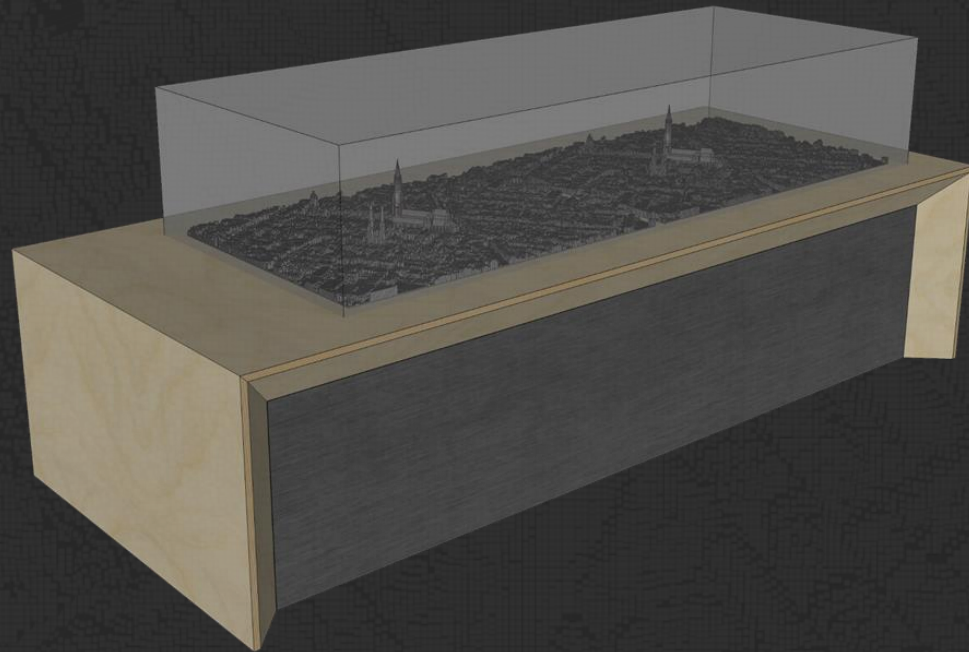


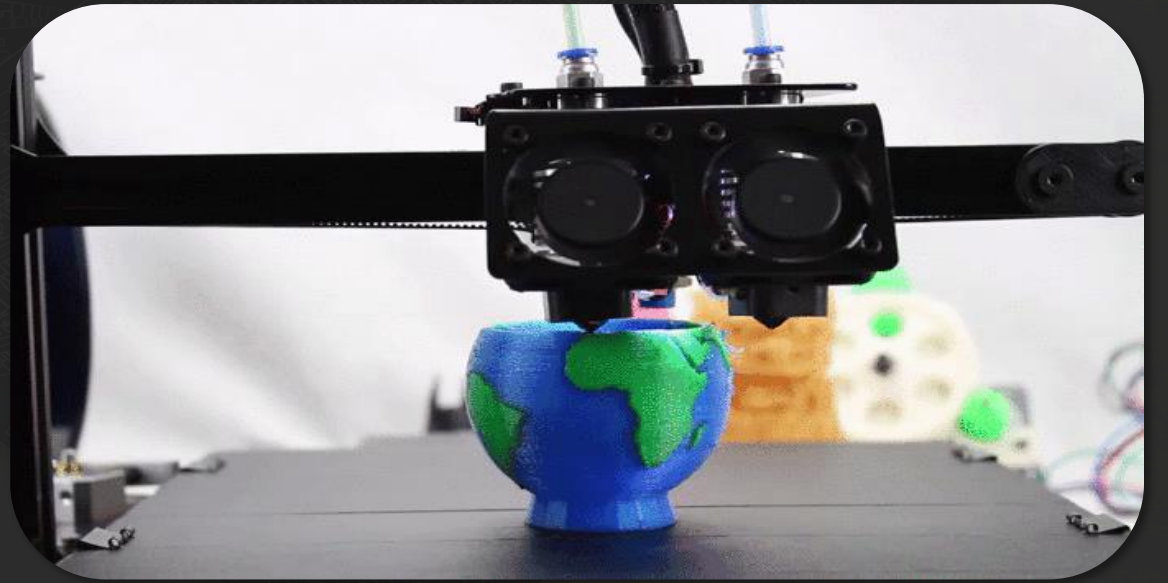
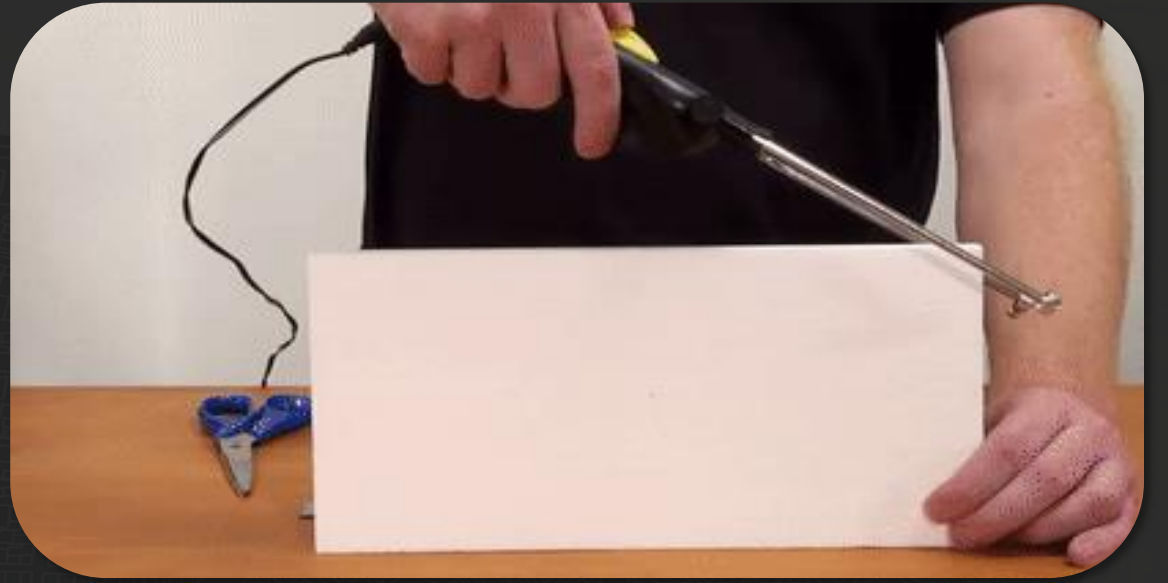
PIM MODEL AS DESIGN TOOL



MODELS

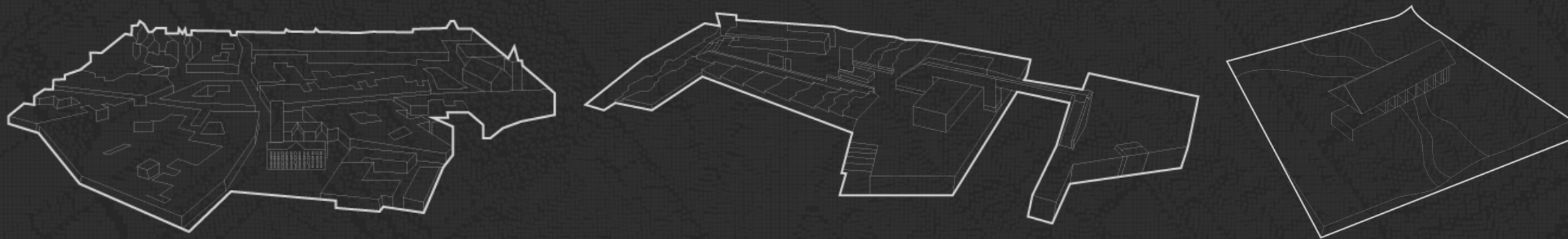


MODELS



PROBLEM

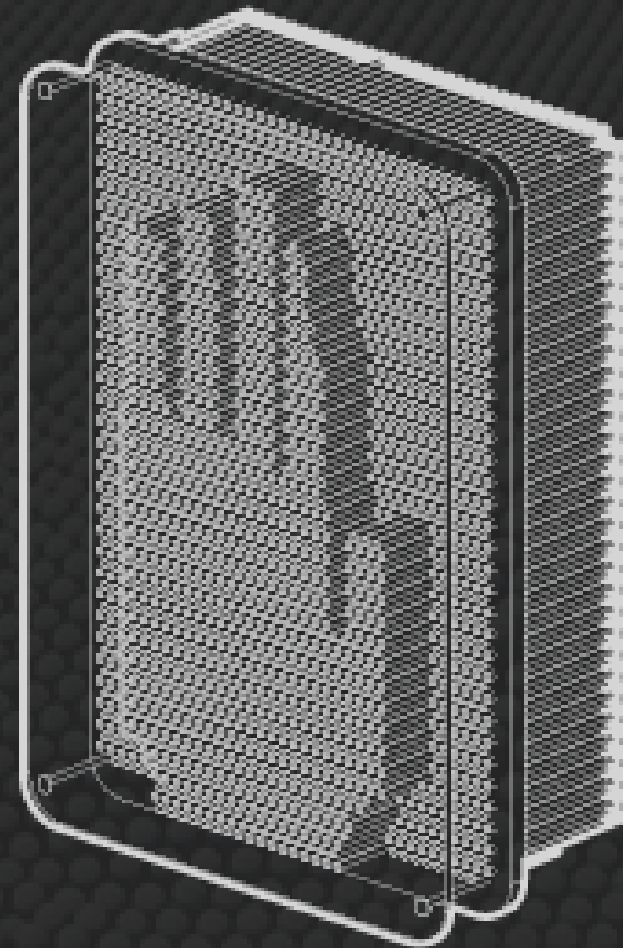
There is no quick way of using digital models/information for physical mass and shade analysis



PIN MODEL

A model that makes use of pins to represent an (imprinted) 3D object. The pins can move in one direction.

To most people known as 3D pin art or a PinPressions™ toy.

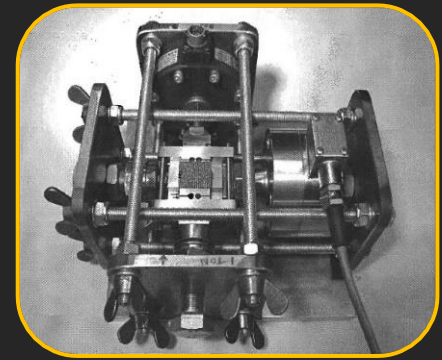


AVAILABLE MODELS



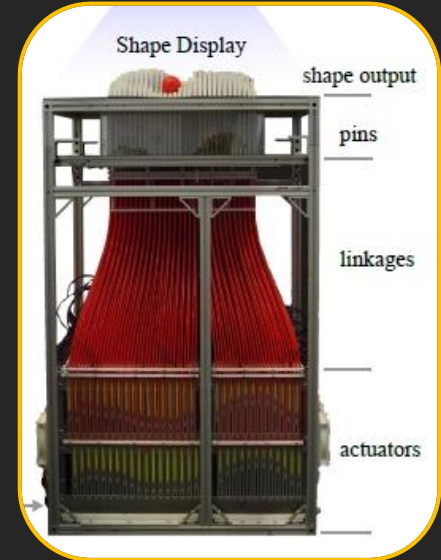
Discrete mold
*Eindhoven University of
Technology (TU/E)*

400 pins
(2006)



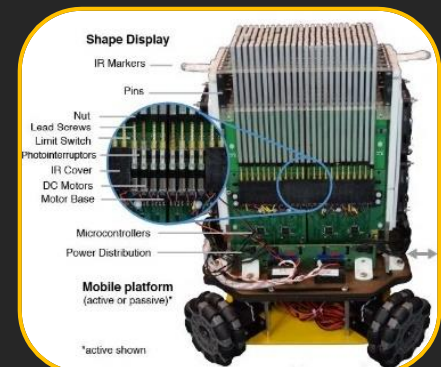
Inform
*Massachusetts Institute of
Technology (MIT)*

900 pins
~\$22.500,- (2013)



Shapeshift
Stanford University

288 pins
~\$10.000,- (2018)

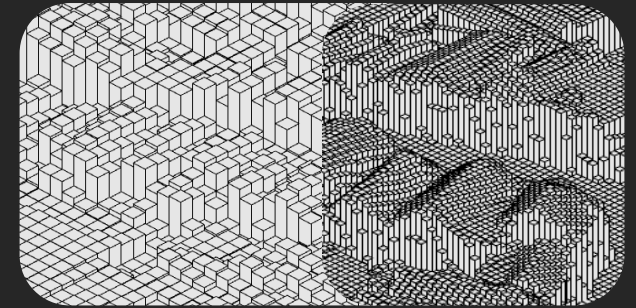


CHALLENGES

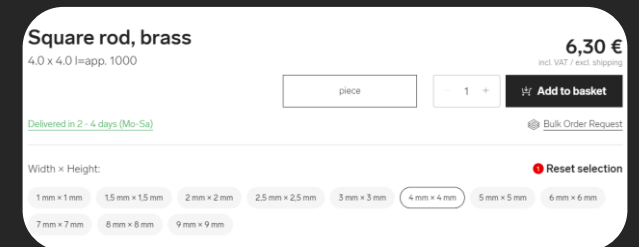
Use case
mainly manufacturing
To designing



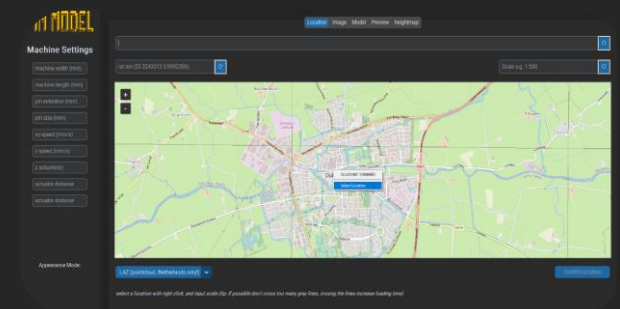
Pin count
Currently: 250-1000
Target: 100k



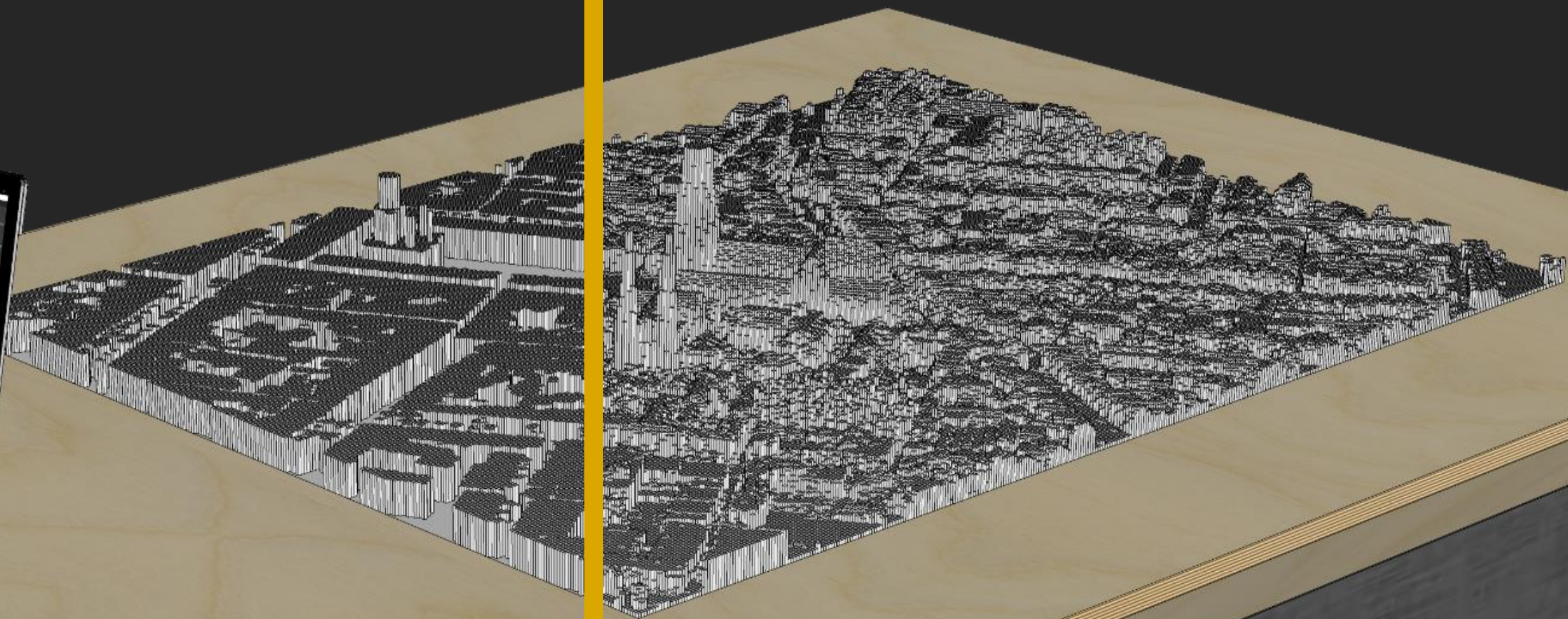
Price
Currently: € 10k - € 22k
Target: € 10k



