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urban analytics lab

Understanding Buildings in Cities:
An Integrated View of Building Properties

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Advisor: Prof. Filip Biljecki

Introduction

Building type / storey



Architectural style / age



Albedo



Color



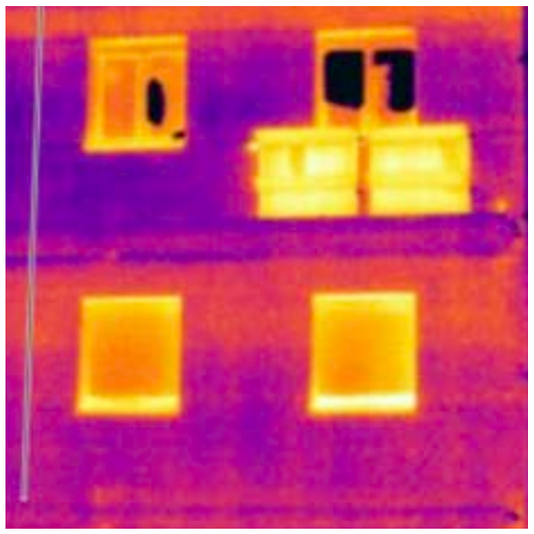
Facade components



Facade materials



Thermal properties

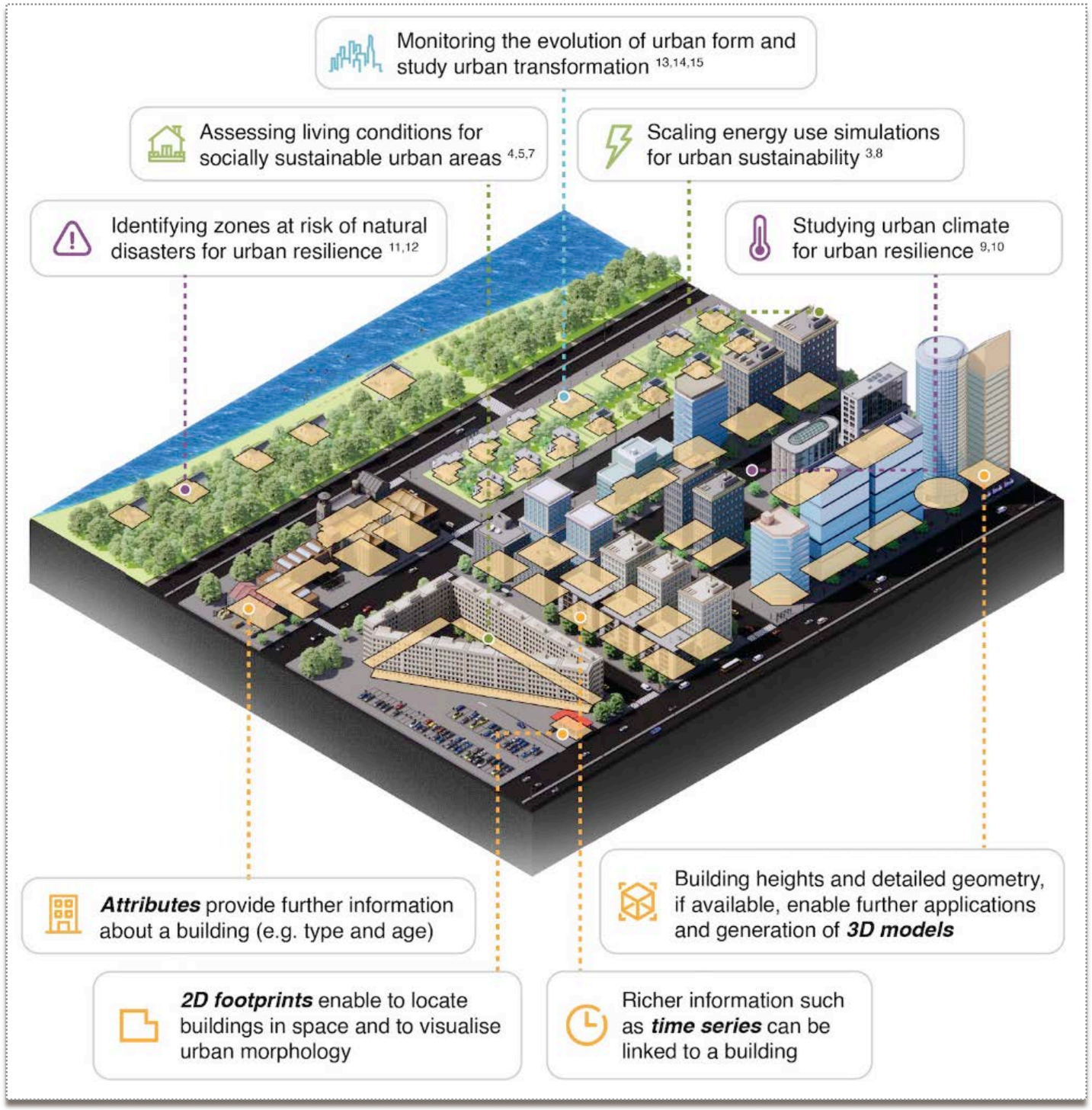


Geometric layout



Duran, A., Waibel, C., Piccioni, V., Bickel, B., Schlueter, A., 2025. A review on artificial intelligence applications for facades. Building and Environment 269, 112310. https://doi.org/10.1016/j.buildenv.2024.112310

Introduction



- Urban transformation
- Energy simulations
- Urban climate study
- Disaster management
- Urban digital twins
- Circular city

Biljecki, F., Chew, L. Z. X., Milojevic-Dupont, N., & Creutzig, F. (2021). Open government geospatial data on buildings for planning sustainable and resilient cities. *arXiv preprint arXiv:2107.04023*.

