

The study demonstrates the efficacy of a combined approach involving Esri CityEngine and ArcGIS Pro in establishing a systematic, user-friendly pipeline for generating LOD2 (Level of Detail 2) models with minimal expertise in the GIS domain. The pipeline automates the calculation of parameters such as eave height, ridge height, and various roof types, producing a feature layer usable within CityEngine for automatic LOD2 model generation.

The results show the successful creation of LOD2 models for study areas while facilitating a streamlined pipeline that conceals workflow complexities from users. The generated pipeline offers comprehensive guidance for users, spanning from data collection to final accuracy assessment. The generated CGA script support modelling 15 roof forms that are most common in Czechia.

AUTOMATED ROOF GENERATION FOR THE CITY OF OLOMOUC USING ESRI CITY ENGINE

Diploma Thesis

1. PROBLEM

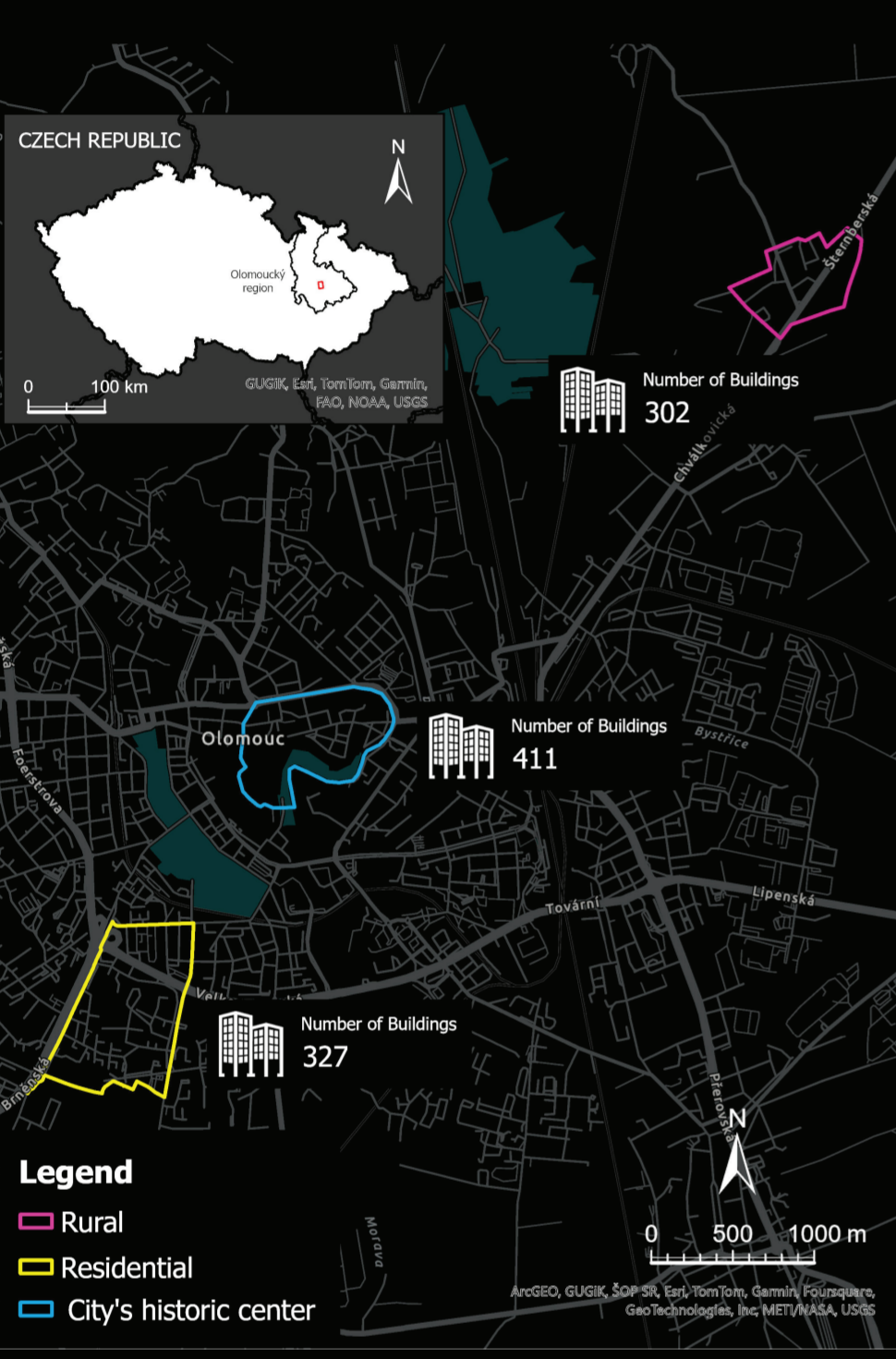
Urban settings bring unique problems and possibilities for efficient urban planning. However, traditional two-dimensional representations frequently fail to capture the complexities of three-dimensional systems, reducing the accuracy needed for informed decision-making.

