Parametric Modelling with GIS

Assoc. Prof. Patrick Janssen
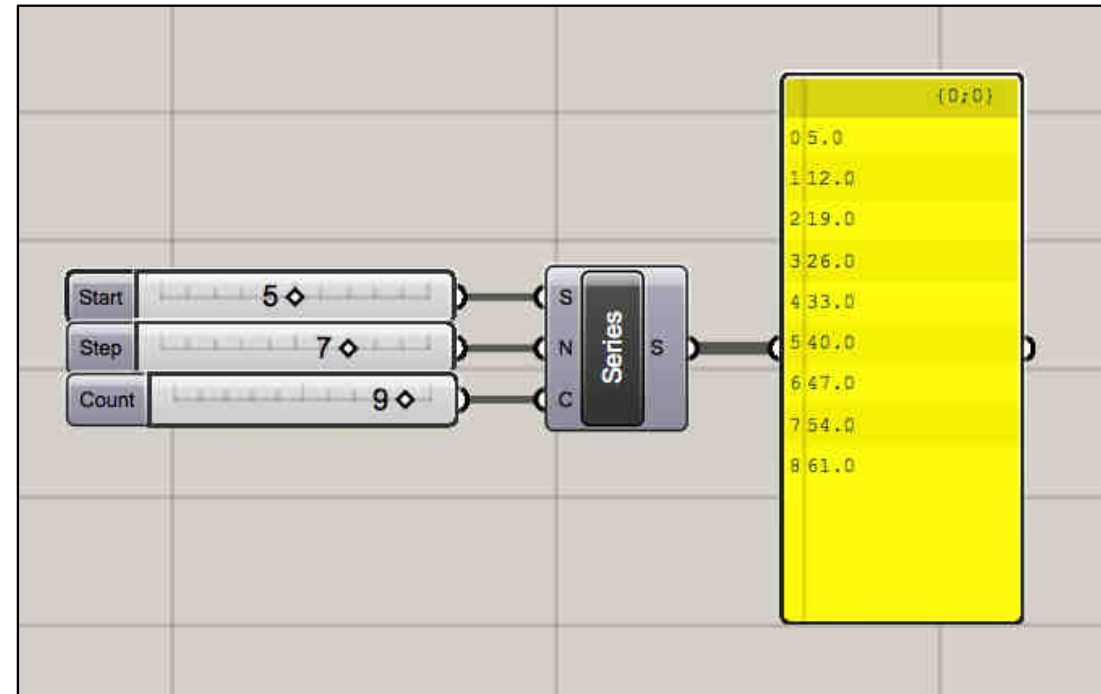
National University of Singapore

- **Background**

- Möbius

- Case Study
  - Stage 1: Geographic Mapping in QGIS
  - Stage 2: Parcel Subdivision in Möbius
  - Stage 3: Parameter Generation in QGIS
  - Stage 4: Urban Model Generation in Möbius
  - Stage 5: Spatial Analysis in QGIS

- Future Research

Background

- Support iterative design generation and performance analyses at an urban scale

- Workflows capable of integrating:
  - geographic mapping
  - parametric modelling

- Parametric modelling
  - no attribute data!
  - no explicit looping!

- Background

- **QGIS - Möbius**

- Case Study
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- Future Research

Möbius

- A parametric modeller in the browser

- Can import and export GIS data (GeoJson, Shp)

- Supports:
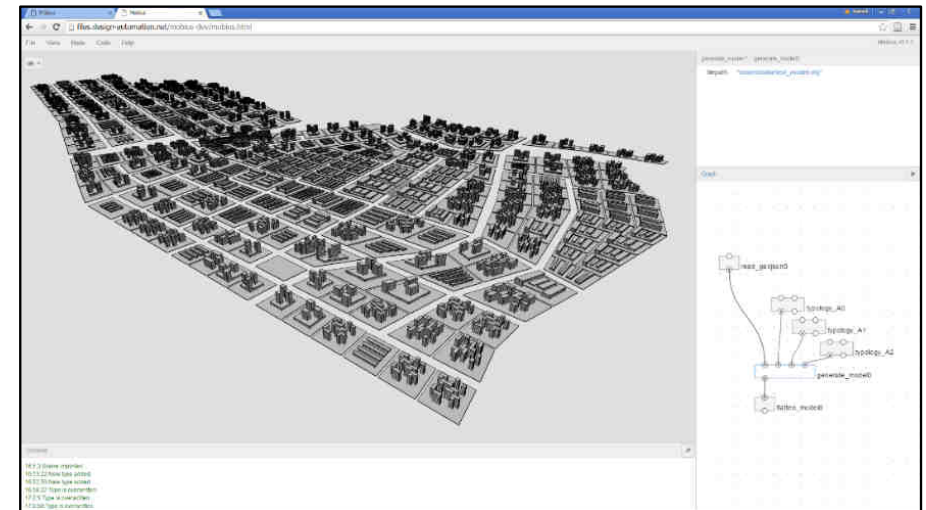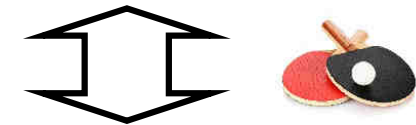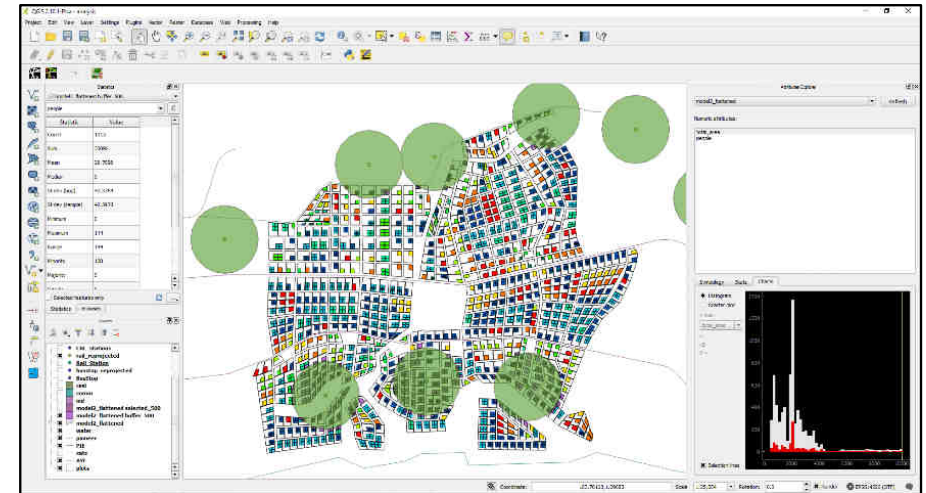 - attribute data
  - iterative loops

