Tutorial: The process of creating the 3D model

This method is part of the article "A method for the automated construction of 3D models of cities and neighbourhoods from official cadastre data for solar analysis", written by Carlos Beltran-Velamazan, Marta Monzón-Chavarrías and Belinda López-Mesa.

There the method is explained and developed and the results obtained are shown. The article is published in the Sustainability magazine, in the following link

https://www.mdpi.com/2071-1050/13/11/6028

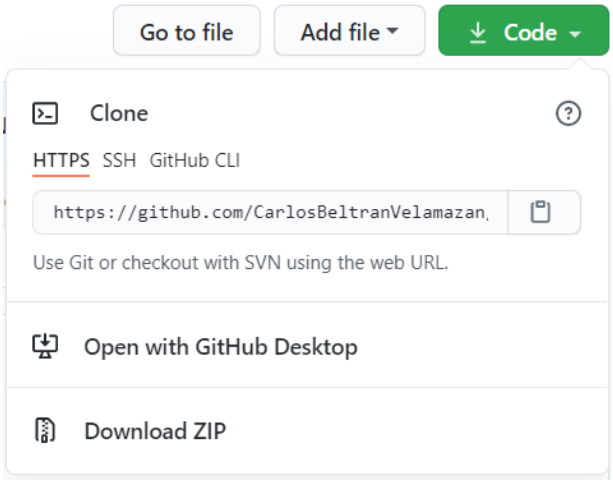
The process of creating the three-dimensional model from the data in GIS has 3 steps:

- Step 0: Download the 3D_Model AutoCAD command
- Step 1: Work in GIS
- Step 2: Work in AutoCAD with the algorithm 3D_Model

Step 0: How to download the 3D_Model algorithm

Go to the link https://github.com/CarlosBeltranVelamazan/3D_model_from_2D-GIS-cadastre.git and click Code -> Download ZIP to download to download a compressed file with the file 3D_Model.lsp and the tutorial with the information to make the model.

Then you have to extract the files from the compressed file, for this it is possible to use Winrar, 7zip or others, the lsp file will be necessary for the work in the step 2.



Step 1: Work in GIS

To make the example we have used QGIS 3.12.2 Desktop with GRASS 7.8.2, but it should be possible to do it in any version of the program. (QGIS can be downloaded from https://www.qgis.org/en/site/forusers/download.html)

1º- Import the Shapefile files from which we want to obtain the 3D, either from the cadastre website, or from the *Spanish Inspire Catastral Downloader* plug-in, or any other.

2º- Select the objects we want to generate the 3D model or delete the information from the file that does not interest us.

Figure 1. Zaragoza's cadastre data

3º- Obtain in the attributes table of the shapefile a column with the height in arabic numbers. This can be obtained directly or must be modified as indicated in the methodology section depending on the base information.

