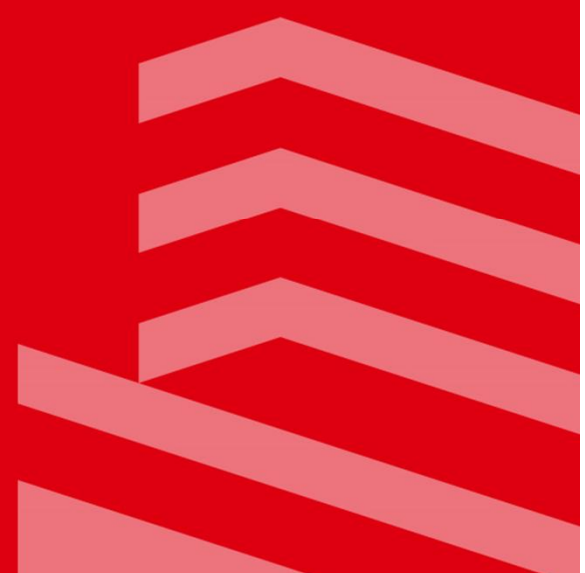




基于Grasshopper的绿色建筑性能化 分析插件的介绍

刘羽岱
华建集团科创中心
2017年04月07日



Grasshopper与建筑方案设计

01

方案阶段的性能分析需求与现状

02

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03

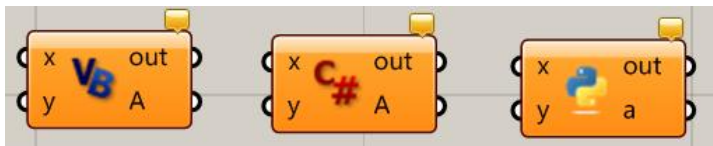
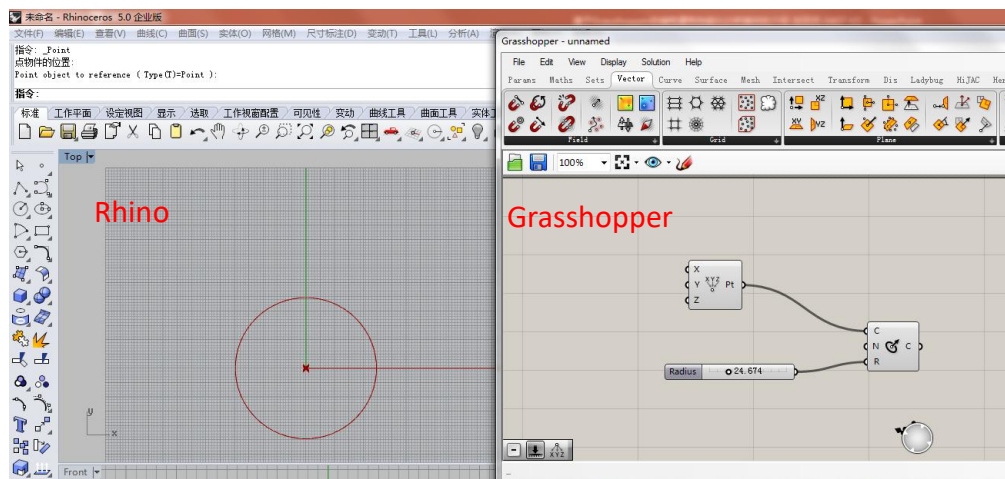
案例实践

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什么是Grasshopper?

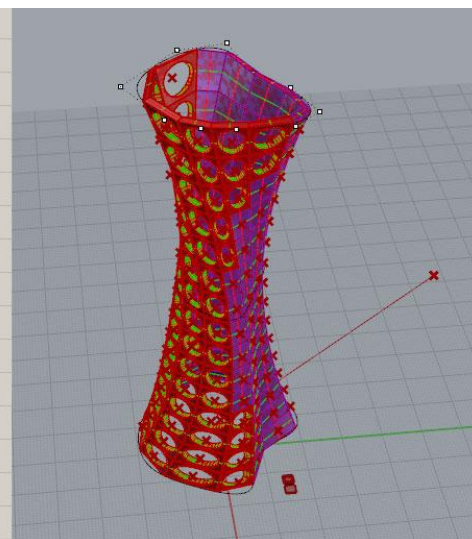
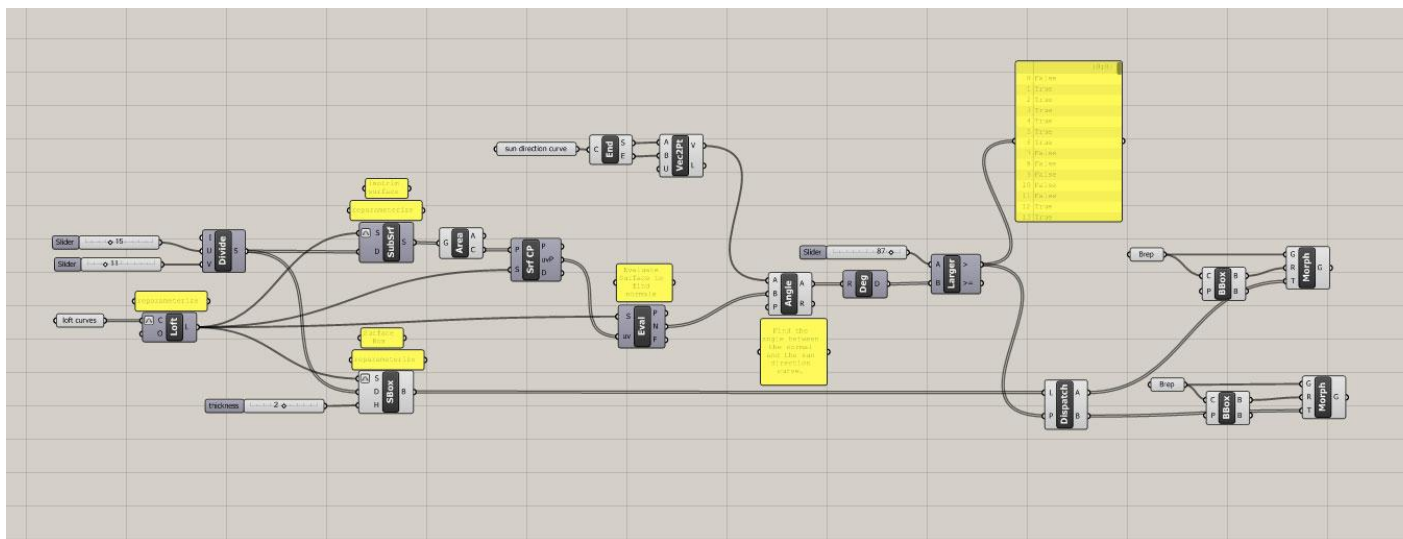
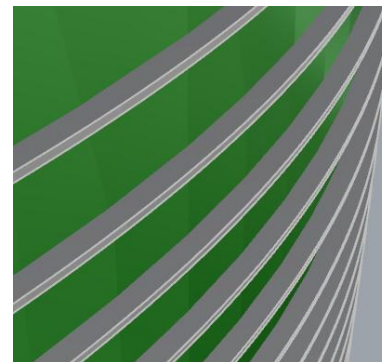
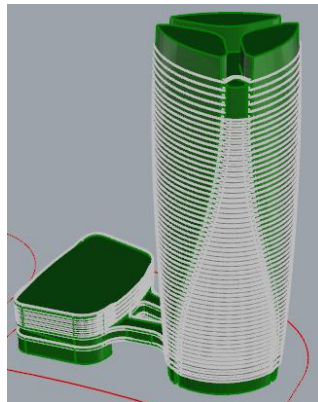
- 犀牛 (Rhincocerors)的**插件**
- 节点式可视化建模工具 (与其他建模软件相比)
- 建筑方案初期的辅助设计工具 (设计的角度)
- 严谨的数据化建模操作流程
- 开放的用户自定义插件,扩展GH 的性能



运算器

Grasshopper在建筑方案设计中的应用

- 建筑找形
- 建筑空间的生成
- 建筑结构构件的创建
- 建筑外表皮设计



建筑参数化设计作品



鸟巢



世界最性感建筑:玛莉莲·梦露大厦



阿斯塔纳国家图书馆



凤凰国际传媒中心

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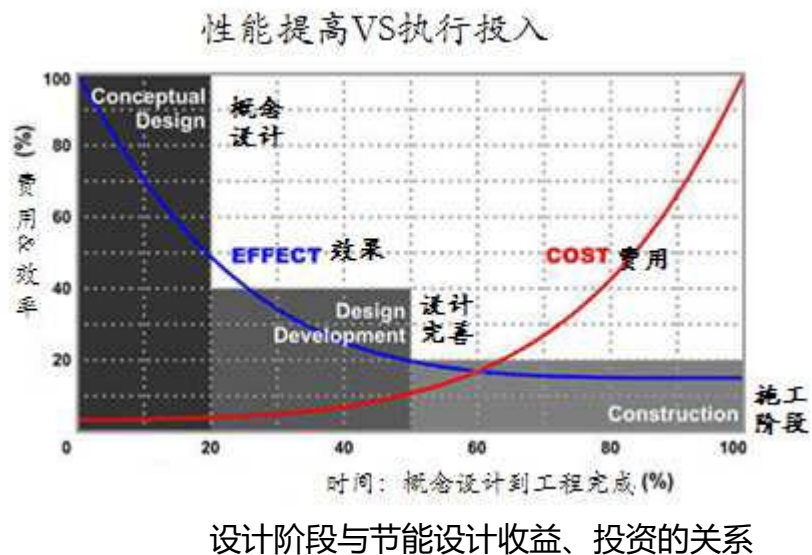
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方案优化设计对提升绿色建筑性能的意义

- 建筑方案设计对建筑能耗有**决定性**的影响
 - 体形、朝向、空间布局、窗墙比等在建筑方案设计阶段确定
 - 40%以上的节能潜力来自于建筑方案初期的规划设计阶段¹
 - 57%的技术措施需要在规划设计和方案设计阶段中落实²