- http://files.design-automation.net/mobius-dev/mobius.html
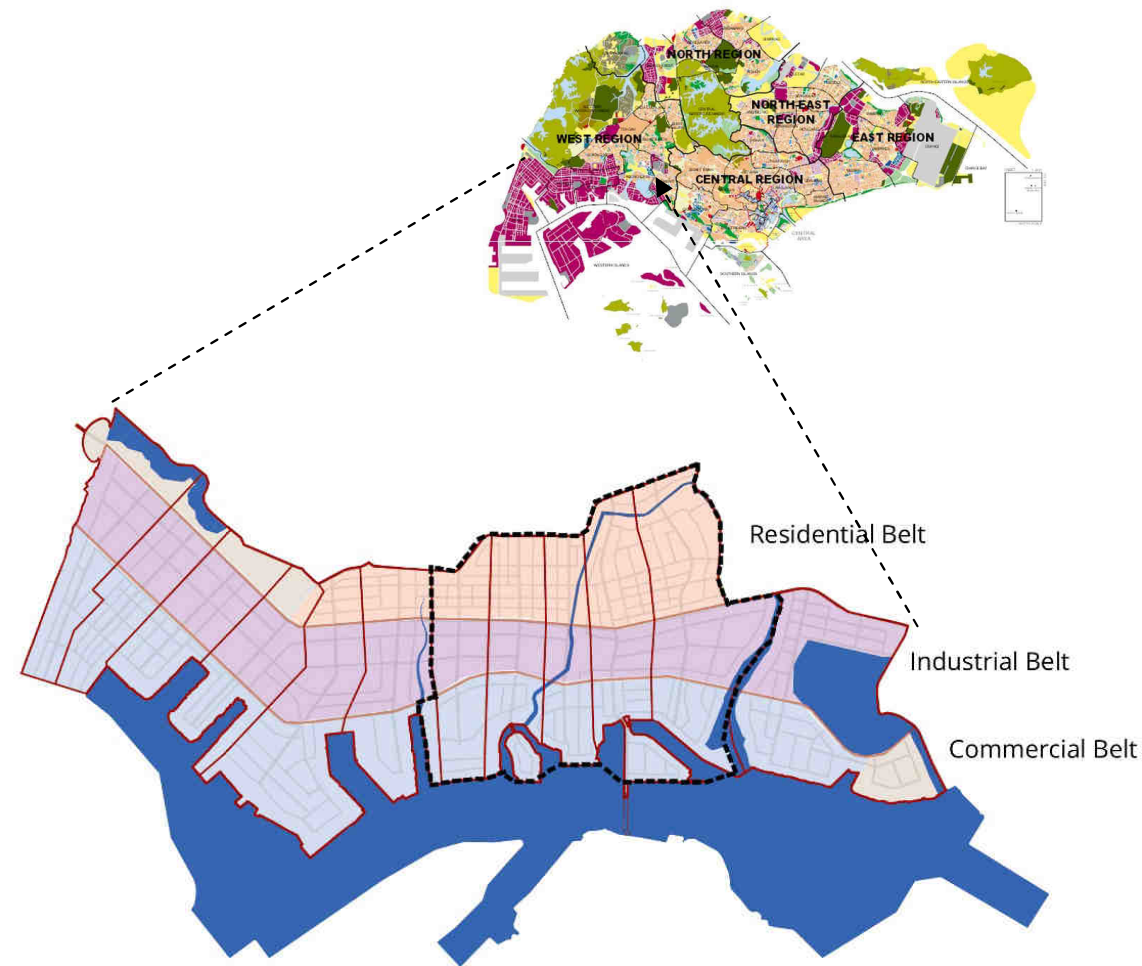
QGIS - Möbius