Constru :: Features Total: 3401, Filtered: 3401, Selected: 0

	PARCELA	HOJA	TIPO	CONSTRU	COORX	COORY	ASYM	AREA	FECHAALTA	FECHABAJA	NINTERNO	REFCAT	Heights
1	01	XM7152B	U	II	675802.70	4611865.96	11	112.79	30160122	99999999	201422213	5920201XM7152B	7
2	15	XM7152B	U	II	675778.36	4611838.18	11	102.20	20150327	99999999	196188699	5820315XM7152B	7
3	15	XM7152B	U	I	675771.41	4611835.23	11	1.11	20150327	99999999	196188698	5820315XM7152B	4
4	15	XM7152B	U	P	675772.02	4611831.27	15	45.30	20150327	99999999	196188697	5820315XM7152B	0
5	32	XM7151H	U	-II+II	675884.10	4611521.53	11	8.93	20150112	99999999	194677895	6017632XM7151H	7
6	32	XM7151H	U	-II	675882.93	4611518.45	12	5.87	20150112	99999999	194677894	6017632XM7151H	0
7	32	XM7151H	U	-II+IITZA	675881.93	4611520.64	11	6.92	20150112	99999999	194677893	6017632XM7151H	7
8	32	XM7151H	U	-I+II	675877.24	4611521.35	11	8.37	20150112	99999999	194677892	6017632XM7151H	7
9	32	XM7151H	U	-II+II	675872.70	4611524.17	11	4.87	20150112	99999999	194677891	6017632XM7151H	7
10	32	XM7151H	U	-I+II	675871.17	4611524.96	11	1.70	20150112	99999999	194677890	6017632XM7151H	7
11	32	XM7151H	U	-I+IITZA	675869.82	4611526.03	11	1.70	20150112	99999999	194677889	6017632XM7151H	7
12	32	XM7151H	U	-II+IITZA	675869.97	4611527.22	11	3.08	20150112	99999999	194677888	6017632XM7151H	7
13	32	XM7151H	U	-I	675867.93	4611527.14	12	5.35	20150112	99999999	194677887	6017632XM7151H	0
14	32	XM7151H	U	-II+II	675868.20	4611530.91	11	25.20	20150112	99999999	194677886	6017632XM7151H	7
15	32	XM7151H	U	-II+IITZA	675863.99	4611531.68	11	4.54	20150112	99999999	194677885	6017632XM7151H	7
16	32	XM7151H	U	-II	675865.69	4611529.37	12	12.84	20150112	99999999	194677884	6017632XM7151H	0
17	32	XM7151H	U	-I+IITZA	675862.17	4611530.51	11	0.72	20150112	99999999	194677883	6017632XM7151H	7

Figure 2. Zaragoza's attributes table

4º- We carry out a vector division of the layer separating the elements by their height, for this we must go to: Vector - Data Management Tools - Split Vector Layer.

And divide the layer by its Heights. In this way we obtain several .gpkg files that contain the parcels separated by their height.

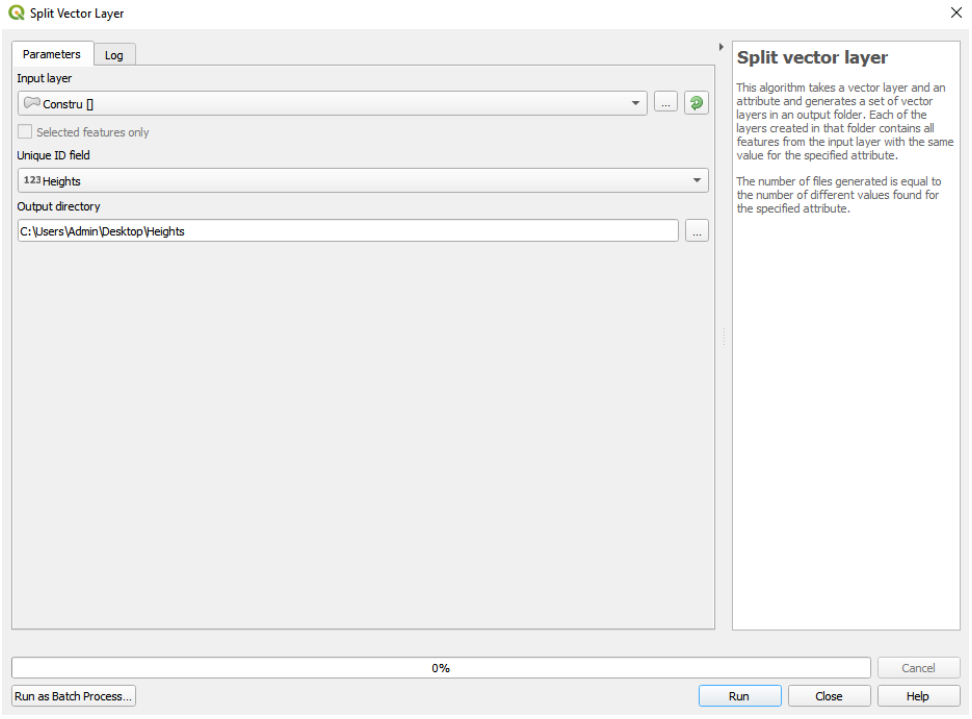


Figure 3. Split vector layer

5º- In Project - Properties… - Default Styles - Default symbols – Fill, we have to select outline black and go to edit symbol and select simple line and change the stroke width option to 0 (hairline) in order to import from elements as lines without width.

