



# Survey to BIM, how to get solids directly from surveying with GNSS or total stations

Thomas Sandström



# Survey to BIM, how to get solids directly from surveying with GNSS or total stations

**Instead of scanning/point clouds!**

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# Adtollo

Software development company working with systems within infrastructure projects, construction, mapping, design

Two business areas

Surveying and Mapping

Document management

# Surveying and Mapping

- Topocad is delivered in more than 30 000 licenses world-wide, in 18 languages
- Modules ranging from Net adjustment to Design
- Base module contains survey calculation, communication, CAD, transformation, terrain modeling and solids



# **BIM in our perspective**



# BIM in our perspective

Adtollo with Topocad has been using BIM since 2015, key words are solids and metadata.

# BIM in our perspective

BIM, with solids, are used for all types of result as volume calculations:

Terrain models, Point clouds, Cross sections, surfaces, etc



# BIM in our perspective

“Traditional” surveying for work with BIM is definitely not obsolete



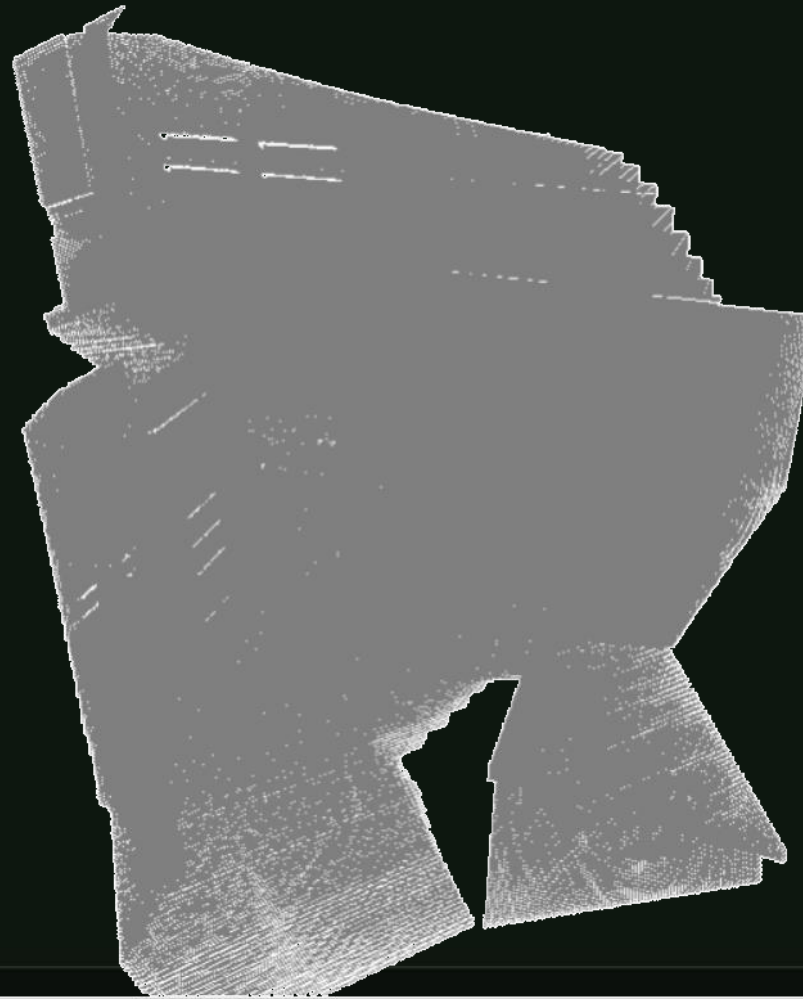
The background of the slide features a complex, abstract pattern of glowing green and blue lines and shapes. These elements include circles, squares, and irregular polygons, some of which are semi-transparent, creating a layered, digital effect. The overall aesthetic is modern and technological, typical of a presentation on BIM or surveying.

**Create BIM objects from any survey**

**Surveying vs scanning**

Create BIM objects from any survey

Surveying vs **scanning**



Create BIM objects from any survey

Surveying vs **scanning**



# Creating solids from survey

Survey with total station or GNSS and create solids as:

- 3D Beam
- 3D Building – Cube – LOD 1
- 3D Building – LOD 2
- 3D Cylinder
- 3D Horizontal sloping pipe
- 3D Pile, squared, circular
- 3D rectangular pillar
- 3D surface
- 3D Sweep

# Survey 3D Beams

<< Simp

Measurement point

A  
 B

Tolerance

Beam definition, points above ground:

	Offset	Height	Var.
AB	<input type="text" value="0,000"/>	<input type="text" value="0,000"/>	<input type="checkbox"/>
BC	<input type="text" value="0,000"/>	<input type="text" value="0,000"/>	<input checked="" type="checkbox"/>

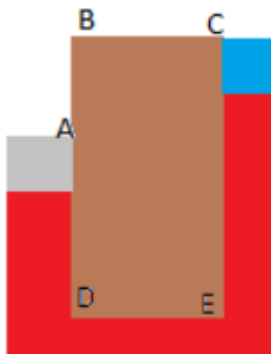
Parametric

Points below ground (not DTM):

AD	<input type="text" value="0,000"/>	<input type="text" value="0,000"/>
DE	<input type="text" value="0,000"/>	<input type="text" value="0,000"/>

Solid

Material:  Product Code:



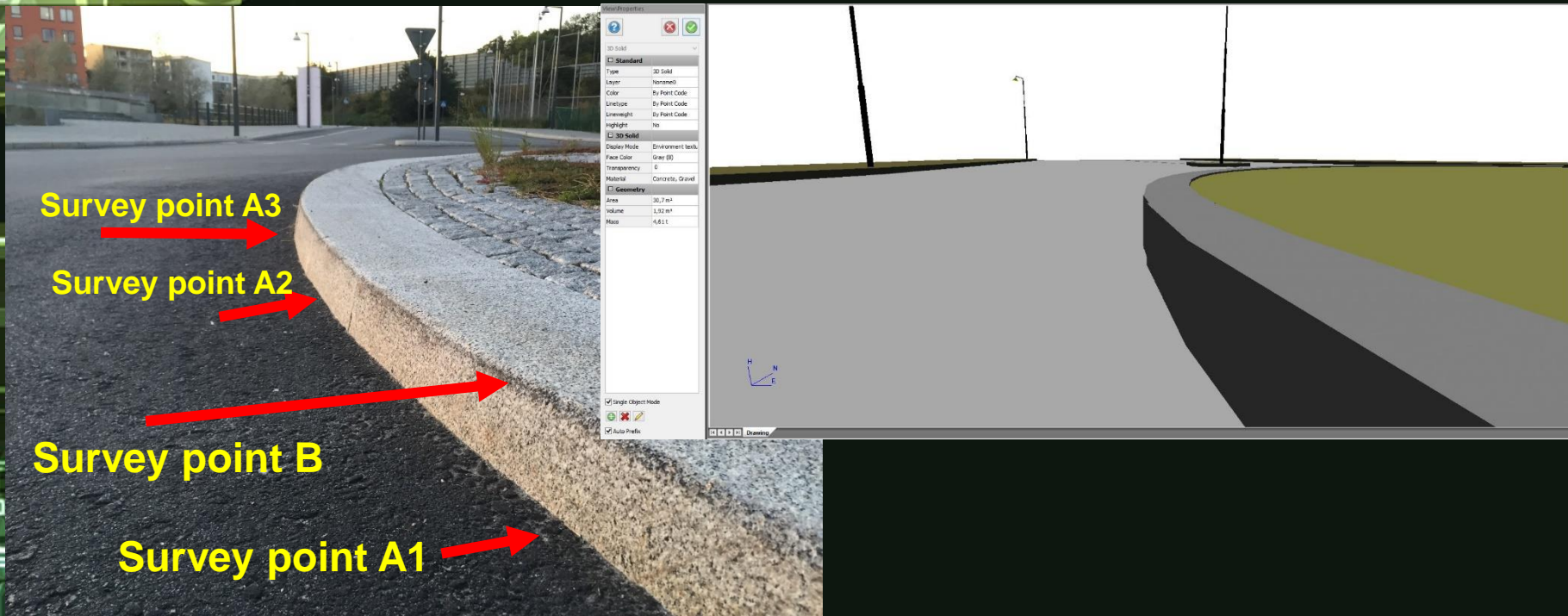
Survey beam, like kerbstone, along the road edge

Result: Solid

LOD >1

Type = Beam

# Survey 3D Beams



# Survey 3D Cylinder (pillar)

The calc. function uses 2 or 3 sequentially surveyed points on a cylinder/pipe to calculate the diameter.