- A workflow that supports iterative generation and evaluation of large-scale urban models

- Alternates between QGIS and Möbius

- Background

- QGIS - Möbius

- **Case Study**
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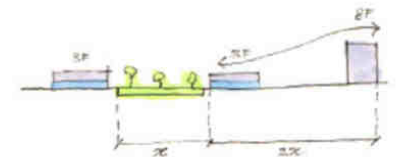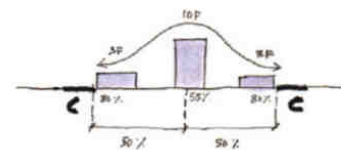 - Stage 5: Spatial Analysis in QGIS
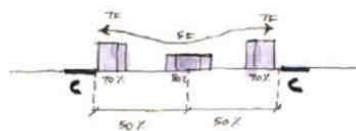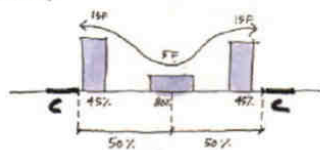
- Future Research

Case Study: 2050, 1 Million

- 5000 ha industrial area in the west of Singapore

- Green lungs, attractive housing and vibrant urbanity for one million people

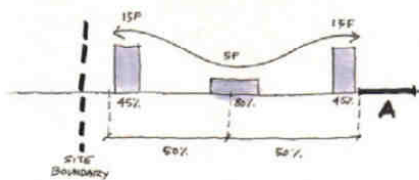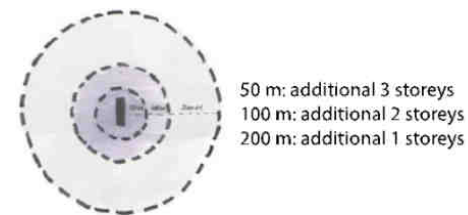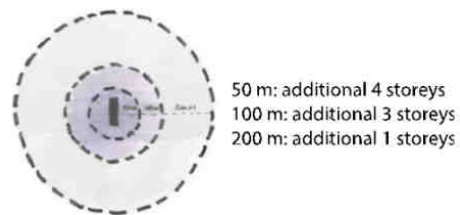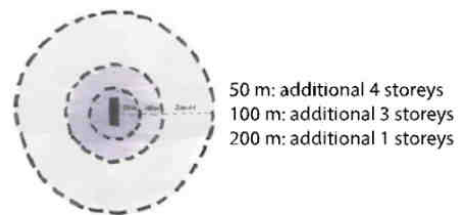- The case study focuses on one student project, called Ecotopia
  - Andrea Meinarti Rachmat
  - Tay Hui Ping Serene
  - Delon Leonard
 - Wu Xing Peng
  - Loh Sze Sian

Case Study

- Students developed a set of rules that defined urban parameters based on the proximity to various elementsin the design
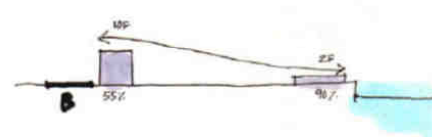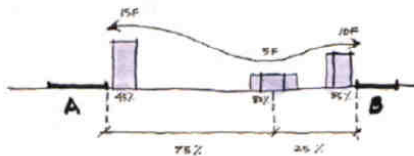
- Background

