

ZSTools

A ZSoil pre-processing tool for Rhino 3D



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What is ZSTools?

- ❑ A Rhino 3D plugin, aimed at harnessing the power of Rhino 3D CAD capabilities in ZSoil

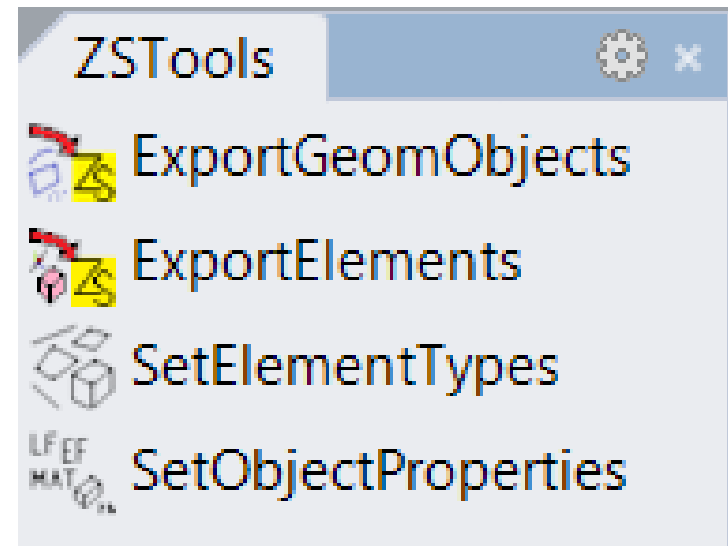


Why Rhino?

- ❑ Rhino is a very **comprehensive 3D modelling tool** that is used by an increasing number of architects, designers and engineers
- ❑ Rhino provides **interfaces to** a large number of **formats**, including pdf, dwg, stl, step, ifc, iges, dxf
- ❑ Rhino can be used for many auxiliary tasks related to 3D FE-modelling, such as digitizing bitmaps, editing pdf's, integrating volumes, surfaces etc.
- ❑ At ~1000 EUR per licence Rhino is relatively **inexpensive**

Scope of ZSTools

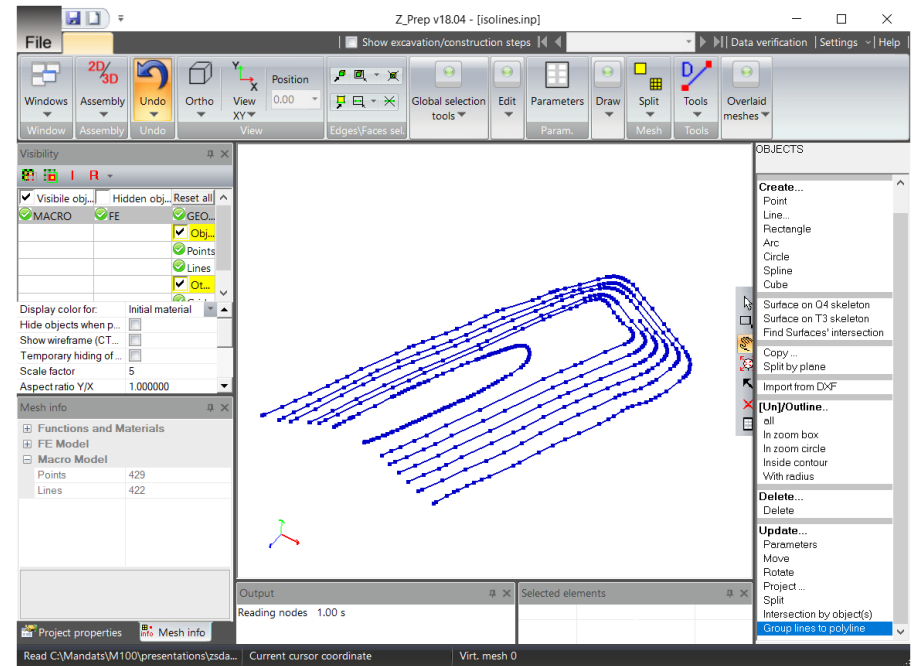
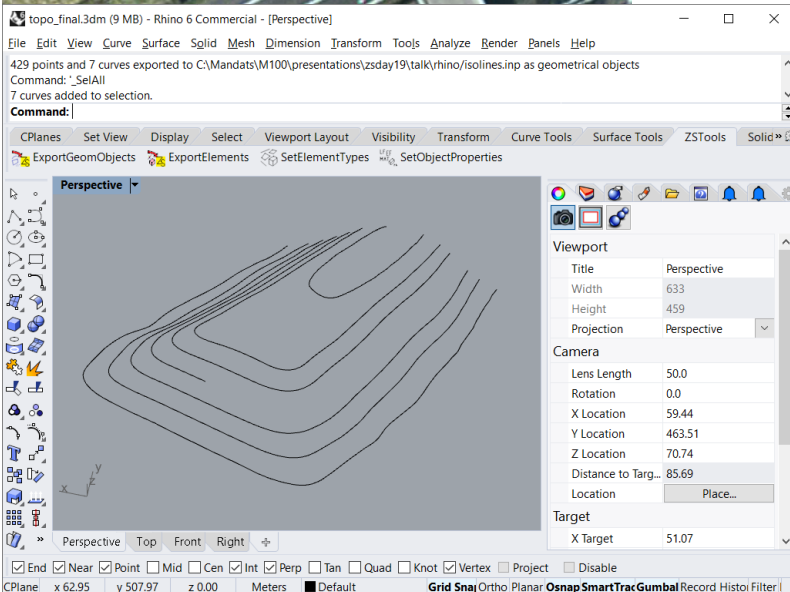
- ❑ **Exporting points and curves** created in Rhino to ZSPrePro as geometric objects.
- ❑ **Exporting** objects such as lines, quadrangular surfaces and hexahedral volumes as **finite elements** to ZSoil.
- ❑ Assign material, load function and existence function numbers to finite elements