**Method**

3 Points     2 Pnts + Radius

Attribute: ACCURACYHEIGHT

---

**Lowest elevation**

Prismaheight from first point

Surveyed plane

Attribute: ACCURACYHEIGHT

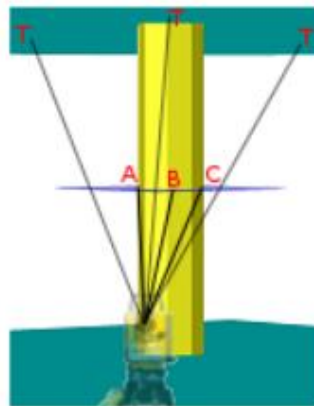
---

**Highest elevation**

Prismaheight from last point (neg.)

Surveyed plane

Attribute: ACCURACYHEIGHT



- Tilted cylinder/pipe
- Solid

Survey order: A,B,C,T,T

Material:  Concrete

Product Code: CCB.1, Piles of con

Pillars vertical or sloping, measure three points on them and decide the length up and down.

Result: Solid

LOD >1

Type = Pile

# Survey 3D pillar

The calc. function uses 3 sequentially surveyed corners on a pillar/cube to calculate four sides.

**Lowest elevation**

Prismaheight from first point

Surveyed plane

Attribute:  ▾

**Highest elevation**

Prismaheight from last point (neg.)

Surveyed plane

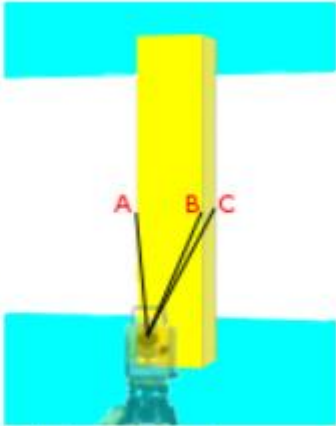
Attribute:  ▾

Survey order: A,B,C

Material:  ▾ Product Code:  ▾

Tilted pillar/cube

Solid



Pillars vertical or sloping, measure three points on them and decide the length up and down.

Result: Solid

LOD >1

Type = Pile



# Survey 3D pillar



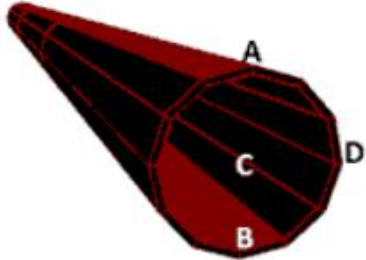
Pillars vertical or sloping, measure three points on them and decide the length up and down.

Result: Solid

LOD >1

Type = Pile

# Survey 3D Sloping pipe



Measurement point

A, above pipe

B, water line

C, mid point

Pipe radius

Measure from D

Size: 0,350

Attribute: ACCURAC<sup>1</sup> ▼

Parametric

Pipe thickness

Size: 0,008

Attribute: ACCURAC<sup>1</sup> ▼

Material:  Plastic. se<sup>1</sup> ▼

Product Code: DFA.1, Pipe, plasti<sup>1</sup> ▼

Measurement of pipe, select measurement point, eventual radius

Result: Solid

LOD >1

Type = Pipe

# Survey 3D Sloping pipe



Measurement of pipe, select measurement point, eventual radius

Result: Solid

LOD >1

Type = Pipe

# Survey 3D Pile

Measurement order

A - B - B2

A - C - C2

A - B - C - C2

Side length (BC):

Pile length

Prism height from A

Prism height from C

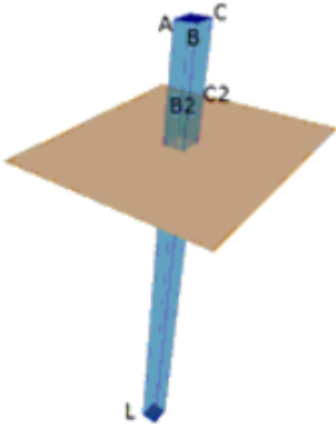
Attribute:

Fixed value:

Prism Offset:

Material:

Product Code:



The diagram shows a 3D perspective of a blue pile. The top surface is a square prism with vertices labeled A, B, and C. The bottom surface is a square with vertices labeled B2 and C2. A vertical line labeled L indicates the length of the pile.

Measurement of pile, measure 2-3 corners, along one of the corners, enter length

Result: Solid

LOD >1

Type = Beam

# Survey 3D Pile



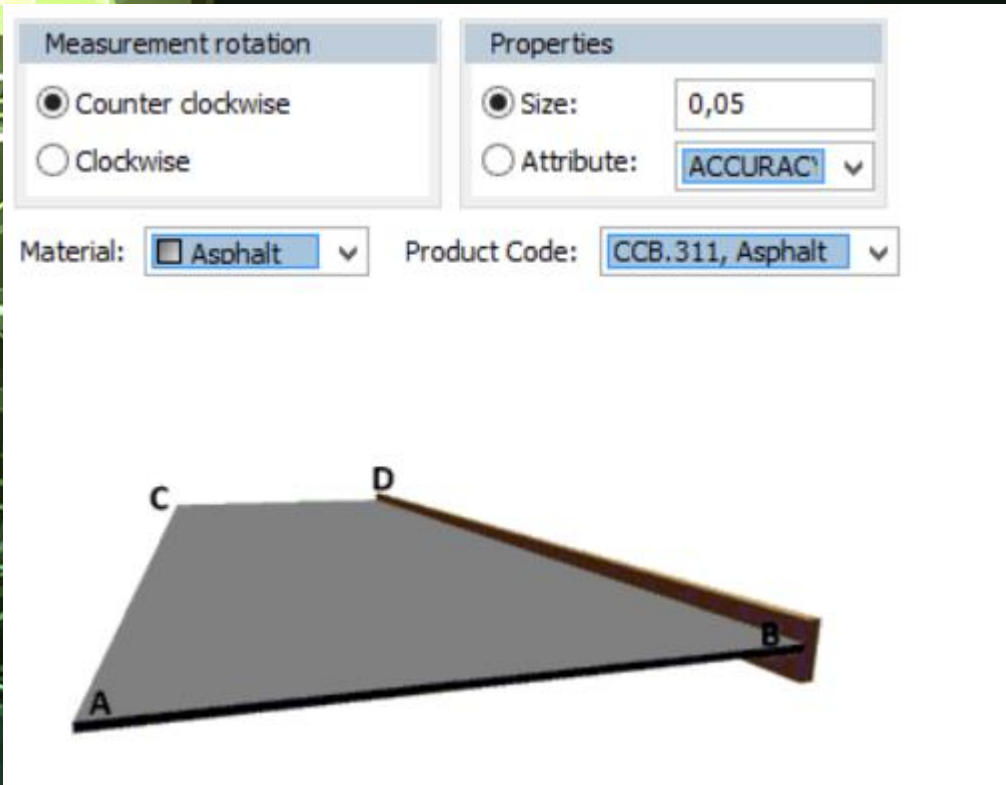
Measurement of pile, measure 2-3 corners, along one of the corners, enter length

Result: Solid

LOD >1

Type = Beam

# Survey 3D Surface



Measurement of surfaces of varying thicknesses

Result: Solid

LOD >1

Type = Surface

# Survey 3D sweep

Symbol: Spont, Spont

Scale: 1,000

Length:

Join the resulting solids

Keep the original line

Parametric

Material:  Steel

Product Code: CCB.2, Piles of steel

Type: Pile



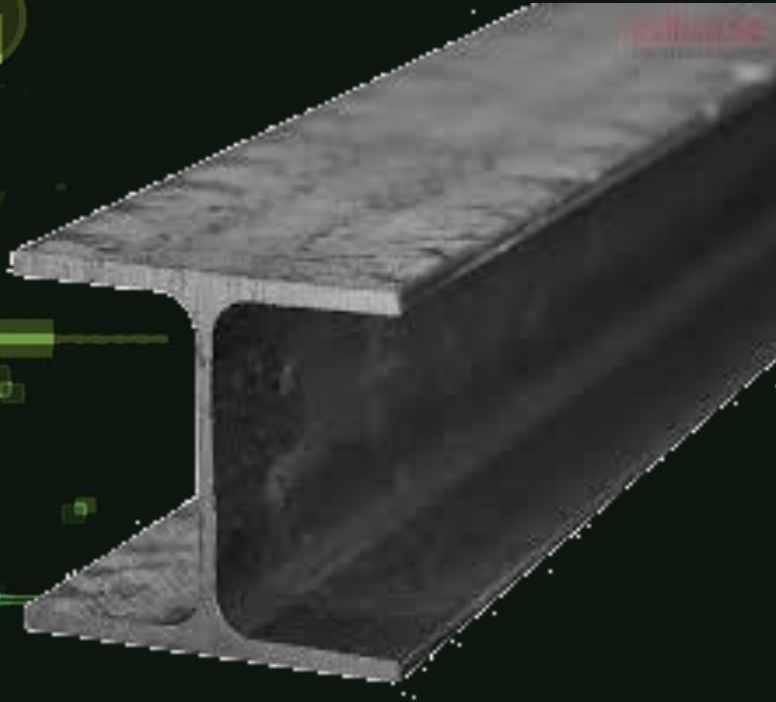
Measurement of any kind of polygon thru measured line.

