Parametric Analysis is the new !

Mostapha [Sadeghipour] Roudsari | Thornton Tomasetti

12th International Radiance Workshop - 14 AUG 2013

STRUCTURE

SKIN

SUSTAINABILITY

Thornton Tomasetti

PERFORMANCE

CONSTRUCTION SUPPORT

PROPERTY LOSS

ACM-NY


Robert Otani


Jonatan Schumacher


Justin Nardone


Ben Howes


Nick Mundell


Matt Naugle


Mostapha Roudsari


Kenny Tam


Alfonso Oliva


Anne Waelkens


Ashley Reed

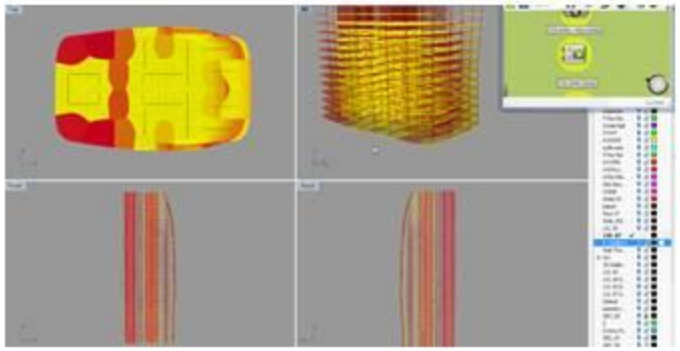

Hiram Rodriguez


Elcin Ertugrul

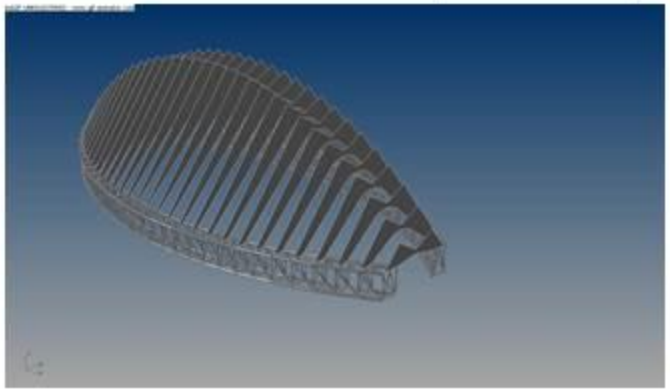
ADVANCED COMPUTATIONAL MODELING

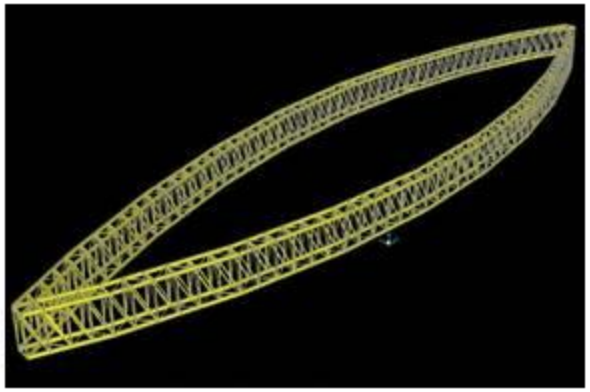




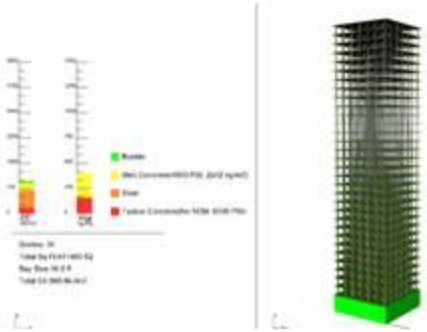



Resorts World Miami Tower 1 | Oliva Alfonso | New York I Architectonica

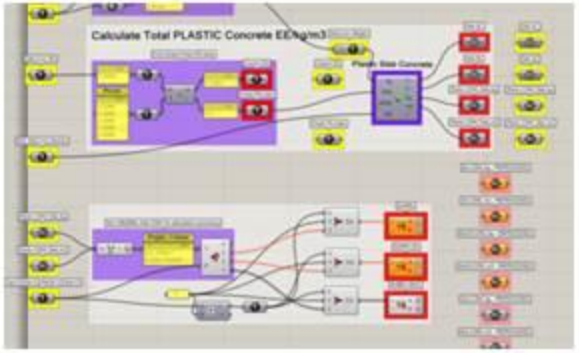




USF Roof | Jonatan Schumacher | New York I Calatrava

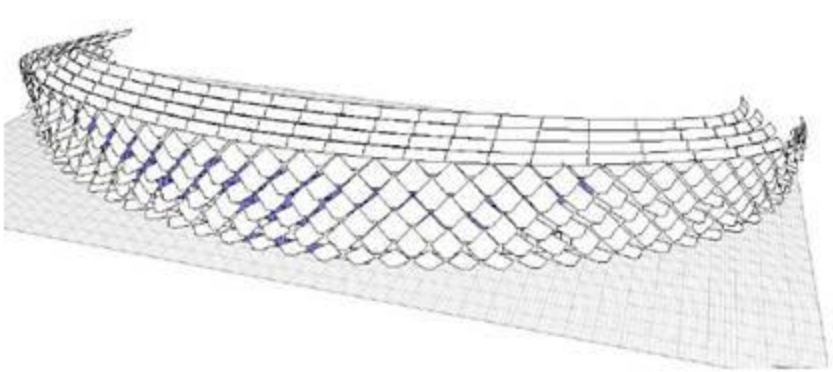


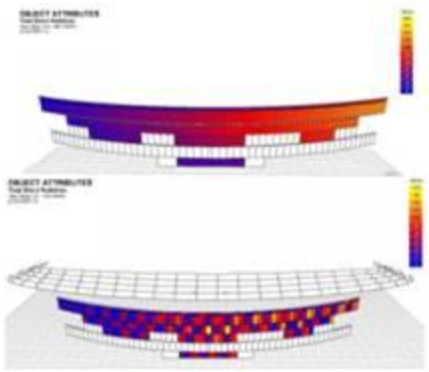


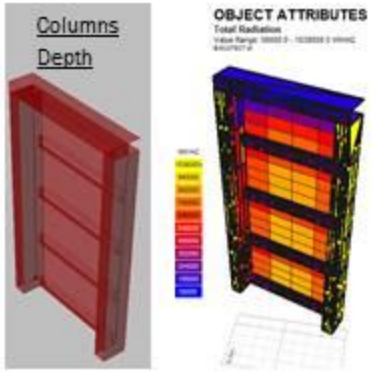


PAR: Waste-To-Building| Matthew Naugle| Philadelphia I PAR

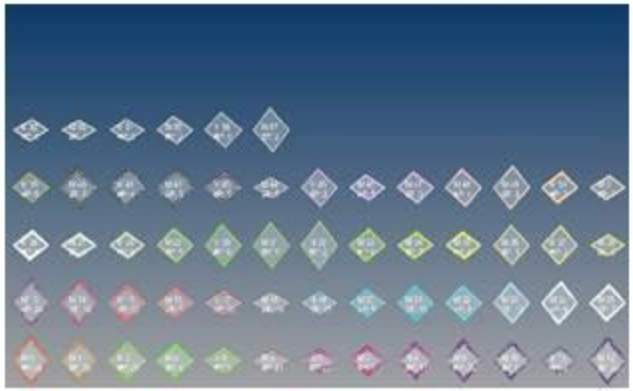
ADVANCED COMPUTATIONAL MODELING

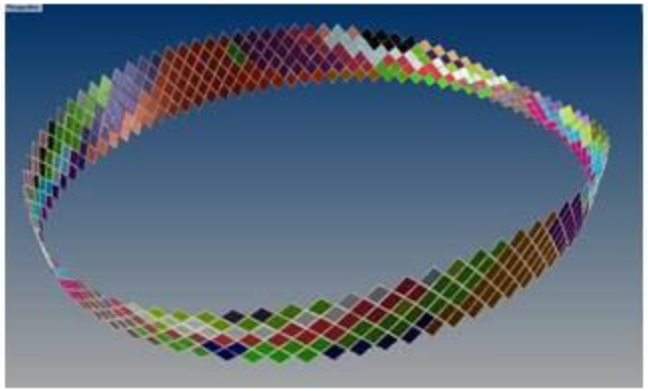


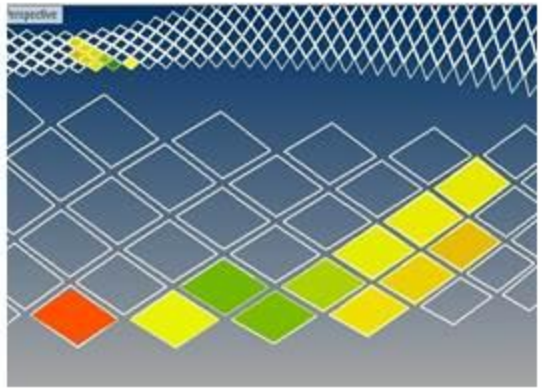




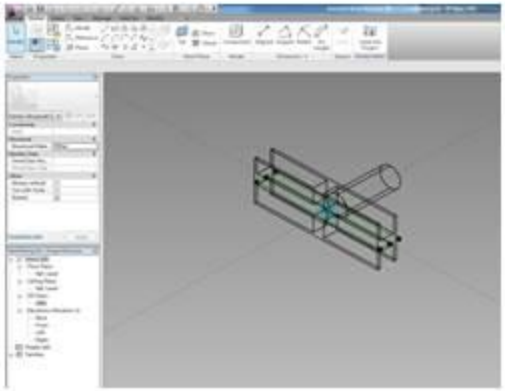
Parametric Solar Radiation Analysis | S. Patrizi, J. Schumacher| New York

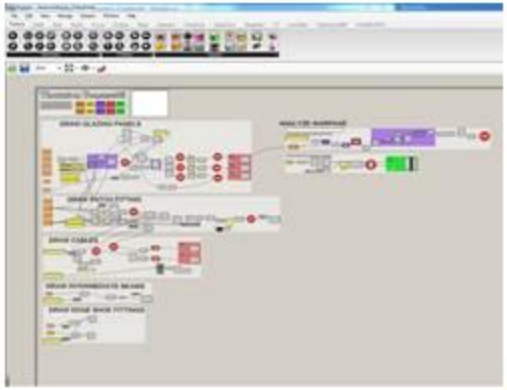






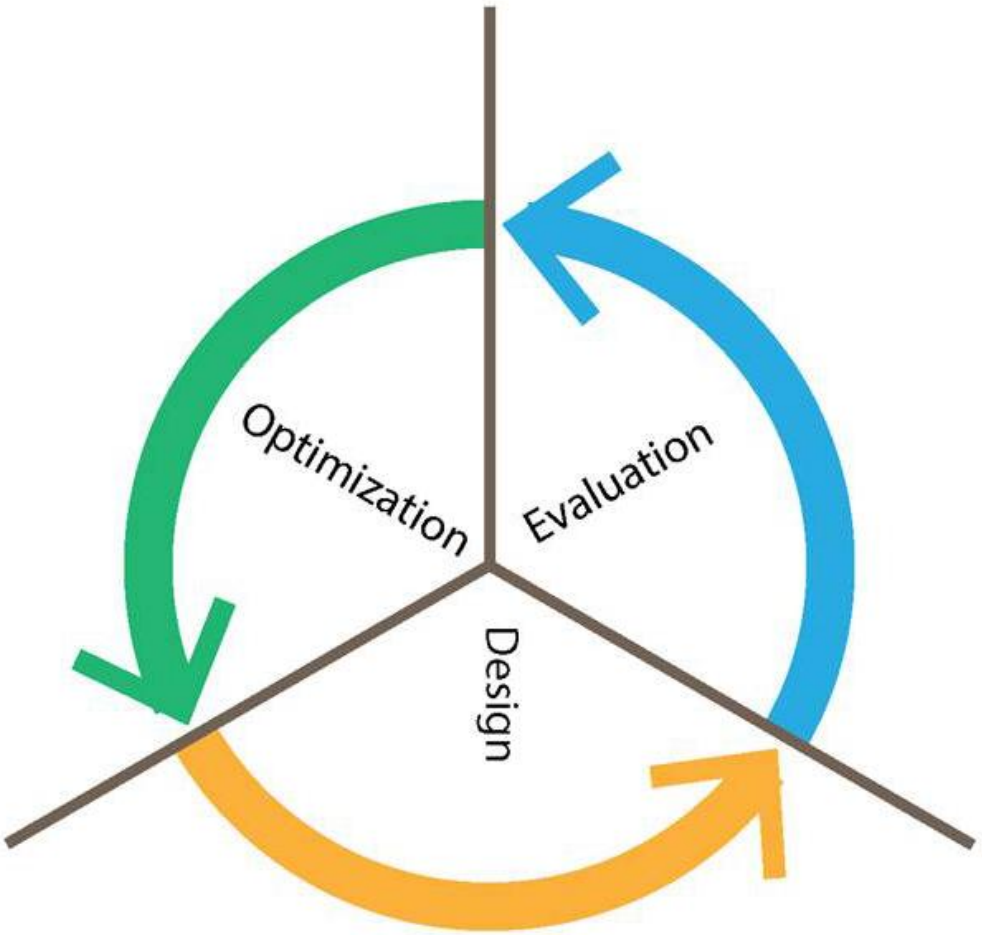
Mold Grouping Optimization | J. Schumacher | New York





Chameleon Revit-GH Test| Barry Beagen| New York

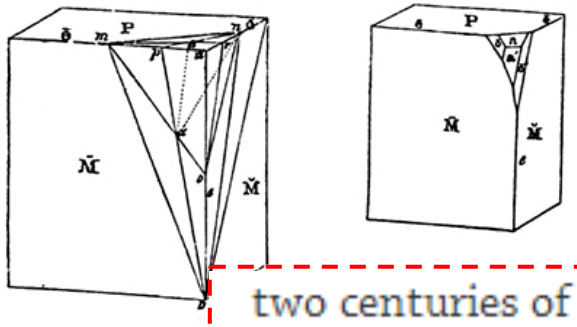
Iterative Process: Design - Evaluation- Optimization



Parametric Design

- **What is [the History of] Parametric Design?**
  Go read this link: http://www.danieldavis.com/a-history-of-parametric/

A History of Parametric

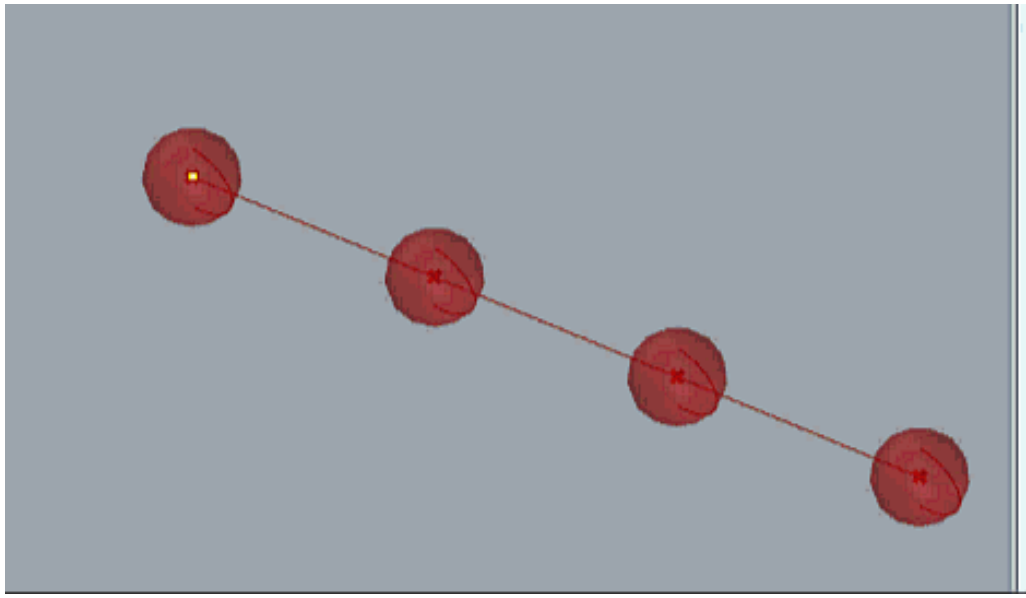


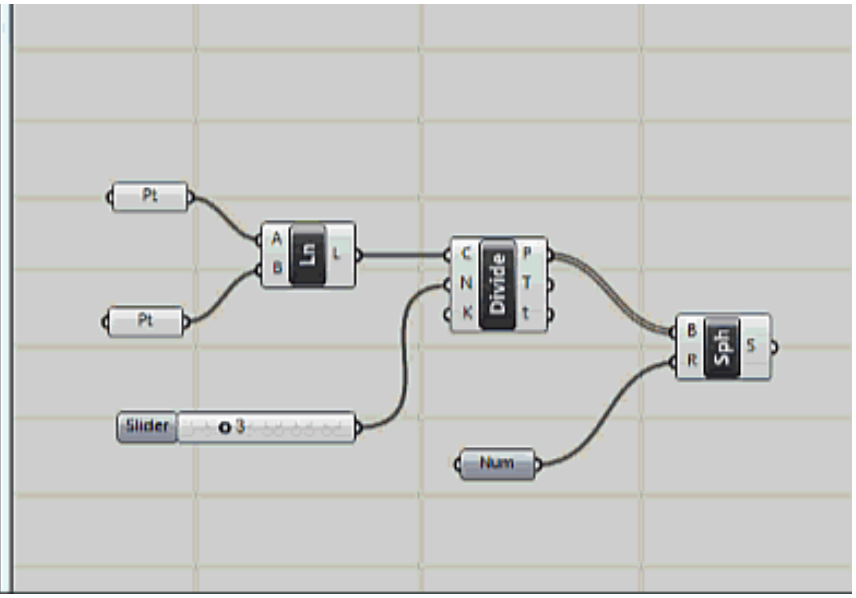
Daniel Davis – 6 August 2013

The first words I wrote in my
deleted. A history of paramet
The time before Grasshopper
Technology Corporation and Ivan Sutherland's Sketchpad, before the invention of the computer, and the birth of Gaudí. I assumed that I should start my thesis here in order to catch the reader up on the last two centuries of developments. A fairly convoluted path that missed potholes of theory and architecture in order to idle past idolised technology. Ultimately this history wasn't scholarly enough and wasn't needed for the argument of my thesis. I deleted it.

two centuries of developments. A fairly convoluted path that missed potholes of theory and architecture in order to idle past idolised technology. Ultimately this history wasn't scholarly enough and wasn't needed for the argument of my thesis. I deleted it.