- QGIS - Möbius

- Case Study
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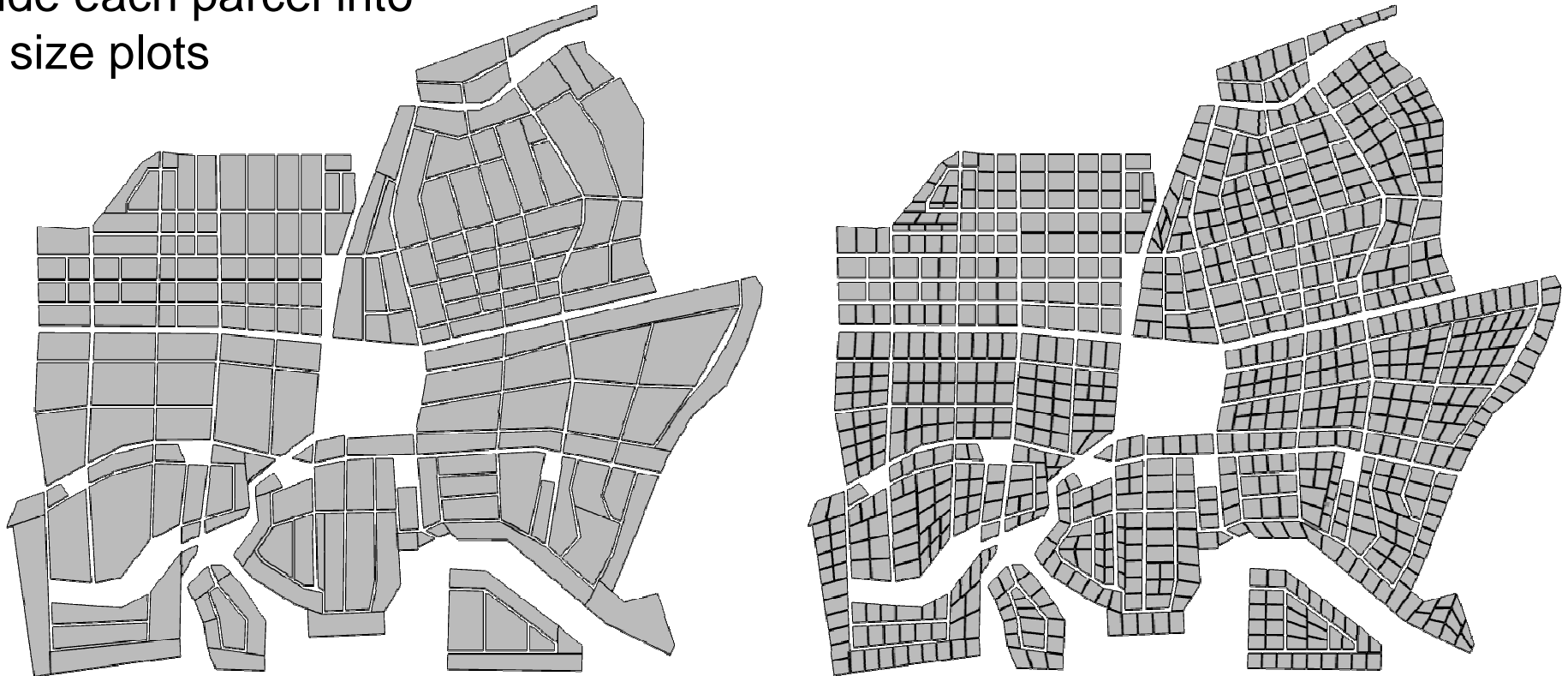
- Future Research

Stage 1: Geographic Mapping in QGIS

- QGIS is used to create a map of the site area using existing GIS data

- Map includes key features required for the rules
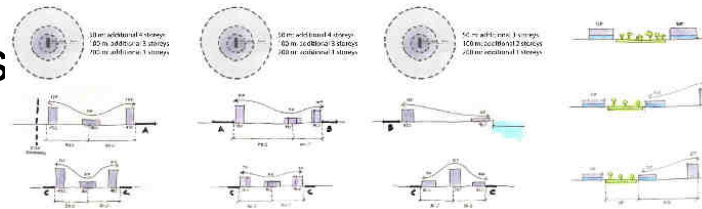   - Coast line
    - Roads
    - Parks
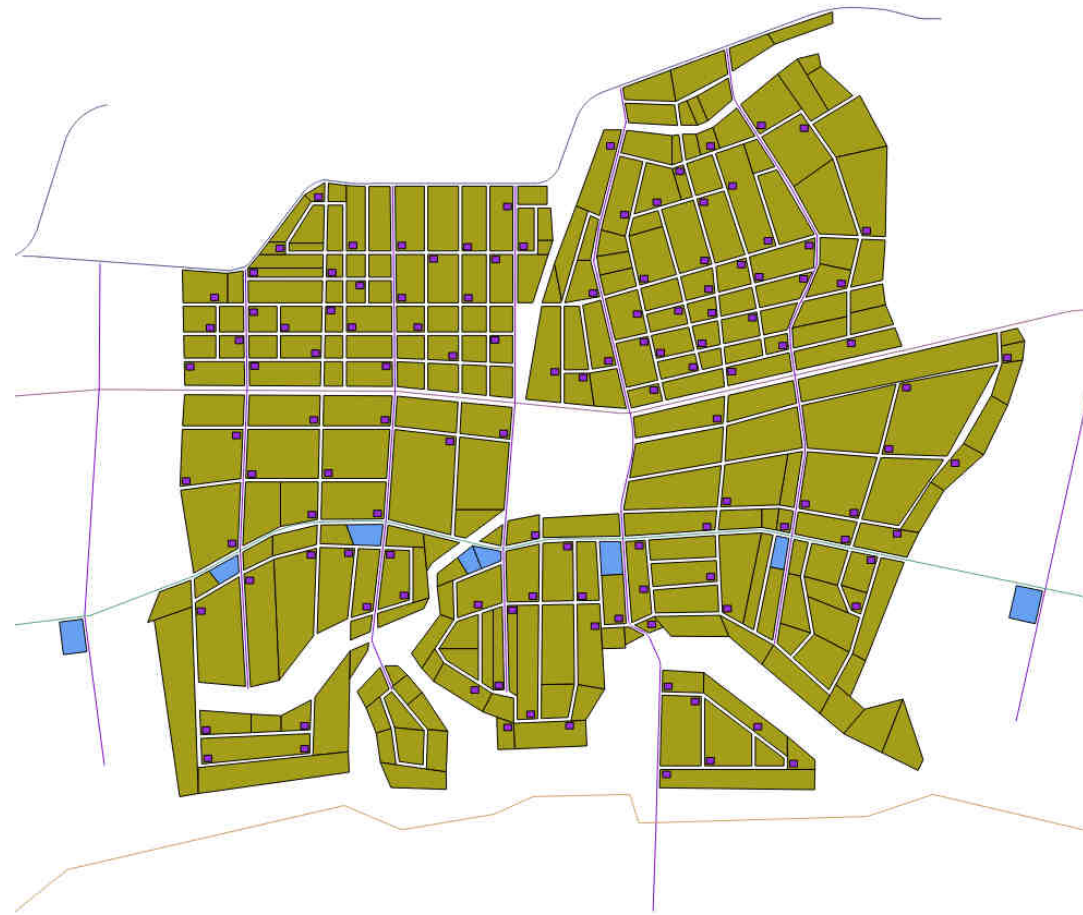
Stage 2: Parcel Subdivision in Möbius