Although 3D modelling softwares allow making LOD2 models it is often take a lot of time and manhours to adopt this process for entire cities. This limitation not only delays project timelines and escalates costs but also hampers scalability.

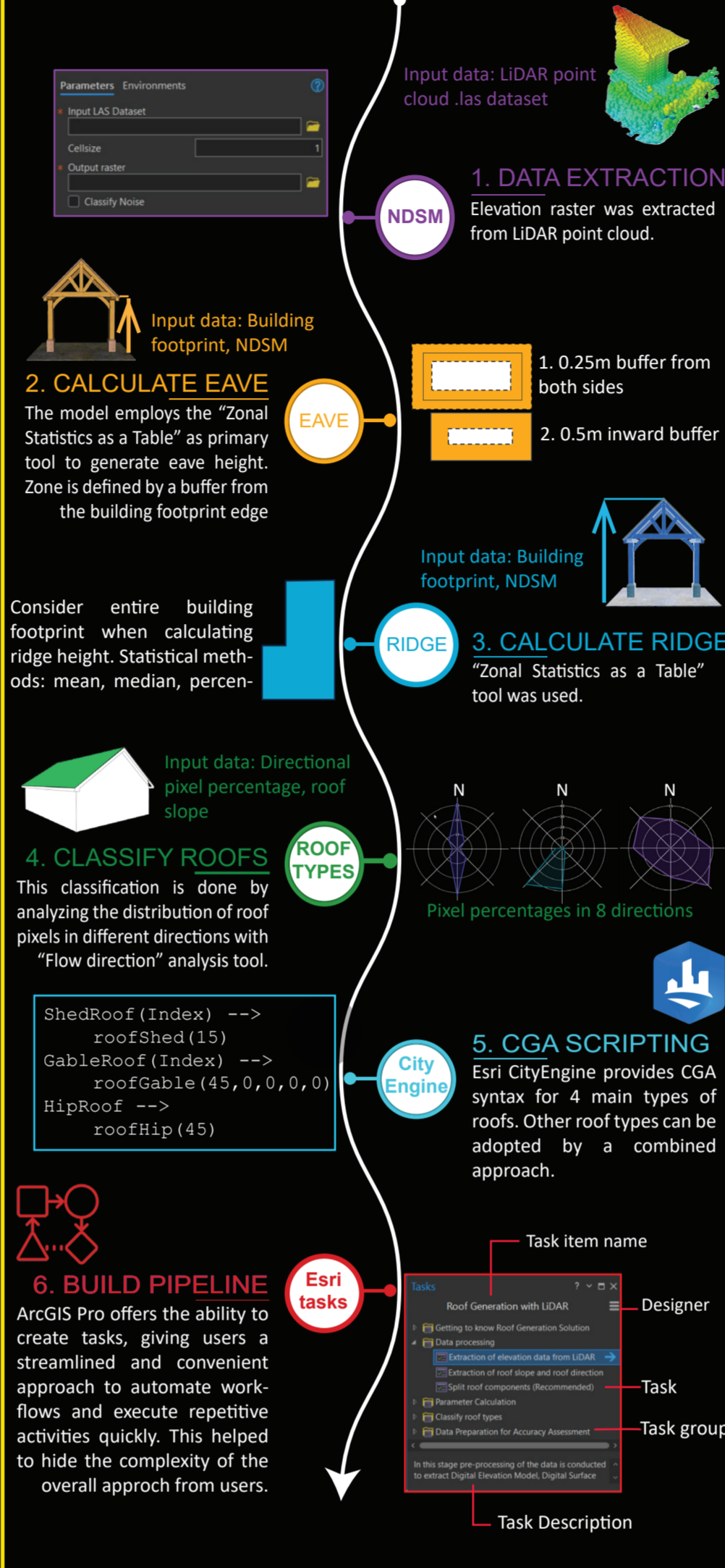
2. SOLUTION

Esri CityEngine provides a potential solution for creating reusable CGA scripts. This research will introduce a systematic pipeline so that users can easily follow the procedure and generate LOD2 models of cities with minimal manual work. The results of the work will enrich the multi-disciplinary fields of Geographic Information Systems (GIS).