Coding
Large data sets



GOAL



USERS

Architects



Students/teachers



Engineers



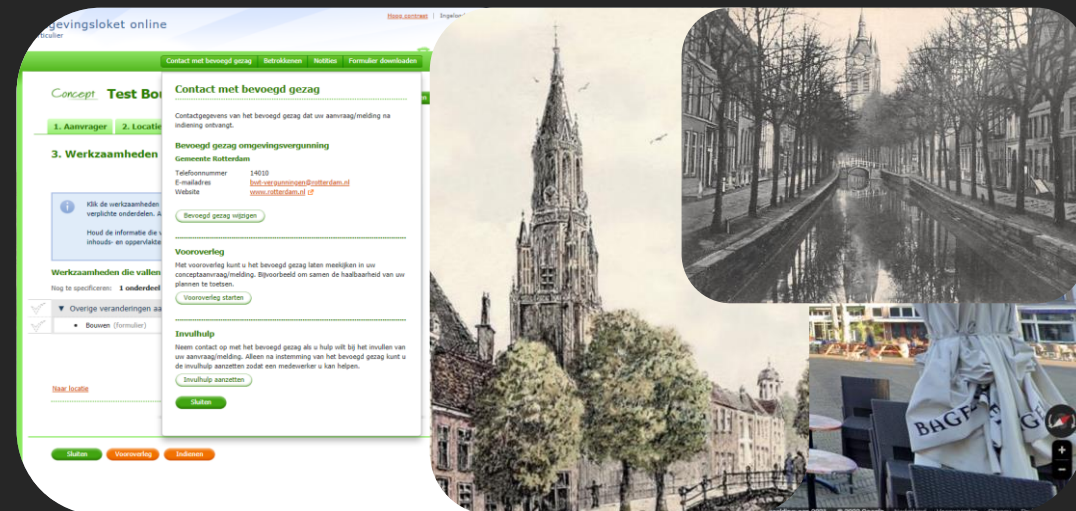
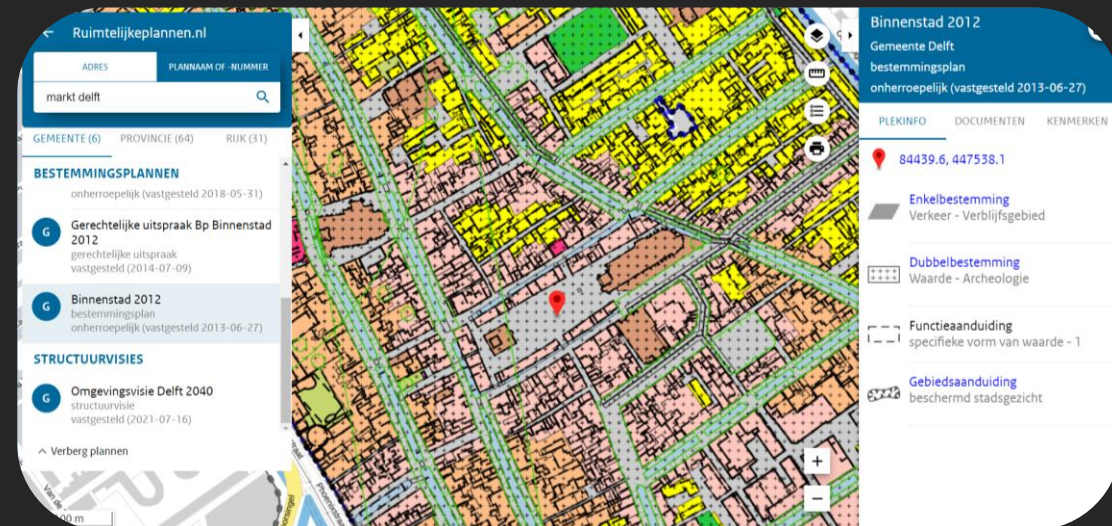
Governments