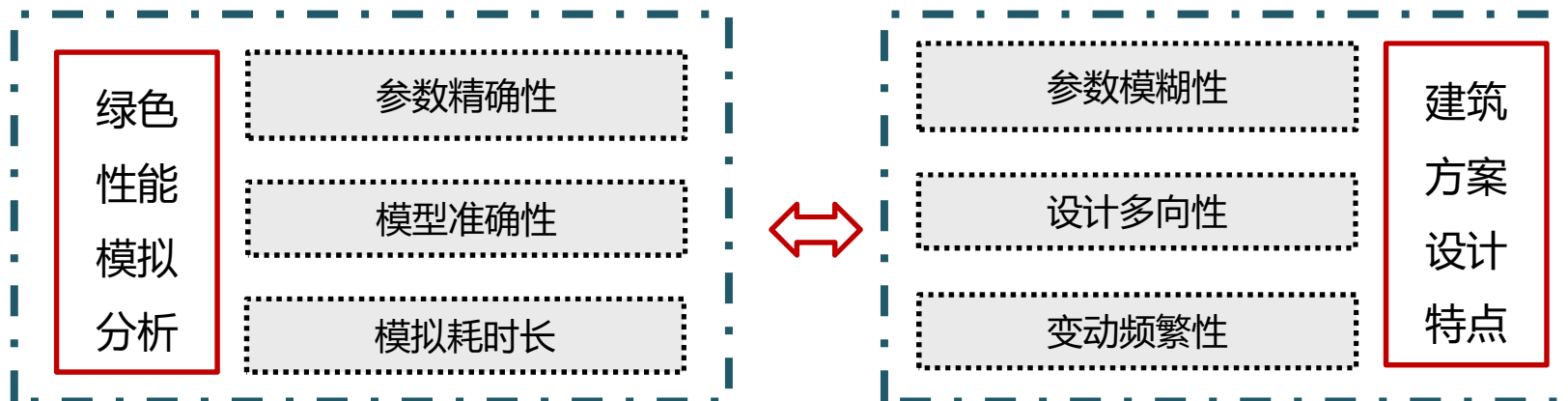
1. 资料来源: IEA ANNEX-30 Bringing Simulation to Applicatio

2. 资料来源: 比利时Pieter de Wilde的调查研究

建筑方案设计性能分析需求

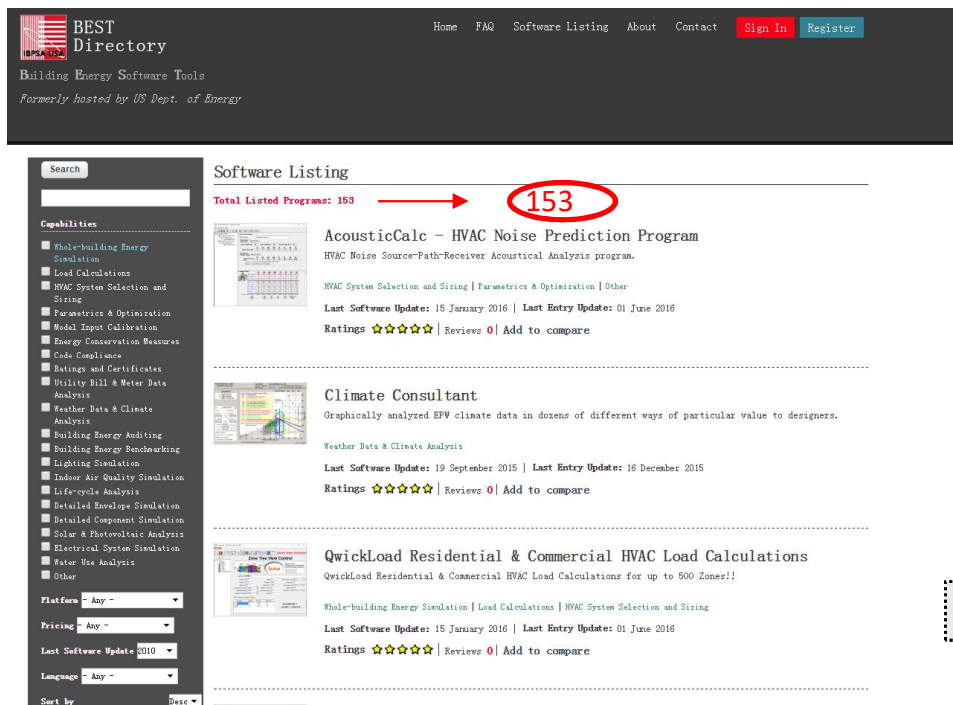
- 绿色、节能已成为当下方案创作争相突出的亮点
- 民用建筑运行能耗管理标准的出台，设置能耗天花板
- 建筑体形、朝向、空间布局、窗墙比等因素与遮阳、采光、通风、能耗的关系较难准确把握
- 方案阶段对于绿色建筑性能分析的要求是“快速、准确、可视化，适应性强”

| | | |
|---|-----------------|----|
| UDC | 中华人民共和国国家标准 | GB |
| P | GB/T 51161-2016 | |
| 民用建筑能耗标准 Standard for energy consumption of building | | |
| 2016-04-15 发布 | 2016-12-01 实施 | |
| 中华人民共和国住房和城乡建设部 联合发布 中华人民共和国国家质量监督检验检疫总局 | | |

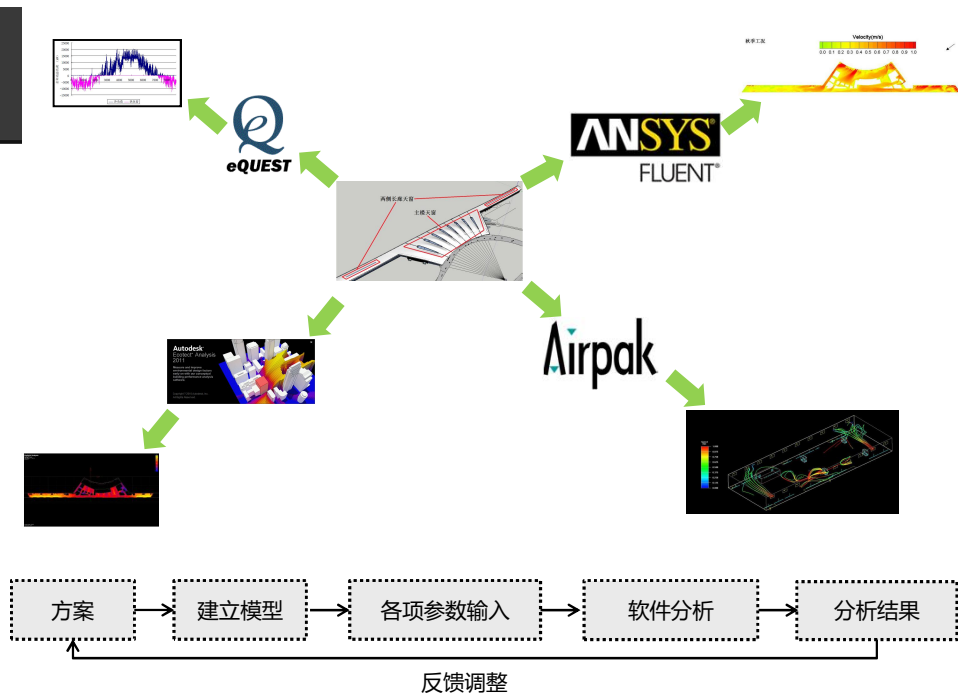


建筑方案设计性能分析现状

- 建筑性能模拟主要集中在**方案设计后期**，且**优化范围有限**
- 建筑性能模拟工具繁多，大多**不符合**设计师的使用习惯，也**未集成**在建筑设计环境平台
- 不同建筑性能模拟分析，往往需要借助不同的模拟分析工具，**与设计模型兼容性差、模型利用度低、建模分析过程繁琐、周期长、反馈存在滞后**等问题



The screenshot shows the BEST Directory website interface. At the top, there are navigation links: Home, FAQ, Software Listing, About, Contact, Sign In, and Register. Below the navigation is a search bar and a list of capabilities including Whole-building Energy Simulation, Load Calculations, HVAC System Selection and Sizing, etc. The main content area is titled 'Software Listing' and shows 'Total Listed Programs: 153', with the number '153' circled in red. Three software entries are visible: AcousticCalc - HVAC Noise Prediction Program, Climate Consultant, and QwickLoad Residential & Commercial HVAC Load Calculations.