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Open FACADES

An Open Framework for Architectural Caption and Attribute Data Enrichment via SVI



Liang, X., Xie, J., Zhao, T., Stouffs, R., Biljecki, F., 2025. OpenFACADES: An open framework for architectural caption and attribute data enrichment via street view imagery. *ISPRS Journal of Photogrammetry and Remote Sensing* 230, 918–942.

How to obtain images of specific buildings?











Open FACADES

An Open Framework for Architectural Caption and Attribute Data Enrichment via Street View Imagery

01. Integrating multimodal crowdsourced data

Image data preparation (Mapillary)



Building data preparation (OpenStreetMap)



building	apartments
start_date	1905
.....	

Isovist analysis + image selection

02. Retrieving building image data

Building detection



Image reprojection

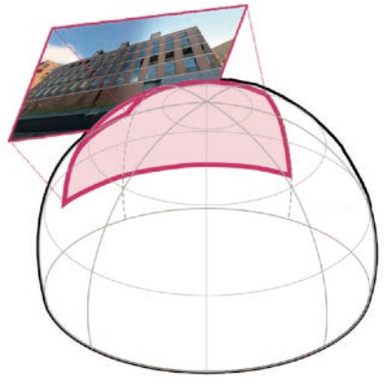


Image filtering



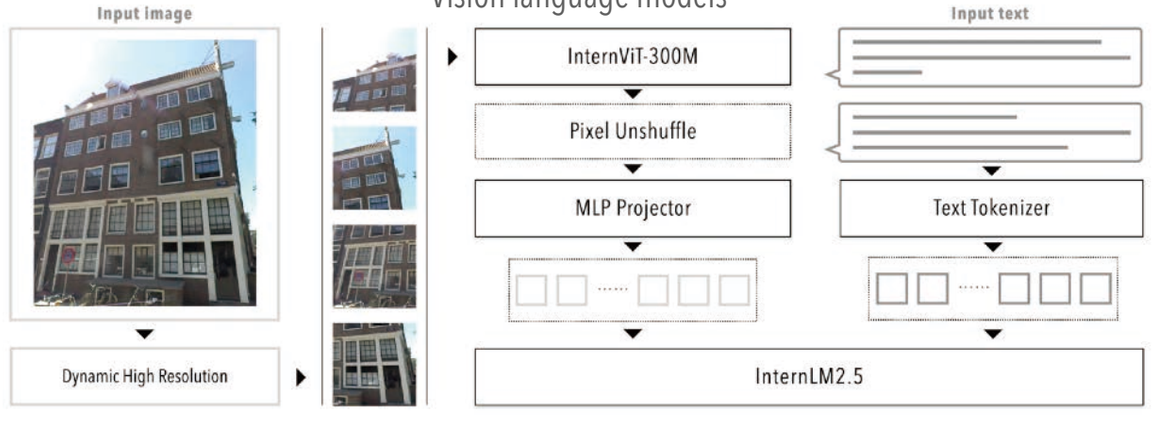
03. Establishing dataset and multimodal models

