
Smart design with ALM
Weight:
**4.1 kilograms**
Displacement:
**4.2 micrometers**

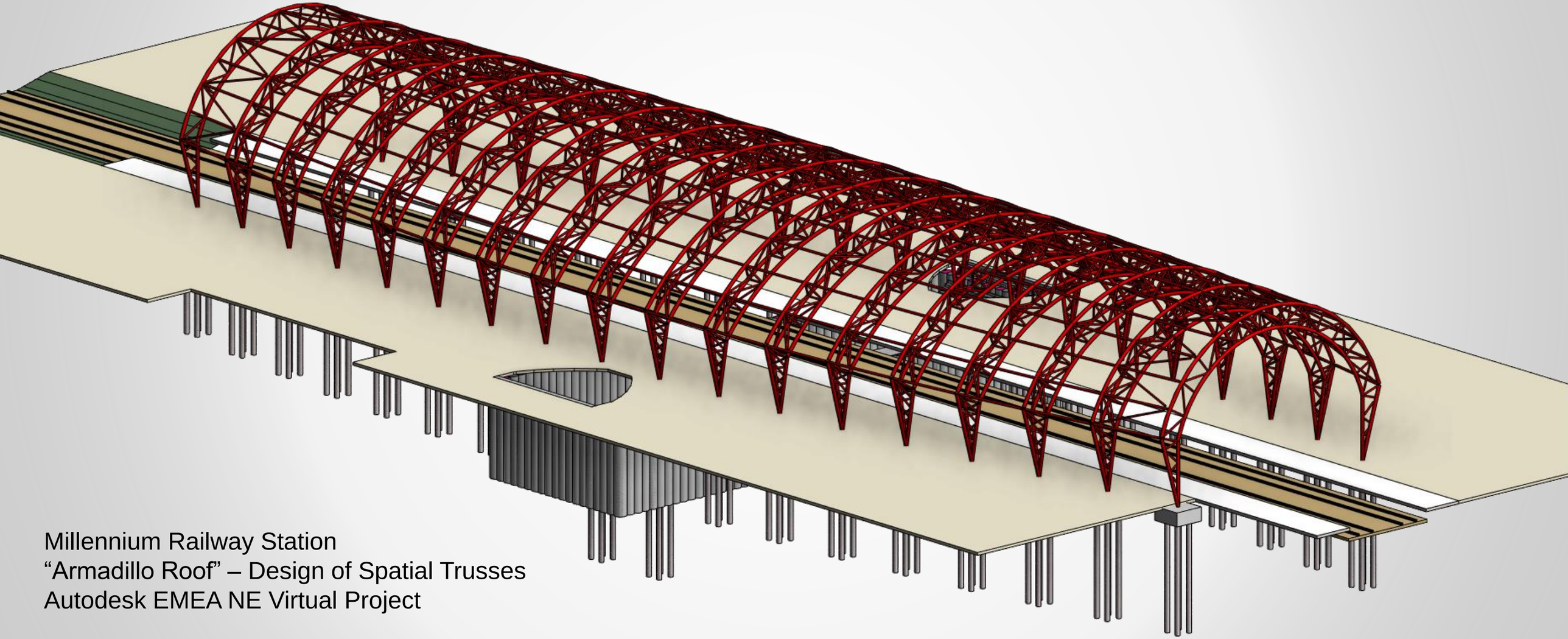
**MODEL 3**
Evolved lattice
Evolutionary design with ALM
Weight:
**2.9 kilograms**
Displacement:
**6.1 micrometers**

Chairs ?


MX3D
ABB

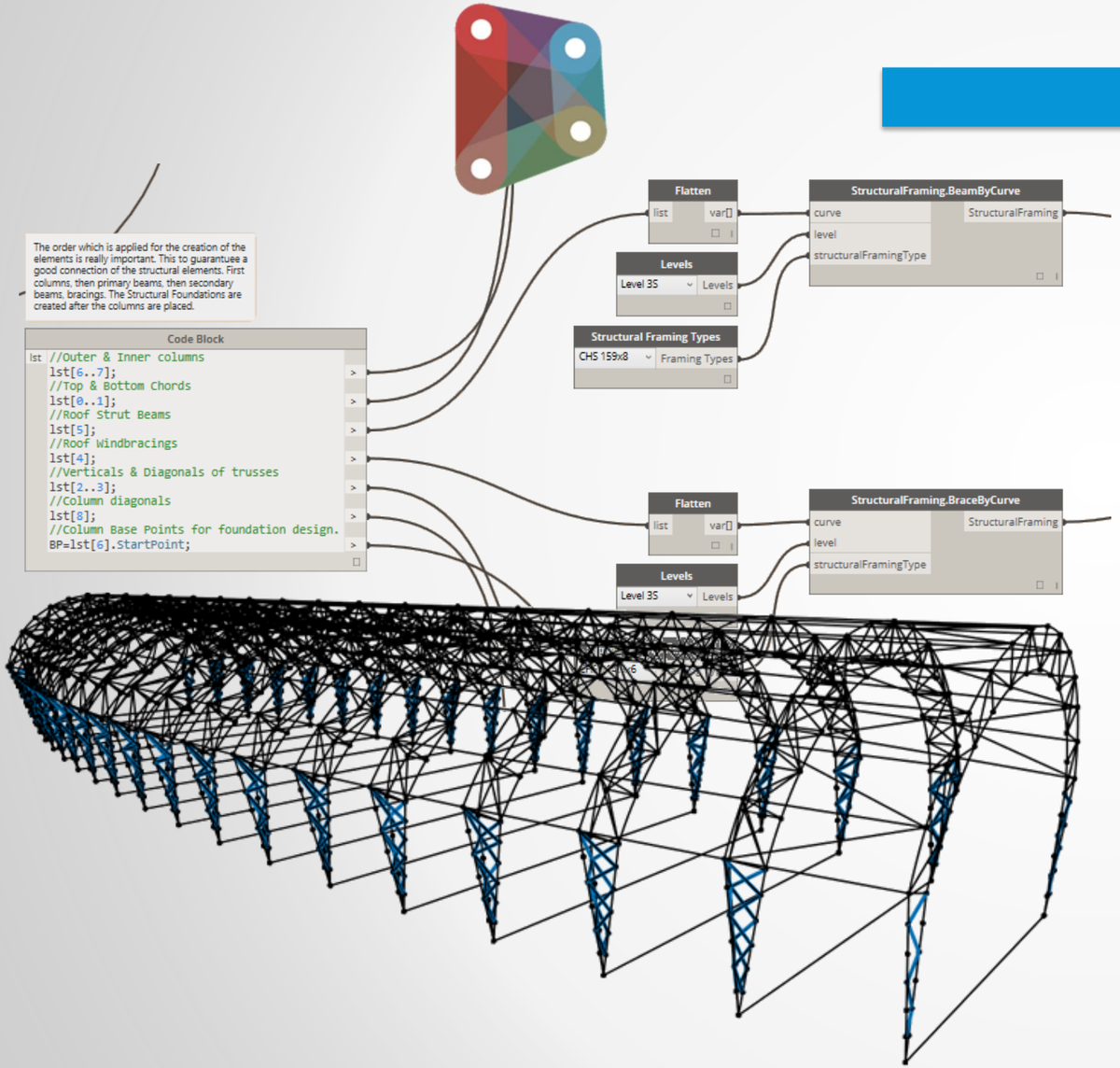
# Computational Design Case 1: Complex steel structure in Revit

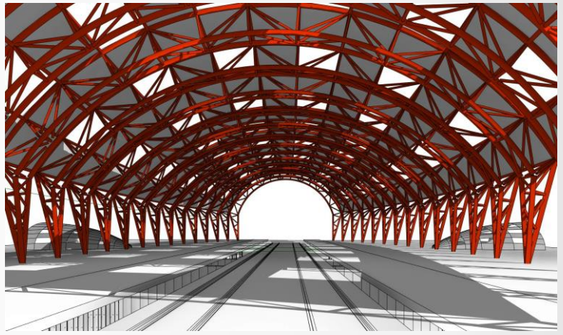
# Complex steel structure in Revit

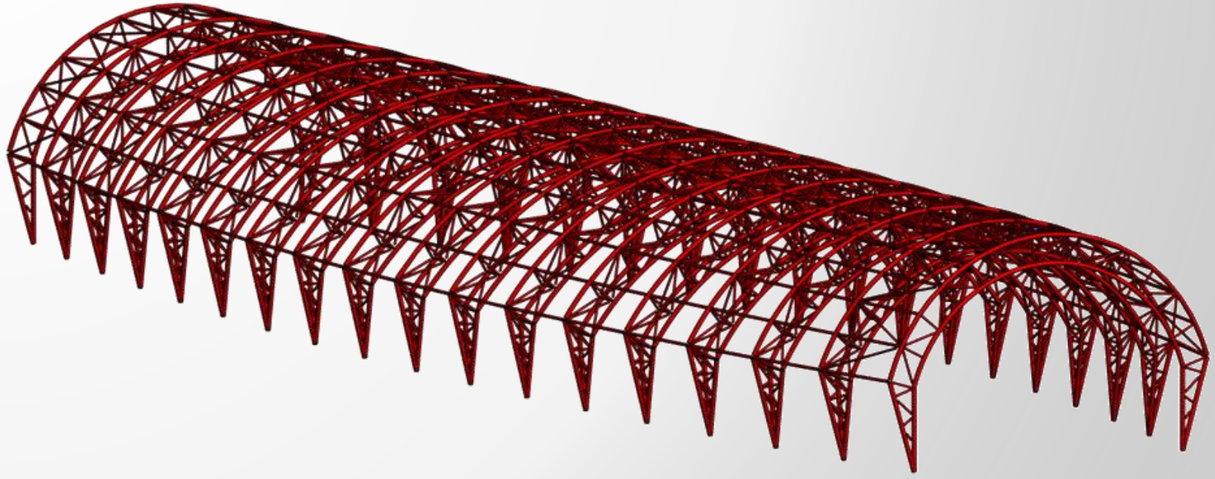


Millennium Railway Station
“Armadillo Roof” – Design of Spatial Trusses
Autodesk EMEA NE Virtual Project