Result: Solid

LOD >1

Type = Beam, Pipe, etc

# Survey 3D sweep



Measurement of  
any kind of  
polygon thru  
measured line.

Result: Solid

LOD >1

Type = Beam



# Survey 3D sweep



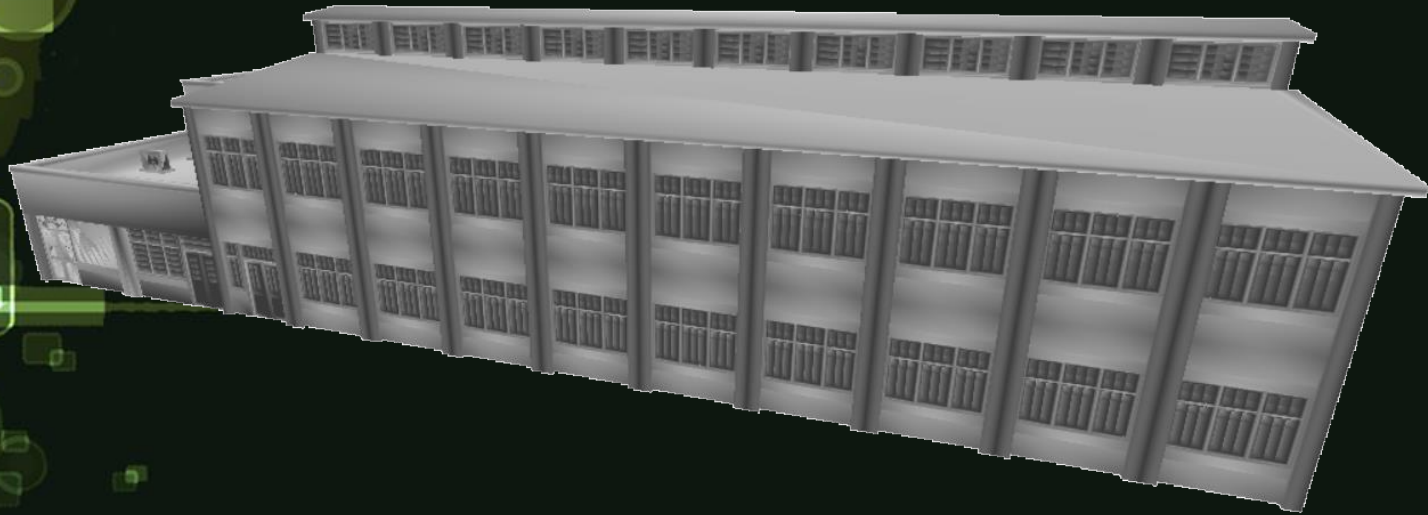
Measurement of any kind of polygon thru measured line.

Result: Solid

LOD >1

Type = Beam

# Survey of a factory

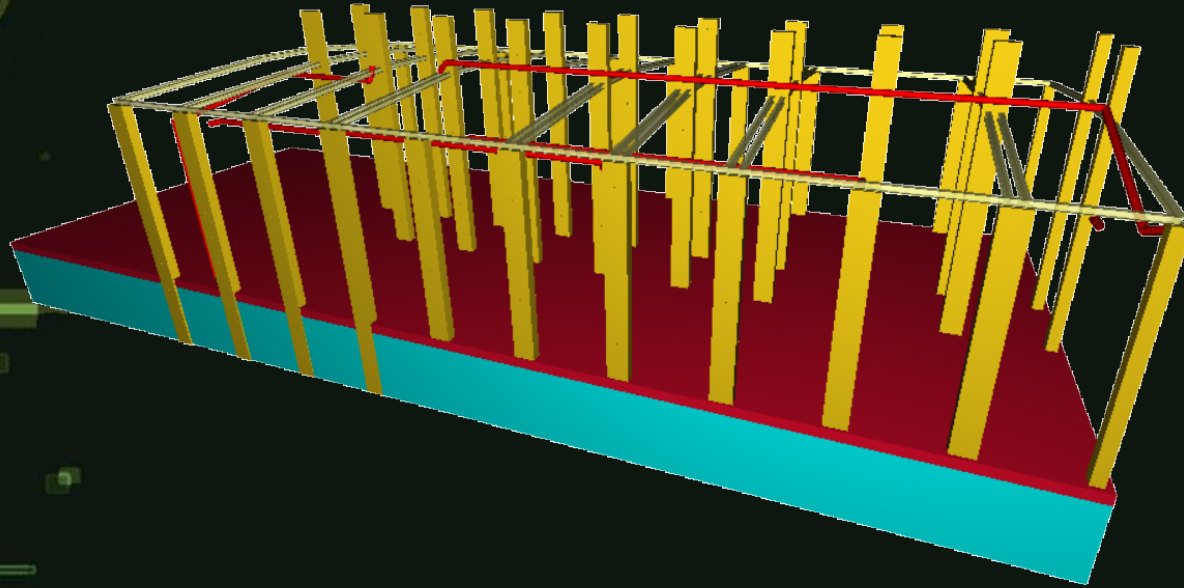


We measure this factory, industry building to see how we end up.



