

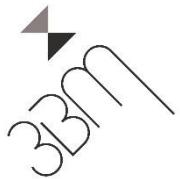
# GIS to BIM using Dynamo

Easily load aerialphotos, cadastral parcels, 3D models and 2D maps in Revit



## Maarten Vroegindeweij

*3BM / Domera*



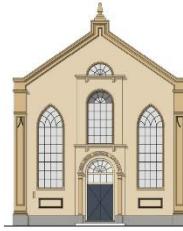
GR CENTRE

LJUBLJANA

11 – 13 OCT 2018

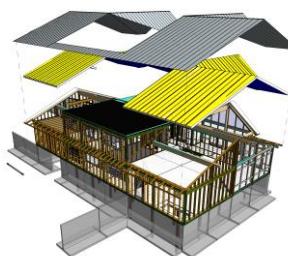
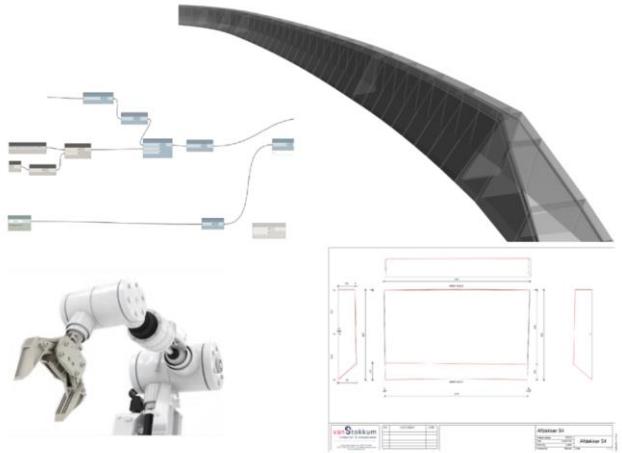
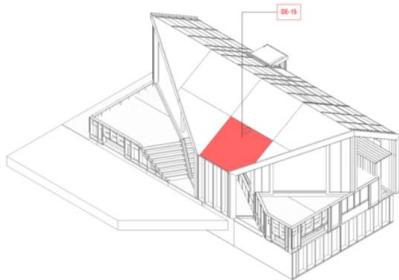
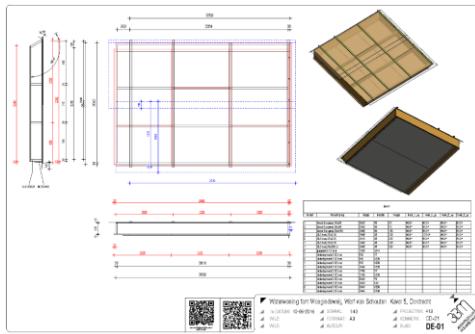
# About 3BM

- Consulting engineers since 2009
- [www.3bm.co.nl](http://www.3bm.co.nl)
- Structural-, Wood Framing, Façade and Prefab Engineering, Monuments



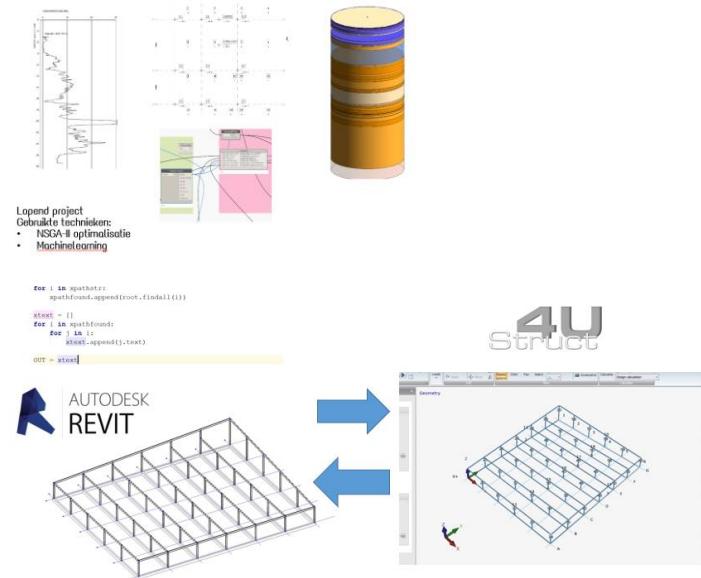
# About 3BM Labs

- Digital Fabrication/Drawing Automation
- Software Development
- Computation BIM
- Optimisation & Machinelearning
- Revit & Dynamo Consultancy



# Some Projects of 3BM Labs

- Wood Framing Robotics
- Foundation Pile Designer
- DYN2Calc
- GIS2BIM Package

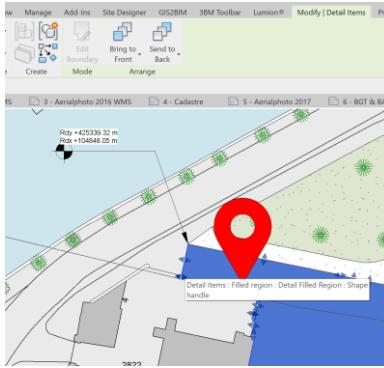


# Contents of this presentation

## Examples

1. Introduction to GIS
2. GIS & BIM
3. Geocoding
4. Coordinates
5. Rasterdata WMS/WMTS
6. VectordataWFS/
7. Direct Download
8. Geo Pointclouds
9. Revit Coordinates
10. Practical examples
11. GIS=Data, where to find it?

# Examples



# INSPIRE Data

## Annex I

<b>Addresses</b> Def.: Location of properties based on address identifiers,... <a href="#">1</a>   <a href="#">2235</a>   <a href="#">29</a>   <a href="#">43</a>	<b>Administrative units</b> Def.: Units of administration, dividing areas where Member... <a href="#">1</a>   <a href="#">1715</a>   <a href="#">74</a>   <a href="#">148</a>	<b>Cadastral parcels</b> Def.: Areas defined by cadastral registers or equivalent. <a href="#">1</a>   <a href="#">12389</a>   <a href="#">46</a>   <a href="#">5</a>   <a href="#">18</a>	<b>Geographical grid systems</b> Def.: Harmonised multi... <a href="#">1</a>   <a href="#">163</a>   <a href="#">5</a>   <a href="#">18</a>	<b>Human health and safety</b> Def.: Geographical distribution of dominance of pathologie... <a href="#">1</a>   <a href="#">1216</a>   <a href="#">272</a>   <a href="#">325</a>	<b>Land use</b> Def.: Territory characterised according to its current and future planned functional... <a href="#">1</a>   <a href="#">67930</a>   <a href="#">5667</a>   <a href="#">6639</a>	<b>Meteorological geographical features</b> Def.: Weather conditions and their measurements... <a href="#">1</a>   <a href="#">421</a>   <a href="#">60</a>   <a href="#">69</a>	<b>Mineral resources</b> Def.: Mineral resources including metal ores, industrial minerals, ... <a href="#">1</a>   <a href="#">254</a>   <a href="#">25</a>   <a href="#">36</a>
<b>Geographical names</b> Def.: Names of areas, regions, localities, cities, suburbs,... <a href="#">1</a>   <a href="#">1585</a>   <a href="#">50</a>   <a href="#">57</a>	<b>Hydrography</b> Def.: Hydrographic elements, including marine areas and al... <a href="#">1</a>   <a href="#">2509</a>   <a href="#">168</a>   <a href="#">195</a>	<b>Protected sites</b> Def.: Area designated or managed within a framework... <a href="#">1</a>   <a href="#">2514</a>   <a href="#">282</a>   <a href="#">291</a>	<b>Coordinate reference systems</b> Def.: Systems for uniquely... <a href="#">1</a>   <a href="#">157</a>   <a href="#">2</a>   <a href="#">4</a>	<b>Natural risk zones</b> Def.: Vulnerable areas characterised according to natural hazards ... <a href="#">1</a>   <a href="#">5097</a>   <a href="#">363</a>   <a href="#">267</a>	<b>Oceanographic geographical features</b> Def.: Physical conditions of oceans (currents, salinity, ... <a href="#">1</a>   <a href="#">720</a>   <a href="#">3</a>   <a href="#">71</a>	<b>Population distribution - demography</b> Def.: Geographical distribution of people, including popul... <a href="#">1</a>   <a href="#">23</a>   <a href="#">1</a>   <a href="#">1</a>	<b>Production and industrial facilities</b> Def.: Industrial production sites, including installations... <a href="#">1</a>   <a href="#">704</a>   <a href="#">113</a>   <a href="#">82</a>
<b>Transport networks</b> Def.: Road, rail, air and water transport networks and rel... <a href="#">1</a>   <a href="#">3213</a>   <a href="#">117</a>   <a href="#">381</a>							

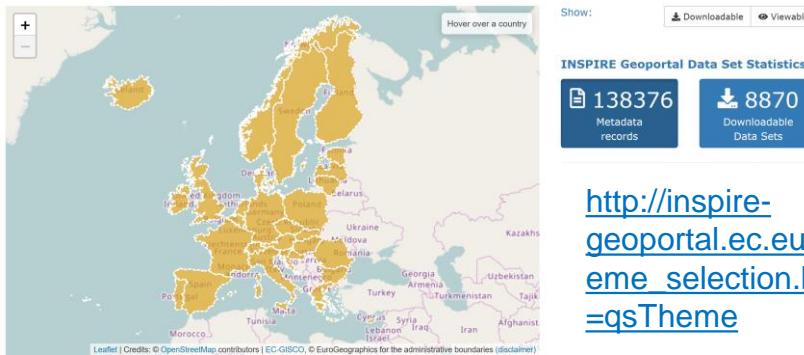
## Annex II

<b>Elevation</b> Def.: Digital elevation models for land, ice and ocean sur... <a href="#">1</a>   <a href="#">4538</a>   <a href="#">133</a>   <a href="#">239</a>	<b>Geology</b> Def.: Geology characterised according to composition... <a href="#">1</a>   <a href="#">2345</a>   <a href="#">126</a>   <a href="#">463</a>	<b>Land cover</b> Def.: Physical and biological cover of the earth's surface... <a href="#">1</a>   <a href="#">1999</a>   <a href="#">145</a>   <a href="#">136</a>	<b>Orthoimagery</b> Def.: Geo-referenced image data of the Earth's surface, fr... <a href="#">1</a>   <a href="#">2152</a>   <a href="#">95</a>   <a href="#">173</a>
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## Annex III

<b>Atmospheric conditions</b> Def.: Physical conditions in the atmosphere. Includes spatial data based on measurements, on models or ... <a href="#">1</a>   <a href="#">448</a>   <a href="#">18</a>   <a href="#">29</a>	<b>Agricultural and aquaculture facilities</b> Def.: Farming equipment and production facilities (including irrigation systems, ... <a href="#">1</a>   <a href="#">358</a>   <a href="#">25</a>   <a href="#">46</a>	<b>Area management / restriction / regulation zones and reporting units</b> Def.: Areas managed, regulated or used for reporting at in... <a href="#">1</a>   <a href="#">16193</a>   <a href="#">3735</a>   <a href="#">4165</a>	<b>Bio-geographical regions</b> Def.: Areas of relatively homogeneous ecological condition... <a href="#">1</a>   <a href="#">265</a>   <a href="#">22</a>   <a href="#">29</a>
<b>Buildings</b> Def.: Geographical location of buildings. <a href="#">1</a>   <a href="#">1377</a>   <a href="#">52</a>   <a href="#">96</a>	<b>Environmental monitoring facilities</b> Def.: Location and operation of environmental monitoring f... <a href="#">1</a>   <a href="#">1598</a>   <a href="#">280</a>   <a href="#">434</a>	<b>Energy resources</b> Def.: Energy resources including hydrocarbons, hydropower, bio-energy, ... <a href="#">1</a>   <a href="#">409</a>   <a href="#">88</a>   <a href="#">128</a>	<b>Habitats and biotopes</b> Def.: Geographical areas characterised by specific ecological conditions, ... <a href="#">1</a>   <a href="#">2014</a>   <a href="#">164</a>   <a href="#">388</a>

## INSPIRE Data Sets - EU & EFTA Country overview



[http://inspire-geoportal.ec.europa.eu/theme\\_selection.html?view=qsTheme](http://inspire-geoportal.ec.europa.eu/theme_selection.html?view=qsTheme)

# 1 GIS(Geographical Information System)

```
<?xml version="1.0" encoding="ISO-8859-1"?>
<wfs:FeatureCollection xmlns:wfs="http://www.opengis.net/wfs/2.0.0 http://service=WFS&version=2.0.0&request=DescribeFeatureType&typeName=cbag%3A
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:bag="http://bu
<wfs:member>
  - <bag:pand gml:id="pand.318800">
    <bag:identificatie>643100002037963</bag:identificatie>
    <bag:bouwjaar>1965</bag:bouwjaar>
    <bag:gebruiksdool>Woonfunctie</bag:gebruiksdool>
    <bag:oppervlakte_min>80</bag:oppervlakte_min>
    <bag:oppervlakte_max>175</bag:oppervlakte_max>
    <bag:aantal_verblifsoobjecten>4</bag:aantal_verblifsoobjecten>
    <bag:geometrie>
      - <gml:MultiSurface srDimension="3" srsName="urn:ogc:def:crs:EPSG::2
        <gml:surfaceMember>
          <gml:Polygon>
            <gml:exterior>
              <gml:LinearRing>
                <gml:posList>106496.561 434466.171 0 106500.4
                  106505.9 434472.5 0 106500.9 434472.9 0 10
                  106505.9 434472.5 0 106500.9 434472.9 0 10
                </gml:LinearRing>
              </gml:exterior>
            </gml:Polygon>
          </gml:surfaceMember>
        </gml:MultiSurface>
      </bag:geometrie>
    </bag:pand>
```

Data



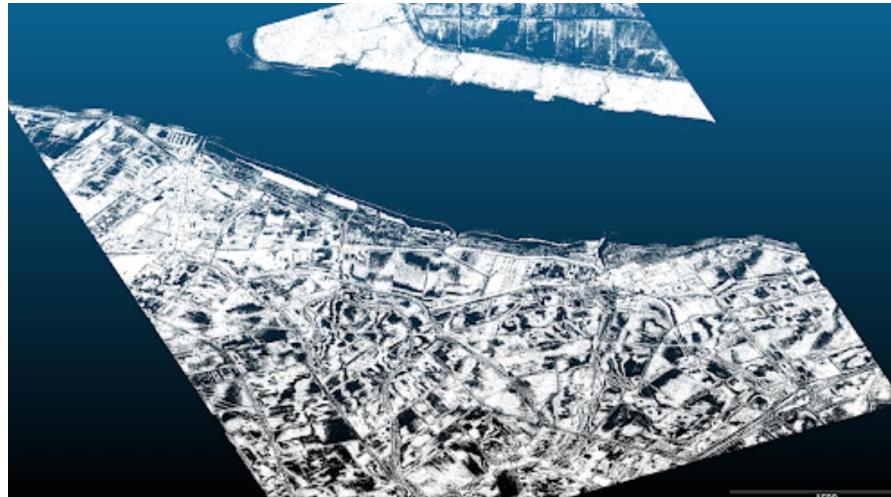
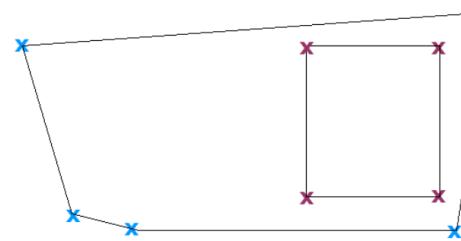
Software



Hardware

# 1.1 GIS data types

- Geographical Vector
- Geographical Raster
- Non geographical data
- Lidar, pointcloud
- Sensordata

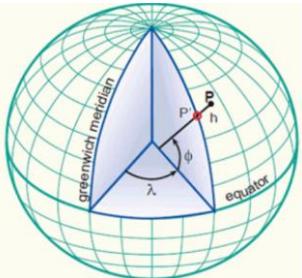


# 1.2 GIS wor(l)ds



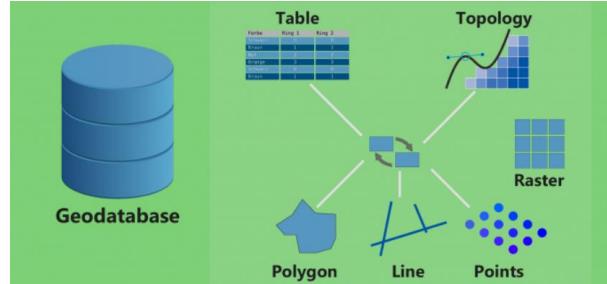
```
<?xml version="1.0" encoding="ISO-8859-1"?>
<wfs:FeatureCollection xsi:schemaLocation="http://www.opengis.net/wfs/2.0 http://
service=WFS&version=2.0.0&request=DescribeFeatureType&typeName=bag%3A
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:bag="http://bu
<wfs:member>
  <bag:pand gml:id="pand.318800">
    <bag:identificatie>443400002037963</bag:identificatie>
    <bag:omschrijving>1920 m² landbouwgrond</bag:omschrijving>
    <bag:status>Pand in gebruik</bag:status>
    <bag:gebruikdoel>winkeelfunctie, woonfunctie</bag:gebruikdoel>
    <bag:oppervlakte>min=80 | bag:oppervlakte_min=80</bag:oppervlakte>
    <bag:oppervlakte>max=175 | bag:oppervlakte_max=175</bag:oppervlakte>
    <bag:aantal_verblifsojecten>4</bag:aantal_verblifsojecten>
    <bag:geometrie>
      <gml:MultiSurface srsDimension="3" srsName="urn:ogc:def:crs:EPSG::2
        <gml:surfaceMember>
          <gml:Polygon>
            <gml:exterior>
              <gml:LinearRing>
                <gml:point><gml:pointId>106496.561 434466.171 0 106500.4
106505.9 434472.5 0 106500.9 434472.9 0 10
                </gml:LinearRing>
              </gml:exterior>
            </gml:Polygon>
          </gml:surfaceMember>
        </gml:MultiSurface>
      </bag:geometrie>
    </bag:pand>
```

Maps



Coordinate Reference Systems

Webservers



Geo Databases

EPSG  
WGS84  
Foss4G  
interpolation  
Ogc  
irregularized  
Grass  
Spatial  
Shapefile  
Inspire  
Qgis  
Autodesk  
GDAL  
Mercator  
Triangular  
Esri  
PostGIS  
Infraworks  
Ogr2ogr  
CRS

# 1.3 some workflows



Autodesk Desktop Connector  
(Link Topography)



## 2.1 The two planets

- GIS: Geographic Information System
- BIM: Building Information Model/CAD



GIS	BIM
User defined structure	More and more standardized
Server based	File based
File & webservices	File based exchange
Large numbers of users	Small number of users
Data driven	Geometry&Data driven

## 2.2 Progress in integration

GIS

### BIM vs. GIS

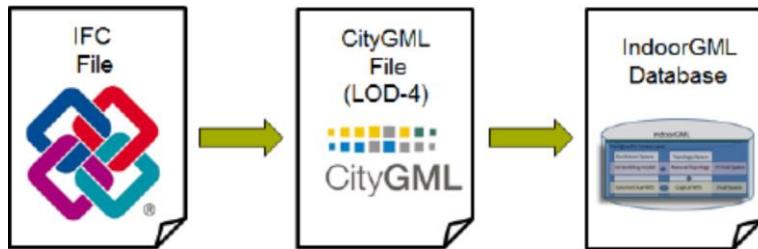
4 Apr, 2012

By: [Heather Livingston](#)

Tech Trends: When it comes to building information modeling, which technology provides the best solution?