Street-level building dataset



- Single-word Q&A
- Multi-class Q&A
- Captioning

Vision language models



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Evaluating human perception of building exteriors using street view imagery

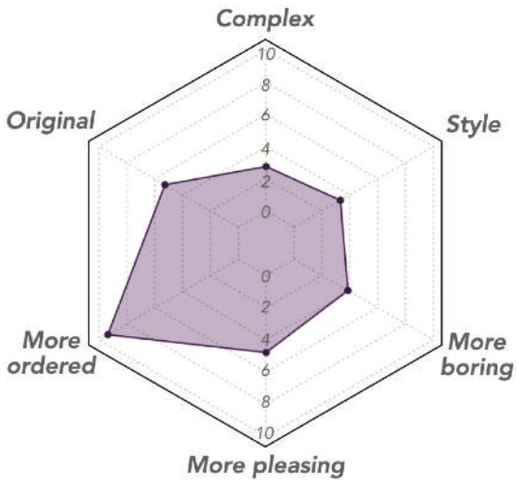
Liang, X., Chang, J.H., Gao, S., Zhao, T., Biljecki, F., 2024. Evaluating human perception of building exteriors using street view imagery. *Building and Environment* 263, 111875.

Human perception on building facade

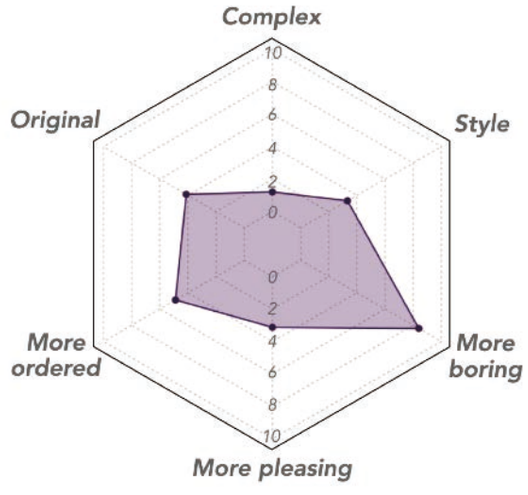
Building dataset

- Complex
- Original
- Ordered
- Pleasing
- Boring
- Style

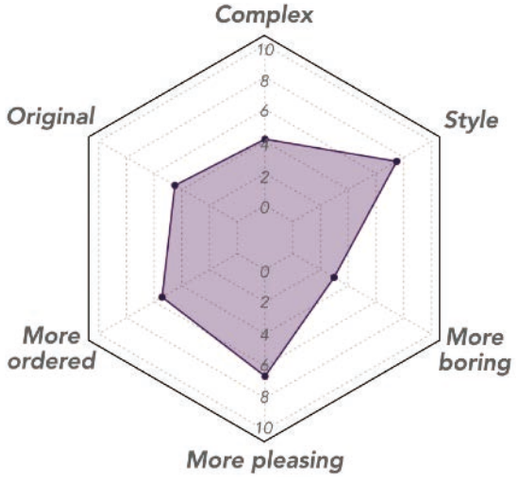




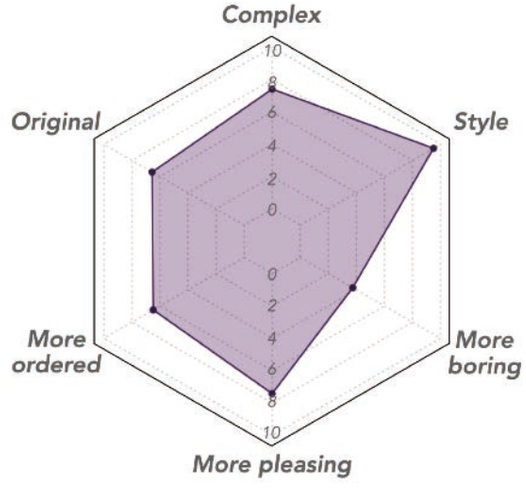












Singapore

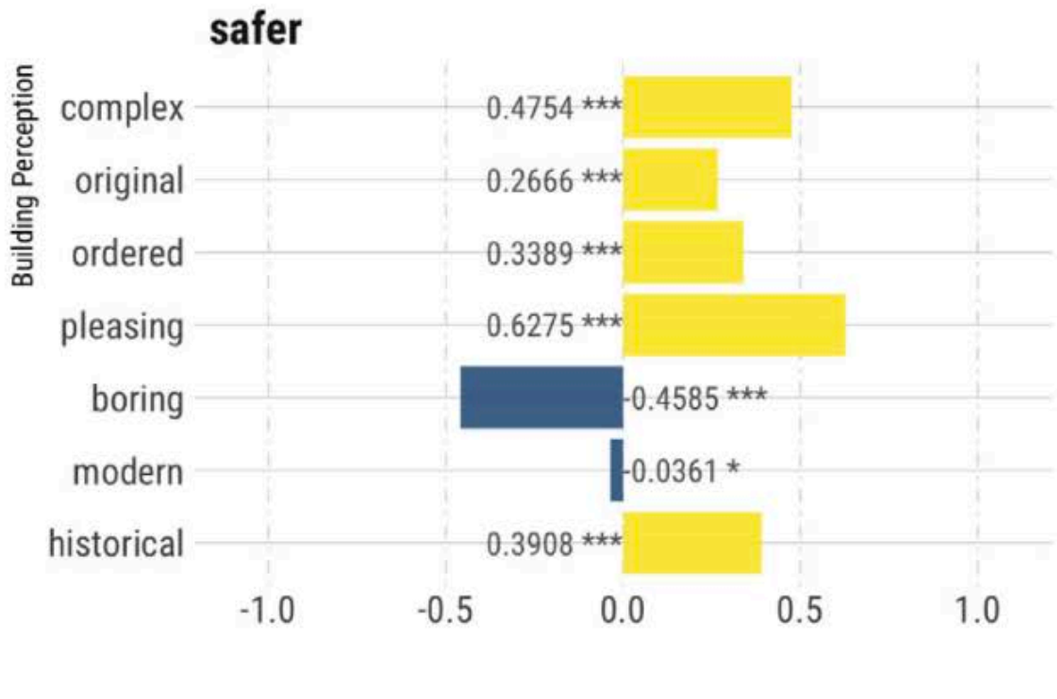
San Francisco

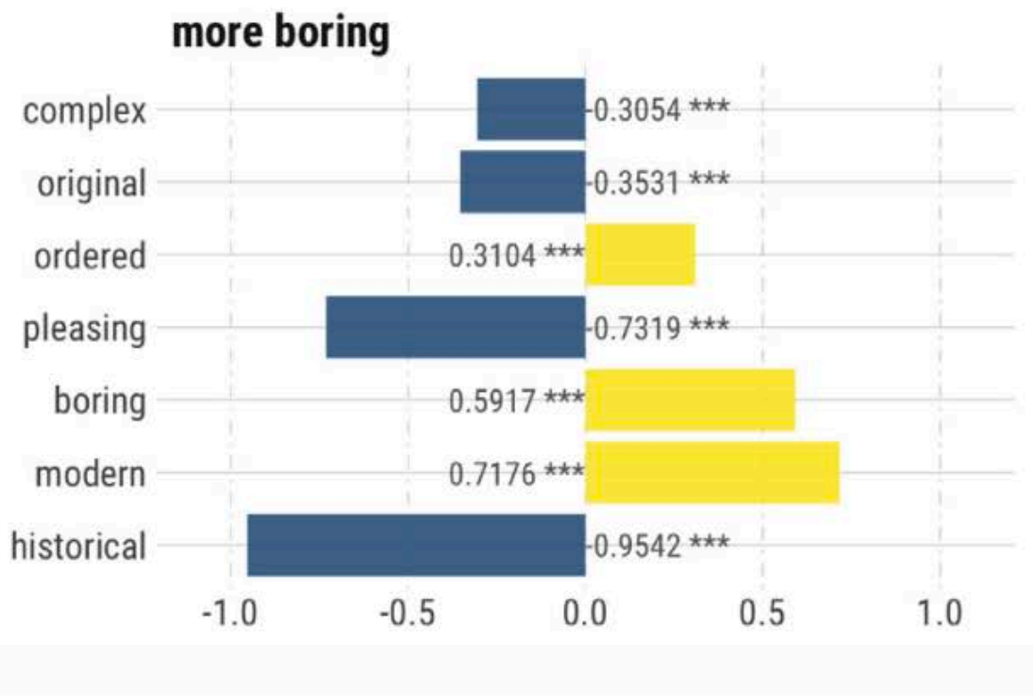