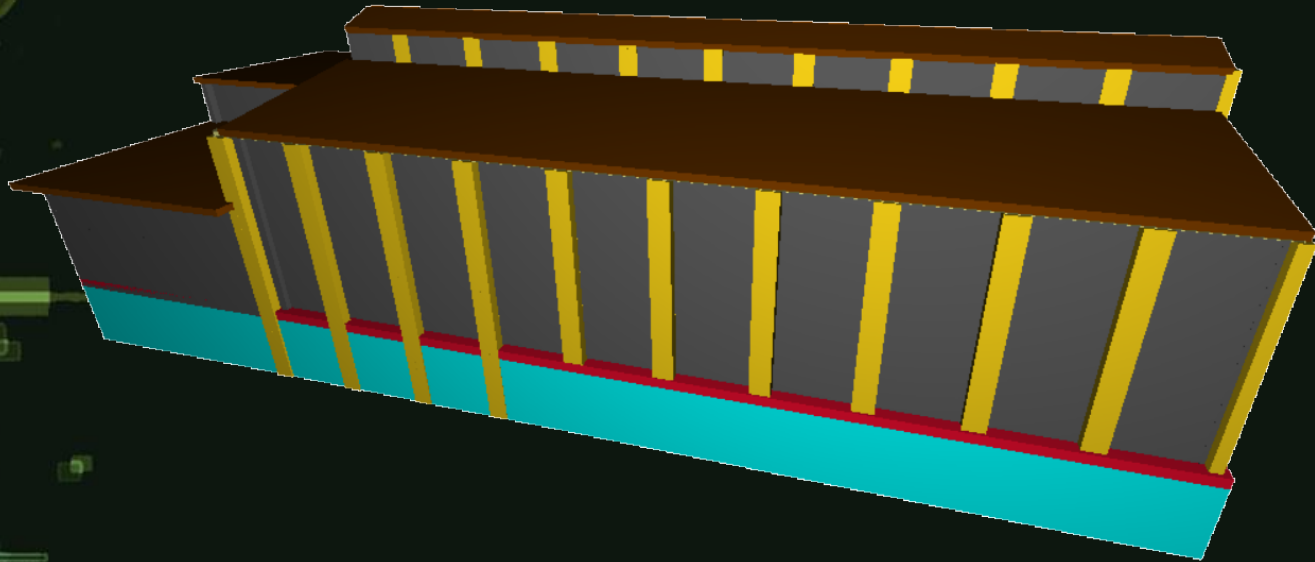
# Demonstration

# Survey of a factory



The result.  
260 observations

# Survey of a factory



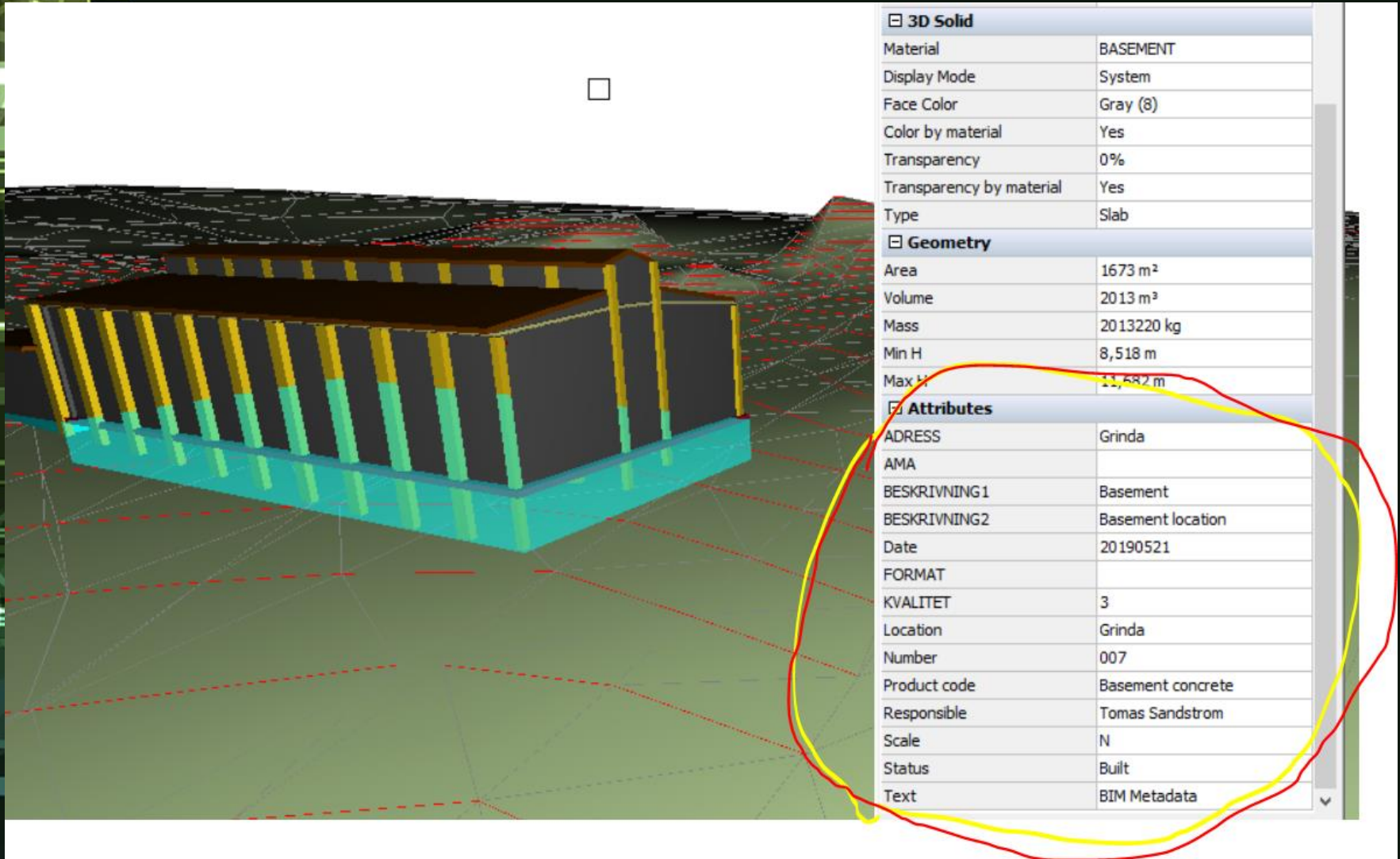
The result.  
260 observations

# Adding metadata, the "I" in BIM

There are several options to add metadata to objects in Topocad:

- Use of attributes in field, will give possibility for unique values.
- Adding attributes, with or without values, for each point code
- Add attributes in multiple with a special command.
- Copy attributes from one object to other object(s)

# Adding metadata, the "I" in BIM



The image displays a 3D BIM model of a basement slab structure. The model is rendered in a perspective view, showing a rectangular slab with a grid of columns. The slab is colored in shades of blue and green, while the columns are yellow and green. The background is a dark, textured surface with a grid of red dashed lines.

On the right side of the image, there is a metadata table for the selected 3D Solid. The table is divided into three sections: 3D Solid, Geometry, and Attributes. The Attributes section is circled in red and yellow.

3D Solid	
Material	BASEMENT
Display Mode	System
Face Color	Gray (8)
Color by material	Yes
Transparency	0%
Transparency by material	Yes
Type	Slab

Geometry	
Area	1673 m <sup>2</sup>
Volume	2013 m <sup>3</sup>
Mass	2013220 kg
Min H	8,518 m
Max H	11,582 m

Attributes	
ADRESS	Grinda
AMA	
BESKRIVNING1	Basement
BESKRIVNING2	Basement location
Date	20190521
FORMAT	
KVALITET	3
Location	Grinda
Number	007
Product code	Basement concrete
Responsible	Tomas Sandstrom
Scale	N
Status	Built
Text	BIM Metadata

# Volume report at once

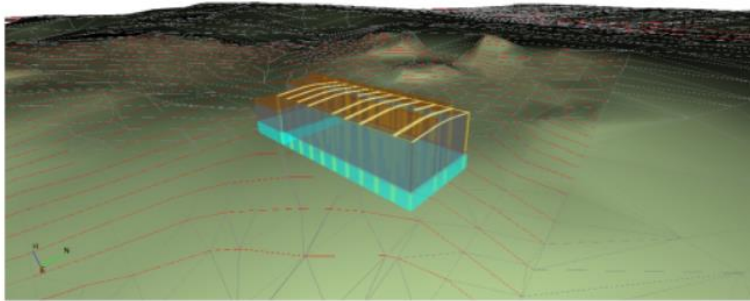
Topocad

## 3D-solid Report

Page 1 of 1

Filename: Factory Result

Coordinate system: SWEREF99 18 00



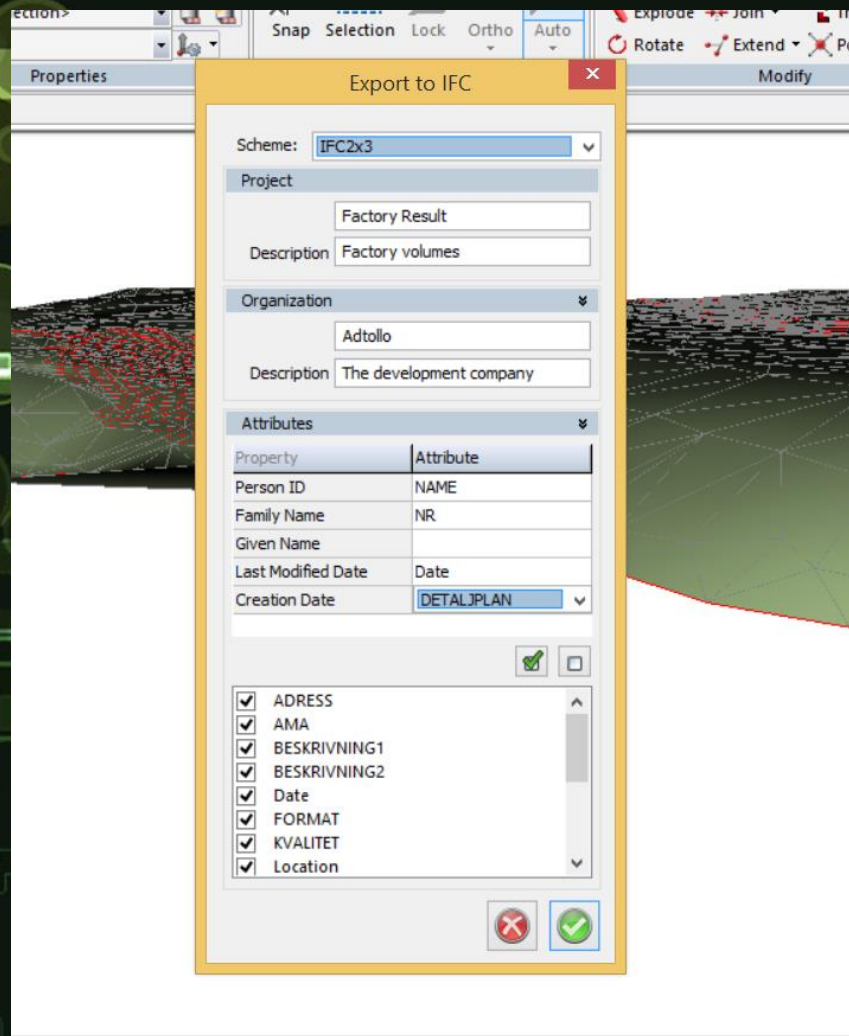
### Solids

Group	Volume	Area	Count
Building, Facade	403 m <sup>3</sup>	2913 m <sup>2</sup>	18
Building, Pipes	0 m <sup>3</sup>	25 m <sup>2</sup>	9
Building, basement	2595 m <sup>3</sup>	2233 m <sup>2</sup>	2
Building, beams	2 m <sup>3</sup>	382 m <sup>2</sup>	55
Building, floor	346 m <sup>3</sup>	1797 m <sup>2</sup>	2
Building, pillar	163 m <sup>3</sup>	1657 m <sup>2</sup>	80
Building, roof	268 m <sup>3</sup>	1909 m <sup>2</sup>	6

Solids are volumes so it is a 1 to 1 report of volumes.