Project developers

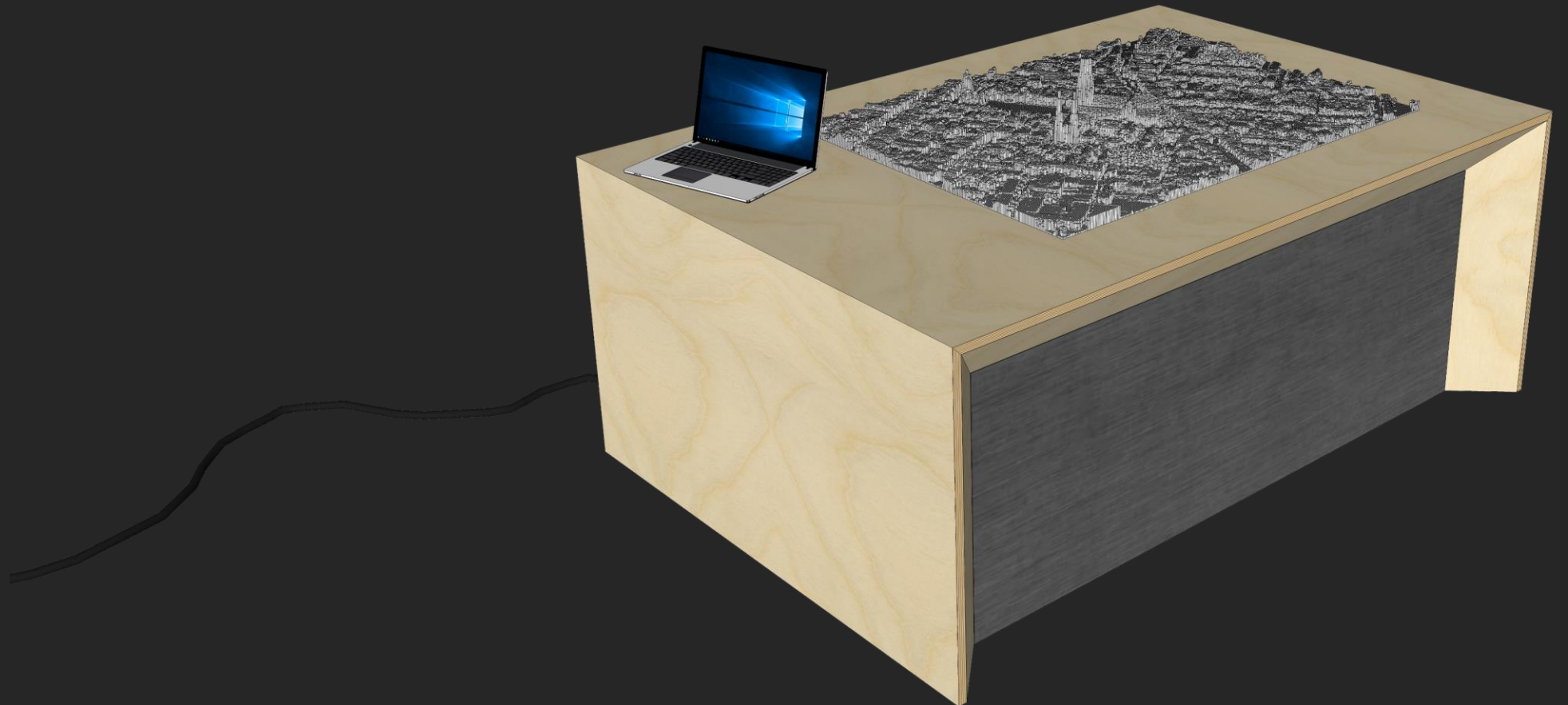
exhibitions



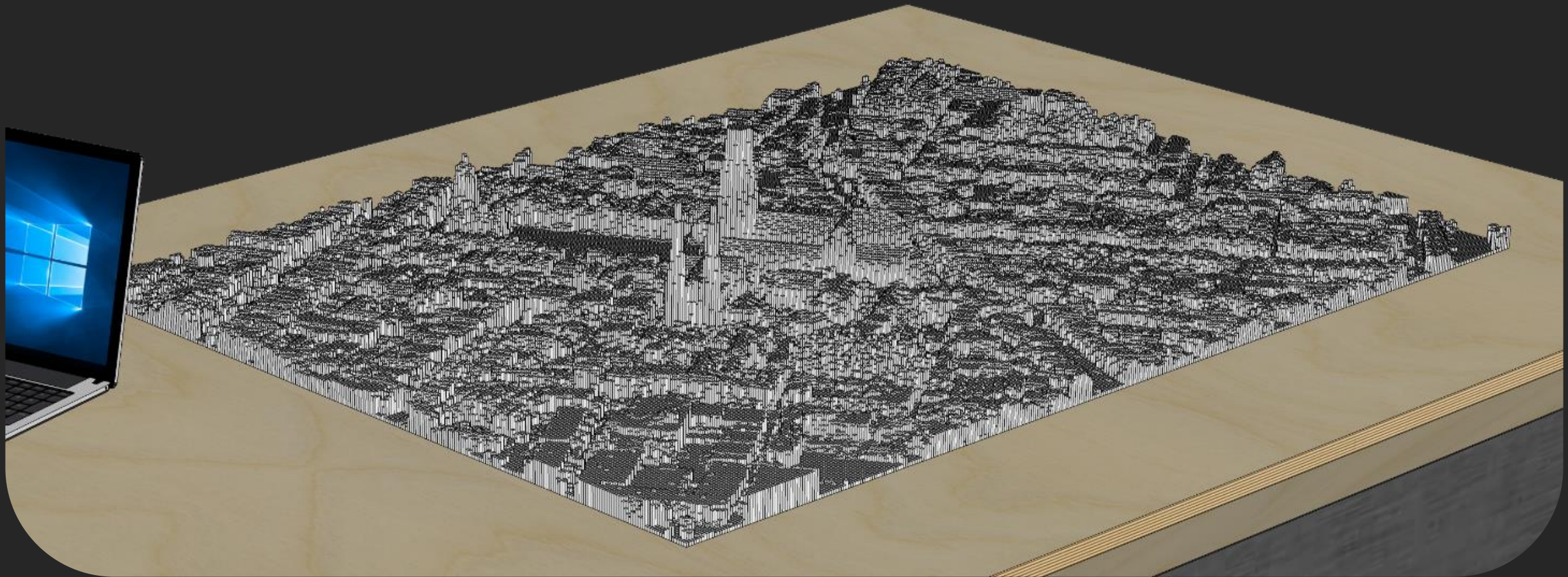
ARCH INITIAL SEARCH



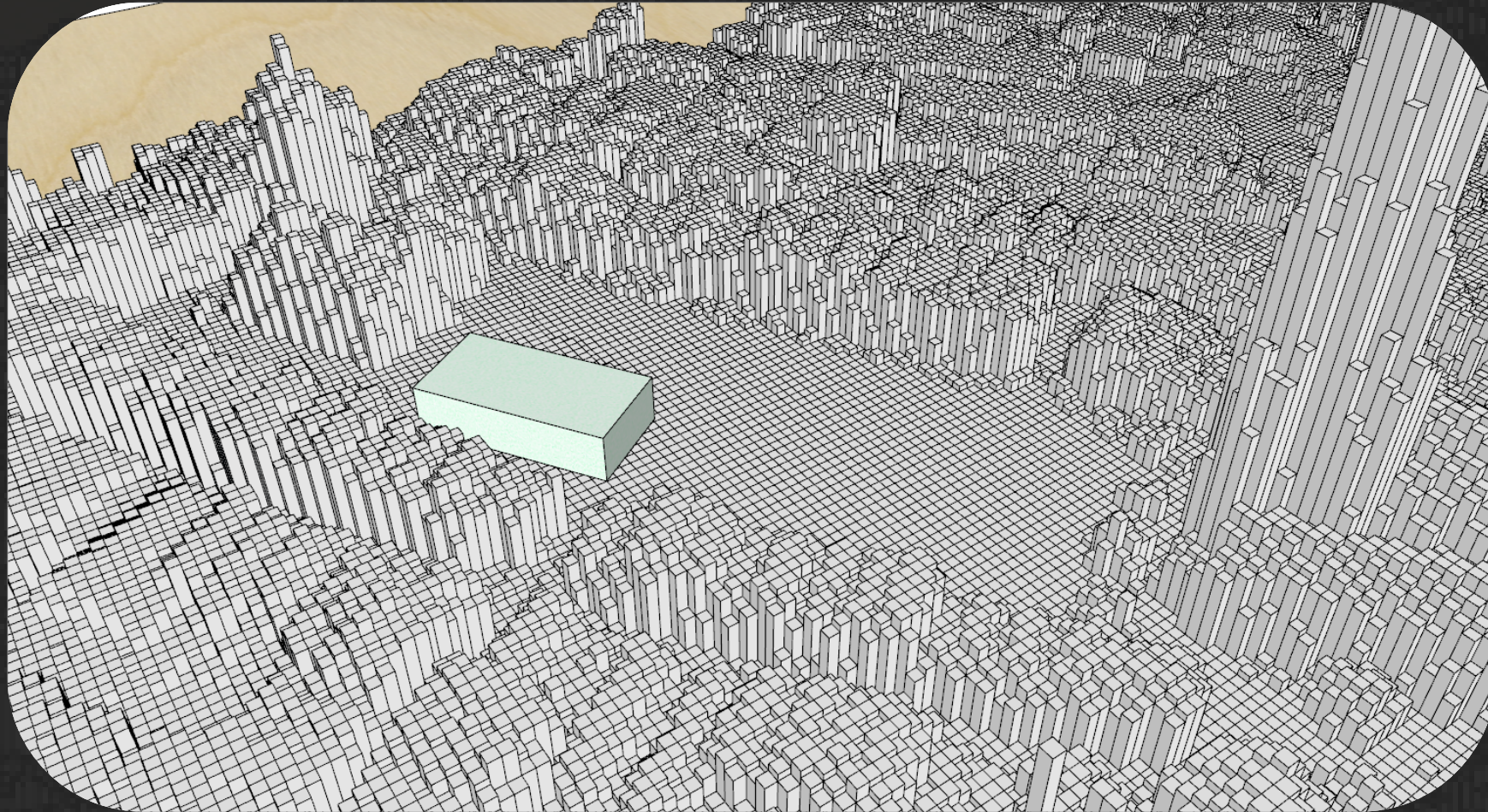
ARCH INITIAL SEARCH



ARCH INITIAL SEARCH



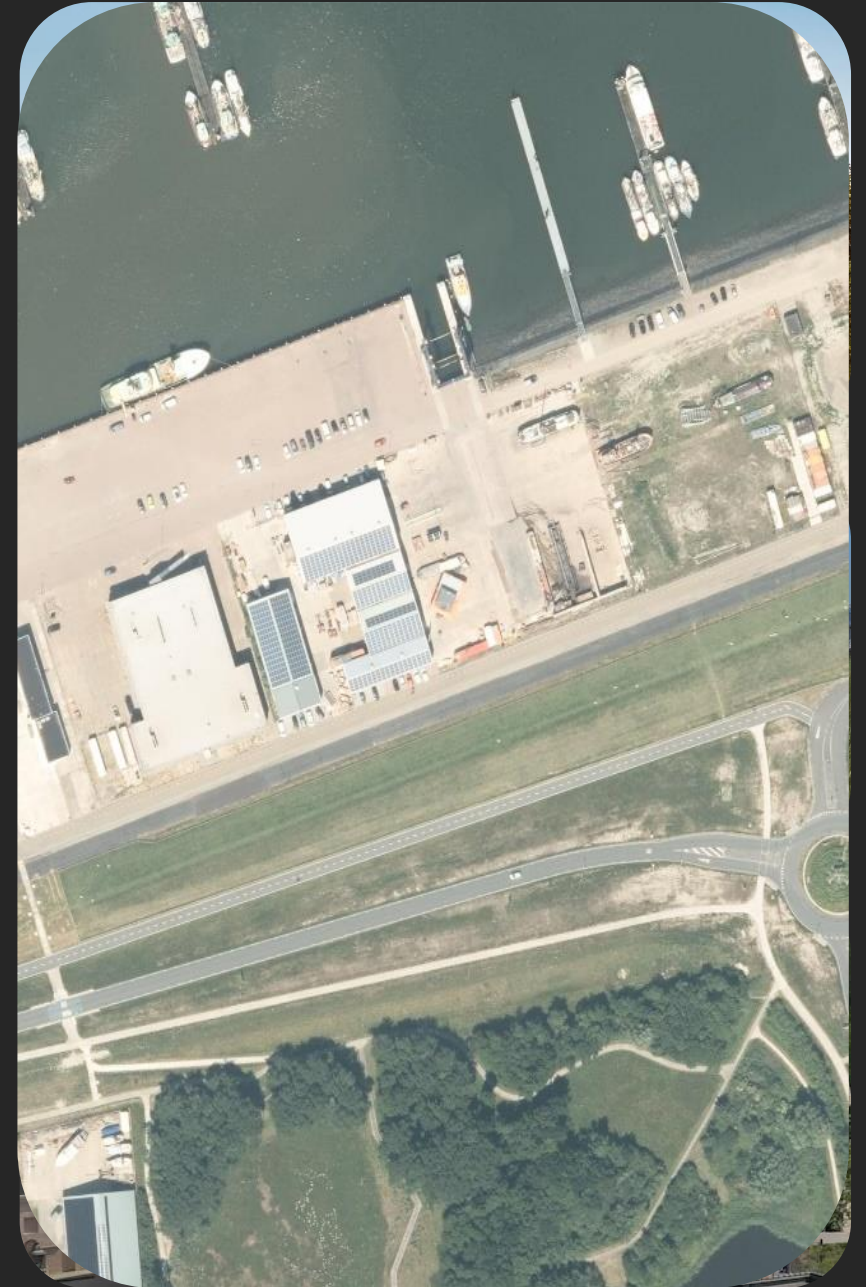
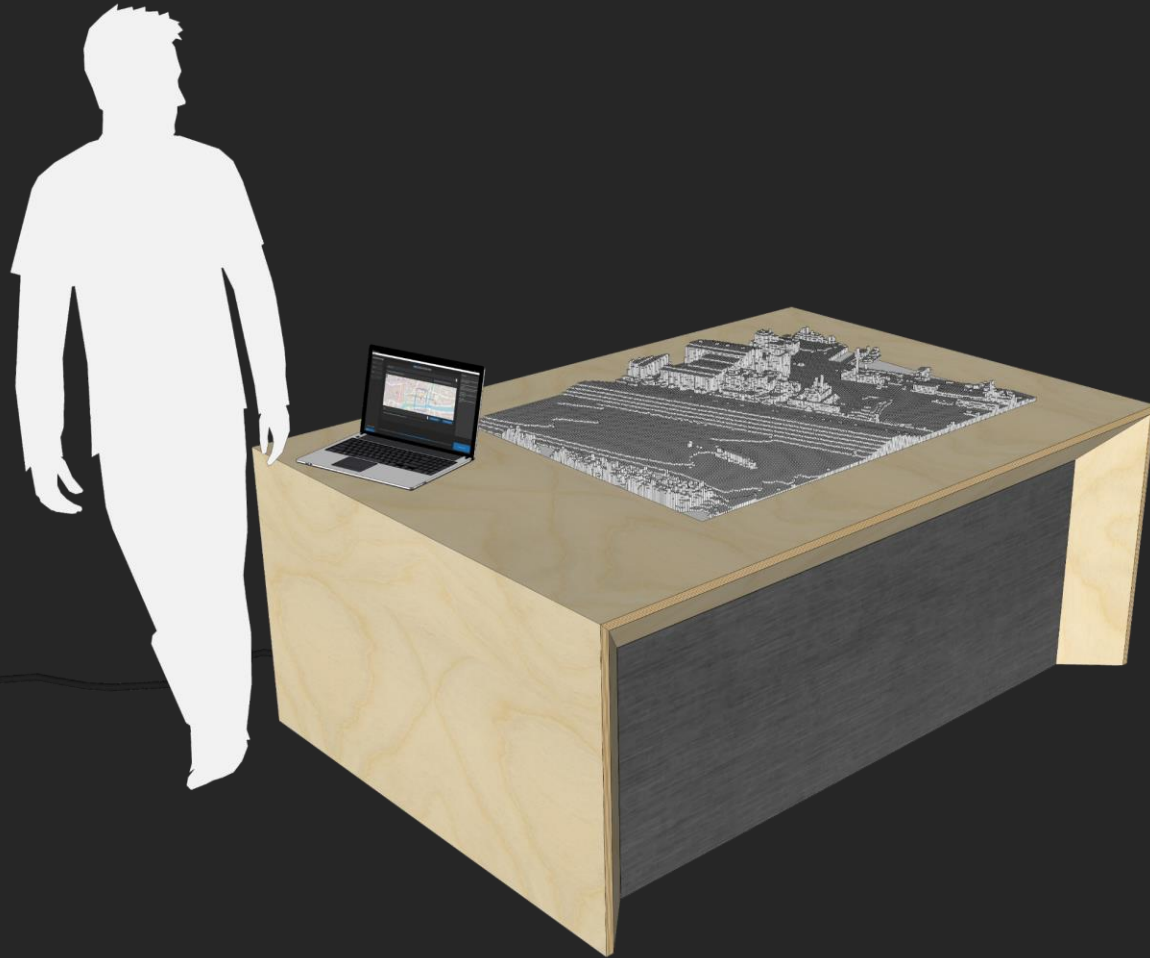
ARCH MASS STUDY



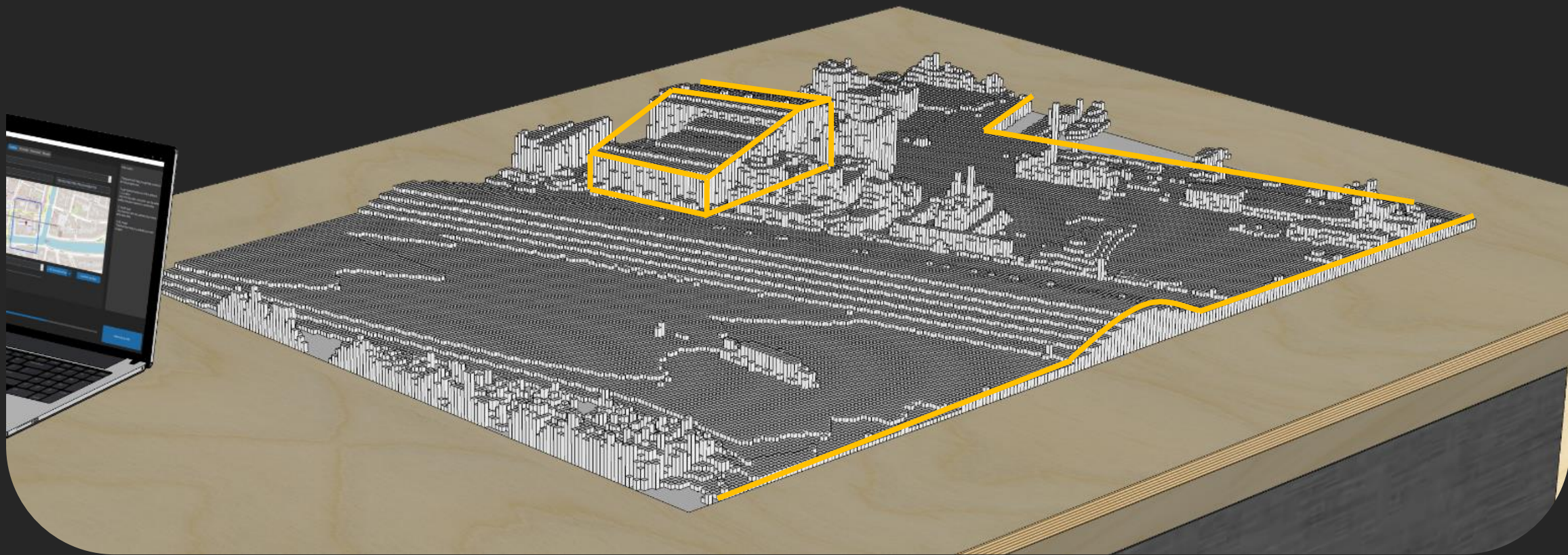
mass added
on top



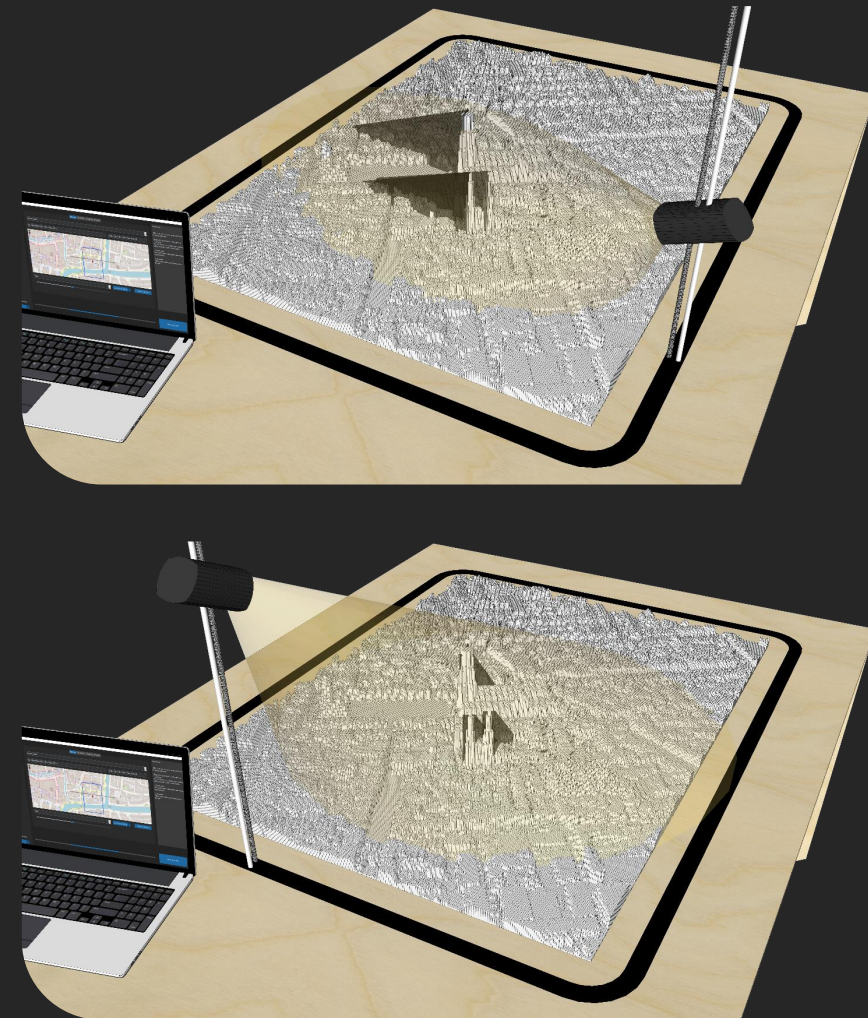
ARCH COMPLEX SITE



ARCH COMPLEX SITE



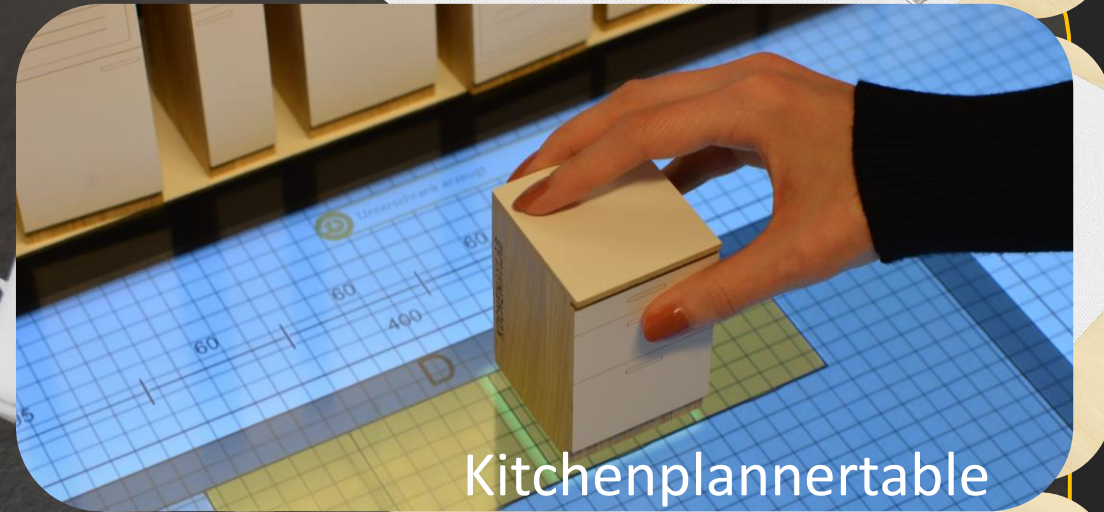
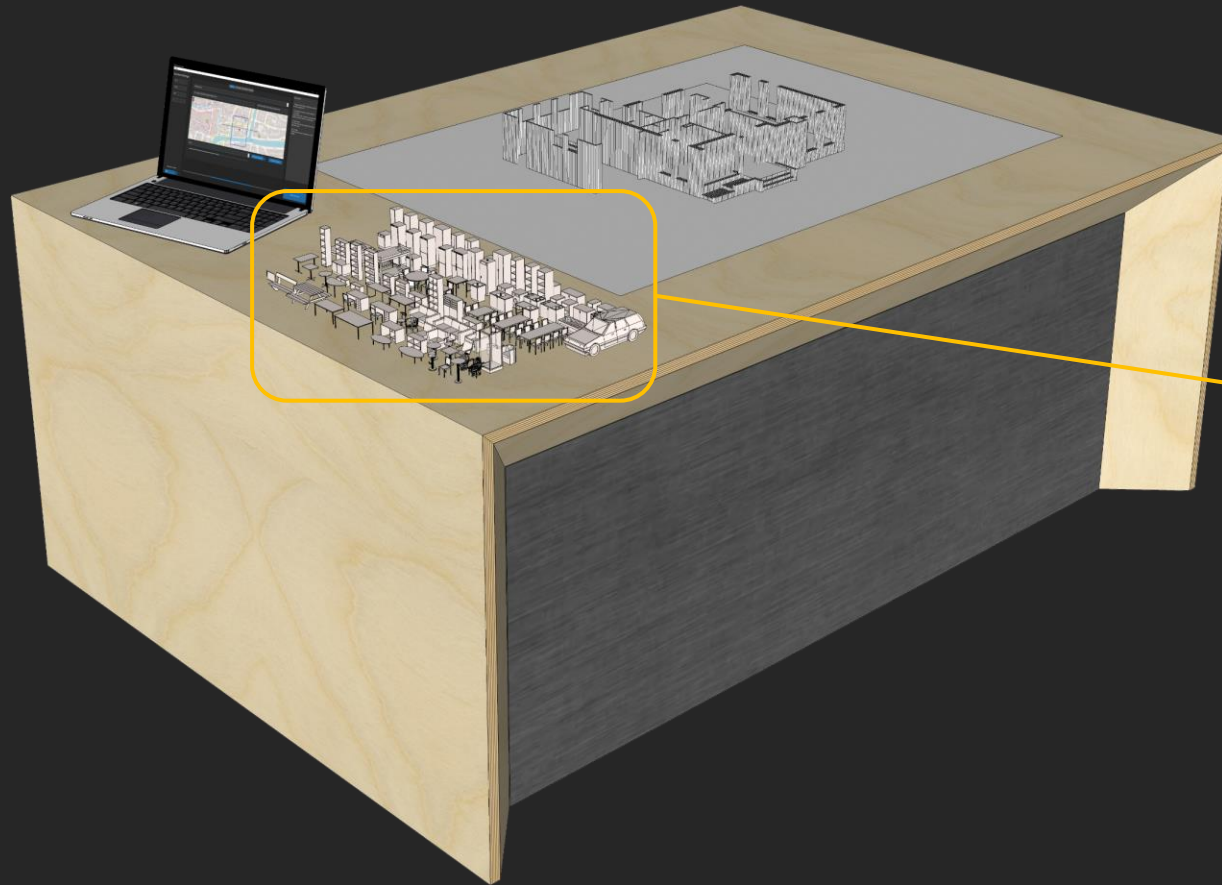
SHADE ANALYSIS