Example: Import topographical data from pdf

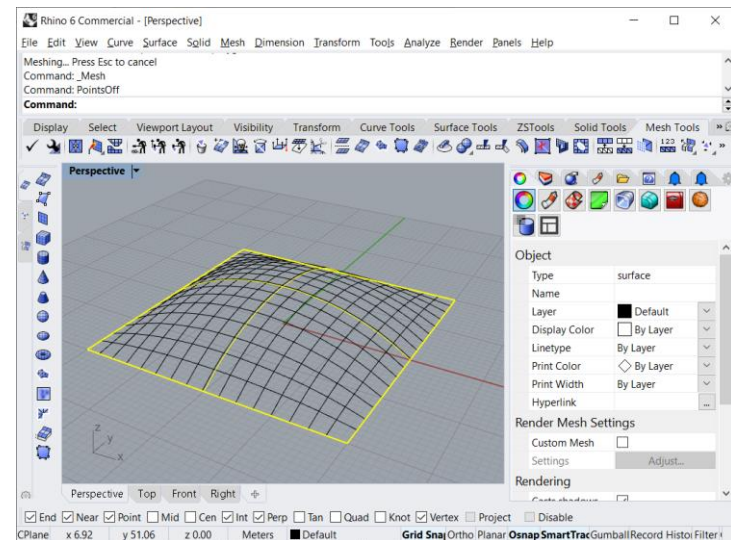
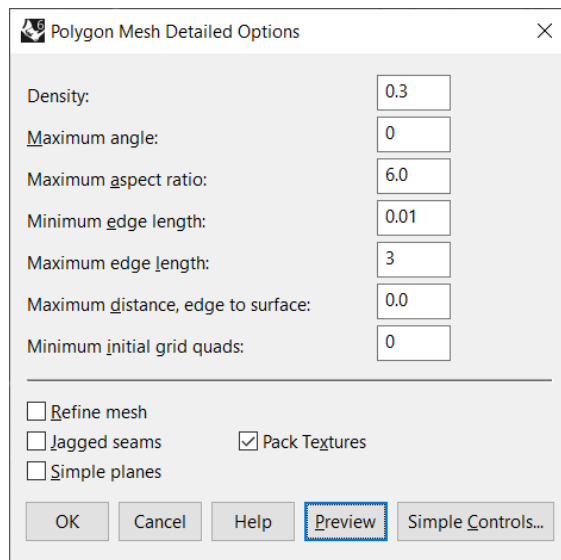


- Import pdf, scale 1cm = 5m (1:500)
- Select isolines, hide everything else
- Move lines vertically to altitude
- Rotate3D by 270° around X-axis
- ExportGeomObjects



Example: Create 3D shell and a lattice dome

- Create surface from 4 points
- ChangeDegree: 3rd order in U and V direction
- PointsOn to show control points
- Grab interior points and lift them
- Mesh surface with parameters:
- Copy mesh



