Virtual 3D City Model Generation in CityGML

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Background

Virtual 3D city models are increasingly vital for urban planning, environmental simulation, and digital governance. However, traditional high-fidelity models often demand expensive data acquisition and complex manual workflows. To overcome these limitations, we propose an automated method to generate virtual 3D city models in CityGML format by integrating open data (e.g., OSM, DEM, and PLATEAU LOD2) with the concept of a *digital cousin*. This approach offers a low-cost, scalable, and flexible solution for generating realistic urban environments.

Contribution

1. Propose an automated framework that synthesizes terrain, roads, vegetation, buildings, and city furniture into CityGML-formatted 3D models.
2. Our method supports LOD 0–2 outputs and enables flexible control of parameters such as building height, roof type, road width, vegetation density.
3. Speed of 5 buildings/second and producing cities of 500 m × 500 m in ~1 minute.
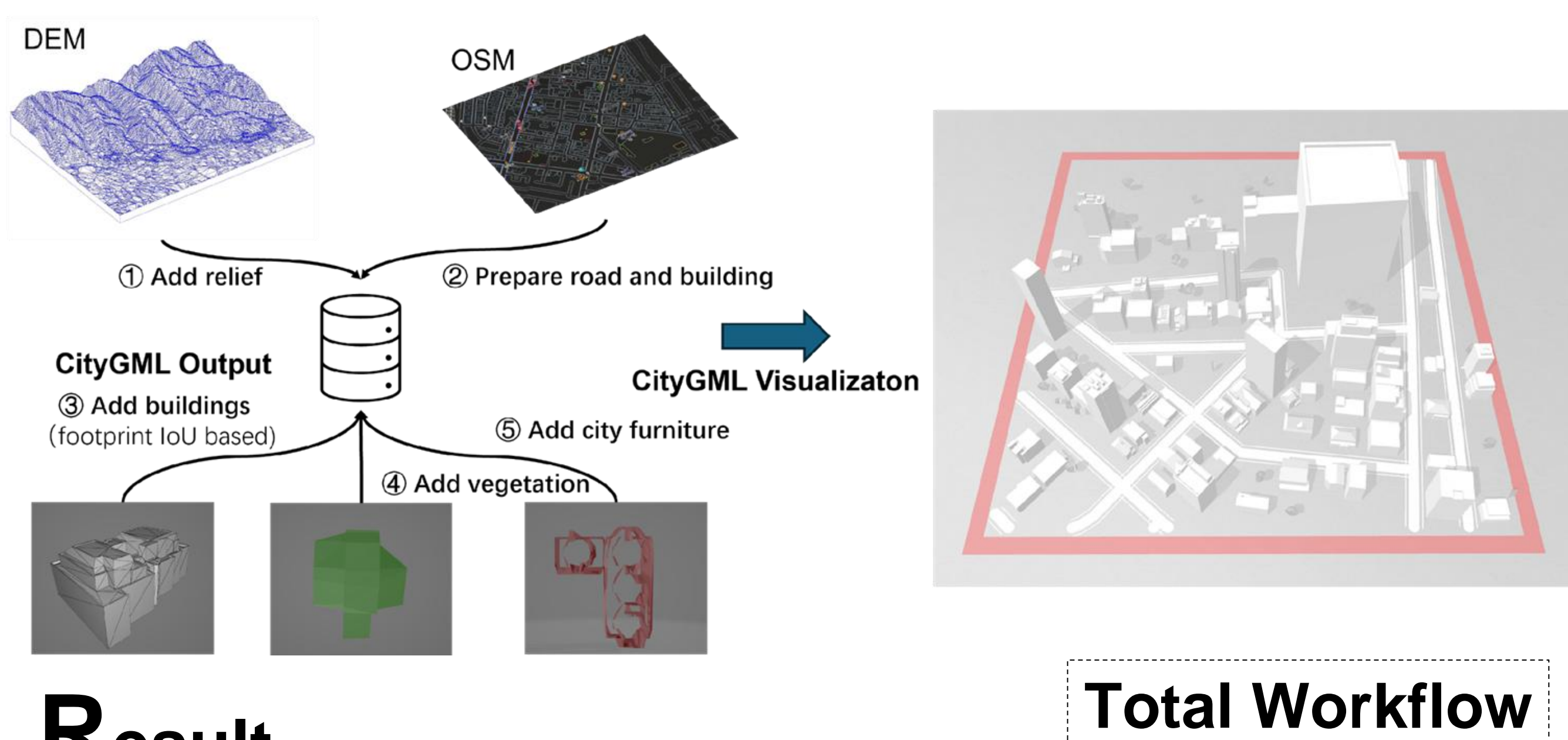
Dataset
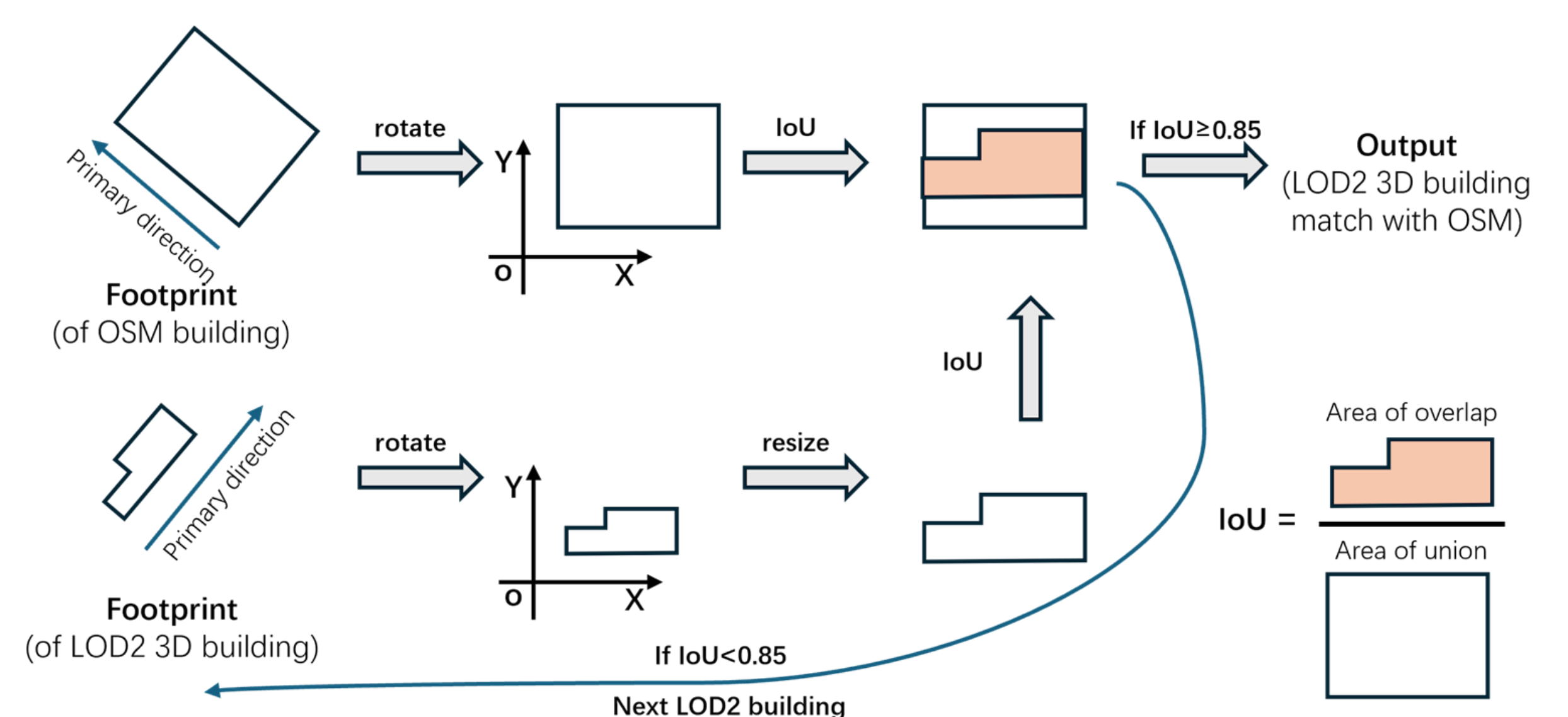
3D Building Models: 69,551 buildings labeled with 6 roof types (Flat, Stepped, Composite, Hip, Gable, Unconventional) from PLATEAU.
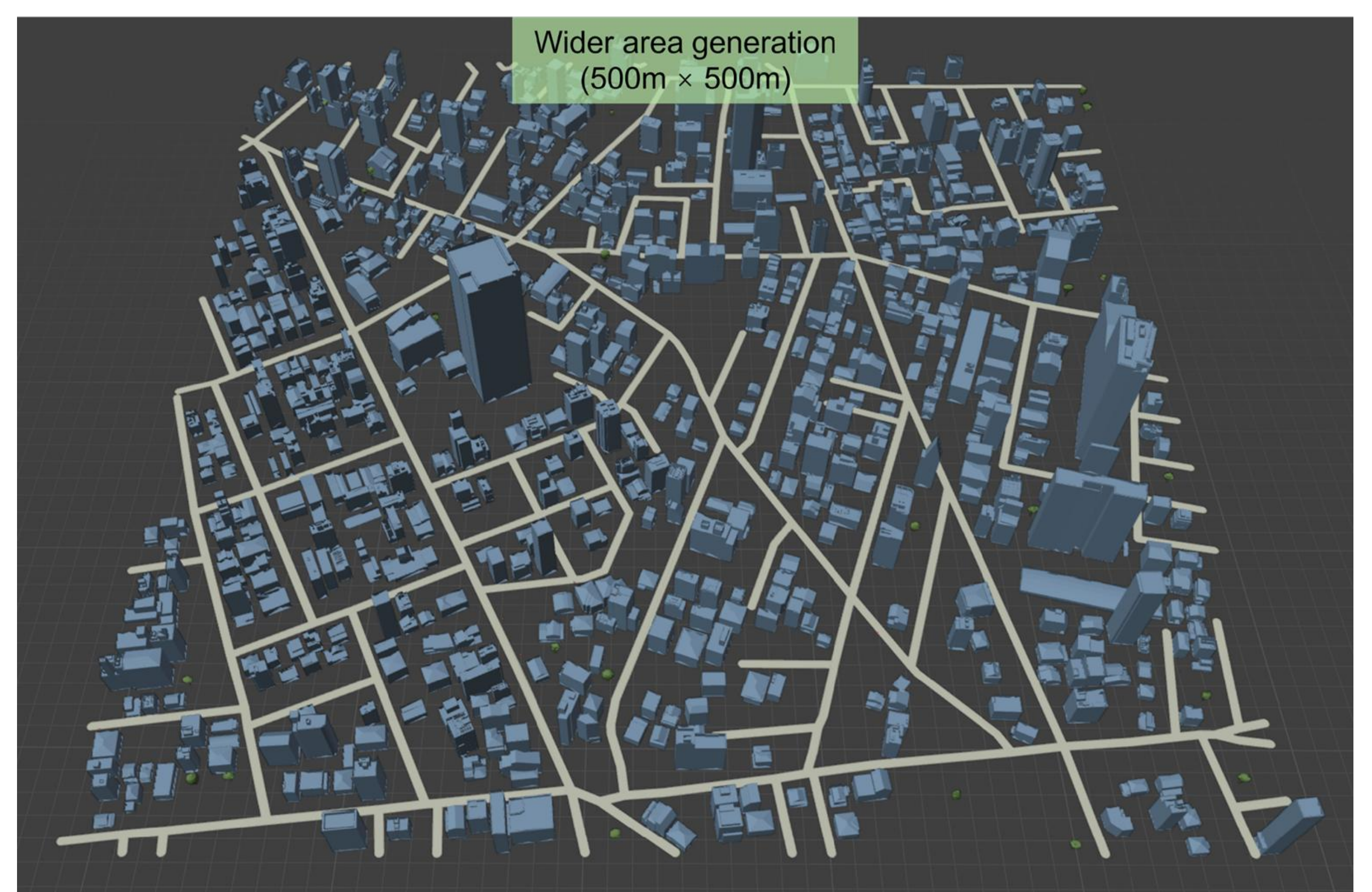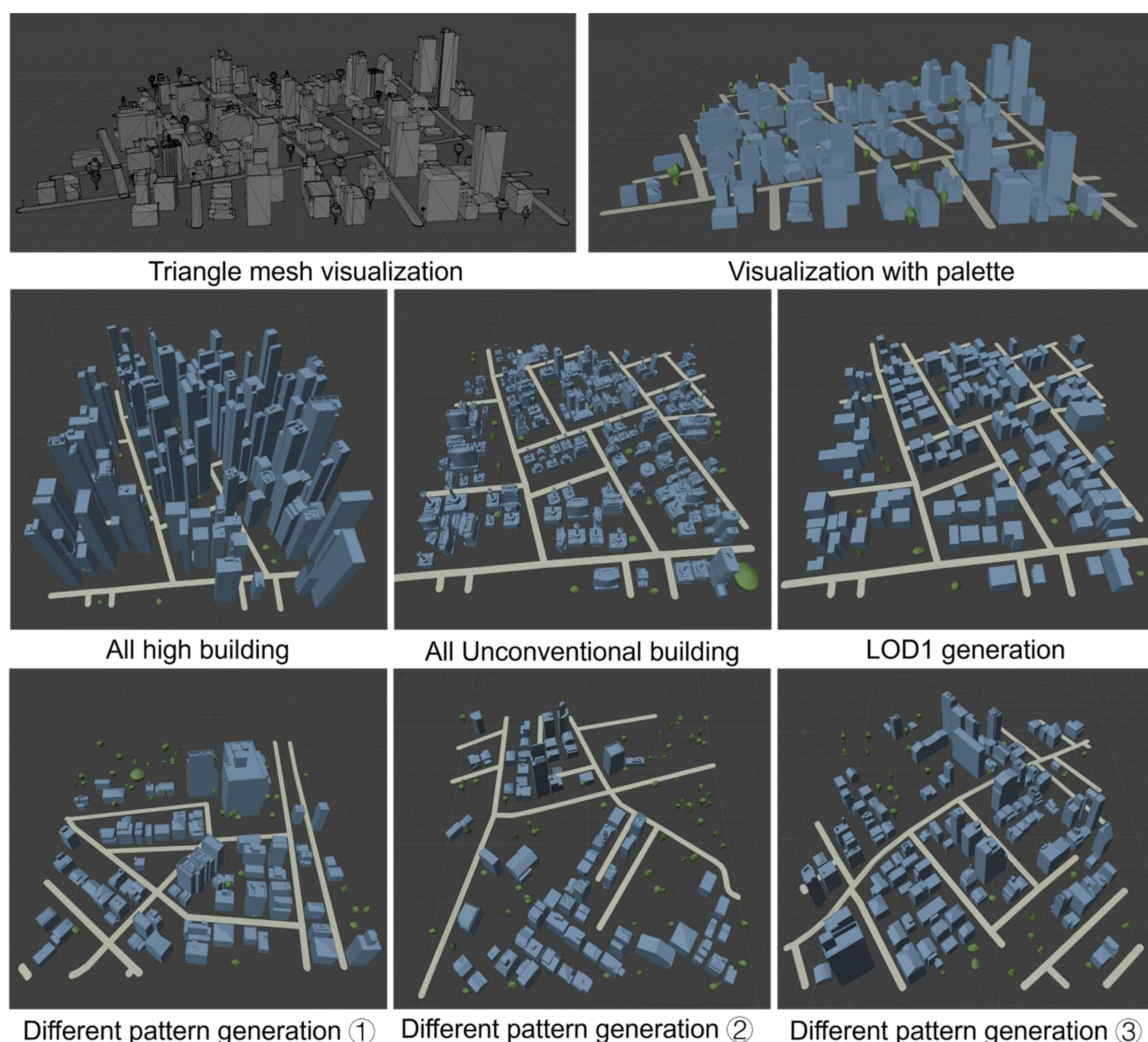
Vegetation & Furniture: 498 labeled objects from open CityGML.

Relief & Roads: DEM (1–10 m resolution) and OSM data for terrain, road layout, and building footprints.

Workflow

Total Workflow

3D Building Generation Workflow

Result

Triangle mesh visualization

Visualization with palette

All high building

All Unconventional building

LOD1 generation

Different pattern generation ①

Different pattern generation ②

Different pattern generation ③

Wider area generation (500m × 500m)

Our method enables intuitive adjustment of city attributes and produces 3D scenes well-suited for simulation, planning, and GIS applications: **Supports CityGML 3.0 output; Enables parameterized scene synthesis; Generation reproducible via random seed control.**