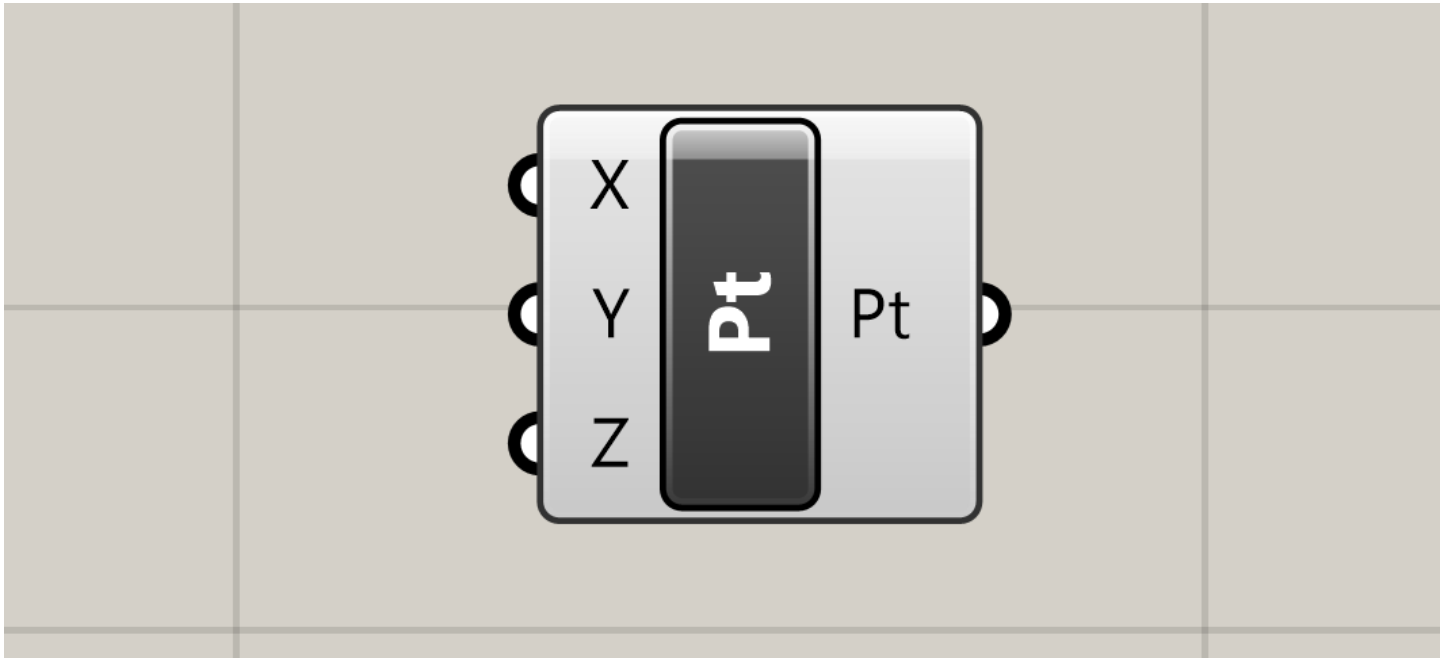
What is Grasshopper?
Why does it matter?





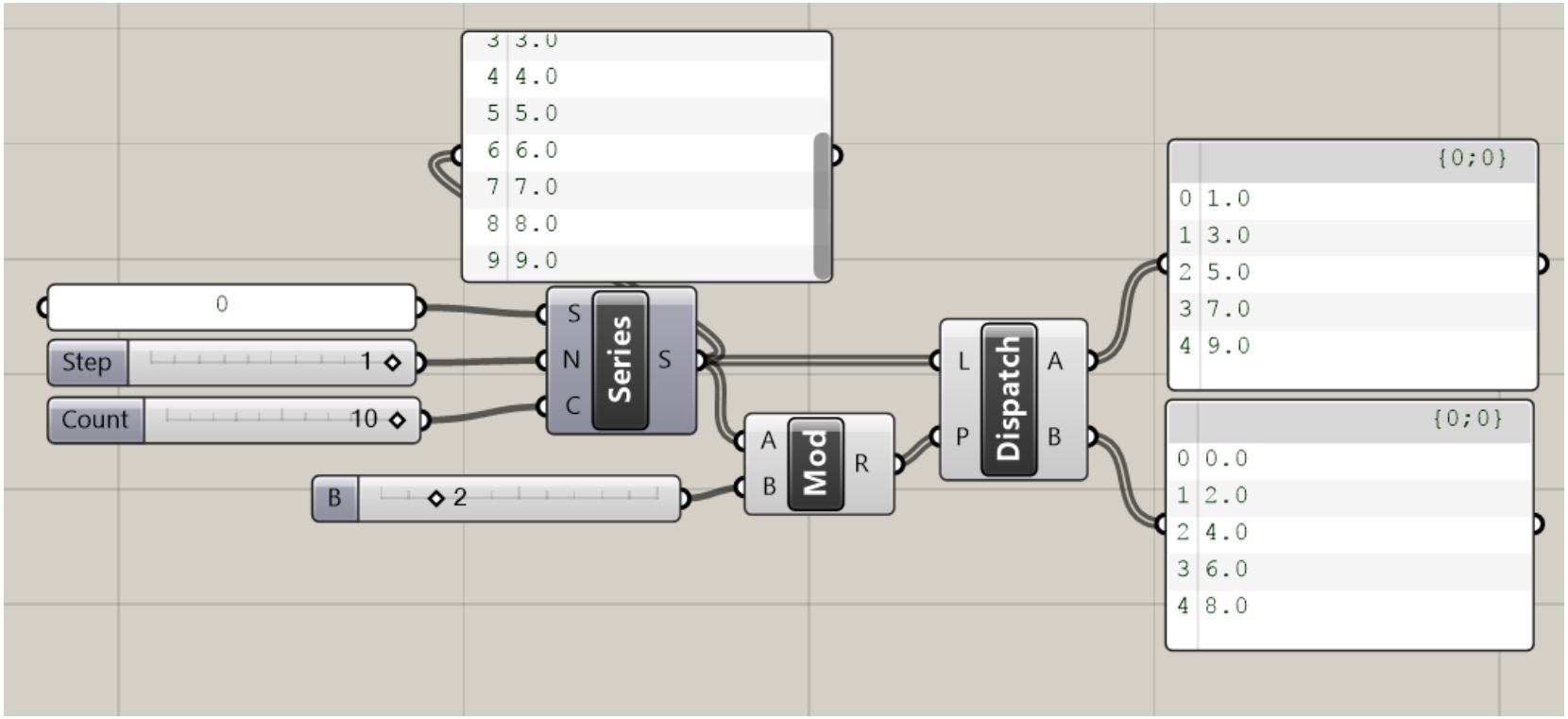
Visual Scripting

Pt = Rhino.Geometry.Point3D(X, Y, Z)

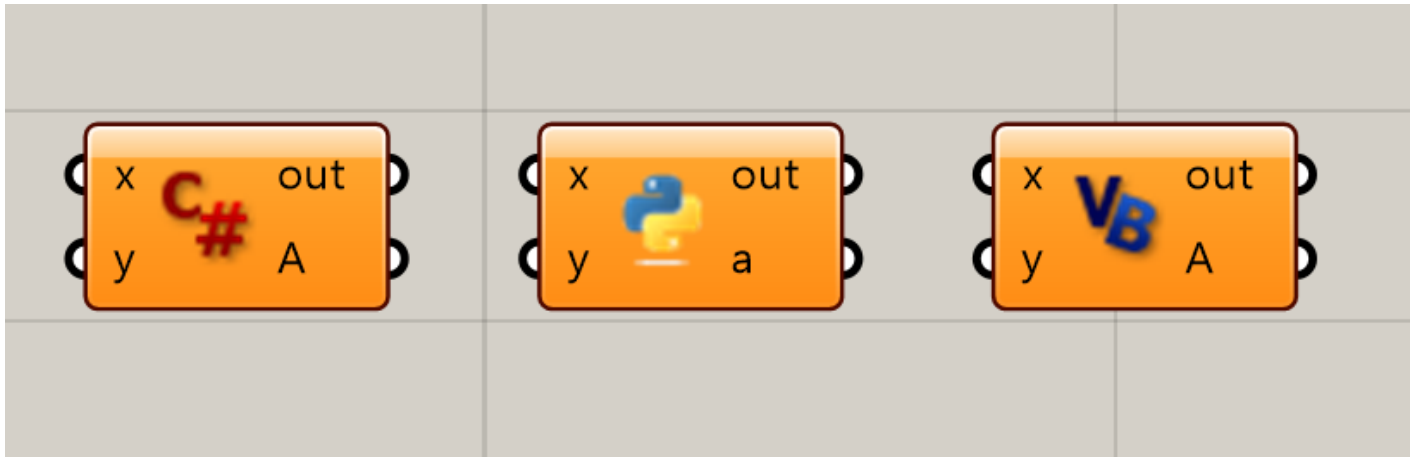


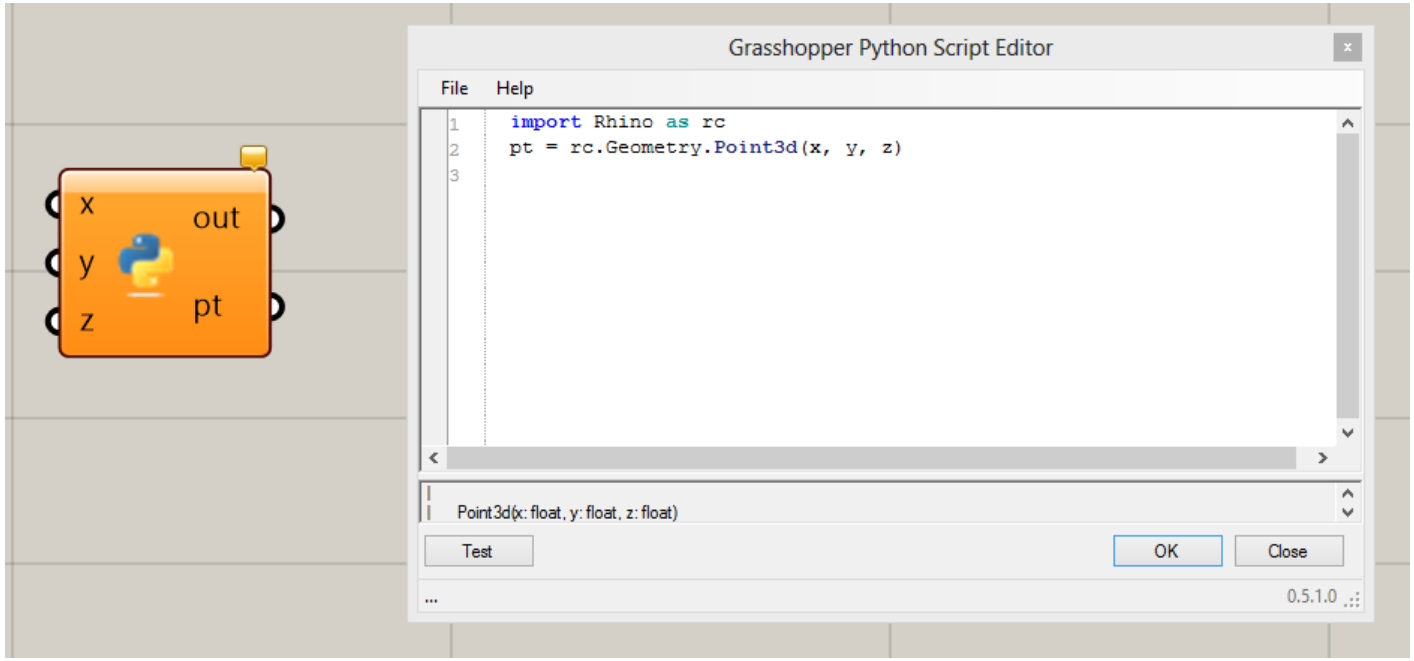
Visual Scripting

```
evenNum = []
oddNum = []
for i in range(10):
        if i%2 == 0: even.append(i)
        else: odd.append(i)
```

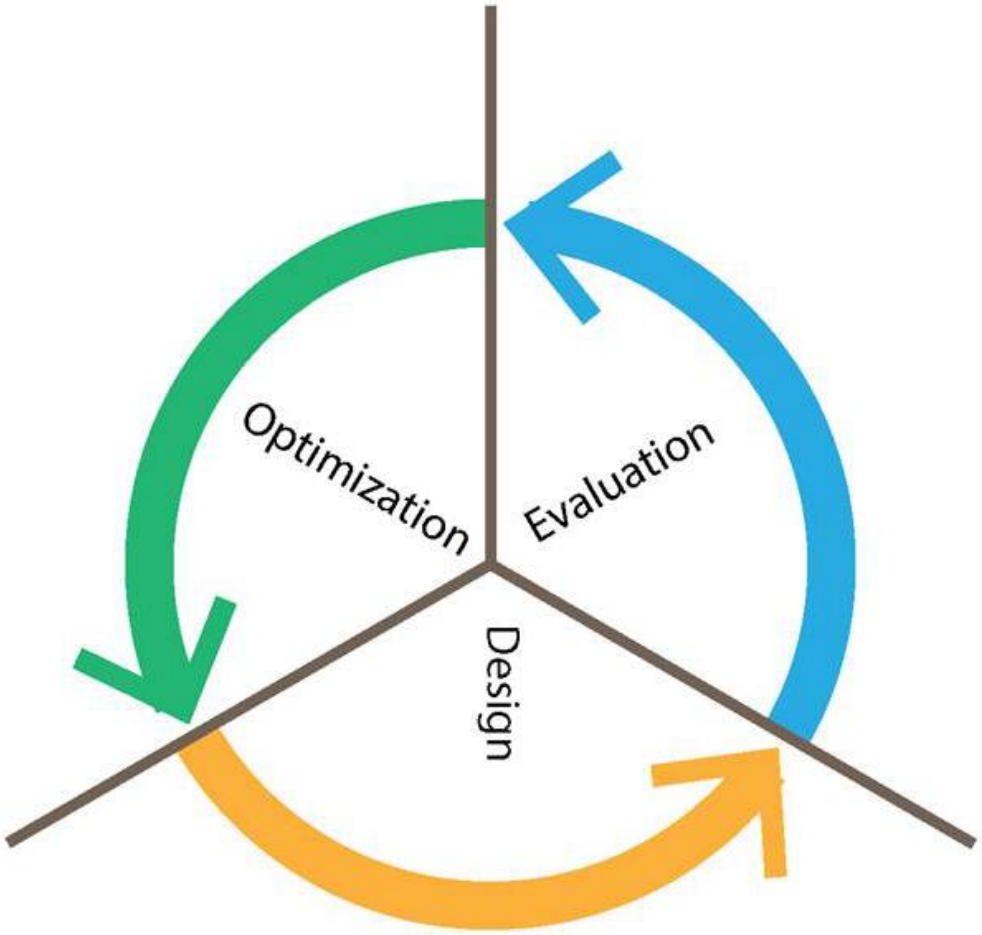


Make your own components!

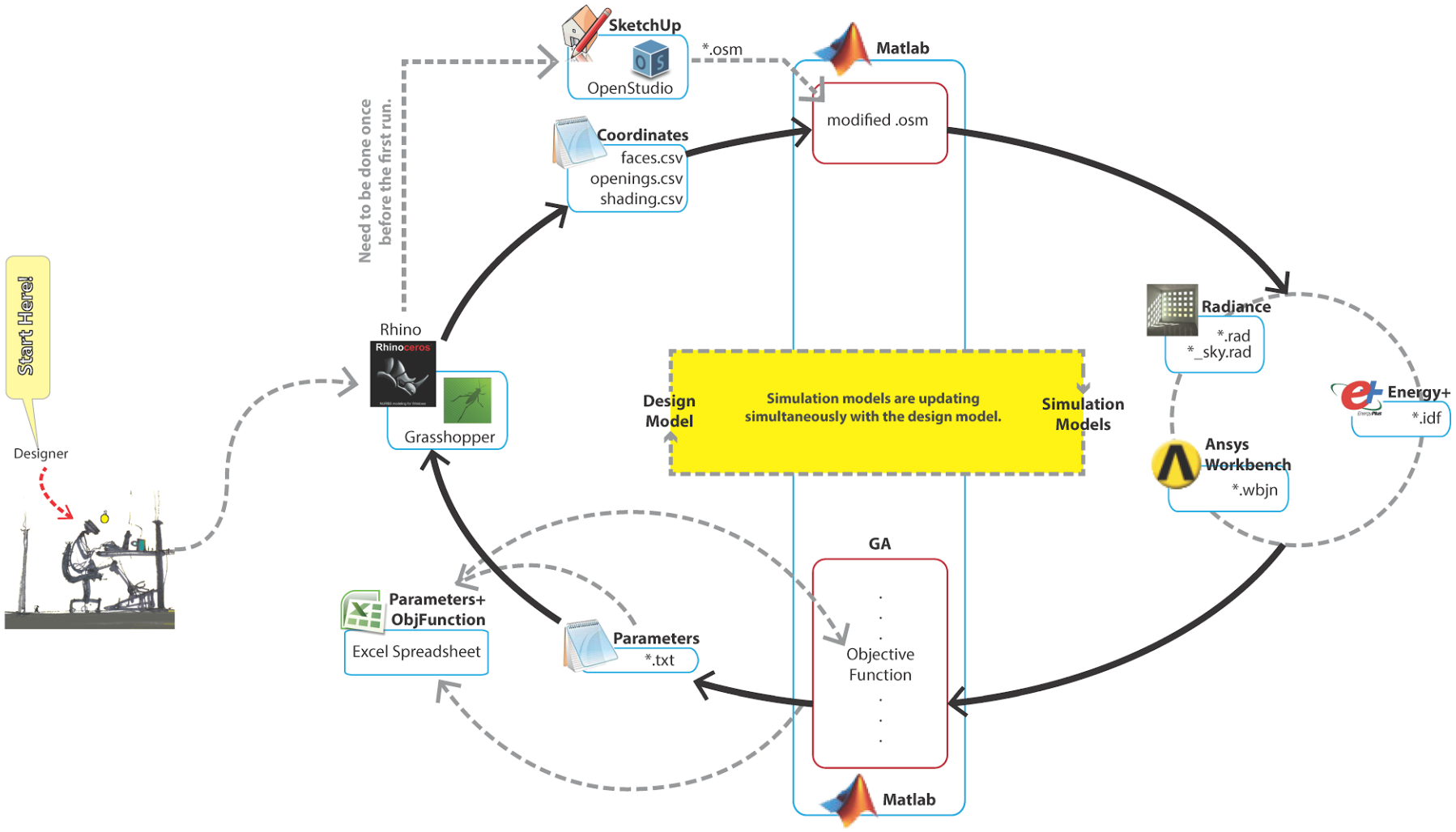




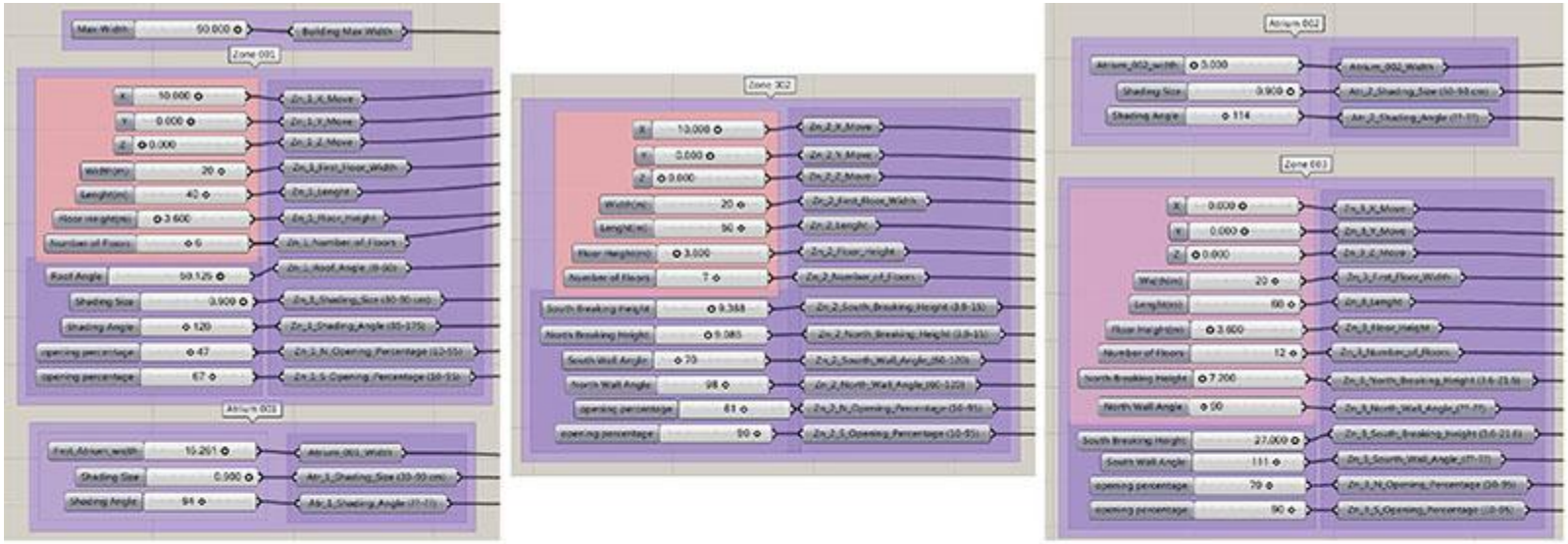
Let's Get Back to the Circle: Design - Evaluation- Optimization

