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GIS-BIM Interoperability for Regeneration of Transurban Areas

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Expanding cities – Diminishing space

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The DATA project

Project features

- 1. Regional Operative Programme 'Veneto'/European Social Fund 2014-2020
- 2. University of Padova, involved departments: DICEA + DII
- 3. Goal: designing pilot scenarios for abandoned transurban areas

Research topics

- 1. WebGIS and data mining
- 2. Building and land information modeling
- 3. Pilot scenarios design
- 4. Urban planning and feasibility studies
- 5. Urban mining
- 6. Data management and ICT

Padova: abandoned areas

SOIL CONSUMPTION

Europe 4 %

Italy 7%

Veneto 12%

Padova 49%

It is possible to contain it through *reuse and reactivation* of underused or decommissioned buildings and abandoned or unplanned areas

0   1 km

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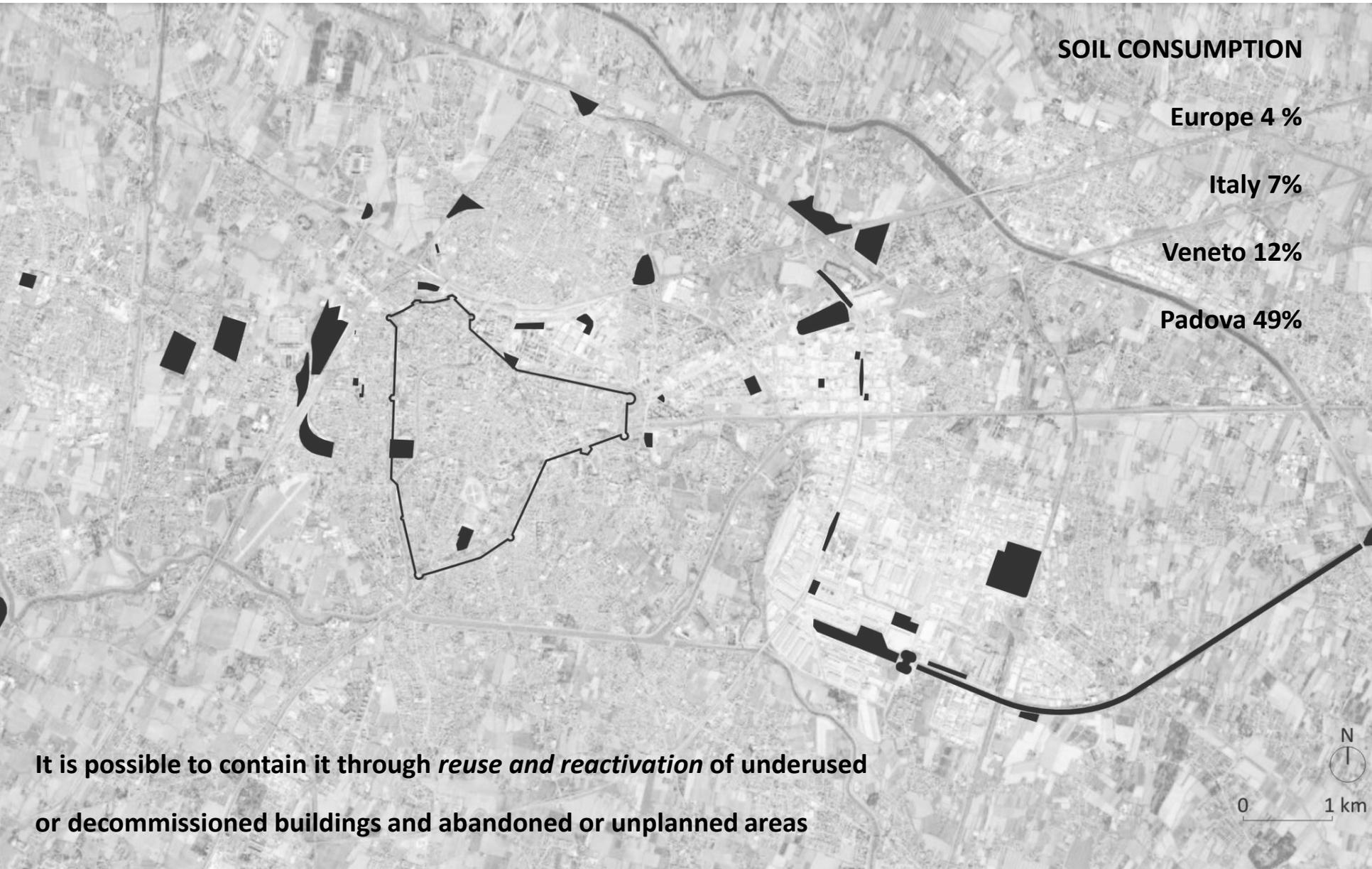
Research area: West Padova