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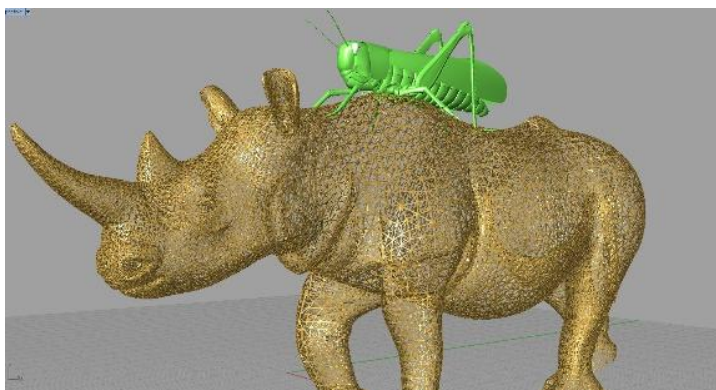
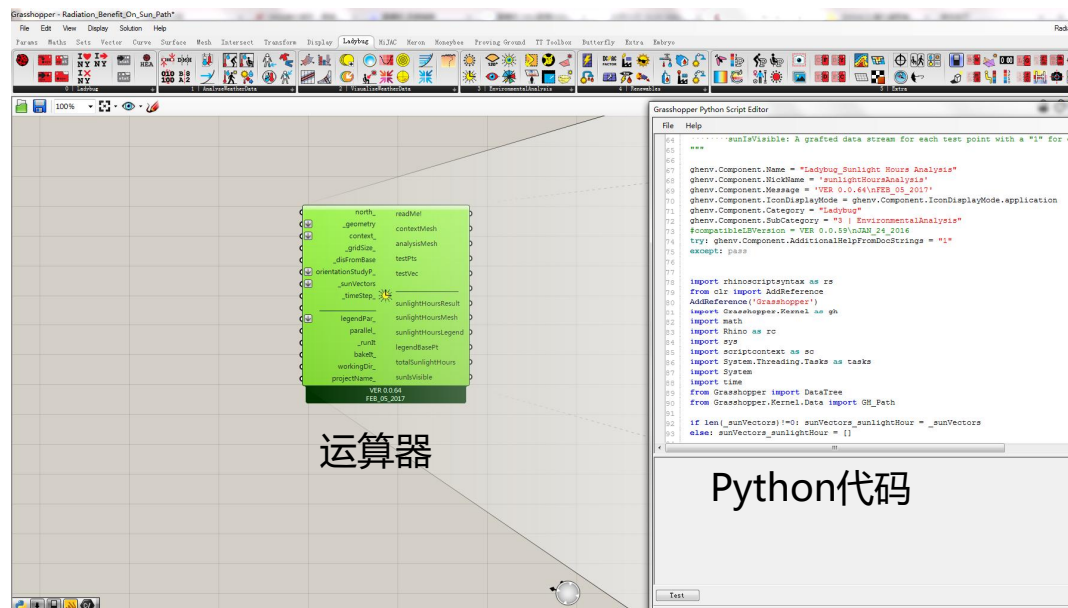
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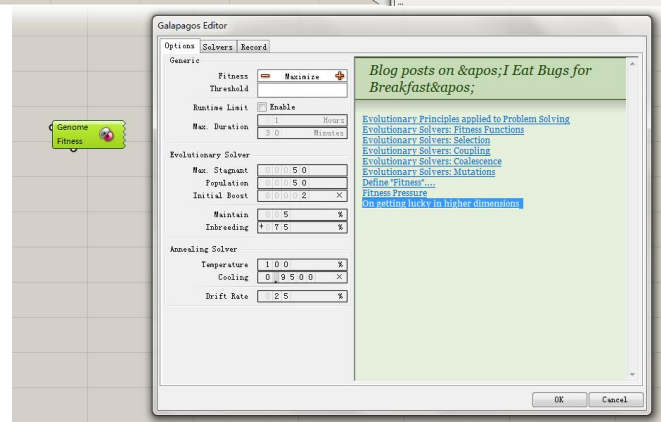
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Grasshopper绿色建筑性能化分析的优势

- 大幅度缩短模拟时间，给建筑师更多的思考空间
- 符合建筑师的使用习惯
- 简化建模过程，模型利用度高
- 保留设计和分析逻辑
- 实现计算结果的优化选择
- 可视化效果更佳



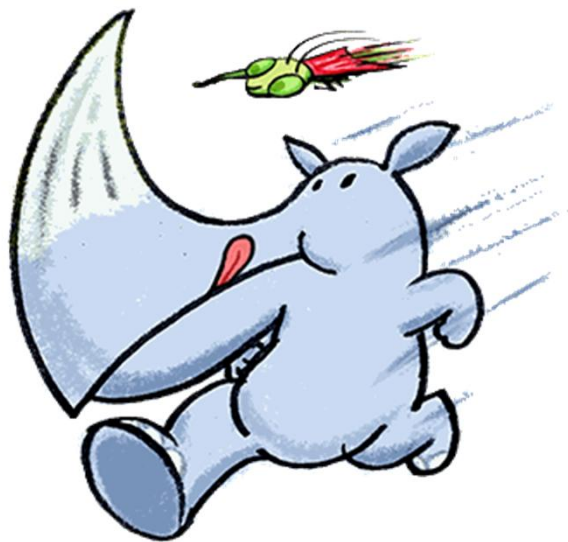
Rhino+GH



优化算法运算器Galapagos

Grasshopper分析插件

Ever growing community



<http://www.food4rhino.com/>

New **food4Rhino** website

Search

Sort by
Last Updated

TYPE
 App (51)
 Resource (0)

PRICE
 Free (51)
 Commercial (1)

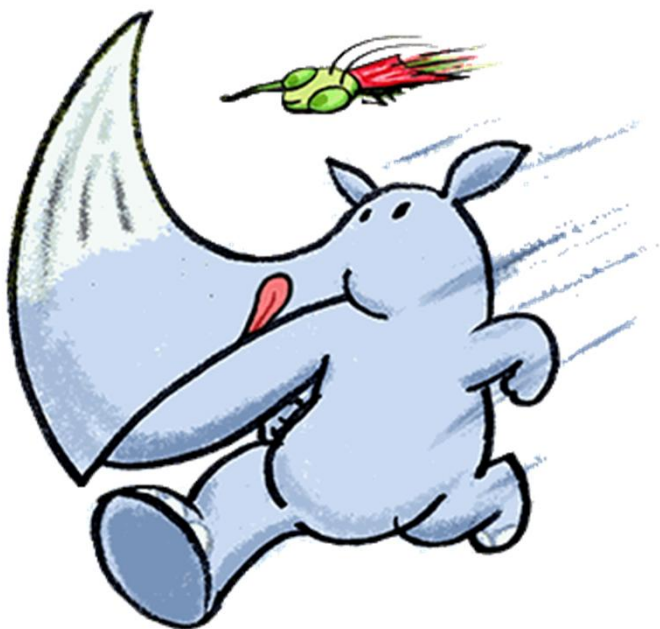
PLATFORM
 Grasshopper (51)
 Windows (51)
 Version 0.x (51)
 Mac (3)
 Version 0.x (3)
 Rhino (3)
 Windows (3)
 Version 5 (3)
 Version 4 (0)
 Version WIP 6 (0)
 Mac (0)
 Version 5 (0)
 Version WIP (0)

APP CATEGORY
 Analysis & Simulation (51)
 Aerospace (5)
 Animation (5)
 Architecture (100)

BROWSE

- SmartSpaceAnalyser** ★★★★★
This is your place to download, learn and share everything about SmartSpaceAnalyser, our highly intuitive tool to perform spatial analysis on a build!
- Opossum—OPTimizatiOn Solver with SUrrogate Models** ★★★★★
Opossum is the first model-based optimization tool for Grasshopper and based on the RBFOpt library
- Ladybug Tools** ★★★★★
Ladybug and Honeybee are open source environmental plugins for Grasshopper to help designers create an environmentally-conscious architecture
- Speckle Streams** ★★★★★☆
Speckle Streams brings parametric models to the web - <http://streams.speckle.xyz>
- Kangaroo Physics** ★★★★★
Kangaroo is a Live Physics engine for interactive simulation, form-finding, optimisation and constraint solving.
- RhinoDLubalRstab** ★★★★★
This GH add-on converts a Rhino geometry into a calculational model for DLUBAL

Grasshopper插件下载量



LADYBUG TOOLS (by Mostapha Sadeghipour Roudasri)



Ladybug allows you to import and analyze standard weather data in Grasshopper; draw diagrams like Sun-path, wind-rose, radiation-rose, etc; customize the diagrams in several ways; run radiation analysis, shadow studies, and view analysis.

Honeybee connects Grasshopper3D to validated simulation engines such as EnergyPlus, Radiance, Daysim and OpenStudio for building energy, comfort, daylighting and lighting simulation.

Licensed under @license GPL-3.0+: (<http://spdx.org/licenses/GPL-3.0+>) Read more here about the license.

Download



Downloads:

72668

Website

Support Email

DIVA-FOR-RHINO (by klagios)



DIVA-for-Rhino is a highly optimized daylighting and energy modeling plug-in for Rhino and Grasshopper. The plug-in was initially developed at the Graduate School of Design at Harvard University and is now distributed and developed by Solemma LLC. DIVA-for-Rhino allows users to carry out a series of environmental performance evaluations of individual buildings and urban landscapes.

DIVA includes these simulations:

- Radiation Maps
- Photorealistic Renderings including HDR file formats
- Point-in-Time Illuminance
- Daylight Autonomy
- Continuous Daylight Autonomy
- Annual Daylight Illuminance

Download



Downloads:

7567

Website

Support Email

License

GECO (by uto)



Ecotect is a highly visual software for architects to work with environmental performance issues. It is designed for early stages of conceptual design, and encourages play to understand environmental factors and interactions.

So making use of Grasshopper [uto] developed a new interface named GECO, which offers a direct link between Rhino/Grasshopper models and Ecotect. The Plug-in allows you to export complex geometries very quickly, evaluate your design in Ecotect and access the performances data, to import the results as feedback to Grasshopper. This could be done as single process or loop to improve performance and the design of a building in the context of its environment. The single results of the process could be saved inside Rhino in the vertices of the analysis mesh to store data for later use inside different design approaches.

if you encounter any problems or you need help, join our discussion now:

To install:

Download



Downloads:

31538

Website

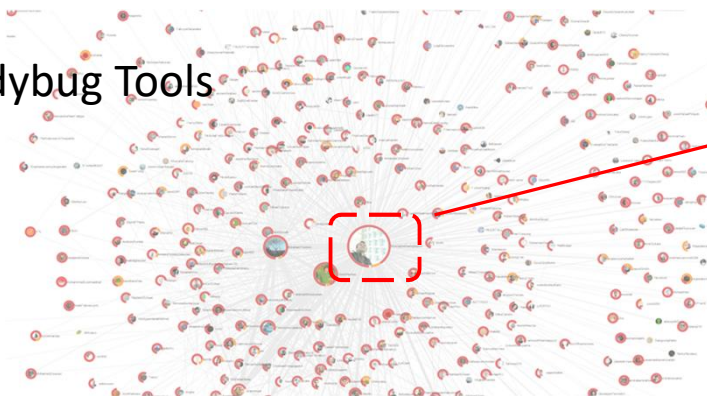
Support Email

Support Forum

License

开发团队及相关网址

Ladybug Tools



Welcome to Hydra! last updated at Sun Apr 10 2016 05:08:51 GMT-0400 (Eastern Daylight Time)

Hydra is a collection of tools for Rhino 5.0+ and Grasshopper 3.0+.