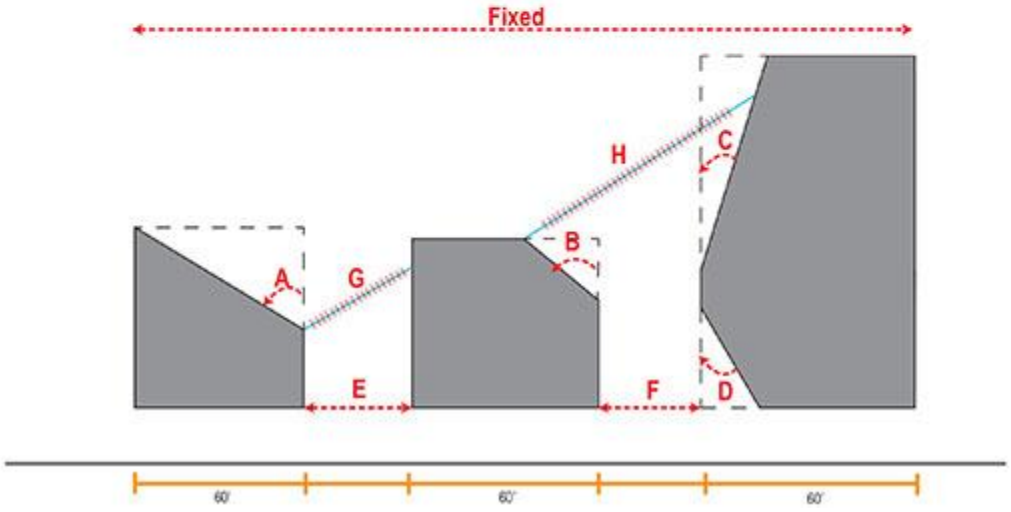


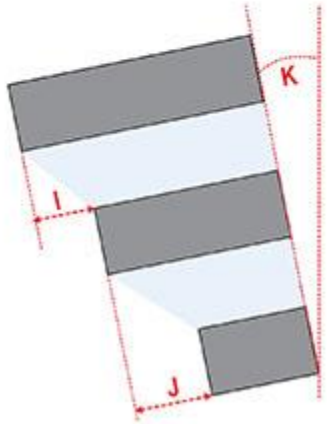
Design <> Evaluation <> Optimization Workflow - Idea



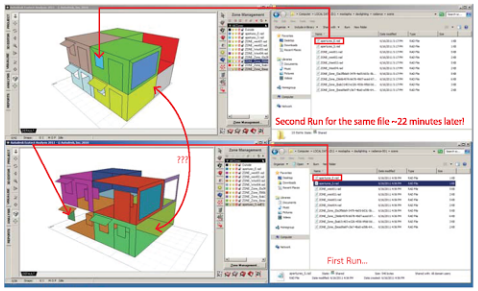
Design Parameters

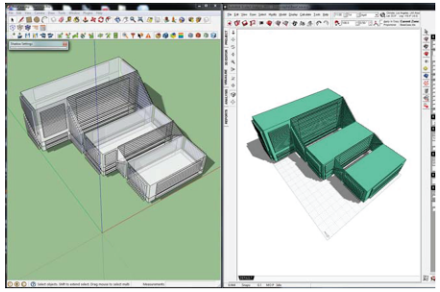


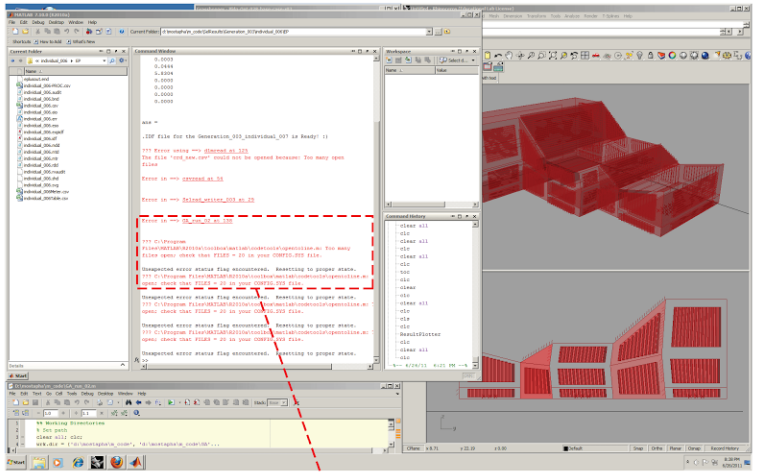


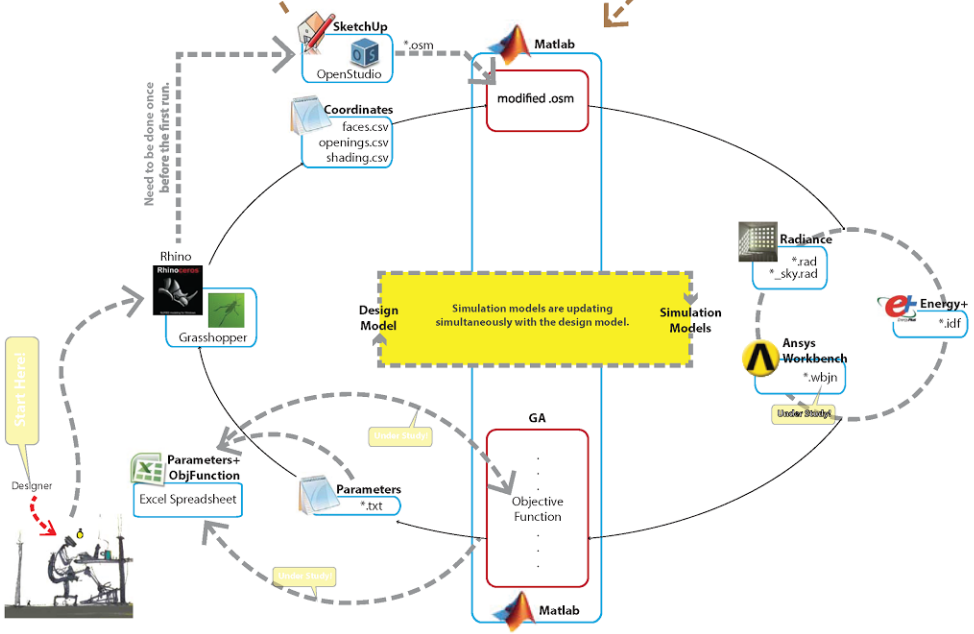


Design <> Evaluation <> Optimization Workflow - Reality!









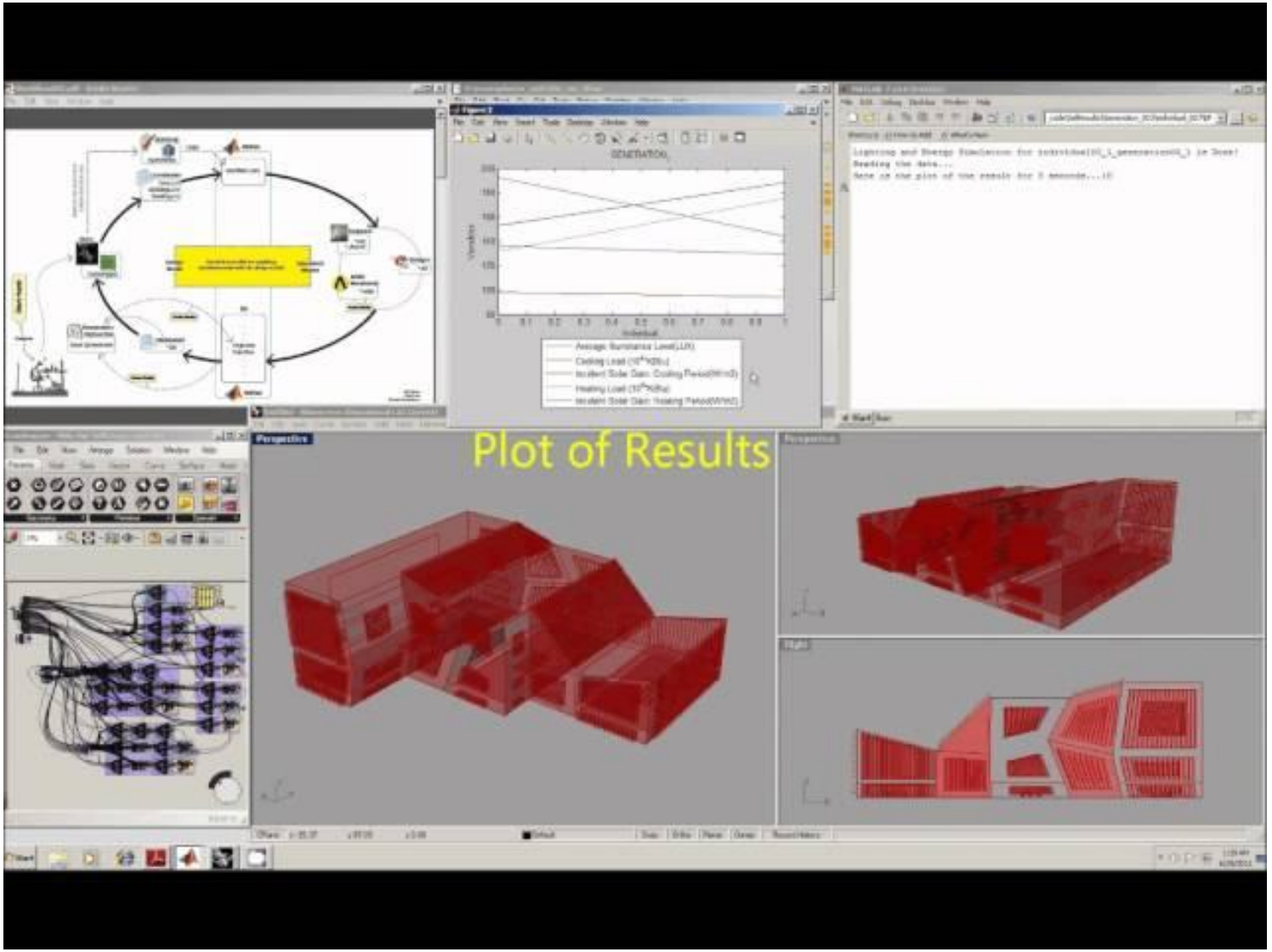

```
Error in ==> GA_run_02 at 138


??? C:\Program
Files\MATLAB\R2010a\toolbox\matlab\codetools\opentoline.m: Too many
files open; check that FILES = 20 in your CONFIG.SYS file.

Unexpected error status flag encountered.  Resetting to proper state.
??? C:\Program Files\MATLAB\R2010a\toolbox\matlab\codetools\opentoline.m:
open; check that FILES = 20 in your CONFIG.SYS file.
```

```
>> addpath=('d:\mostapha\mleplus')
MATLAB has lost its connection to the license manager.
Unless the connection is restored, MATLAB will exit in 18 minutes.
```

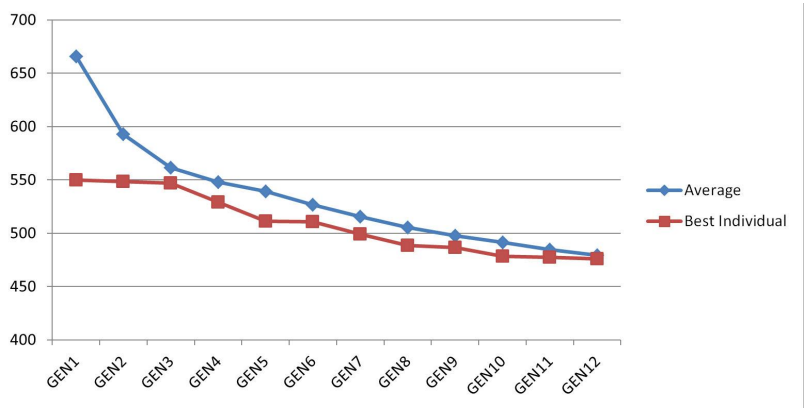
Design <> Evaluation <> Optimization Workflow - Result

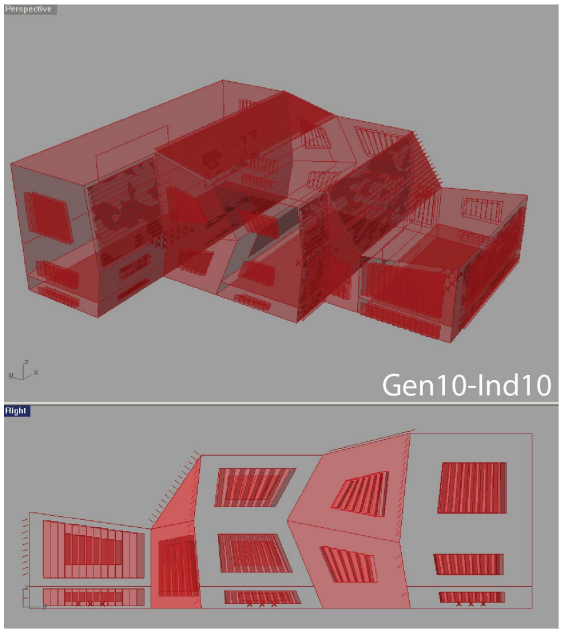


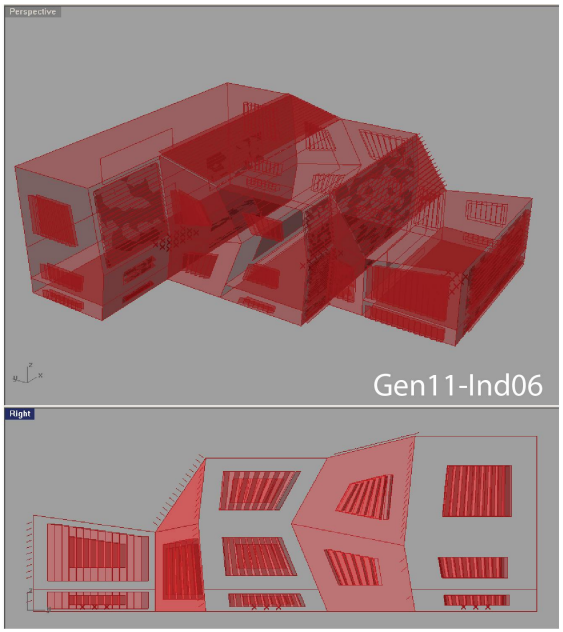
http://www.youtube.com/watch?v=fYw7KexxThM

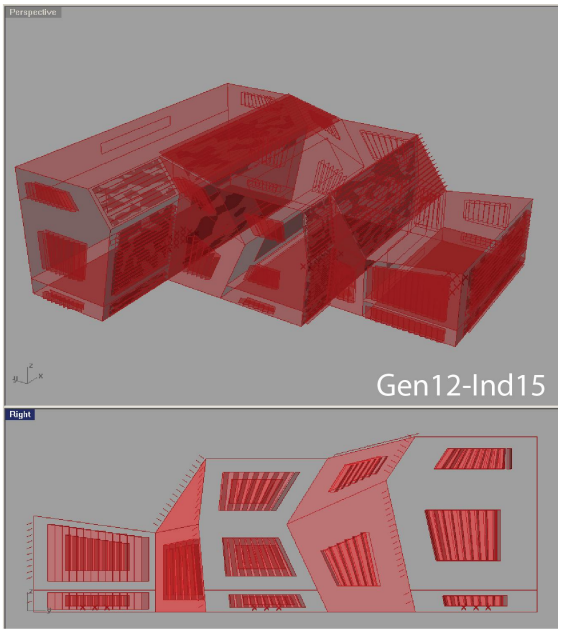
Postpartum Depression

- Was it worth it?
- How long does it take to set up a similar workflow for the next project?
- Can I show to someone else how to do it?
- ...

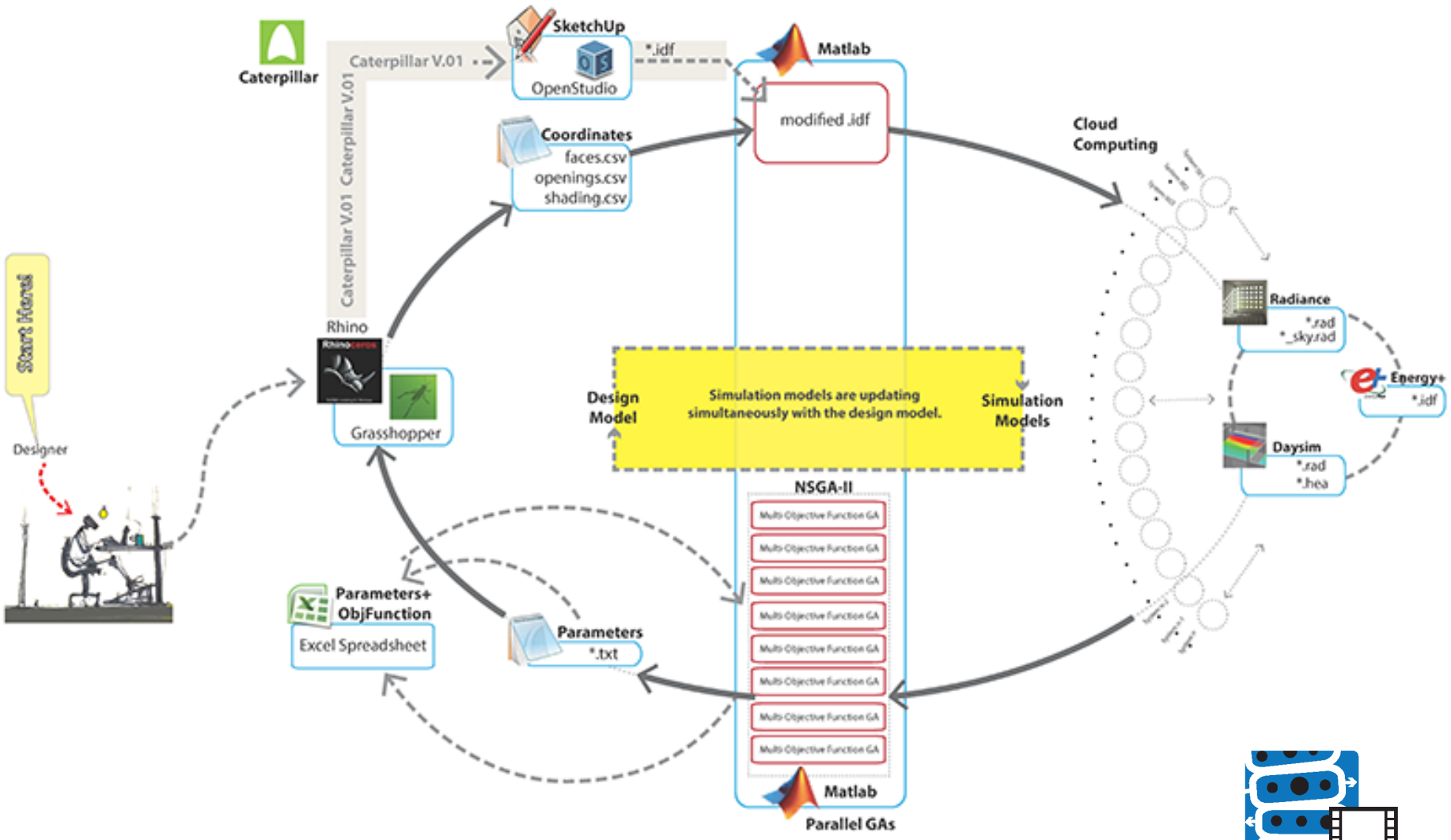








Few Months later...