Building map of the research area

GIS and BIM interoperability

COMMON EXCHANGE FORMATS

GIS ⟶ CityGML

CityGML is able to represent 3D city models provided with semantic features. It is structured into Levels Of Detail (LOD), from 0 to 4.

BIM ⟶ IFC

In an IFC model entities are divided in categories and can belong to different Levels of Development (LODt), from 100 to 400.

RESEARCH FRAMEWORK AND PURPOSE

DATA has a **multi-scale** approach: in a framework where urban peripheries are considered a relation system between a city and the surrounding territory, the project aims to combine the methods of urban and territorial analysis.

The presented work tests **direct conversion** from GIS to BIM using visual programming tools.

Software used for conversion

QGIS and **Revit** are among the most diffused platforms respectively for GIS and BIM

Dynamo is an open source visual programming tool, also available as a Revit plug-in

Data and attributes used for conversion

To check the feasibility of the process of **data transmission** from GIS environment to BIM, a test has been performed on a sample area, corresponding to the core intervention zone of DATA project, in the western periphery of Padova.

Selected **base data** were:

-an excerpt of the Regional Technical Map, reporting building functions

-a portion of the municipality map of volumetric units

Selected **attributes** for GIS-BIM conversion, for each polygon representing a building, were:

-ID code

-Function code

-Function description

-Bottom elevation above sea level

-Top elevation above sea level

-Height

GIS layer detail and attribute table

In QGIS, attributes of volumetric map and Regional Technical Map were integrated through a spatial join.
The new obtained layer was then cleaned deleting unnecessary attributes and indexed.

GIS-BIM conversion process
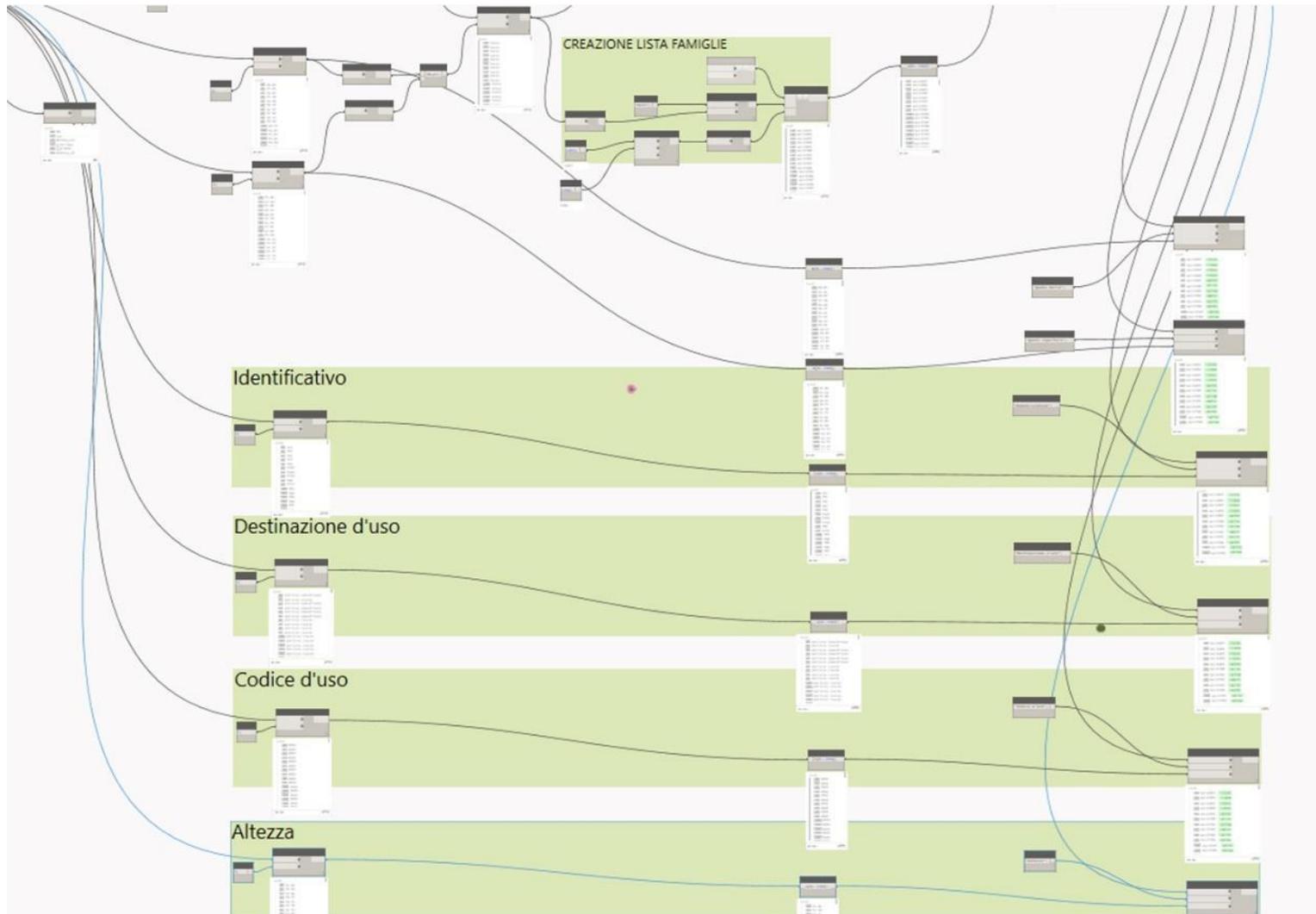
A screenshot from Dynamo workflow. Starting from building height values, extrusion solids were generated. The script associated to these solids the other parameters from the GIS layer, with corresponding values.

