International Summer School: Historic Masonry Structures

TNA Workshop

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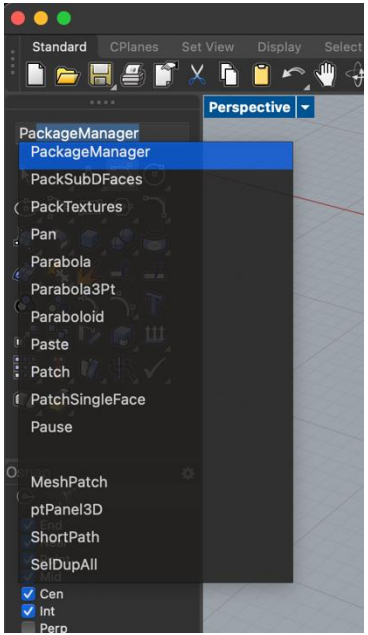
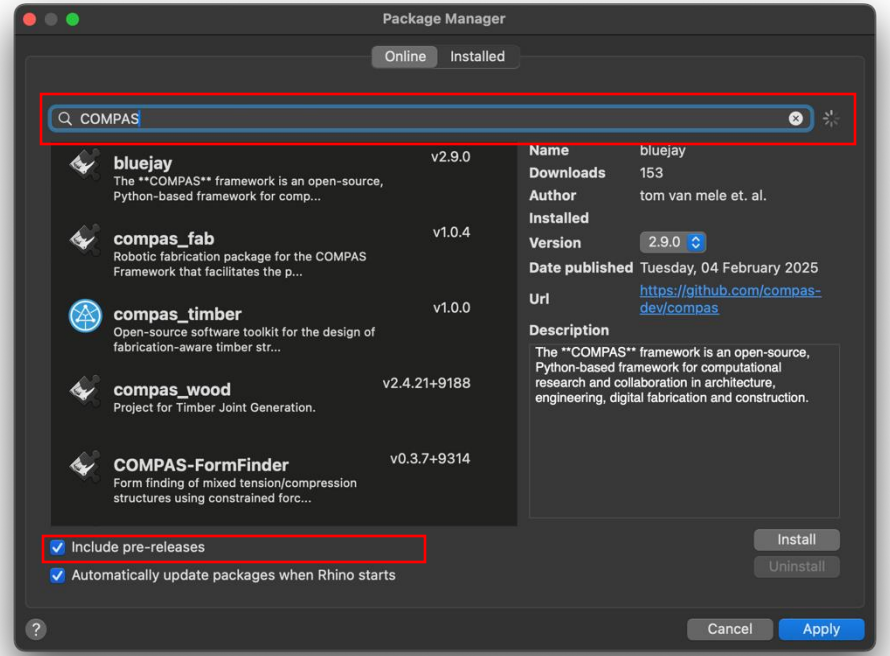
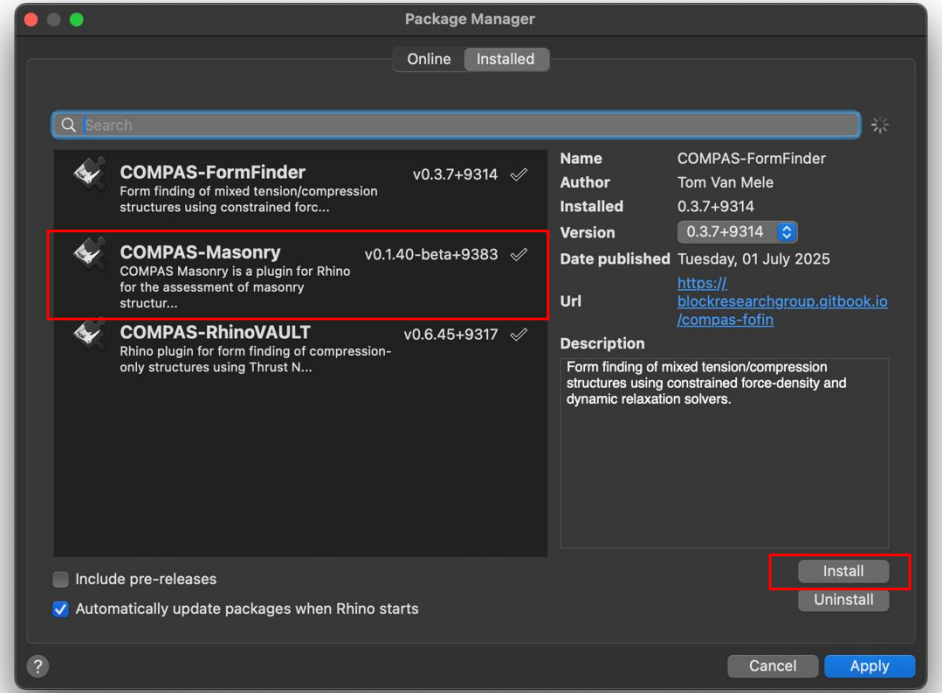
Rhino 8 Command: **PackageManager**