- Möbius is used to recursively
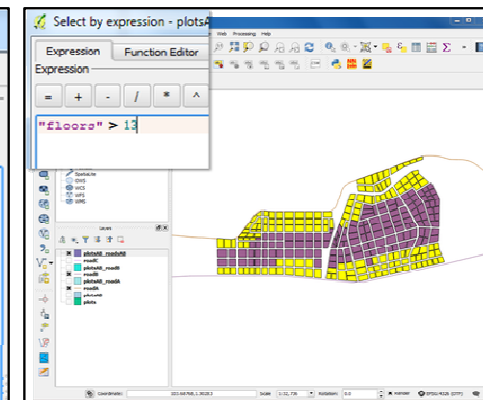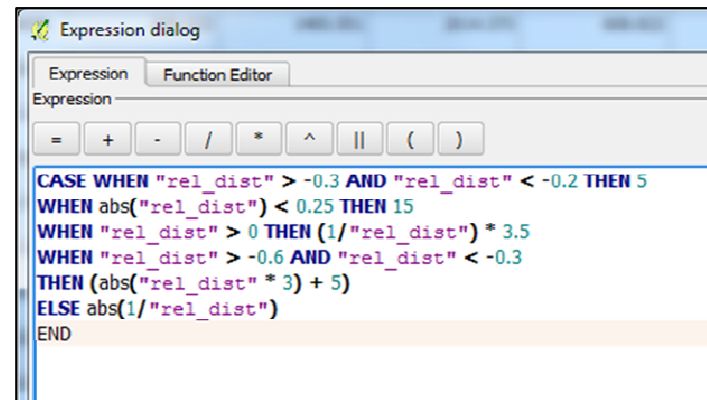 subdivide each parcel into
  similar size plots

Stage 3: Parameter Generation in QGIS

- QGIS is used to create attributes that capture the spatial rules.
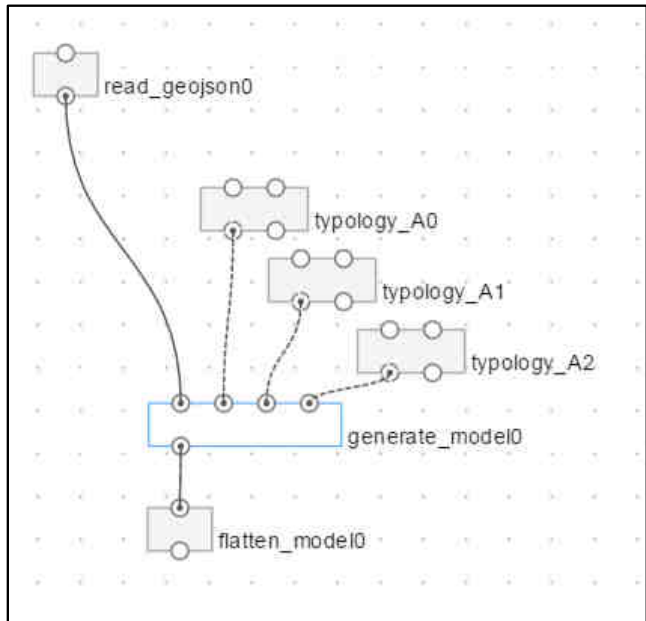
  - proximity functions
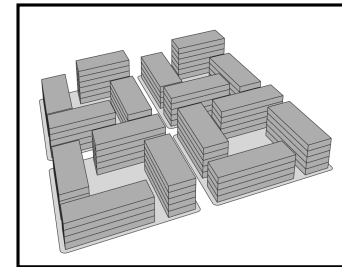 - custom formulas