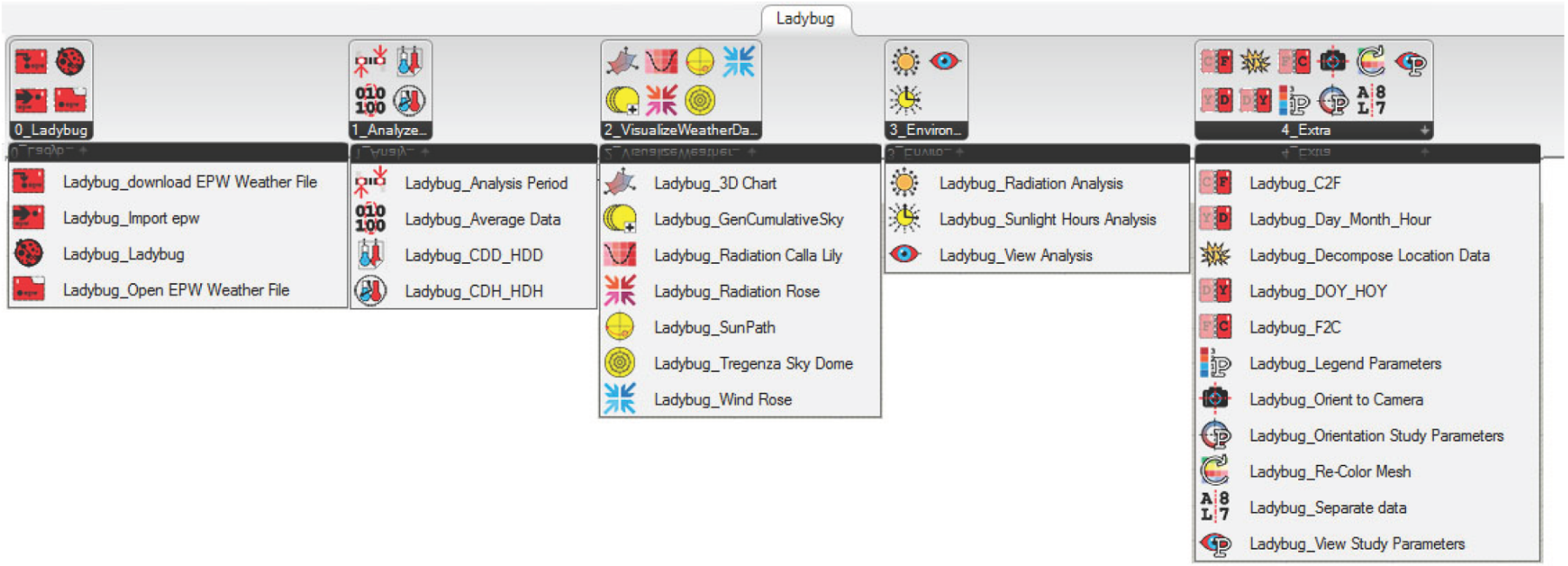


http://www.youtube.com/watch?v=qdbo0uM9mj4

Turning Point

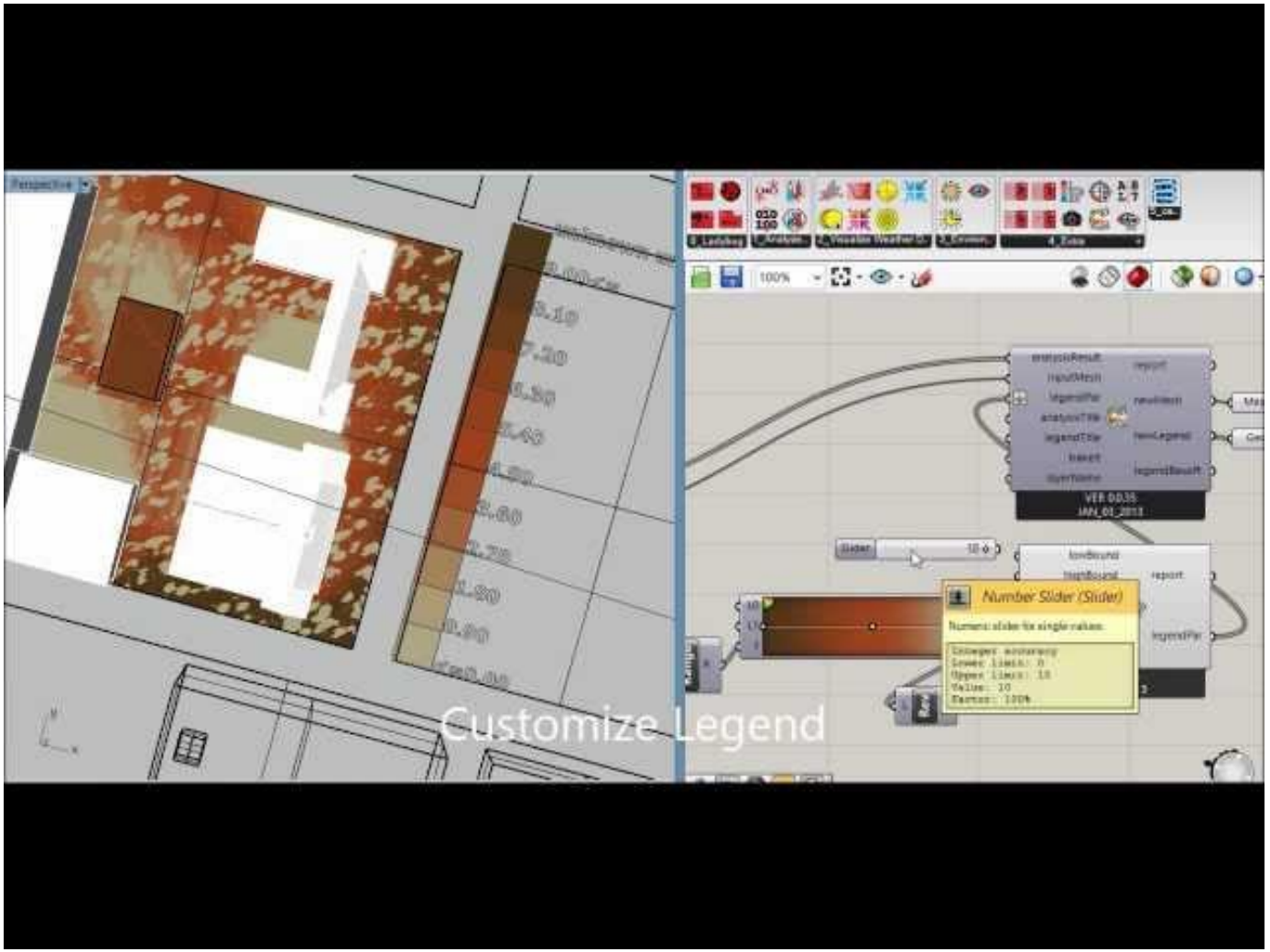
Keep It Simple but not Stupid!

Ladybug: Parametric [Weather Data] Analysis



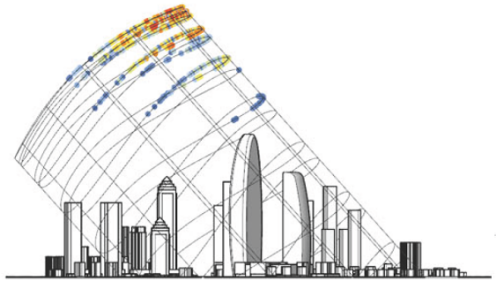
http://www.youtube.com/watch?v=OEjwAyC2I_0

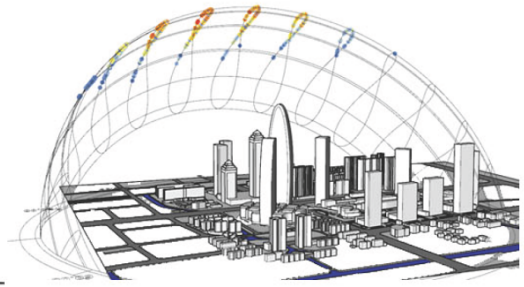
Ladybug: Sun Path (Radiance)

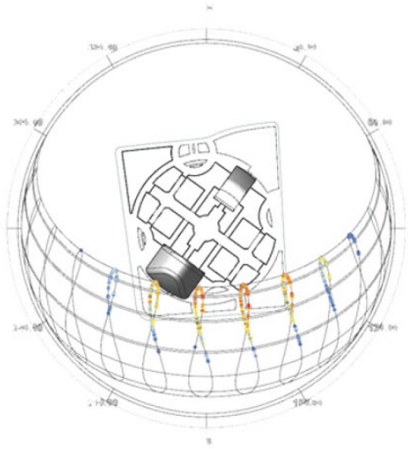


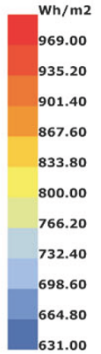
1:04

Ladybug: Sun Path (Radiance) + Hourly Weather Data

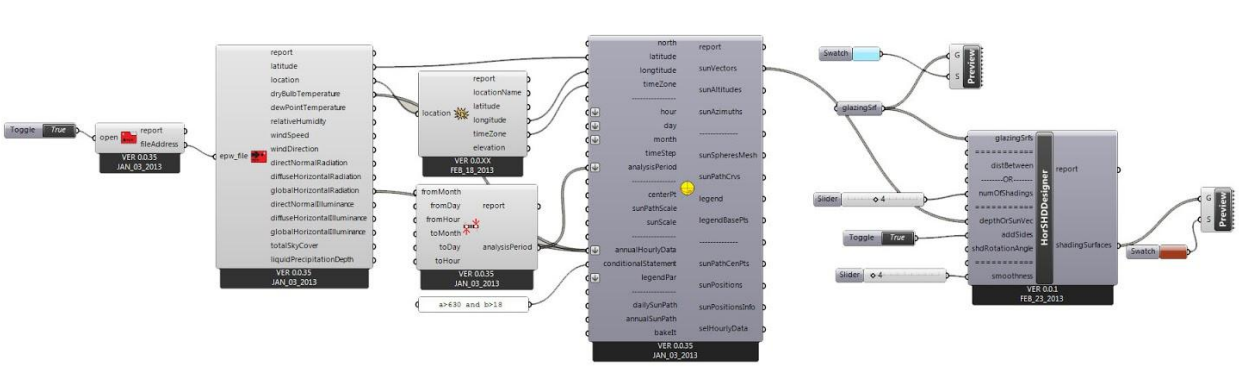


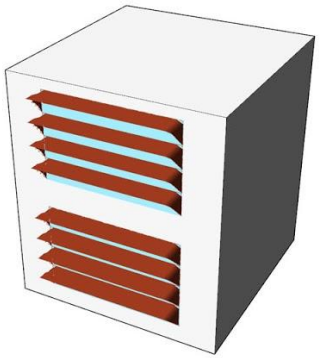




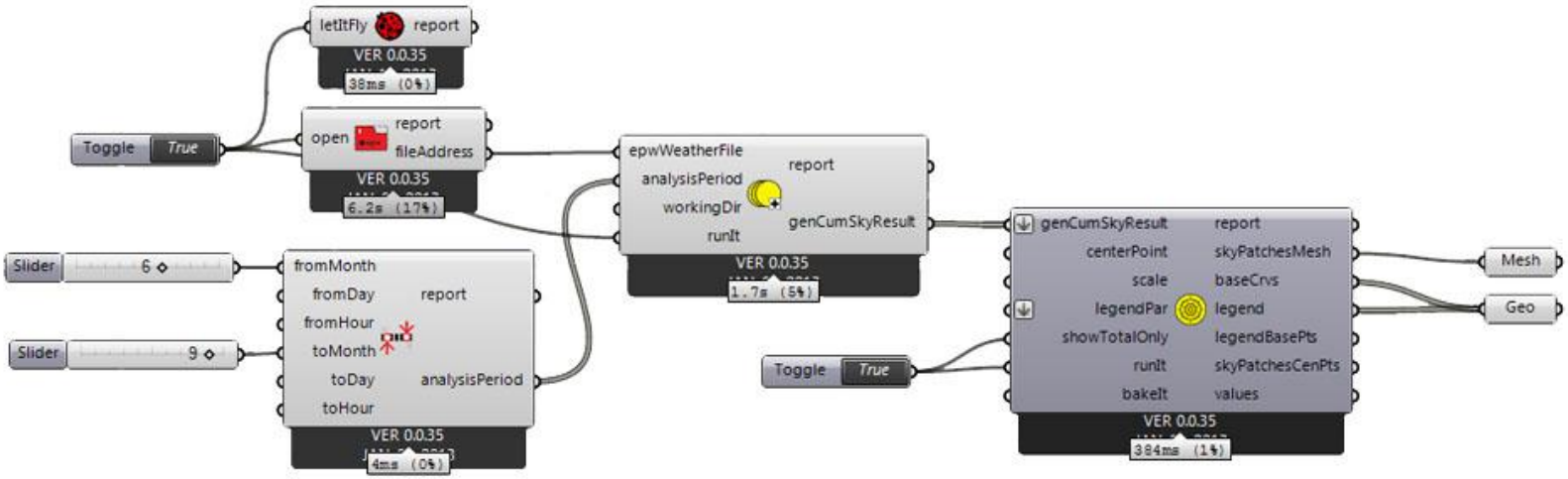


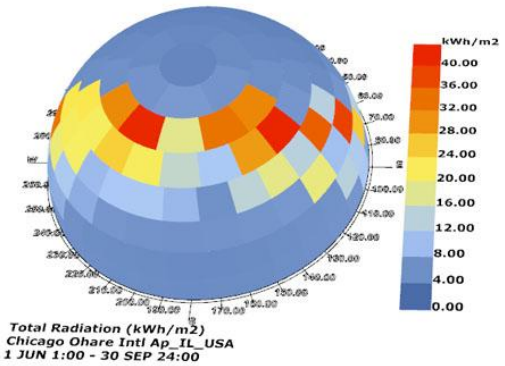
Sun-Path Diagram - Latitude: 41.98
Hourly Data: Global Horizontal Radiation (Wh/m2)
Chicago Ohare Intl Ap_IL_USA
... **...** **...**
Conditiontional Selection Applied:
Global Horizontal Radiation>630
and Dry Bulb Temperature>18
556.0 hours of total 4616.0 sun up hours(12.05%).

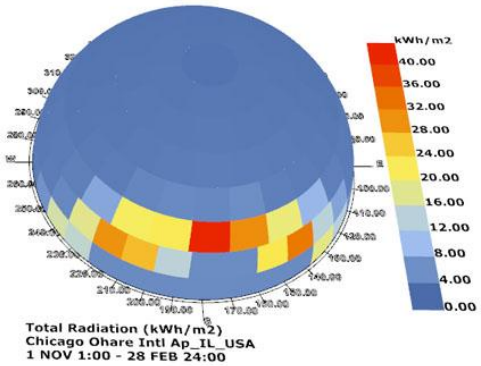




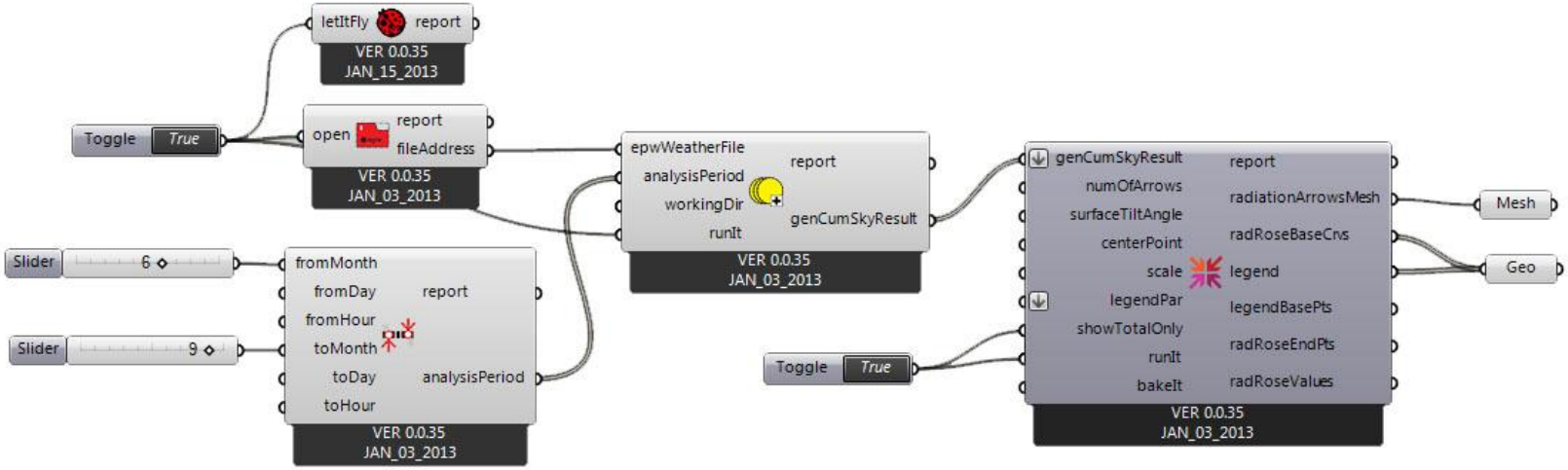
Ladybug: Tregenza Sky Dome (GenCumulativeSky)

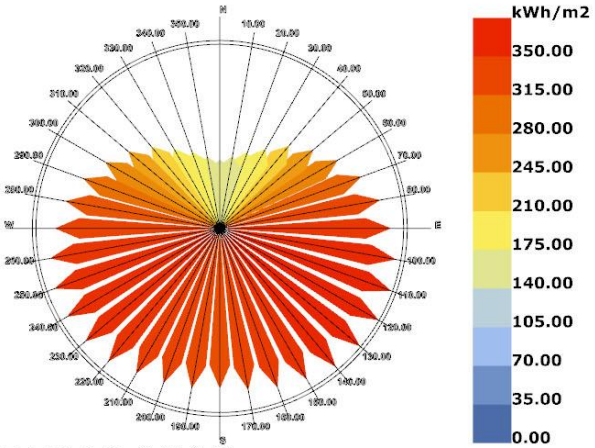




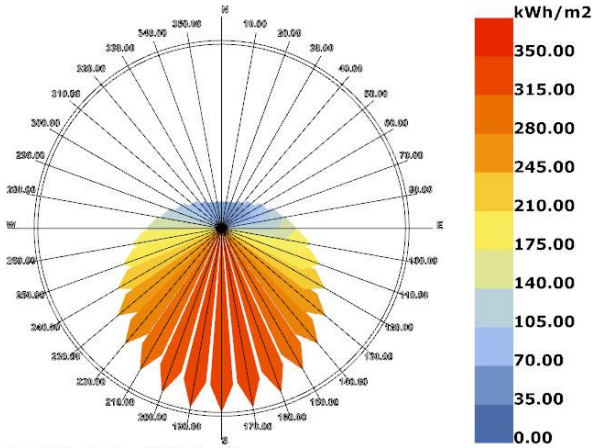


Ladybug: Radiation Rose (GenCumulativeSky)