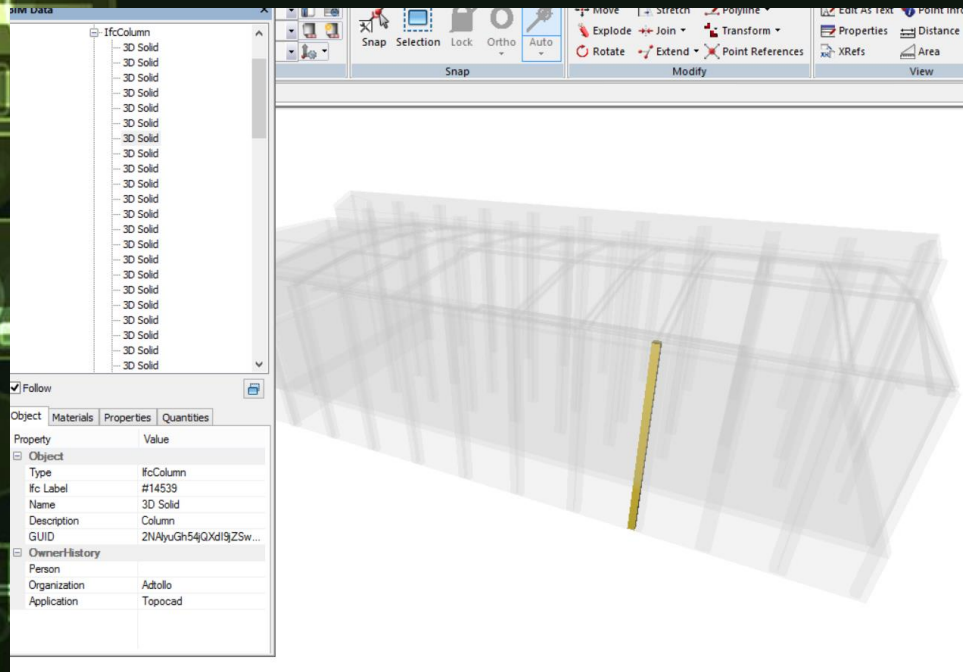
# Export to ifc or CityGML



Export to ifc or CityGML.

Attributes are transferred to metadata.

# Import of the ifc



Import of our ifc file  
back to Topocad.

Metadata is  
transferred to  
attributes.

GUID is added

# Conclusion

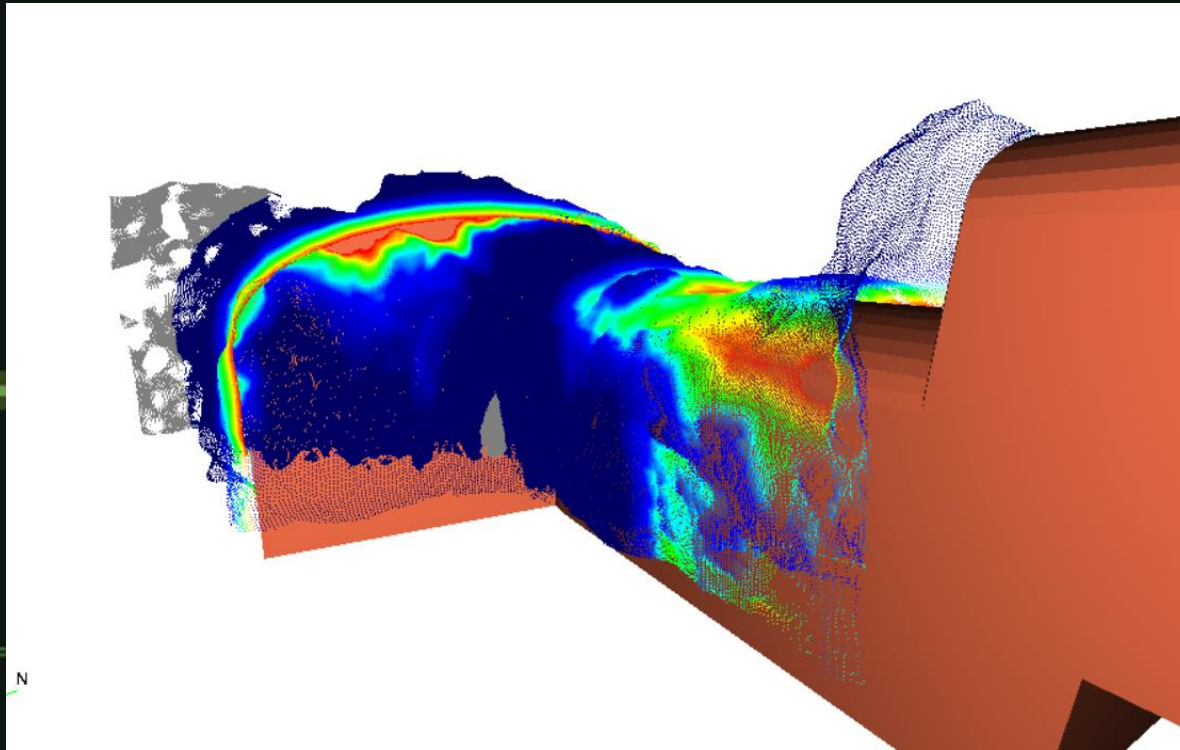
Surveying with traditional methods is not a bad option for creating BIM data!



Thanks for your interest!

Thomas Sandström

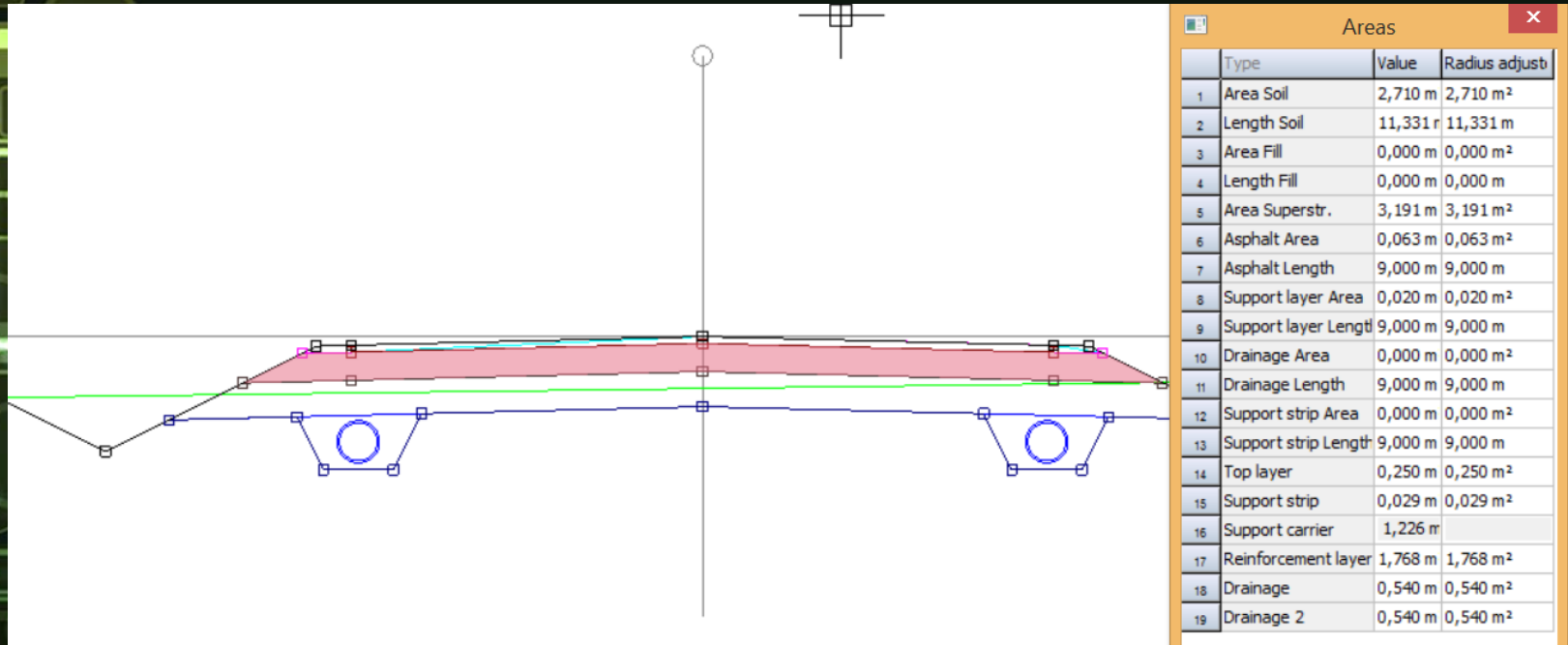
# Comparisons



Comparisons of a point cloud vs a solid model.