| | | | |
|---|------------------------------------|--|--|
| Radiant Asymmetry Discomfort | Human UI - Adjusting Appearance | Dynamo Test | Urban Microclimate - Simple Spatial LUTs |
| Adaptive Comfort Chart | RorschachShadowDiagram | SkyPassage Sky View, and Sky Catalogue | Test Points and Legend Parameters Ladybug Dynamo |
| SunpathLadybug Dynamo | SunlightHoursLadybug Dynamo | Import EPW Ladybug Dynamo | Import LBNL WINDOW Glazing Assessor EnergyPlus |
| Import Glazing System from LBNL WINDOW | THERM Window Frame Construction | Analyze THERM Results | THERM Comparison of Stud Wall Constructions |
| ES Electric Lighting based on daylight | ES Electric Lighting Basic Example | ES Electric Lighting Setup | Thermal Bridging with THERM and EnergyPlus |
| THERM Export Workflow | EnergyPlus Window Shade Generator | Shapefile to Dynamo | Evaporative Cooling Tower |
| Area Capture | Urban Weather Generator Workflow | Ladybug Creating Solar Envelopes | Radiation in an Urban Canyon |
| Sky View in an Urban Canyon | Rebel Weather Studio with Hecaya | Perforated Facades | Estimate Glare Potential Over a Year |
| Integrated Daylight and Energy simulation | Map Annual Comfort on Sunpath | Microclimate Map - Simple | Green Roof Energy Model |

<http://hydrashare.github.io/hydra/>

Mostapha Sadeghipour Roudsari's Page

Mostapha Sadeghipour Roudsari's Photos

Welcome to Grasshopper
Sign Up or Sign In

Translate
选择语言
由 Google 翻译驱动

Search Grasshopper
Google Custom Search
Search

Photos
by Michael Pryor

Grasshopper
ALGORITHMIC MODELING FOR RHINO

Home View Get Learn Talk Attend My Page

About Grasshopper...
For designers who are exploring new shapes using generative algorithms, **Grasshopper** is a graphical algorithm editor tightly integrated with Rhino's 3-d modeling tools. Unlike RhinoScript, Grasshopper requires no knowledge of programming or scripting, but still allows designers to build form generators from the simple to the awe-inspiring.

Start Here:
Download and install Grasshopper...
There are many resources available to learn more about Grasshopper.

Introduction to Grasshopper Videos by David Rutten.
Wondering how to get started with Grasshopper? Look no further. Spend some time with the creator of Grasshopper, David Rutten, to learn the fundamental of Grasshopper. No experience necessary. This video series and many other tutorials are available on our [Tutorials page](#)...

Also, check out these [tutorial videos](#)...

Rhino WIP for Windows now available
All Rhino 5 for Windows users are invited to [Serennetti](#), where Rhino is developed. We are inviting current users to try, test, and provide feedback on the work-in-progress (WIP) release while it is still in development. You will need:

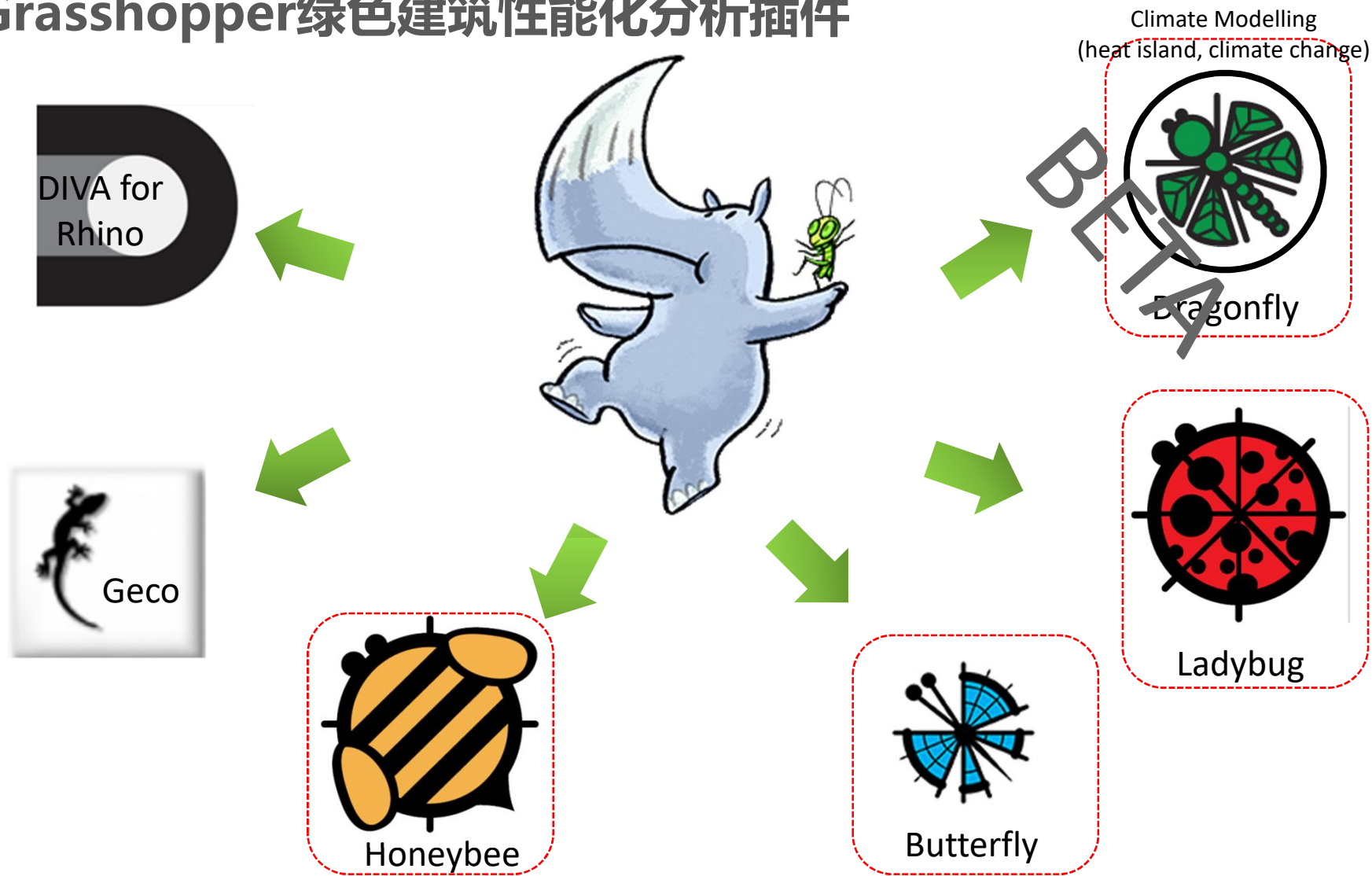
- 64-bit Windows 7 or above
- Your Rhino 5 for Windows license key. You can find it [here](#)...

News
Events
Last Month
Next Month

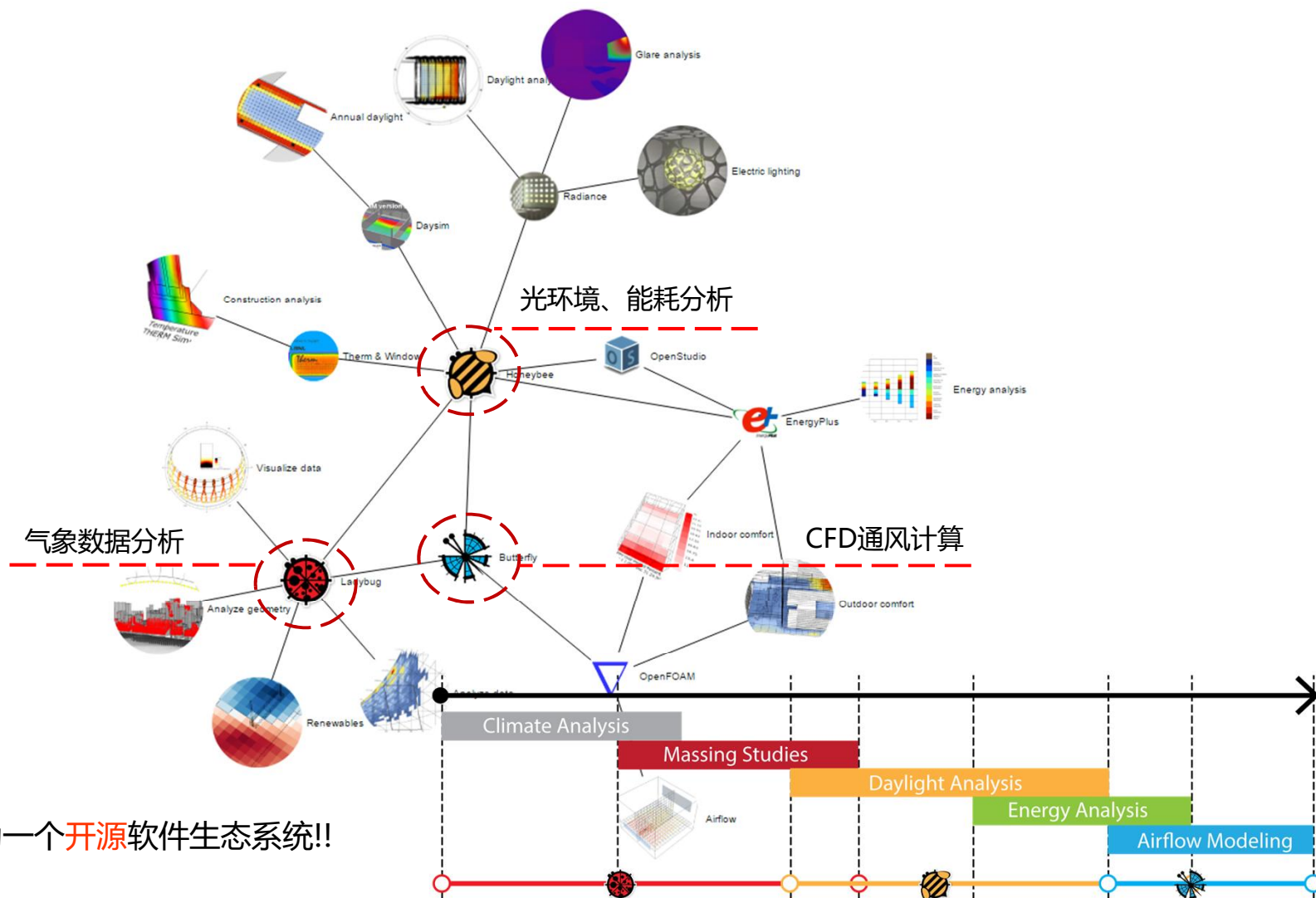
edn.com 的响应...