Figure 4. Default styles recommended

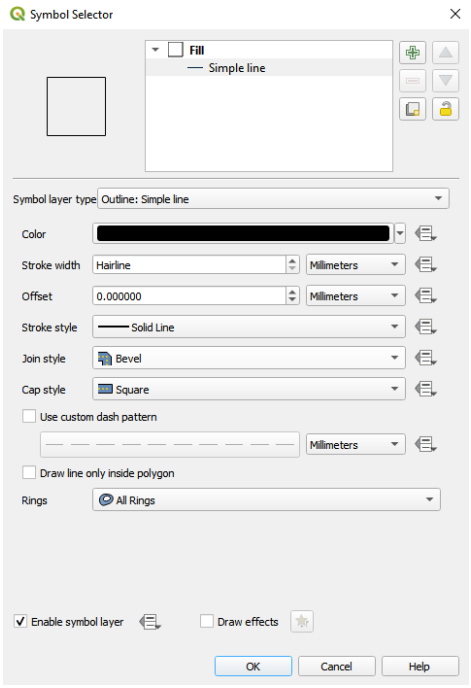


Figure 5. Stroke width option set to 0 (Hairline)

6º- Import the gpkg files into the project

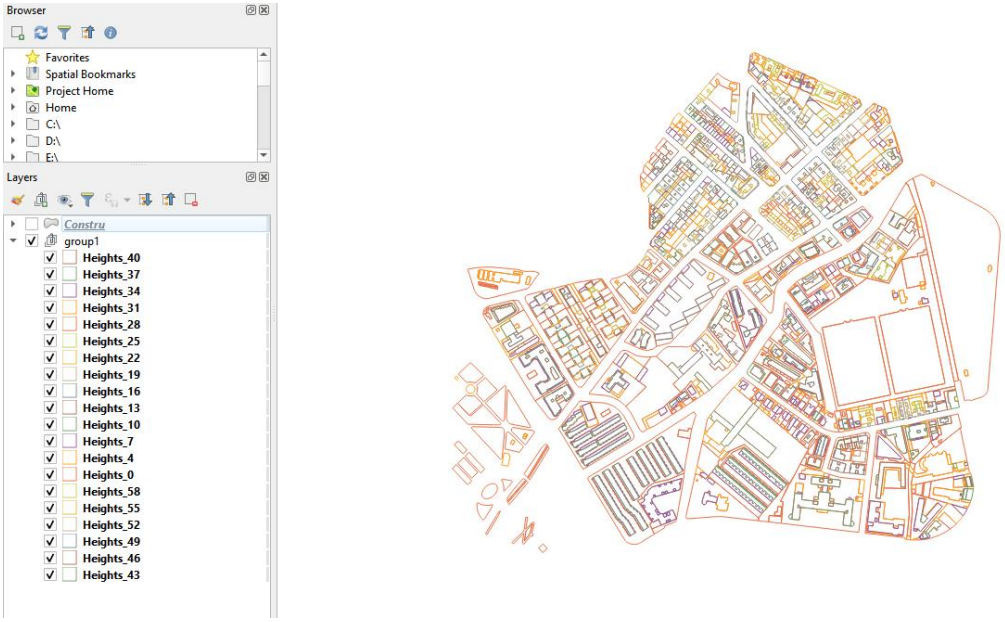


Figure 6. Result of importing the .gpkg files

7º- Export the project as dxf, Project - Import / Export - Export project to DXF

We have to choose a name and select which layers we want to export to create the 3D Model. Note: All the elements needed to be exported have to be visible on the screen.