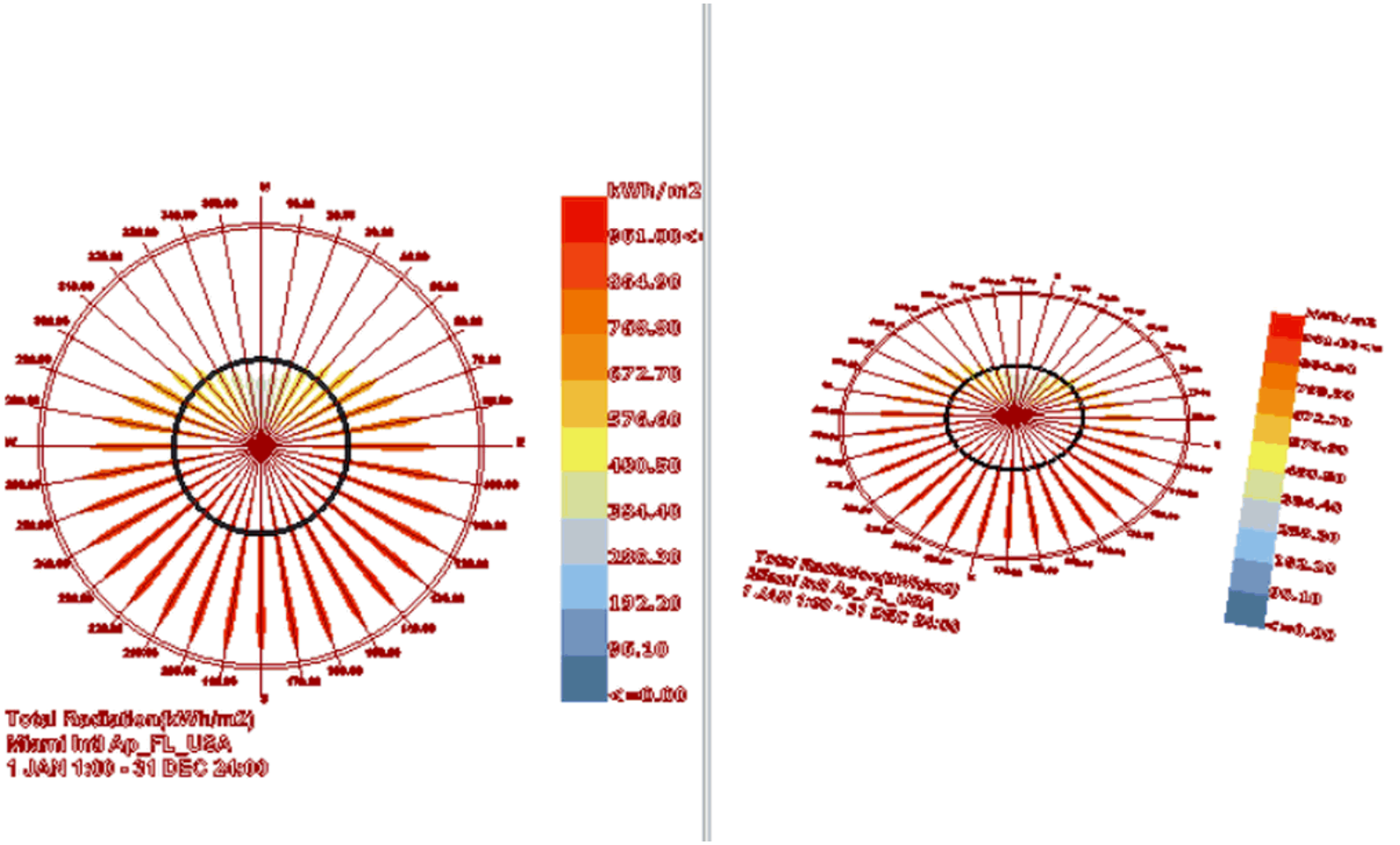


Total Radiation(kWh/m2)
Chicago Ohare Intl Ap_IL_USA
1 JUN 1:00 - 30 SEP 24:00

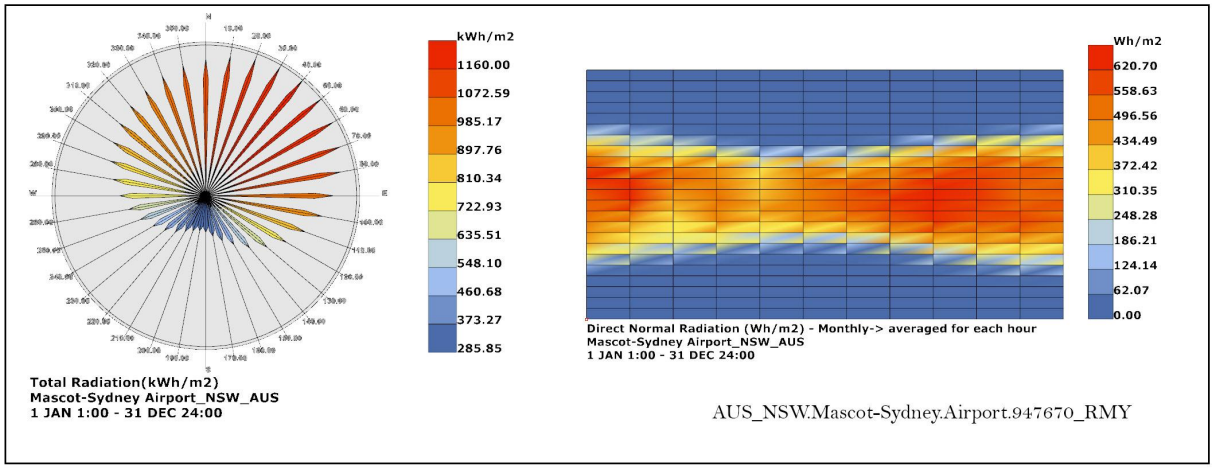


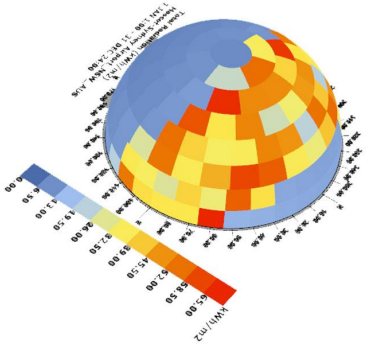
Total Radiation(kWh/m2)
Chicago Ohare Intl Ap_IL_USA
1 NOV 1:00 - 28 FEB 24:00

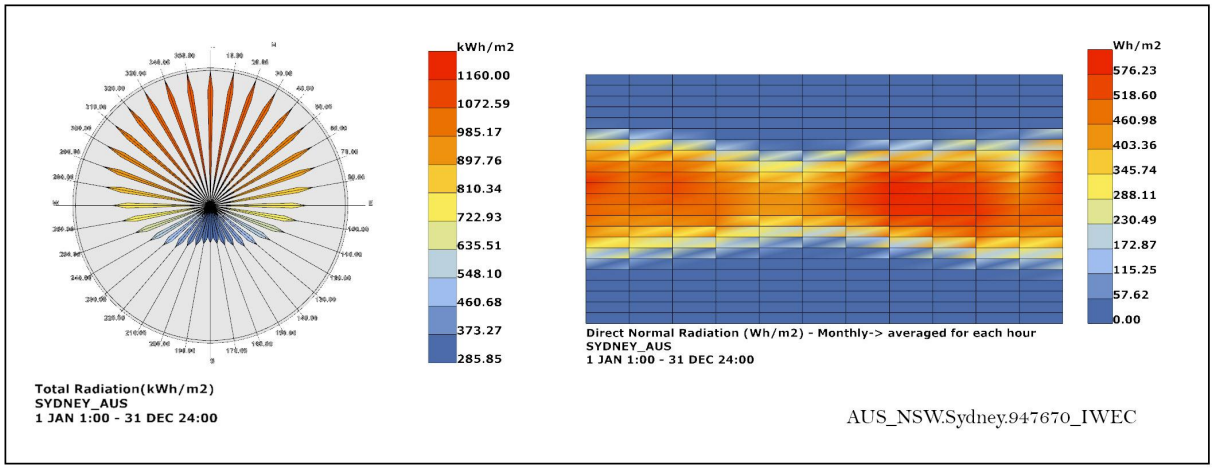
Ladybug: Interactive Radiation Rose (GenCumulativeSky)

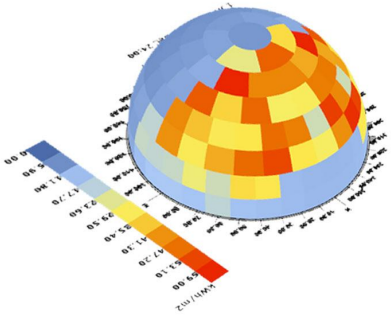


Ladybug: Weather Data Verification

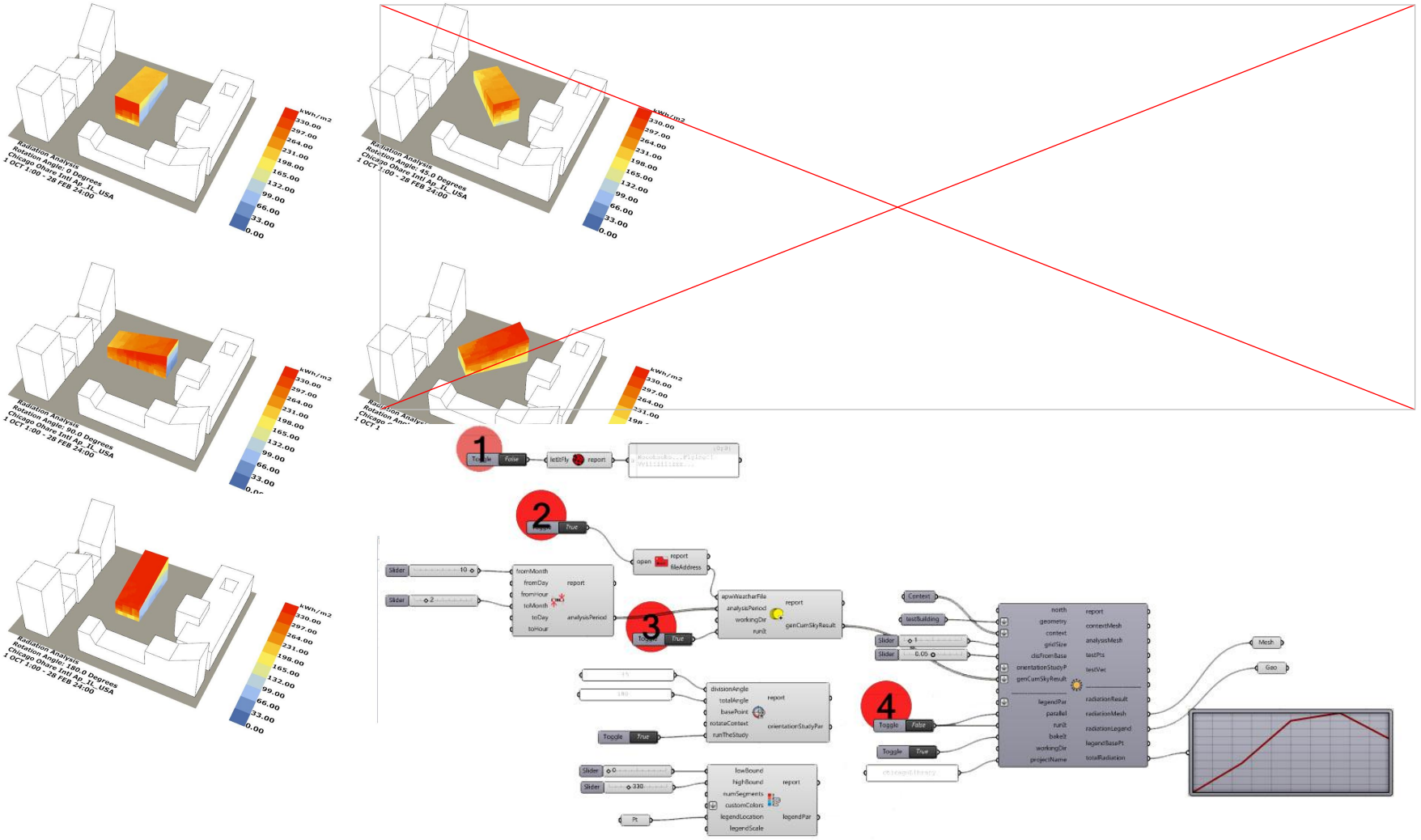




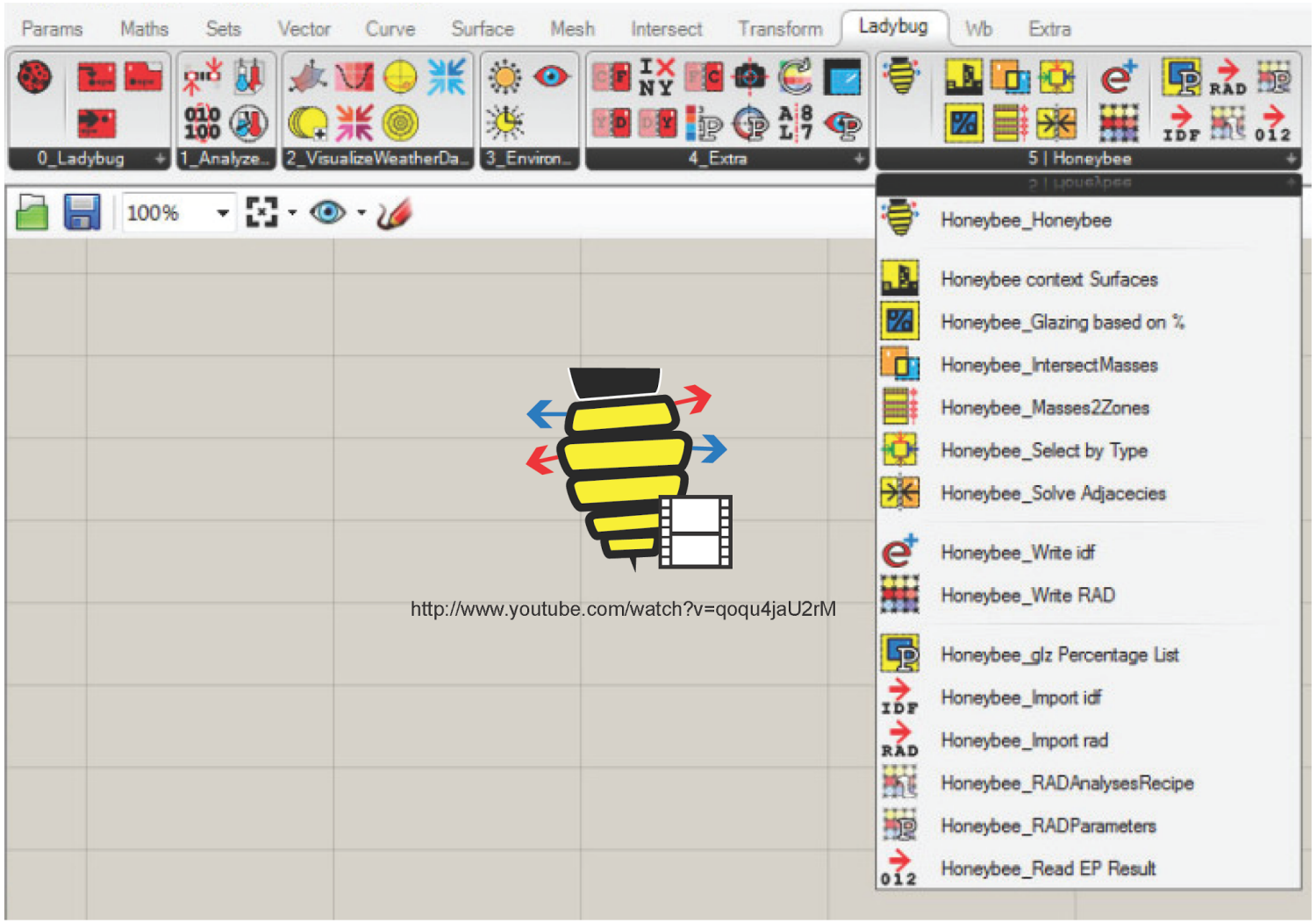




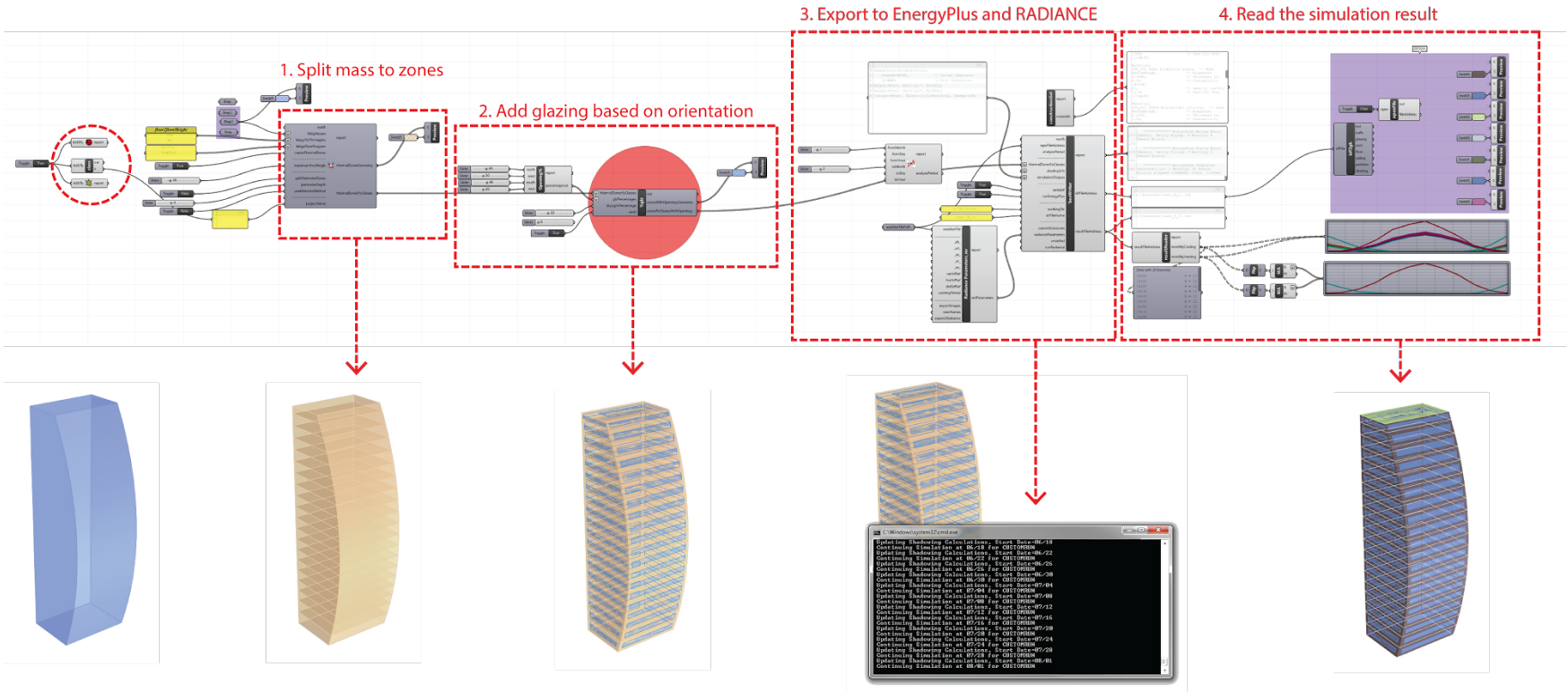
Ladybug: ~Realtime Radiation Studies (GenCumulativeSky + Parallel Raytracing)