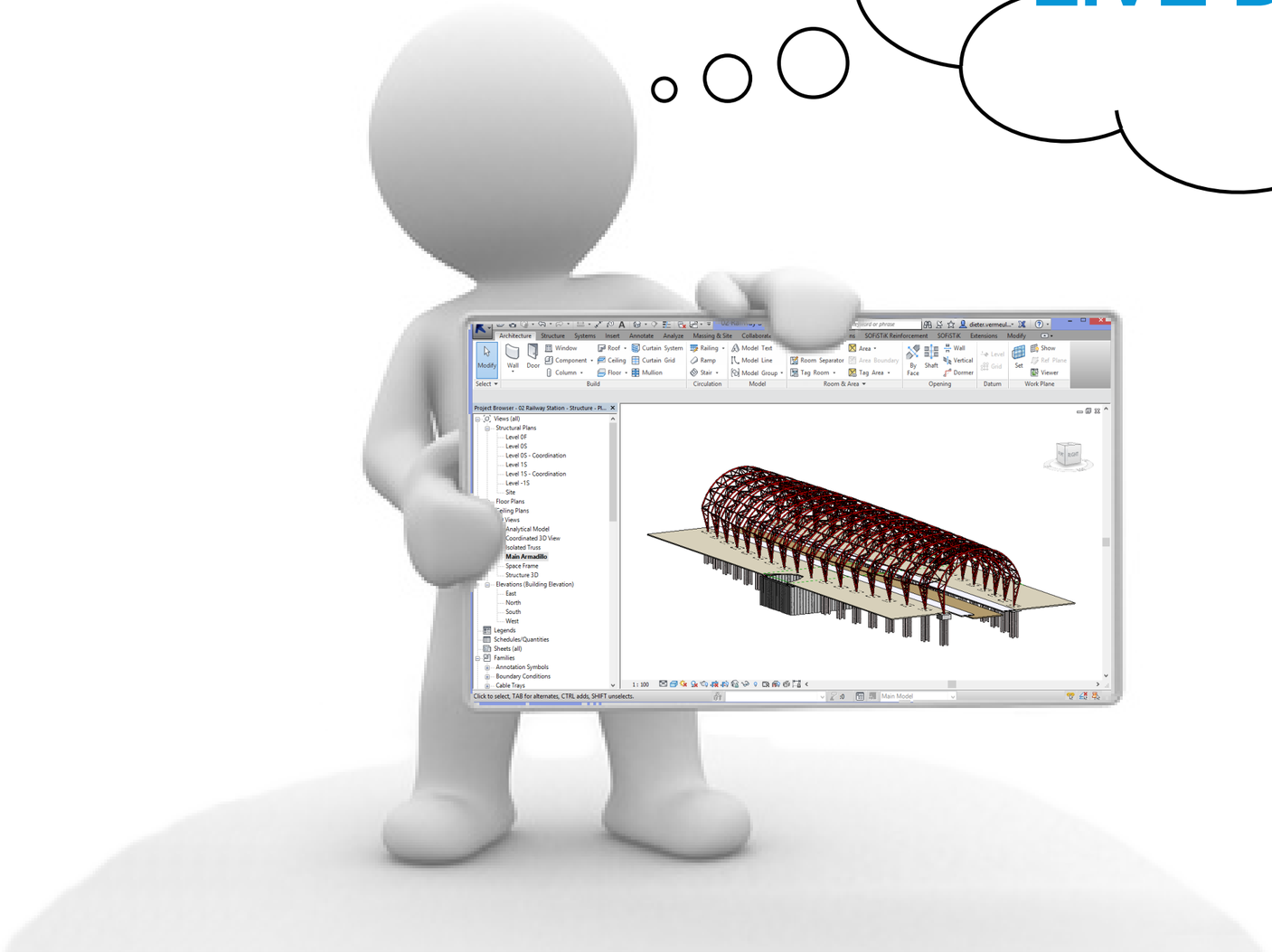
# Complex steel structure in Revit





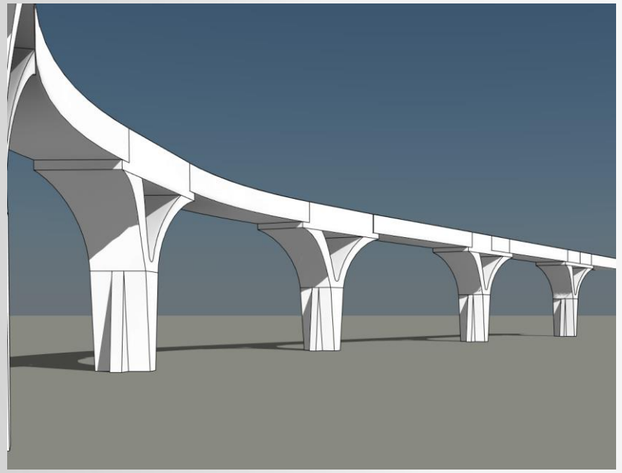


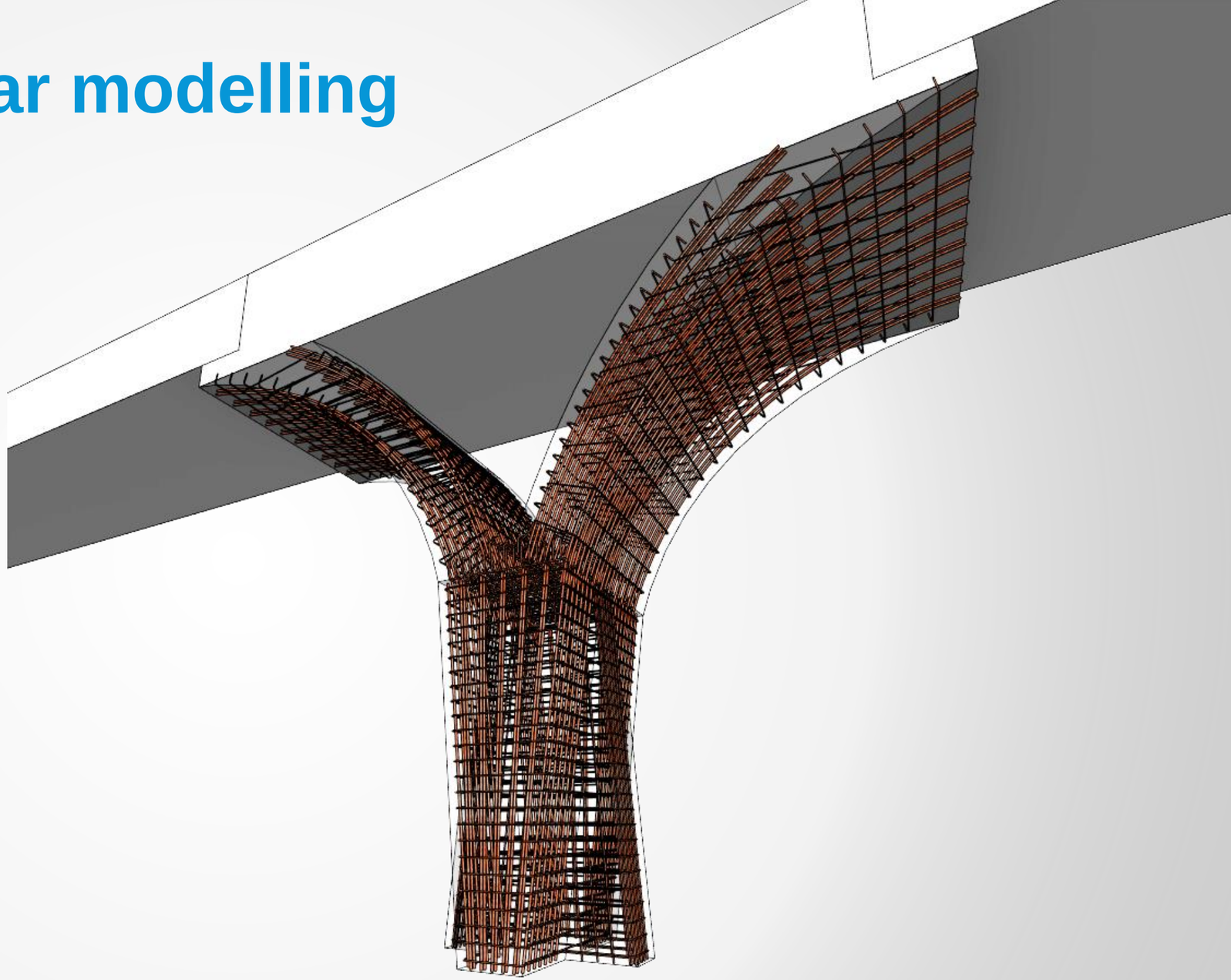
# LIVE DEMO !



# Computational Design Case 2
# Rebar modelling with Dynamo & Revit

# Computational Rebar modelling





Diabolo Elevated Railway, Brussels, Belgium
Original Design by Tuc Rail
Reworked in Revit by Dieter Vermeulen