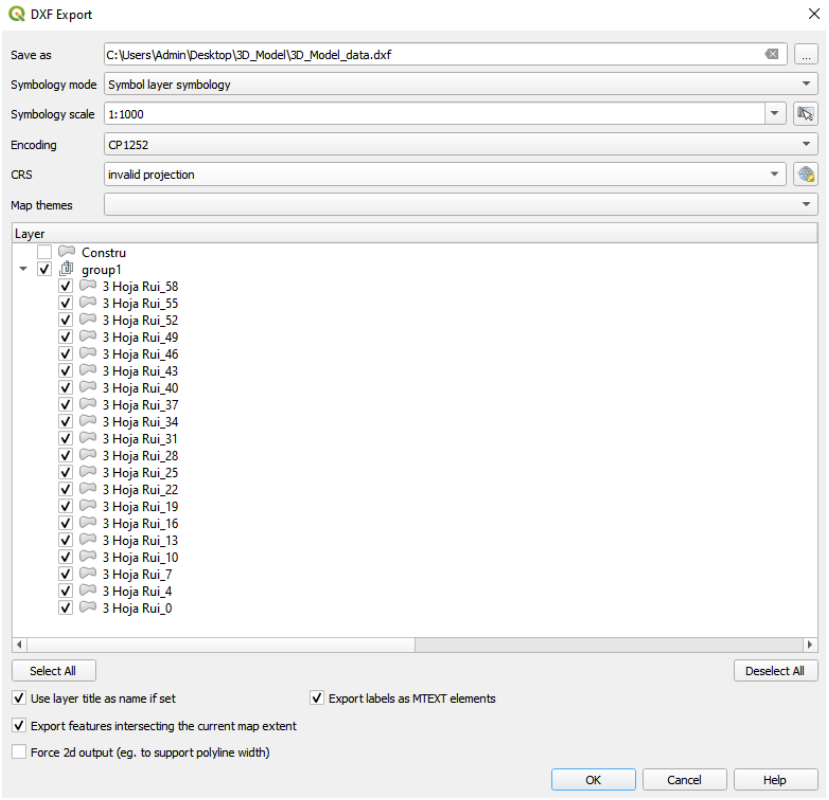


Figure 7. DXF Export configuration

Step 2: Work in AutoCAD with the algorithm 3D_Model

1º- Open dxf file in AutoCAD

Figure 8. DXF file opened in AutoCAD

2º- Install the 3D_Model command, in order to do this go to Manage - Load aplication, select the file 3D_Model.lsp and press "Load", in the options select "Always Load" or "Load Once", you must see "3D_Model.LSP successfully loaded ", close of Load application.