Search for: **COMPAS**
Include pre-releases [ON]



Find: **COMPAS-Masonry Version >= 0.1.52**
Install and close and open Rhino to Update

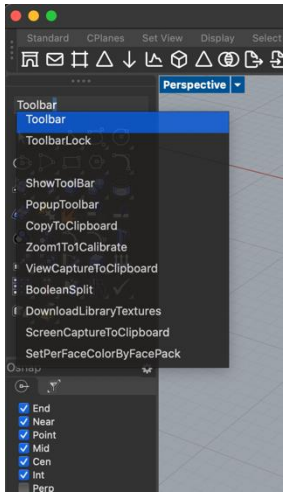


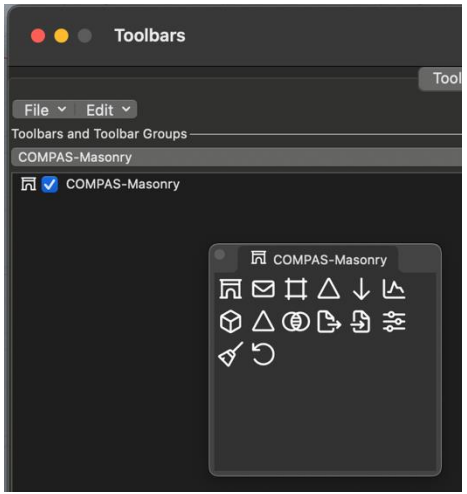
Open COMPAS-Masonry Toolbar
If not opened by default

TNA Commands

DEA Commands

Settings





Masonry Init: Initialize the plug-in

TNA_Envelope: Create intrados and extrados geometry

TNA_Form: Create Form Diagram of problem

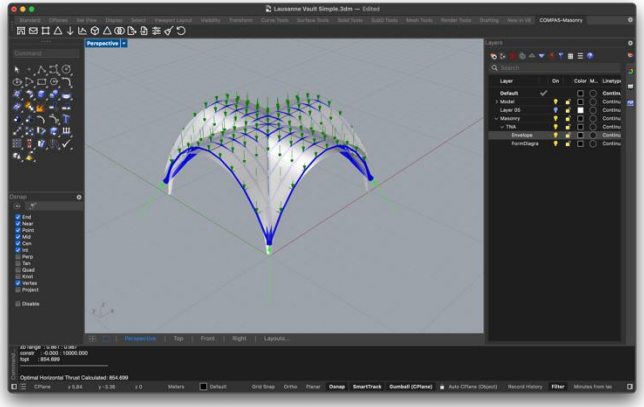
TNA_Supports: Assign Supports to the form diagram`

TNA_Loads: Assign Loads to the form diagram

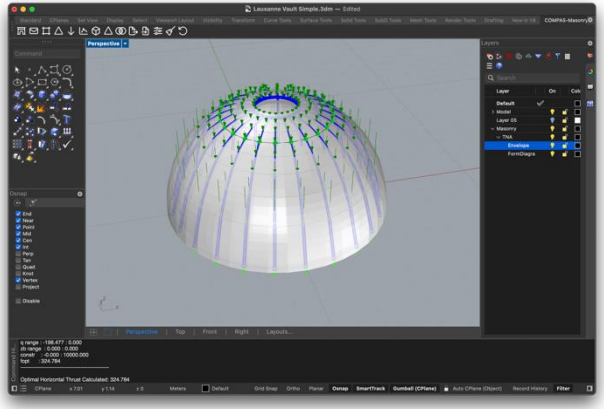
TNA_Analysis: Select and run analysis.