# Rebar modelling with Dynamo & Revit

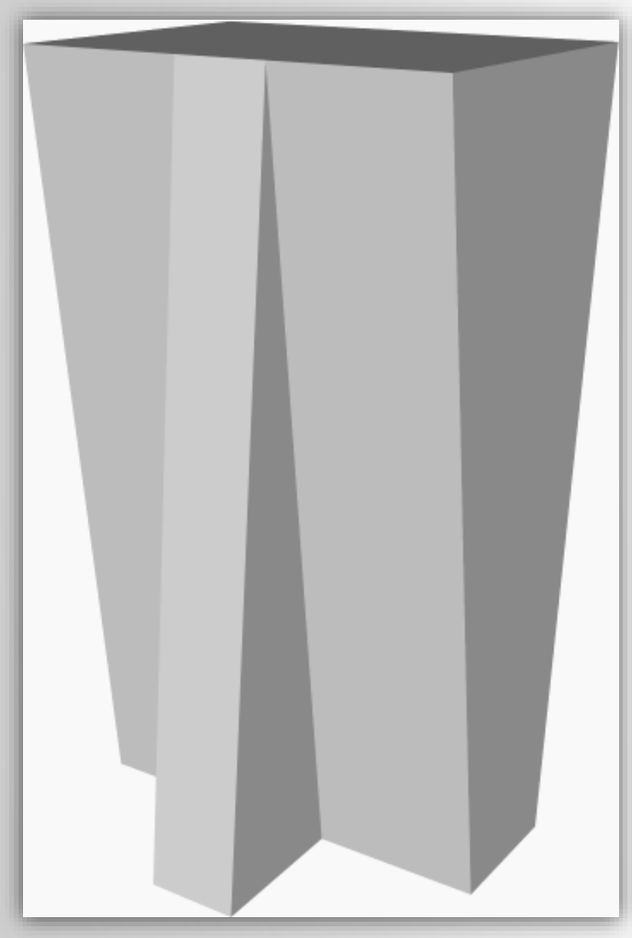
## Step 1 – Excel Configuration

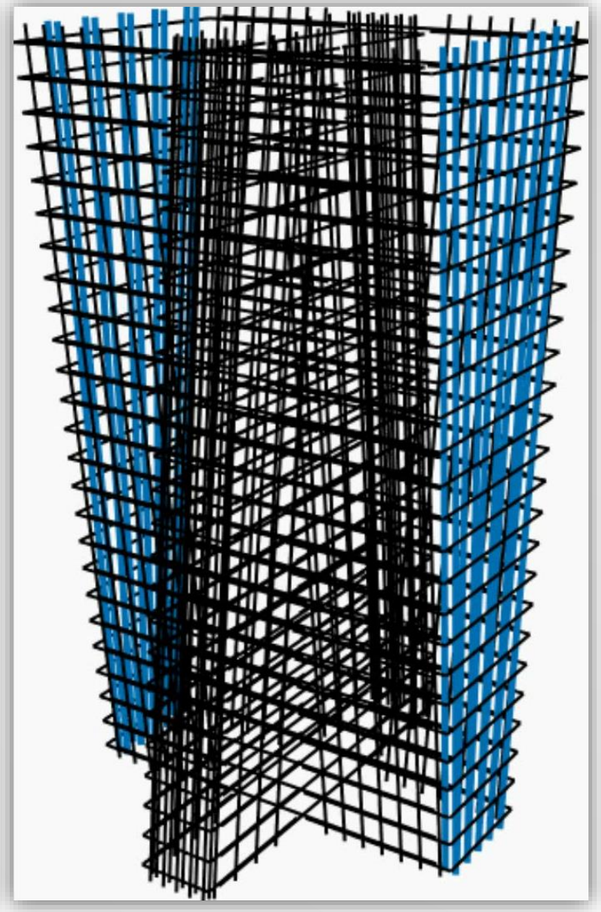
| REBAR CAGE CONFIGURATION<br>COLUMN BOTTOM PART | | |
|---|---|---|
| Cover to bar face | 40 | [mm] |
| Material quality | 500S | |
| Minimal bottom cover to face of stirrup | 50 | [mm] |
| **Longitudinal Rebars** | | |
| **Rebar at core bearing part** | | |
| Diameter | 32 | [mm] |
| Number of bars front face | 10 | |
| Number of bars side face | 7 | |
| Number of layers front face | 2 | |
| Number of layers side face | 1 | |
| **Rebar at front face triangular buttress** | | |
| Diameter | 20 | [mm] |
| Number of bars front face | 5 | |
| Number of bars side face | 4 | |
| Number of layers front face | 2 | |
| Number of layers side face | 1 | |
| **Stirrups** | | |
| **Hairpins** | | |
| Diameter | 16 | [mm] |
| Distance between hairpins | 200 | [mm] |
| **Transversal rebars** | | |
| Diameter | 16 | [mm] |
| Distance between bars | 200 | [mm] |

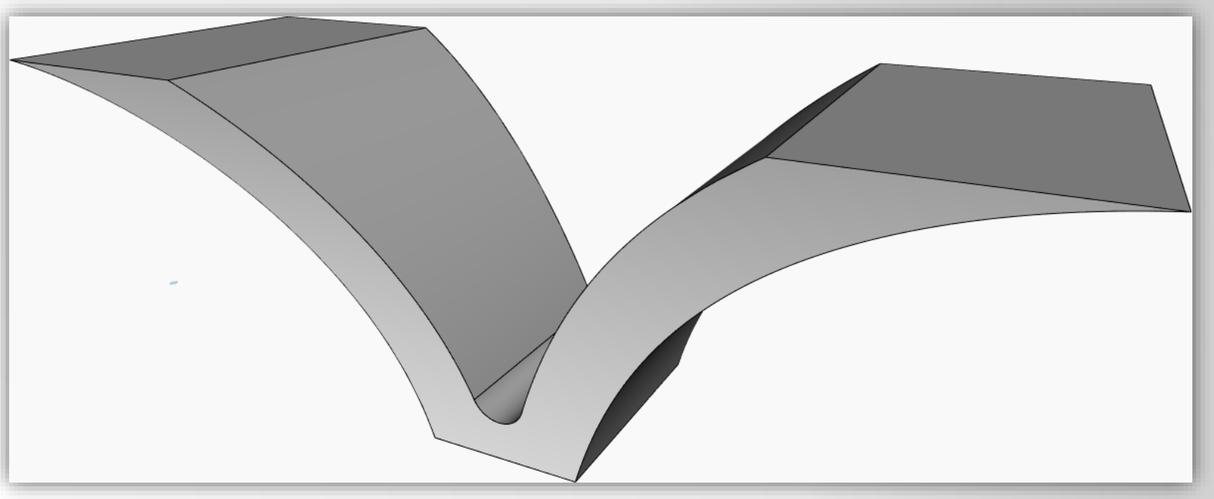
| Parameter | Value | Description |
|---|---|---|
| material | 500S | Material indication string |
| diam vert | 32 | Diameter vertical longitudinal reinforcement |
| num vert out | 10 | Number of bars side arms outer face |
| num vert in | 10 | Number of bars side arms inner face |
| lay vert out | 2 | Number of layers side arms outer face |
| lay vert in | 3 | Number of layers side arms inner face |
| center offset vert out | 72 | Distance from outer face to center of vertical longitudinal reinforcement |
| center offset vert in | 72 | Distance from inner face to center of vertical longitudinal reinforcement |
| diam hor | 16 | Diameter horizontal transversal reinforcement |
| dist hor | 200 | Distance between horizontal transversal rebars |
| center offset hor | 48 | Distance from face to center of horizontal transversal reinforcement |
| shift hairpin | 16 | Shift distance for hairpins rebars (= diameter horizontal transversal) |
| diam hairpin | 12 | Diameter of the hairpins |
| dist hairpin | 200 | Distance between hairpins |
| anchor hairpin | 350 | Length of the anchor lines of the hairpins |
| center offset hairpin | 46 | Distance from face to center of hairpins |
| diam base bottom | 20 | Diameter base bottom reinforcement |
| dist base bottom | 200 | Distance between bottom reinforcement bars in both directions |
| center offset base bottom lay 1 | 50 | Distance from face to center base bottom reinforcement lower layer |
| center offset base bottom lay 2 | 70 | Distance from face to center base bottom reinforcement upper layer |
| diam base top | 20 | Diameter base curved top reinforcement |
| dist base top curve | 200 | Distance between curved bars direction 2 |
| num base top straight | 3 | Number of straight bars direction 1 |
| center offset base top lay 1 | 50 | Distance from face to center base curved top reinforcement 1st layer |
| center offset base top lay 2 | 70 | Distance from face to center base curved top reinforcement 2nd layer |
| cover to bar face | 40 | Cover to bar face |