Example: Create 3D shell and a lattice dome

Shell dome:

- Unweld, then Explode to split mesh into quads
- MeshToNURB to transform mesh quads into surfaces
- SelSrf to select all surfaces

Lattice dome (beams):

- TriangulateMesh to create triangles
- DupEdge to create lines on mesh edges
- SelCrv to select all lines
- SetObjectProperties: material to 2

Example: Create 3D shell and a lattice dome

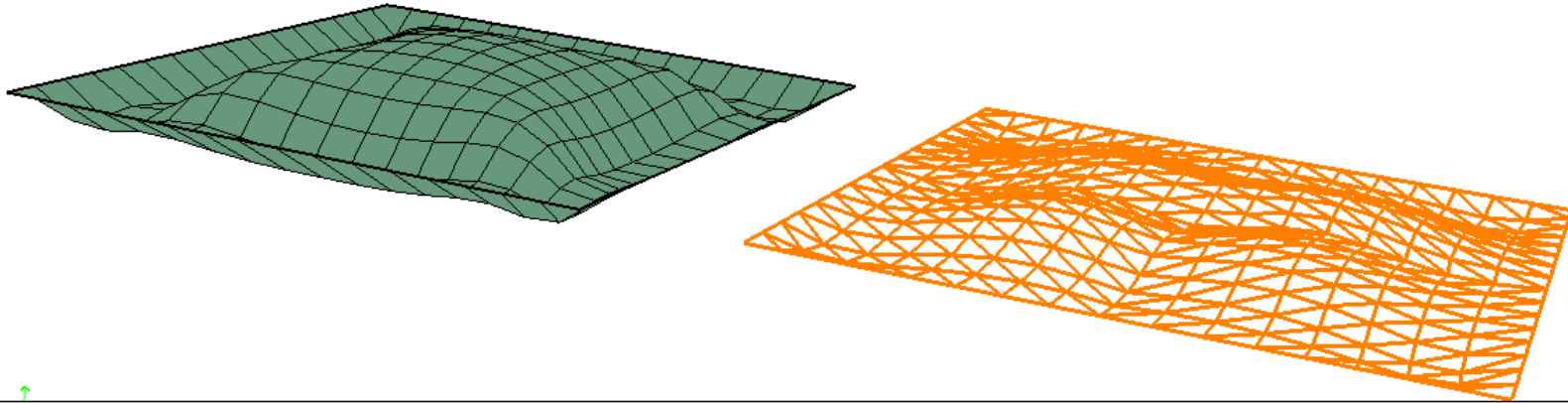
For both:

- SetElementTypes: Shells and Beams
- SetObjectProperties: EF to 1, thickness to 0.2 (for shells)
- Rotate3D by 270° around X-axis
- ExportElements (local Z-direction: 0,1,0)

In ZSoil PrePro:

- Create BC's on contour nodes
- Create nodal loads on a couple of excentric nodes (e.g. $F_y = -20$ kN on 6 nodes), LTF = 1
- LTF 1: (1,0), (2,1)
- EF 1: $t_1 = 0.99$
- Shell material: $\gamma = 25$ kN/m³, $E = 20$ GPa
- Beam material: $\gamma = 80$ kN/m³, $E = 200$ GPa, circ. tube $D = 0.3$ m, $th = 0.05$ m
- Driver: Time dependent, 0 to 2