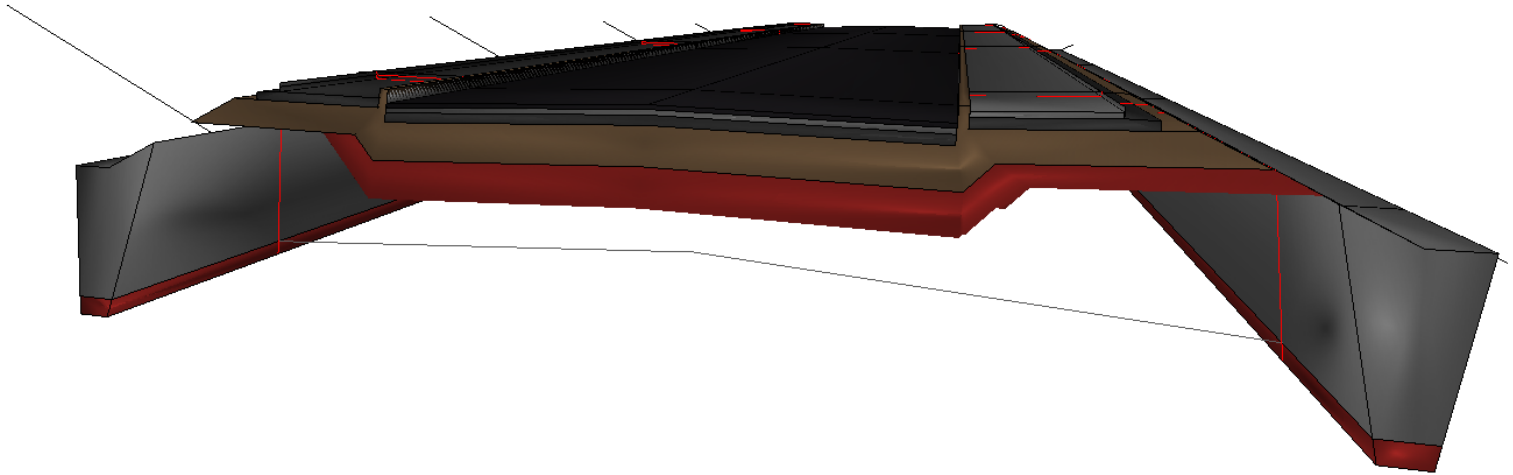
Red = inside, Blue = too much outside!

# Volumes = solids



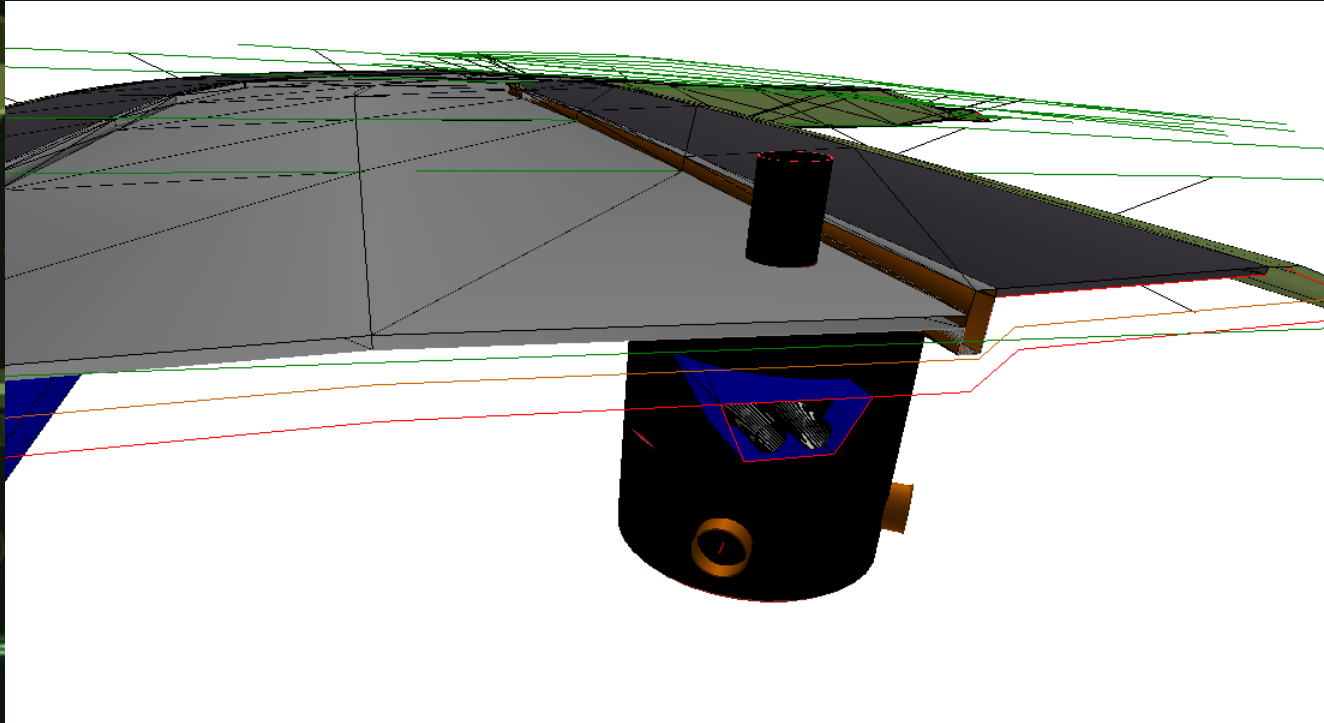
- Cross sections calculation – result ends up as machine guidance and solids for export to BIM systems.

# Volumes = solids



- Cross sections calculation – result ends up as machine guidance and solids for export to BIM systems.

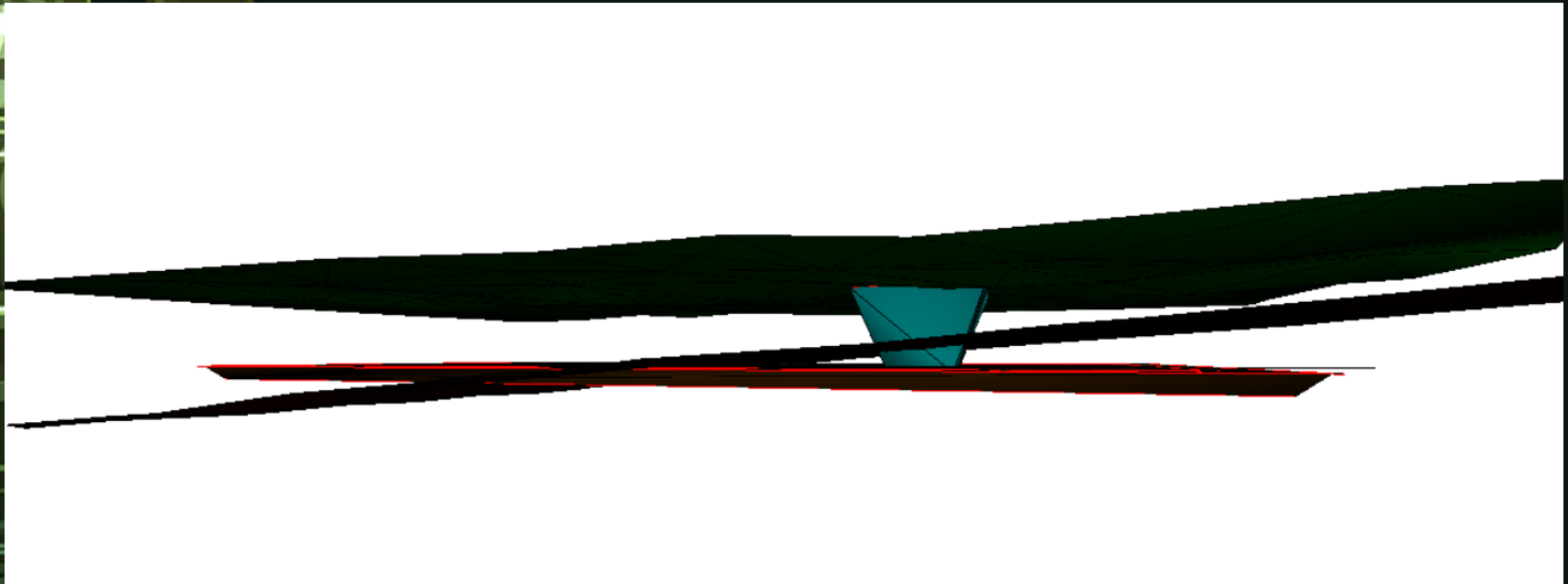
# Volumes = solids



- Cross sections calculation – result ends up as machine guidance and solids for export to BIM systems and for volumes.