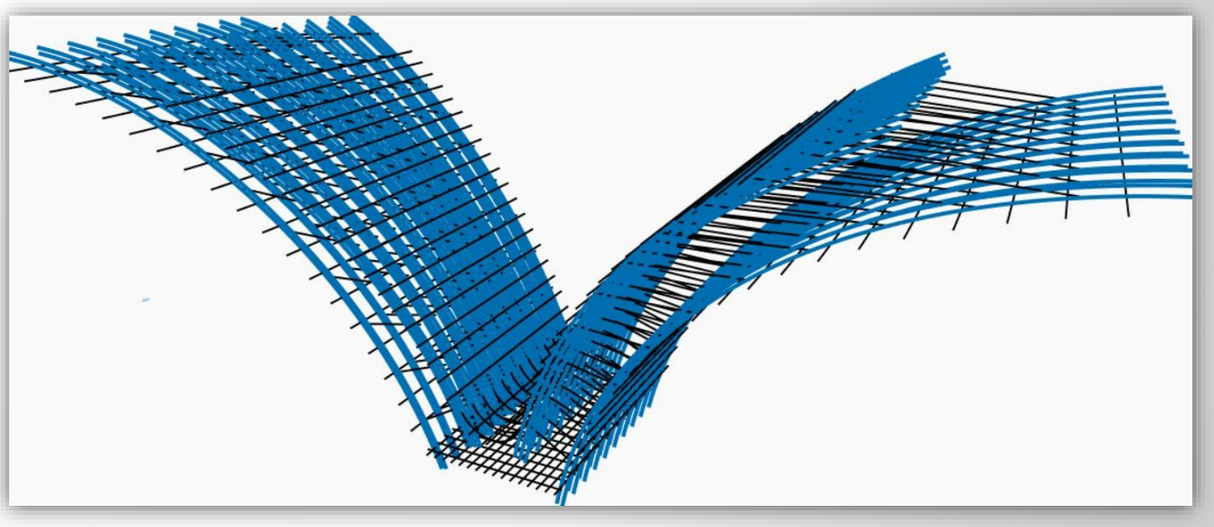
# Rebar modelling with Dynamo & Revit

**Step 2 – Rebar outlines in Dynamo**



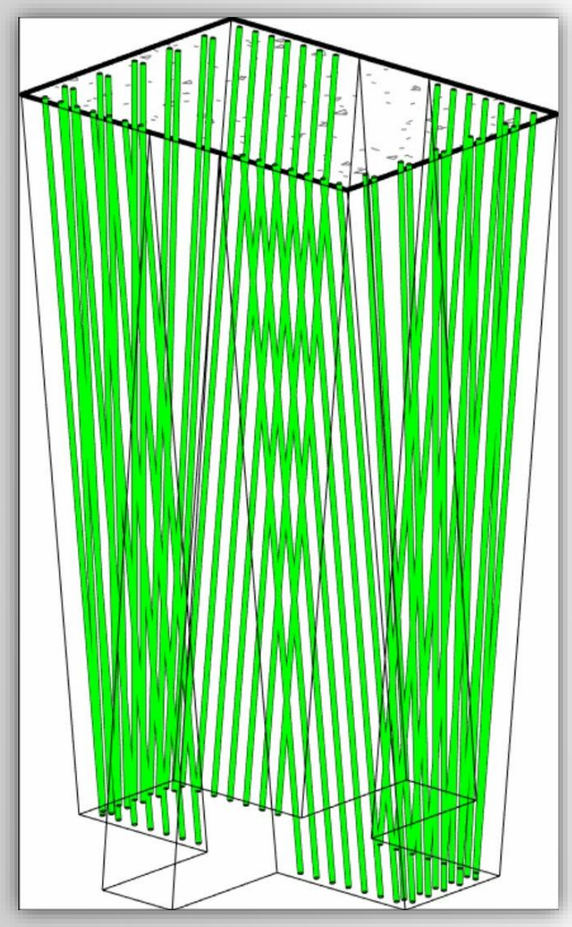


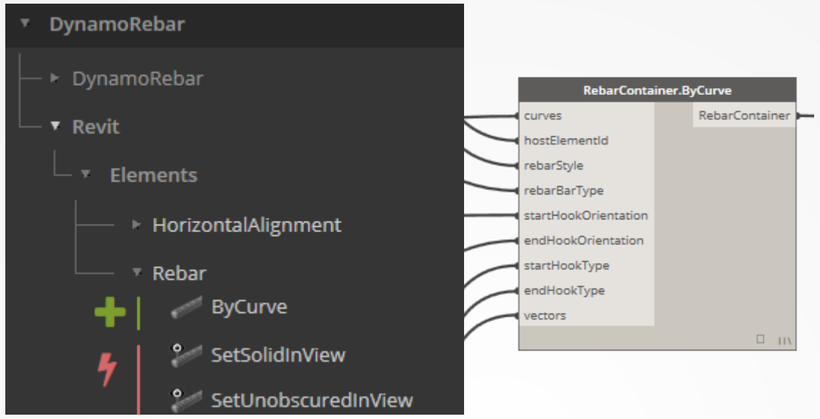




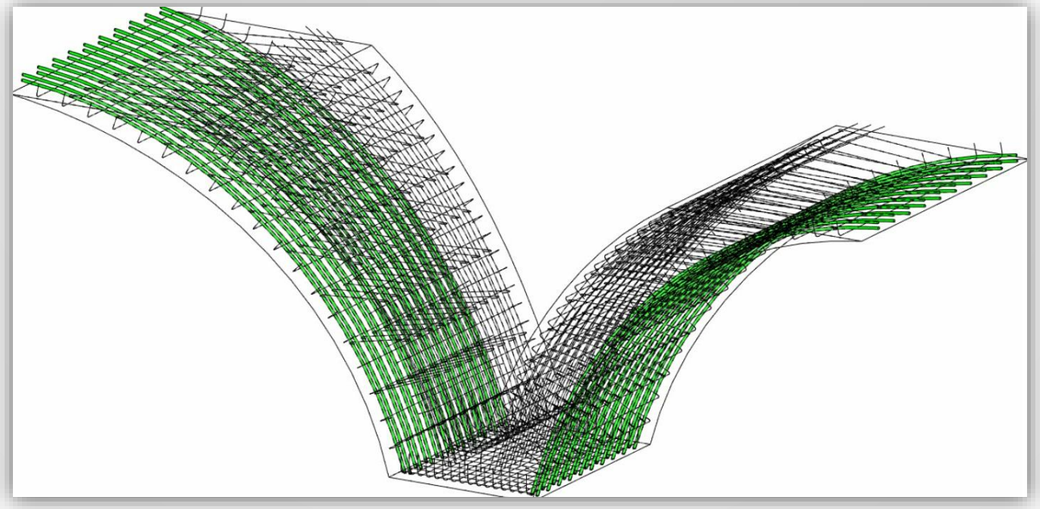
# Rebar modelling with Dynamo & Revit

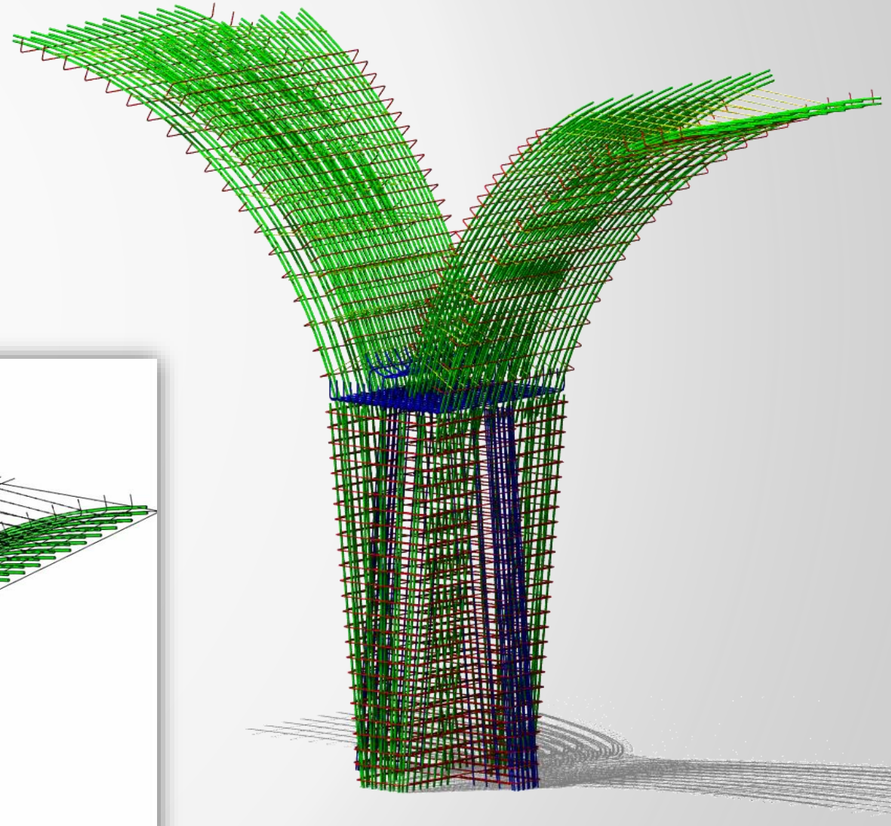
**Step 3 – Rebar Creation in Revit**





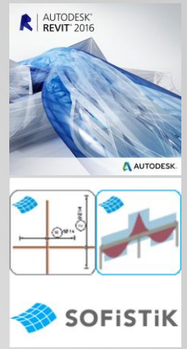

"Dynamo for Rebar" package





# Rebar modelling with Dynamo & Revit

## Step 4 – Rebar Detailing in Revit with Sofistik

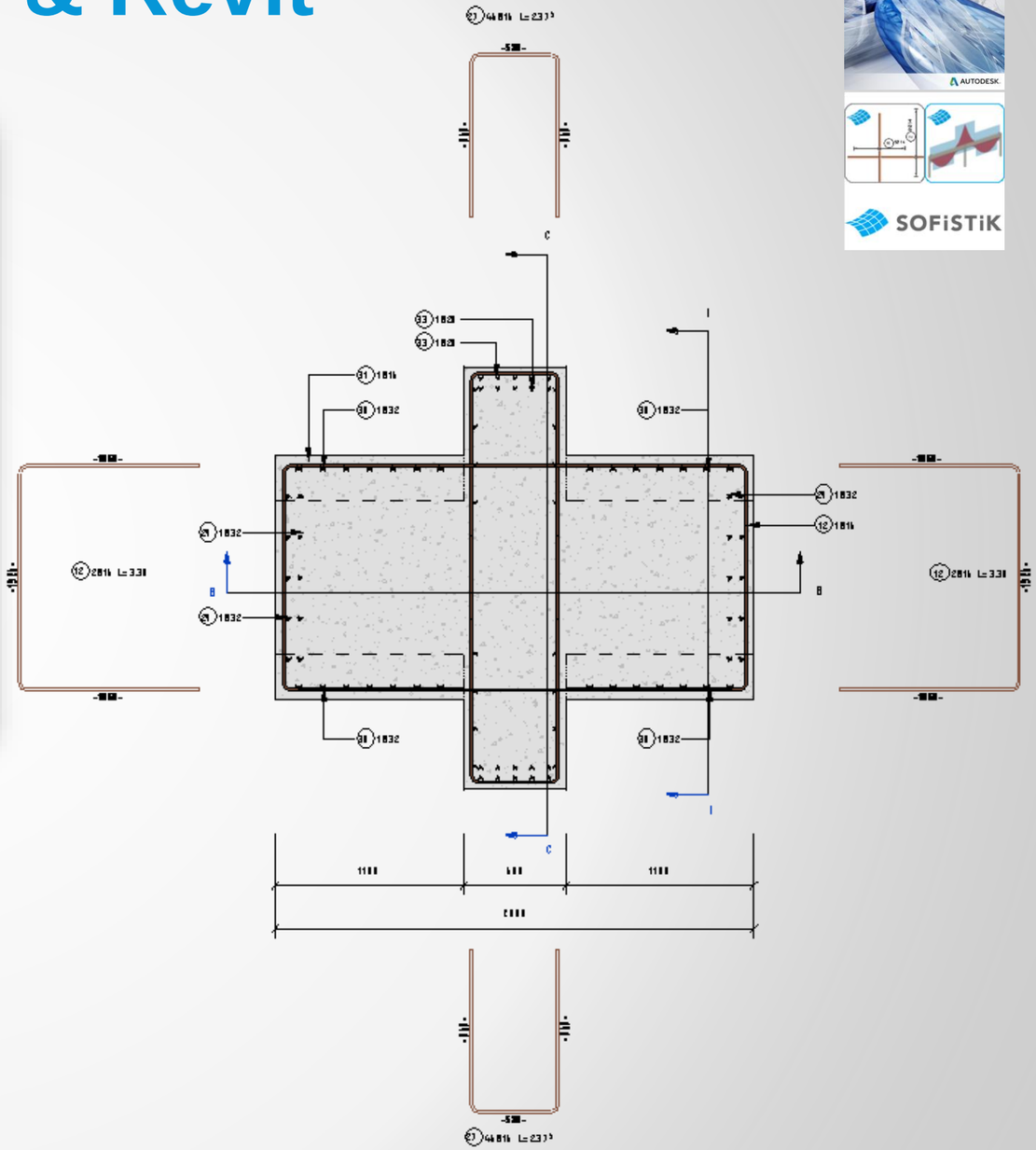



**Rebar Schedule**

| Mark | Shape Code | Bar Diameter | A | B | C | Quantity | Bar Length | Shape Image |
|---|---|---|---|---|---|---|---|---|
| 01 | 21 | 16 mm | 1060 mm | 842 mm | 1060 mm | 2 | 2896 mm | 1060[mm] 842[mm] 1060[mm] |
| 02 | 21 | 16 mm | 1060 mm | 886 mm | 1060 mm | 2 | 2940 mm | 1060[mm] 886[mm] 1060[mm] |
| 03 | 21 | 16 mm | 1060 mm | 930 mm | 1060 mm | 2 | 2984 mm | 1060[mm] 930[mm] 1060[mm] |