<http://www.grasshopper3d.com>

Grasshopper绿色建筑性能化分析插件



Grasshopper绿色建筑性能化分析插件

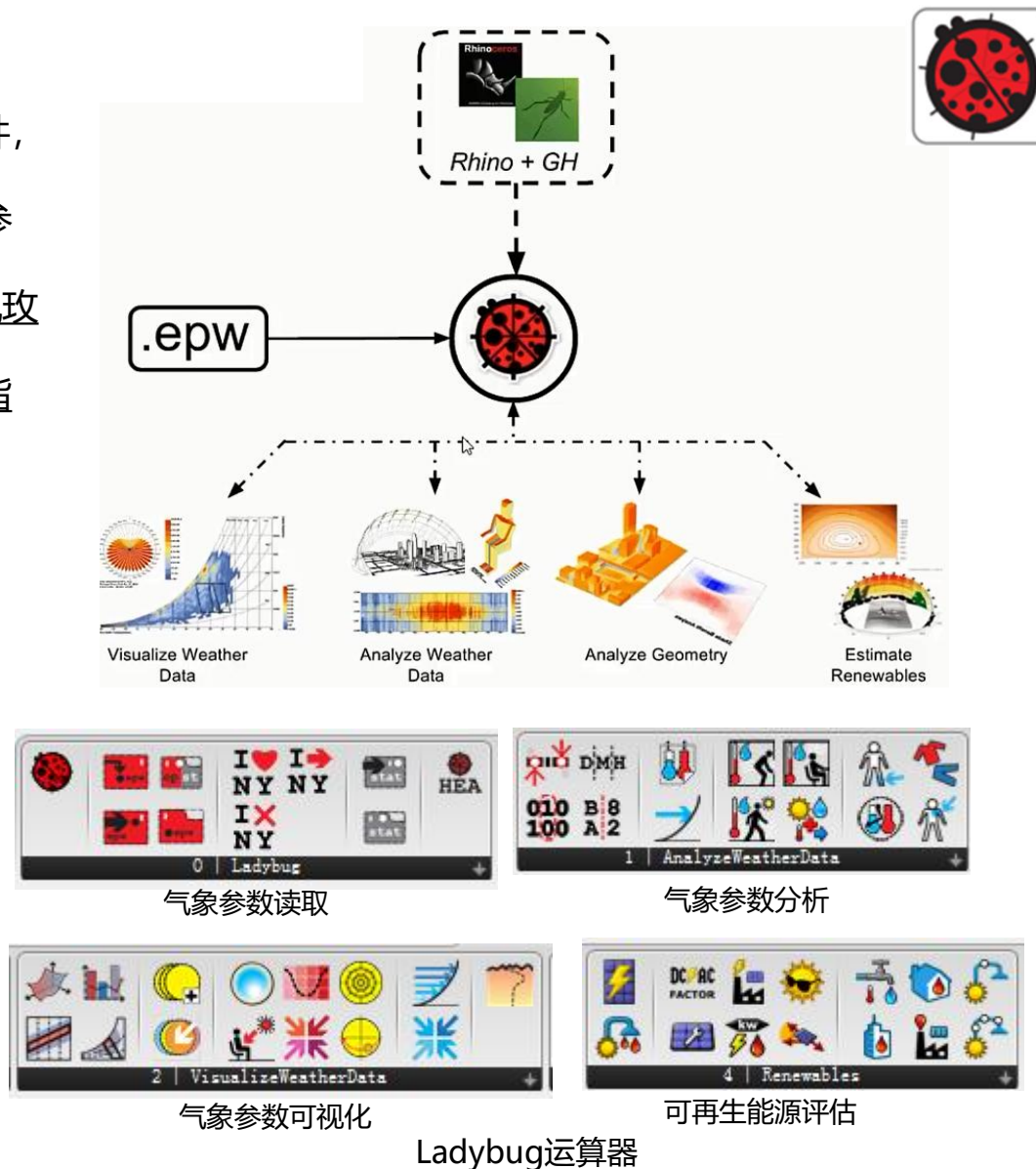


什么是Ladybug?

- Ladybug是一款Grasshopper的环境分析插件，可以帮助设计师在建筑方案初期，完成气象参数分析，包括气象参数可视化、太阳路径，风玫瑰，遮阳分析、室内PMV计算、室外舒适性指标UTCI计算、运行辐射分析、阴影分析等。

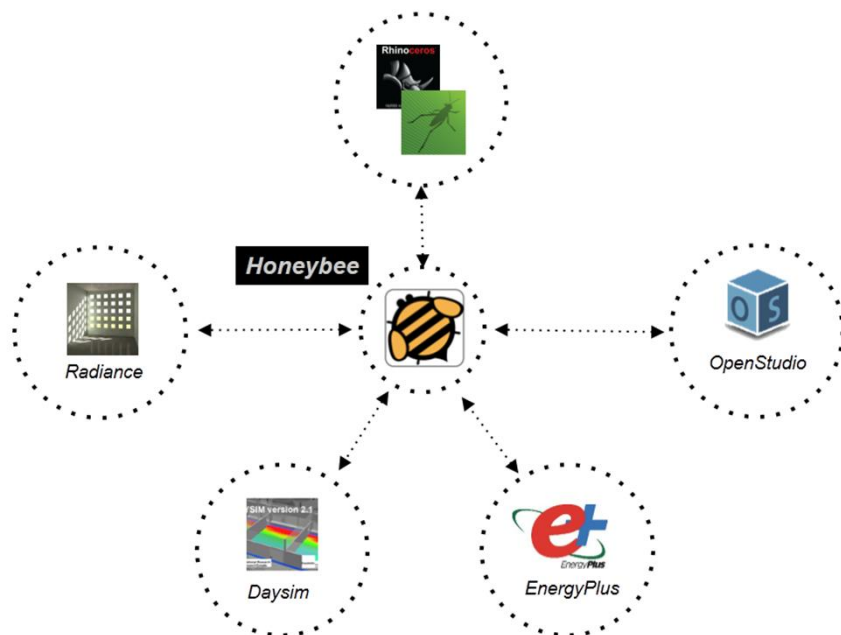
Ladybug特点

- 使得建筑环境分析过程变得更简单和快速
- 将环境分析整合到方案设计过程
- 满足方案设计过程中个性化的可视化展示
- 采用GHPython编程，开源



什么是Honeybee?

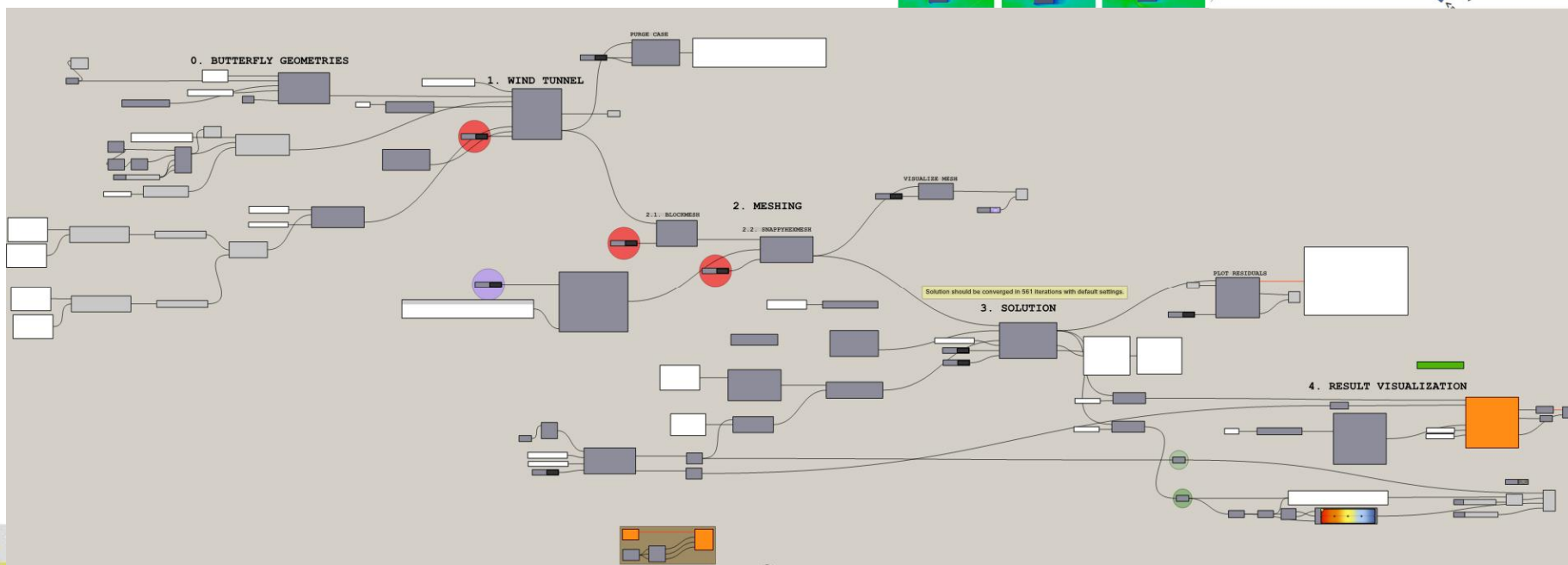
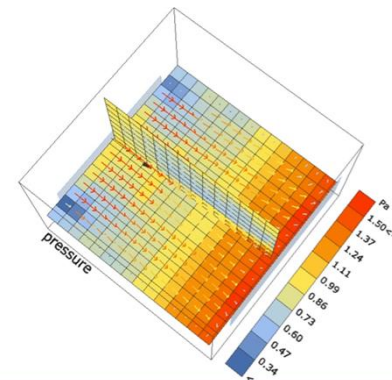
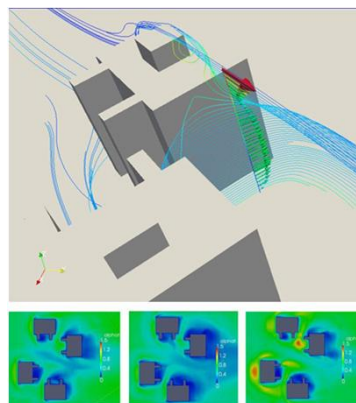
- Honeybee连接Grasshopper模型和仿真引擎，
 可以采用**参数化的方式**调用这些模拟分析工具
 引擎,进行建筑能耗及采光模拟。Honeybee可
 以通过参数化的方式设置系统类型、分区方案、
 运行时间表、日光感应器的布置和控制等。



Honeybee运算器

什么是Butterfly?

