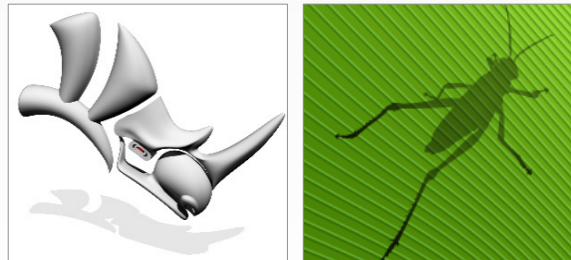


# Building zero energy districts in tropical climates.

## Development of design tools for morphology/comfort/energy coupled optimization.

Coupling multiple weather-based simulation models and tools via a Rhino-Grasshopper platform.



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# Background

## Global environmental study of buildings in urban areas

- Plenty of existing tools & simulation models used separately with often data that could be shared
- All using 3D models that evolve, get more detailed and complex along the different design phases (different formats)
- Coupled simulation and cross-analysis of results is difficult
- Need for more flexibility, more coupling, more optimization

# Objectives

- Facilitate the exploration of multiple urban design scenarios with a unique, evolving 3D model
- Take into account the microclimate and its interplay with the urban form
- Optimize the urban morphology for building passive design strategies
- Develop a unique, reactive and flexible simulation/analysis/optimization platform with Rhino-Grasshopper
- Develop a set of tools, rules of thumb for urban design in tropical climate

# Approach

Parametric modelling allows to

Generate

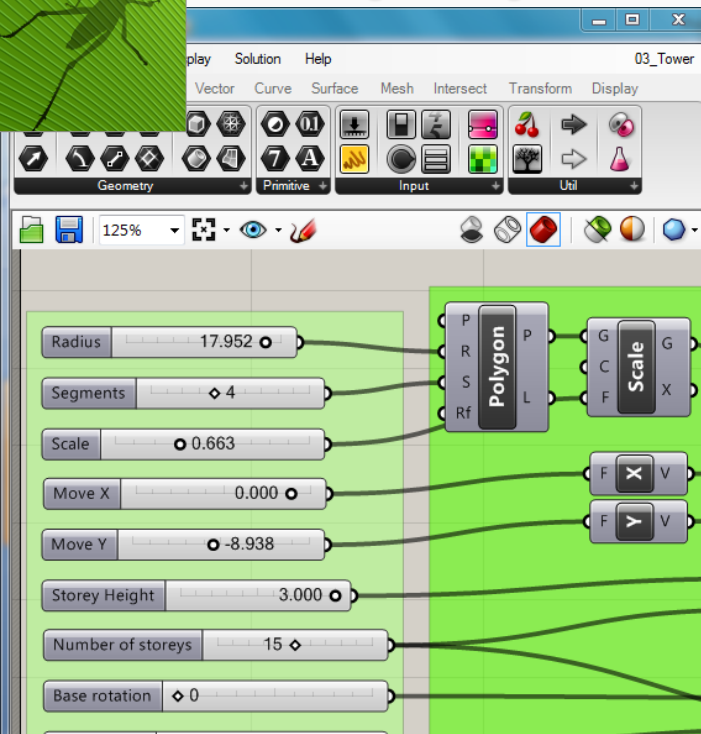
Control

Optimize

Complex 3D geometries such as  
3D model of a district with multiple buildings and its topography