COLLABORATION • PERFORMANCE • TECHNOLOGY | DECEMBER 6-10, 2010 | WASHINGTON, D.C.

### Introduction to BIM – GIS Integration



# 3 Webservices

1. Geocoding
2. WMS: Web Map Service(Raster)
3. WMTS/TMS: Web Map Tile Service(Raster)
4. WFS: Web Feature Service(Vector)
5. Download (Raster&Vector)
6. ARCGIS REST API Raster/Vector data via ArcGIS API
7. Website interface

# 3.1 Geocoding



## Request&Response

[https://maps.googleapis.com/maps/api/geocode/xml?](https://maps.googleapis.com/maps/api/geocode/xml?address=Dunajska%20cesta+18+Ljubljana+Slovenia&key=...)

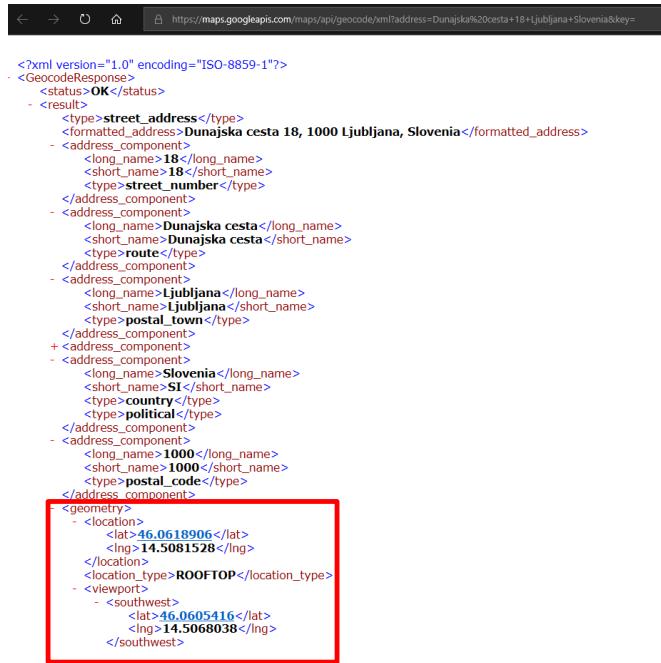
address=Dunajska%20cesta

+18

+Ljubljana

+Slovenia

&key=



The screenshot shows a browser window with the URL <https://maps.googleapis.com/maps/api/geocode/xml?address=Dunajska%20cesta+18+Ljubljana+Slovenia&key=...>. The page displays an XML document representing the geocoding response. The XML structure includes a `<status>OK</status>`, a `<result>` block containing address components (street address, route, town, country, postal code), and a `<geometry>` block with location coordinates (lat: 46.0618906, lon: 14.5081528) and a viewport (southwest corner at lat: 46.0605416, lon: 14.5068038).

```
<?xml version="1.0" encoding="ISO-8859-1"?>
<GeocodeResponse>
  <status>OK</status>
  <result>
    <street_address>Dunajska cesta 18, 1000 Ljubljana, Slovenia</street_address>
    <formatted_address>Dunajska cesta 18, 1000 Ljubljana, Slovenia</formatted_address>
    <address_component>
      <long_name>18</long_name>
      <short_name>18</short_name>
      <type>street_number</type>
    </address_component>
    <address_component>
      <long_name>Dunajska cesta</long_name>
      <short_name>Dunajska cesta</short_name>
      <type>route</type>
    </address_component>
    <address_component>
      <long_name>Ljubljana</long_name>
      <short_name>Ljubljana</short_name>
      <type>postal_town</type>
    </address_component>
    <address_component>
      <long_name>Slovenia</long_name>
      <short_name>SI</short_name>
      <type>country</type>
      <type>political</type>
    </address_component>
    <address_component>
      <long_name>1000</long_name>
      <short_name>1000</short_name>
      <type>postal_code</type>
    </address_component>
  </result>
  <geometry>
    <location>
      <lat>46.0618906</lat>
      <lng>14.5081528</lng>
    </location>
    <location_type>ROOFTOP</location_type>
    <viewport>
      <southwest>
        <lat>46.0605416</lat>
        <lng>14.5068038</lng>
      </southwest>
    </viewport>
  </geometry>
</GeocodeResponse>
```

# 3.2 Geocoding



## Request&Response

<https://nominatim.openstreetmap.org/search/>

Dunajska%20cesta

%20

18

%20

Ljubljana

%20

Slovenia

?format=xml

&addressdetails=1

&limit=1

&polygon\_svg=1

```
<?xml version="1.0" encoding="ISO-8859-1"?>
<searchresults more_url="https://nominatim.openstreetmap.org/search.php?query=Dunajska+cesta+18+Ljubljana+Slovenia&addressdetails=1&polygon_svg=1&exclude_place_ids=48974321&format=xml&accept-language=en-NL" exclude_place_ids="48974321" point_of_interest_query="Dunajska cesta 18 Ljubljana Slovenia" attribution="Data © OpenStreetMap contributors, ODbL 1.0. http://www.openstreetmap.org/copyright" timestamp="2015-08-15T20:05:39+0000">
  <place class="place" importance="0.531" type="house" display_name="18, Dunajska cesta, Župančičeva Jama, Bežigrad, Ljubljana, Obračna Enota Ljubljana, OsrednjeSlovenska, 1000, Slovenia" lon="14.508124" lat="46.0618854" geosvg="cx="14.508124" cy="-46.061885400000001" boundingbox="46.0618354,46.0619354,14.508074,14.508174" place_rank="30">
    <osm_id>3788670827</osm_id>
    <osm_type>node</osm_type>
    <place_id>48974321</place_id>
    <house_number>18</house_number>
    <neighbourhood>Župančičeva Jama</neighbourhood>
    <suburb>Bežigrad</suburb>
    <city>Ljubljana</city>
    <county>Obračna Enota Ljubljana</county>
    <state_district>OsrednjeSlovenska</state_district>
    <postcode>1000</postcode>
    <country>Slovenia</country>
    <country_code>SI</country_code>
  </place>
</searchresults>
```

# 3.3 Geocoding



## Request&Response

<http://geodata.nationaalgeoregister.nl/locatieserver/v3/>

free?

wt=json

&rows=1

&q=

dordrecht%20

and%20

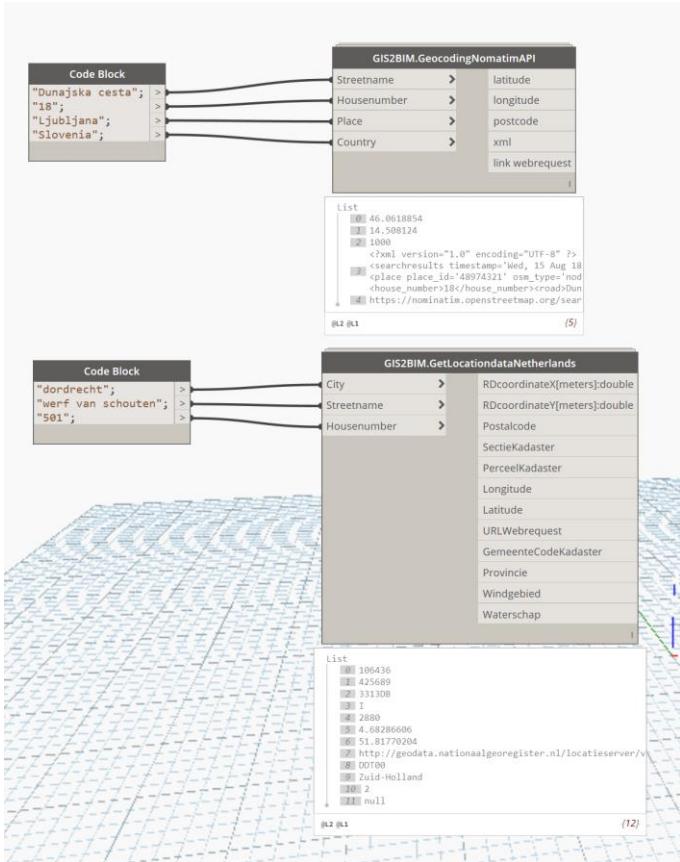
werf%20van%20schouten

%20and%20

501

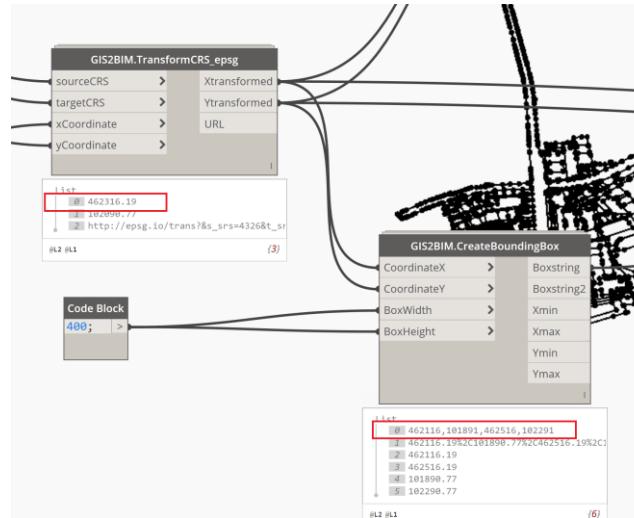
```
→ ○ ⓘ geodata.nationaalgeoregister.nl/locatieserver/v3/?q=dordrecht%20van%20schouten%20501
{
  "response": {"numFound": 1, "start": 0, "maxScore": 58.86275, "docs": [
    {
      "bron": "BAG",
      "woonplaatscode": "2351",
      "type": "adres",
      "woonplaatsnaam": "Dordrecht",
      "wijkcode": "WK050502",
      "huis_nlt": "501",
      "openbareruimtetype": "Weg",
      "buurtnaam": "Stadsdewerven",
      "gemeentecode": "0505",
      "weergavenaam": "Werf van Schouten 501, 3313DB Dordrecht",
      "straatnaam_verkort": "Werf van Schouten",
      "id": "adr-e1c48cf69f7858ce0aa7b7267d915c88",
      "gekoppeld_perceel": ["DDT00-I-2880"],
      "gemeentenaam": "Dordrecht",
      "buurtcode": "BU05050201",
      "wijknaam": "Wijk 02 Noordflank",
      "identificatie": "0505010000093914-050520000093927",
      "openbareruimte_id": "050530000086605",
      "provinciecode": "PV28",
      "postcode": "3313DB",
      "provincienaam": "Zuid-Holland",
      "centroide_ll": "POINT(4.68286606 51.81770204)",
      "nummereraanduiding_id": "050520000093927",
      "adresreebaarobject_id": "0505010000093914",
      "huisnummer": "501",
      "provincieafkorting": "ZH",
      "centroide_rd": "POINT(106435.788 425688.985)",
      "straatnaam": "Werf van Schouten",
      "score": 58.86275
    }
  ]
}
```

# 3.4 Dynamo

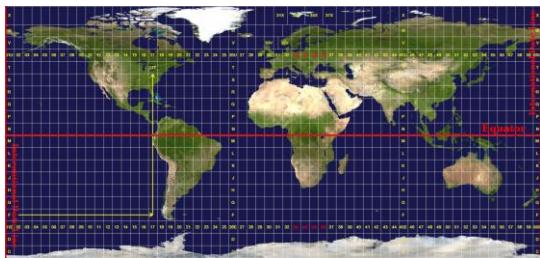
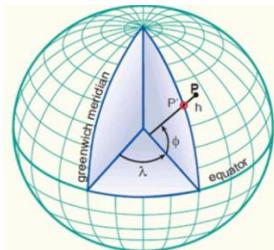
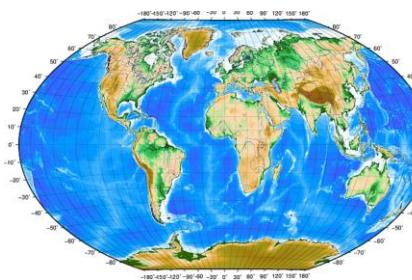


# 3.5 Application

- Coordinate for boundingbox for webrequests
- Windload



# 4.1 Coordinate Reference Systems(CRS)



- Geographical CRS
  - Sphere
  - Latitude, Longitude
- Projected
  - Flat Plane
  - X, Y
- Mercator
  - Global Map Projection

## 4.2 Coordinate Reference Systems(CRS)

- >13000
- Extreme useful
- WGS-84(lat lon) EPSG:4326
- Slovenia: **EPSG:3911**



Boznia and Herzegovina; Croatia  
code 3962

Accuracy 5.0 m (default)  
3 parameters

Covered area

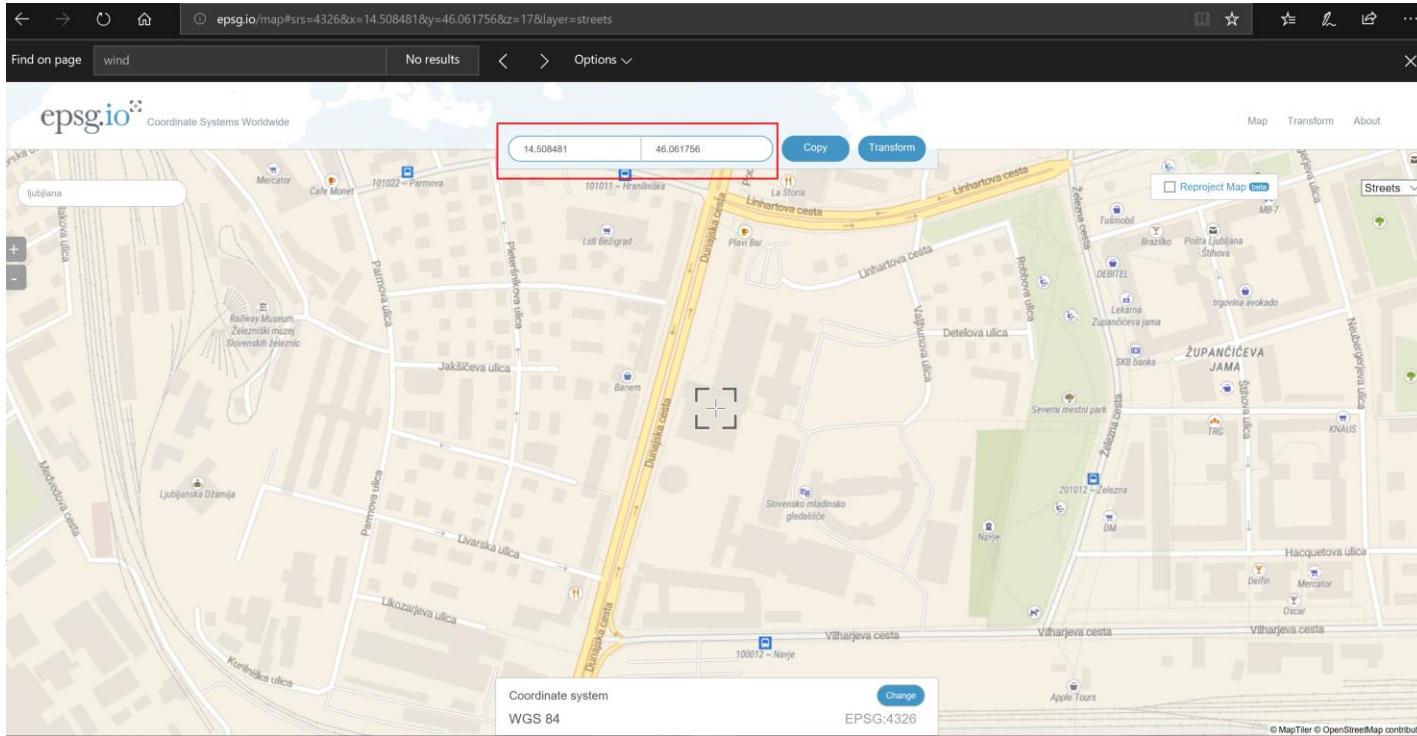


Center coordinates  
758399.73 4862864.41

Projected bounds:  
363774.72 4524239.54  
1113039.95 5224384.21

WGS84 bounds:  
13.38 40.85  
23.04 46.88

# 4.4 Current Location WGS 84



# 4.5 Current Location EPSG 3912

## Transform coordinates

Online convertor for lat & long coordinates, geodetic datums and projected systems

### Input coordinate system

EPSG:4326 WGS 84

[Change](#)

### Input coordinates

Longitude: 14°30'30.532"

Format: D°M'S"

Latitude: 46°3'42.322"

[Transform](#)

[Swap ↘](#)

### Show position on a map

Unit: degree (supplier to define representation)

Area of use: World.