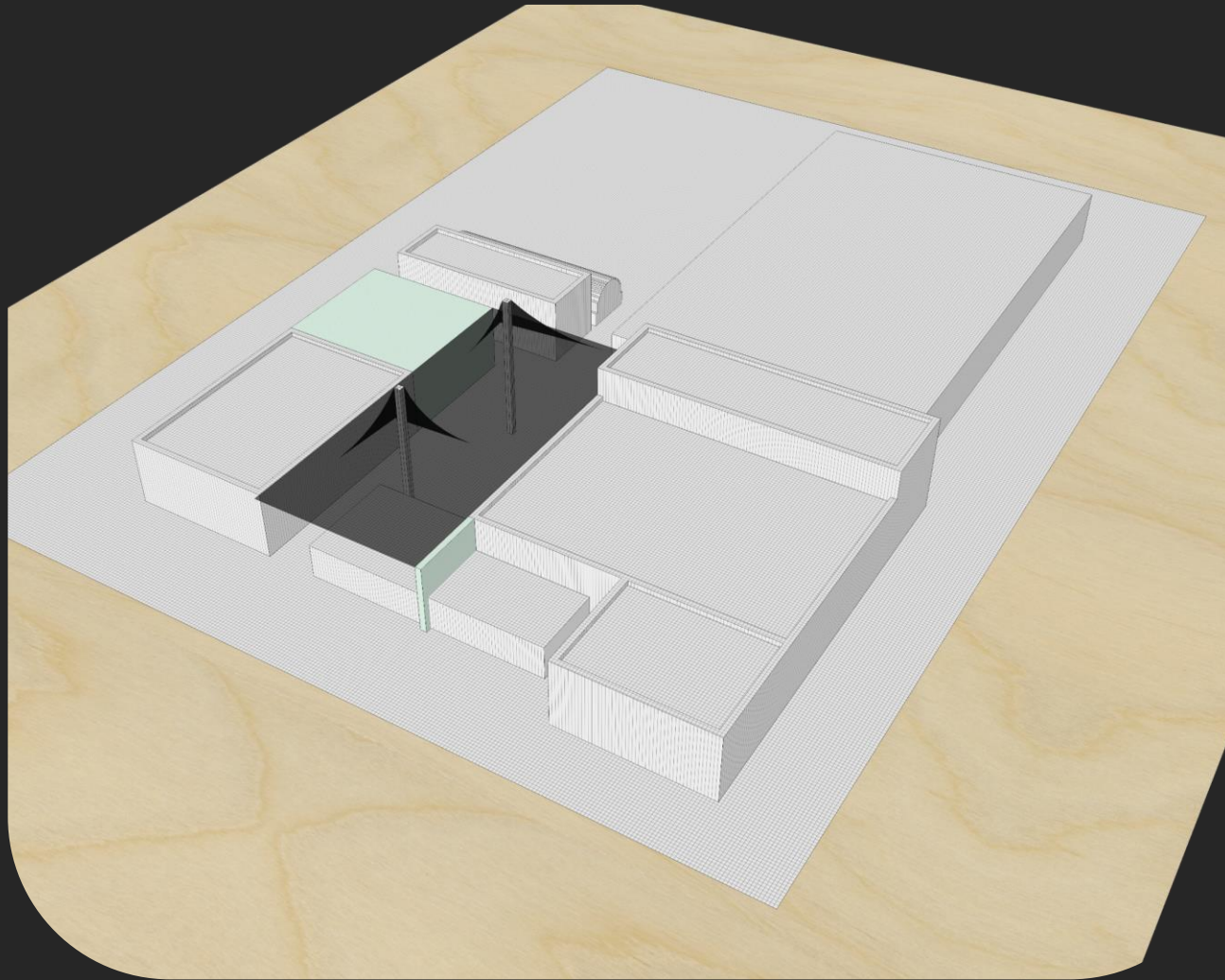
SHADE ANALYSIS



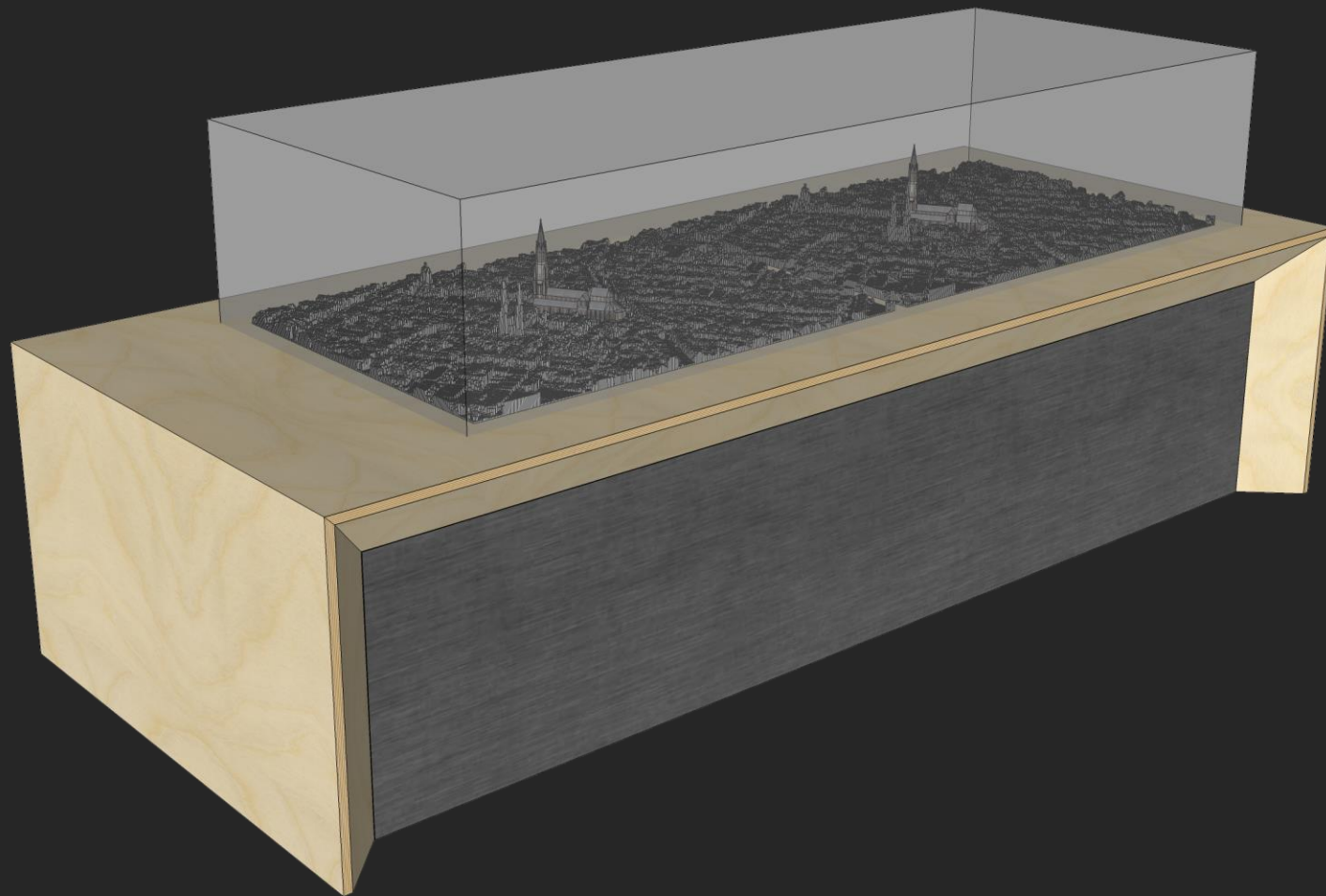
INTERIOR DESIGN



FREE FORM ROOFING



OTHER DISPLAY

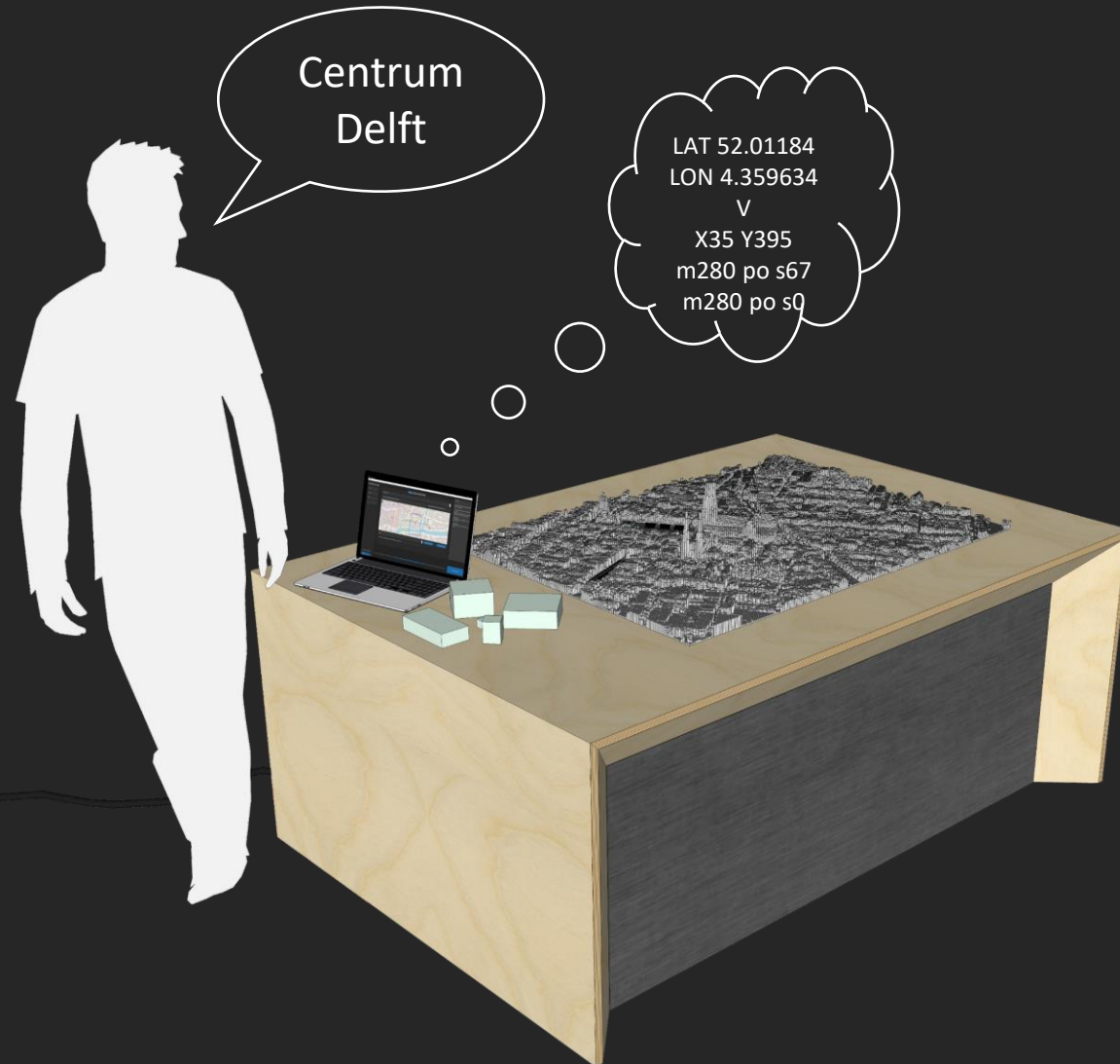


AUGMENTED REALITY



https://www.linkedin.com/posts/michalgula_hxdr-3d-hxgnliveglobal-ugcPost-7074629154695991296-cKbP?utm_source=share&utm_medium=member_android

DESIGN



Visual Pins

Visuals/working layer

State pins

Pin height

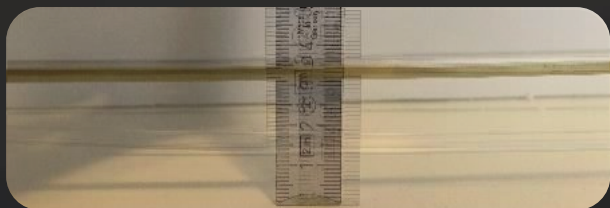
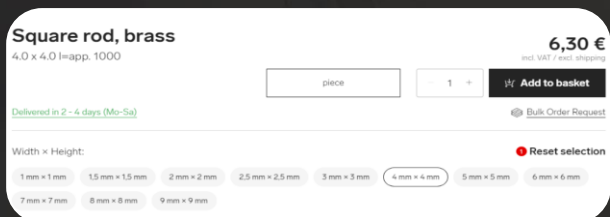
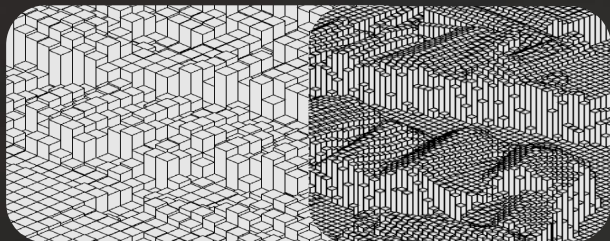
Carriage

movement

Electronics

movement

PINS

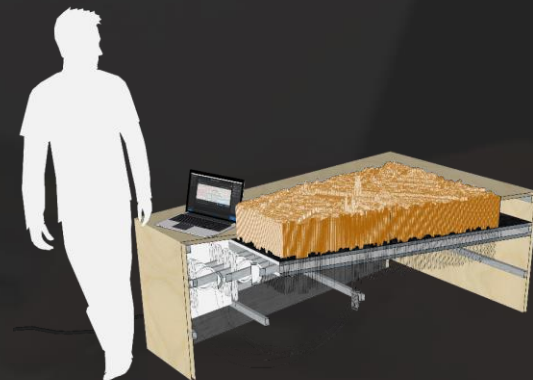


Size

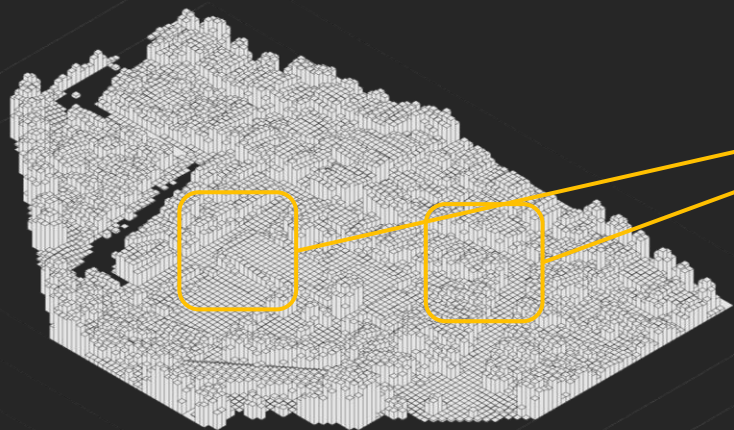
Price

Tolerance

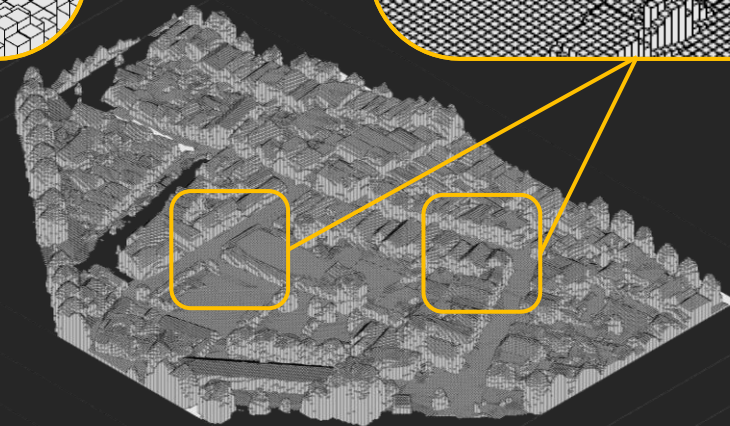
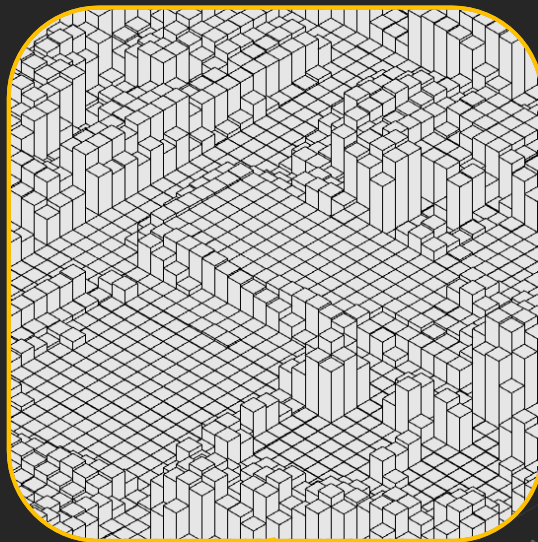
Deformation