3D BIM model
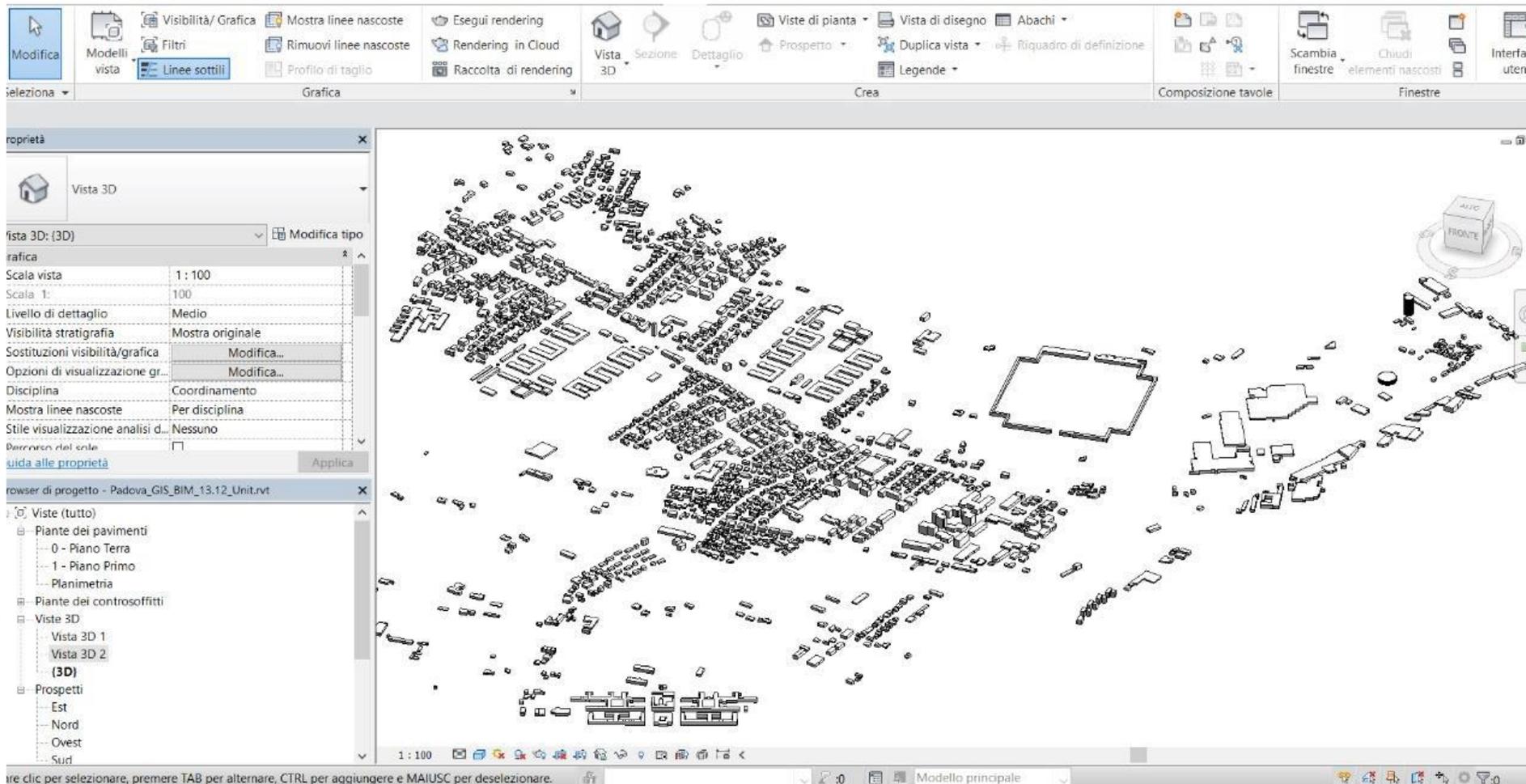
The output is a 3D model of a portion of Padova, where every building is by itself a simplified threedimensional model provided with all the information also loaded in GIS environment