Accuracy: Unknown

[More details](#)

### Output coordinate system

EPSG:3912 MGI 1901 / Slovene National Grid

[Change](#)

### Output coordinates

X: 462343.73

Y: 102076.23

### Show position on a map

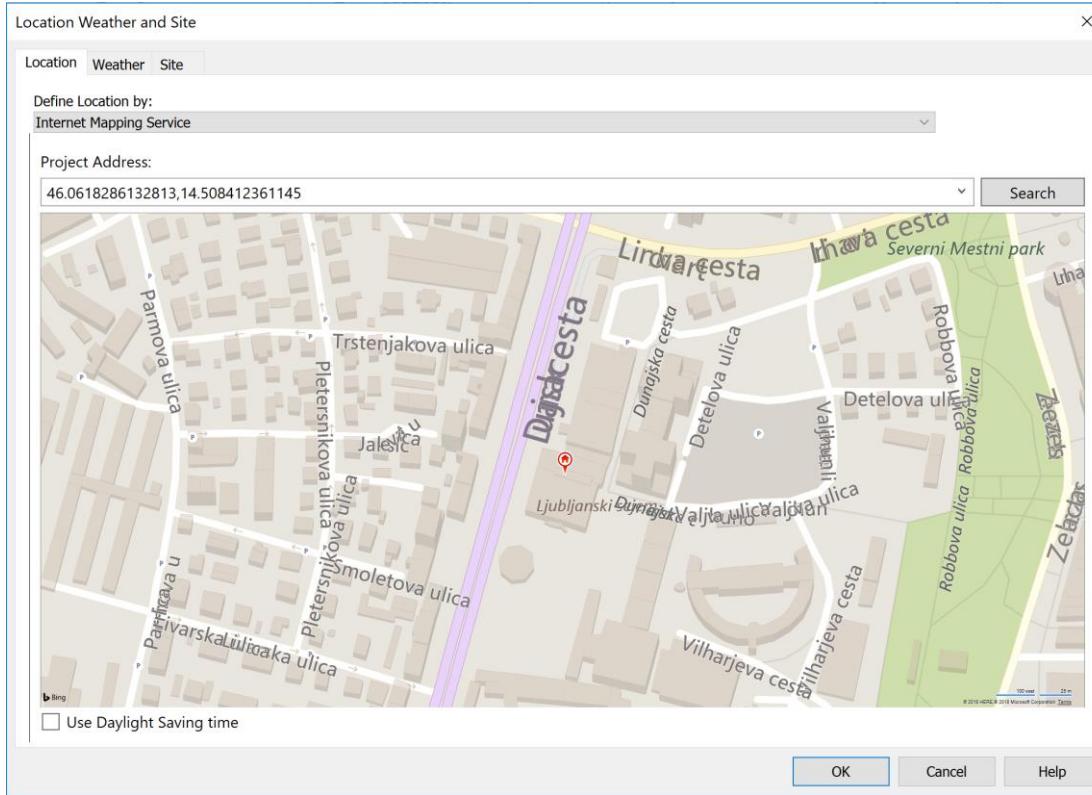
Unit: metre

Area of use: Slovenia - onshore and offshore.

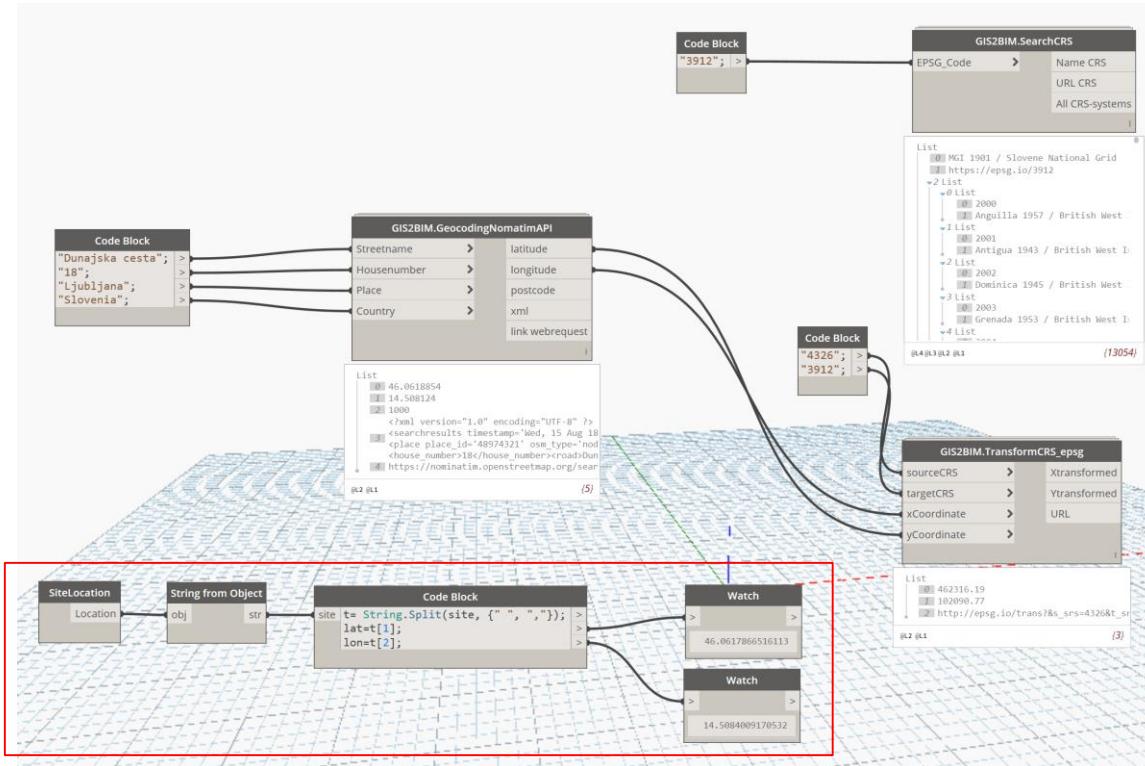
Accuracy: 5 m

[More details](#)

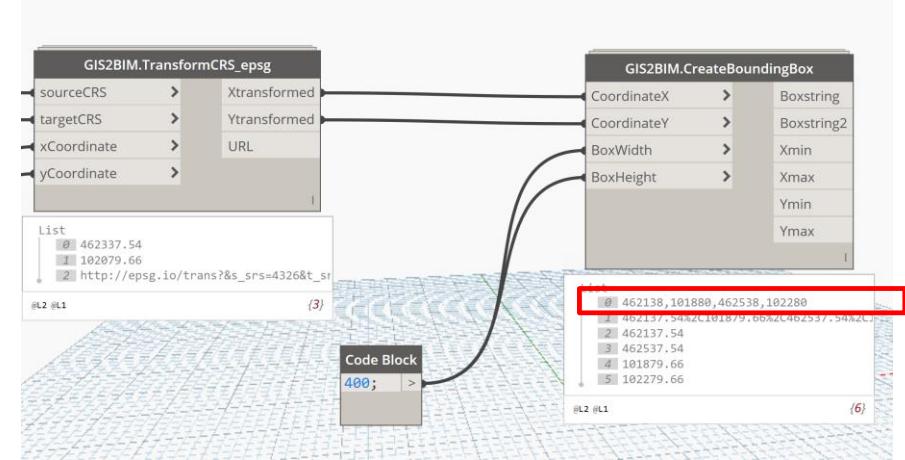
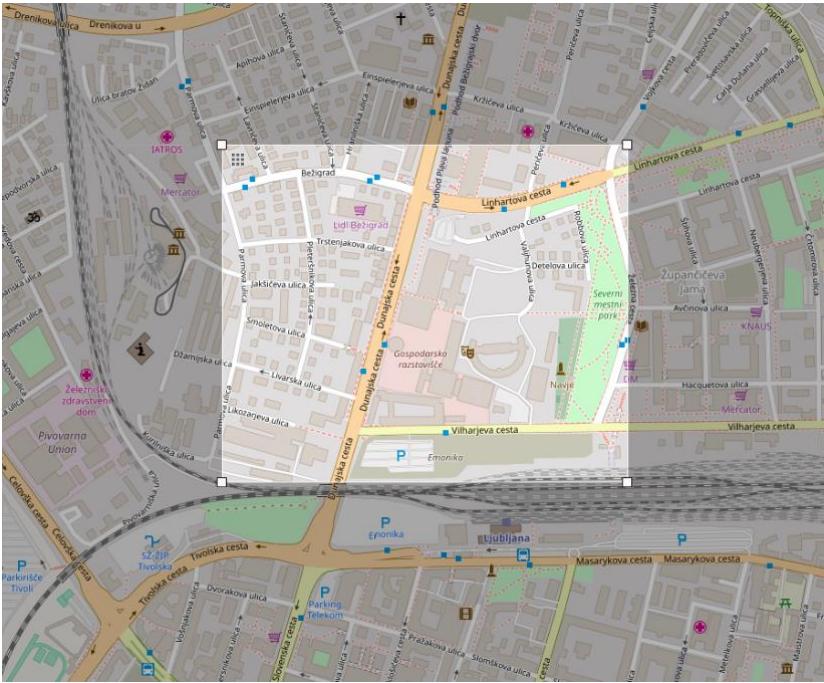
# 4.6 Revit Site Location



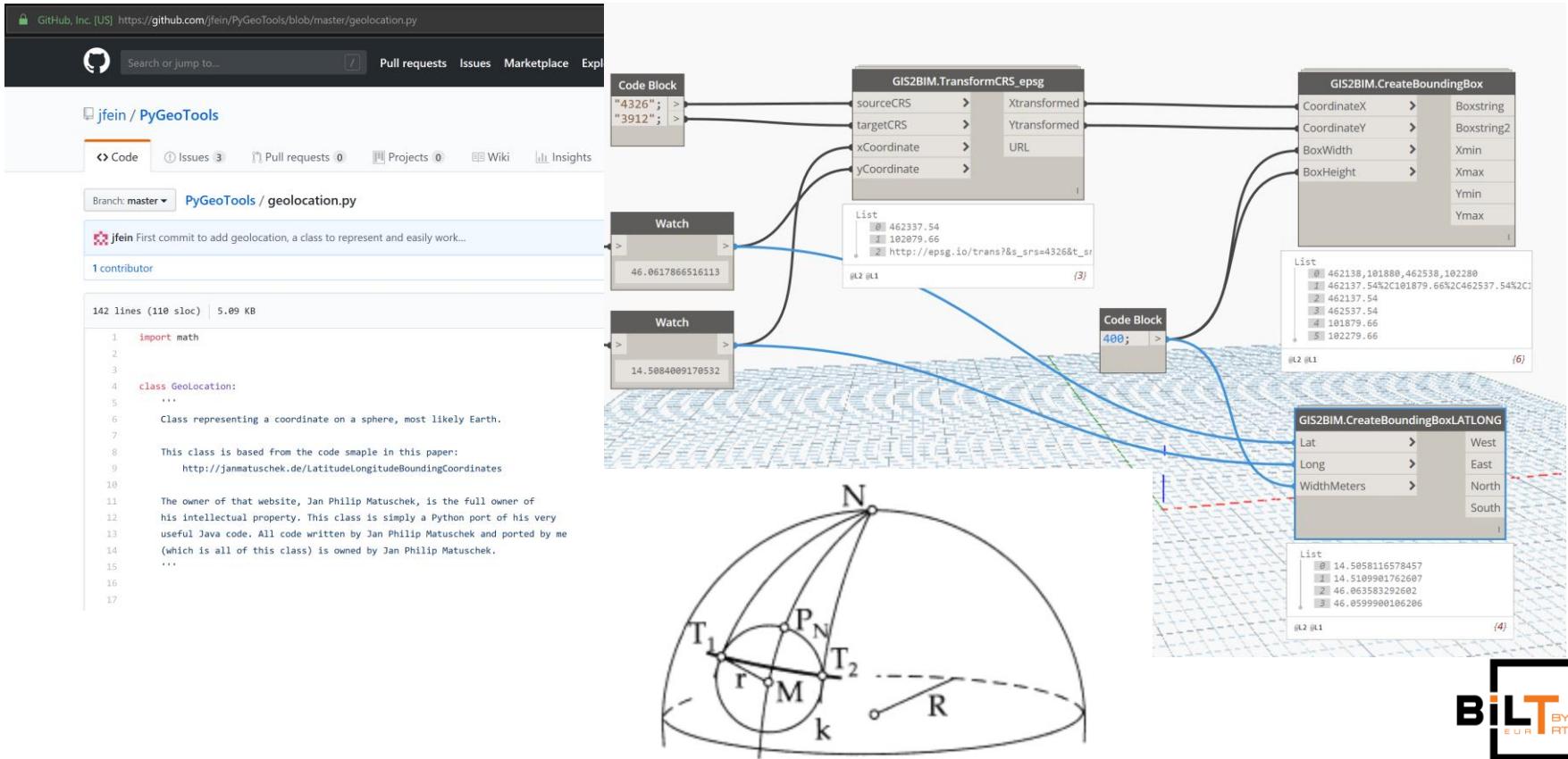
# 4.7 Dynamo: Get/Transform



# 4.8 Boundingbox



# 4.9 Boundingbox WGS-84



# 5 Web Map Service(RASTER)

## Request&Response

[https://prostor4.gov.si/  
ows2-elf-m/elf\\_cp/ows?service=wms  
&request=GetCapabilities](https://prostor4.gov.si/ows2-elf-m/elf_cp/ows?service=wms&request=GetCapabilities)

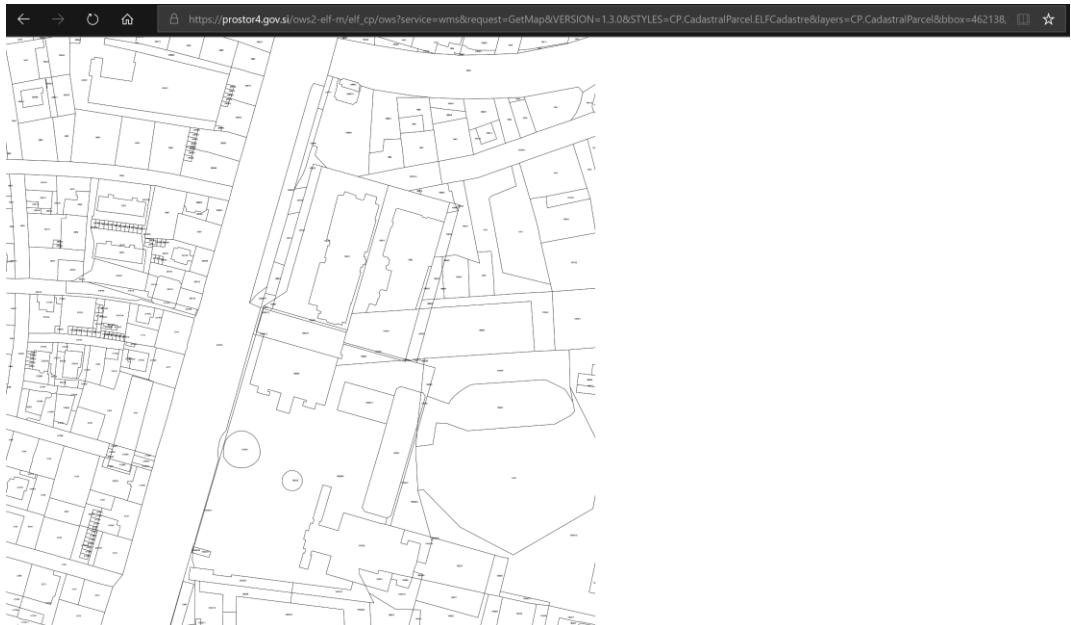
### Important:

- Format
- Layer, title
- CRS
- Layer Name

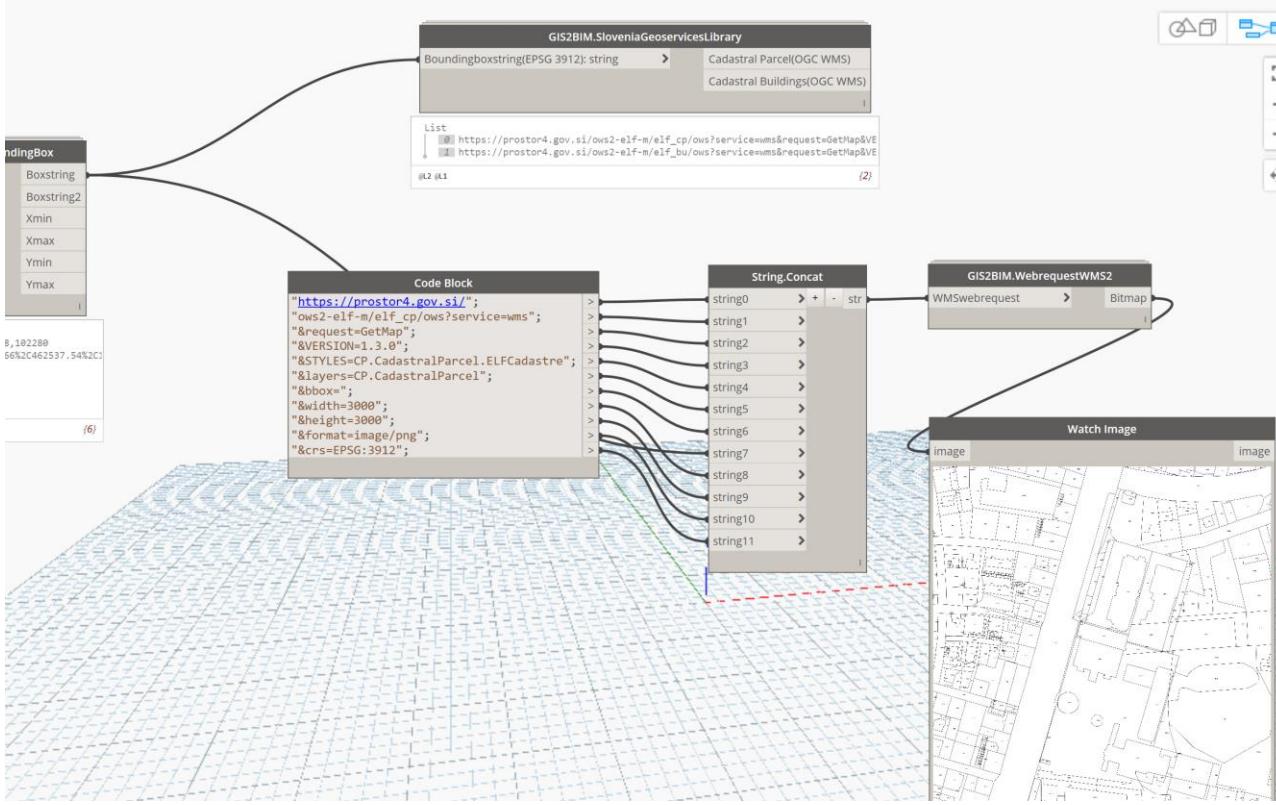
# 5.1 Web Map Service(WMS)

## Request&Response

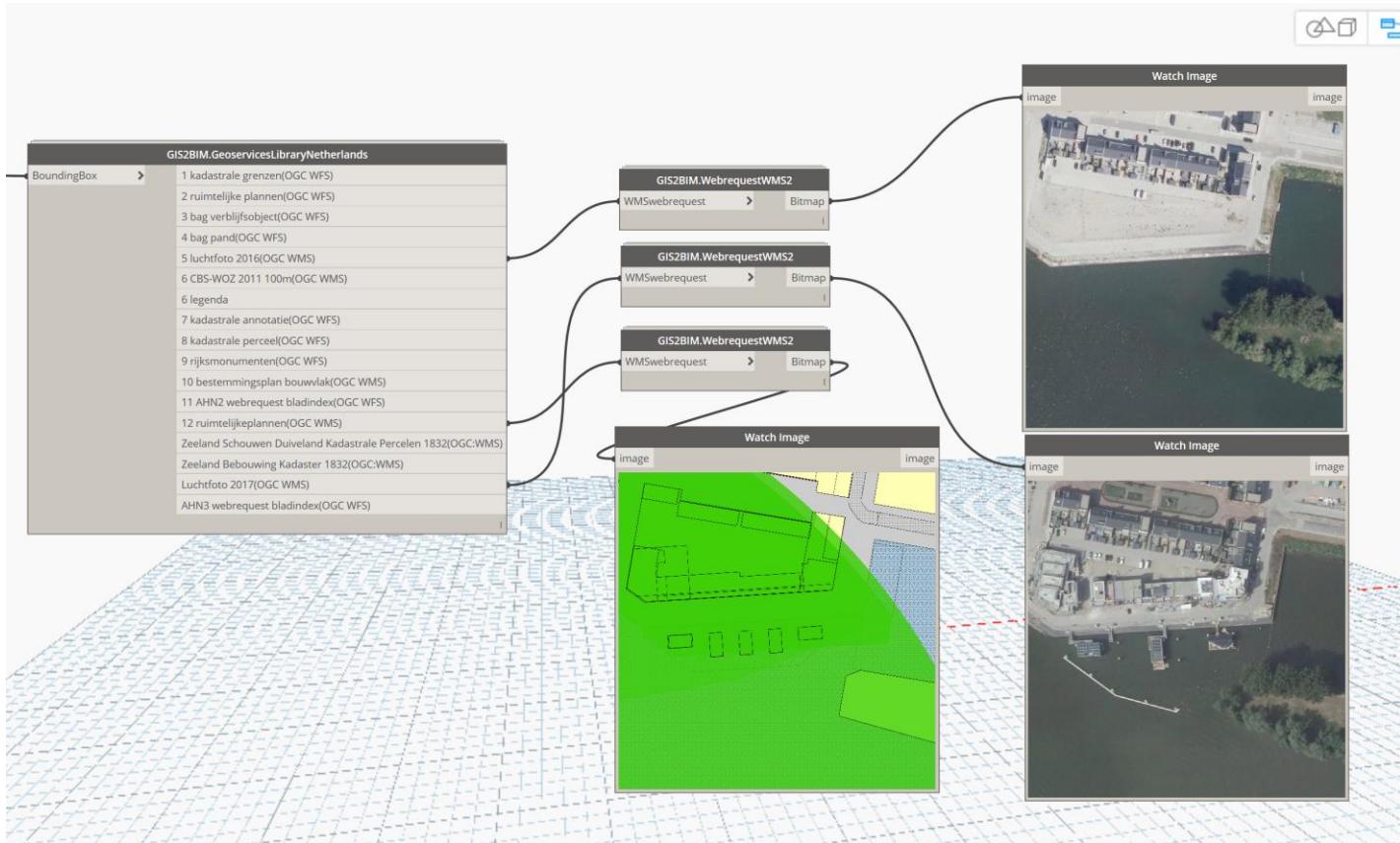
```
https://prostor4.gov.si/  
ows2-elf-m/elf_cp/ows?service=wms  
&request=GetMap  
&VERSION=1.3.0  
&STYLES=CP.CadastralParcel.ELFCadastre  
&layers=CP.CadastralParcel  
&bbox= 462116,101891,462516,102291  
&width=3000  
&height=3000  
&format=image/png  
&crs=EPSG:3912
```



# 5.2 WMS in Dynamo



# 5.3 Other WMS(raster) data



# 5.4 WMTS(Web Map Tile Service)

[www.maptiler.org/google-maps-coordinates-tile-bounds-projection/](http://www.maptiler.org/google-maps-coordinates-tile-bounds-projection/)

[Maptiler](#)

**Tiles à la Google Maps: Coordinates, Tile Bounds and Projection**

Click on a tile to display the numerical boundaries...

Kaart    Satelliet    Search Box

Google: (141634,93195)  
TMS: (141634,168948)  
QuadTree: 120230320101002032  
Zoom 18

Google: (141635,93195)  
TMS: (141635,168947)  
QuadTree: 120230320101002115  
Zoom 18

Google: (141636,93195)  
TMS: (141636,168946)  
QuadTree: 120230320101002122  
Zoom 18

Google: (141637,93195)  
TMS: (141637,168945)  
QuadTree: 120230320101002129  
Zoom 18

Google: (141638,93195)  
TMS: (141638,168944)  
QuadTree: 120230320101002132  
Zoom 18

Google: (141639,93195)  
TMS: (141639,168943)  
QuadTree: 120230320101002139  
Zoom 18

Google: (141640,93195)  
TMS: (141640,168942)  
QuadTree: 120230320101002146  
Zoom 18

Google: (141641,93195)  
TMS: (141641,168941)  
QuadTree: 120230320101002153  
Zoom 18

Google: (141642,93195)  
TMS: (141642,168940)  
QuadTree: 120230320101002160  
Zoom 18

Google: (141643,93195)  
TMS: (141643,168939)  
QuadTree: 120230320101002167  
Zoom 18

Google: (141644,93195)  
TMS: (141644,168938)  
QuadTree: 120230320101002174  
Zoom 18

Google: (141645,93195)  
TMS: (141645,168937)  
QuadTree: 120230320101002181  
Zoom 18

Google: (141646,93195)  
TMS: (141646,168936)  
QuadTree: 120230320101002188  
Zoom 18

Google: (141647,93195)  
TMS: (141647,168947)  
QuadTree: 120230320101002195  
Zoom 18

Google: (141648,93195)  
TMS: (141648,168946)  
QuadTree: 120230320101002202  
Zoom 18

Google: (141649,93195)  
TMS: (141649,168945)  
QuadTree: 120230320101002209  
Zoom 18

Google: (141650,93195)  
TMS: (141650,168944)  
QuadTree: 120230320101002216  
Zoom 18

Want to create custom map tiles from an image or geodata?

MapTiler application can generate map tiles from JPEG, TIFF and PNG images, from scanned maps, created in Photoshop or programmatically. It is easy to assign location to the map (see video). GeoData with embedded location and standard GIS formats such as GeoTIFF, ECW, MrSID are fully supported. Maps are usable on the web, in mobile devices or desktop GIS.

[Read more or directly download the app](#)

 MapTiler  
Fast maps for the web and mobile.

# 5.5 WMTS/TMS Calculate

Choose zoomlevel

Find your tilenumbers from coördinates

```
scratch.py x
1 def LatLonToMeters(self, lat, lon):
2     """Converts given lat/lng in WGS84 Datum to XY in Spherical Mercator EPSG:900913"""
3
4     mx = lon * self.originShift / 180.0
5     my = math.log(math.tan((90 + lat) * math.pi / 360.0)) / (math.pi / 180.0)
6
7     my = my * self.originShift / 180.0
8     return mx, my
9
10 def MetersToTile(self, mx, my, zoom):
11     """Returns tile for given mercator coordinates"""
12
13     px, py = self.MetersToPixels(mx, my, zoom)
14     return self.PixelsToTile(px, py)
15
16 def TileBounds(self, tx, ty, zoom):
17     """Returns bounds of the given tile in EPSG:900913 coordinates"""
18
19     minx, miny = self.PixelsToMeters(tx * self.tileSize, ty * self.tileSize, zoom)
20     maxx, maxy = self.PixelsToMeters((tx + 1) * self.tileSize, (ty + 1) * self.tileSize, zoom)
21     return [minx, miny, maxx, maxy]
```

# 5.6 WMTS/TMS in Dynamo

Use dynamo to download

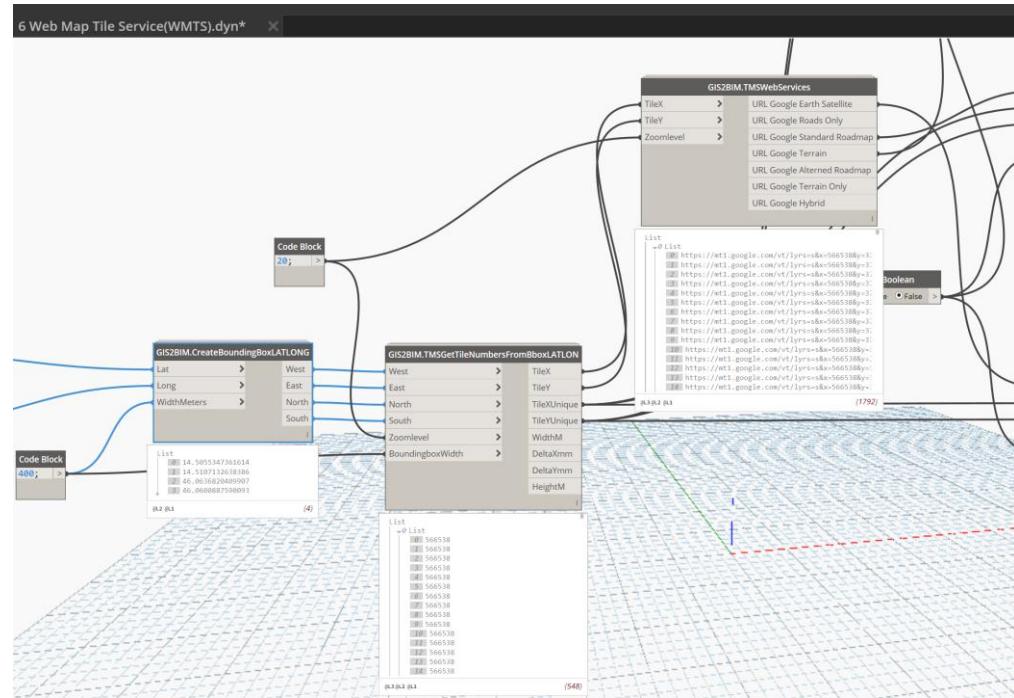
Google is used as example

<https://mt1.google.com/vt/lyrs=s&x=566538&y=372790&z=20>

&x=566538

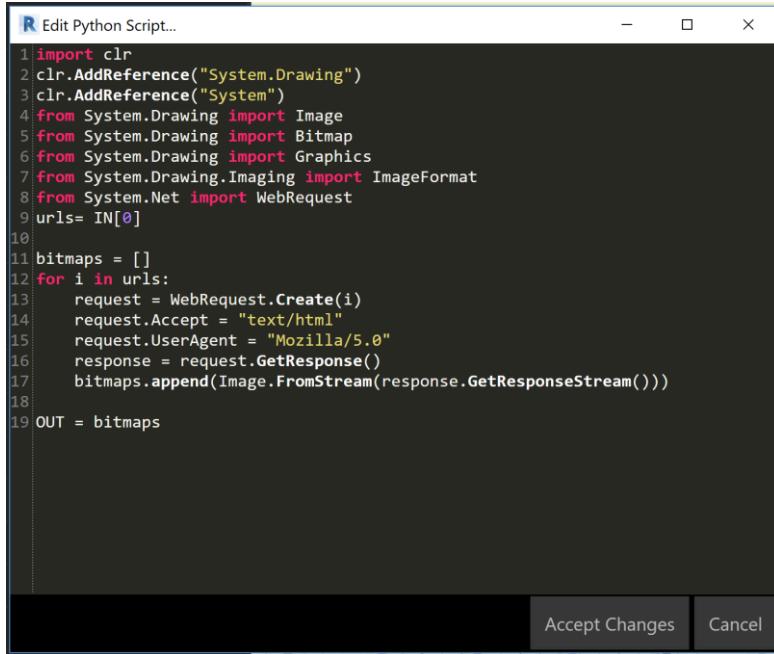
&y=372790

&z=20



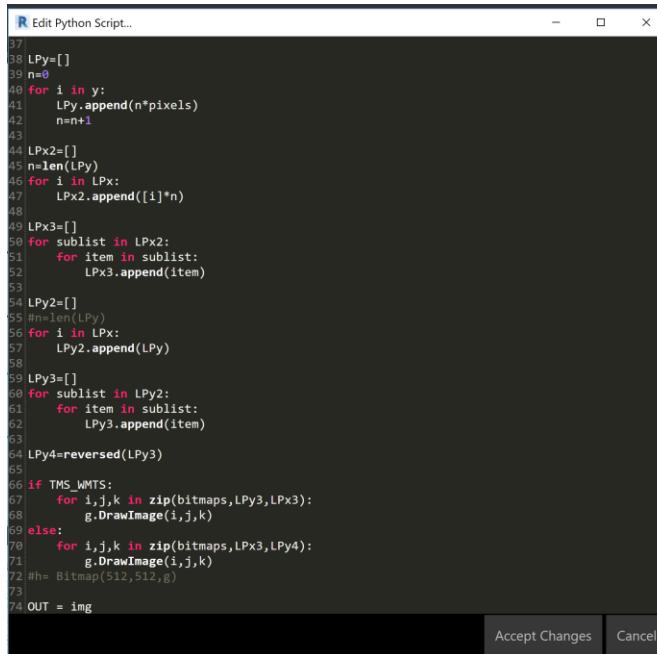
# 5.7 WMTS/TMS in Dynamo

Python to get an image from the web



```
R Edit Python Script...
1 import clr
2 clr.AddReference("System.Drawing")
3 clr.AddReference("System")
4 from System.Drawing import Image
5 from System.Drawing import Bitmap
6 from System.Drawing import Graphics
7 from System.Drawing.Imaging import ImageFormat
8 from System.Net import WebRequest
9 urls= IN[0]
10
11 bitmaps = []
12 for i in urls:
13     request = WebRequest.Create(i)
14     request.Accept = "text/html"
15     request.UserAgent = "Mozilla/5.0"
16     response = request.GetResponse()
17     bitmaps.append(Image.FromStream(response.GetResponseStream()))
18
19 OUT = bitmaps
```