Settings: Visualization Settings

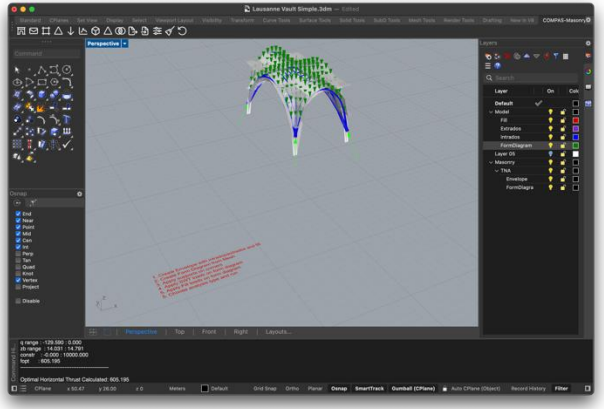
Clear and Redraw: Update scene



1 – Cross Vault

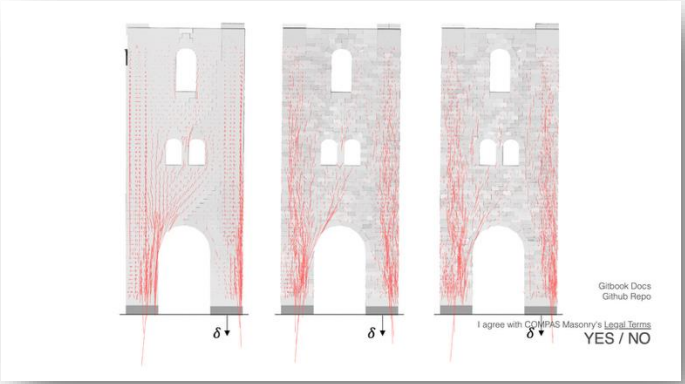


2 – Dome

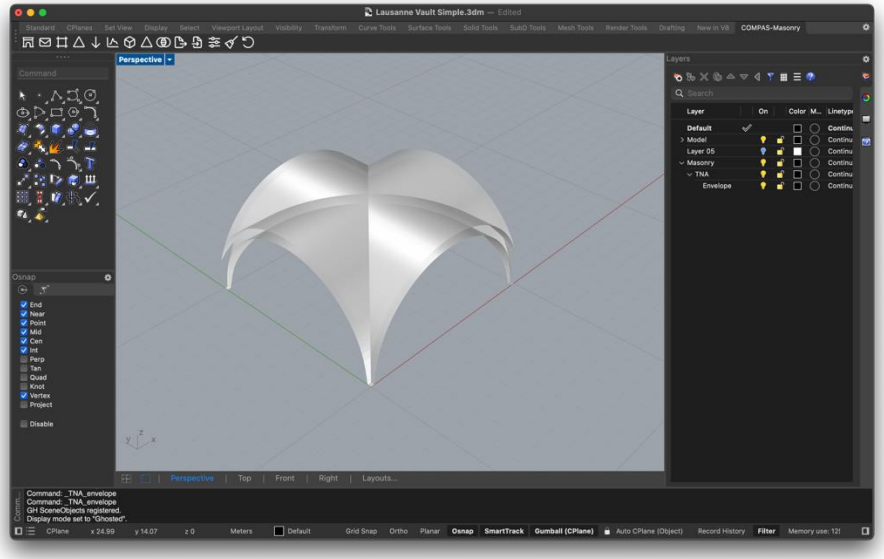


3 – Surveyed Vault

Masonry Init: Initialize the plug-in

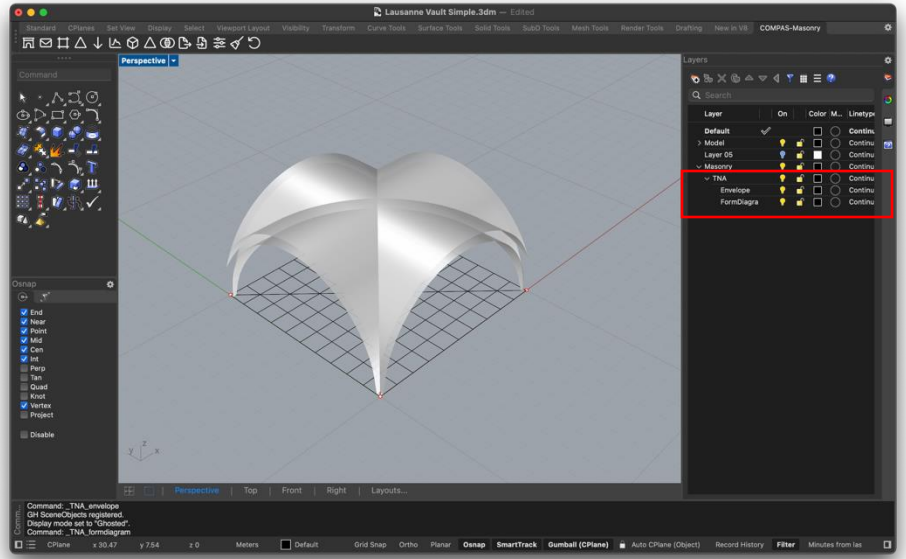


TNA_Envelope: Create intrados and extrados geometry