Deformed mesh under self-weight

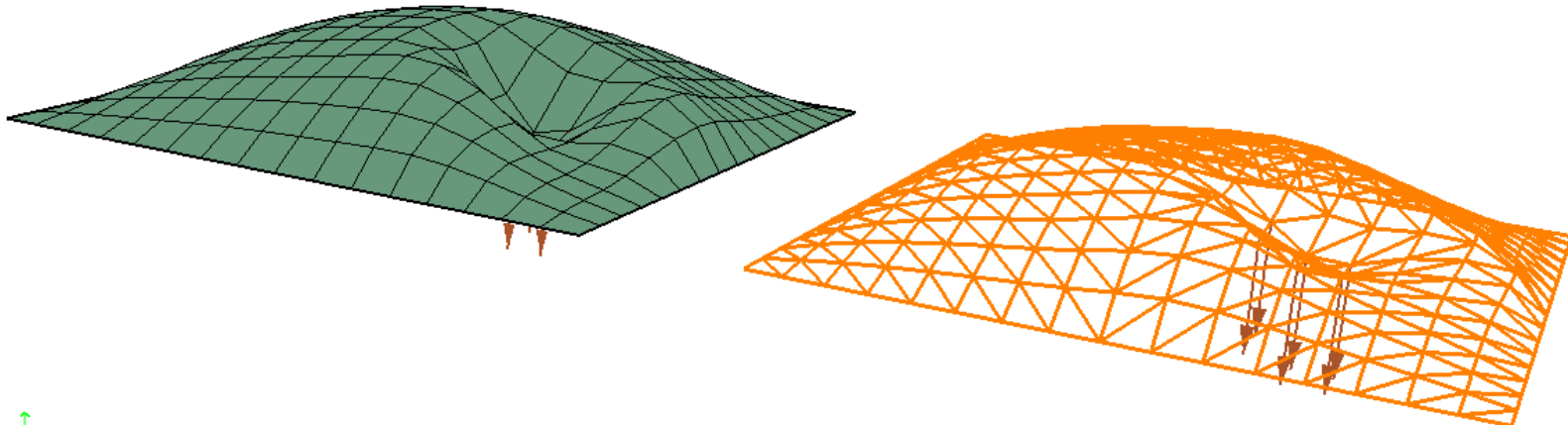


↑
 DEFORMED MESH
 TIME = 1.000[h]
 ZSOIL 18.06 License : GEOMOD 2019 Project : domes Date : 29. 8.2019 14:47

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MAX-UX	5.300e-04
MIN-UX	-5.216e-04
MAX-UY	0.000e+00
MIN-UY	-1.455e-03
MAX UJ	1.455e-03
UNIT	[m]

Deformed mesh under variable loading



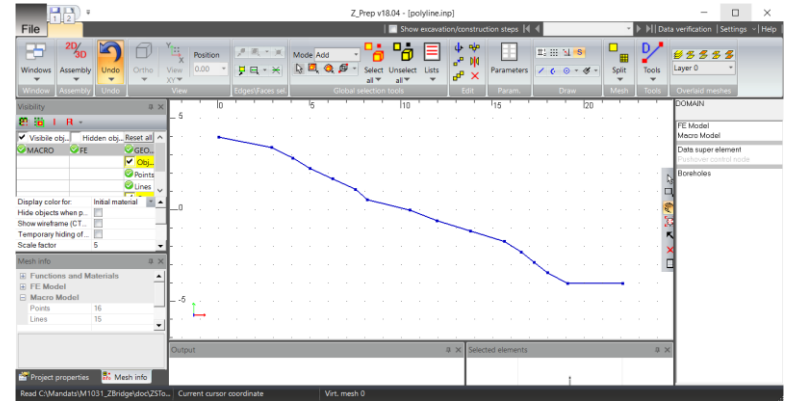
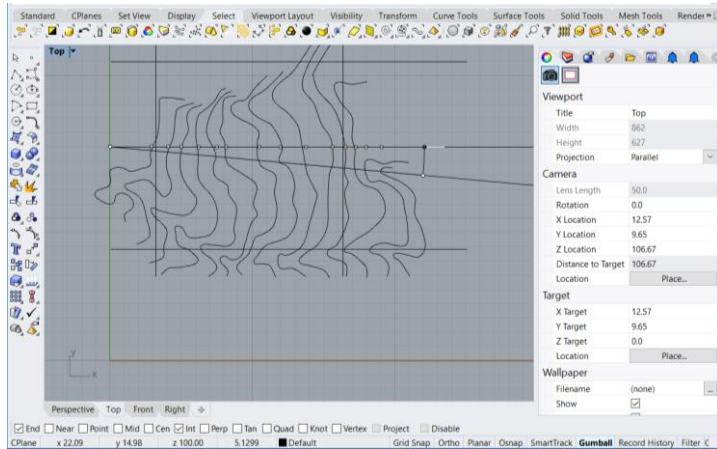
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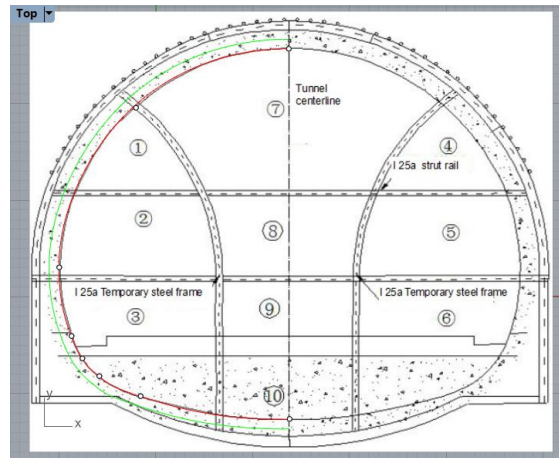
MAX-UX	6.120e-05
MIN-UX	-1.030e-04
MAX-UY	9.121e-05
MIN-UY	-4.087e-04
MAX UJ	4.239e-04
UNIT	[m]