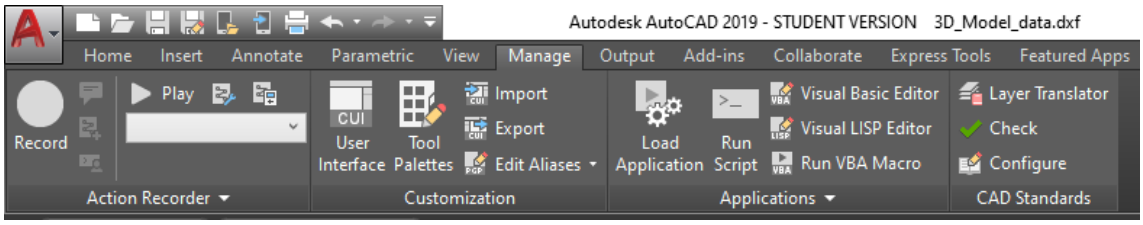


Figure 9. Select Load Application

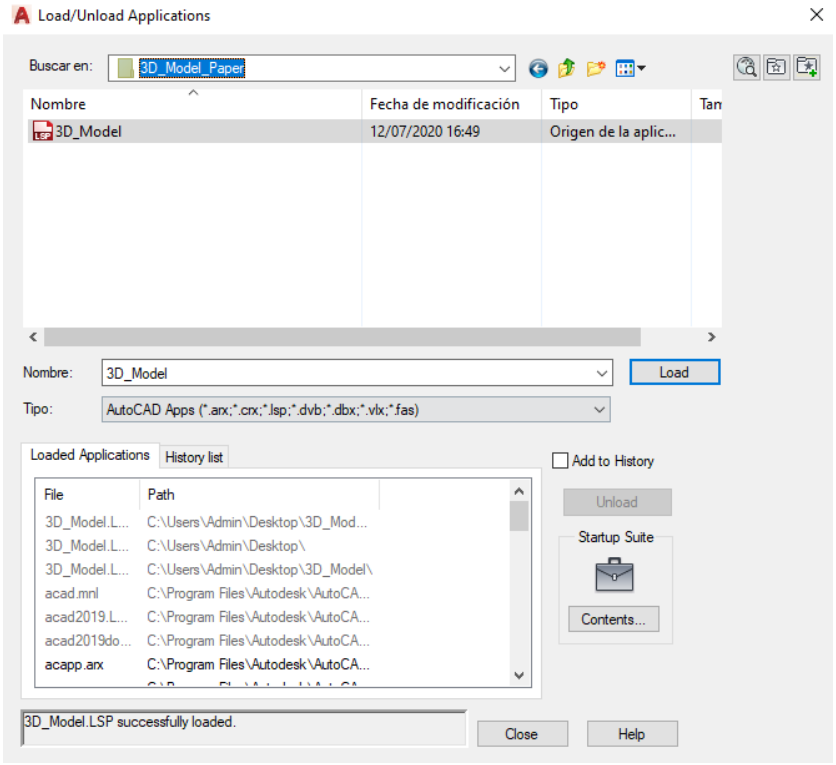


Figure 10. Select Load Application

3º The algorithm selects all the elements in the layer and extrudes it the height written in the name of the layer, its fundamental to the correct work of this algorithm that the names of the layers are only the number of meters you want to extrude each layer .

For example: 10, 20, etc… All the elements not desired to be extruded should be in the layer 0.