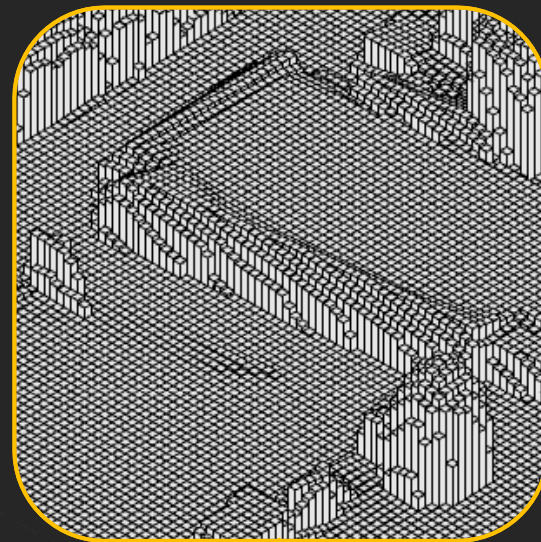
PIN DENSITY



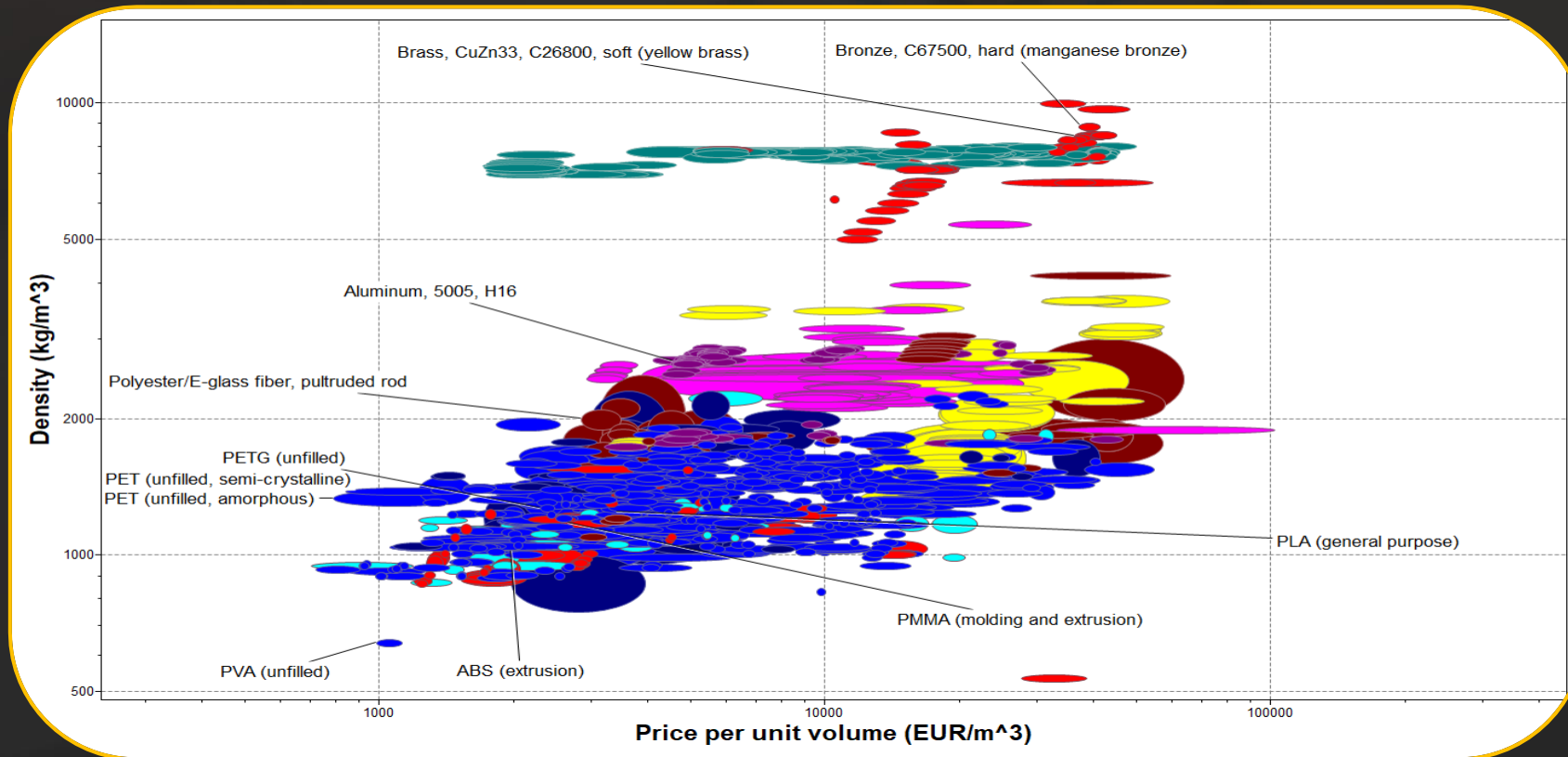
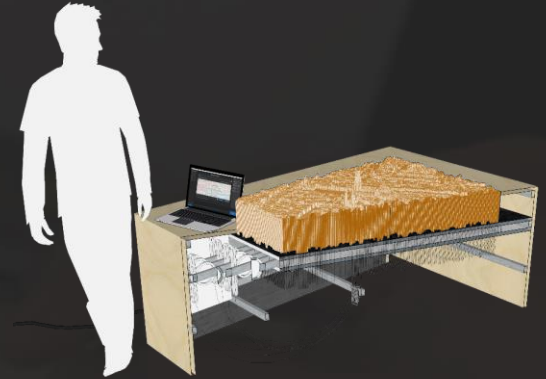
10mm (10k pins)



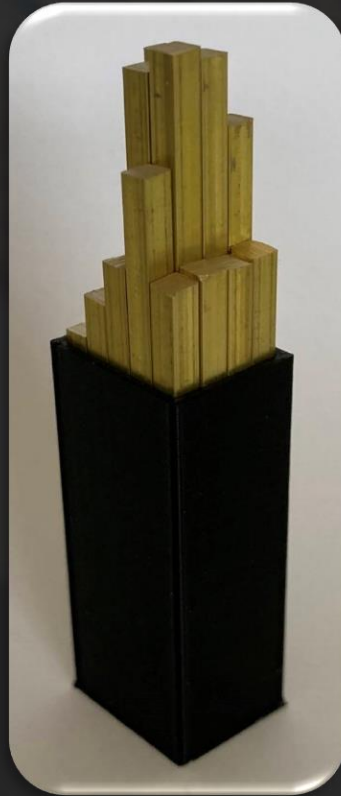
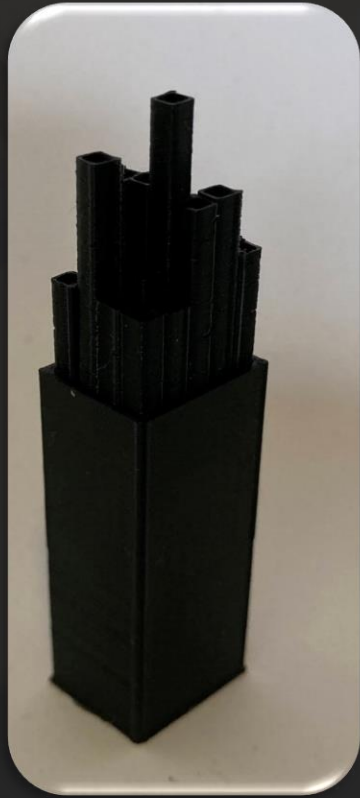
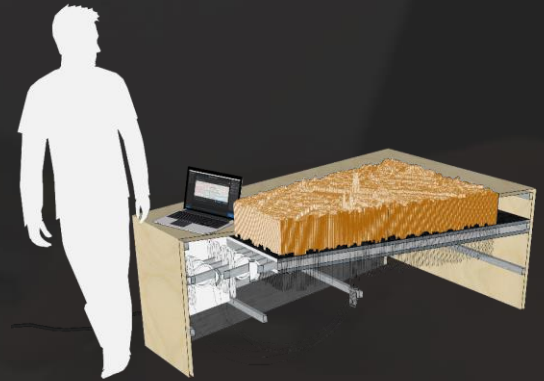
3mm (100k pins)



PINS



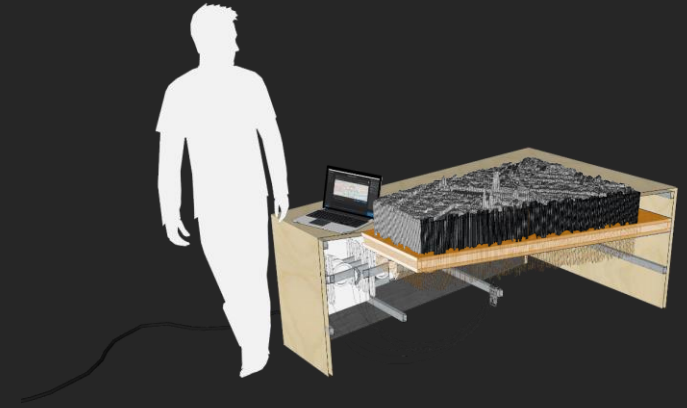
PINS



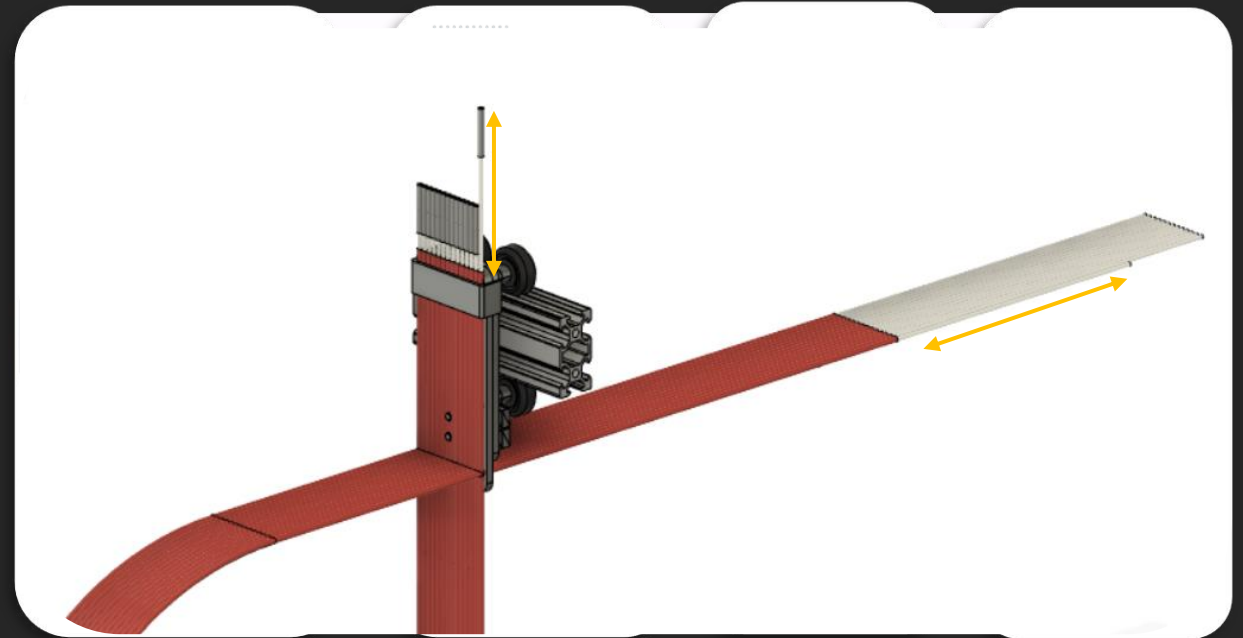
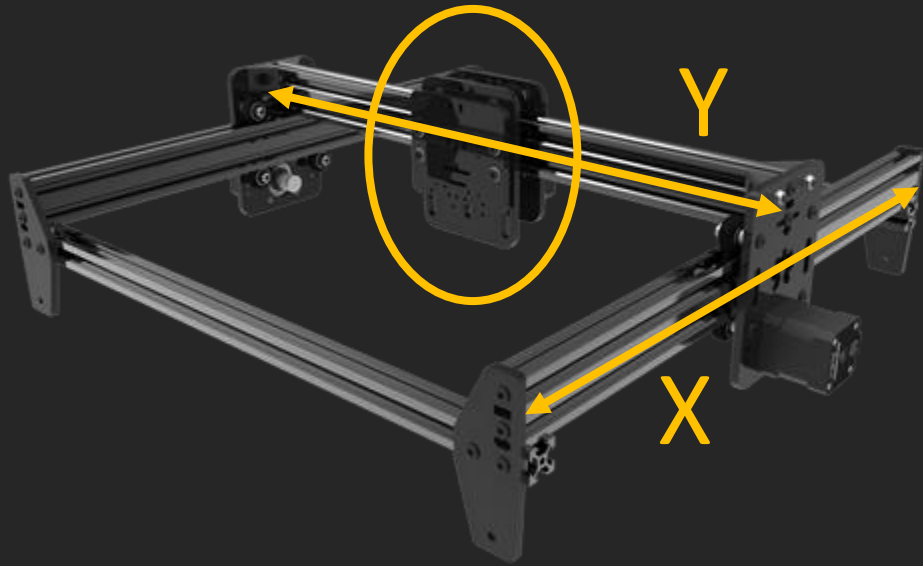
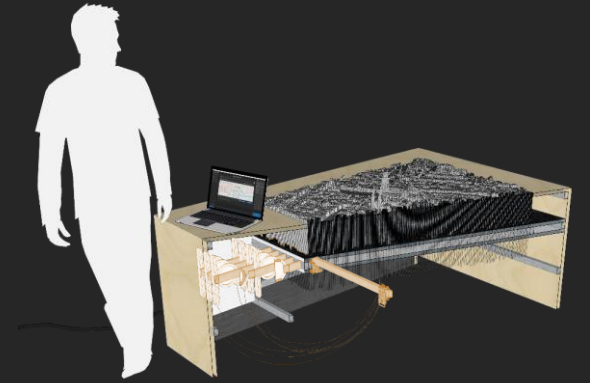
STATE LAYER