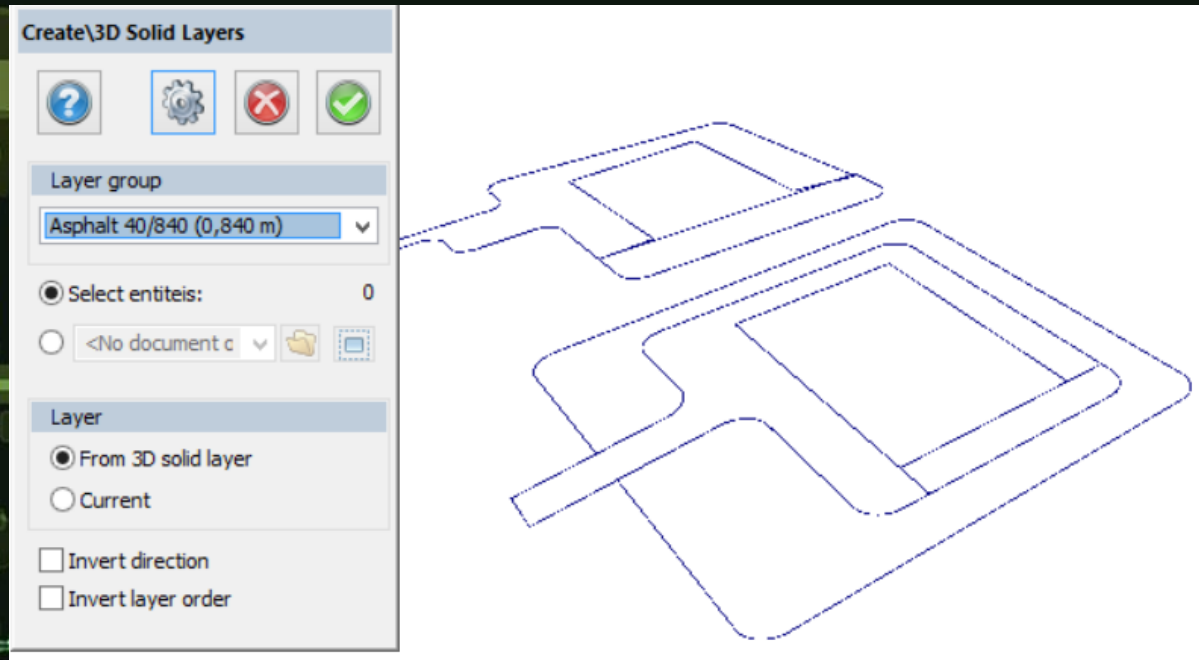


# Volumes = solids



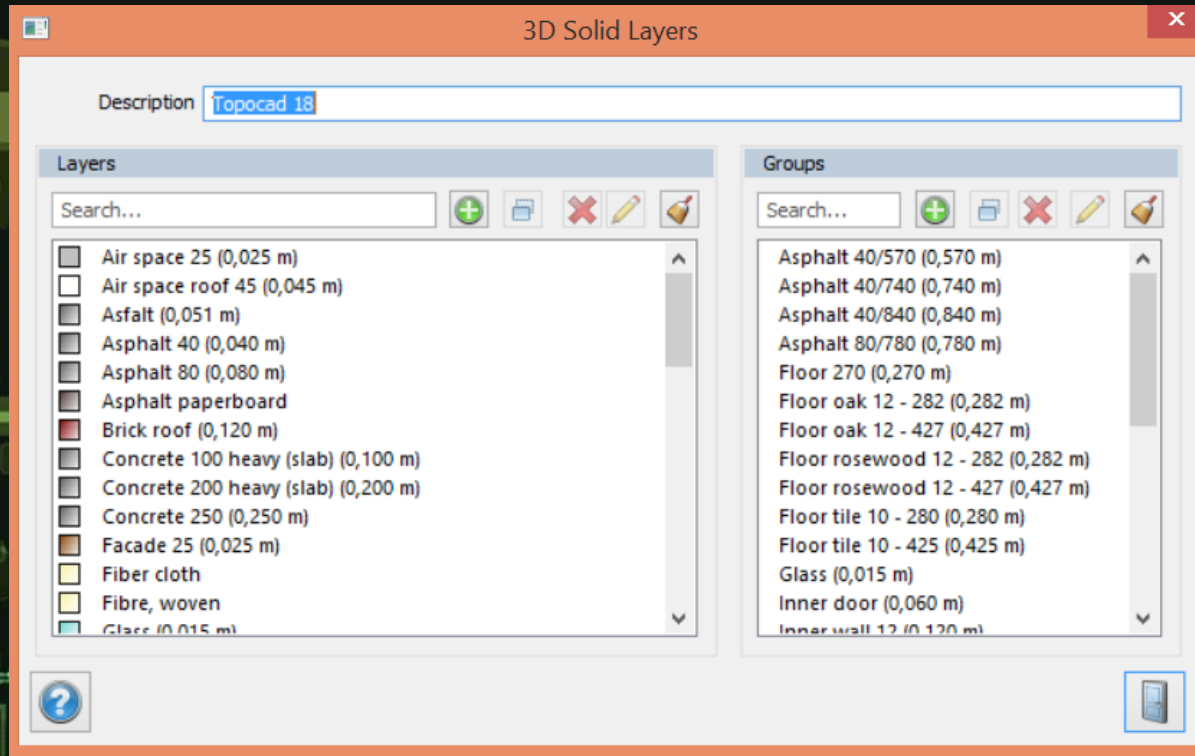
- Volume from terrain models, any number of models. Result ends up as solids.

# Volumes = solids



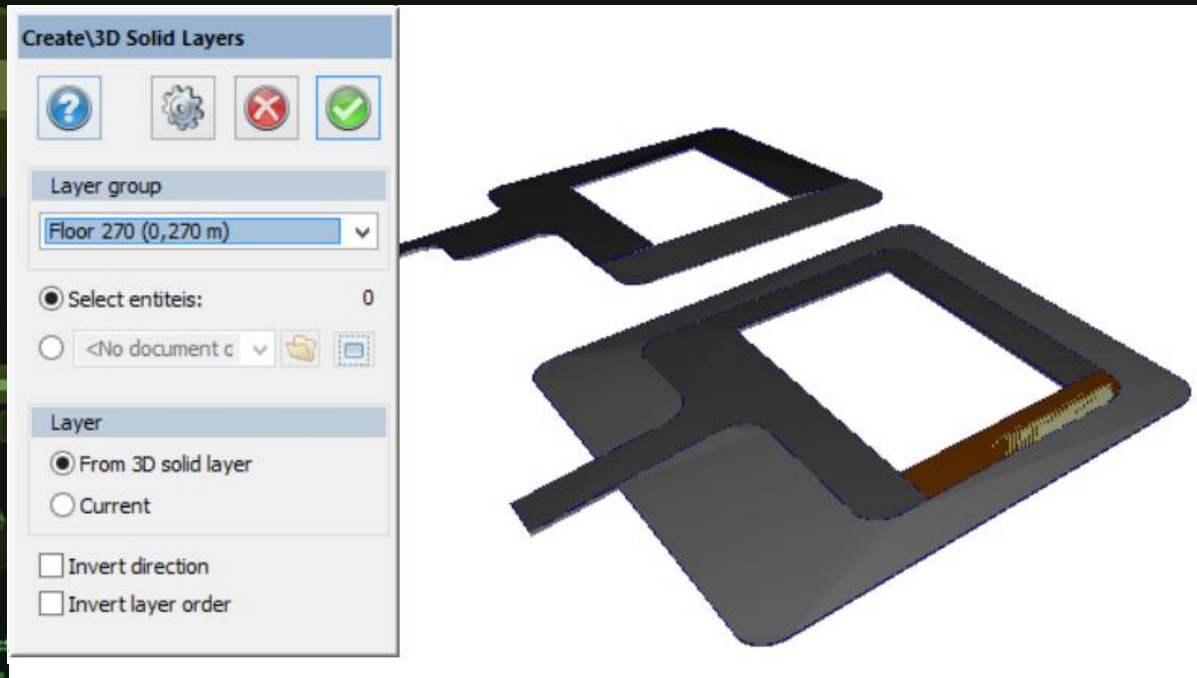
Solid receipts -> create solids of any surfaces