Amsterdam

Low ordered score (≤ 3)

Medium ordered score (> 3 & ≤7)

High ordered score (> 7)





(+) Higher **complexity** and **historical** ambiance positively contribute to all streetscape perceptions.

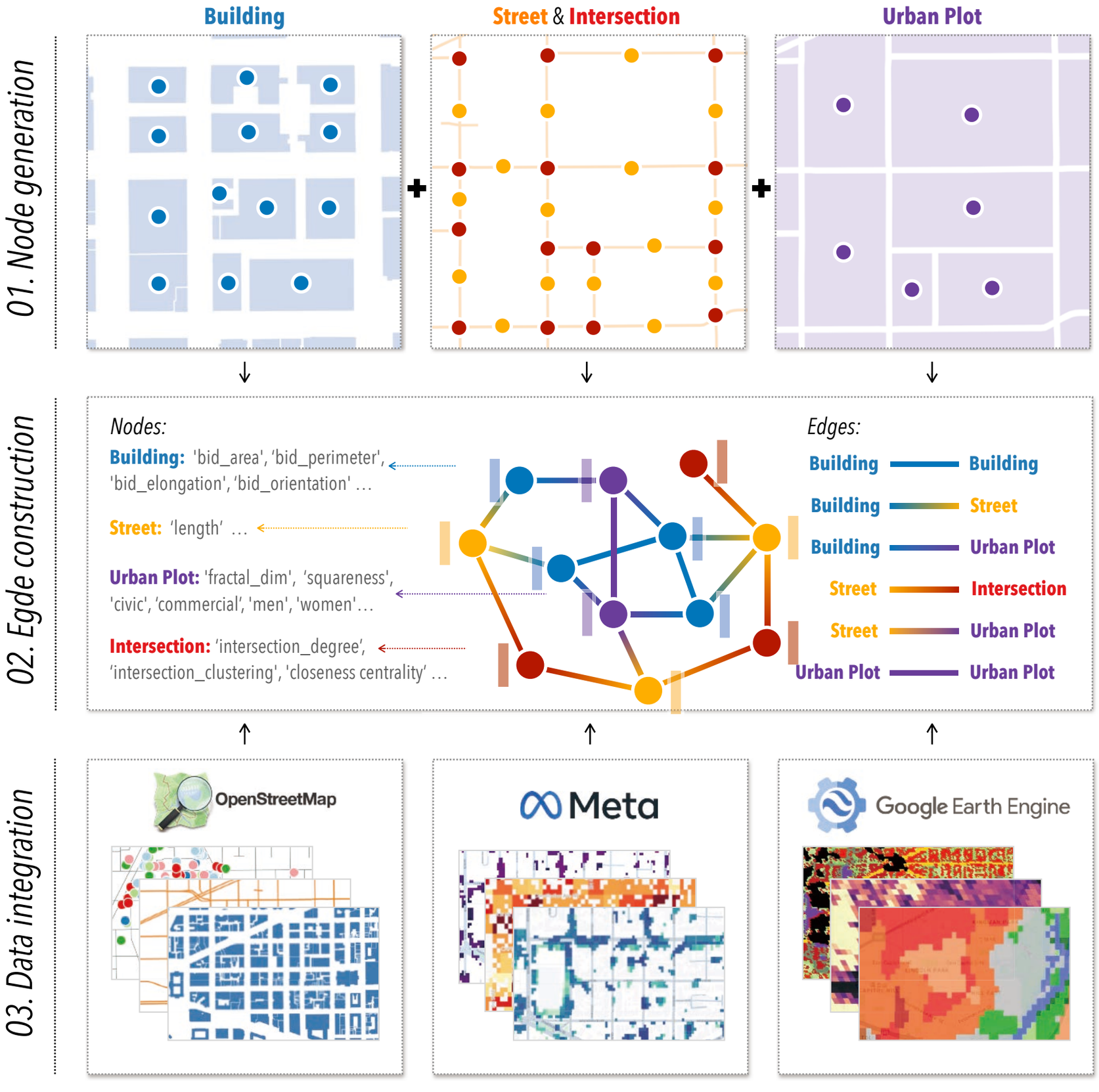
(+) Higher **orderliness** contributes significantly to perceptions of **safety** and **wealth**, but also increases feeling of **boring** on streetscape.