3. STUDY AREA

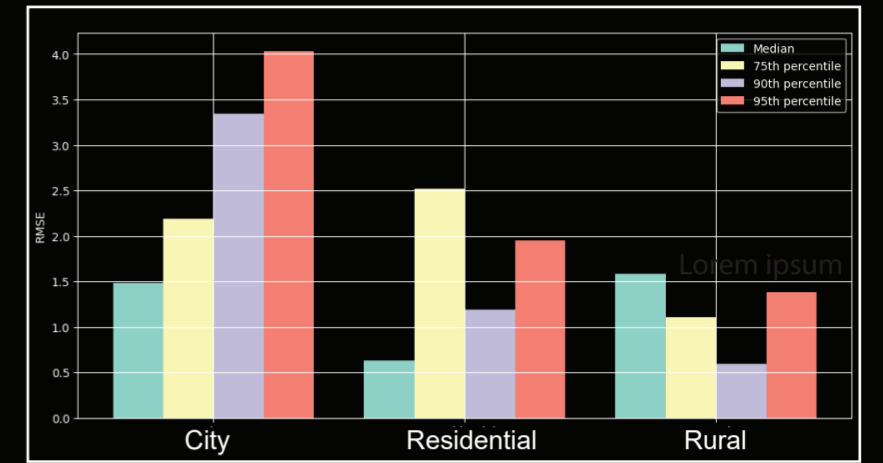


4. METHODOLOGY

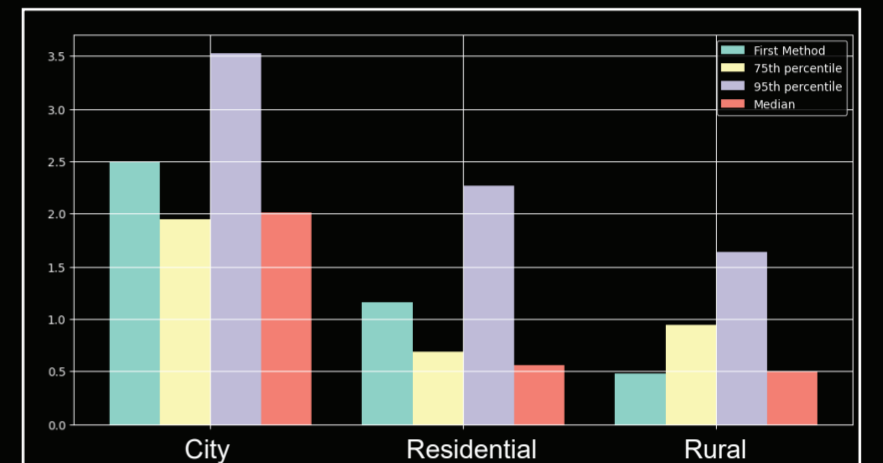


6. ACCURACY ASSESSMENT

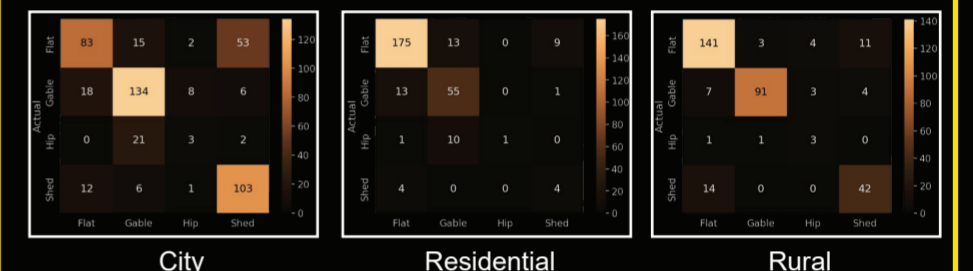
RMSE of ridge height calculation



RMSE of eave height calculation

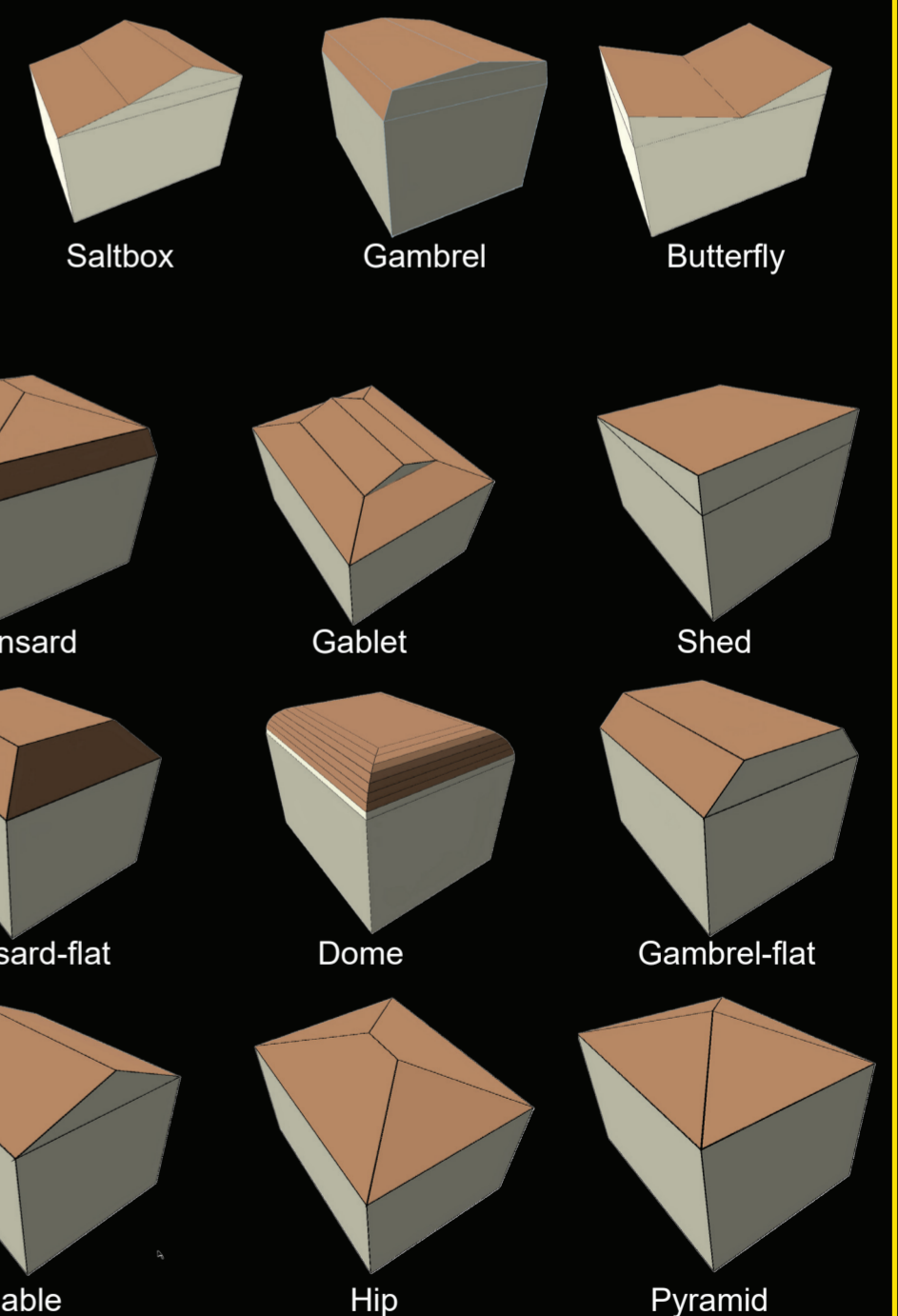


Roof classification accuracy (Confusion matrix)



The classification performance varies across different roof types and regions. While the model demonstrates high accuracy in identifying certain roof types such as Flat and Gable in the Residential and Rural regions, it struggles with accurate classification of Hip roofs, particularly in the City Center region. Shed roofs generally exhibit moderate accuracy across all regions, indicating room for improvement in the model's ability to classify this roof type accurately.