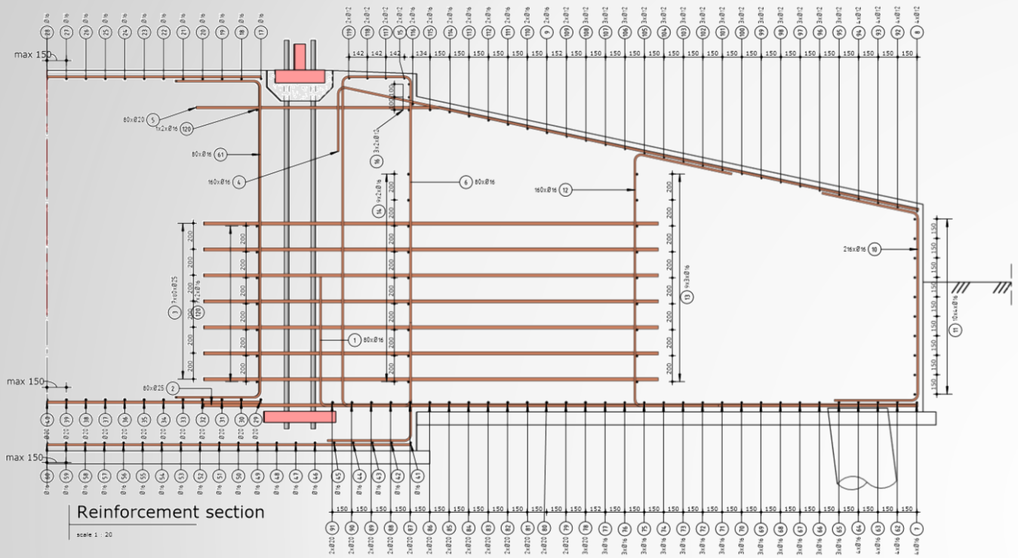
BENDING SCHEDULE St

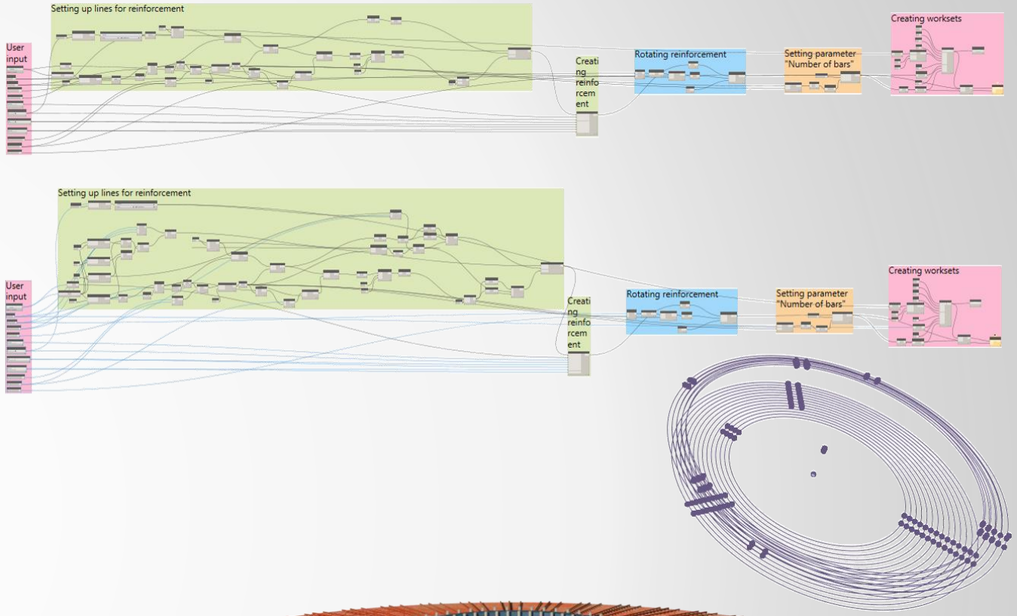
| Bar-mark | Bar-diameter | Length of each bar | Total number | T | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 16 | 2896 | 2 | | | | | | | | | | |
| 02 | 16 | 2940 | 2 | 5880 | 4 | 21 | | 1060 | 886 | 1060 | | | |
| 03 | 16 | 2984 | 2 | 5968 | 4 | 21 | | 1060 | 930 | 1060 | | | |

