APPENDIX B

ALGORITHMS

QGIS

Collection of all the algorithms used for the development of Attributes and Metrics starting from Volume and Void Components' input layers as explained in section 5.3.4 and shown in Figure 49.

- Volume Filter
- Surface (work of ArcMap Free Vertical Surface intermediate output)
- UV2B
- Court
- Block
- Attributes
- Metrics

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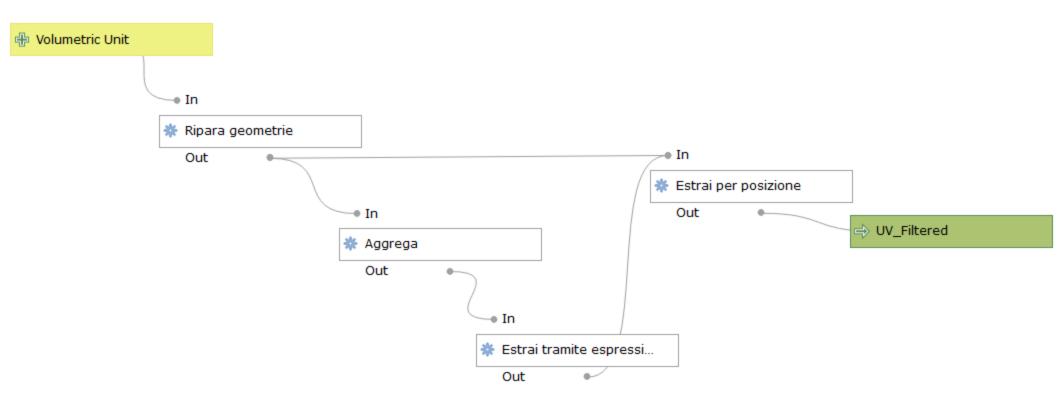
Presentation of the Free Vertical Surface Model builder module that has been used in place of QGis Surface for some computational limits.

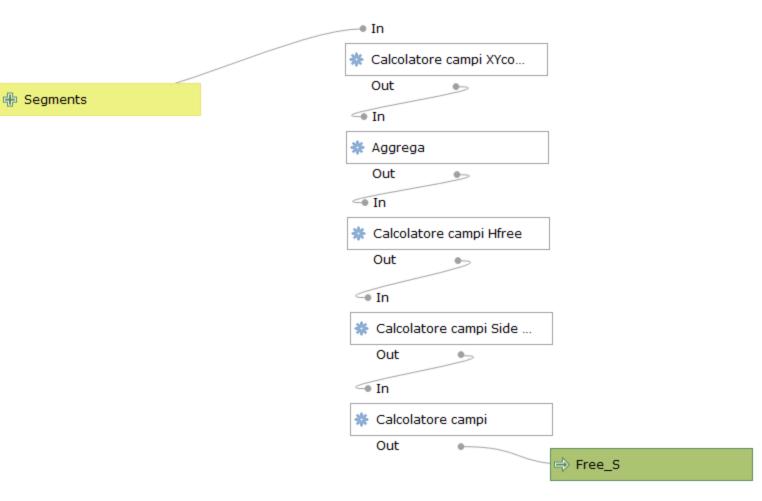
- Description and Formula
- Screenshots of the procedure