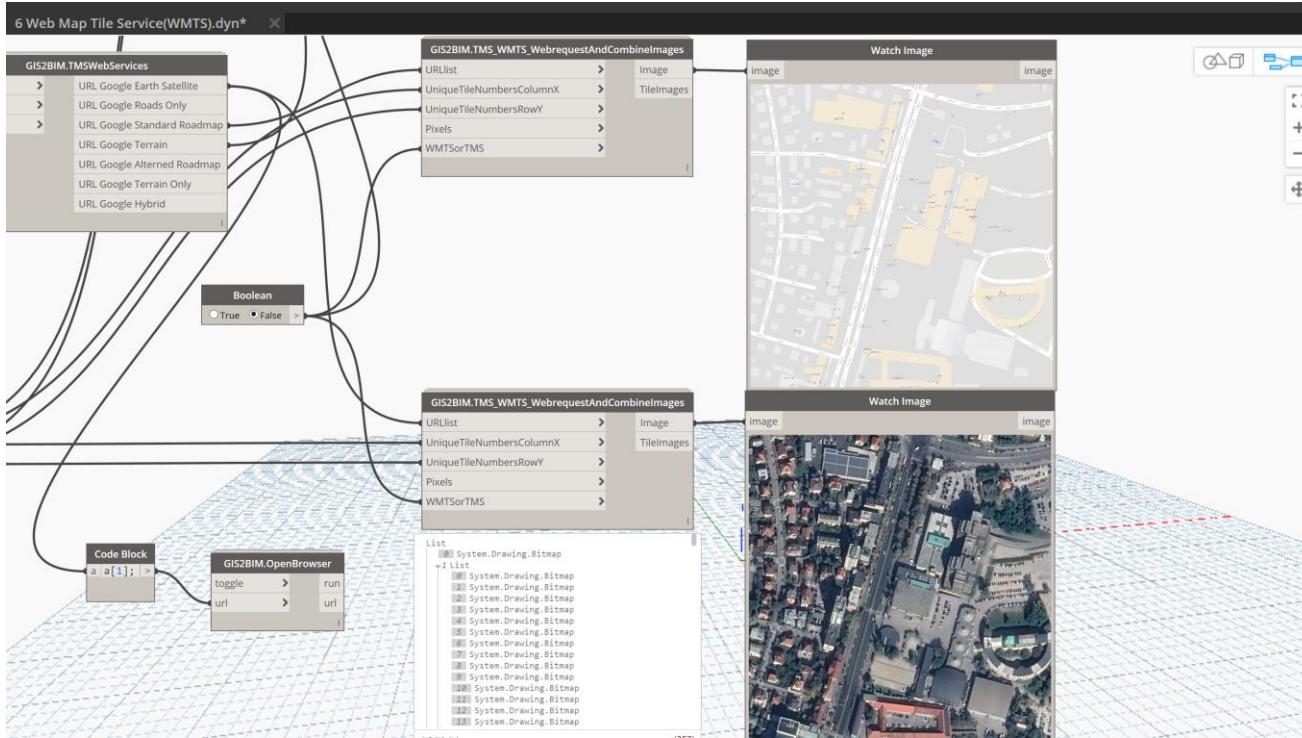
The screenshot shows a Python script window titled "Edit Python Script...". The script uses the System.Drawing and System namespaces. It defines a list "bitmaps" and iterates through a list of URLs "urls" (from the input "IN[0]"). For each URL, it creates a "WebRequest", sets the accept header to "text/html", and the user agent to "Mozilla/5.0". It then gets the response and adds the resulting image (from the stream) to the "bitmaps" list. Finally, it assigns the list to the output variable "OUT". At the bottom, there are "Accept Changes" and "Cancel" buttons.



```
R Edit Python Script...
37 LPy=[]
38 n=0
39 for i in y:
40     LPy.append(n*pixels)
41     n=n+1
42
43 LPx2=[]
44 n=len(LPy)
45 for i in LPx:
46     LPx2.append([i]*n)
47
48 LPx3=[]
49 for sublist in LPx2:
50     for item in sublist:
51         LPx3.append(item)
52
53 LPy2=[]
54 #n=len(LPy)
55 for i in LPx:
56     LPy2.append(LPy)
57
58 LPy3=[]
59 for sublist in LPy2:
60     for item in sublist:
61         LPy3.append(item)
62
63 LPy4=reversed(LPy3)
64
65 if TMS_WMTS:
66     for i,j,k in zip(bitmaps,LPy3,LPx3):
67         g.DrawImage(i,j,k)
68     else:
69         for i,j,k in zip(bitmaps,LPx3,LPy4):
70             g.DrawImage(i,j,k)
71
72 #h= Bitmap(512,512,g)
73
74 OUT = img
```

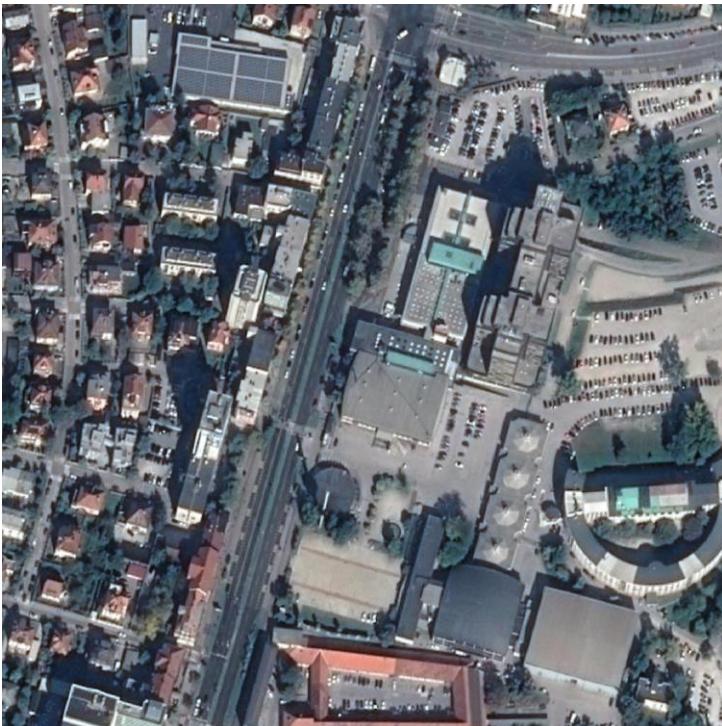
The screenshot shows a Python script window titled "Edit Python Script...". It starts by initializing lists "LPy", "LPx2", "LPx3", "LPx2", "LPx3", "LPy2", "LPy3", and "LPy4". It then checks if "TMS\_WMTS" is True. If so, it iterates over the "bitmaps", "LPy3", and "LPx3" lists and draws each image onto a "g" object using "DrawImage". If not, it iterates over the "bitmaps", "LPx3", and "LPy4" lists and draws each image onto the same "g" object. Finally, it assigns the resulting image to the output variable "OUT". At the bottom, there are "Accept Changes" and "Cancel" buttons.

# 5.8 Result



# 5.9 Revit

- Import image in view on scale
- Add image to rendermaterial via API



## 5.10 other applications ;-)



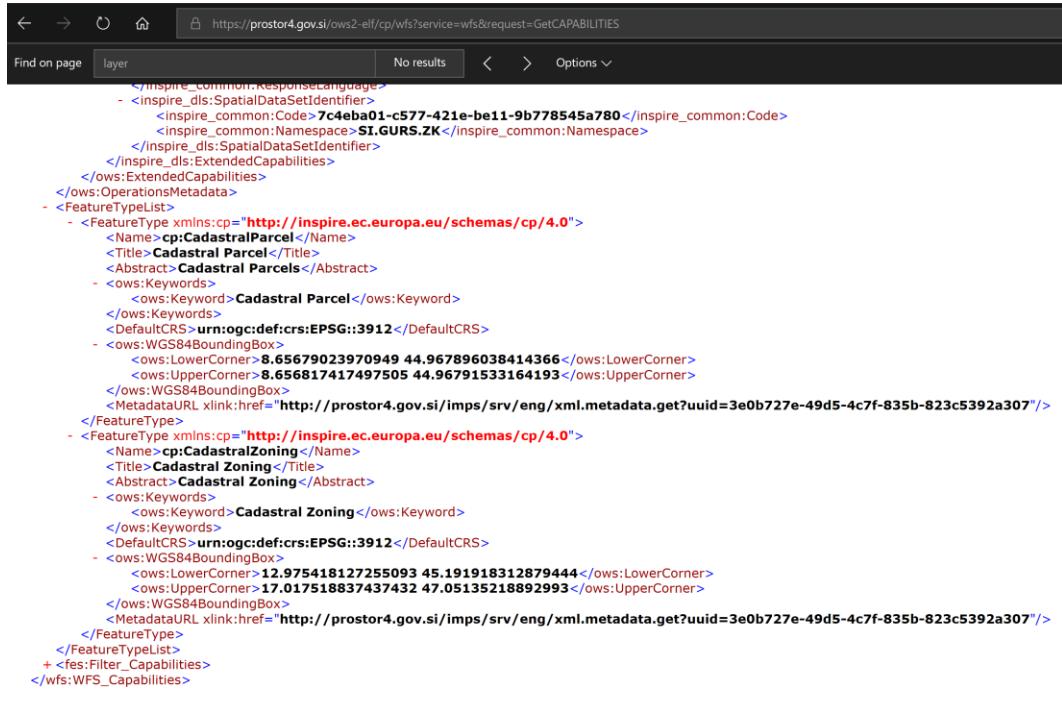
# 6 Web Feature Service(WFS)

## Request&Response

<https://prostor4.gov.si/ows2-elf/cp/wfs?service=wfs&request=GetCapabilities>

### Important:

- Operations:
  - GetFeature
  - OutputFormat
- Featuretype
  - Parcels
  - Annotation



The screenshot shows a browser window displaying the XML response to a WFS GetCapabilities request. The URL in the address bar is https://prostor4.gov.si/ows2-elf/cp/wfs?service=wfs&request=GetCapabilities. The page content is a large block of XML code representing the service's capabilities.

```
</inspire_common:ResponseLanguage>
- <inspire_dls:SpatialDataSetIdentifier>
  <inspire_common:Code>7c4eba01-c577-421e-be11-9b778545a780</inspire_common:Code>
  <inspire_common:Namespace>SI.GURS.ZK</inspire_common:Namespace>
</inspire_dls:SpatialDataSetIdentifier>
</inspire_dls:ExtendedCapabilities>
</ows:ExtendedCapabilities>
</ows:OperationsMetadata>
- <FeatureTypeList>
  - <FeatureType xmlns:cp="http://inspire.ec.europa.eu/schemas/cp/4.0">
    <Name>cp:CadastralParcel</Name>
    <Title>Cadastral Parcel</Title>
    <Abstract>Cadastral Parcels</Abstract>
    - <ows:Keywords>
      <ows:Keyword>Cadastral Parcel</ows:Keyword>
    </ows:Keywords>
    <DefaultCRS>urn:ogc:def:crs:EPSG::3912</DefaultCRS>
    - <ows:WGS84BoundingBox>
      <ows:LowerCorner>8.65679023970949 44.967896038414366</ows:LowerCorner>
      <ows:UpperCorner>8.656817417497505 44.96791533164193</ows:UpperCorner>
    </ows:WGS84BoundingBox>
    <MetadataURL xlink:href="http://prostor4.gov.si/imps/srv/eng/xml.metadata.get?uuid=3e0b727e-49d5-4c7f-835b-823c5392a307"/>
  </FeatureType>
  - <FeatureType xmlns:cp="http://inspire.ec.europa.eu/schemas/cp/4.0">
    <Name>cp:CadastralZoning</Name>
    <Title>Cadastral Zoning</Title>
    <Abstract>Cadastral Zoning</Abstract>
    - <ows:Keywords>
      <ows:Keyword>Cadastral Zoning</ows:Keyword>
    </ows:Keywords>
    <DefaultCRS>urn:ogc:def:crs:EPSG::3912</DefaultCRS>
    - <ows:WGS84BoundingBox>
      <ows:LowerCorner>12.975418127255093 45.191918312879444</ows:LowerCorner>
      <ows:UpperCorner>17.017518837437432 47.05135218892993</ows:UpperCorner>
    </ows:WGS84BoundingBox>
    <MetadataURL xlink:href="http://prostor4.gov.si/imps/srv/eng/xml.metadata.get?uuid=3e0b727e-49d5-4c7f-835b-823c5392a307"/>
  </FeatureType>
</FeatureTypeList>
+ <fees:Filter_Capabilities>
</wfs:WFS_Capabilities>
```

# 6.1 Example

## Request&Response

[https://prostor4.gov.si/ows2-elf/cp/wfs?](https://prostor4.gov.si/ows2-elf/cp/wfs?service=wfs&request=GetFeature&typeName=cp:CadastralParcel&bbox=462116,101891,462516,102291)

service=wfs

&request=GetFeature

&typeName=cp:CadastralParcel

&bbox=462116,101891,462516,102291

<https://prostor4.gov.si/ows2-elf/cp/wfs?service=wfs&request=GetFeature&typeName=cp:CadastralParcel&bbox=462116,101891,462516,102291>

```
<?xml version="1.0" encoding="ISO-8859-1"?>
<wfs:FeatureCollection xsi:schemaLocation="http://www.opengis.net/wfs/2.0 http://schemas.opengis.net/wfs/2.0/wfs.xsd http://kadastralekaartv3.geonovum.nl
http://geodata.nationalegeoregister.nl/kadastralekaartv3/wfs?service=WFS&version=2.0&request=DescribeFeatureType&typeName=kadastralekaartv3%3Akadastralegrens
http://www.opengis.net/gml/3.2 http://schemas.opengis.net/gml/3.2.1/gml.xsd" timeStamp="2018-09-03T05:21:46.127Z" numberReturned="719" numberMatched="719"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:gml="http://www.opengis.net/gml/3.2" xmlns:wfs="http://www.opengis.net/wfs/2.0"
xmlns:kadastralekaartv3="http://kadastralekaartv3.geonovum.nl" xmlns:xs="http://www.w3.org/2001/XMLSchema">
  <wfs:member>
    <- kadastralekaartv3:kadastralegrens gml:id="kadastralegrens.21283704">
      <kadastralekaartv3:lokaleID>340382684</kadastralekaartv3:lokaleID>
      <kadastralekaartv3:logischtijdstipOntstaan>2000-03-02T10:19:37.000</kadastralekaartv3:logischtijdstipOntstaan>
      <kadastralekaartv3:type>Definitief</kadastralekaartv3:type>
      <kadastralekaartv3:grenslijn>
        <gml:LineString srsDimension="2" srsName="urn:ogc:def:crs:EPSG::28992">
          <gml:posList>106210.787 425498.259 106220.376 425494.568 106257.216 425480.386</gml:posList>
        </gml:LineString>
      </kadastralekaartv3:grenslijn>
    </kadastralekaartv3:kadastralegrens>
  </wfs:member>
  <wfs:member>
    <- kadastralekaartv3:kadastralegrens gml:id="kadastralegrens.22370760">
      <kadastralekaartv3:lokaleID>340890942</kadastralekaartv3:lokaleID>
      <kadastralekaartv3:logischtijdstipOntstaan>2007-12-14T13:16:08.000</kadastralekaartv3:logischtijdstipOntstaan>
      <kadastralekaartv3:type>Definitief</kadastralekaartv3:type>
      <kadastralekaartv3:grenslijn>
        <gml:LineString srsDimension="2" srsName="urn:ogc:def:crs:EPSG::28992">
          <gml:posList>106257.539 425520.766 106256.24 425518.484 106253.499 425520.044 106254.797 425522.326 106257.539 425520.766</gml:posList>
        </gml:LineString>
      </kadastralekaartv3:grenslijn>
    </kadastralekaartv3:kadastralegrens>
  </wfs:member>
  <wfs:member>
    <- kadastralekaartv3:kadastralegrens gml:id="kadastralegrens.22380225">
      <kadastralekaartv3:lokaleID>341329490</kadastralekaartv3:lokaleID>
      <kadastralekaartv3:logischtijdstipOntstaan>2007-12-14T13:16:08.000</kadastralekaartv3:logischtijdstipOntstaan>
      <kadastralekaartv3:type>Definitief</kadastralekaartv3:type>
      <kadastralekaartv3:grenslijn>
        <gml:LineString srsDimension="2" srsName="urn:ogc:def:crs:EPSG::28992">
          <gml:posList>106221.91 425510.19 106234.86 425503.87 106244.28 425499.22 106251.86 425495.44 106261.32 425490.79</gml:posList>
        </gml:LineString>
      </kadastralekaartv3:grenslijn>
    </kadastralekaartv3:kadastralegrens>
  </wfs:member>
  <wfs:member>
    <- kadastralekaartv3:kadastralegrens gml:id="kadastralegrens.22395219">
      <kadastralekaartv3:lokaleID>340550909</kadastralekaartv3:lokaleID>
      <kadastralekaartv3:type>Definitief</kadastralekaartv3:type>
      <kadastralekaartv3:grenslijn>
        <gml:LineString srsDimension="2" srsName="urn:ogc:def:crs:EPSG::28992">
          <gml:posList>106141.474 425685.048 106206.33 425631.67 106246.75 425598.48 106247.53 425594.06 106245.29 425591.06 106245.34 425591</gml:posList>
        </gml:LineString>
      </kadastralekaartv3:grenslijn>
    </kadastralekaartv3:kadastralegrens>
  </wfs:member>
</wfs:FeatureCollection>
```