(–) **Boring** architectural design can diminish a sense of safety.

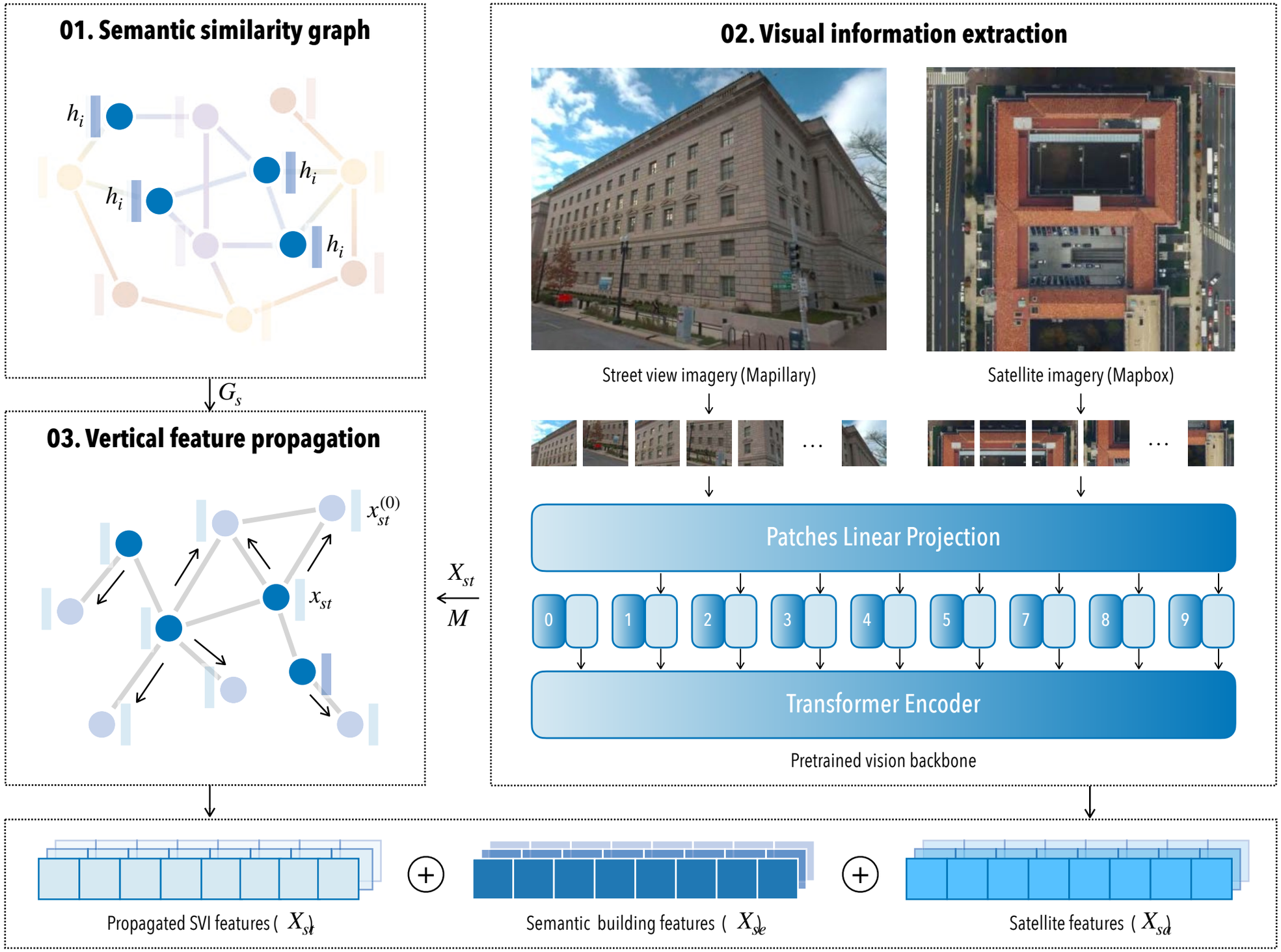
Heterogeneous graph neural networks for building attribute prediction from hierarchical urban features and cross-view imagery