- Butterfly = Grasshopper + OpenFoam
- Butterfly是一个用Python编写的GH插件，用来生成OpenFOAM的执行文件



Butterfly 0.0.04
2017-Mar-19

First public release of Butterfly. Download the zip file. Unzip the file and open and run the installer.gh. You need to install OpenFOAM to use butterfly. Follow the installation instruction here: <https://github.com/ladybug-tools/butterfly/wiki>

Log in

Free Installer

Grasshopper与建筑方案设计

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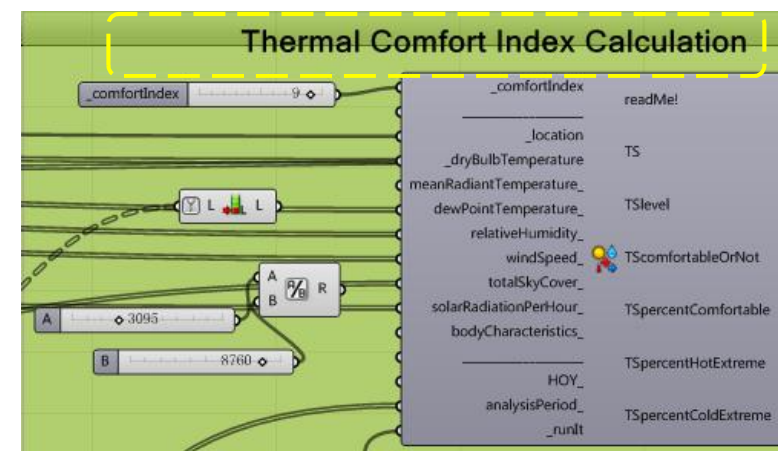
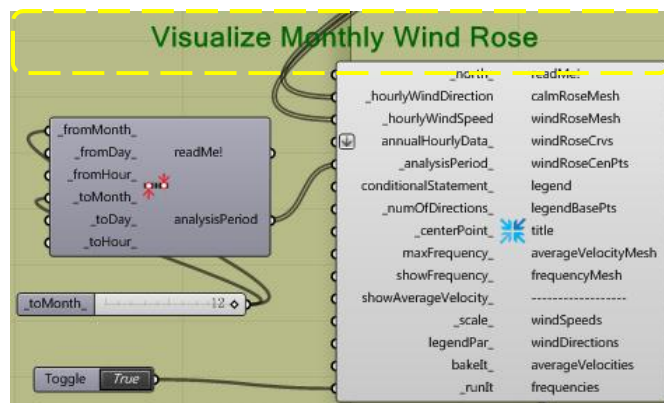
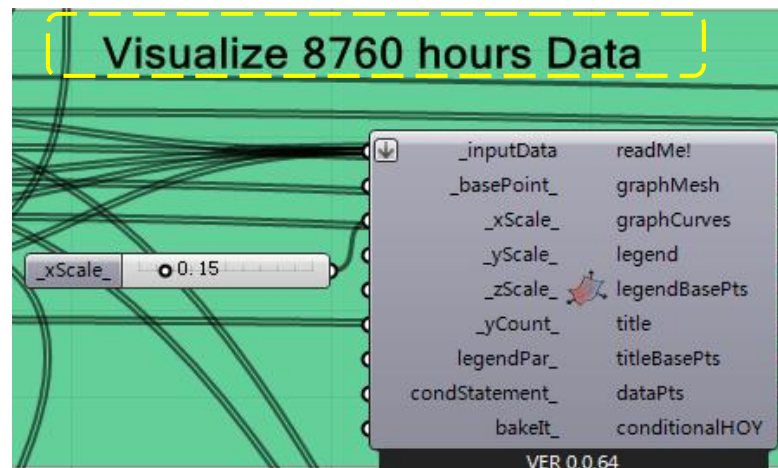
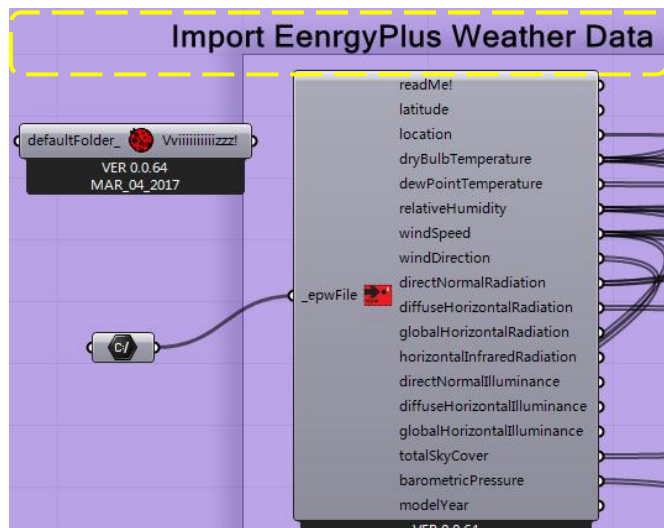
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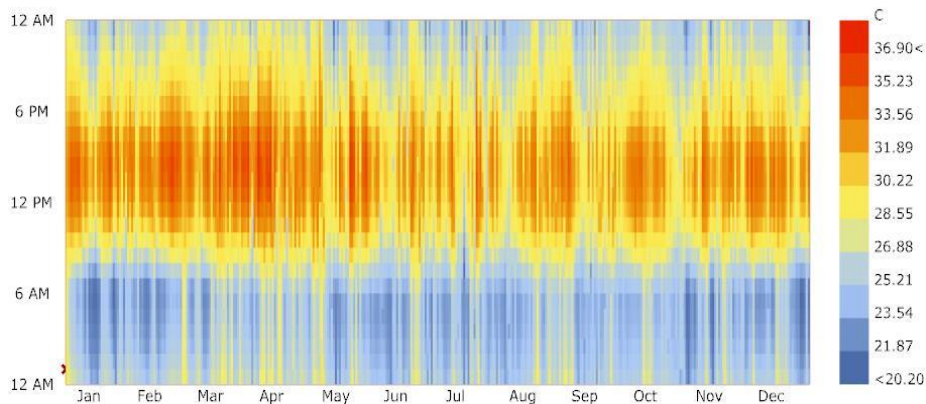
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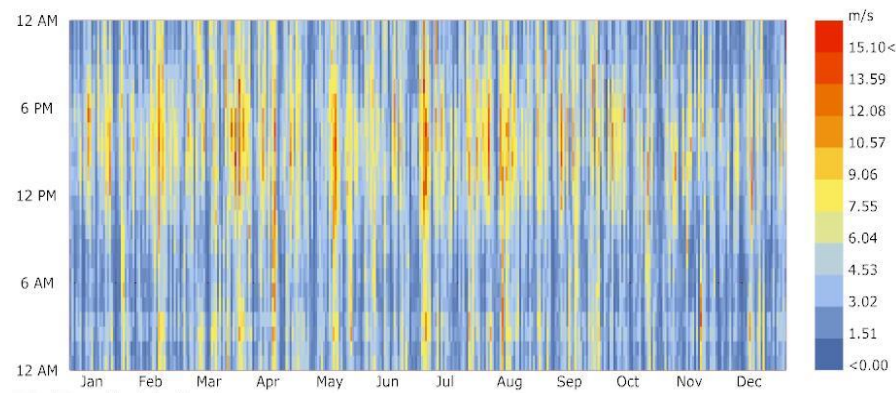
Ladybug气象数据分析