1000+ moves
no notabel loss in friction



DESIGN



DESIGN

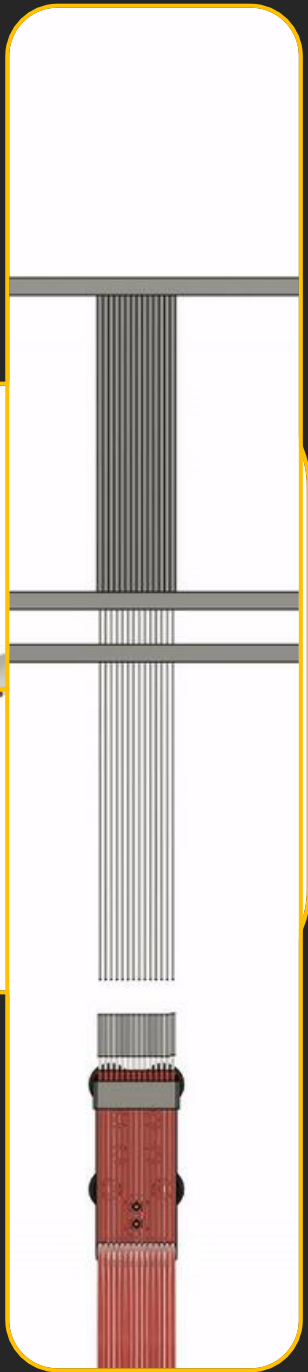
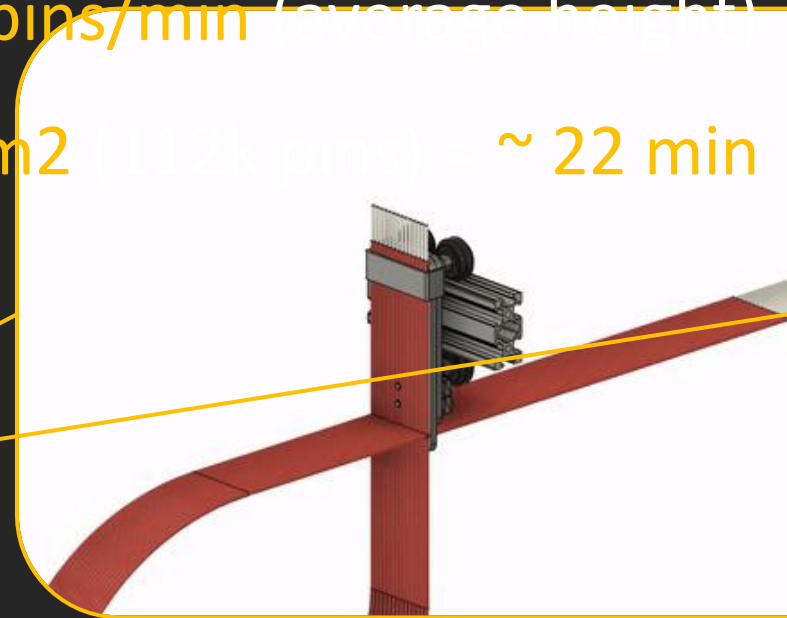
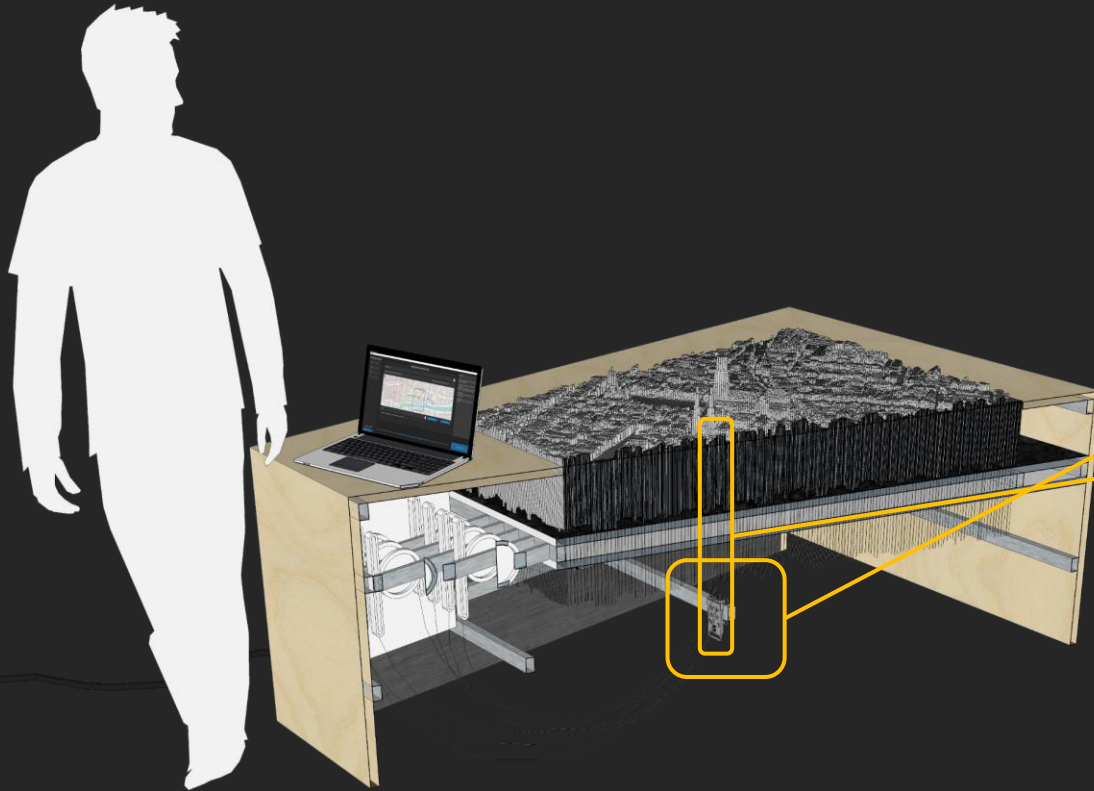
up to 40 independently moving motors

1240 pins/min (full height)

5000 pins/min (average height)

1 m²

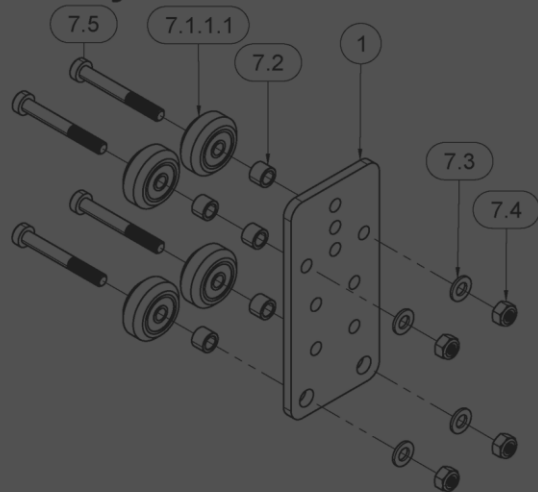
~ 22 min



ASSEMBLY

Gantry

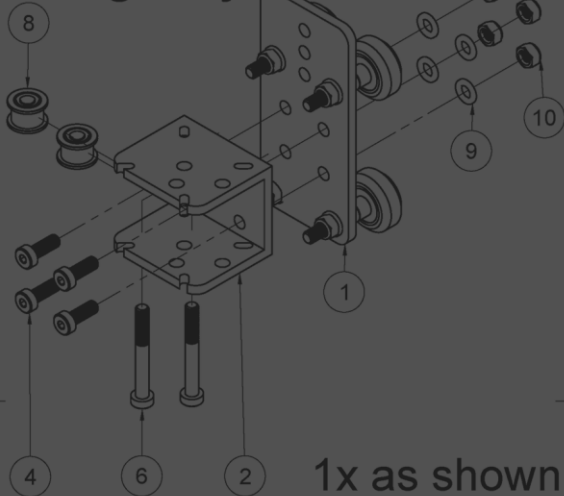
3x



Parts List

Item	Qty	Part Number
1	1	Gantry plate
7	4	Wheel assembly
7.1	1	V-Wheel Kit
7.1.1	1	Solid V-Wheel
7.1.1.1	1	Component5
7.1.1.1.1	1	External1
7.1.2	2	Ball Bearing 625 2RS 5x16x5
7.1.2.1	1	Component4
7.2	2	94669A042_Aluminum Unthreaded Spacer
7.3	1	91166A240_Zinc-Plated Steel Washer
7.4	1	94645A102_High-Strength Steel Nylon-Insert Locknut
7.5	1	93070A133_Alloy Steel Low-Profile Socket Head Screw

Side gantry

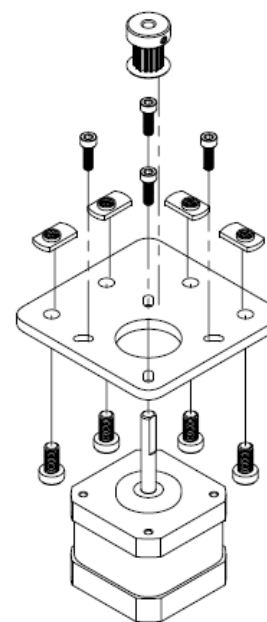
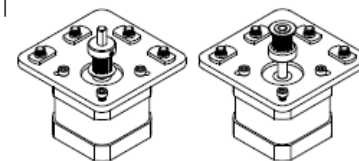


1x as shown
1x mirrored

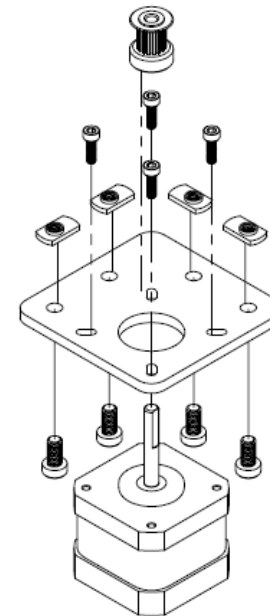
Parts List

Item	Qty	Part Number
1	1	Gantry plate
2	1	Corner and motor mount
3	2	20x40-V-Slot-Extrusion
4	4	93070A124_Alloy Steel Low-Profile Socket Head Screw
5	2	93070A129_Alloy Steel Low-Profile Socket Head Screw
6	2	93070A133_Alloy Steel Low-Profile Socket Head Screw
7	4	Wheel assembly
8	2	3693N14_High-Strength HTD Timing Belt Idler Pulley
9	4	Wheel assembly v5 (1)
10	4	Wheel assembly v5 (2)

Motor Mount



1X Motor mount



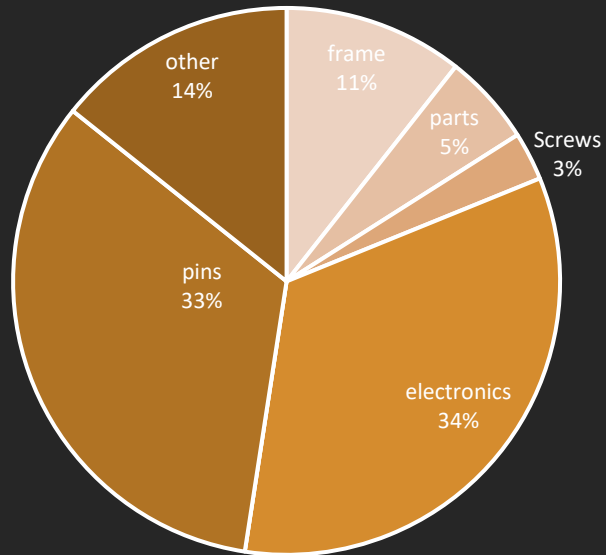
1X Motor mount (inverted pulley)

Parts List

Item	Qty	Part Name
1	2	Motor mount plate
2	2	Stepper motor
3	2	Toothed Pulley
4	8	M3 - 10mm bolt
5	8	M5 - 20mm bolt
6	8	T-slot nut

PRICE

Prototype

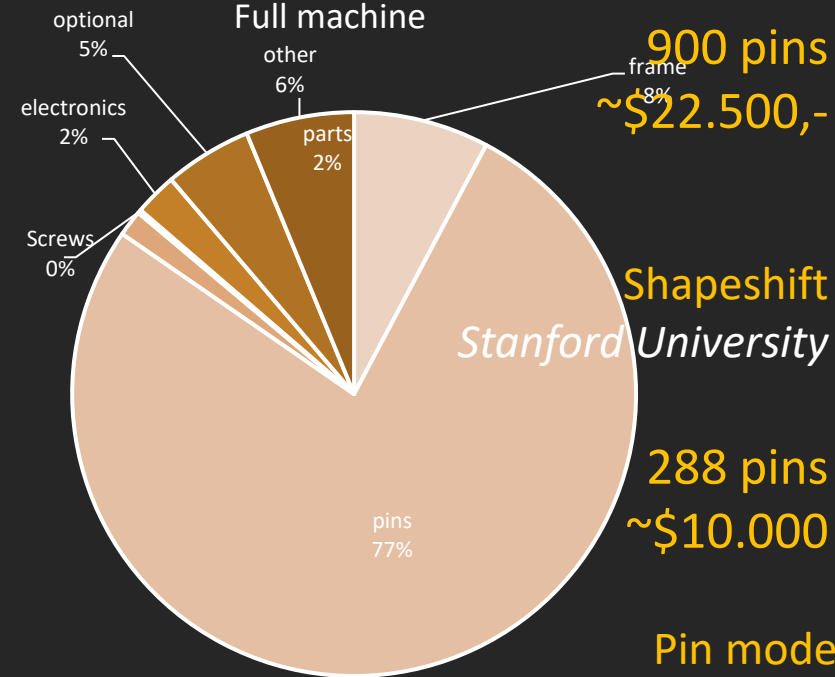


Full scale(1 m2)

112.000 pins

€ 20k

Full machine



900 pins
~\$22.500,-

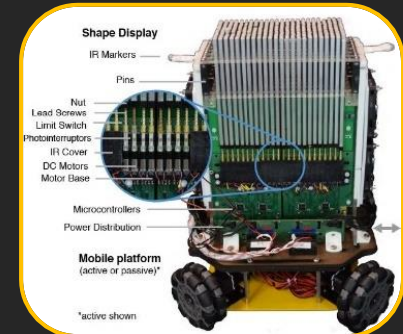
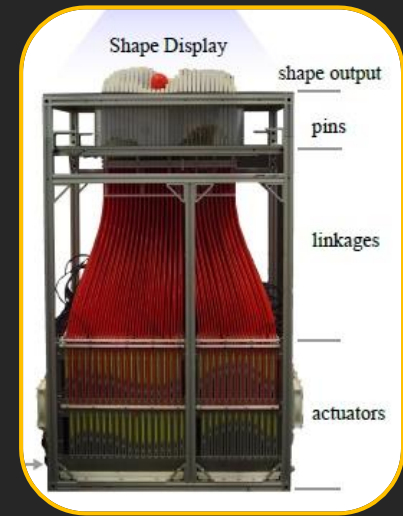
Shapeshift