Other uses of ZSTools

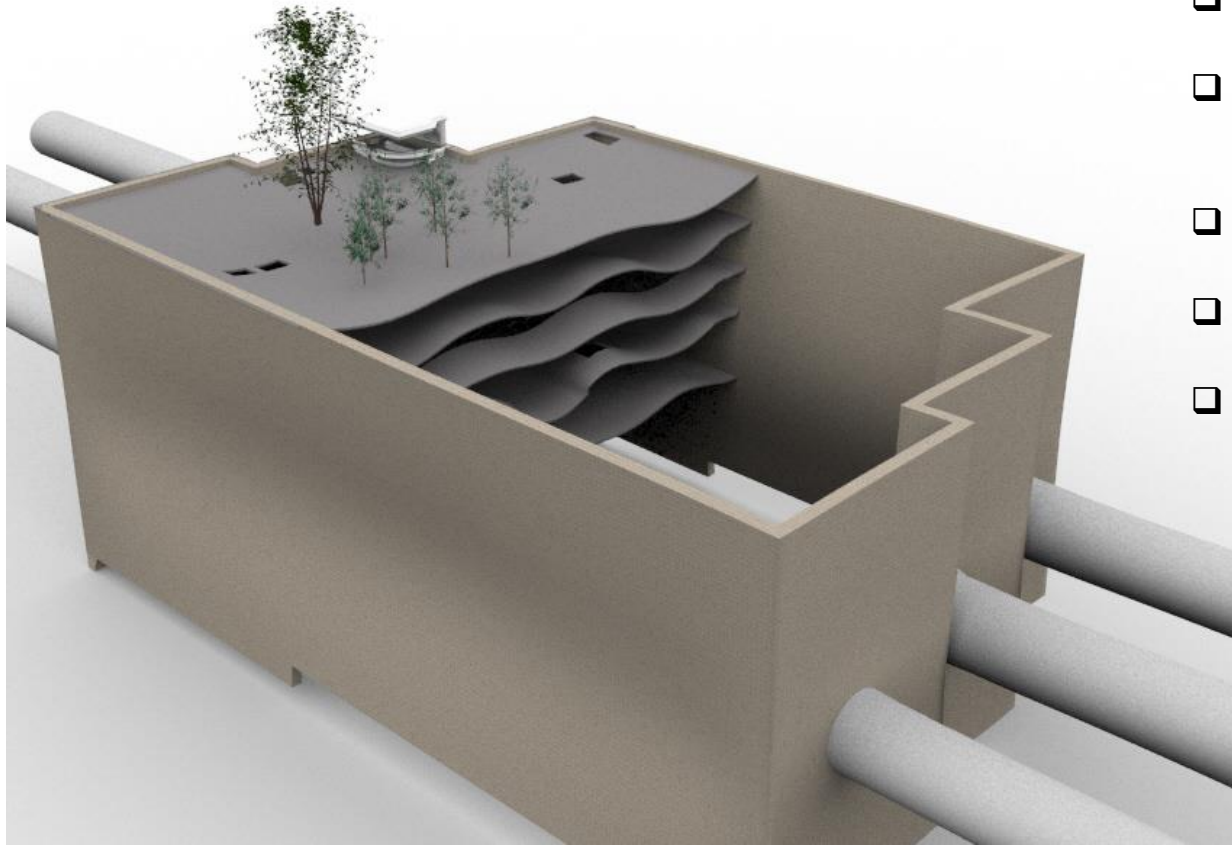
- ❑ Create 2D models from topographical maps



- ❑ Digitize Bitmaps in Rhino
- ❑ Construct simplified geometries when available drawings contain too much detail



Other uses for Rhino: Render ZS models



- Export results in PostPro to paraview
- Use ExtractSurface filter to convert mesh to polygonal dataset
- Save Data in *.ply format
- Import file into Rhino
- Add colors, materials, lights etc., then render the scene to create view

Thank you for your attention!