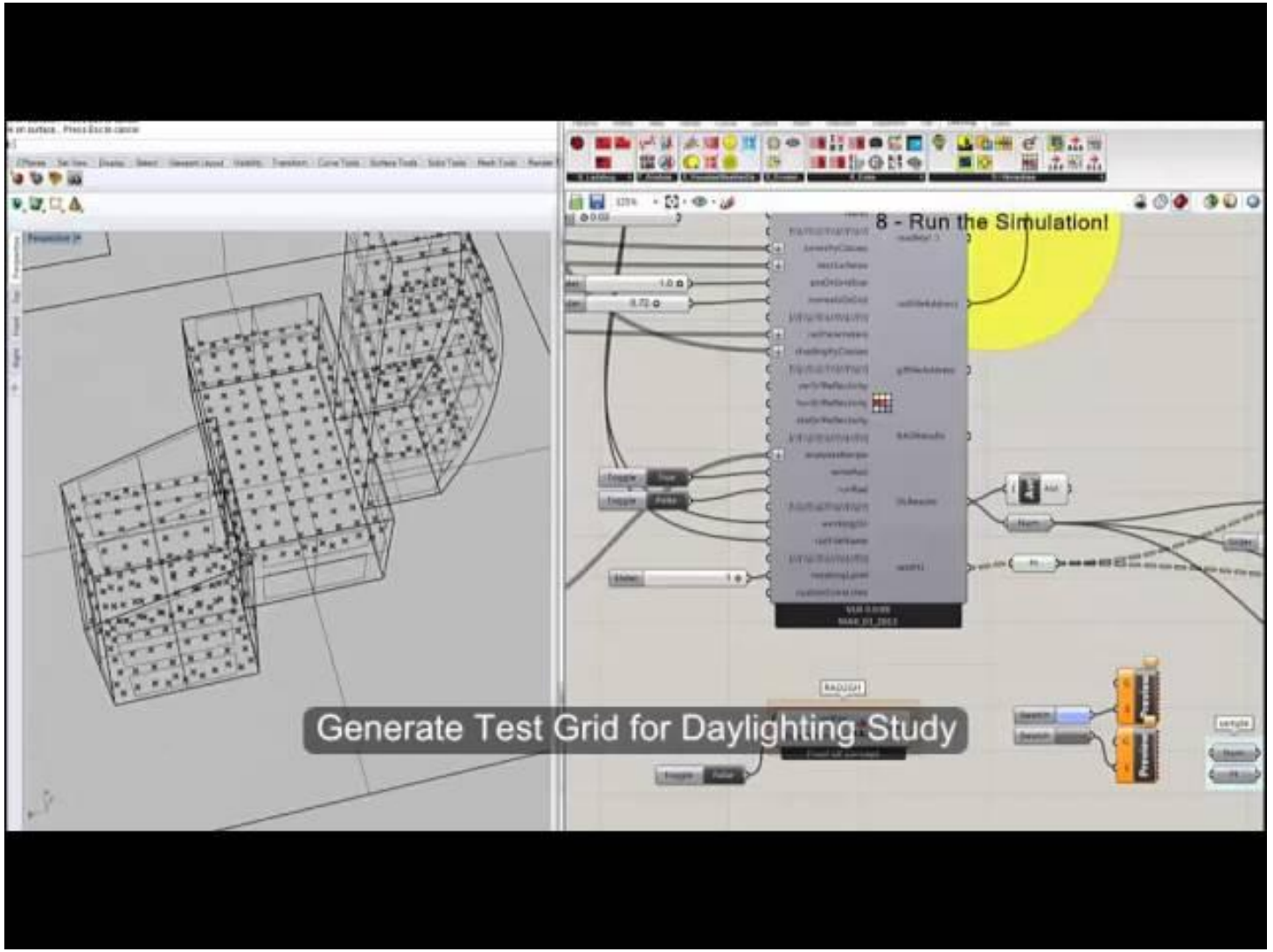
Honeybee: Grasshopper <> Radiance/Daysim/EnergyPlus



Honeybee: WorkFlow

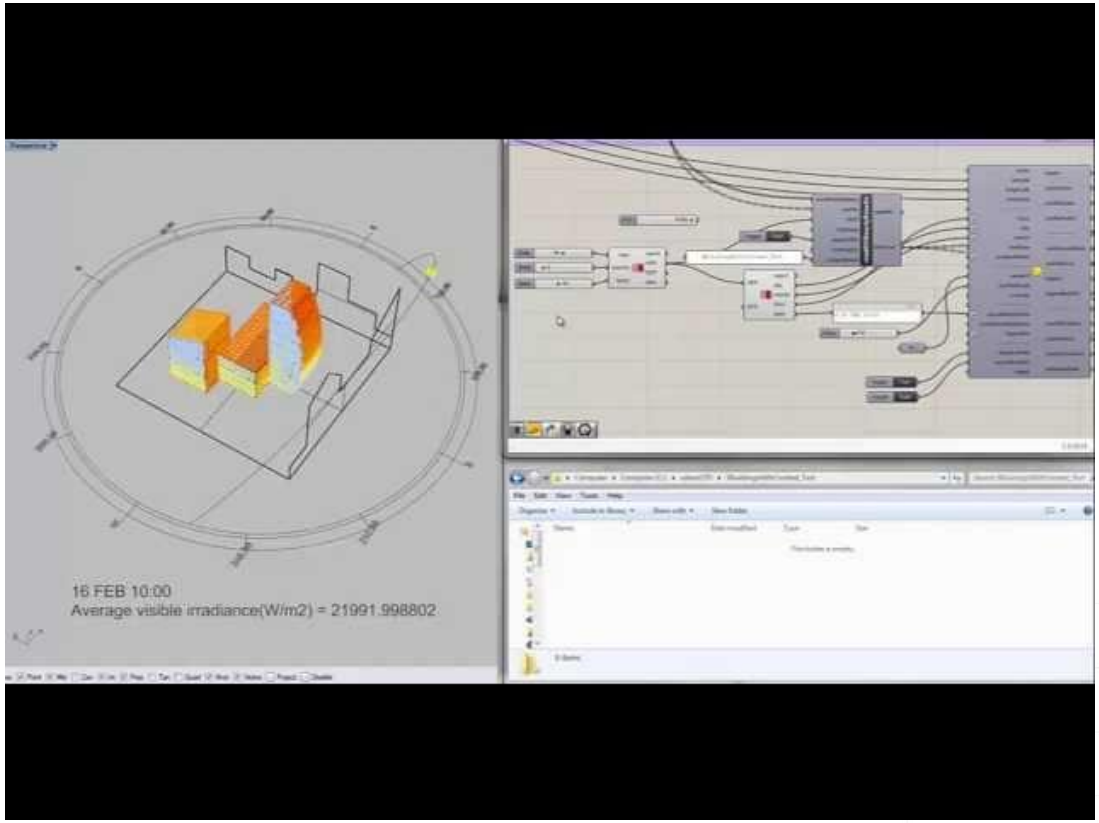


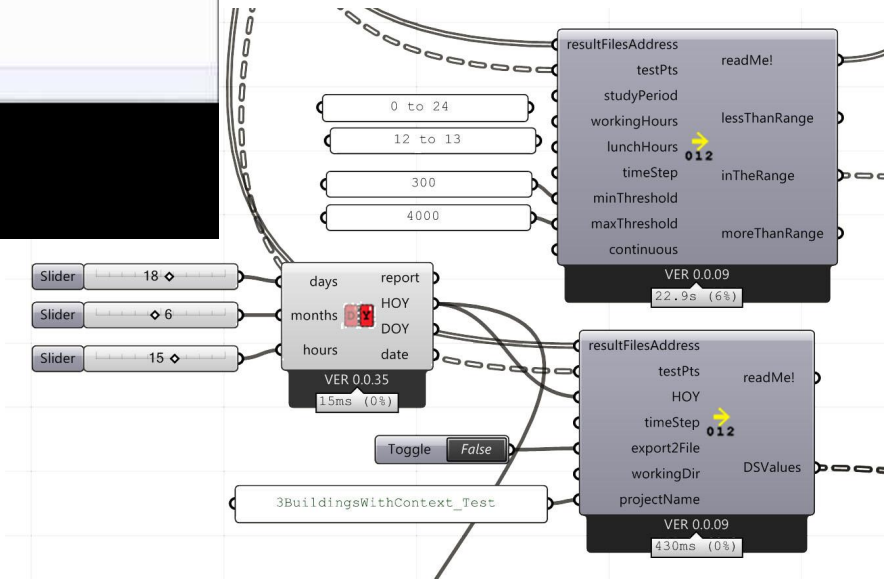
Honeybee: All in 2 Minutes!



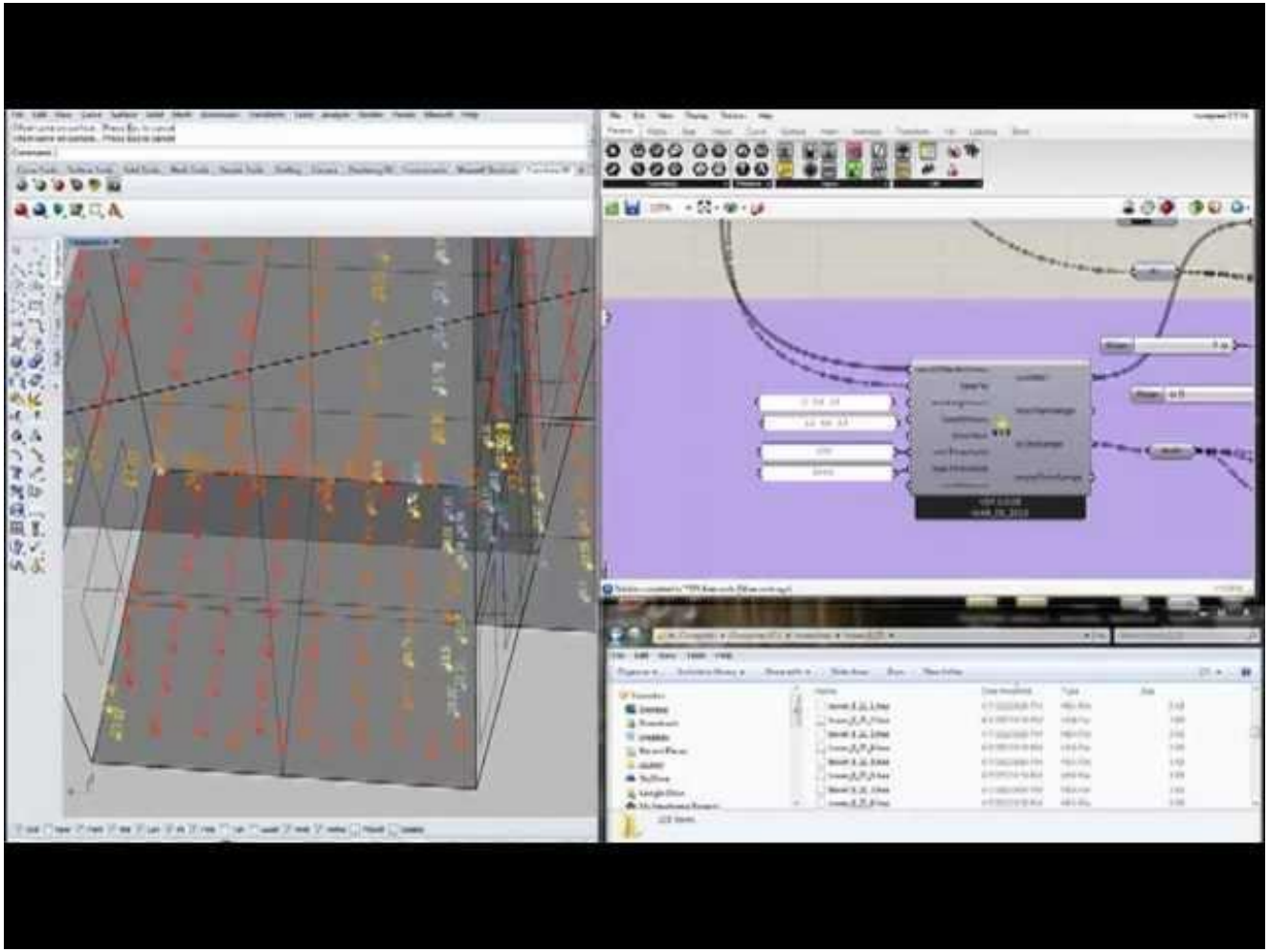
Watch the full length video here: http://www.youtube.com/watch?v=aoMy4O3vN6g

Honeybee: Make it faster and More Parametric Friendly!

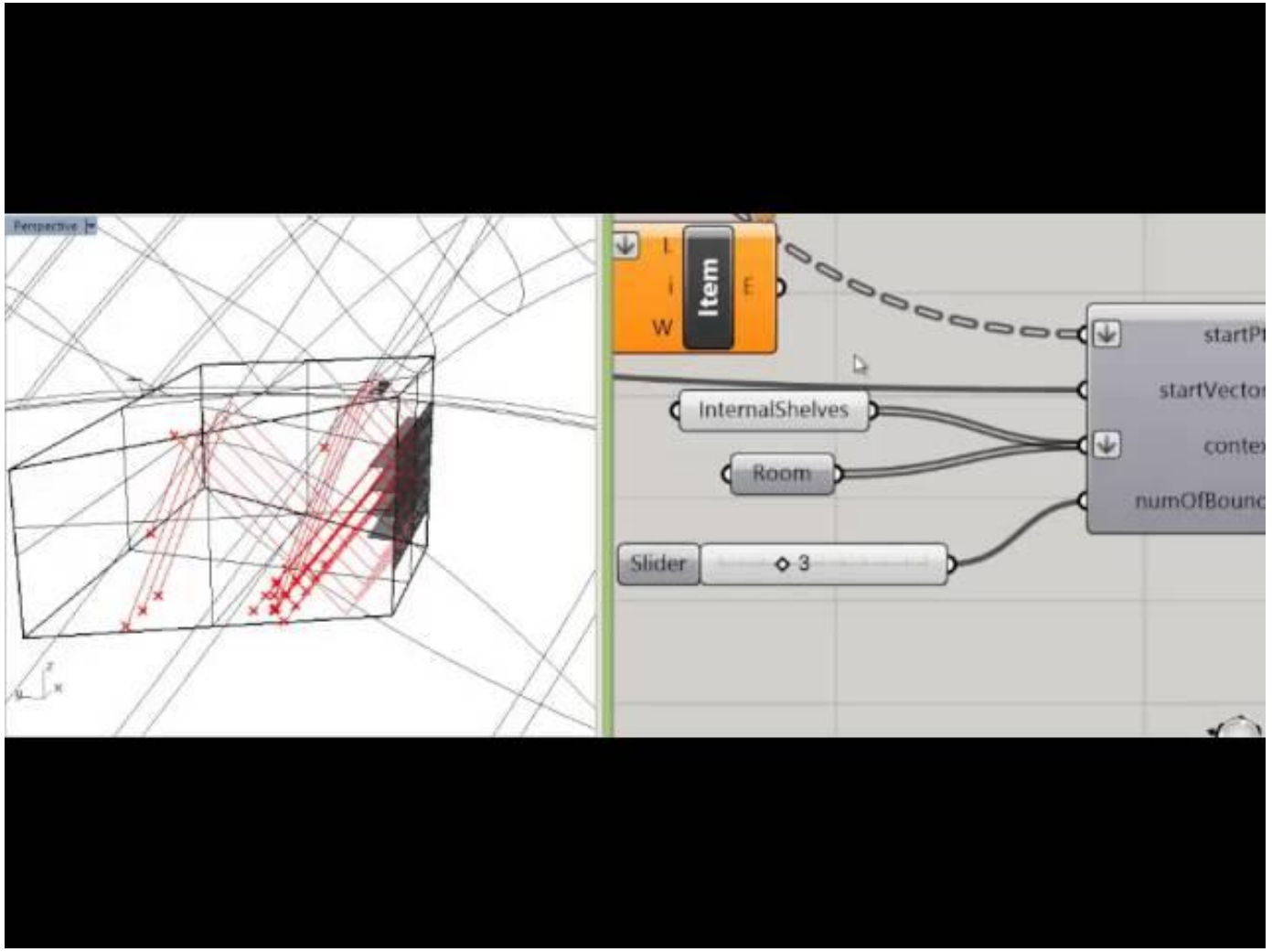




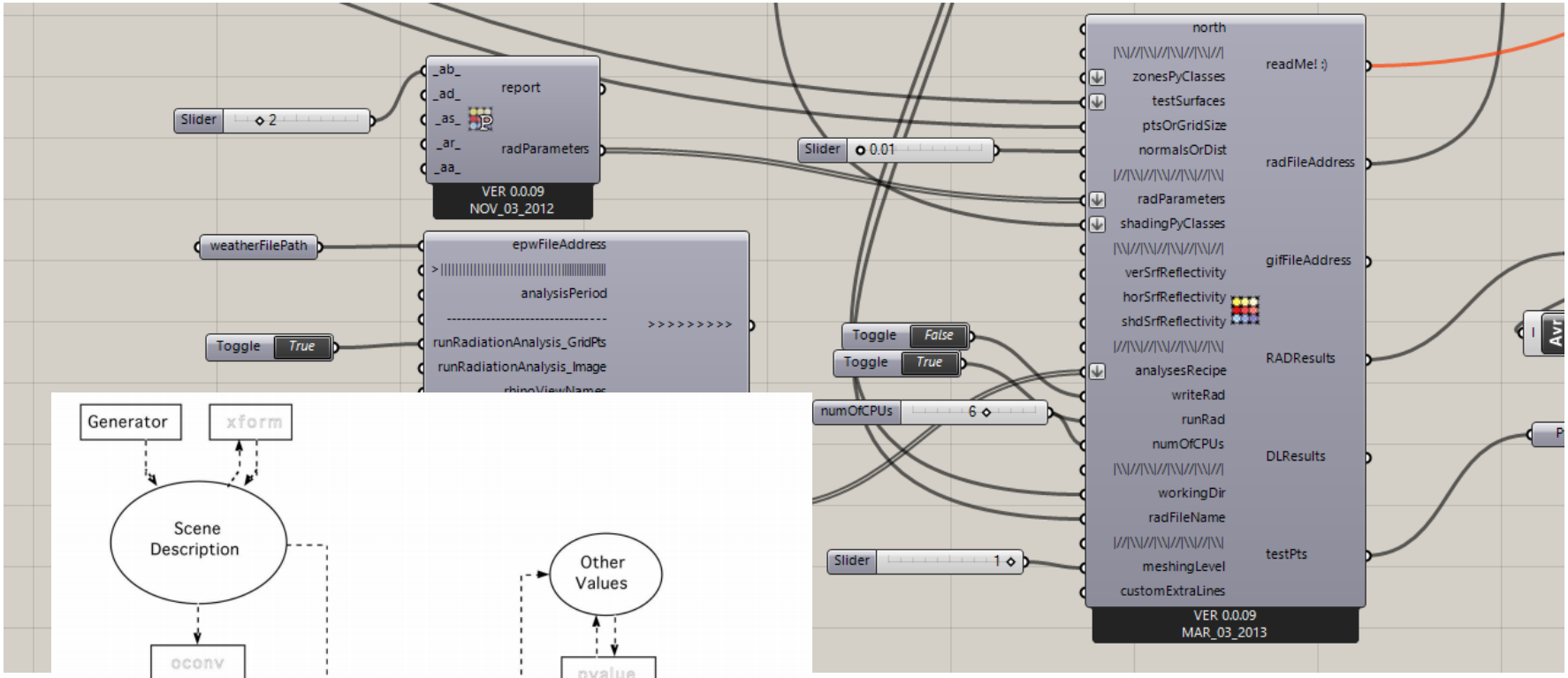
Honeybee: Make it faster and More Parametric Friendly!