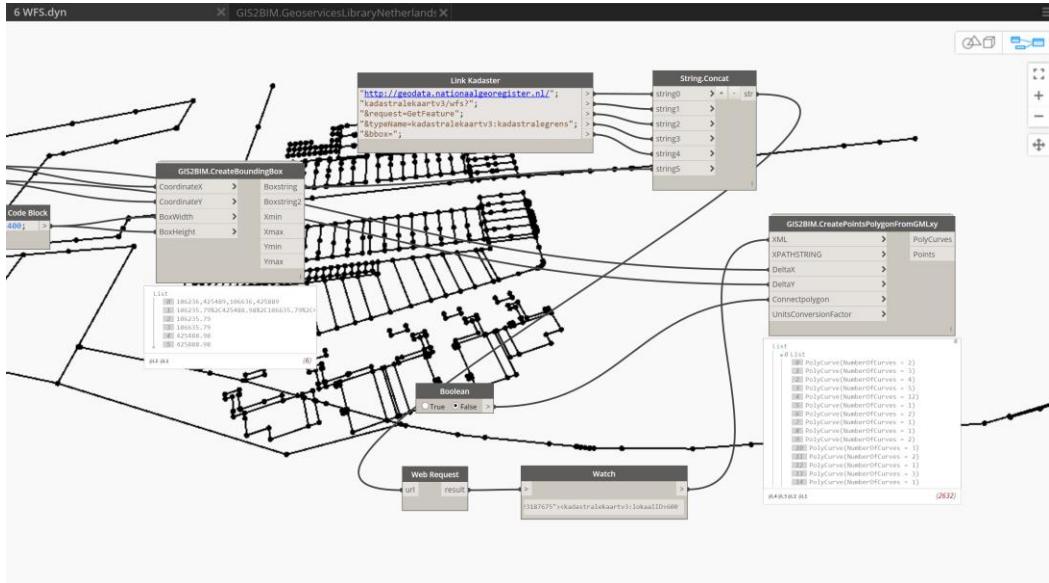
# 6.2 Dynamo

## Request&Response

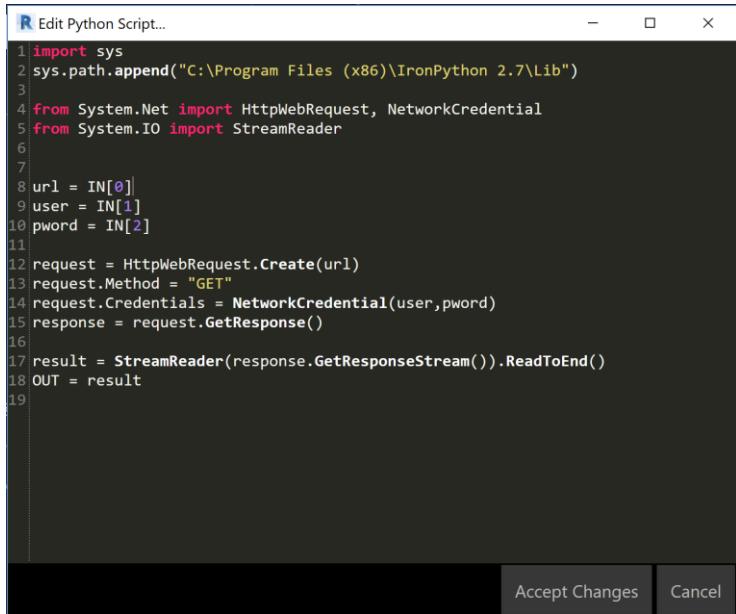
[https://prostor4.gov.si/ows2-elf/cp/wfs?](https://prostor4.gov.si/ows2-elf/cp/wfs?service=wfs&request=GetFeature&typeName=cp:CadastralParcel&bbox=462116,101891,462516,102291)  
service=wfs  
&request=GetFeature  
&typeName=cp:CadastralParcel  
&bbox=462116,101891,462516,102291

### Import:

- Use Xpath to query the XML.
- Transform CRS-coordinates to projectcoordinates
- Set Shared Coordinate

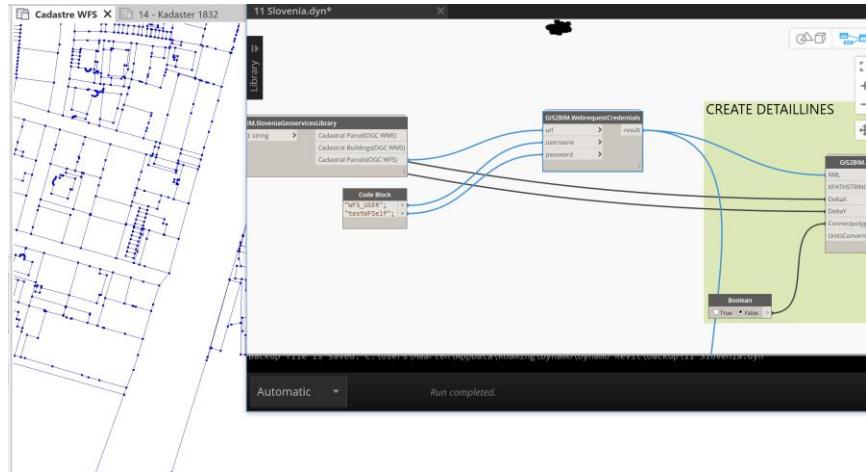


# 6.3 Authentification



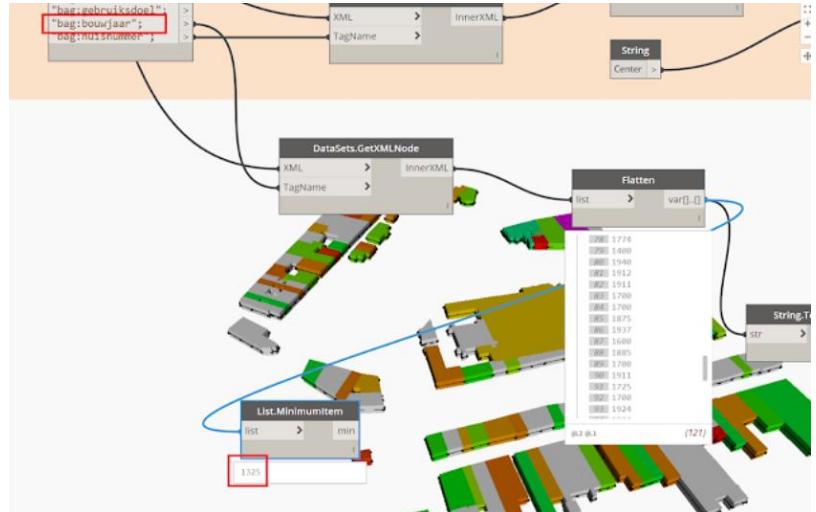
```
R Edit Python Script...
1 import sys
2 sys.path.append("C:\Program Files (x86)\IronPython 2.7\Lib")
3
4 from System.Net import HttpWebRequest, NetworkCredential
5 from System.IO import StreamReader
6
7
8 url = IN[0]
9 user = IN[1]
10 pword = IN[2]
11
12 request = HttpWebRequest.Create(url)
13 request.Method = "GET"
14 request.Credentials = NetworkCredential(user,pword)
15 response = request.GetResponse()
16
17 result = StreamReader(response.GetResponseStream()).ReadToEnd()
18 OUT = result
19
```

Accept Changes Cancel



# 6.4 Application

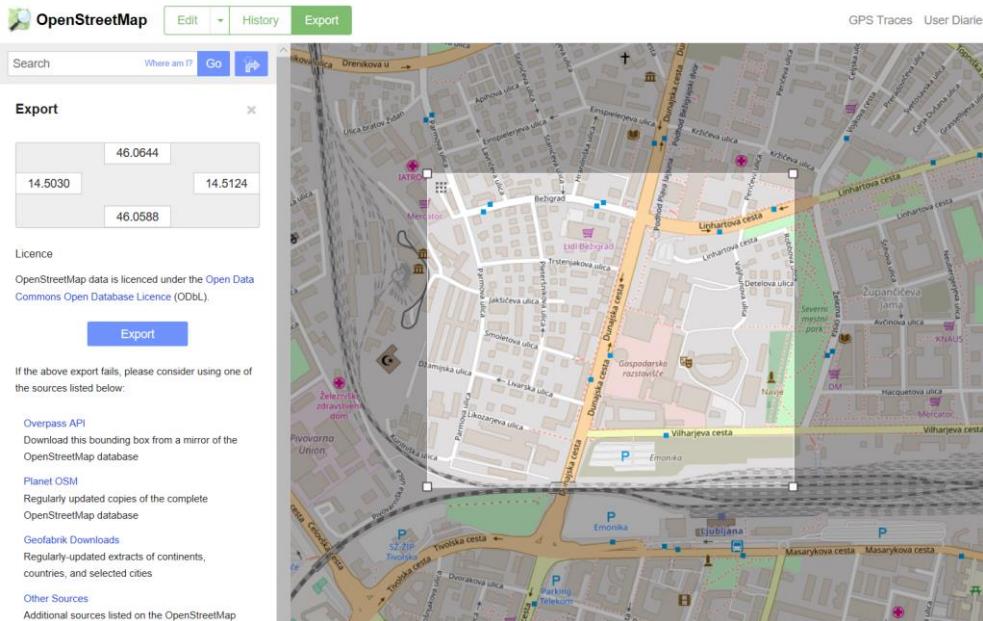
- Create siteplan on coordinates in style
- Create 3D-model of buildings



# 7 Direct Download Open Streetmap

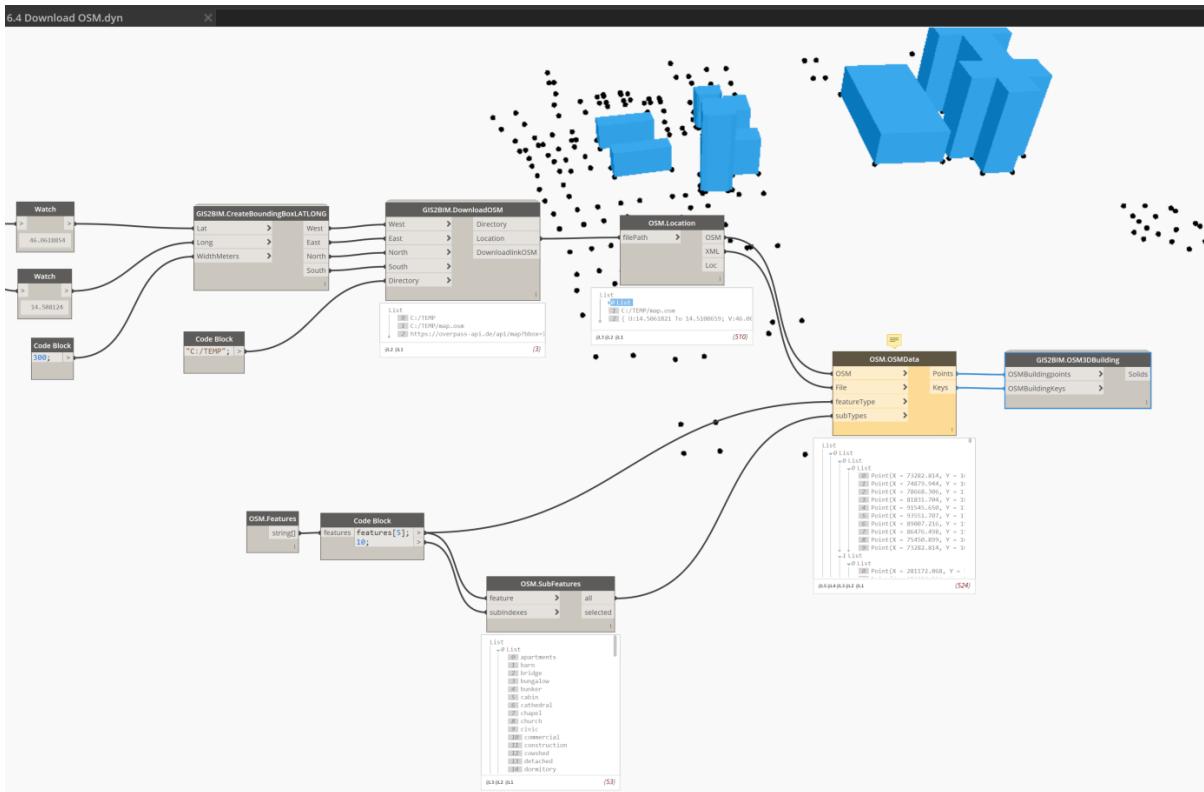
- [www.openstreetmaps.org](http://www.openstreetmaps.org)

<https://overpass-api.de/>  
api/  
map?  
bbox=  
14.5061820521,46.0605379193,  
14.5100659479,46.0632328807



# 7.2 Download Open Streetmap

- Package ELK



## 7.3 Fileformats

- Shapefile                      DynamoGIS-package
- GeoTiff                        ELK
- GML                            GIS2BIM
- JSON                           Python

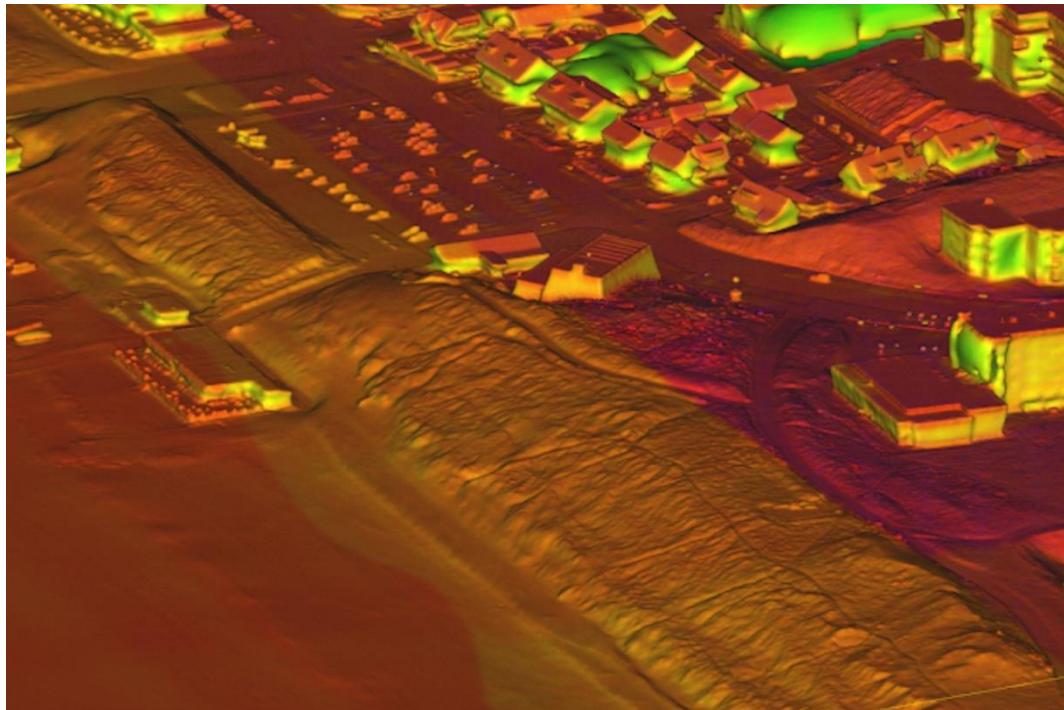
[www.GDAL.org](http://www.GDAL.org) use OGR2OGR.exe to convert all Raster and Vector fileformats to every other format

Like KML, GRASS, GTX, SQLite, DGN, OSM etc.