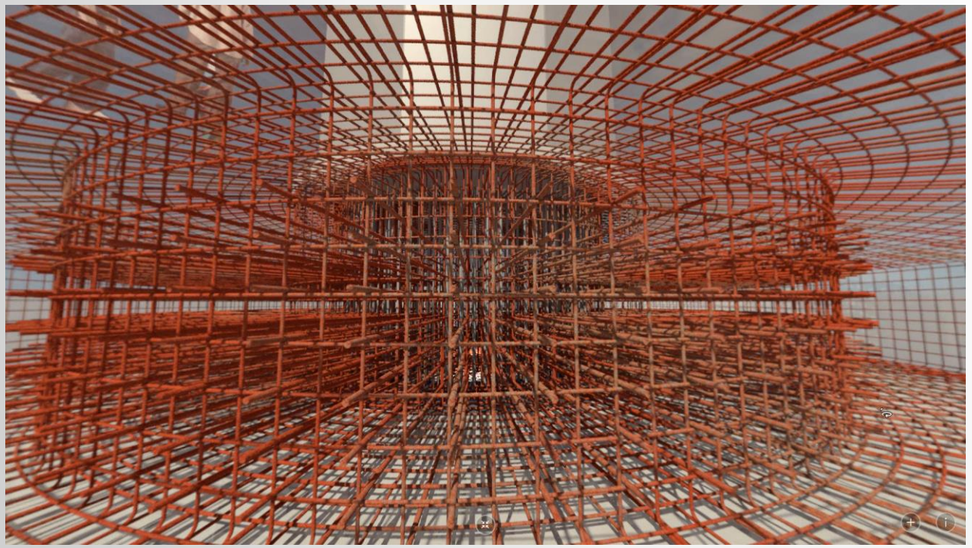


SUITE

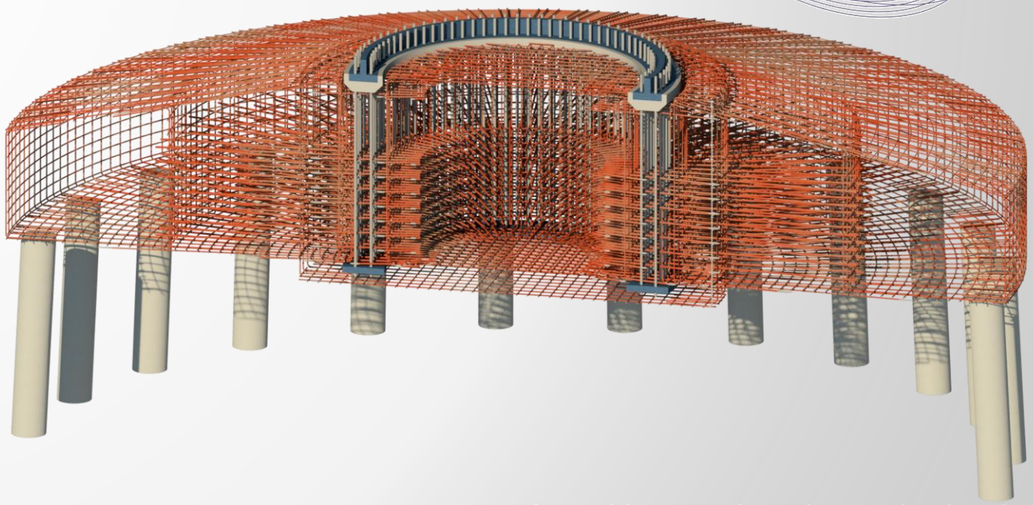
# Reinforced Concrete Foundation Design



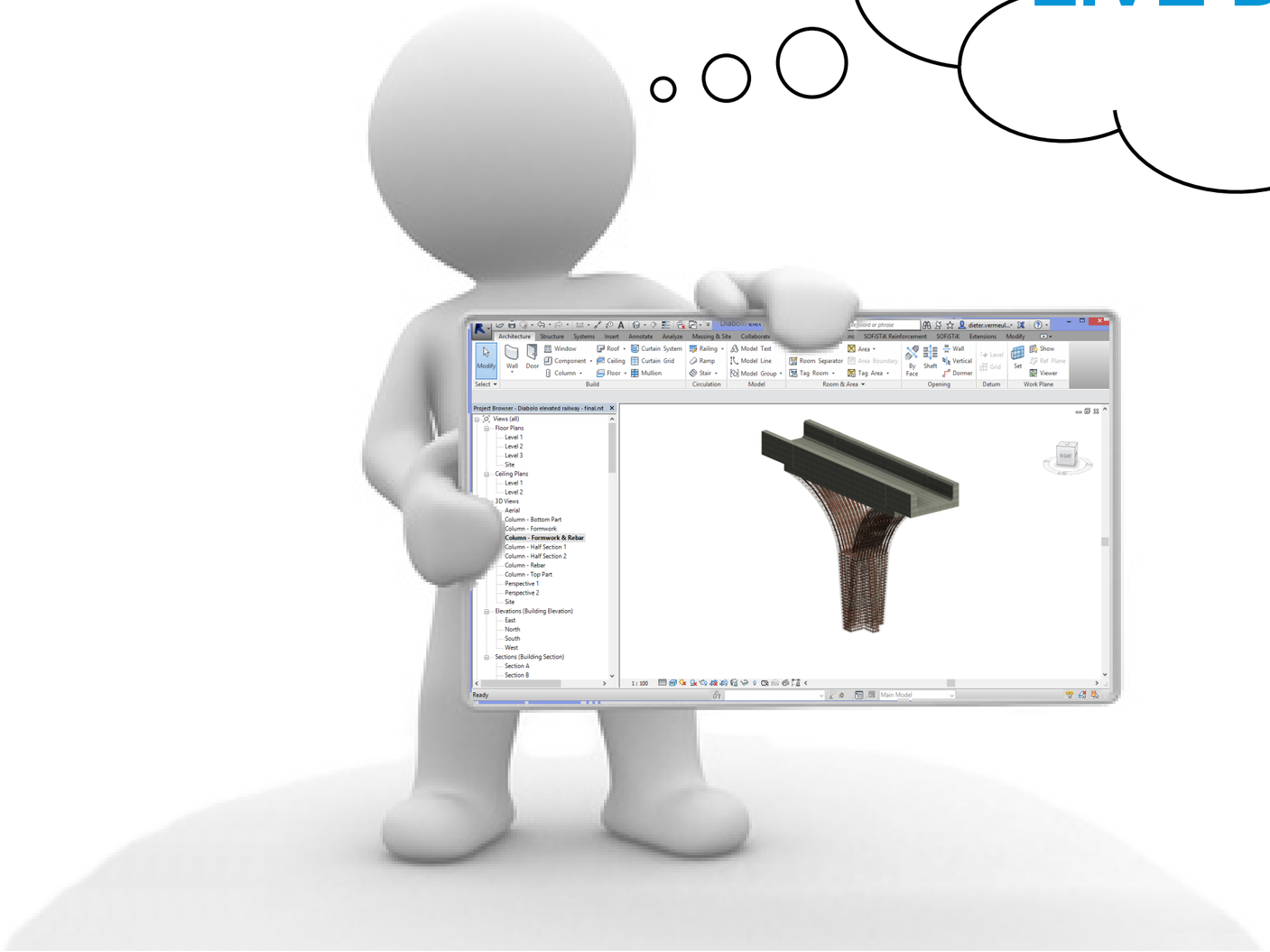



Watch here

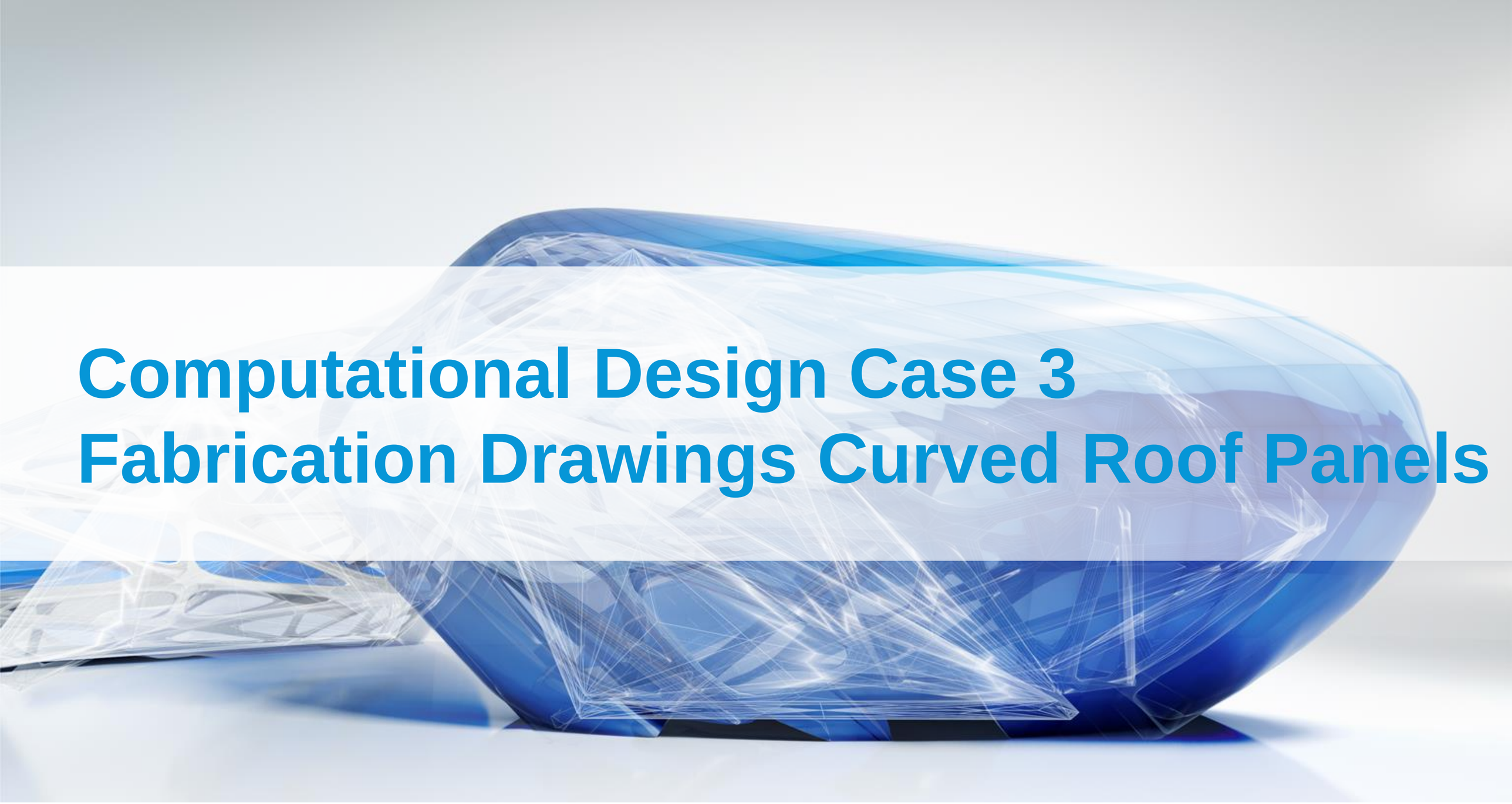


Authored by ABT bv, The Netherlands

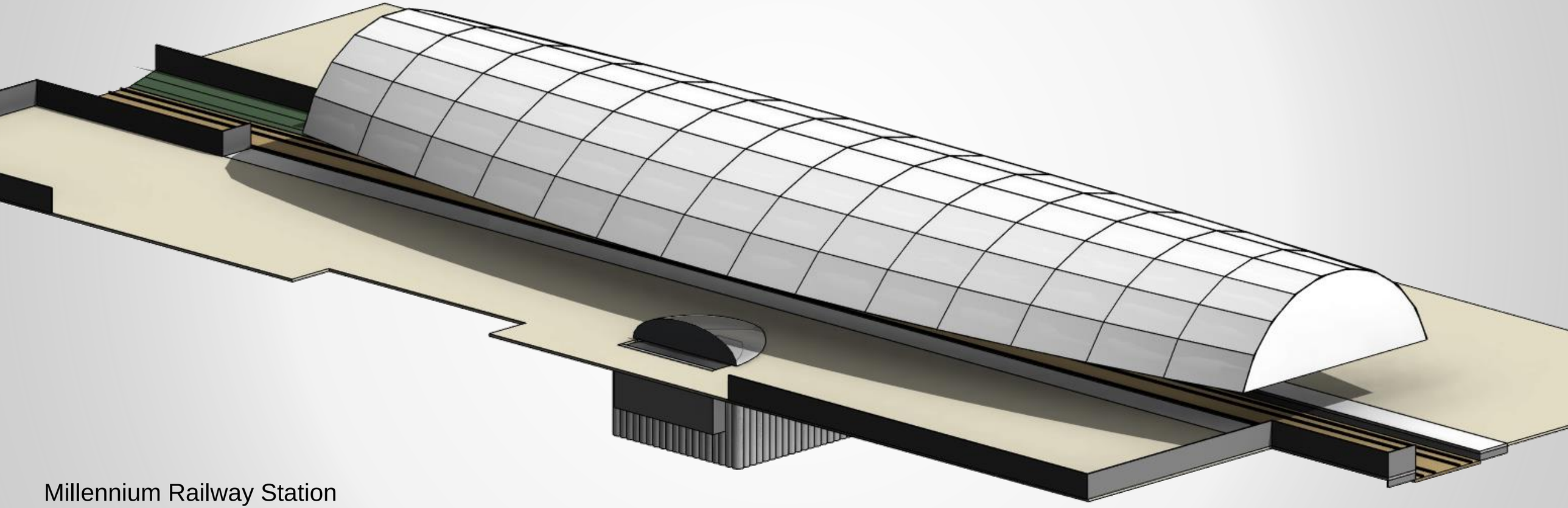
# LIVE DEMO !



# Computational Design Case 3
# Fabrication Drawings Curved Roof Panels



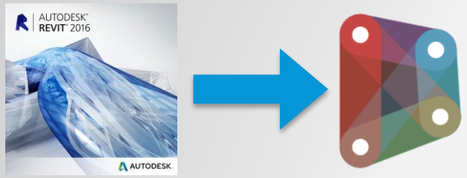
# Fabrication Drawings Curved Roof Panels

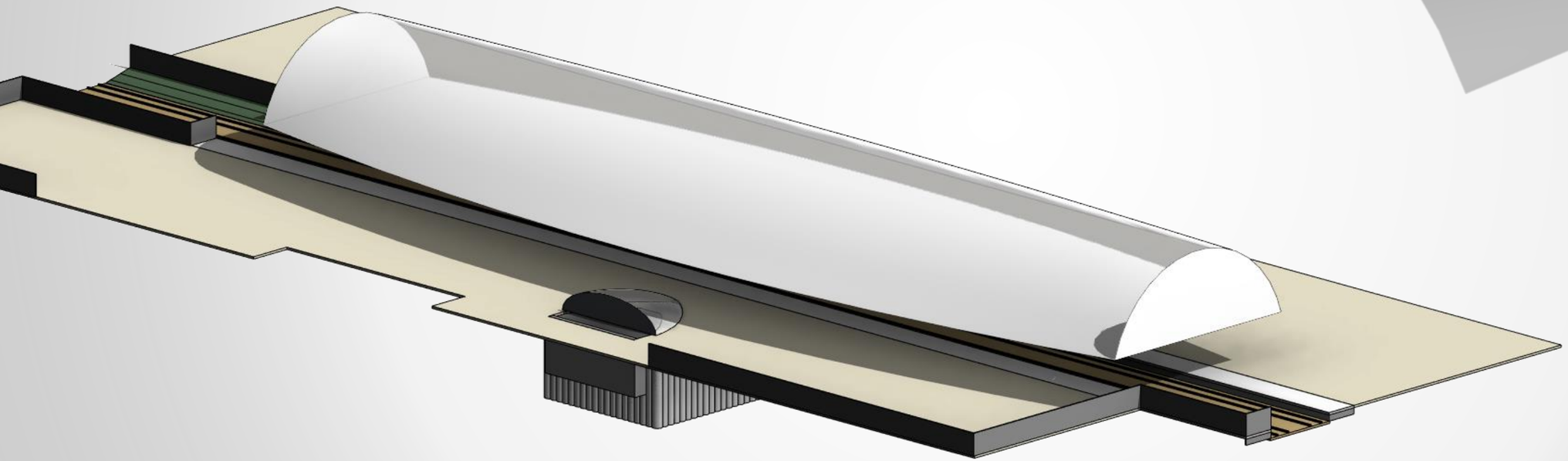


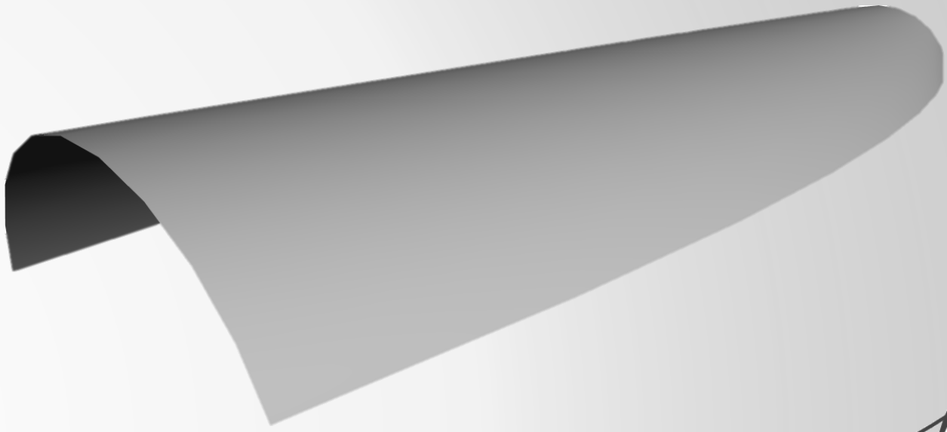
Millennium Railway Station
“Armadillo Roof” – Roof Panel Fabrication
Autodesk EMEA NE Virtual Project

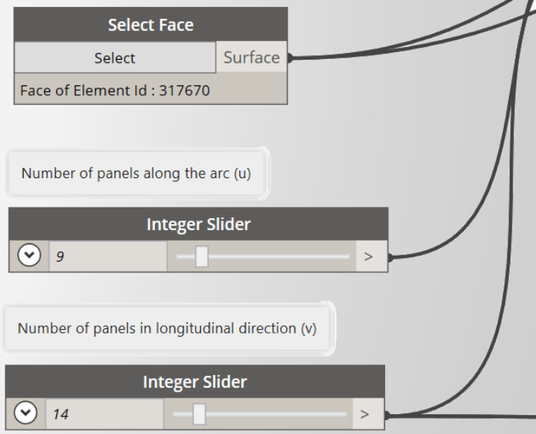
# Fabrication Drawings Curved Roof Panels