Stage 4: Urban Model Generation in Möbius

- Möbius is used to generate urban models using a library of parametric urban typologies.
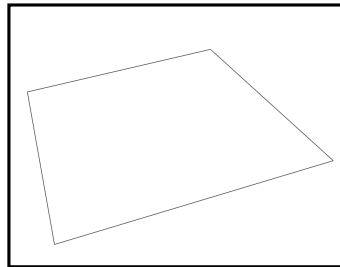
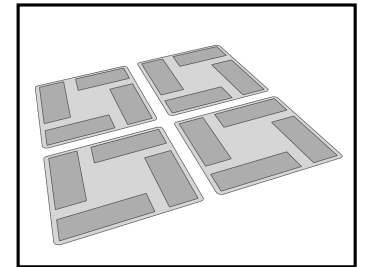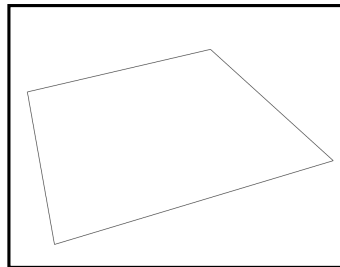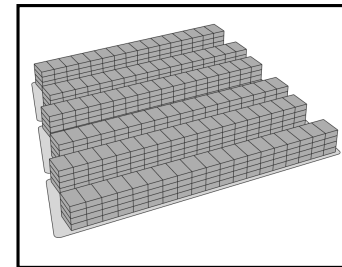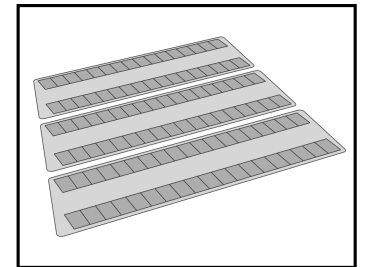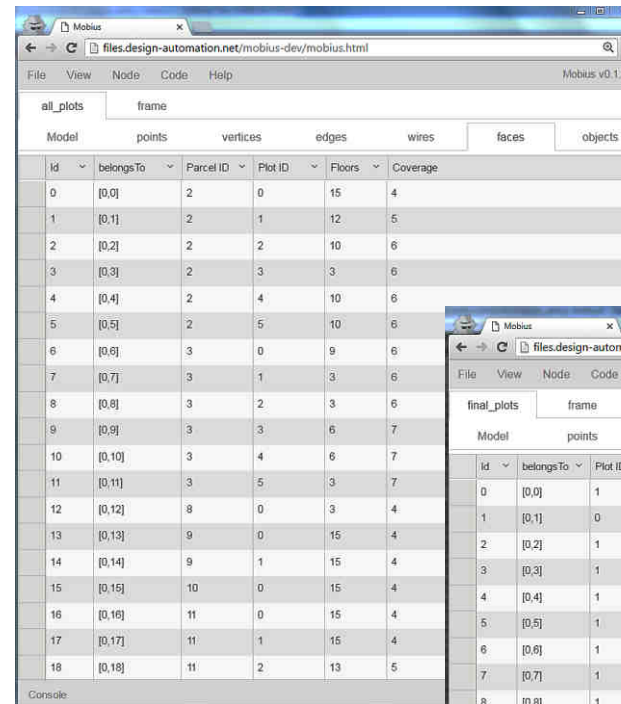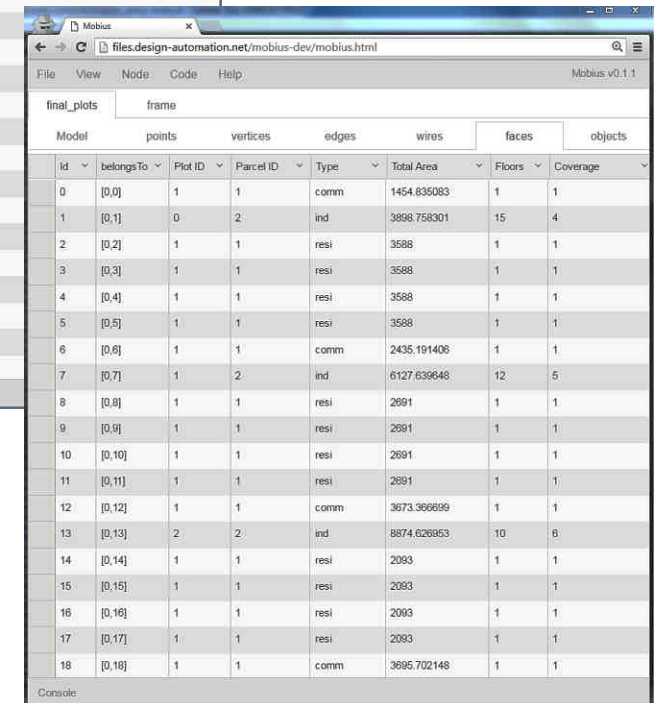# Stage 4: Urban Model Generation in Möbius

- Floor areas are saved as attributes attached to a 2D polygon.