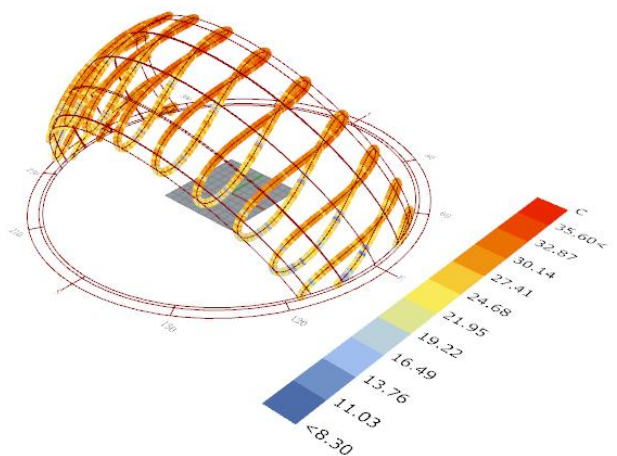
Ladybug可视化气象数据



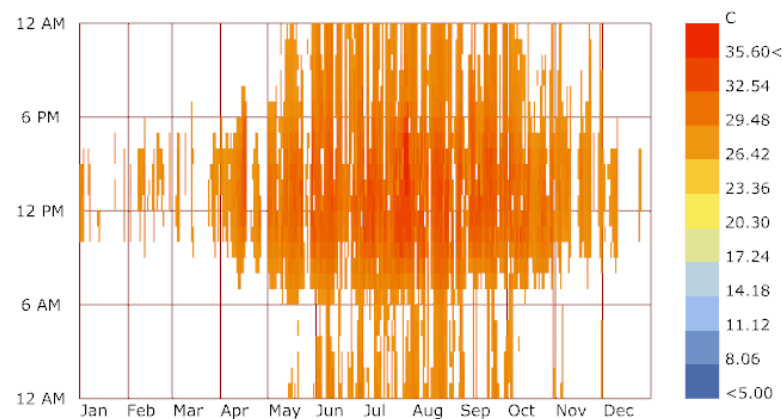
全年干球温度分布



全年风速分布



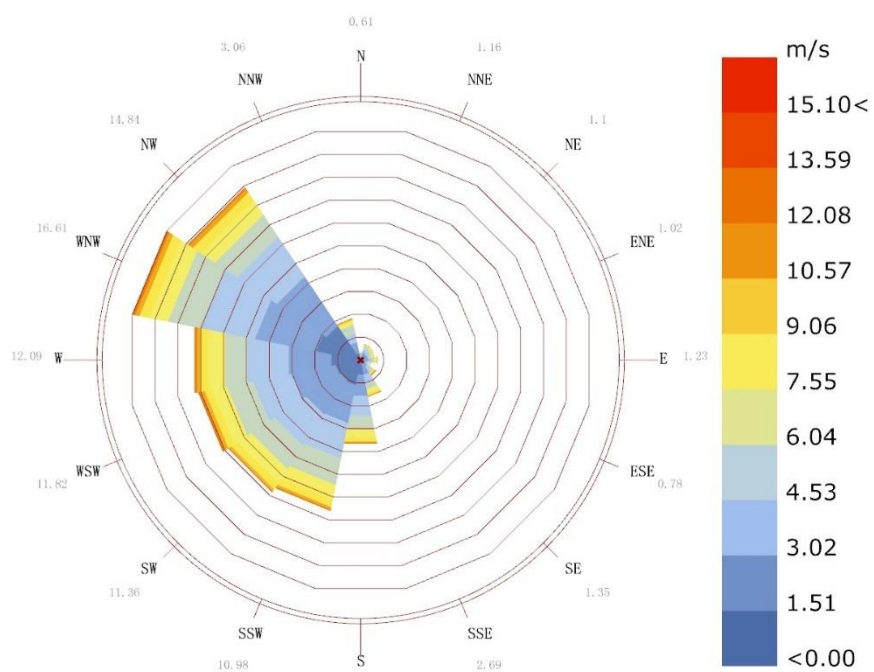
全年干球温度和太阳轨迹结合显示



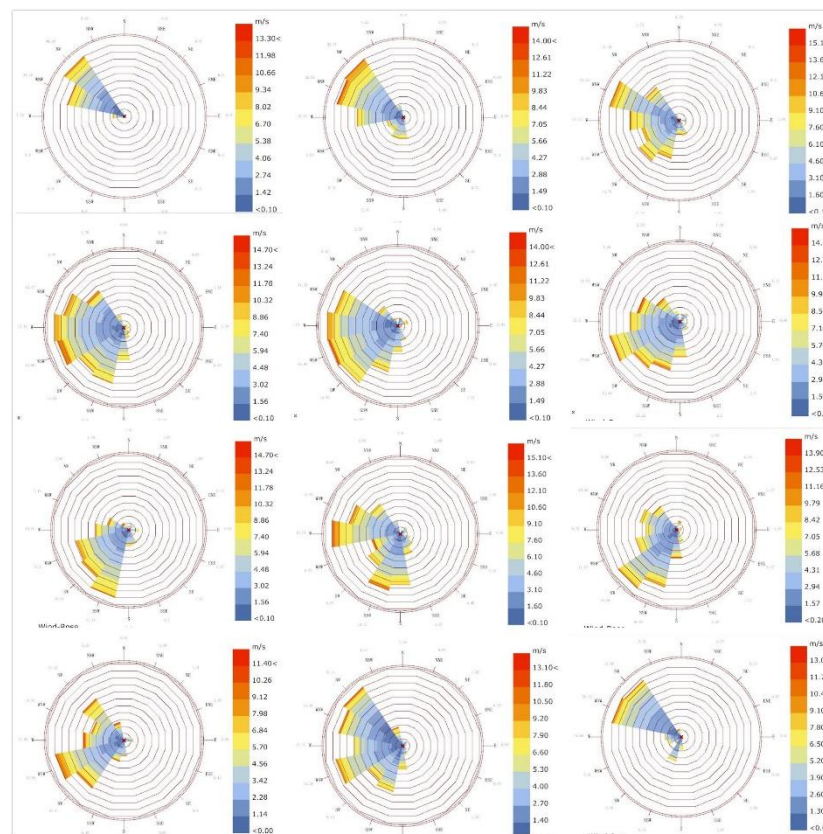
气象数据筛选

Ladybug气象数据分析

全年风玫瑰图



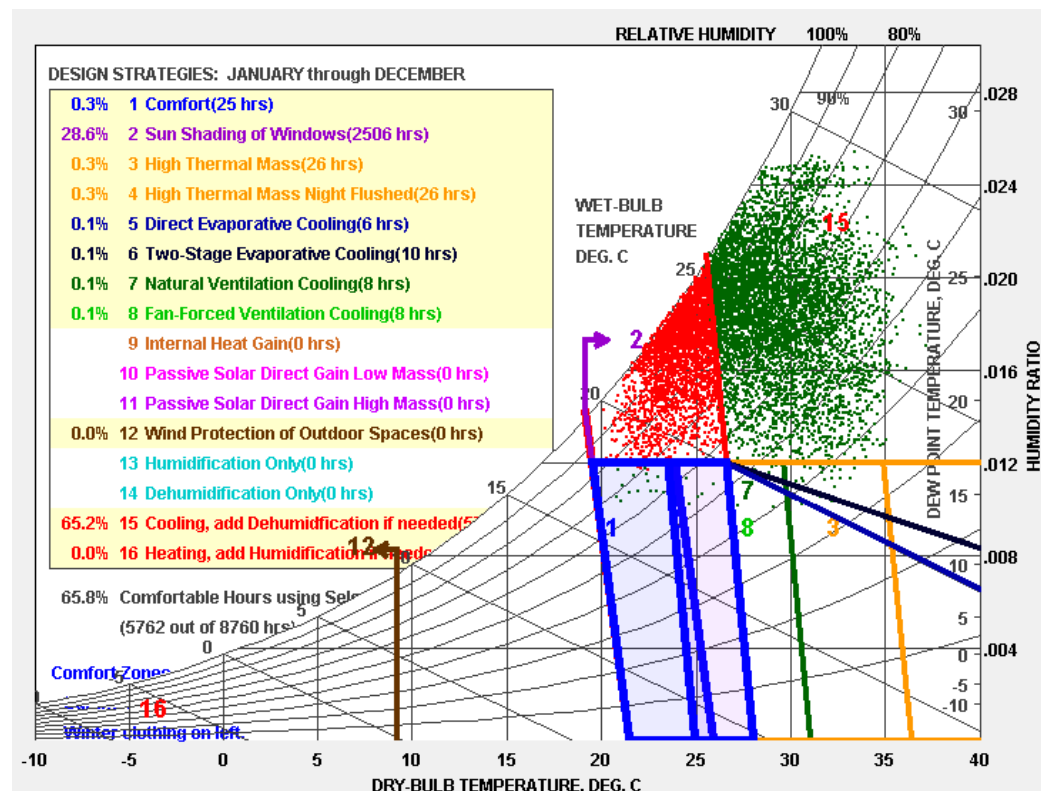
逐月风玫瑰图



Ladybug气象数据分析

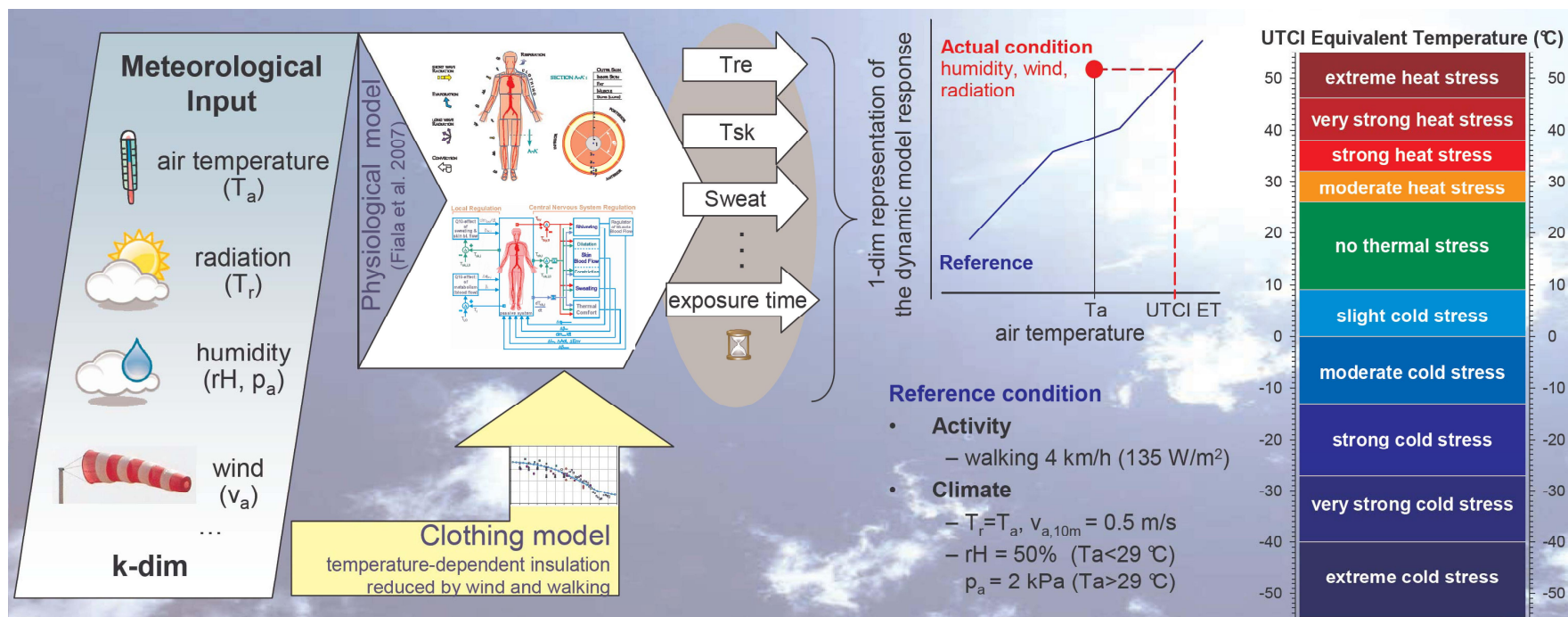
焓湿图

- 0.3% -舒适
- 28.6%-外窗遮阳
- 0.1%-自然通风
- 0.1%-直接蒸发冷却
- 65.2%-需要降温 and 除湿