BIM-level attribute values
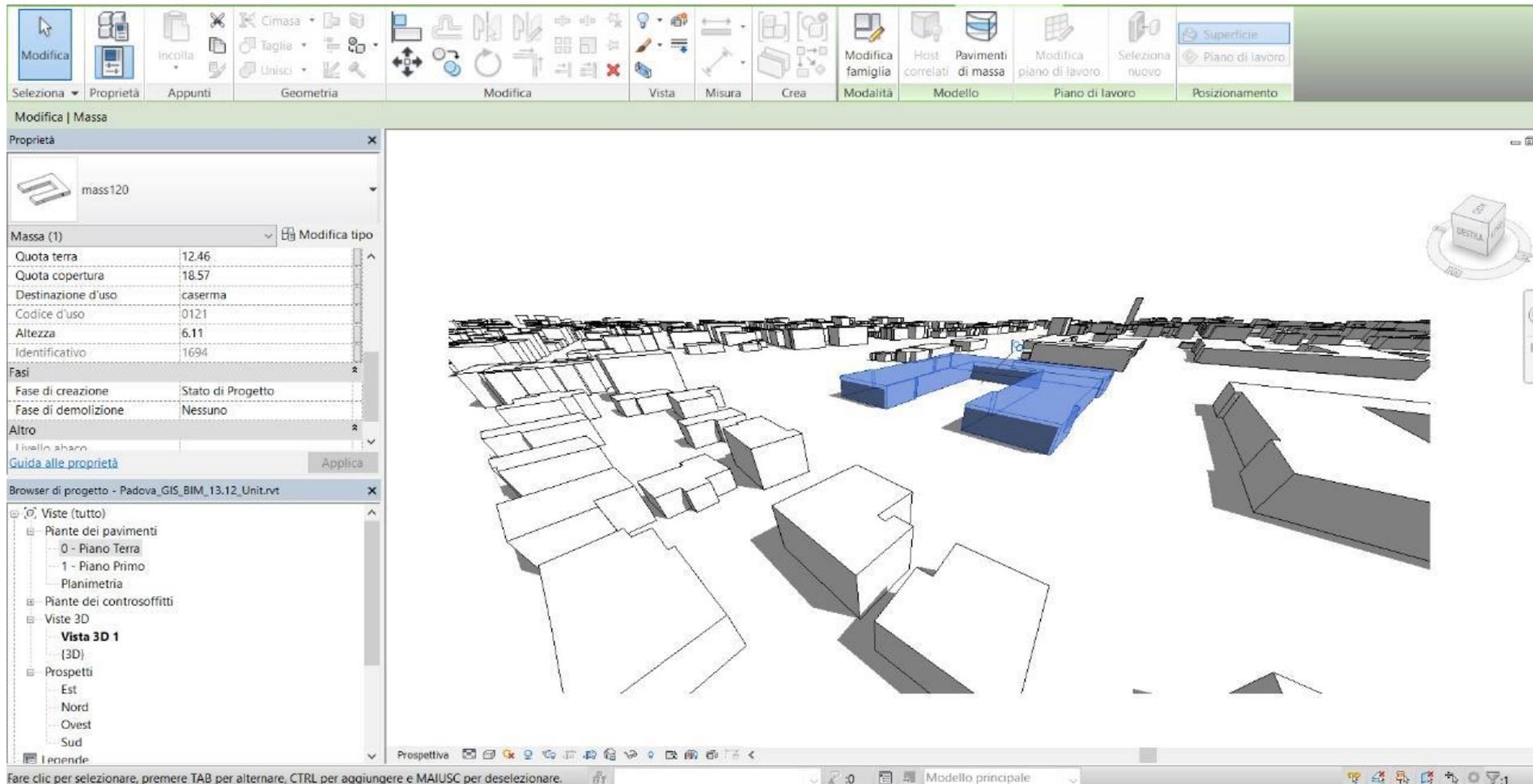
The building selected is the same previously shown on QGIS, now viewed in Revit showing the same attribute values.