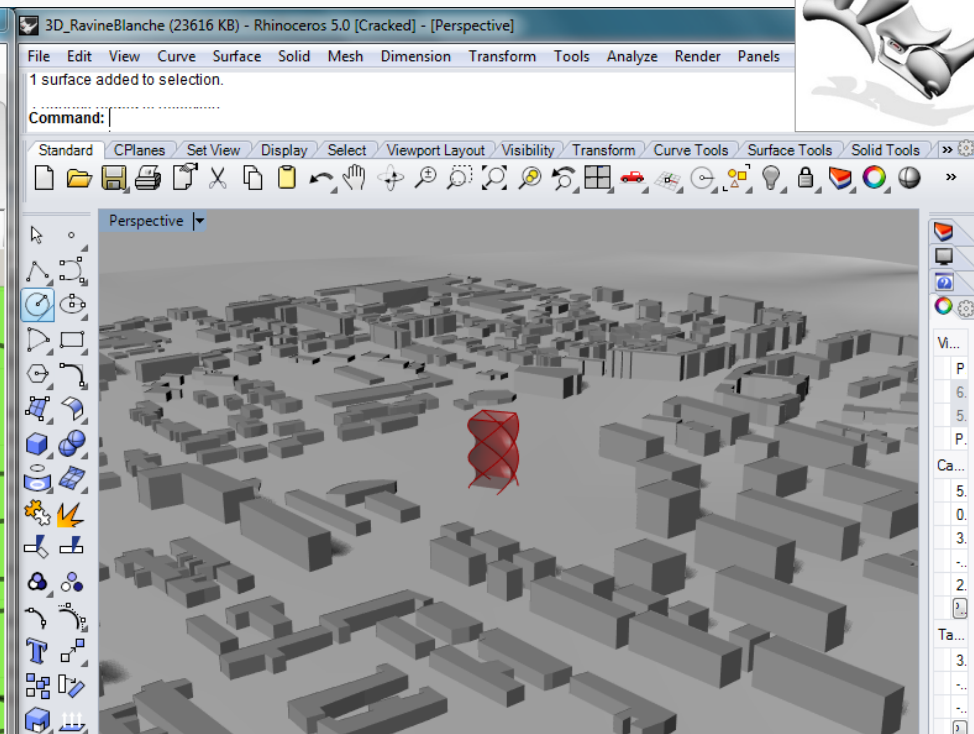
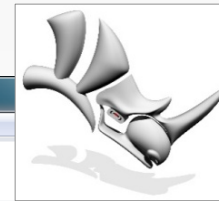


Visual Programming



GH modules  
for control, generation & optimization

3D Modeller & Interface



Auto-generated 3D model  
From BDtopo & OpenStreetMap files

# Poster

See you near-by  
the smallest poster



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### APPROACH

The couple Rhino-Grasshopper is a **parametric modelling** tool that is able to algorithmically control 3D models and geometrically optimize them to any defined criteria.



Grasshopper as a script-based Rhino plugin makes generating **complex geometries** easy. Architectural building designs belong to these complex geometries and are nowadays a reality.



Environmental sustainable building design requires the use of **multiple weather-based simulation tools** to assess the effect of the built environment on the local weather conditions.

### OBJECTIVES

How to design bioclimatic neighborhoods in dense tropical urban areas?

Current design practice for buildings located in dense urban tropical areas imply multiscale, independent and multi-scale models, tools and interfaces making continuity of the overall building environmental study (from mesoscale to microscale) impossible. This **modeling issue** makes the efficiency of passive design strategies adapted to tropical climates **uncertain**.

- The **objectives** of the presented thesis are:
- To take into account both thermal and airflow transfers at the urban scale
  - To improve currently available models;
  - To couple them;
  - To make them suitable for urban tropical microclimate simulation.
  - To develop a unique, reactive and flexible environmental models coupling platform via Rhino-Grasshopper.

### METHODOLOGY - DESIGN PROCESS

"Design is the process of realizing intentions."

Developing design tools for morphology/comfort/energy coupled optimization involves a development methodology following a **global design process**.

This thesis' methodology is built around selected design principles and **experiences** drawn from zero energy built and monitored projects in the **tropical climate of La Reunion**. The methodology can be illustrated by the following spiral.

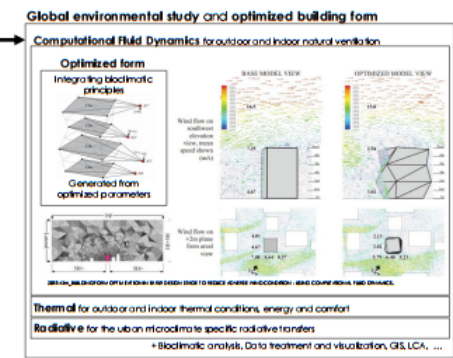
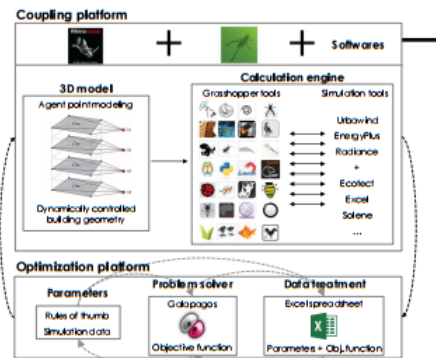
From zero energy building design experience, to passively optimized urban form.



### EXPECTED RESULTS

The expected achievement of this thesis is a **coupling platform**, solving continuity (temporal and spatial) issues of current **global environmental study** of buildings in tropical urban areas.

It will use the great range of weather-based simulation tools to assess the impact of the urban microclimate on buildings, occupants and pedestrians' comfort and ultimately **optimize the urban form to passive design strategies**.



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