Liang, X., Yap, W., Biljecki, F., 2026. Heterogeneous graph neural networks for building attribute prediction from hierarchical urban features and cross-view imagery. *ISPRS Journal of Photogrammetry and Remote Sensing* 234, 185–204.

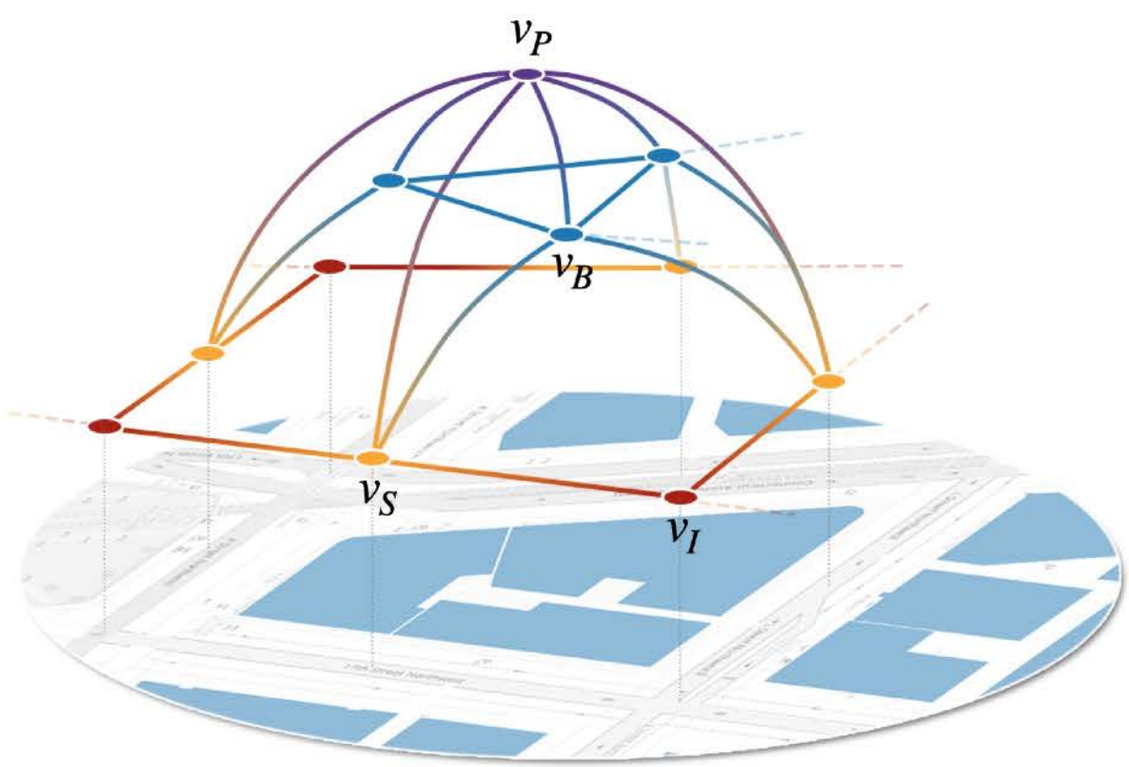
Urban graph: representing hierarchical urban environment