Workflow layout and reverse process
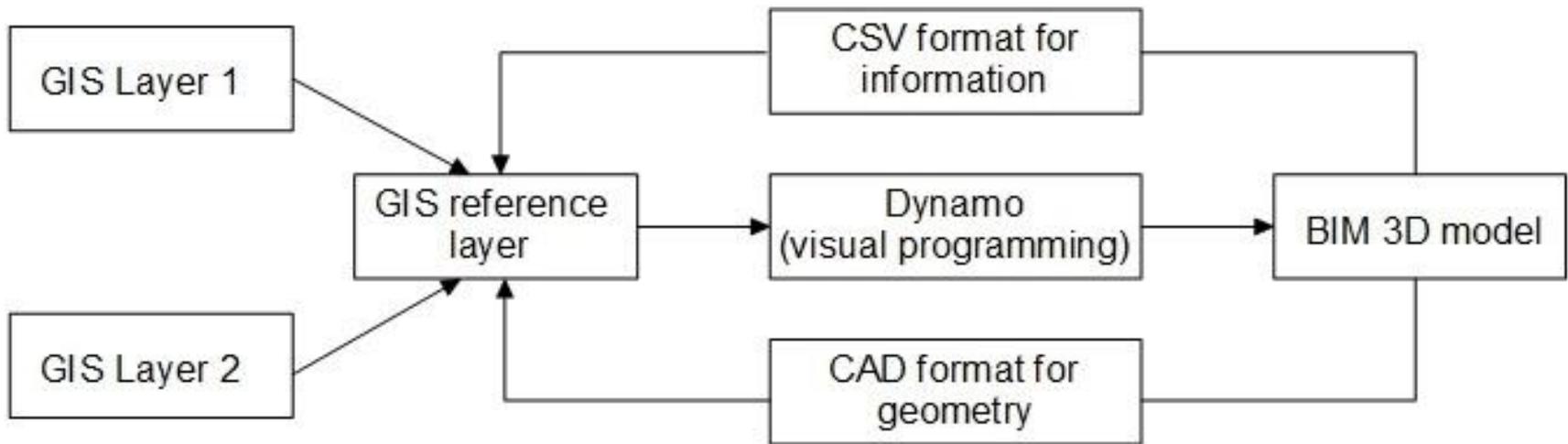
As-built volumes added or edited in Revit can be brought back to QGIS by exporting a plan view of the model to a CAD format, e.g. DXF, where they can be integrated to an existing layer.

For information, from the Revit model one can extract a CSV attribute table; on QGIS, a tabular join can be performed on it. In this way, additional parameters or new values can be conveyed to the GIS level.

Conclusions

The procedure described above puts a direct connection between two major software, respectively QGIS and Revit. It is more oriented to **data transmission** from GIS to BIM than to the construction of a detailed BIM model, but limited to its purposes it is very accurate and perfectly replicable. Further tests will be made to improve some passages and possibly to add new data related to the development of design scenarios and the creation of a communication platform.

The performed workflow is just a sample of what is possible to do. The range of applications is wide: it could be a support for implementing and updating a 3D digital building **cadastre** by public administrations; it could also be used in urban transformation processes. For example, data about **energy performance** category of buildings may be collected, together with building orientation and climate data, to enhance energy sustainability; a series of detailed social and economic data surveyed on field could be combined with a building-scale map of empty dwellings for **real estate management** projects .

Thank you for listening

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