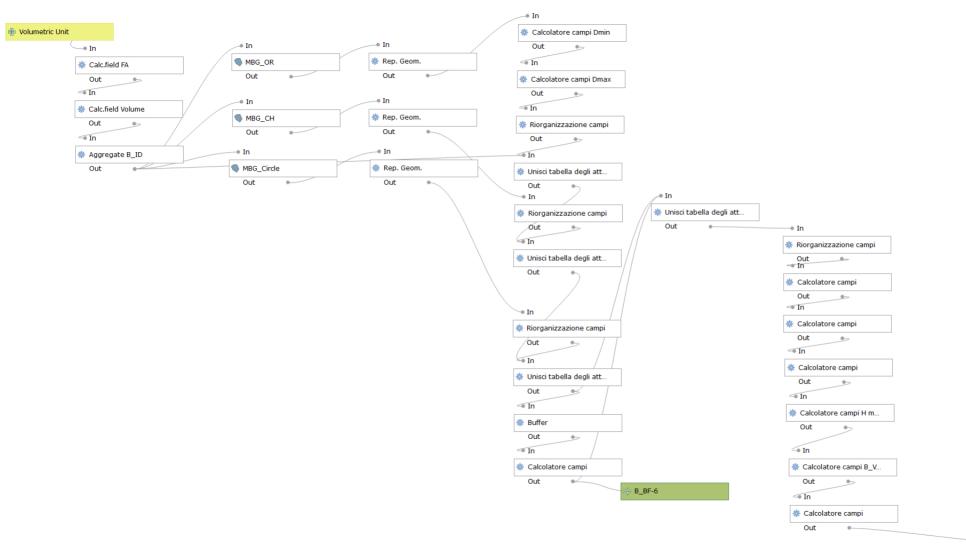
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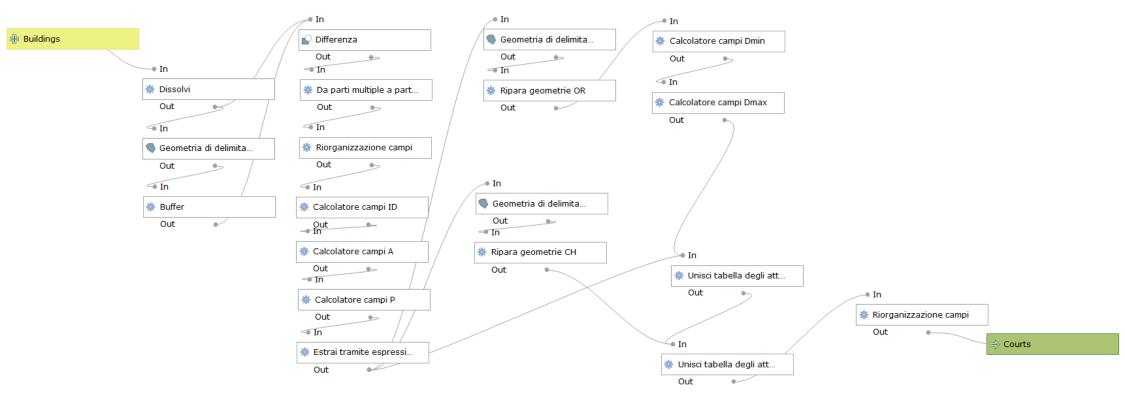
Two visual scripting examples developed for the partmership with Vectorworks and based on Tadi et al. (2017) for Porosity and with a similar approach using metrics found in the literature for Compactness. Porosity algorithm only compute values and draws the diagrams (here shown for morphological variations with a fix building density) while Compactness one also creates random shapes that simulate the agglomeration of urban patches.