# Volumes = solids



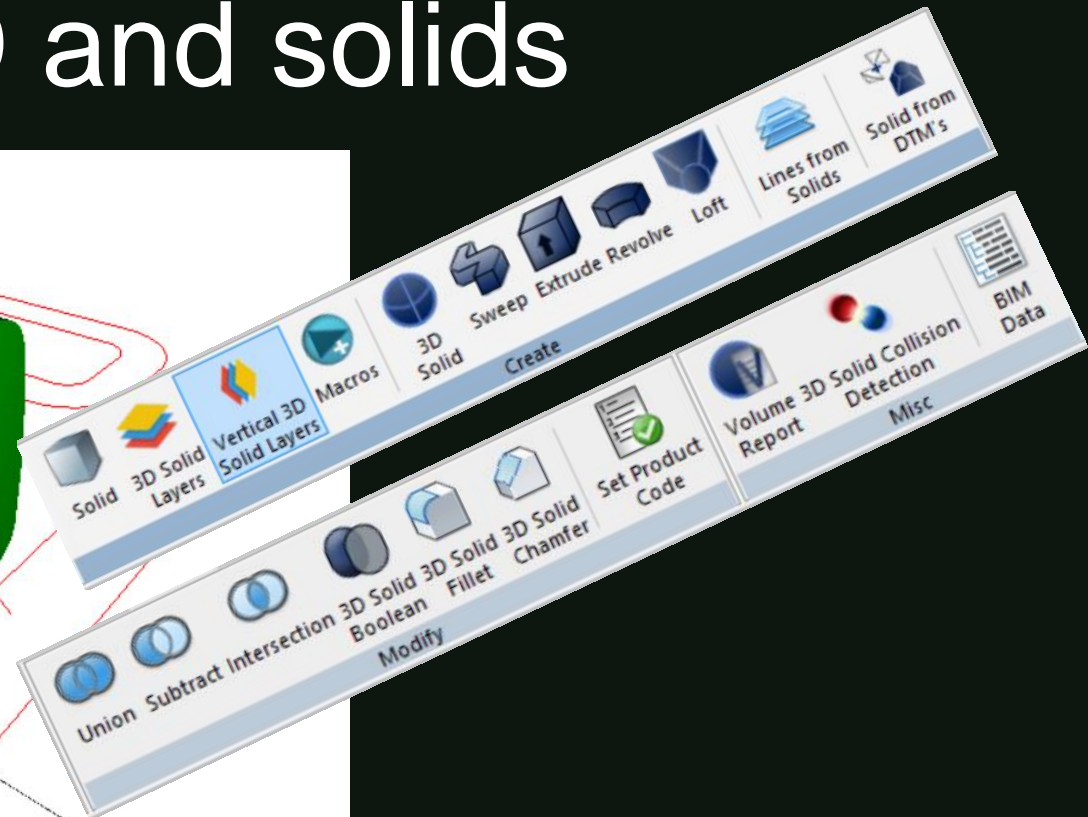
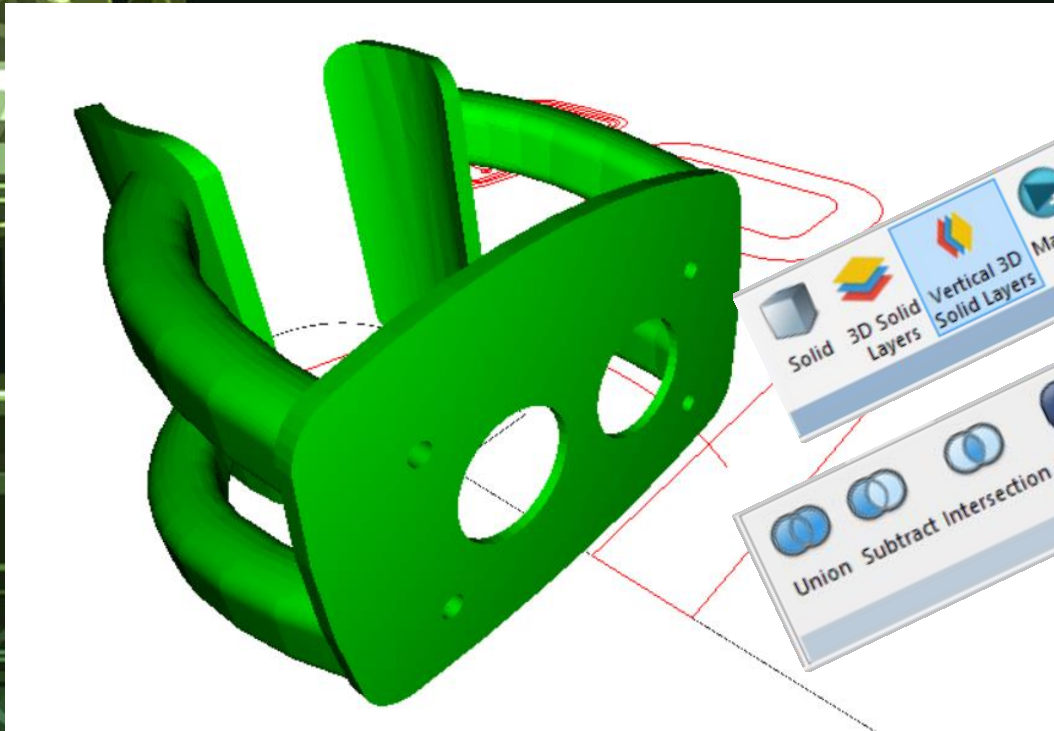
Solid recipes -> create your own receipt

# Volumes = solids



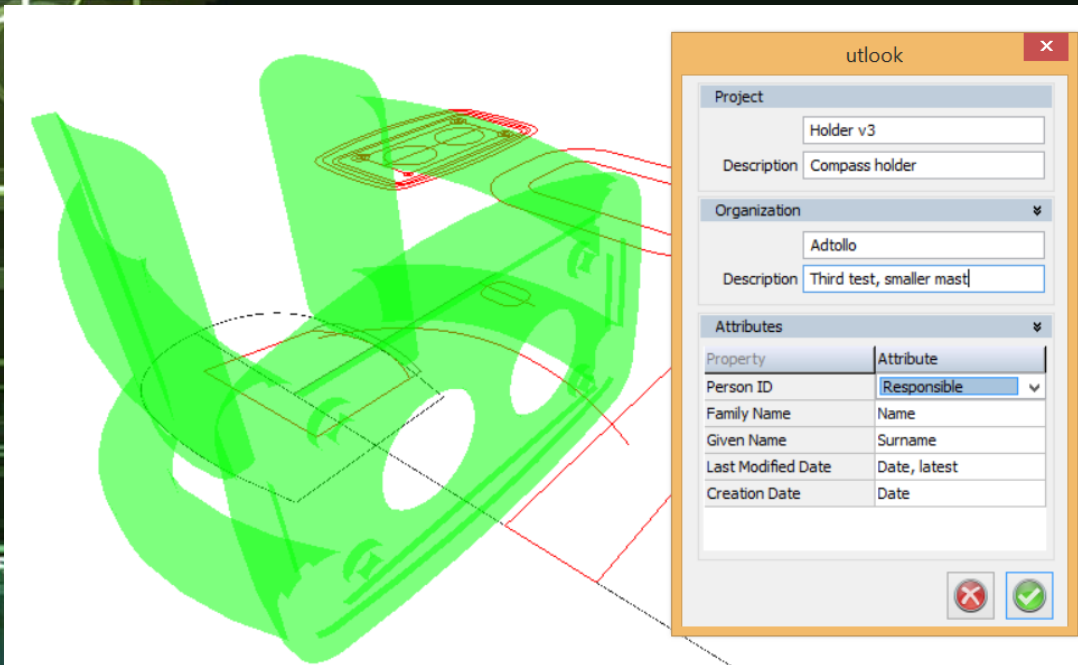
Solid recipies -> create your own receipt

# CAD and solids



All commands to create and modify solids, including sweep, loft, revolve, extrude, Boolean operations and others.

# BIM in Topocad



Import and export functions for IFC and CityGML, with an automatic connection between metadata and attributes

# BIM

- BIM – a good system for buildings!
- BIM – transfer data in ifc, CityGML file formats, waiting for InfraGML...
- IFC -> Solids and surfaces
  - Requires "Type"
- LOD – Level of Details
- Solids -> Volumes
- I in BIM = Information