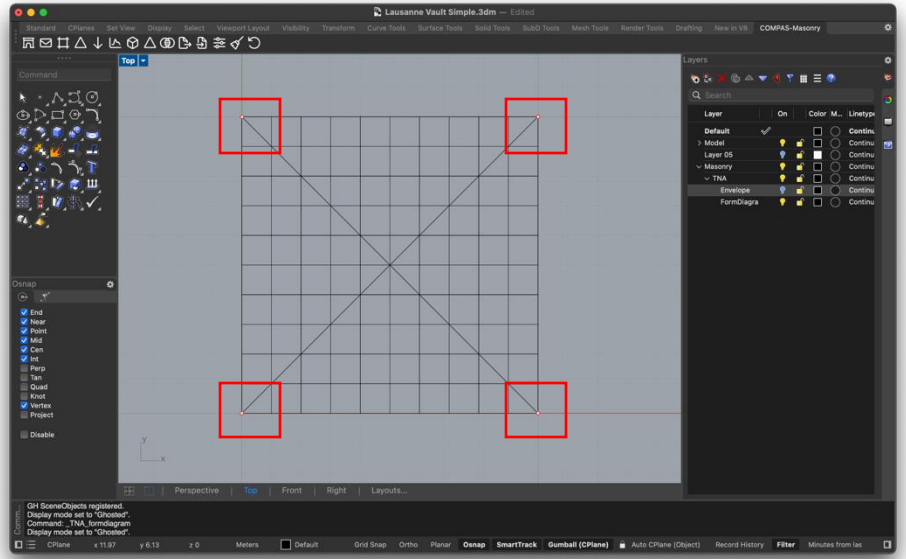
Parameters:
From Library > CrossVault > Enter Origin > Enter size > Enter Thickness > Enter material specific weight

TNA_Form: Create Form Diagram of problem



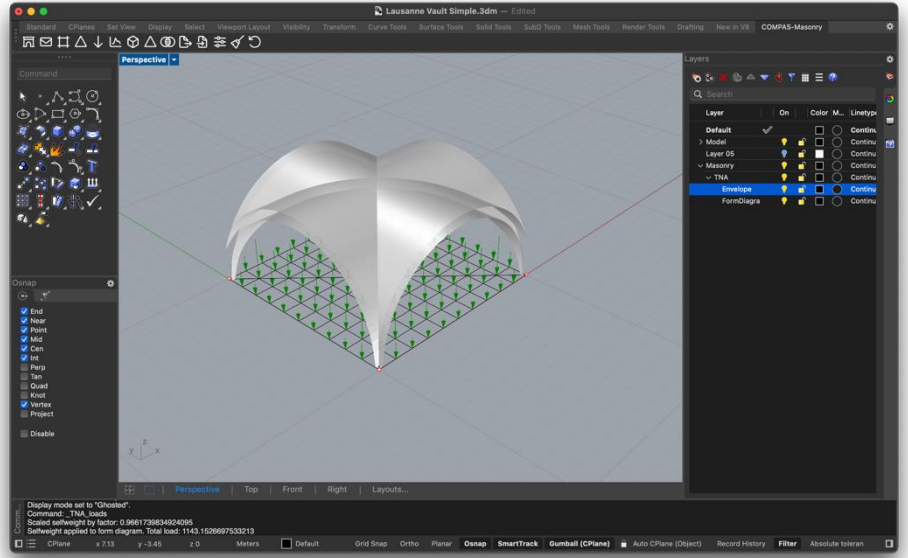
Parameters:
From Pattern > Cross > Enter Origin > Enter size > Enter discretization