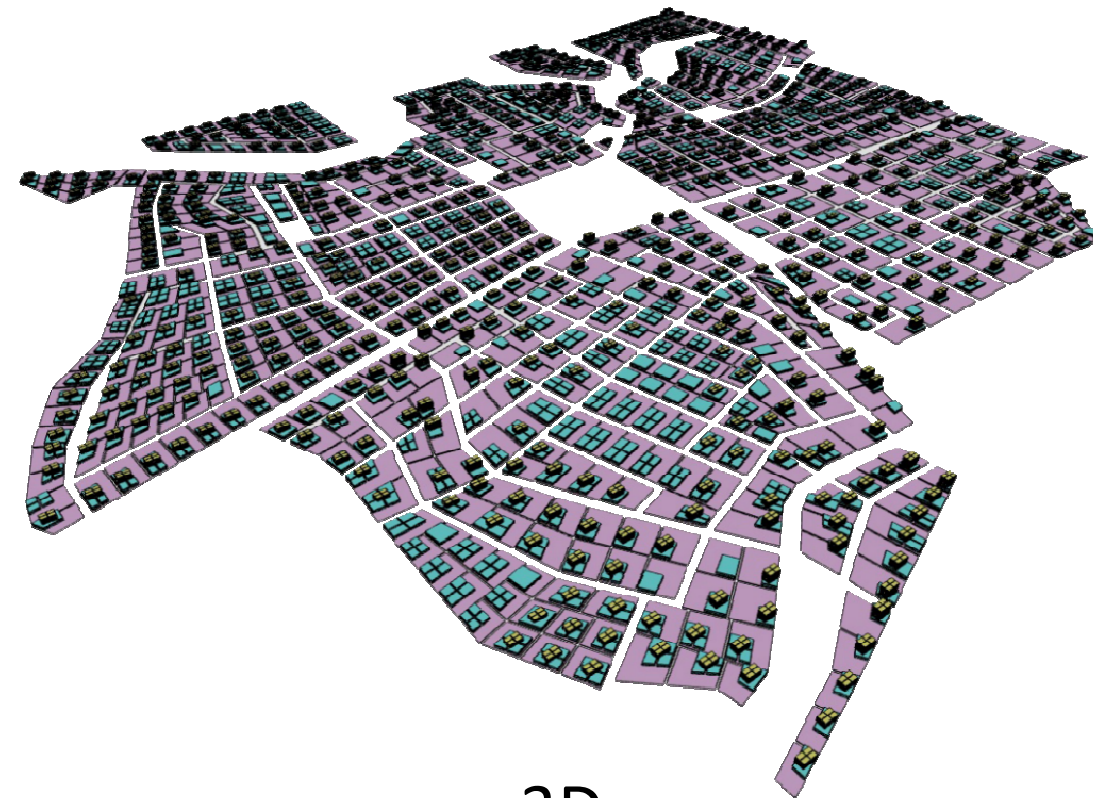 - *residential area*

  - *commercial area*

  - *industrial area*

Stage 4: Urban Model Generation in Möbius

3D

2D + attributes

Stage 5: Spatial Analysis in QGIS

- QGIS is used to analyse the flattened map of the urban model.

- Additional attributes are created:
  - the number of people in each building
  - the percentage of people within a certain walking distance of transport nodes
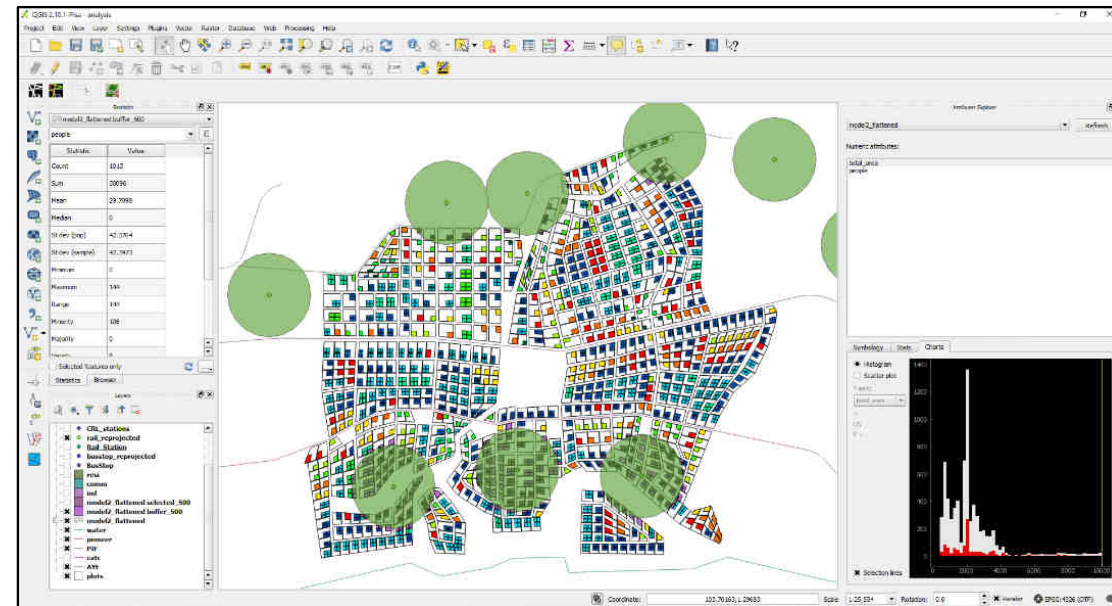
Option 1