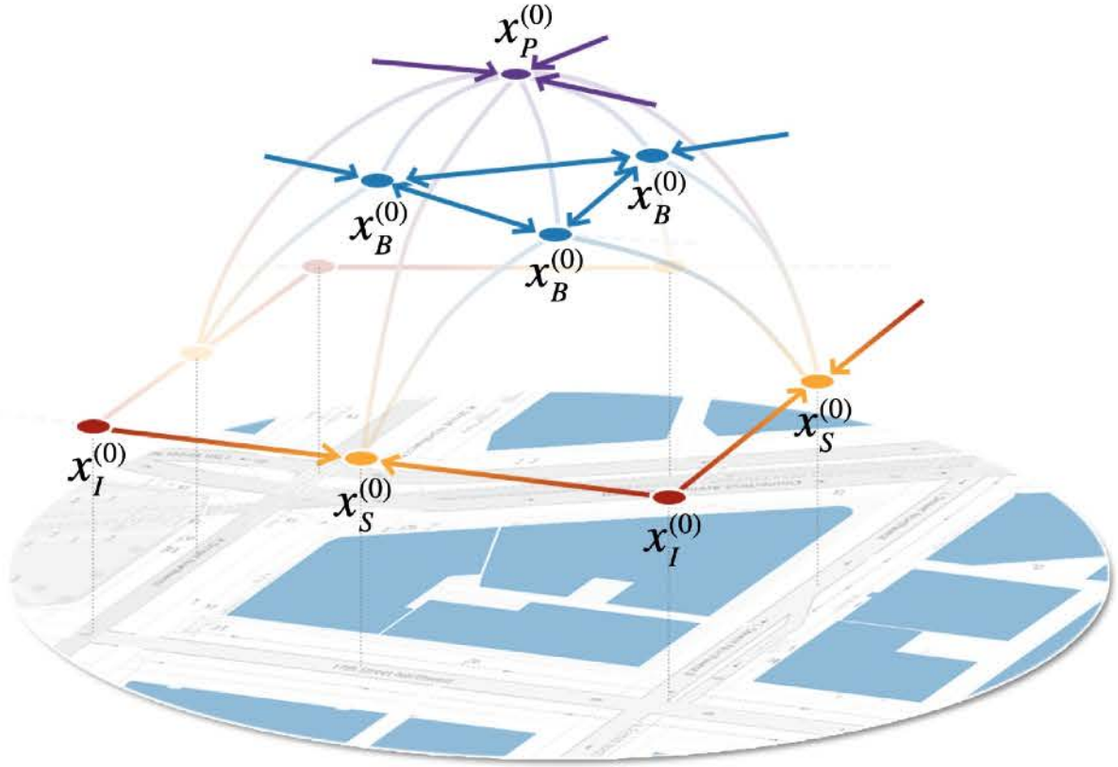
Deep features fusion



Urban graph: representing hierarchical urban environment



(a) urban heterogeneous graph



(b) intra-type propagation

Building — Building

Building — Urban Plot

Urban Plot — Urban Plot

Building — Street

Street — Intersection

Street — Urban Plot