Stanford University

288 pins
~\$10.000

Pin model
Prototype

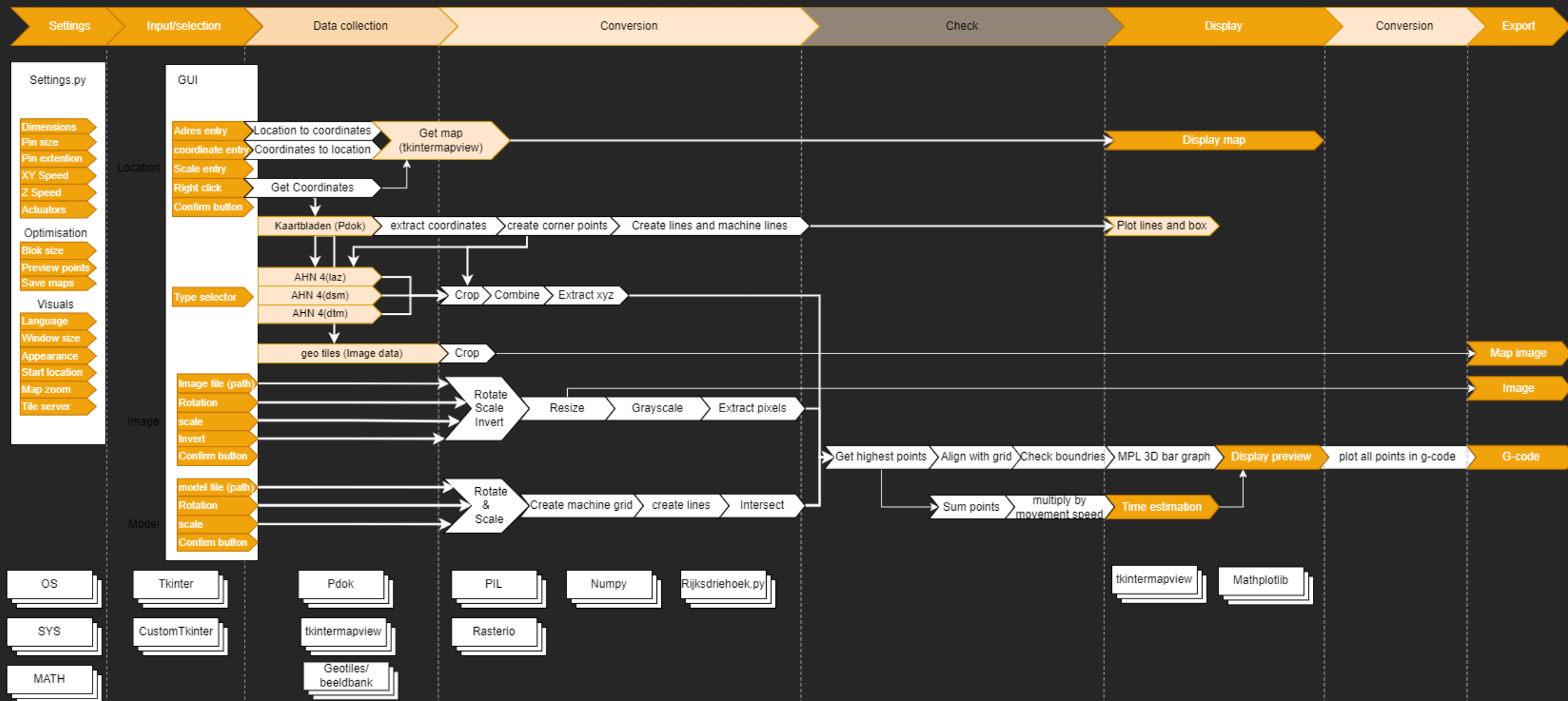
3500 pins
€ 1.288

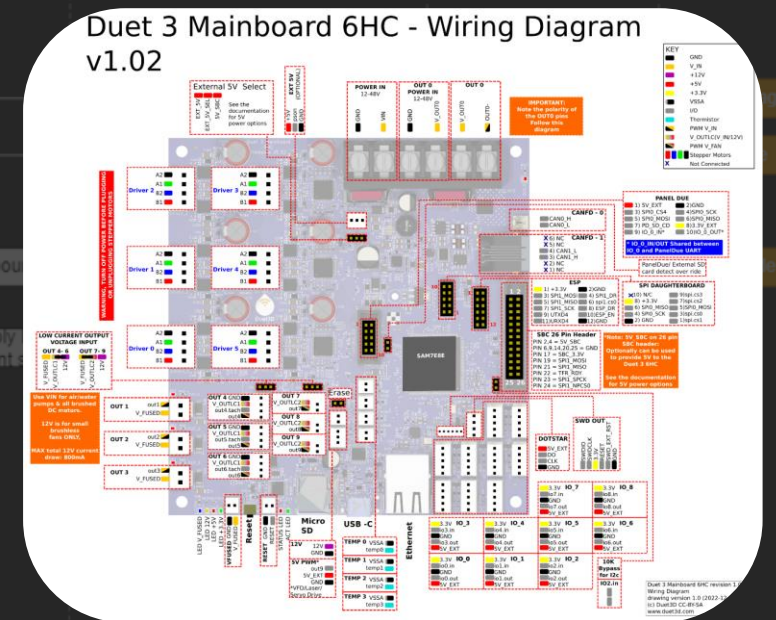


* Only material costs

** Based on consumer prices (only material)

CODE FLOWCHART





CODE GUI

Settings

Input/selection

Data collection

Conversion

Check

Display

Conversion

Export

Settings.py

Dimensions

Pin size

Pin extension

XY Speed

Z Speed

Actuators

Optimisation

Blok size

Preview points

Save maps

Visuals

Language

Window size

Appearance

Start location

Map zoom

Tile server

GUI

Adres entry

coordinate entry

Scale entry

Right click

Confirm button

Type selector

Image file (path)

Rotation

scale

Invert

Confirm button

model file (path)

Rotation

scale

Confirm button

Location to coordinates

Coordinates to location

Get Coordinates

Kaartbladen (Pdok)

extract coordinates

create corner

AHN 4(laz)

AHN 4(dsm)

AHN 4(dtm)

geo tiles (Image data)

Crop

Rotate

Scale

Invert

Confirm button

model file (path)

Rotation

scale

Invert

Confirm button

model file (path)

Rotation

scale

Invert

Confirm button

Get map

(tkintermapview)

Get Coordinates

Kaartbladen (Pdok)

extract coordinates

create corner

AHN 4(laz)

AHN 4(dsm)

AHN 4(dtm)

geo tiles (Image data)

Crop

Rotate

Scale

Invert

Confirm button

model file (path)

Rotation

scale

Invert

Confirm button

model file (path)

Rotation

scale

Invert

Confirm button

IN MODEL

Machine Settings

machine width (mm)

machine length (mm)

pin extension (mm)

pin size (mm)

xy-speed (mm/s)

z-speed (mm/s)

z actuator(s)

actuator distance

actuator distance

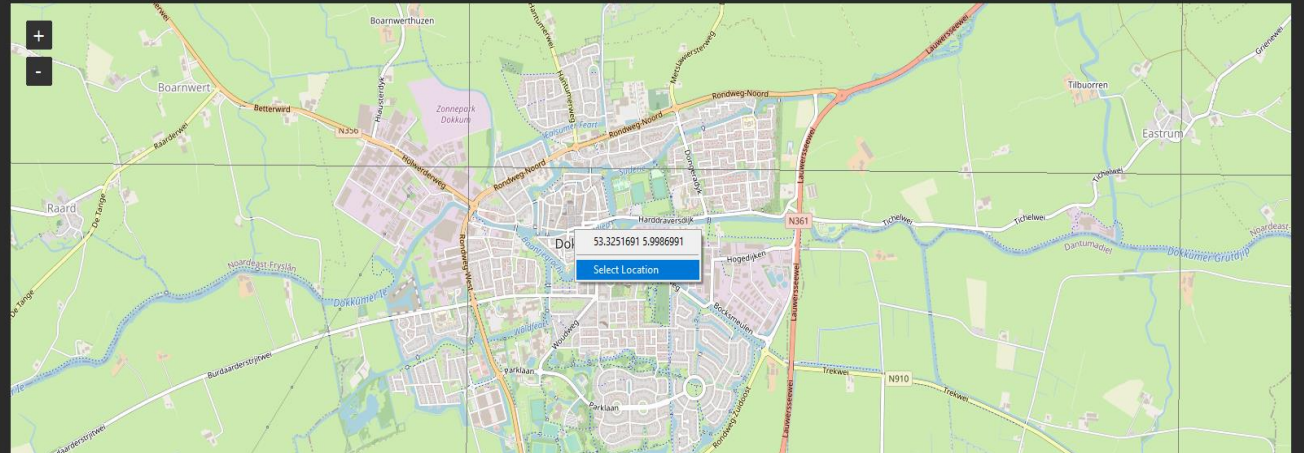
Appearance Mode:

Dark

Location Image Model Preview heightmap

lat lon (53.3243515 5.9992306)

Scale e.g. 1:500

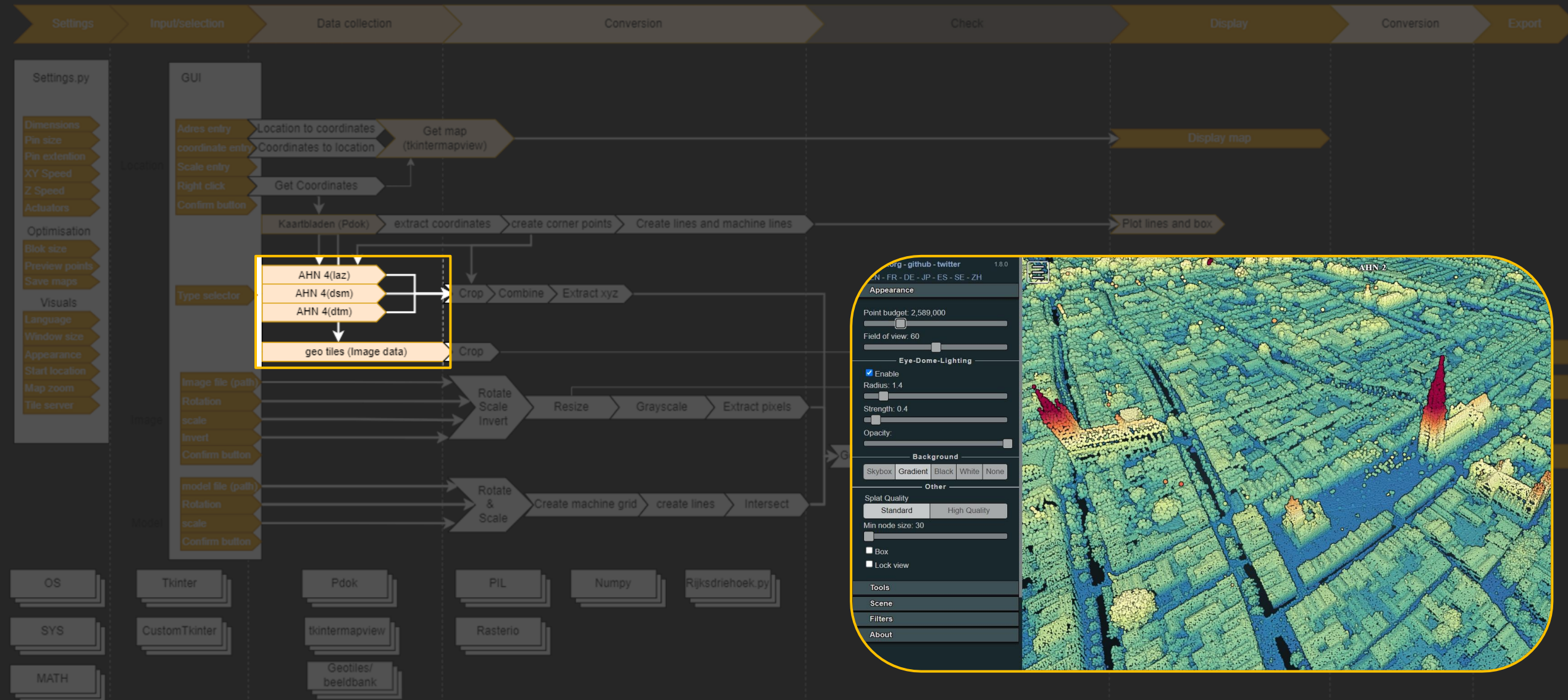


.LAZ (pointcloud, !Netherlands only!)

Confirm location

select a location with right click, and input scale (tip: If possible don't cross too many gray lines, crossing the lines increase loading time)

CODE POINTCLOUD



CODE TIFF SATALITE

Settings

Input/selection

Data collection

Conversion

Check

Display

Conversion

Export

Settings.py

Dimensions

Pin size

Pin extension

XY Speed

Z Speed

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Right click

Confirm button

Location

Location

Location

Location

Location

Location

Location

Location

Location

Location

Location

Location

Location

Location

Location

Location

Location

Location

Location

Location

Location

Location

Location

Location

Location to coordinates

Coordinates to location

Get Coordinates

Get map

(tkintermapview)

Kaartbladen (Pdok)

extract coordinates

create corner

AHN 4(laz)

AHN 4(dsm)

AHN 4(dtm)

geo files (Image data)

Crop

Combine

Export

Image file (path)

Rotation

scale

Invert

Confirm button

Image

Image

Image

Image

Image

Image

Image

Image

Image

Get map

(tkintermapview)

Kaartbladen (Pdok)

extract coordinates

create corner

AHN 4(laz)

AHN 4(dsm)

AHN 4(dtm)

geo files (Image data)

Crop

Combine

Export

Image file (path)

Rotation

scale

Invert

Confirm button

Image

Image

Image

Image

Image

Image

Image

Image

Image

Image

Image

Image

Get map

(tkintermapview)

Kaartbladen (Pdok)

extract coordinates

create corner

AHN 4(laz)

AHN 4(dsm)

AHN 4(dtm)

geo files (Image data)

Crop

Combine

Export

Image file (path)

Rotation

scale

Invert

Confirm button

Image

Image

Image

Image

Image

Image

Image

Image

Image

Image

Image

Image

Get map

(tkintermapview)

Kaartbladen (Pdok)

extract coordinates

create corner

AHN 4(laz)

AHN 4(dsm)

AHN 4(dtm)

geo files (Image data)

Crop

Combine

Export

Image file (path)

Rotation

scale

Invert

Confirm button

Image

Image

Image

Image

Image

Image

Image

Image

Image

Image

Image

Image

Get map

(tkintermapview)

Kaartbladen (Pdok)

extract coordinates

create corner

AHN 4(laz)

AHN 4(dsm)

AHN 4(dtm)

geo files (Image data)

Crop

Combine

Export

Image file (path)

Rotation

scale

Invert

Confirm button

Image

Image

Image

Image

Image

Image

Image

Image

Image

Image

Image

Image

Get map

(tkintermapview)

Kaartbladen (Pdok)

extract coordinates

create corner

AHN 4(laz)

AHN 4(dsm)

AHN 4(dtm)

geo files (Image data)

Crop

Combine

Export

Image file (path)

Rotation

scale

Invert

Confirm button

Image

Image

Image

Image

Image

Image

Image

Image

Image

Image

Image

Image

Get map

(tkintermapview)

Kaartbladen (Pdok)

extract coordinates

create corner

AHN 4(laz)

AHN 4(dsm)

AHN 4(dtm)

geo files (Image data)

Crop

Combine

Export

Image file (path)

Rotation

scale

Invert

Confirm button

Image

Image

Image

Image

Image

Image

Image

Image

Image

Image

Image

Image

Get map

(tkintermapview)

Kaartbladen (Pdok)

extract coordinates

create corner

AHN 4(laz)

AHN 4(dsm)

AHN 4(dtm)

geo files (Image data)

Crop

Combine

Export

Image file (path)

Rotation

scale

Invert

Confirm button

Image

Image

Image

Image

Image

Image

Image

Image

Image

Image

Image

Image

Get map

(tkintermapview)

Kaartbladen (Pdok)

extract coordinates

create corner

AHN 4(laz)

AHN 4(dsm)

AHN 4(dtm)

geo files (Image data)

Crop

Combine

Export

Image file (path)