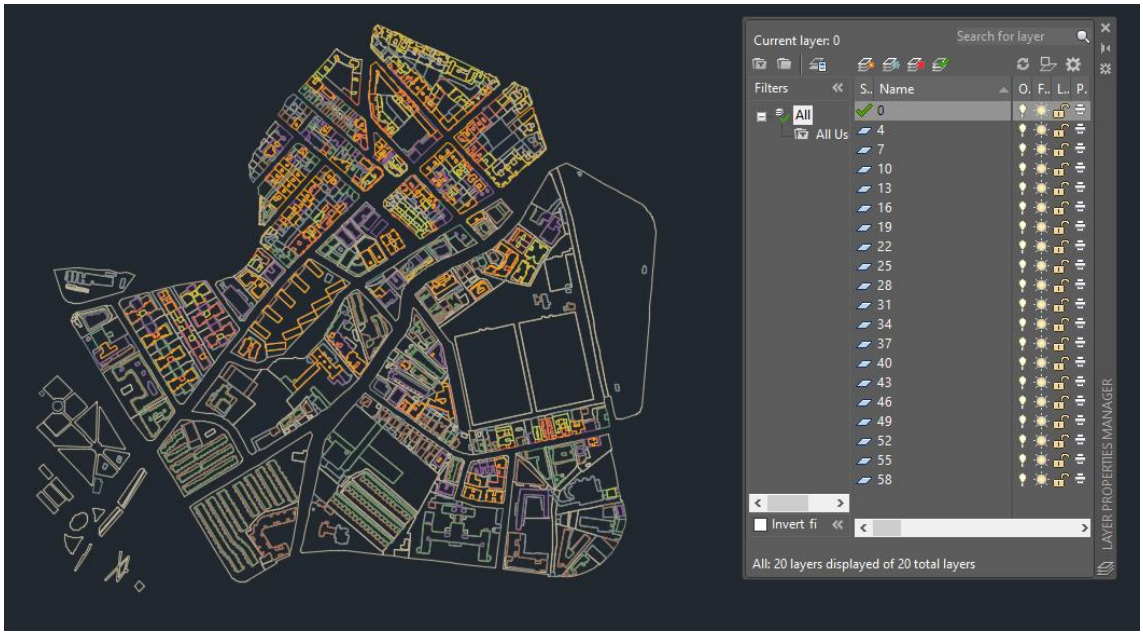


Figure 11. Heights written in the layer's name

4º Type the command 3D_Model, the algorithm should start immediately

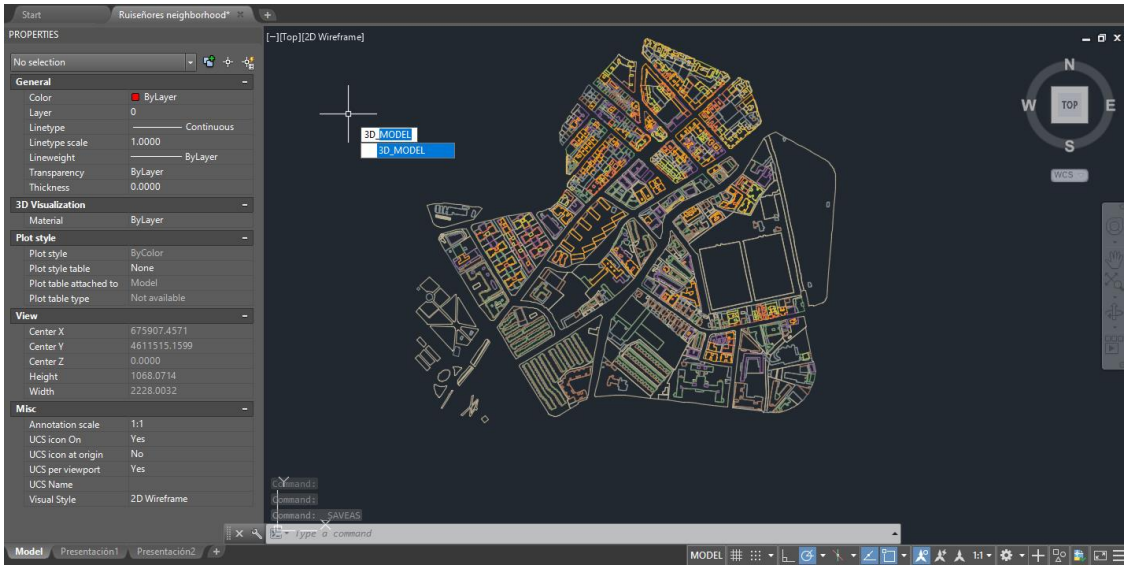


Figure 12. 3D_Model command

5º Wait until the algorithm ends and shows the message "The 3D Model has been completed"