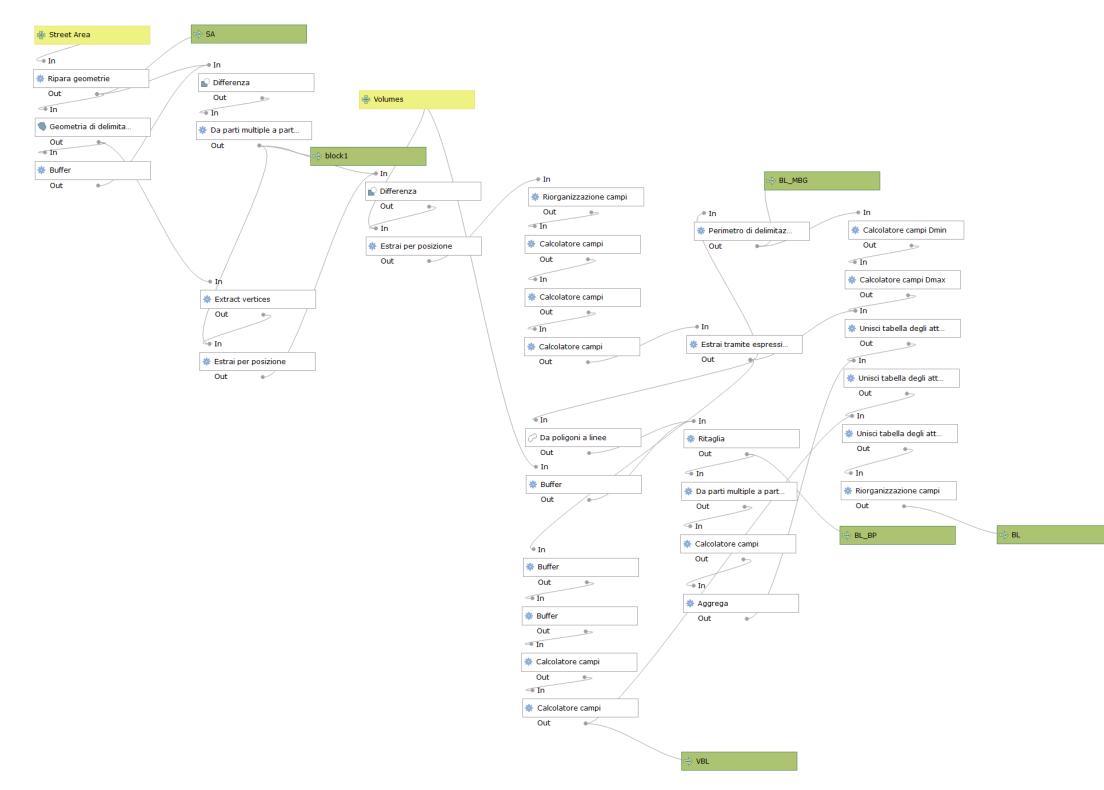
- Porosity
- Compactness

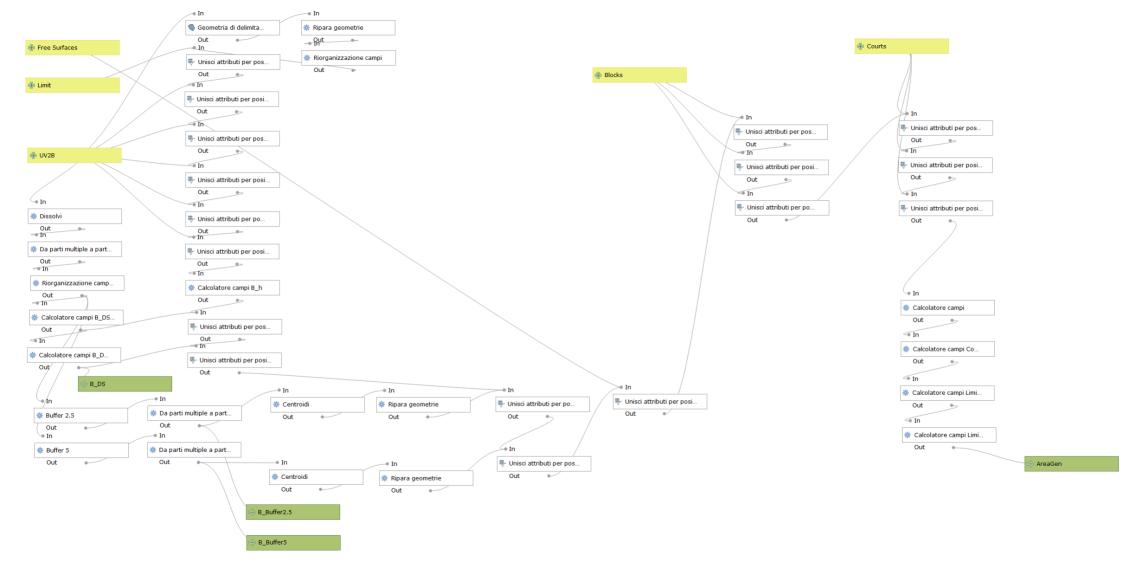










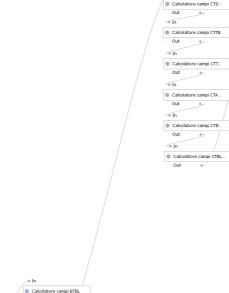


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MODEL BUILDER

One of the model developed for the research is here presented. This is about the computation of the free vertical surfaces using as input the volumetric units layer. This is the only part that required the use of ESRI ArcMap software while all the rest has been developed using the open source QGis.

The goal is to achieve within a GIS environment what is actually a very simple operation for 3D modelling software, calculating the filtering from the total vertical surfaces those that share a portion of their area with other surfaces. Contact surfaces can belong to the same building (UV – UV) or to the same Bds (B – B). In a 3D modelling environment we would normally perform a boolean union of building volumes, in order to obtain a single full object, followed by an explosion or Brep deconstruction to receive as output the single free faces. In GIS terms this could be seen as a tridimensional Dissolve followed by a split according to volumes edges, but unfortunately is not possible to do it.

The algorithm follow an alternative and more tortuous path that will be explained step by step before showing the code.

Free Vertical Surface

Input: Volumetric Units (UV)

Feature to Line: trasformtion from polygons to lines

Feature Vertices to point: extraction of verteces from the lines just obtained in a point layer

Split Line at Point: split of the lines using the points generated by the previous step. In this way each line will be divided also according to verteces belonging to an adjacent different line.

Add Geometry Attributes: Add to these new lines the x and y coordinates of the centroid as attributes and the length of the line (LENGTH field)

Add field: XYCOORD, text field to host a code composed by the two coordinates of the centroid just created

Calculate Field: XYCOORD, concatenation of the two coordinates in a single text code

Dissolve: on XYCOORD field, asking to mantain as attributes the minimum and maximum value of height field and the count of the dissolved geometries [1;2]

Add Field: H_FREE to host the difference between maximum (Hmax) and minimum (Hmin) height for contact surfaces