Rotation

scale

Invert

Confirm button

Image

Image

Image

Image

Image

Image

Image

Image

Image

Image

Image

Image

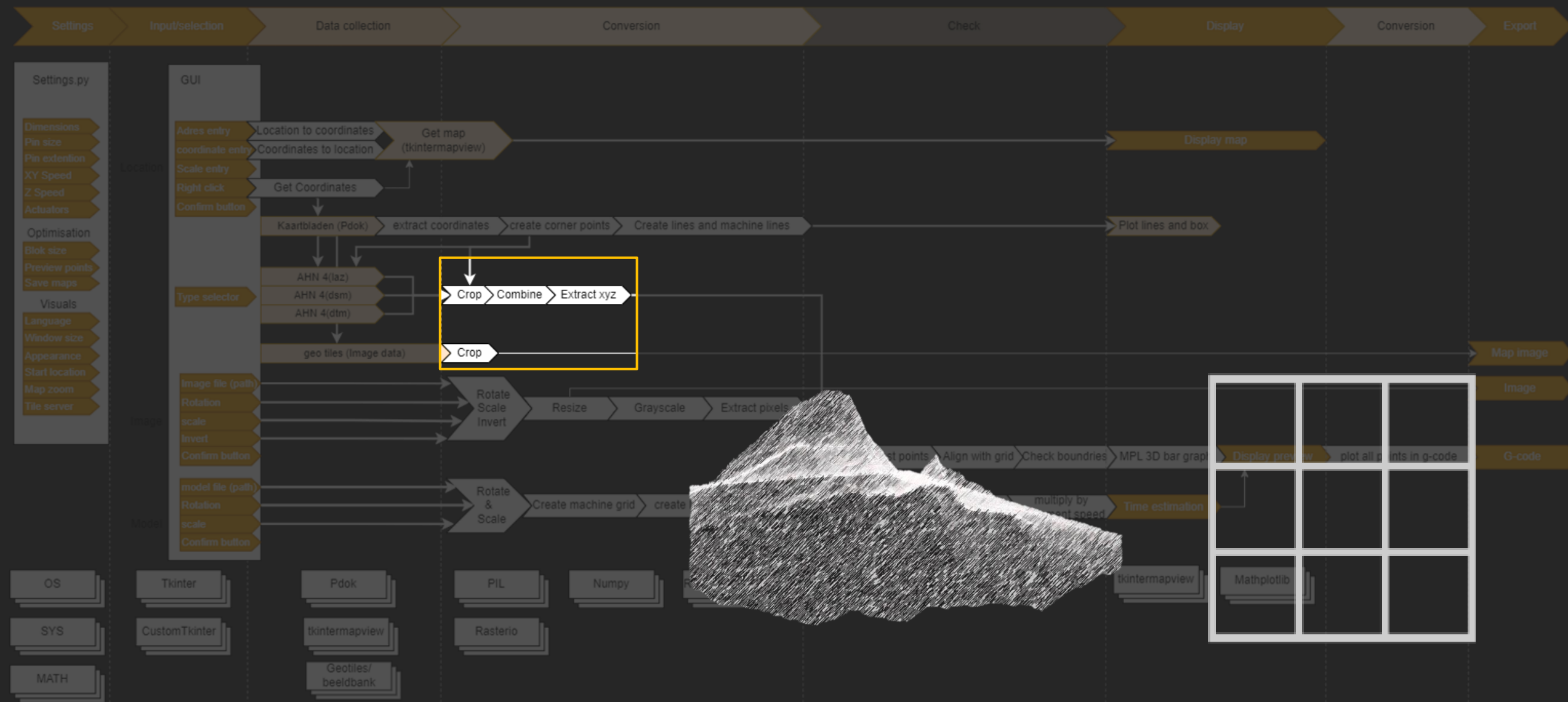
Image

Image

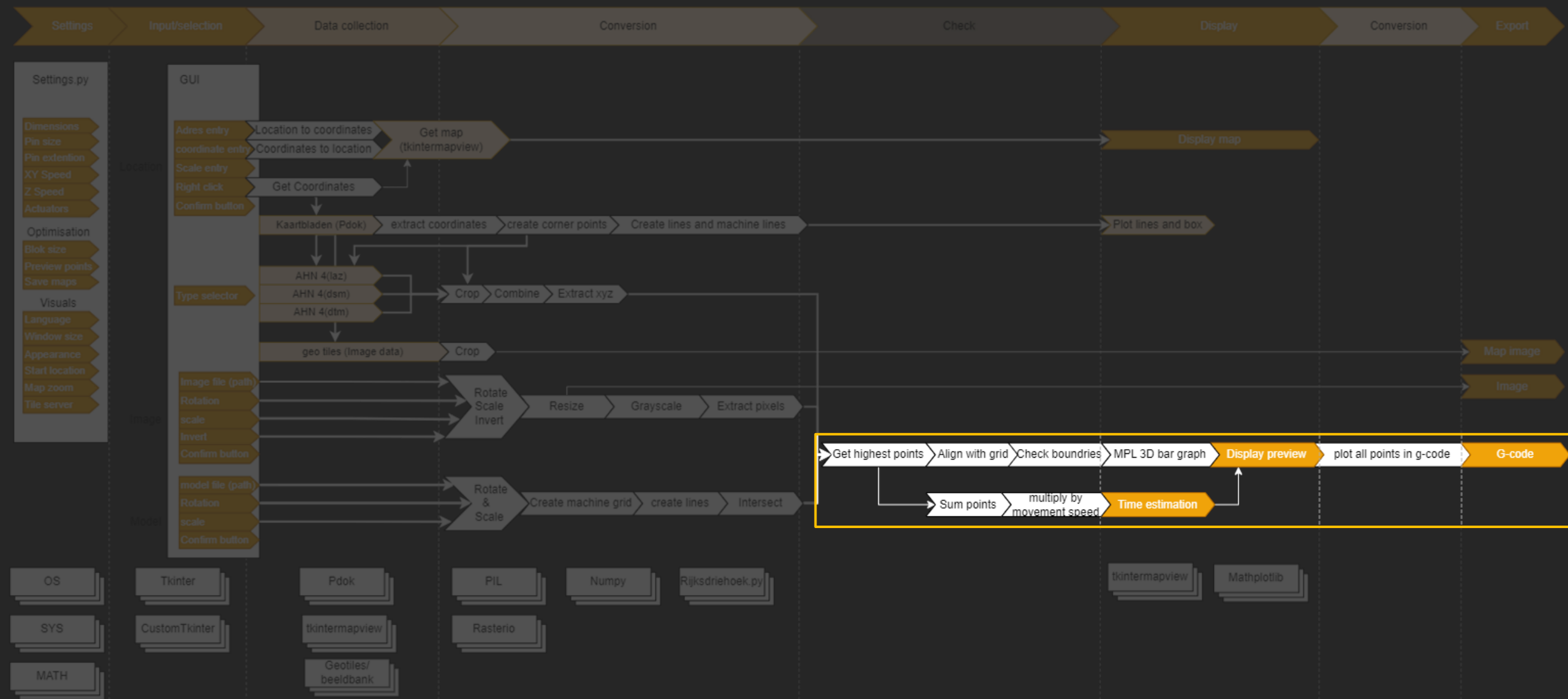
code



CODE CONVERT



GCODE



```
;Generated with Blockup generator V2.4.6 -- Development
;Estimated runtime: 0:01:06
;machine size: 140mm x 180mm
;pin size: 3.05mm
;pin extention length: 150mm
;pin rows: 45(x) 59(y)
;location: Markt 80 {2611 GW} Delft Zuid-Holland Nederland
;wgs coordinates: 52.01230748445793 4.3607772133952665
;used scale: 1:800
;used maps/files:
```

```
;(Reset machine)
G28 ;Home
G21 ;Metric
G90 ;absolute
```

```
;(model)
g0 x0.0 y3.05
M280 P3 S33.42175066312997
M280 P4 S33.42175066312997
M280 P5 S34.61538461538461
G4 P95
M280 P3 S0
M280 P4 S0
M280 P5 S0
G4 P95
g0 x0.0 y6.1
M280 P3 S32.22811671087533
M280 P4 S34.61538461538461
M280 P5 S34.61538461538461
G4 P95
M280 P3 S0
M280 P4 S0
M280 P5 S0
G4 P95
```

```
;(return)
G28 ;Home
;End of Gcode
```

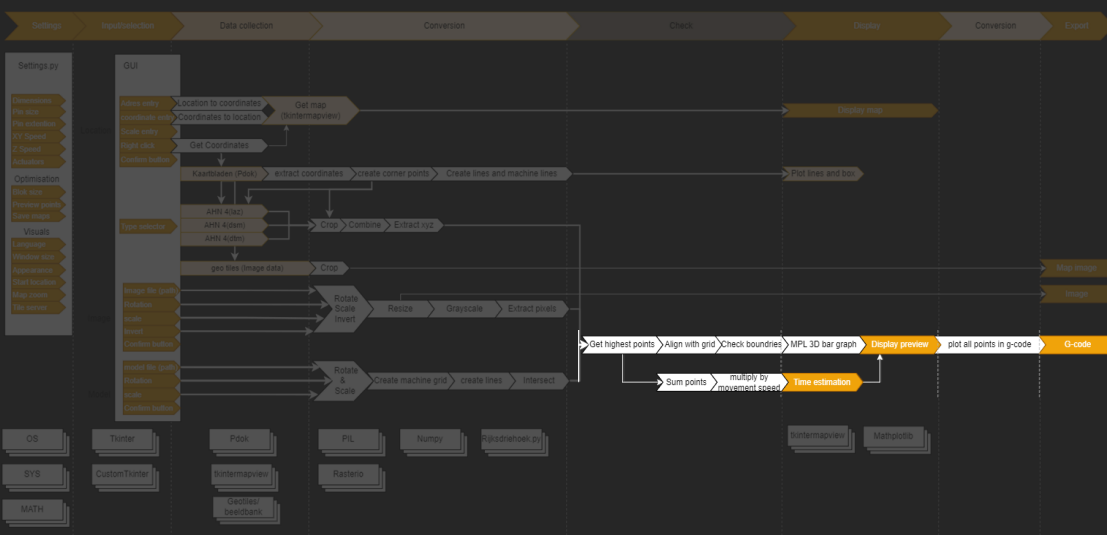
#general information used for debugging

#reset machine, make sure it always starts at the same point

#go to first location
#move servo 1
#move servo 2
#move servo 3
#time for servos to move
#reset servos

#time for servos to move back
#repeat

#move machine back to starting position



PIN MODEL

Machine Settings

Use to override settings

machine width (mm)

machine length (mm)

pin extension (mm)

pin size (mm)

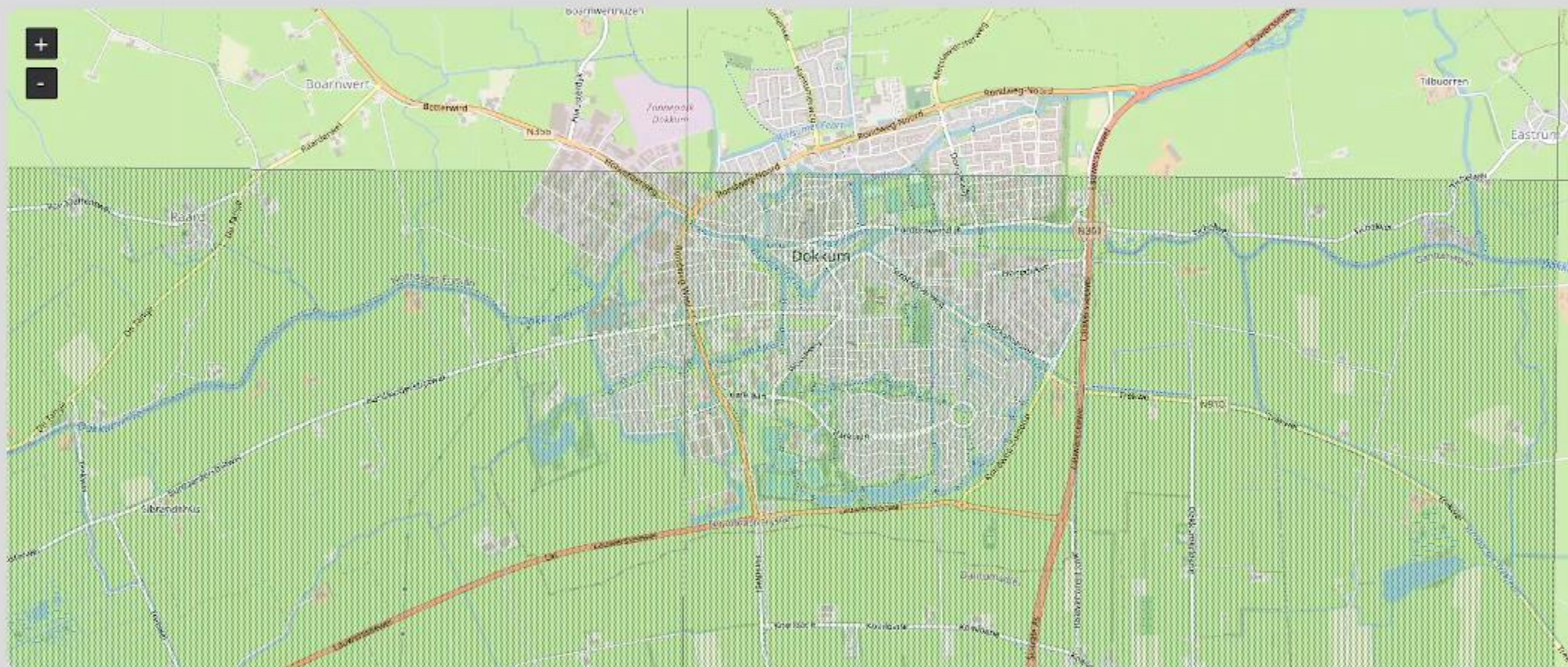
Appearance Mode:

system

Location Image Model Shade Preview

lat lon (53.3243515 5.9992306)

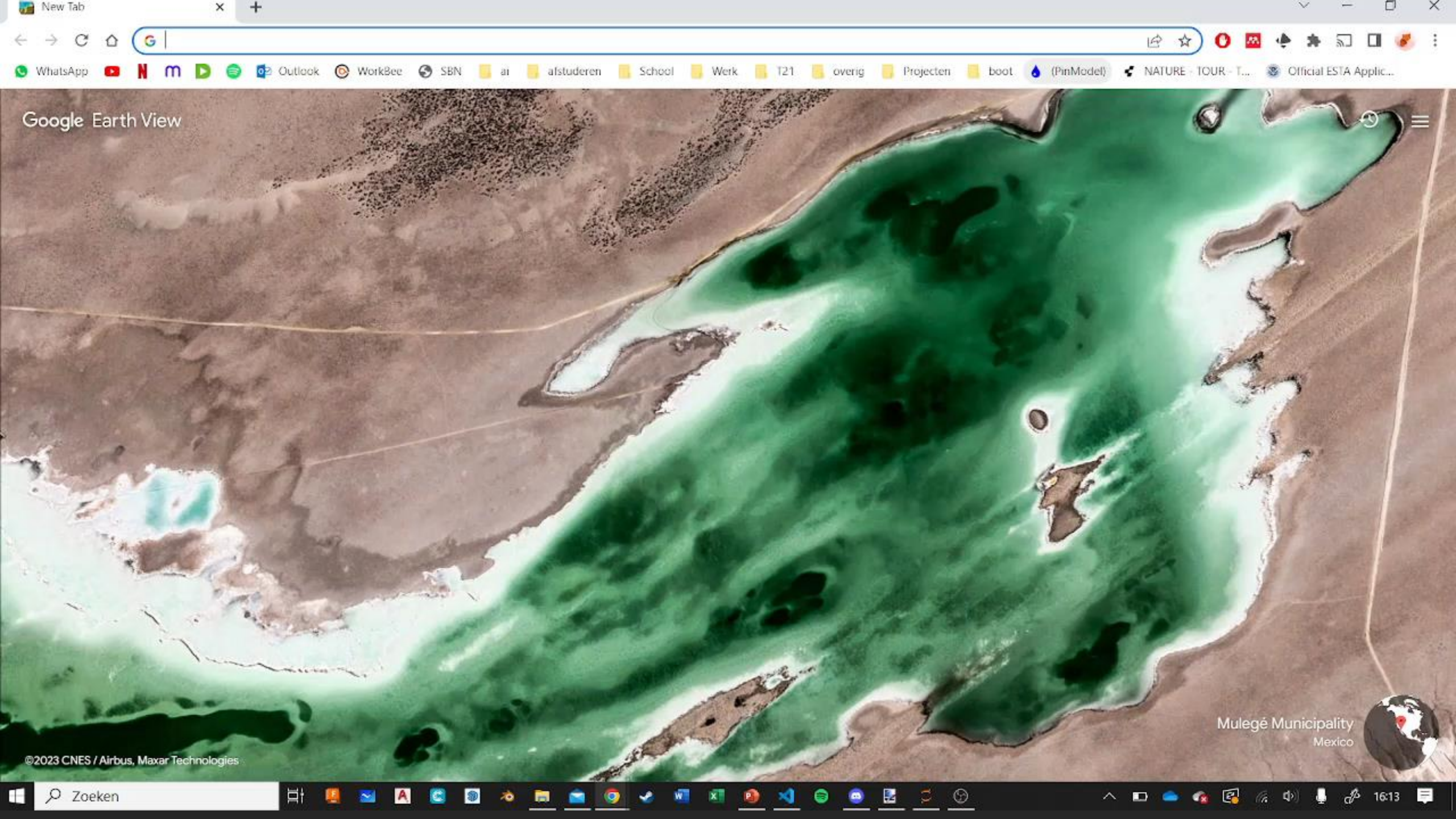
Scale e.g. 1:500



DSM (Surface model, Netherlands only)

Confirm location

select a location with right click, and input scale (tip: If possible don't cross too many gray lines, crossing the lines increase loading time)



Google Earth View

Mulegé Municipality
Mexico

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PIN MODEL