**Step 1 – Initial Base Geometry**



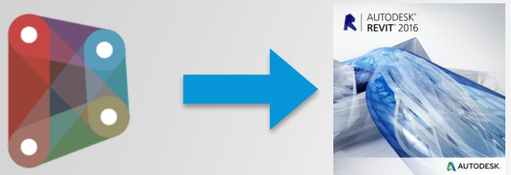



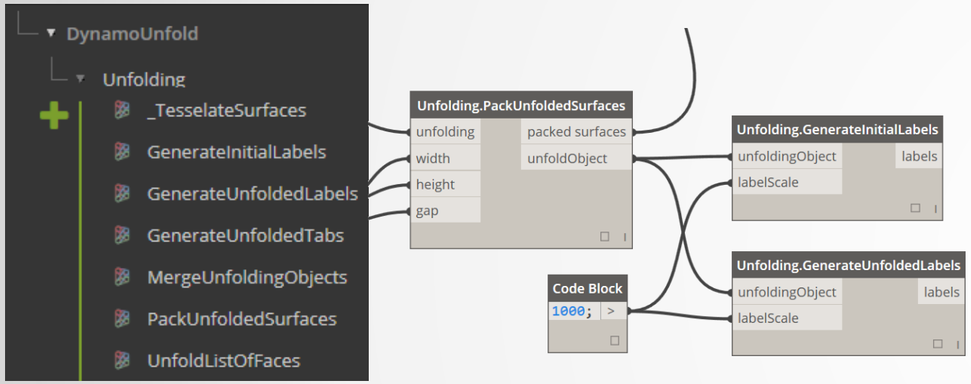


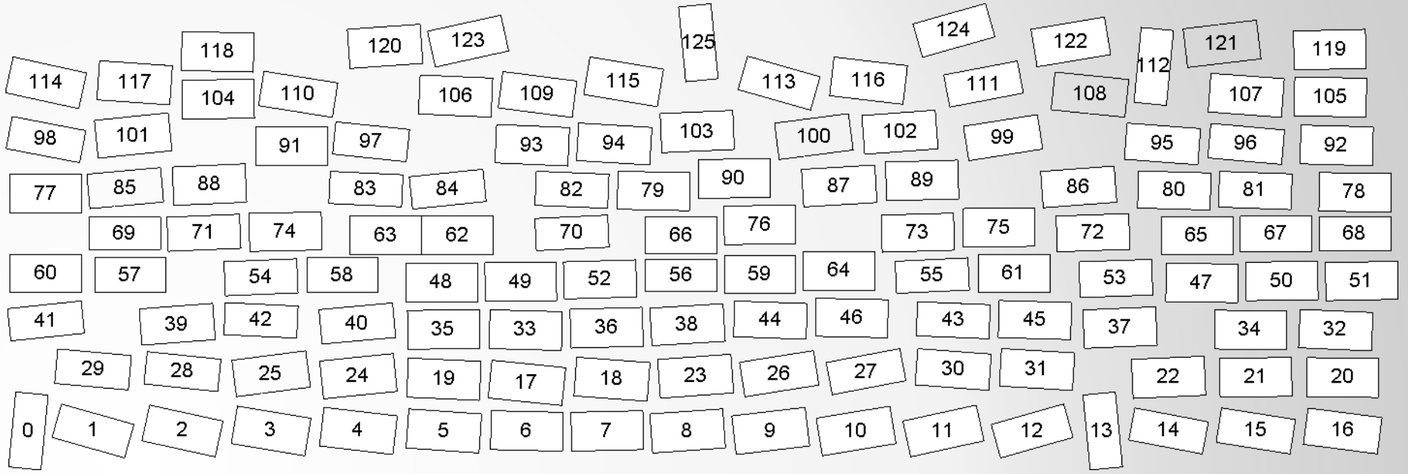


# Fabrication Drawings Curved Roof Panels

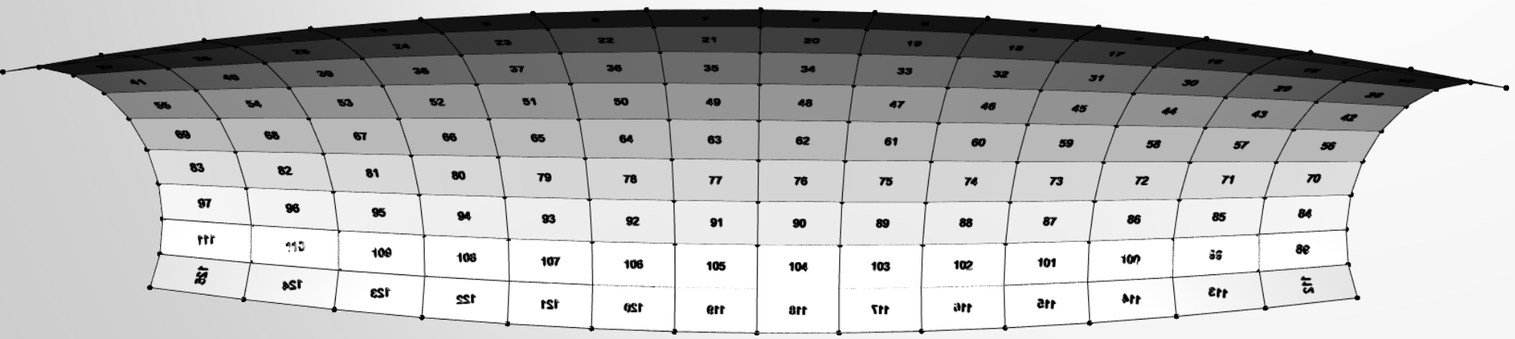
## Step 2 – Unfolding and flattening

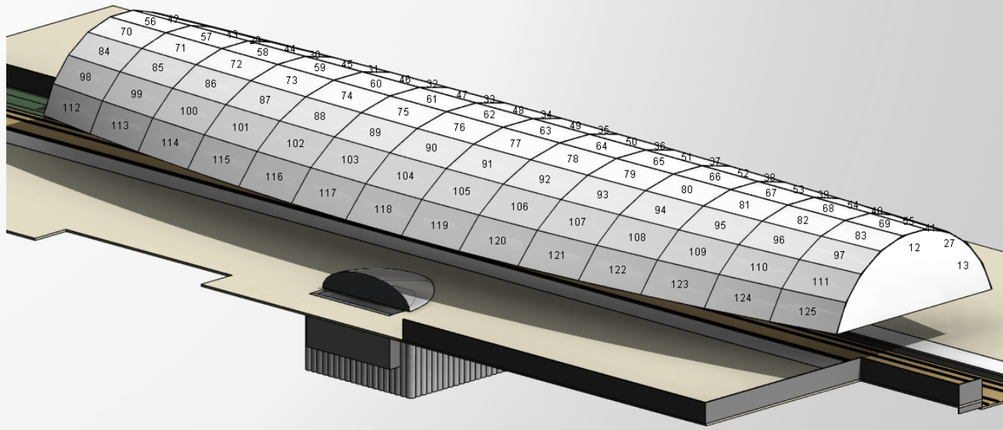


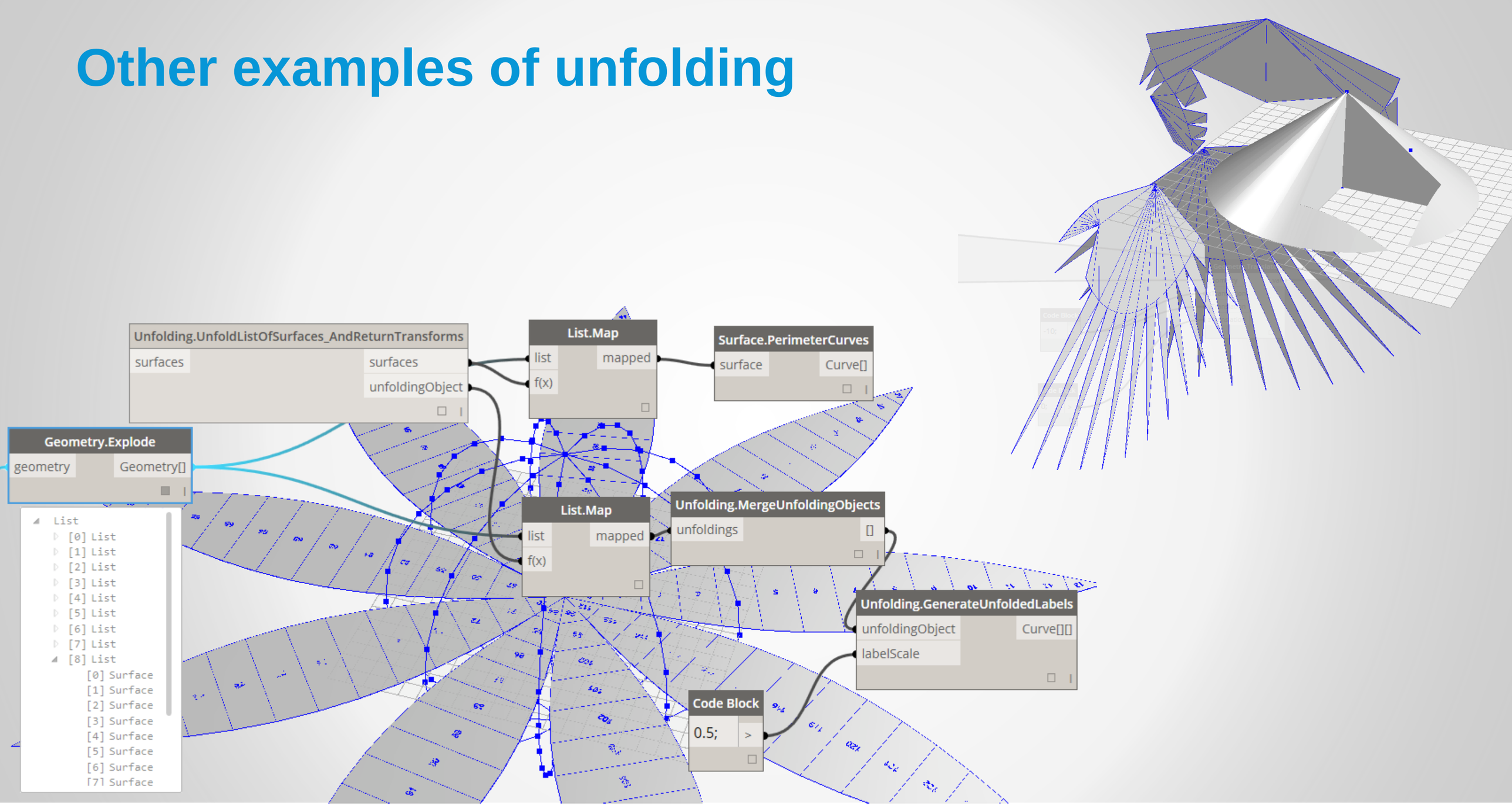



"Dynamo Unfold" package

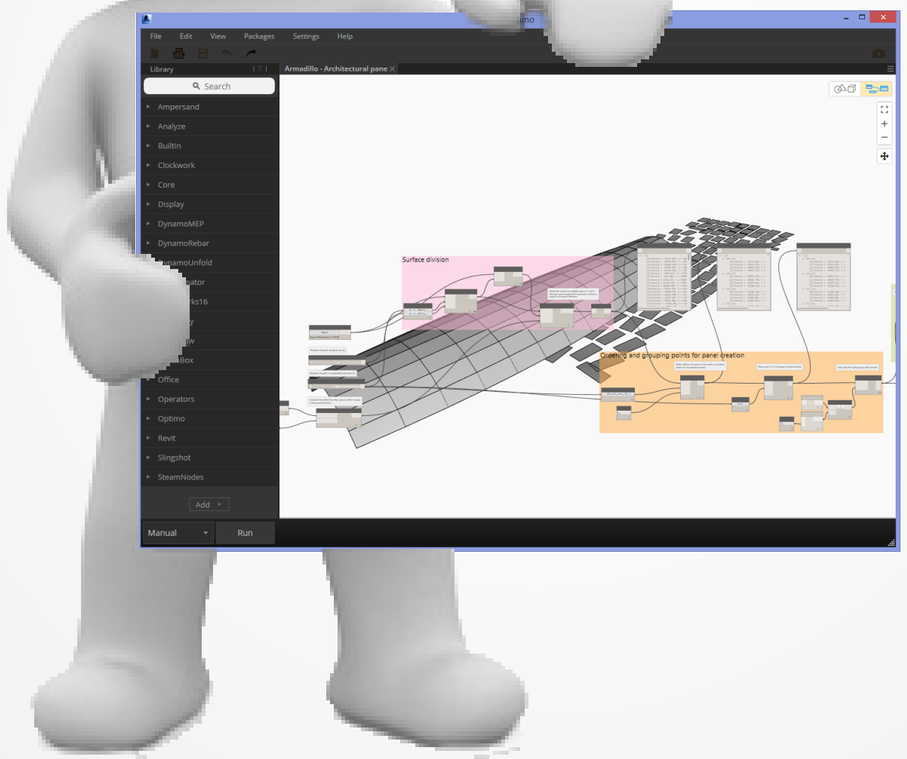




# Other examples of unfolding



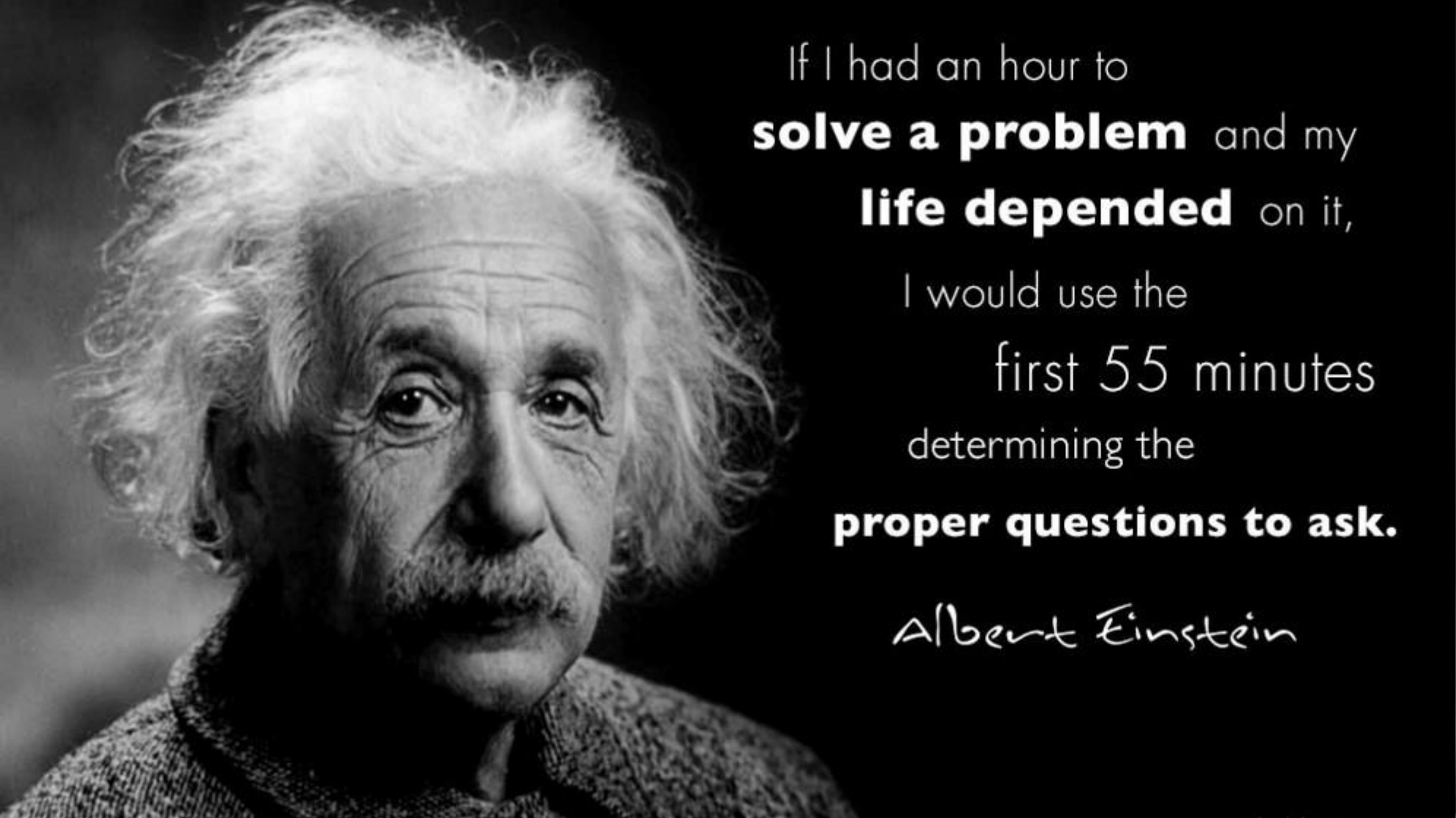
# Live Demo


File
Edit
View
Packages
Settings
Help
Library
Search
Ampersand
Analyze
Builtin
Clockwork
Core
Display
DynamoMEP
DynamoRebar
Office
Operators
Optimo
Revit
Slingshot
SteamNodes
Add
Manual
Run
Armadillo - Architectural pane
Surface division
Ordering and grouping points for panel creation