Calculate Field: H_FREE, Hmax – Hmin

Add Field: FREE_S to host free vertical surfaces

Calculate Field: FREE_S according to the following formula:

dim x

if [COUNT_UN_V] = 1 then

x = [Hmax] * [LENGTH]

elseif [COUNT_UN_V] <> 1 then

x = [H_FREE]* [LENGTH]

end if

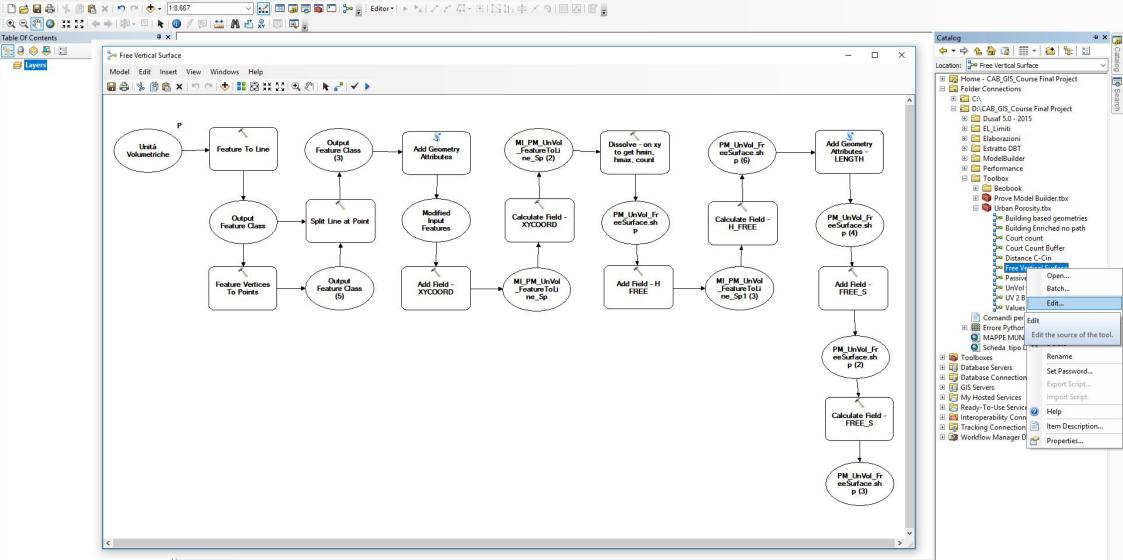
that means: if one line doesn't overlap with others (count = 1) take Hmax as value and multiply it by the LENGTH field, If two lines overlap (more than two is physically impossible) take H_FREE field and multiply it by the LENGTH field.

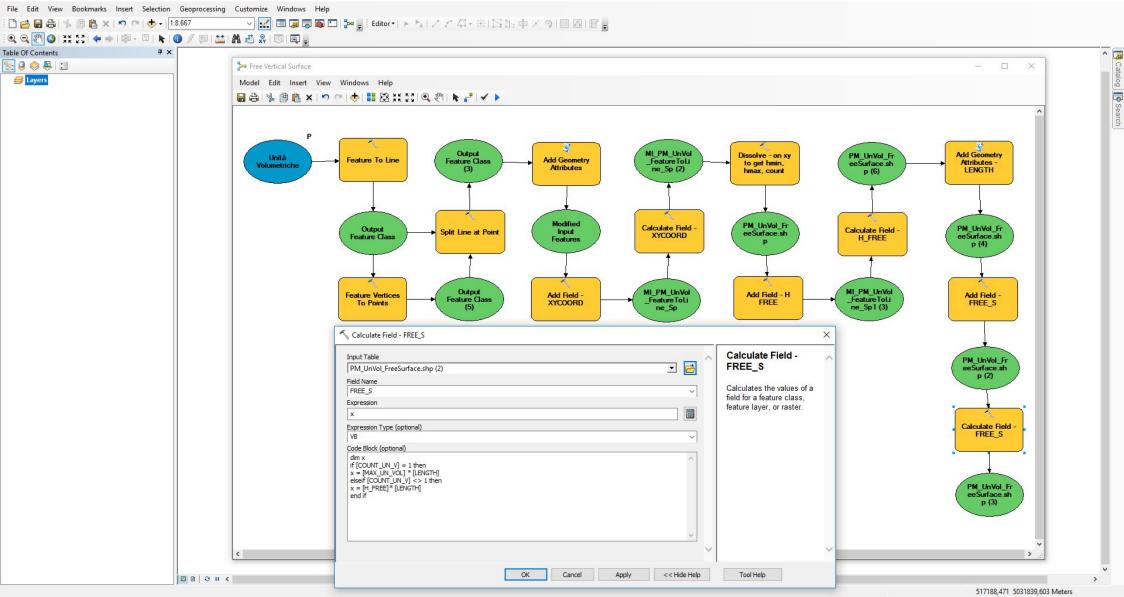
A set of pictures will show this process for the Porto di Mare Area:

- Blank Model builder module, before inputs
- Validated Model builder module with FREE_S expression
- Loading...
- Line output with attribute table
- Free Surface map
- Free Surface on Max Surface map

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