TNA_Supports: Assign Supports to the form diagram`



Parameters:
Check Supports and Add/Remove supports.
Corners are Selected as Default.

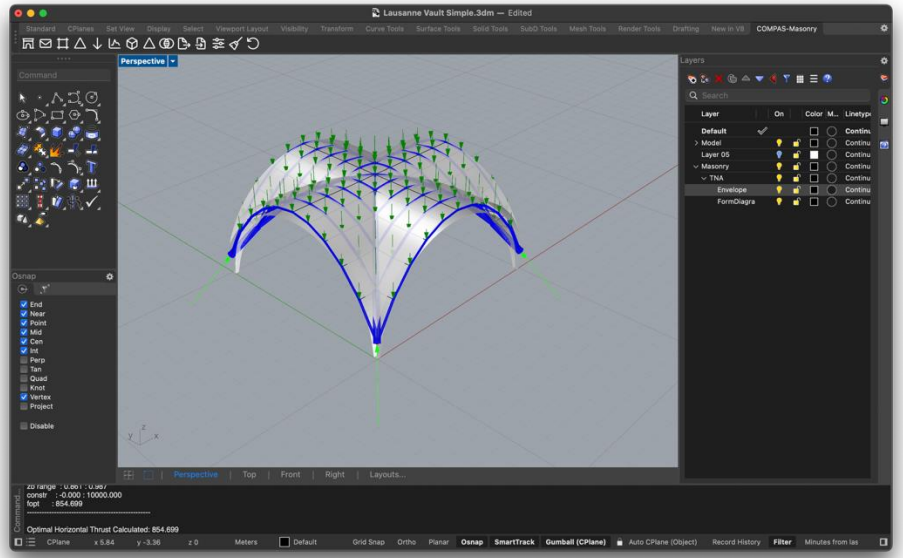
TNA_Loads: Assign Loads to the form diagram



Parameters:
Add Load > Selfweight > Normalize Weight

```
Command: _TNA_loads
Scaled selfweight by factor: 0.9661739834924095
Selfweight applied to form diagram. Total load: 1143.1
```

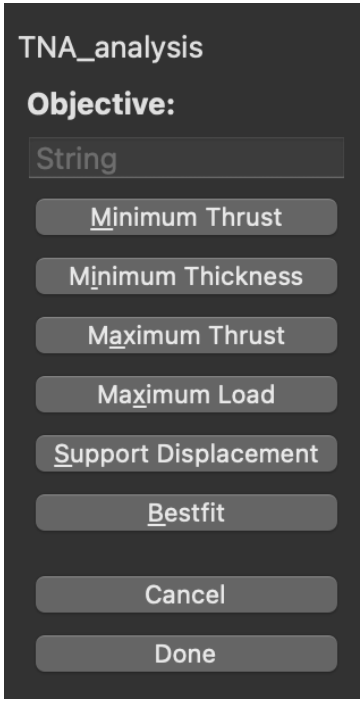
TNA_Analysis: Select and run analysis.