Honeybee: Make it faster and More Parametric Friendly!



Honeybee: Does it look right?



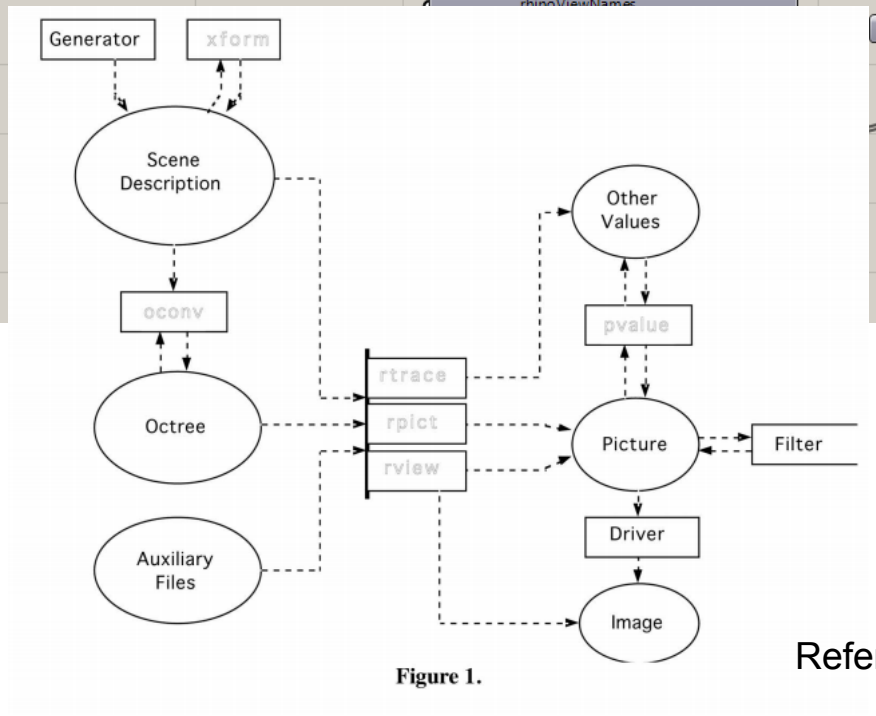
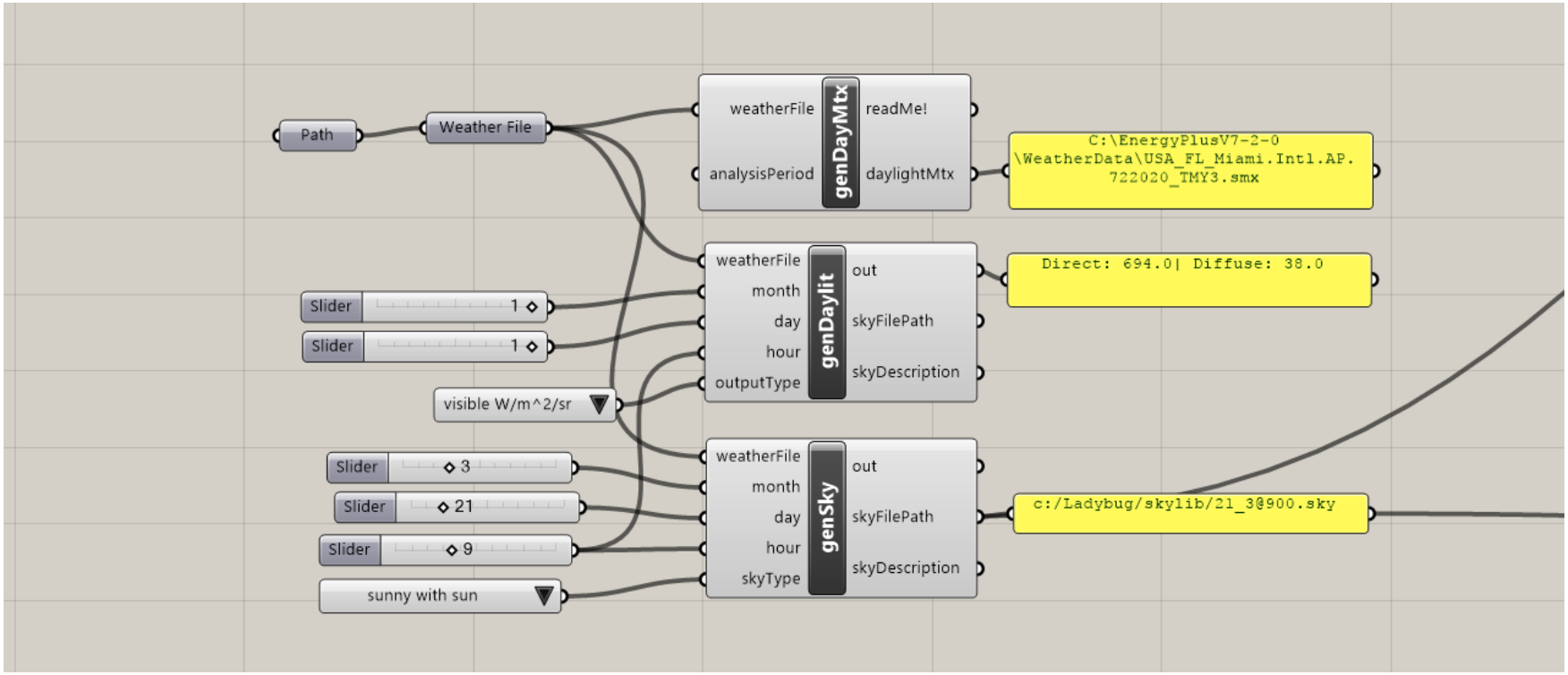


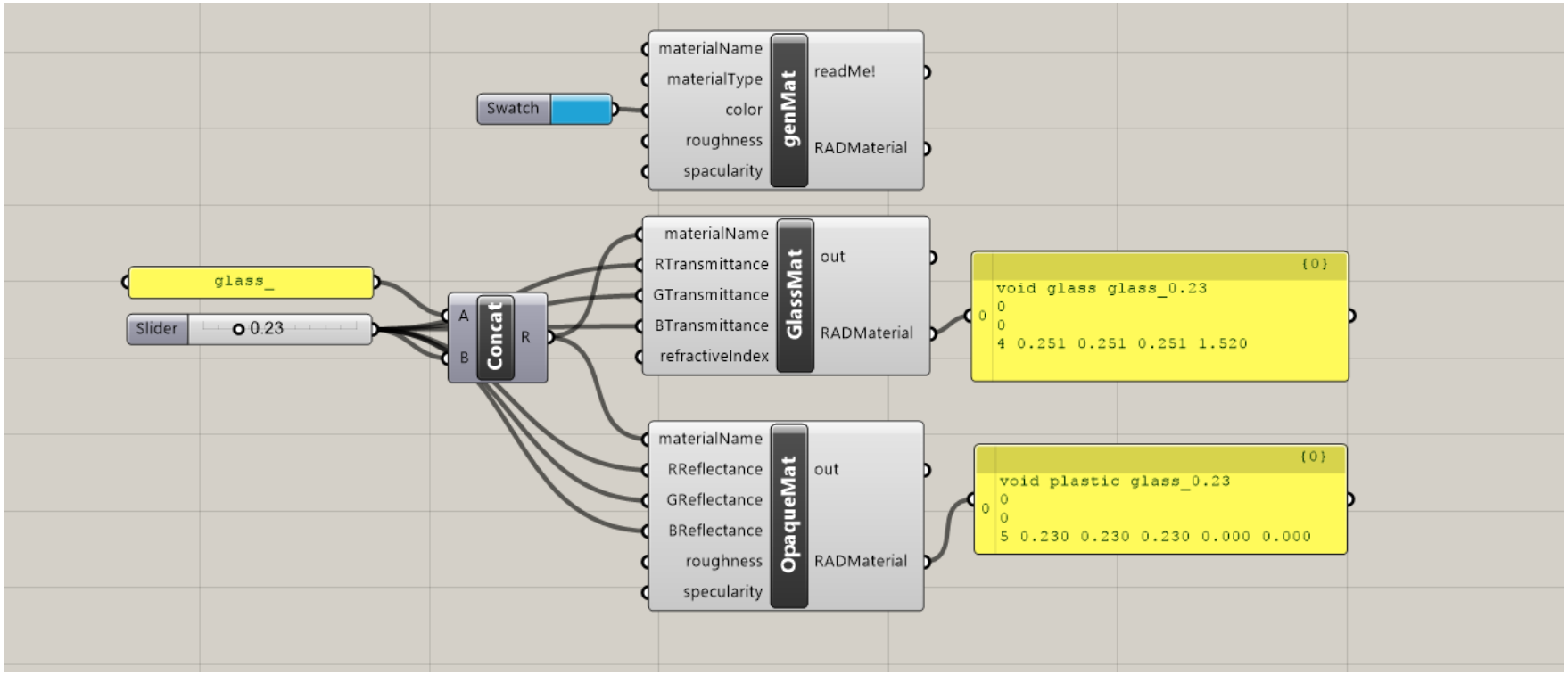
Figure 1.

Reference: http://radsite.lbl.gov/radiance/refer/refman.pdf

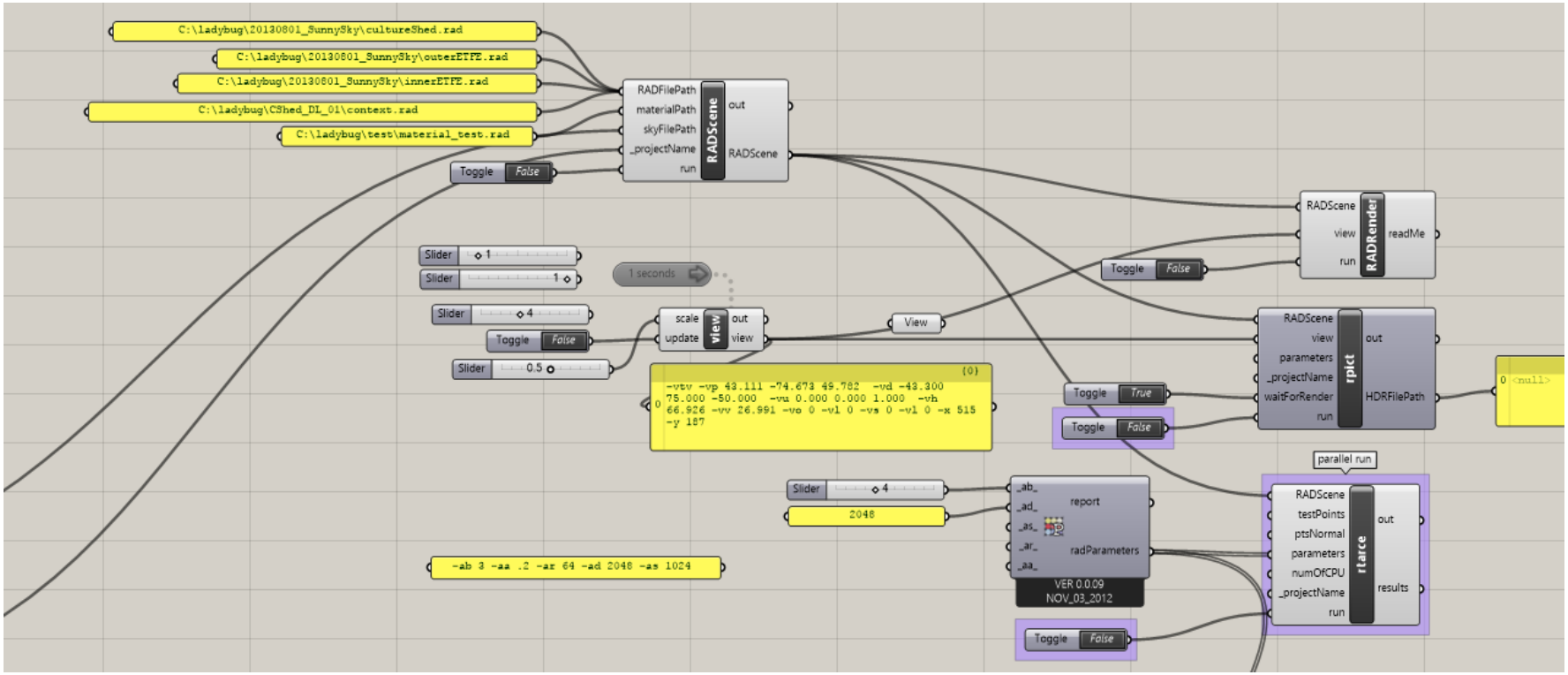
Honeybee: Multiple Sky Methods



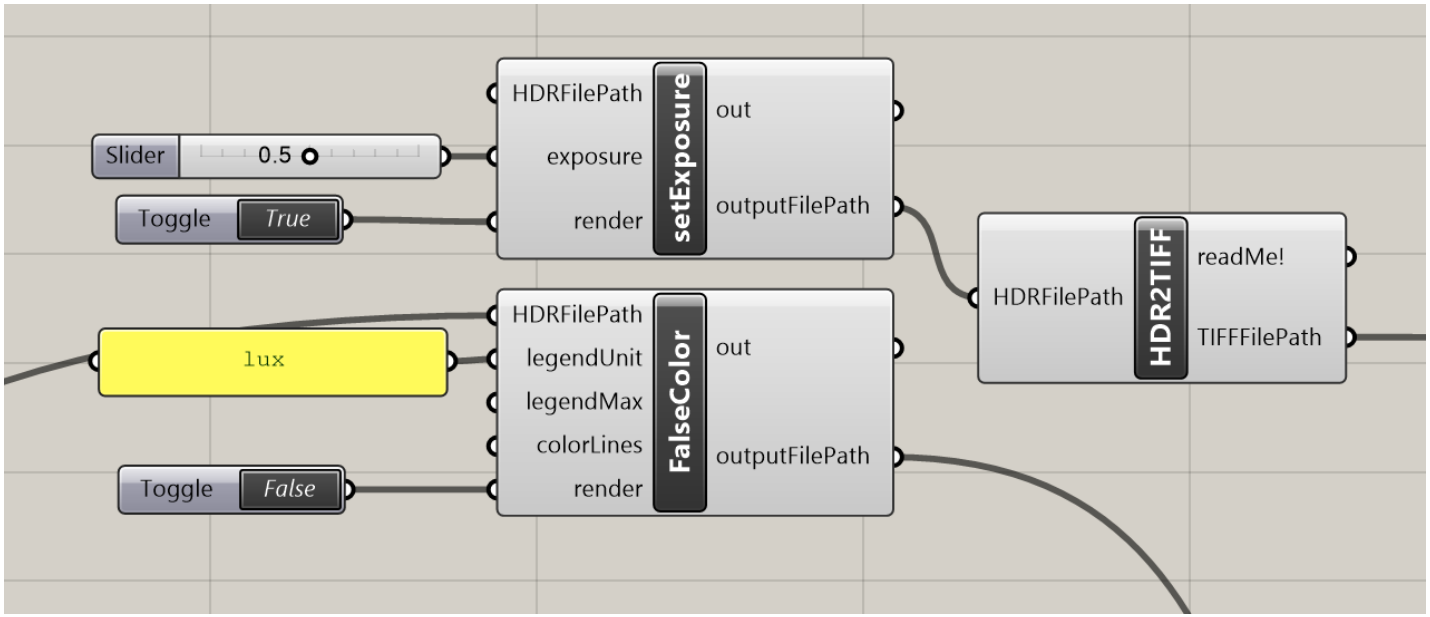
Honeybee: Multiple Material Components



Honeybee: OCT + View + Rendering/Simulation Options



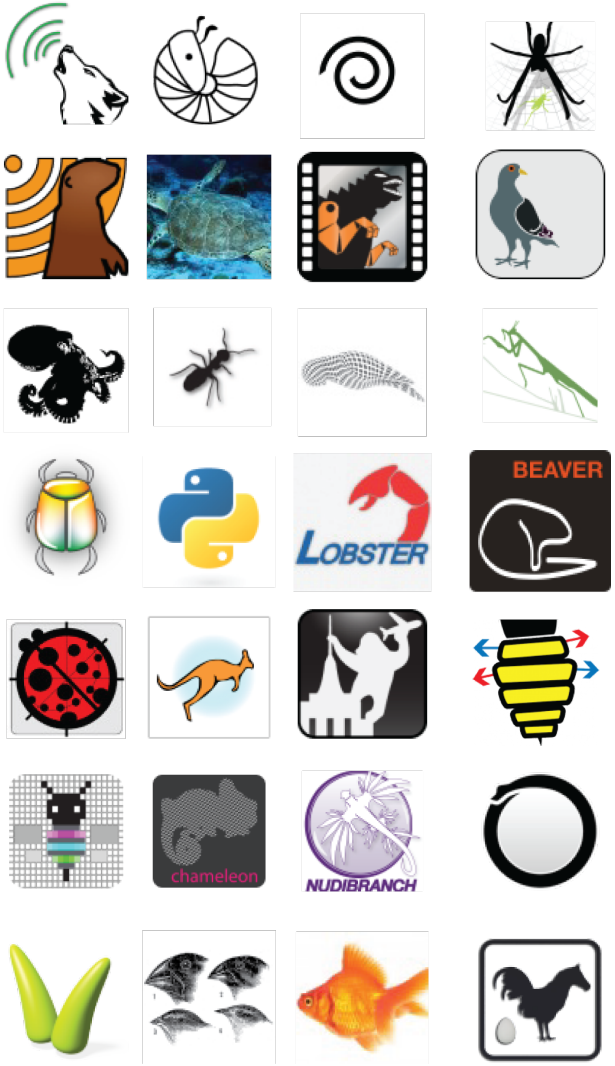
Honeybee: Result Modification



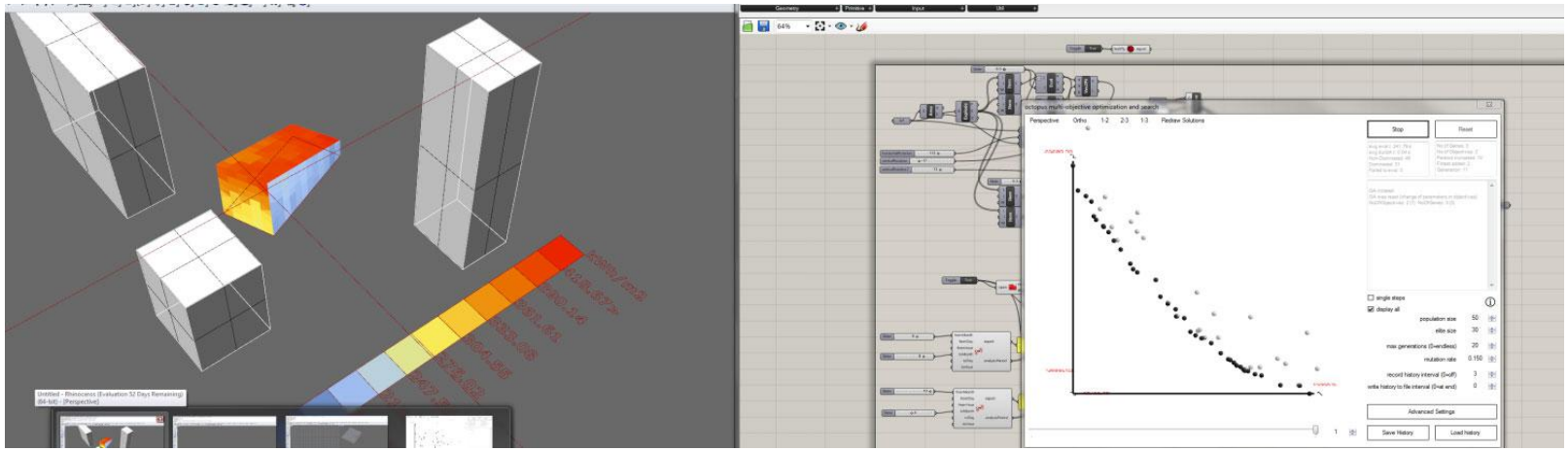
What's happening inside the zoo after Ladybug?