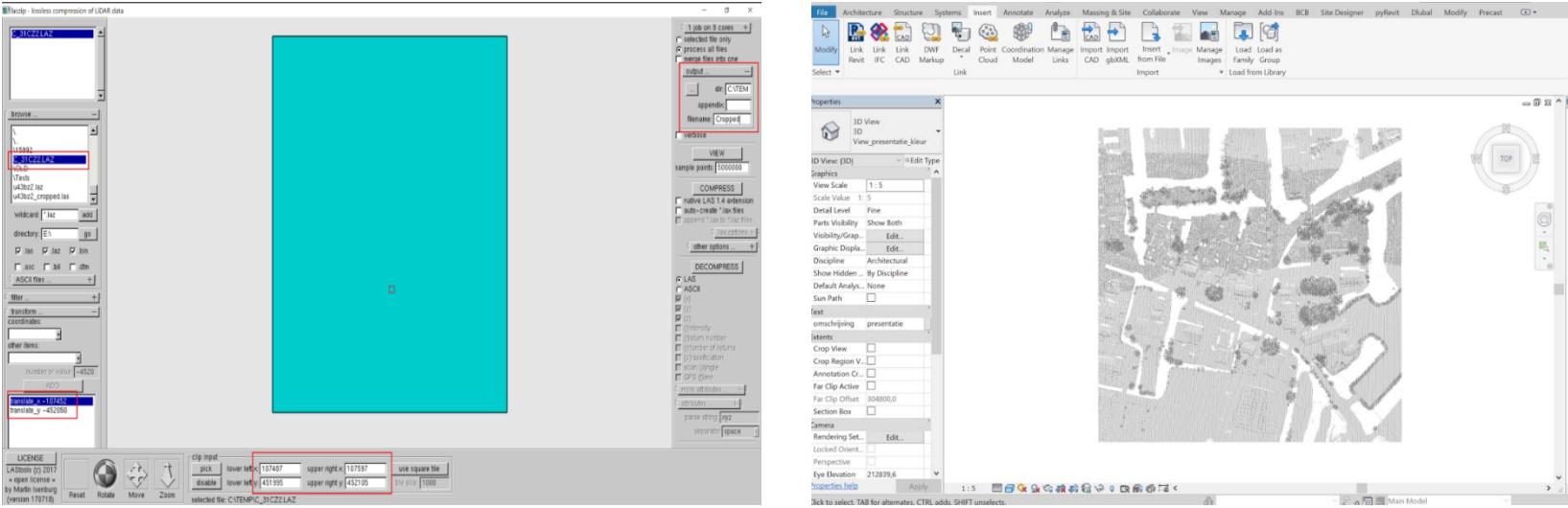
# Summary

1. Geocoding
2. WMS: Web Map Service(Raster)
3. WMTS/TMS: Web Map Tile Service(Raster)
4. WFS: Web Feature Service(Vector)
5. Download (Raster&Vector)
6. ARCGIS REST API Raster/Vector data via ArcGIS API

# 8 GEO Pointclouds



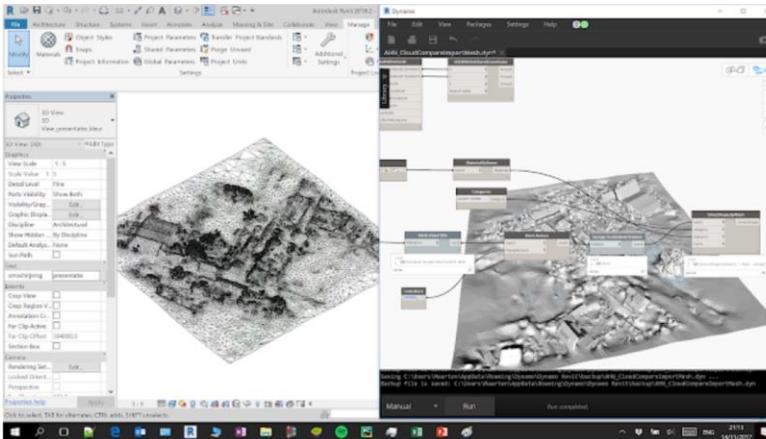
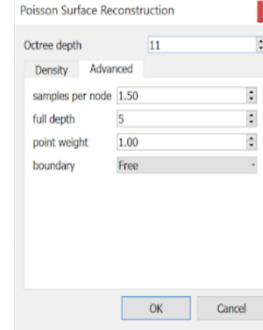
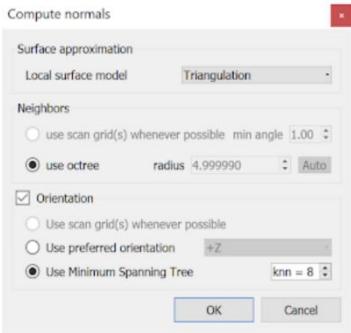
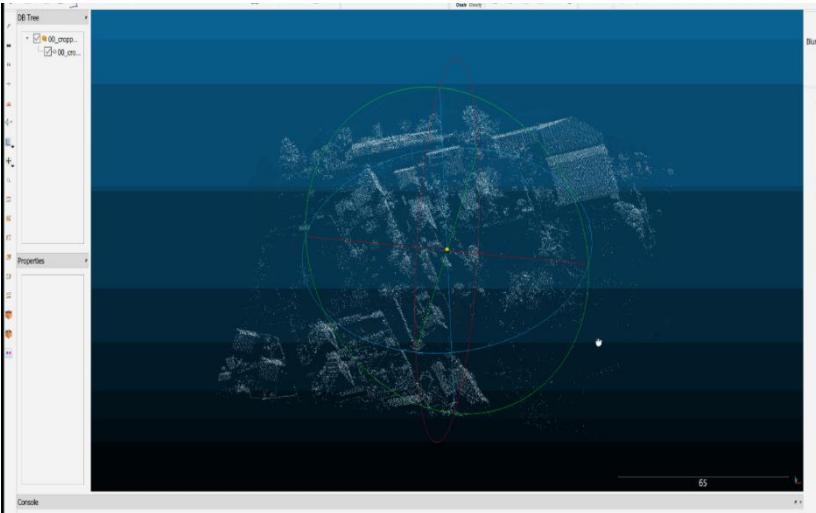
# 8.1 Link pointcloud into Revit



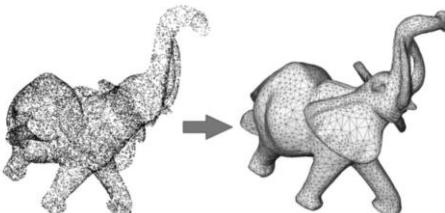
LASZIP:

```
C:/TEMP/laszip.exe -i "C:\Users\Maarten\Desktop\TEMP\C_31AZ1.LAZ" -  
translate_x -102542 -translate_y -468572 -inside 102417 468447 102667  
468697 -odir "C:/TEMP" -o "BILT_cropped.laz"
```

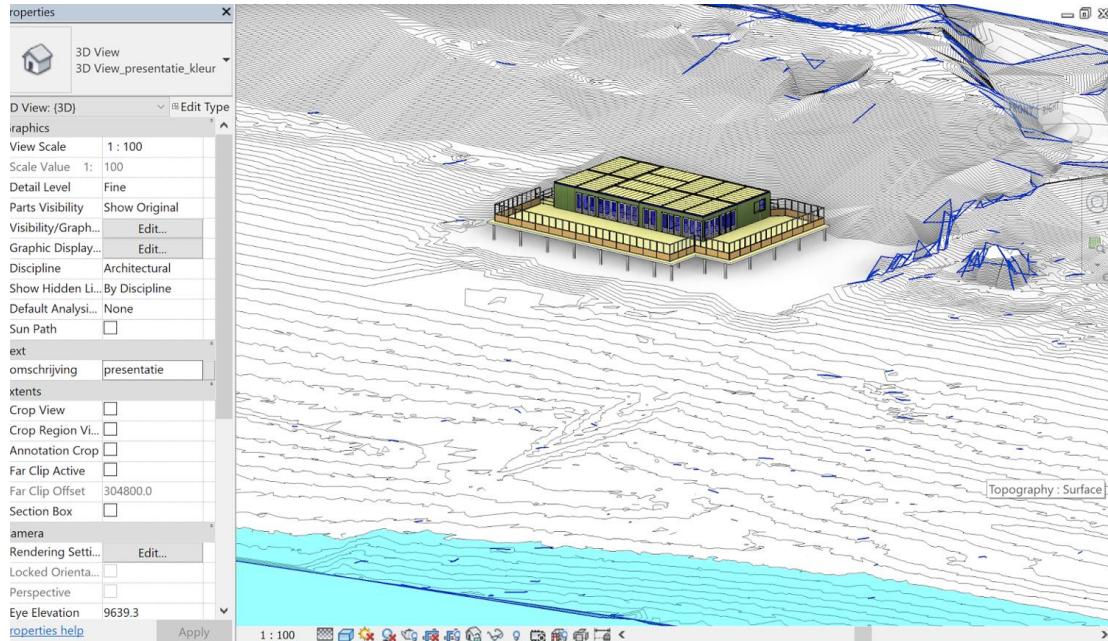
## 8.2 Mesh a pointcloud



- Pointclouds & Dynamo.....
- Mesh & Dynamo & Revit....
- Mesh: 200.000-500.000 triangles

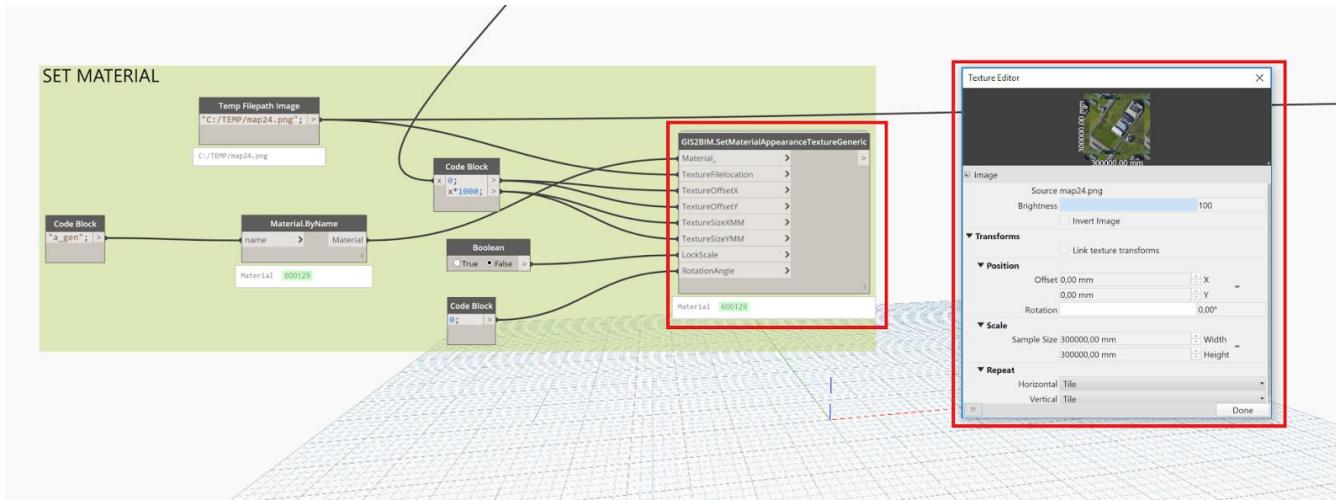


## 8.3 Pointcloud to toposurface

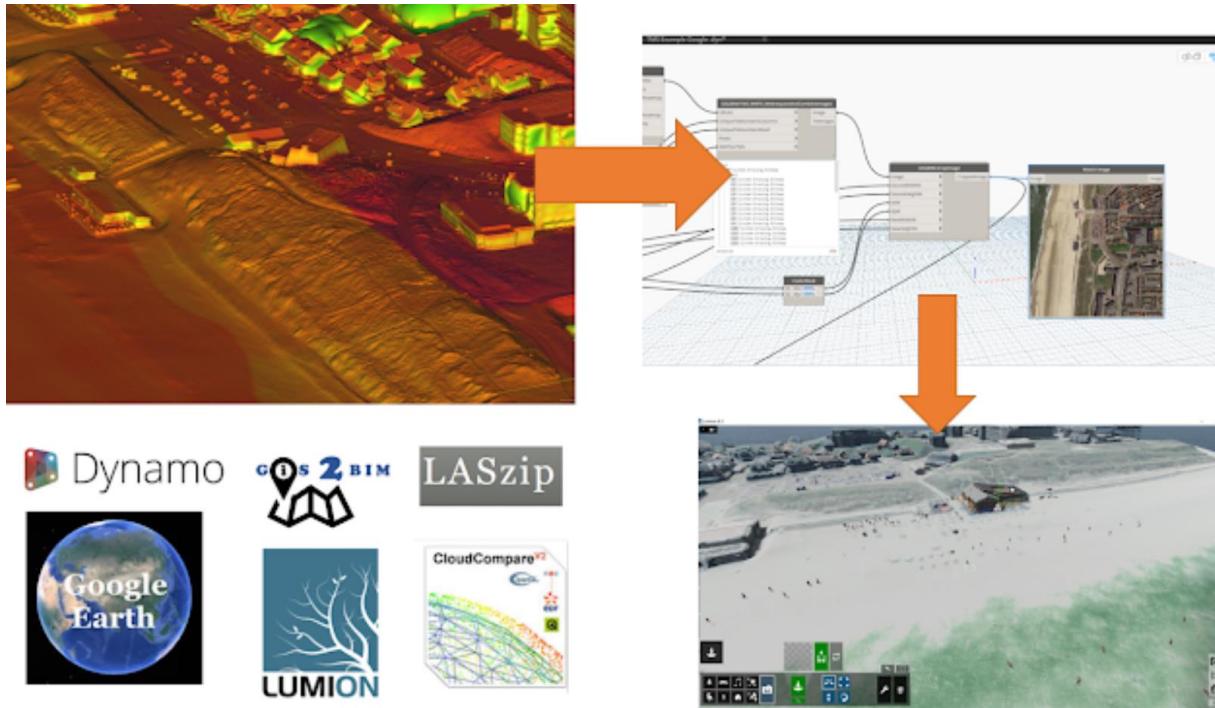


# 8.4 Aerialphoto to material

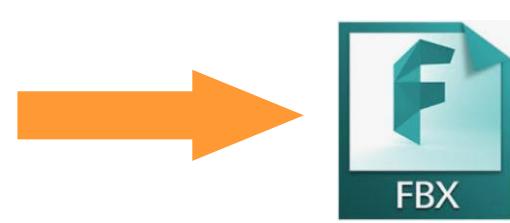
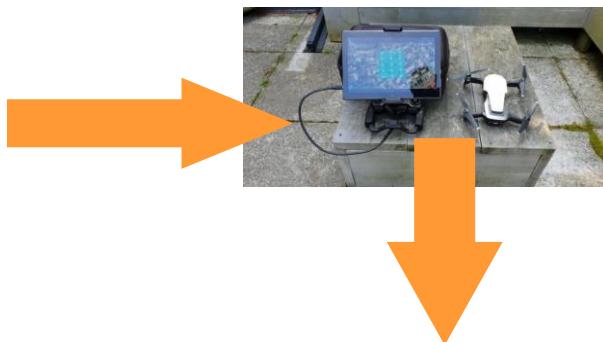
- Material API since Revit 2018.1



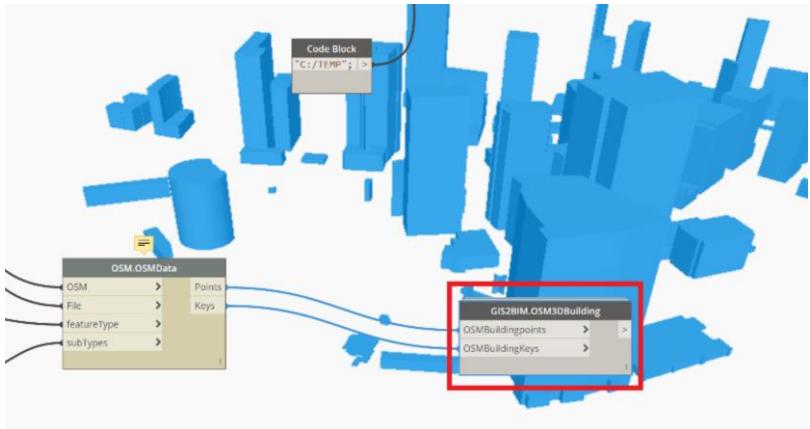
## 8.4 Aerialphoto to material



## 8.5 Drone to Mesh

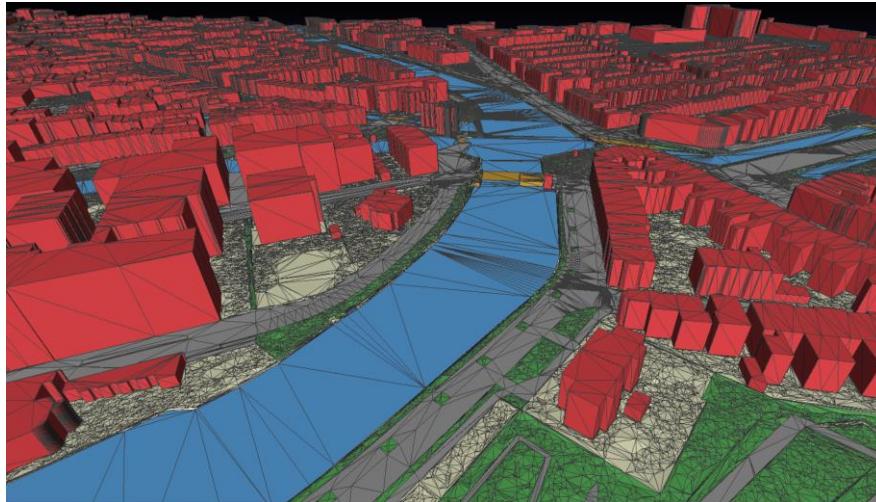


# 8.6 Masses from buildingoutline



# 8.7 Buildingoutline combined with pointclouddata

3dfier(open source project on github)