Option 2
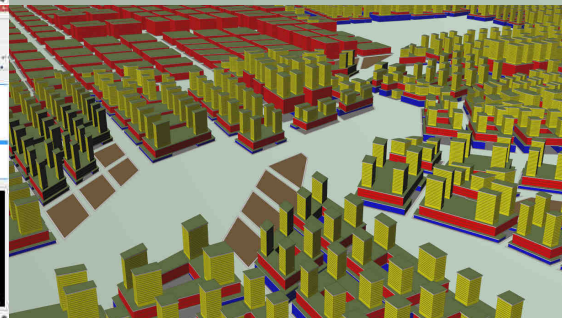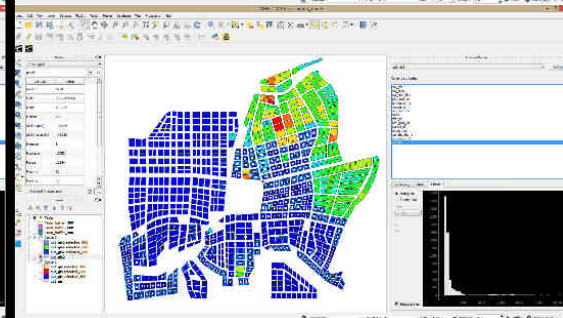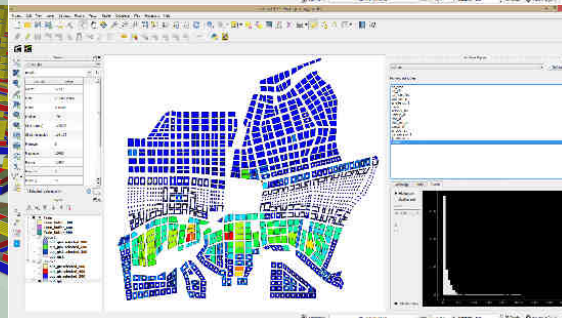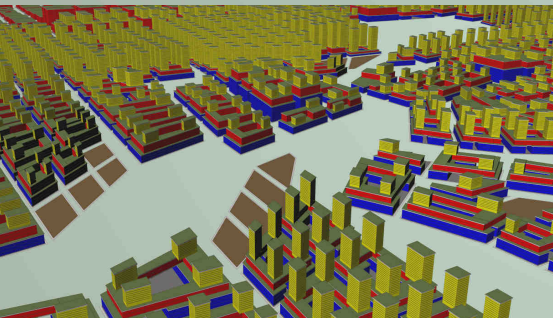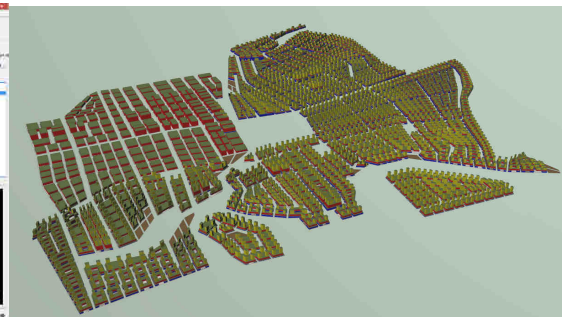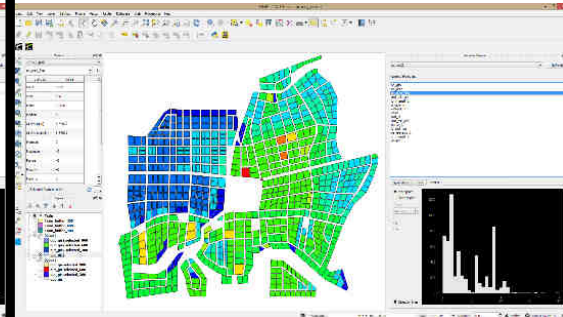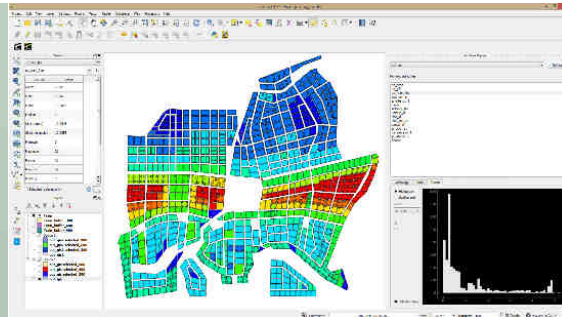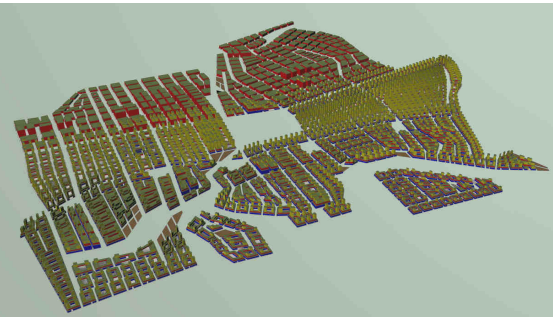
Total (residents): 910,000
300m buffer: 1% of residents
600m buffer: 6% of residents
900m buffer: 14% of
  residents

Total (residents): 650,000
300m buffer: 2% of residents
600m buffer : 9% of residents
900m buffer : 20% of
  residents

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- **Future Research**

Future Research

- Explore the integration of a rule or grammar-based data synthesis method within the visual programming approach

- Thanks for listening!

- Collaborators
  Assoc. Prof. Rudi Stouffs, NUS

- Research Assistants
  Akshata Mohanty, NUS
  Elvira Tan, NUS
  Ruize Li, NUS

- Janssen, P., Stouffs, R., Mohanty, A., Tan, E., Li, R., 2016. Parametric Modelling with GIS, in: *Proceedings of the 33rd eCAADe Conference.* Oulu, Finland, pp. 59–68.