+

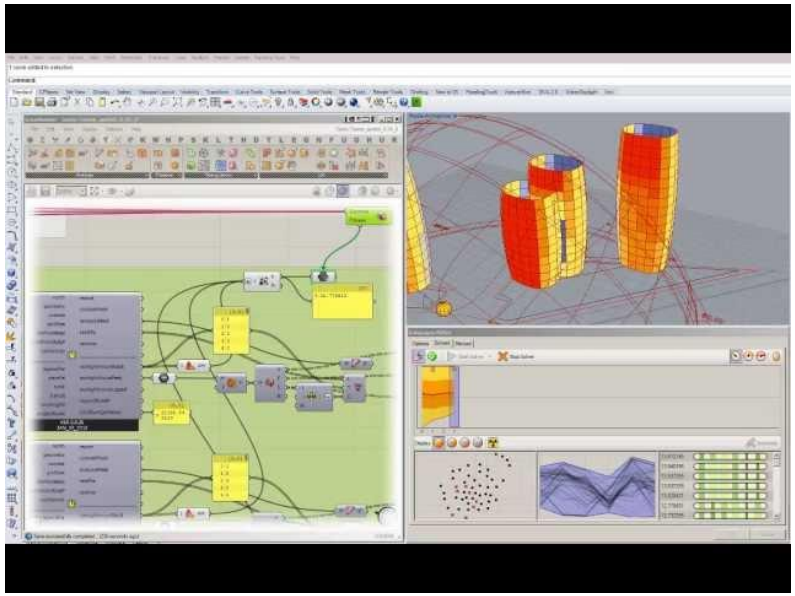
+



Multi-objective optimization study (Ladybug + Octopus)



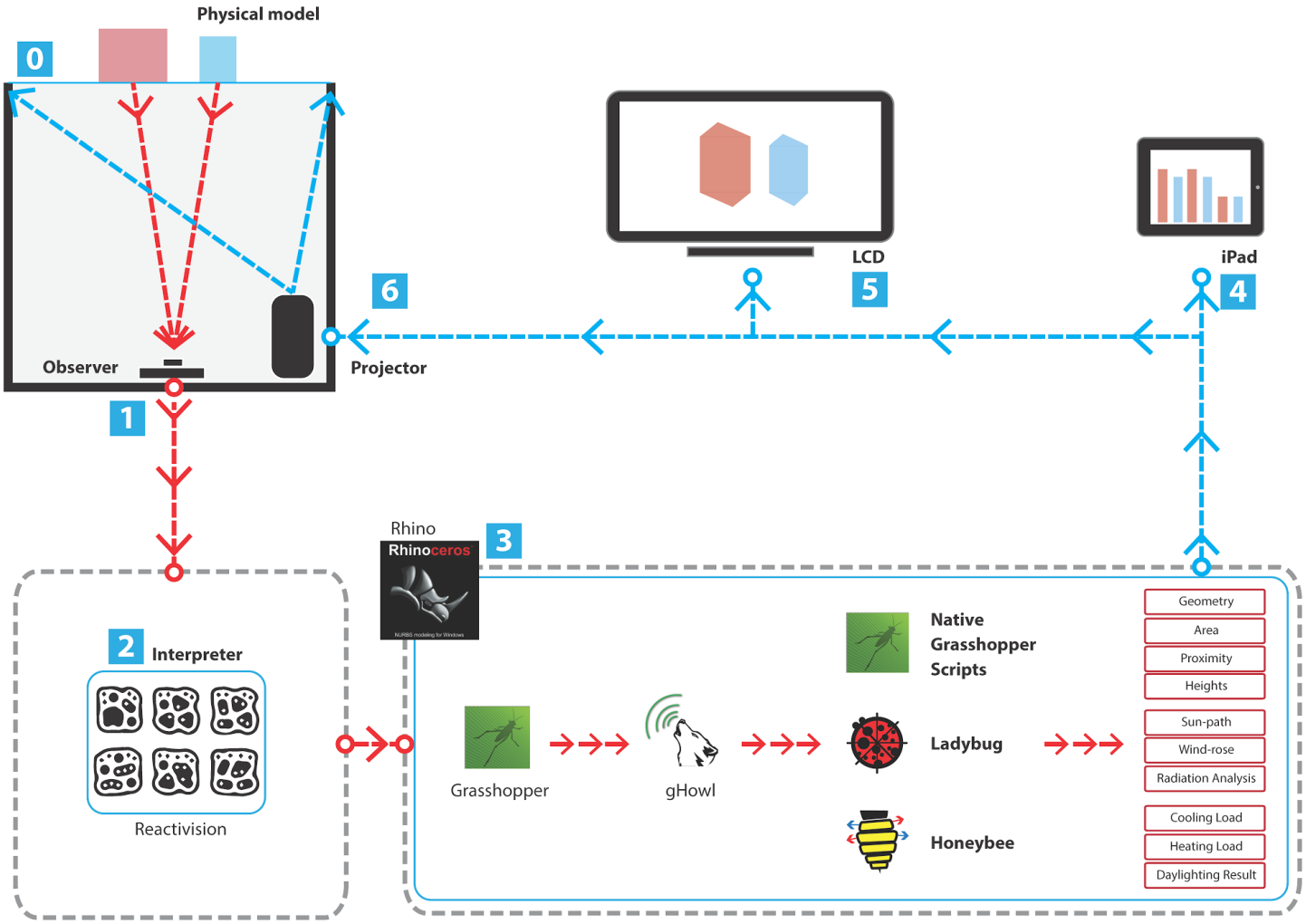
Check the video here:
(http://www.youtube.com/watch?v=6c32kZN19FU)



WIP by Francesco De Luca
(http://www.youtube.com/watch?v=6c32kZN19FU)

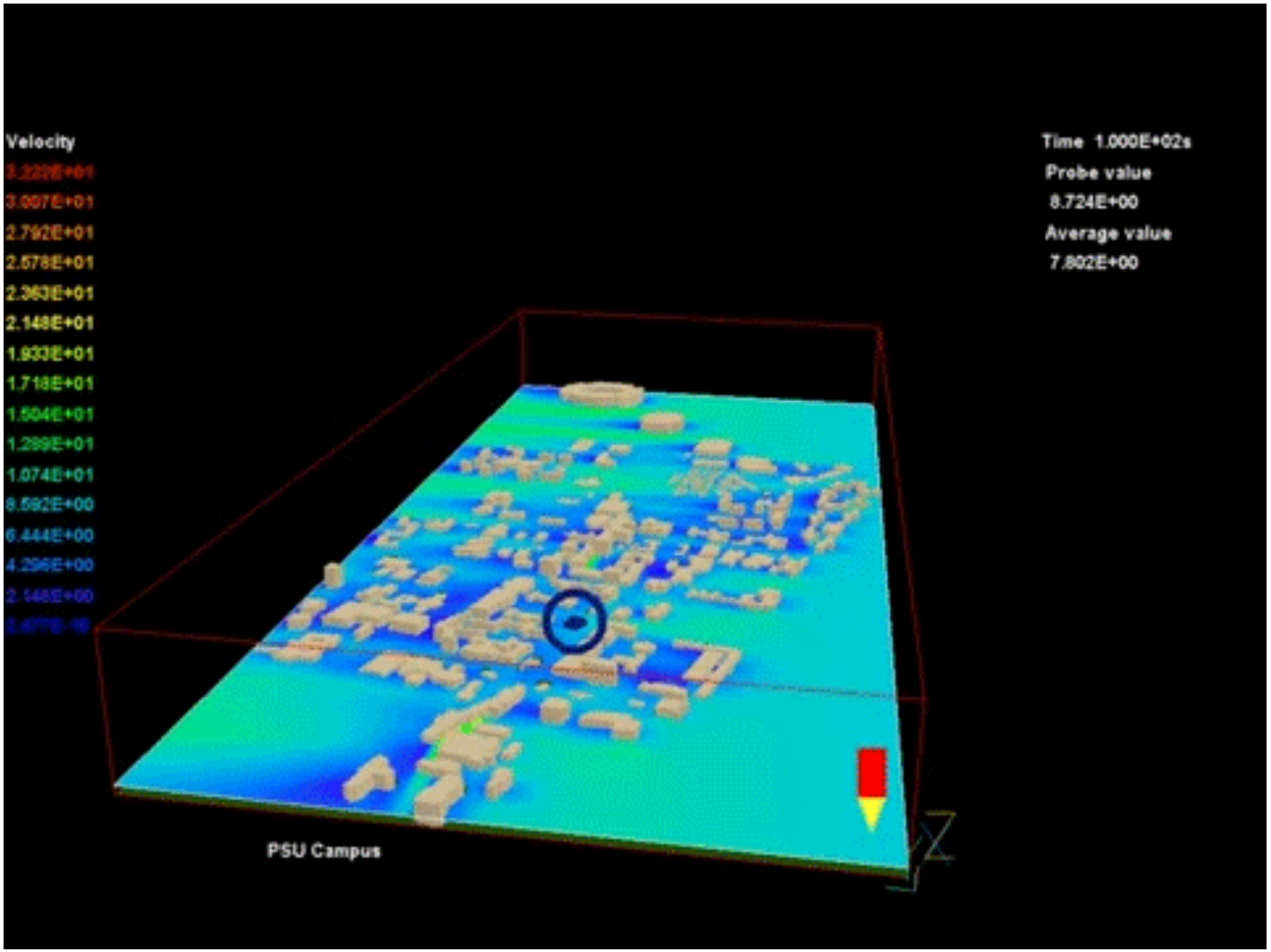
(Ladybug + Galapagos)

Tangible Design Interface (... + gHowl + Ladybug + Honeybee)



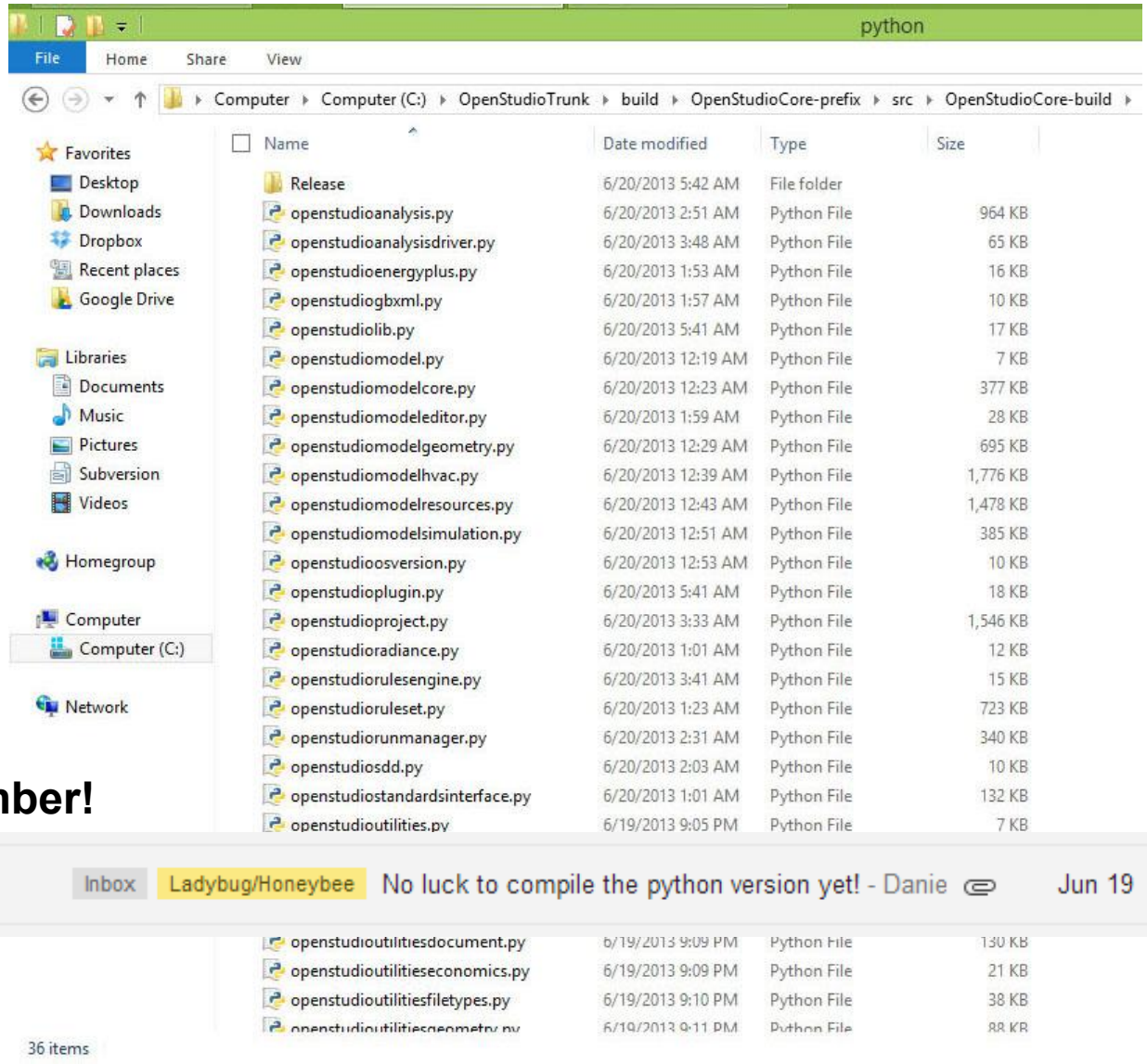
In collaboration with Anthony Viola (http://www.youtube.com/watch?v=cUqxE3rk8_M)

Butterfly: Grasshopper + Radiance + OpenFoam (web-based)

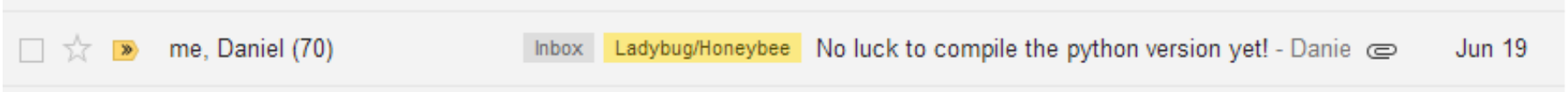


In collaboration with EFRI-SEED project (http://www.buildsci.us/efri-pulse.html)

Grasshopper <> OpenStudio

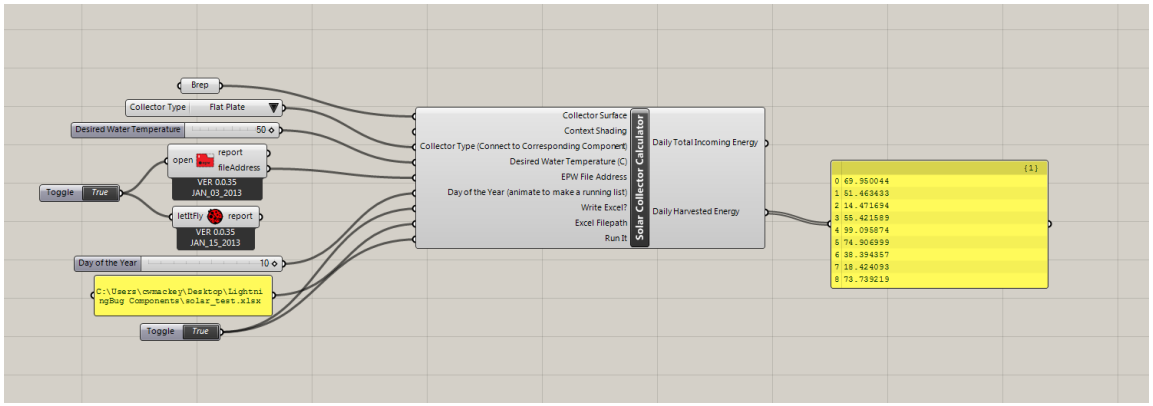


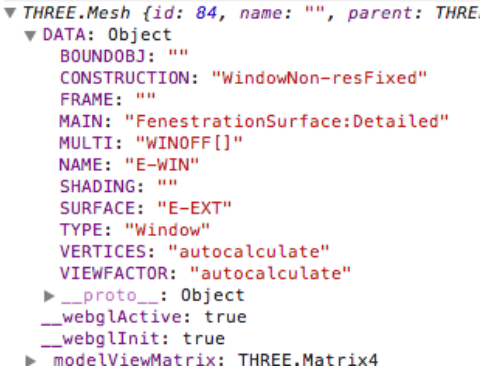
Thanks Daniel Macumber!

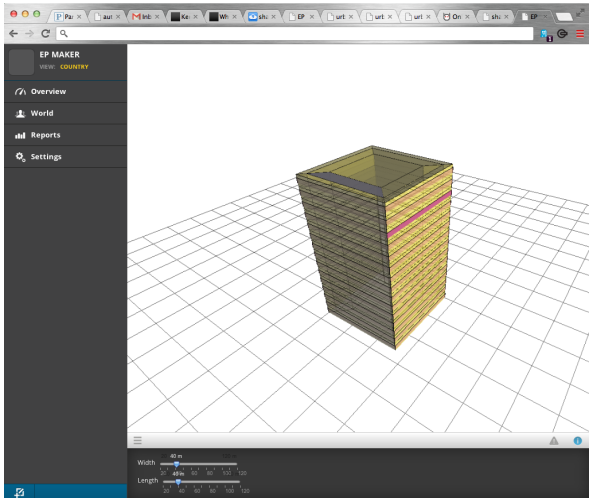


Other developments...

- Grasshopper/Rhino <-> Ladybug/Honeybee <-> GIS
- Web-based Applications for Parametric Environmental Analysis
- New components on top of the Ladybug
- There will be a new release pretty soon!
- ...







Thank you!

Questions? Suggestions? Comments? …

http://thorntontomasetti.com/blog/acm

Advanced Computational Modeling

Thornton Tomasetti