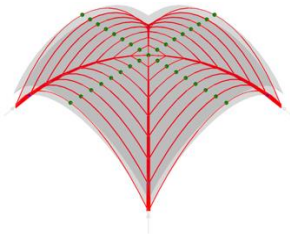


Parameters:
Minimum Thrust Analysis

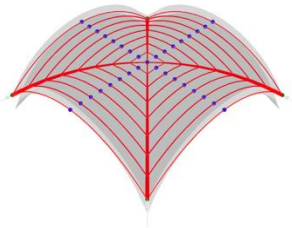
```
----------------------------------------------------
TNO v.2.0
Solution  : Optimization terminated successfully
q range : -145.096 : 0.000
zb range  : 0.861 : 0.987
constr    : -0.000 : 10000.000
fopt      : 854.699
----------------------------------------------------

Optimal Horizontal Thrust Calculated: 854.699
```

TNA_Analysis: Select and run analysis.

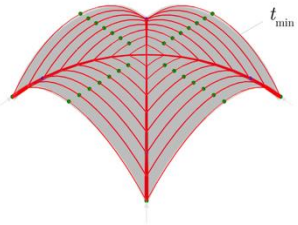




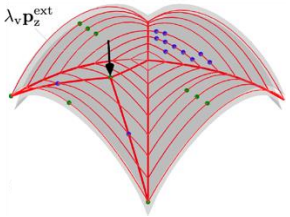
min. thrust



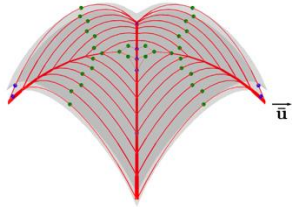
max. thrust



min. thickness



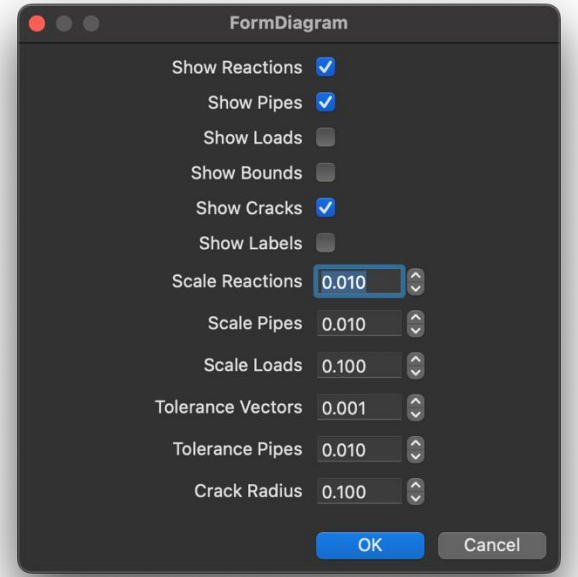
max. vert. load



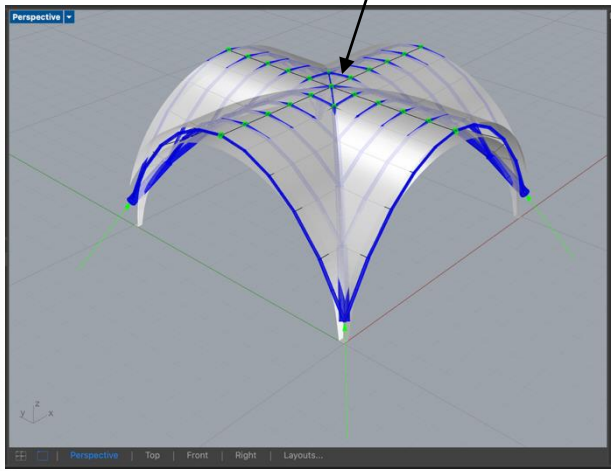
complementary energy

R. Maia Avelino, "Thrust Network Optimisation for the Assessment of Vaulted Masonry Structures," Doctoral Thesis, ETH Zurich, 2023.