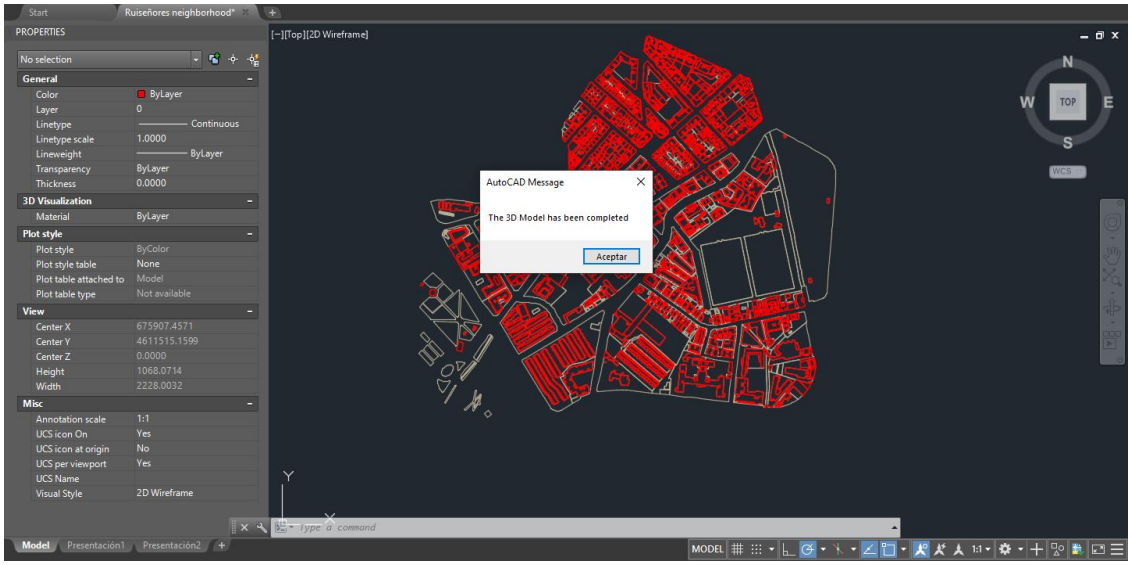


Figure 13. Final message when the algorithm ends

Now the 3D model is completed and can be used in Autocad or exported to other software.

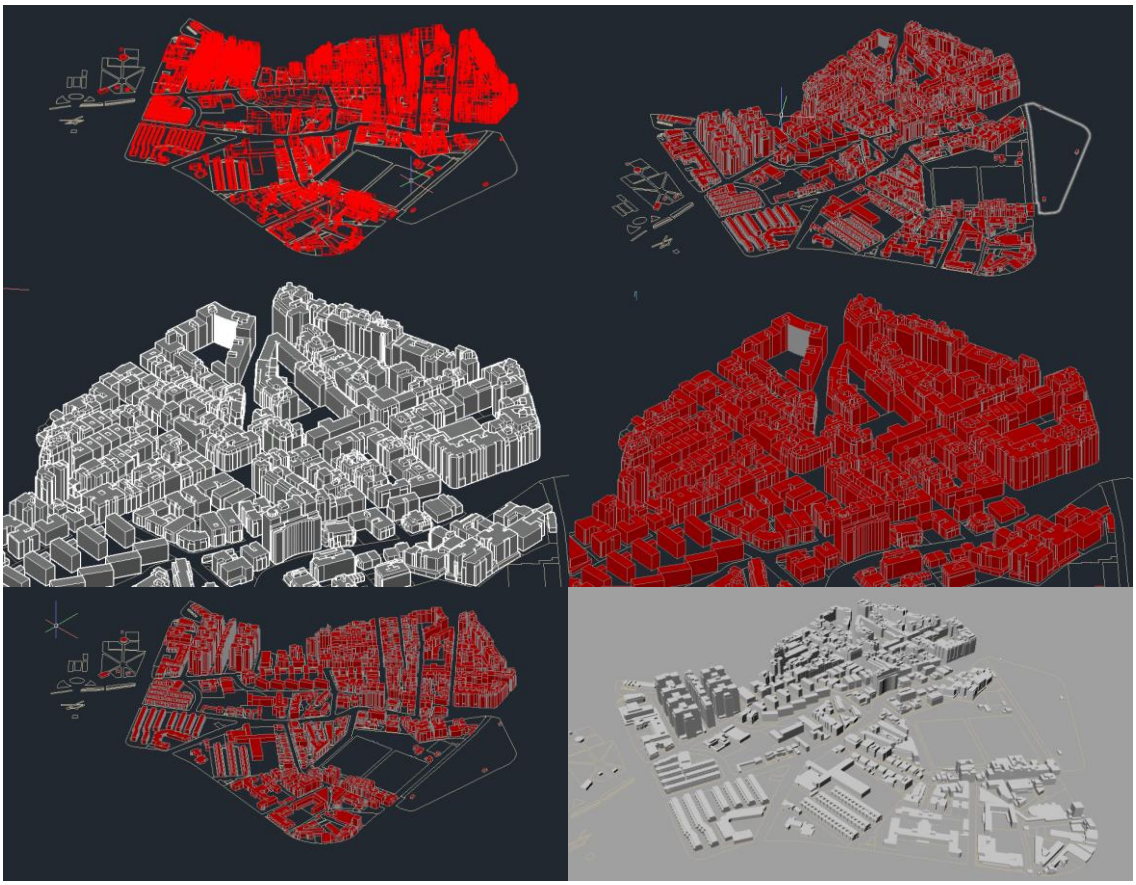


Figure 14. Images of the finished model