7. SUPPORTED ROOF TYPES



5. RESULTS

City center buildings



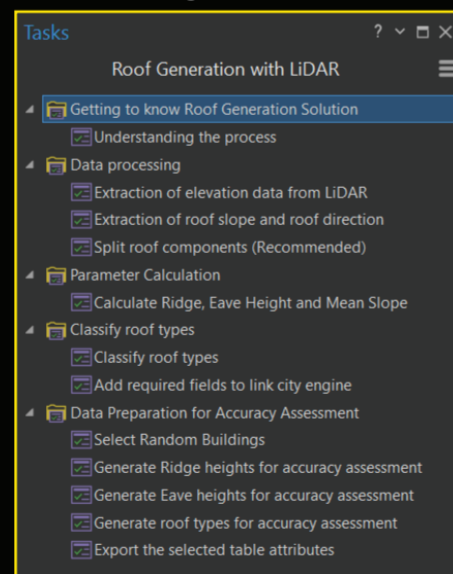
Residential buildings



Rural buildings



Processing pipeline



CityEngine GUI Parameters

Visualization Options	
Representation	solid color
RoofColour	#A67B5B
WallColour	#F5F5DC
Cleanup	TRUE
OutlineStatus	FALSE
Building Attributes	
EvHgt_2	5.247917 (Object)
RidgeHeight	7.549457 (Object)
AccuRoofFo	GableHip
DrmFrm	SingleDormer
DrmDrc	0 (Object)
BID	133 (Object)
DrmRoof	Shed
drmRot	0 (Object)
Roof related attributes	
PipHgt	0 (Object)
Index	1
GabHipSid1	0 (Object)
GabHipSid2	0 (Object)
GabHipFrm	0 (Object)
saltbox_ratio	0.333

8. CONCLUSION

The main goal of this project was to provide a systematic process for automatically generating LOD2 buildings in the city of Olomouc. This work established the feasibility and efficacy of the approach for autonomously producing LOD2 buildings in Olomouc. The objectives were met by devising a methodical strategy, writing reusable CGI scripts, and evaluating the correctness of created 3D roof models.

This research marks a significant milestone in the field of urban modeling and analysis, providing a robust and adaptable methodology for generating LOD2 buildings in Olomouc and beyond. By leveraging advanced GIS technologies and computational tools, this study has not only addressed current challenges in building generation but has also paved the way for future advancements in the field.