Settings: Visualization Settings

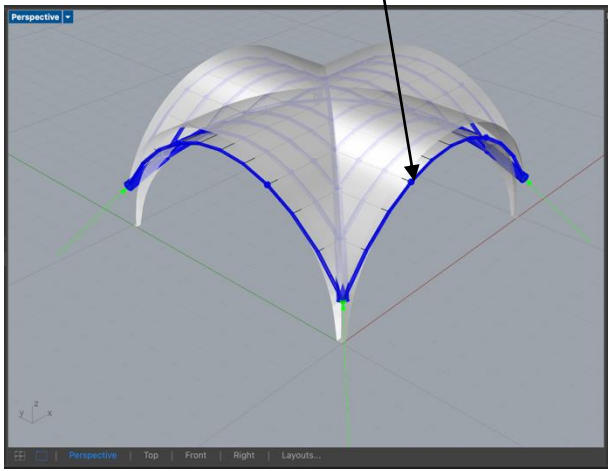


Intrados cracks = Extrados touches

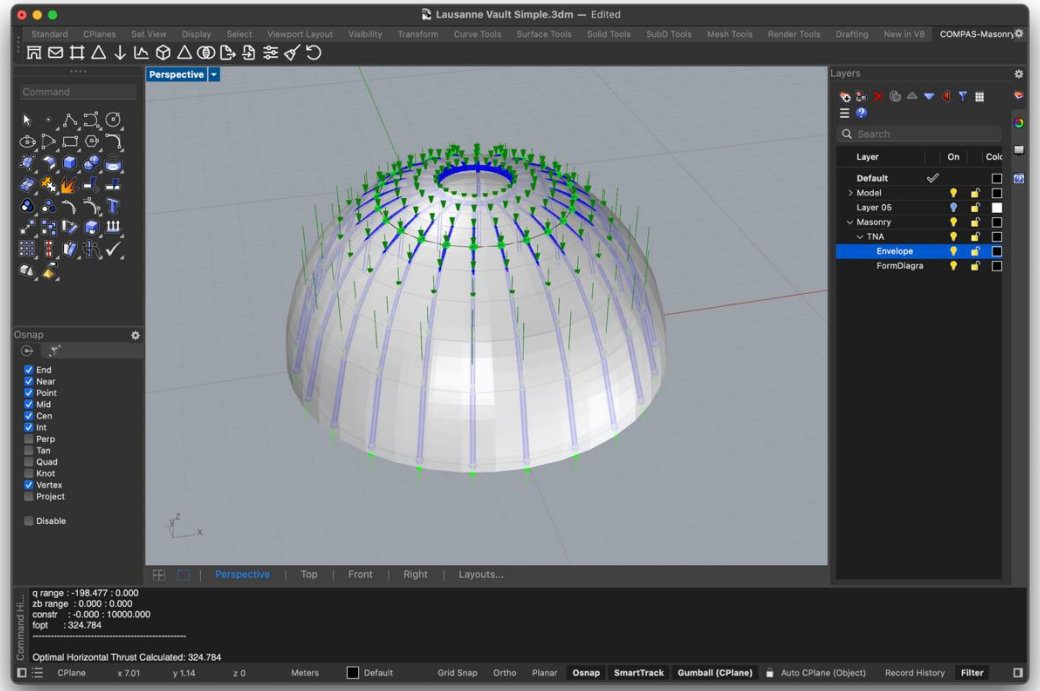


min. thrust

Extrados cracks = intrados touches



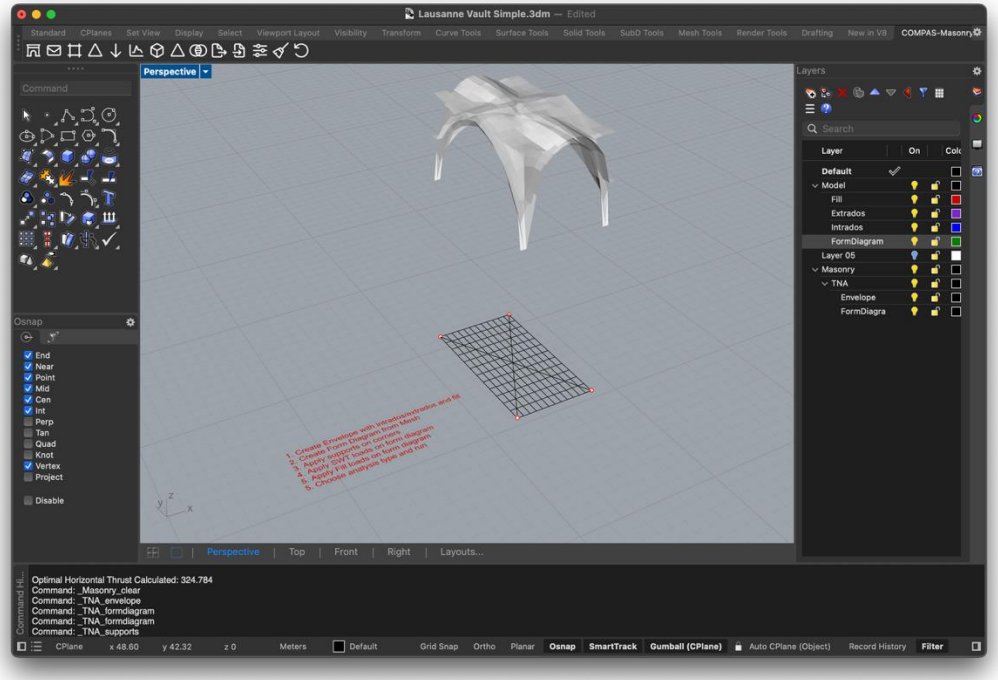
max. thrust



Envelope:
Dome > Set Radius and Radius of Oculus
Set thickness and Density

Form:
Circular diagram > Set Radius and Radius of Oculus
Set Density

Analysis:
Minimum thrust