# More Dynam(o)ite Your Design

- Keep an eye on **RevitBeyondBIM** blog

- Dynamo for Structural Analysis in class
  **ES9542 - Dynam(o)ite Your Design for Engineers**
  Tuesday, Dec 1, 8:00 AM - 9:30 AM
  Lando 4304, Level 4


If I had an hour to
solve a problem and my
life depended on it,
I would use the
first 55 minutes
determining the
proper questions to ask.
Albert Einstein

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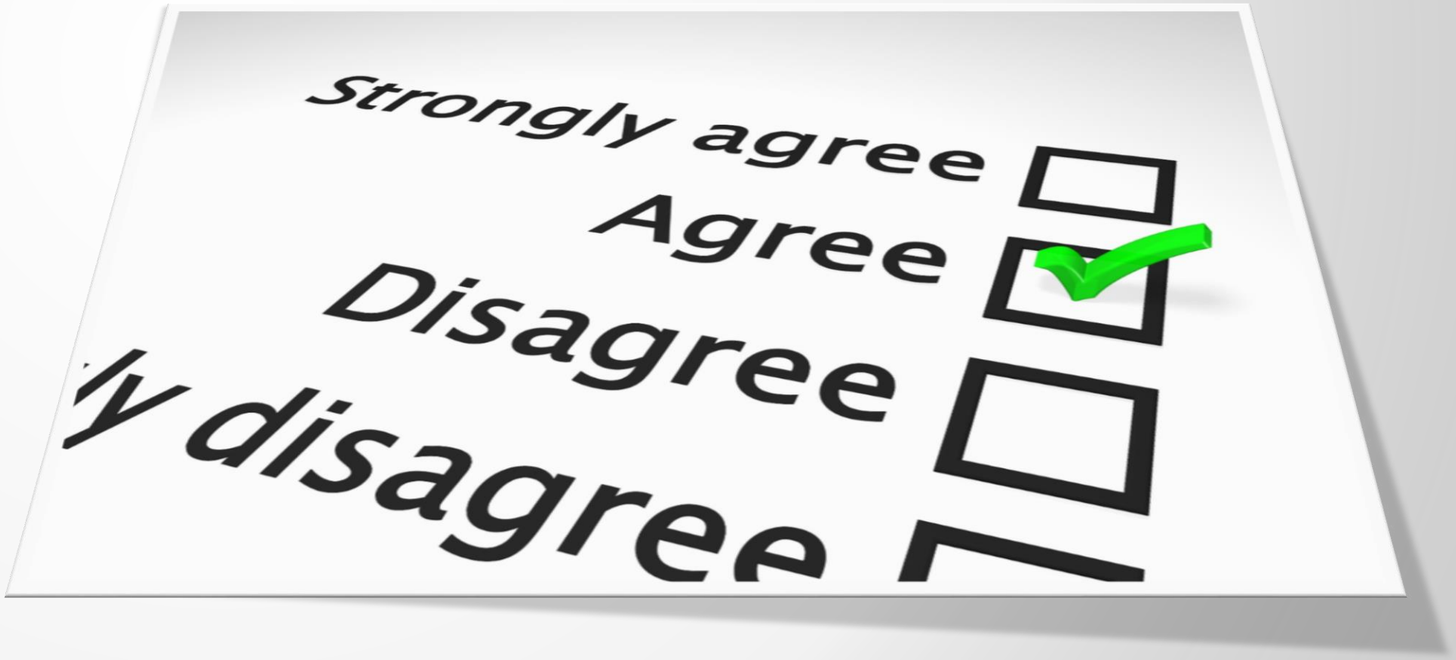
- AU 2016 passes awarded daily!
- Give your feedback after each session.
- Give instructors feedback in real-time.



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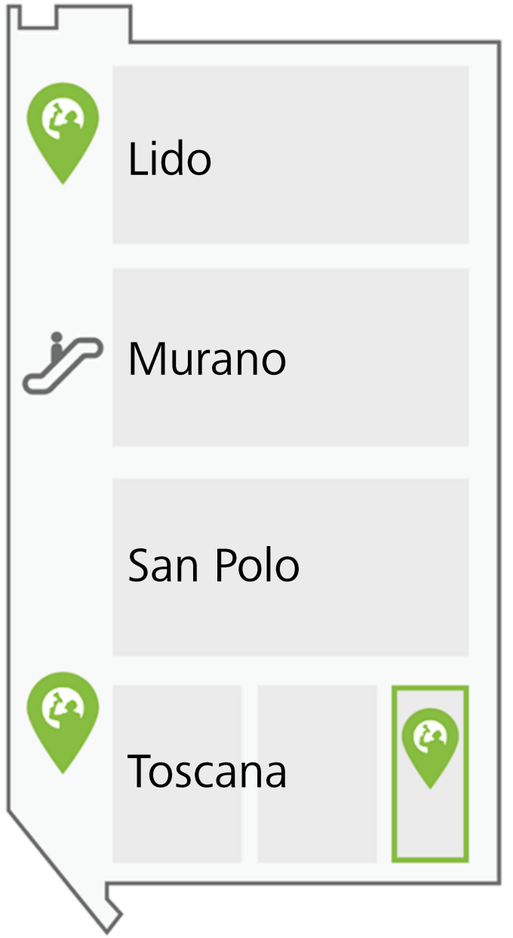
…and maybe win a GoPro camera!

## Venetian Level 3



For more information visit **http://autode.sk/AU2015VOC**

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