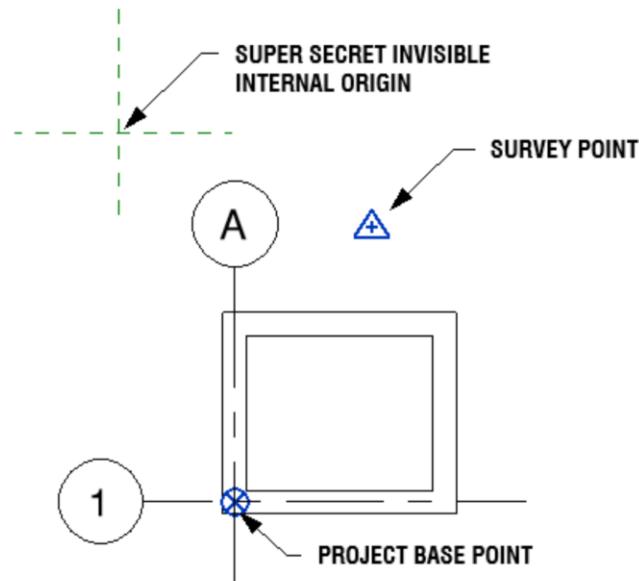
# 9 Revit Coordinates

Many times again a headache

- Internal Origin
- Project Base Point
- Survey Point(s)

Excellent explanation: Revit Pure

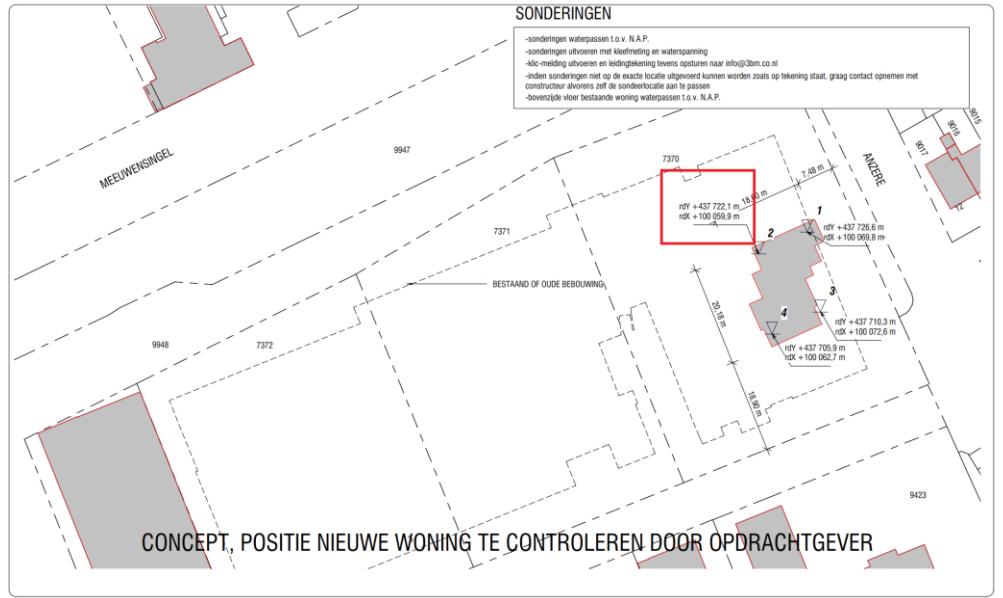
- <https://revitpure.com/blog/13-tips-to-understand-revit-base-points-and-coordinate-system>



# 9 Revit Coordinates

Use **Shared Coordinates/Survey Point** for your countries Coordinate Reference System.

- In the industry and civil engineering everyone needs a coordinates in a certain CRS.



► Sonderingstekening

► Villa Roco

Capelle a/d IJssel

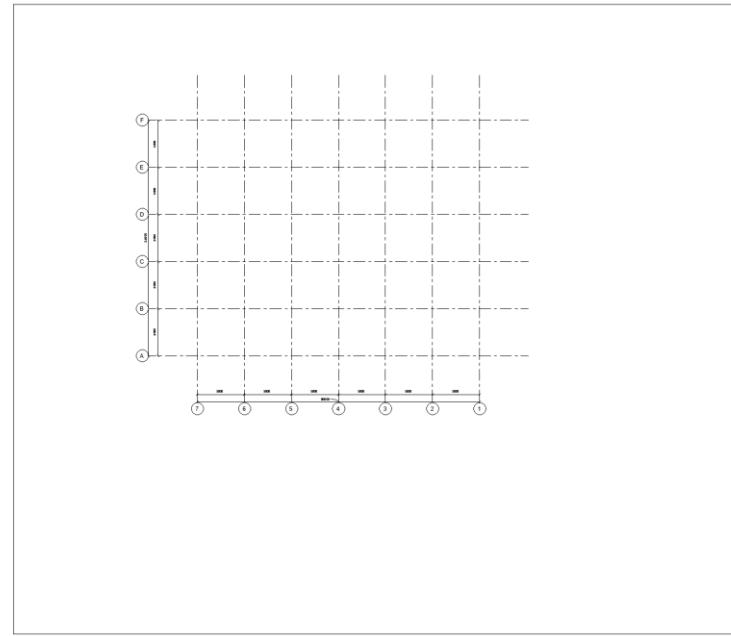
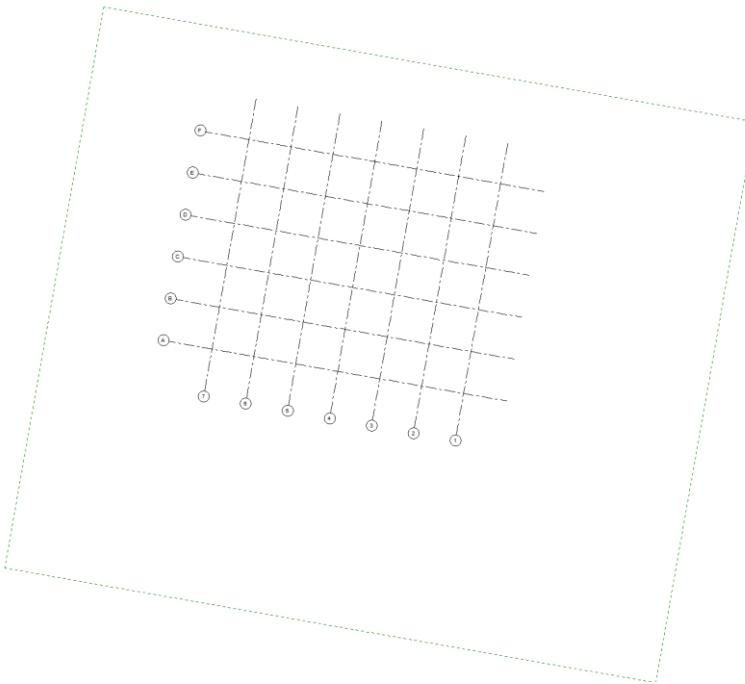
▲ KENMERK: PROJECTNR: 885 ▲ AUTEUR: M.D. Vroegindeweij  
▲ FORMAAT: A3 ▲ 1e DATUM: 19-01-2018 ▲ OPDRACHTGEVER:  
▲ SCHALD: 1:500 ▲ WIJZ.A 12-07-2018 Kokon Architecten

ST-21



# 9 Revit Coordinates

**Do not use** rotate True North combined with shared coordinates. **Use scopeboxes** for the rotation



# 9 Revit Coordinates

## Summary for my best practice

- **Do not use** rotate True North combined with shared coordinates if you want to accurate.
- Use scopeboxes for the rotation.
- Use **Shared Coordinates** for your countries Coordinate Reference System.
- **Project Base Point** should be always on the ‘super invisible origin’ using ‘move to startup location’.
- IFCSite refers to the coordinates of **the super secret internal origin relative to the survey point**
- Coordinates of elements are related to the **internal origin**.

# 10 Practical Examples & Ideas

- Location Analysis
- 3D Building & Pointcloud & Data
- CPT in 3D Optimisation Pile Foundation
- Historical Cadastre

# 10.1 Location Analysis

- Use a lot of WMS, WFS, WMTS services together to create a location analysis report in Revit

-OPEN IN REVIT-



# 10.2 3D Building&Data

Combine Download, WFS, Lidar to create a 3D-model.



# 10.3 CPT in 3D & Pile Optimization

**Graph (Left):**

Depth (m)	WATERSPANNING (MPa)	CONUSWEERSTAND (MPa)
0.0	0.2	0.4
0.6	0.6	0.8
1.2	0.8	1.0
1.8	1.0	1.2
2.4	1.2	1.4
3.0	1.4	1.6
3.6	1.6	1.8
4.2	1.8	2.0
4.8	2.0	2.2
5.4	2.2	2.4
6.0	2.4	2.6
6.6	2.6	2.8
7.2	2.8	3.0
7.8	3.0	3.2
8.4	3.2	3.4
9.0	3.4	3.6
9.6	3.6	3.8
10.2	3.8	4.0
10.8	4.0	4.2
11.4	4.2	4.4
12.0	4.4	4.6
12.6	4.6	4.8
13.2	4.8	5.0
13.8	5.0	5.2
14.4	5.2	5.4
15.0	5.4	5.6
15.6	5.6	5.8
16.2	5.8	6.0
16.8	6.0	6.2
17.4	6.2	6.4
18.0	6.4	6.6
18.6	6.6	6.8
19.2	6.8	7.0
19.8	7.0	7.2
20.4	7.2	7.4
21.0	7.4	7.6
21.6	7.6	7.8
22.2	7.8	8.0

**Autodesk AutoCAD Interface:**

**GIDBM RunWithCPT Flowchart:**

```

graph TD
    Start((Start)) --> Input[Input]
    Input --> GIDBM[GIDBM RunWithCPT]
    GIDBM --> RunCompleted[Run completed]
    GIDBM --> Output[Output]
    Output --> End((End))

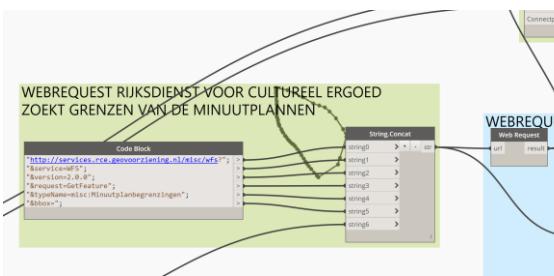
```

**Table (Bottom Right):**

	A	B	C	D	E	G	H
1	sonder	-	paalpunkt	.27	273-330	.356-400	.380-431
4	101	-31.5	779	1064	1108		
6	101	-32	1048	1437	1602		
8	101	-31	1214	1496	1662		
10	101	-33	1134	1460	1628		
12	101	-33.5	1136	1524	1684		
19	102	-31.5	1254	1671	1858		
21	102	-32	1249	1557	1737		
23	102	-32.5	1410	2026	2269		
25	102	-33	1455	2026	2269		
27	102	-33.5	1539	1992	2123		
34	103	-32	1130	1431	1598		
36	103	-32	1138	1539	1709		
38	103	-32.5	1177	1424	1594		
40	103	-33	1178	1424	1594		
42	103	-33.5	1417	1877	2101		
45	104	-32	799	1079	1201		
47	104	-32.5	853	1150	1273		
49	104	-33	937	1220	1343		
51	104	-33.5	1044	1403	1549		
56	105	-31.5	891	1207	1348		
58	105	-32	957	1234	1356		
60	105	-32.5	964	1244	1368		
62	105	-33	1035	1394	1547		
64	105	-33.5	1074	1466	1623		
71	106	-32	903	1129	1259		
73	106	-32	905	1129	1259		
75	106	-32.5	967	1249	1389		

**BUILT BY RTC**

# 10.4 Historical Cadastre



# 11 Dynamo Packages/software

ELK: for converting Open Streetmap Data

MeshToolkit: for loading meshes

Spring Nodes: convert ToolkitMesh to Mesh

DynamoGIS: importing Shape Files

DynaWeb: for complex webrequests

GIS2BIM: for o.a. WMS/WFS/WMTS/TMS requests and  
geoservices.

Revit addin: Mesh Import from OBJ files

## Opensource software

LASzip: Quickly crop, transform pointclouds

Cloudcompare/Meshlab Surface Reconstruction Algoritmns

# 11 INSPIRE Data Themes

- INSPIRE: Infrastructure for Spatial Information in Europe.
- <http://inspire-geoportal.ec.europa.eu/>
- [http://inspire-geoportal.ec.europa.eu/theme\\_selection.html?view=qsTheme](http://inspire-geoportal.ec.europa.eu/theme_selection.html?view=qsTheme)

Annex I

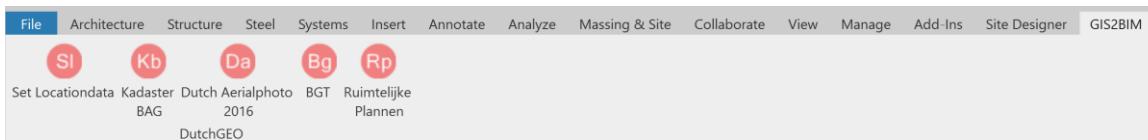
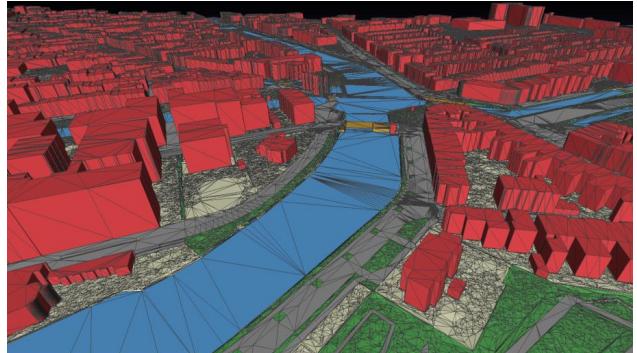
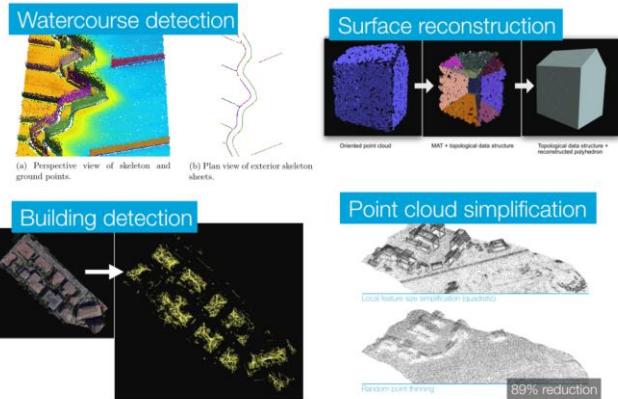
 <b>Addresses</b> Def.: Location of properties based on address identifiers,...  <a href="#">View</a>   <a href="#">Download</a>   <a href="#">Comments</a>	 <b>Administrative units</b> Def.: Units of administration, dividing areas where Member...  <a href="#">View</a>   <a href="#">Download</a>   <a href="#">Comments</a>	 <b>Cadastral parcels</b> Def.: Areas defined by cadastral registers or equivalent.  <a href="#">View</a>   <a href="#">Download</a>   <a href="#">Comments</a>	 <b>Geographical grid systems</b> Def.: Harmonised multi...  <a href="#">View</a>   <a href="#">Download</a>   <a href="#">Comments</a>
 <b>Geographical names</b> Def.: Names of areas, regions, localities, cities, suburbs...  <a href="#">View</a>   <a href="#">Download</a>   <a href="#">Comments</a>	 <b>Hydrography</b> Def.: Hydrographic elements, including marine areas and al...  <a href="#">View</a>   <a href="#">Download</a>   <a href="#">Comments</a>	 <b>Protected sites</b> Def.: Area designated or managed within a framework...  <a href="#">View</a>   <a href="#">Download</a>   <a href="#">Comments</a>	 <b>Coordinate reference systems</b> Def.: Systems for uniquely...  <a href="#">View</a>   <a href="#">Download</a>   <a href="#">Comments</a>
 <b>Transport networks</b> Def.: Road, rail, air and water transport networks and rel...  <a href="#">View</a>   <a href="#">Download</a>   <a href="#">Comments</a>			

# 11 GIS=Data, Other sources

- 1300 webservices: ESRI Geoportal:  
<http://gptogc.esri.com/geoportal/rest/find/document?searchText=WMS&start=1&max=10&f=searchpage>
- <http://inspire-geoportal.ec.europa.eu/>
- 944 WMS-servers with 339254 layers: [http://www.skylab-mobilesystems.com/en/wms\\_serverlist.html](http://www.skylab-mobilesystems.com/en/wms_serverlist.html)
- Slovenia: <http://prostor4.gov.si/imps/srv/eng/catalog.search#/home>
-

# 11 Future Innovations

- Combine 2D GIS datasets and pointclouds(3dfier), make available in 3D Vector Tiles in CityGML and CityJSON
- Better integration of ARCGIS webservices in Revit/Infraworks

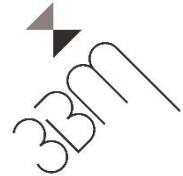


# **REMINDER:**

## **Speaker Feedback is appreciated**

*Fill in the Survey on the Mobile App*

<http://prostor4.gov.si/imps/srv/eng/catalog.search#/home>



GR CENTRE

**LJUBLJANA**

11 – 13 OCT 2018



## 1.4 GIS to BIM using Dynamo

Maarten Vroegindeweij

3BM/Domera

*dutchrevitblog.blogspot.com*

GR CENTRE

LJUBLJANA

11 – 13 OCT 2018