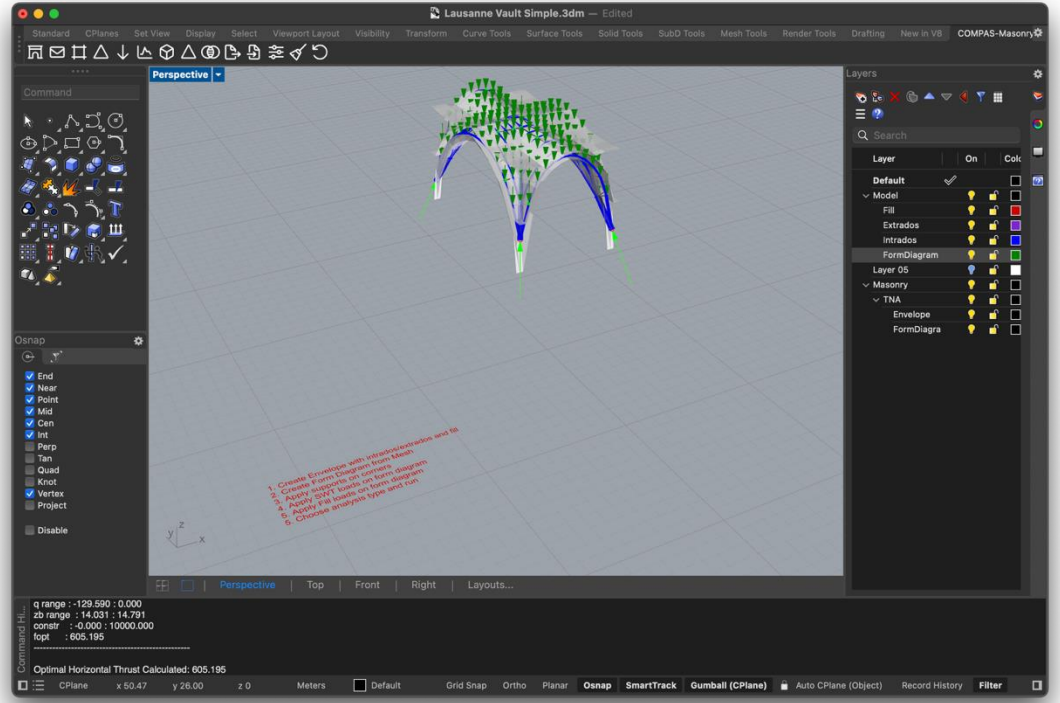
Envelope:
From Bounds > Select Intrados / Extrados and Fill

Form:
From RhinoMesh > Select Mesh

Supports:
Assign corner supports

Loads:
Assign SWT and Fill Loads

Analysis:
Minimum thrust



Envelope:
From Bounds > Select Intrados / Extrados and Fill

Form:
From RhinoMesh > Select Mesh

Supports:
Assign corner supports

Loads:
Assign SWT and Fill Loads

Analysis:
Minimum thrust