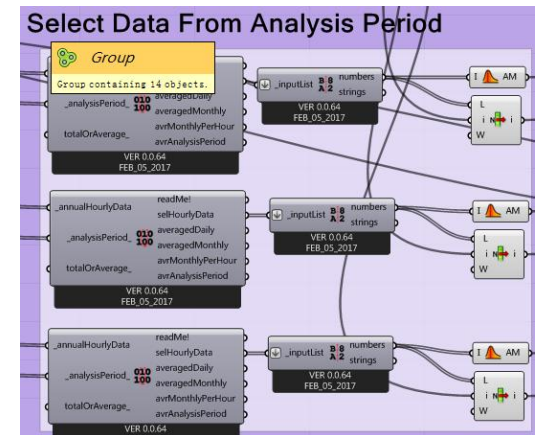
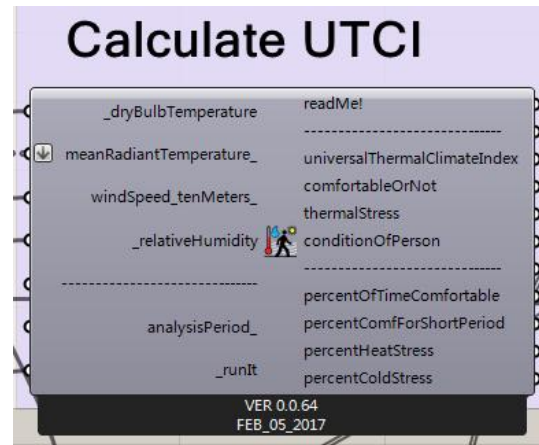
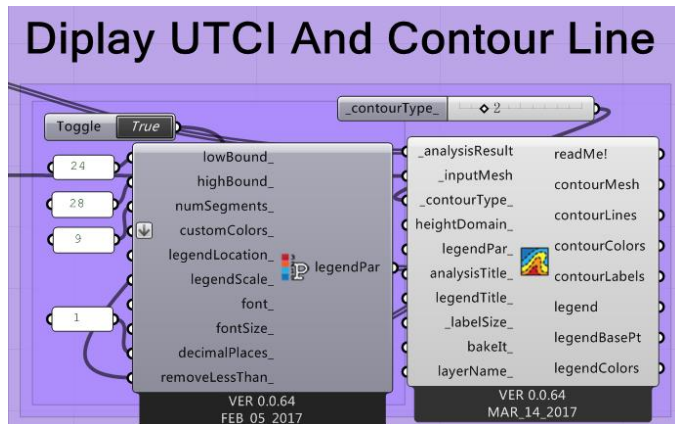
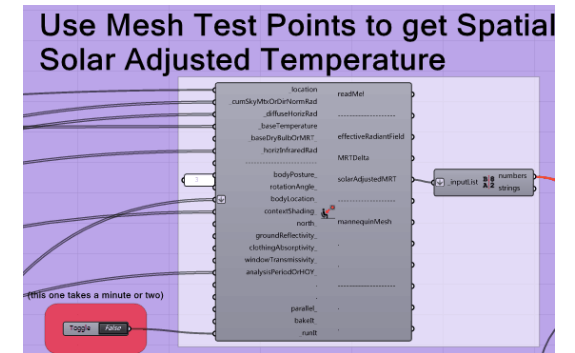
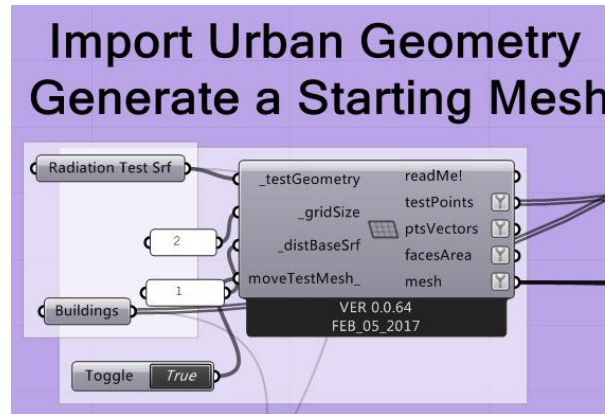
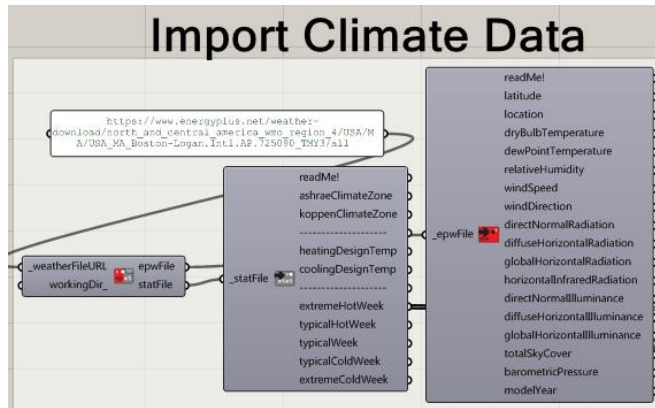


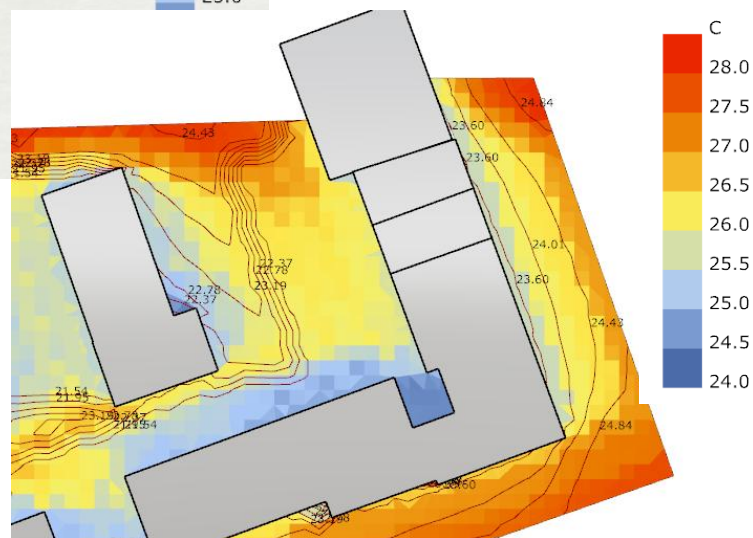
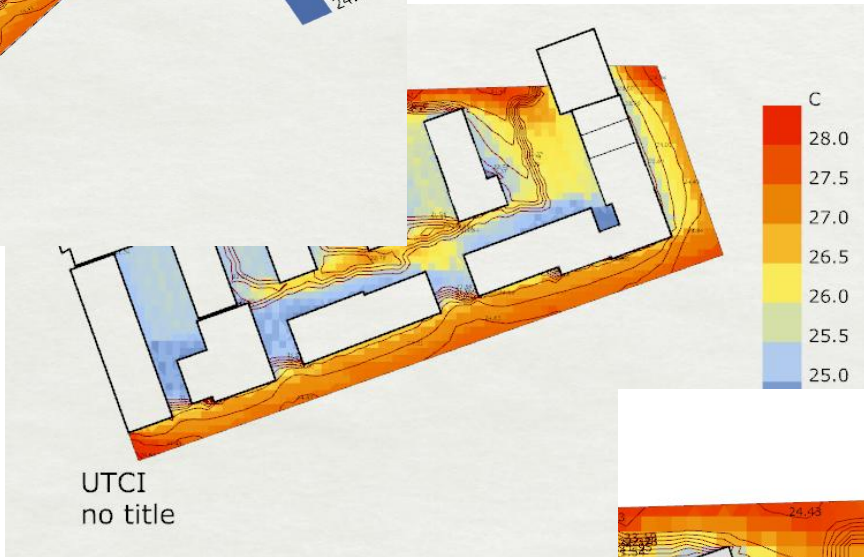
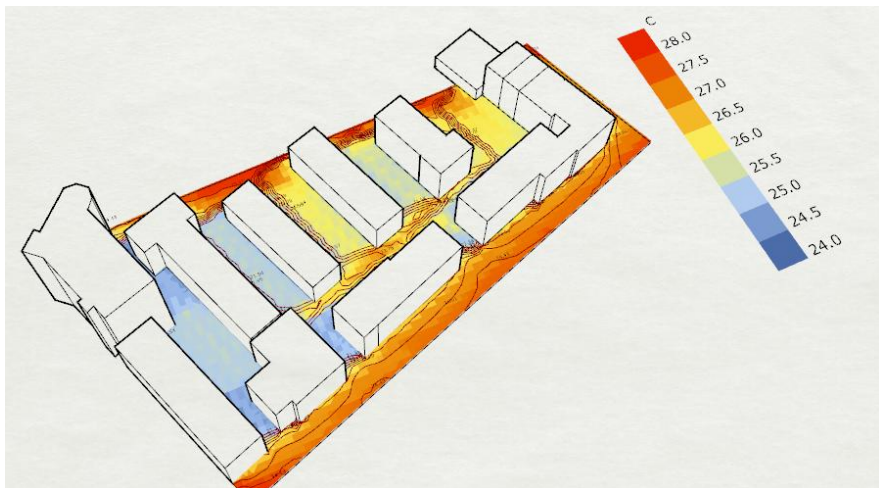
Ladybug室外热舒适指标UTCI计算

- 国际通用的热舒适评价指数UTCI：选择Fiala 的多节点人类生理和热舒适模型作为基础模型，可详细地描述人体与外界环境的热交换，适用于不同气候、不同季节，不同纬度地区

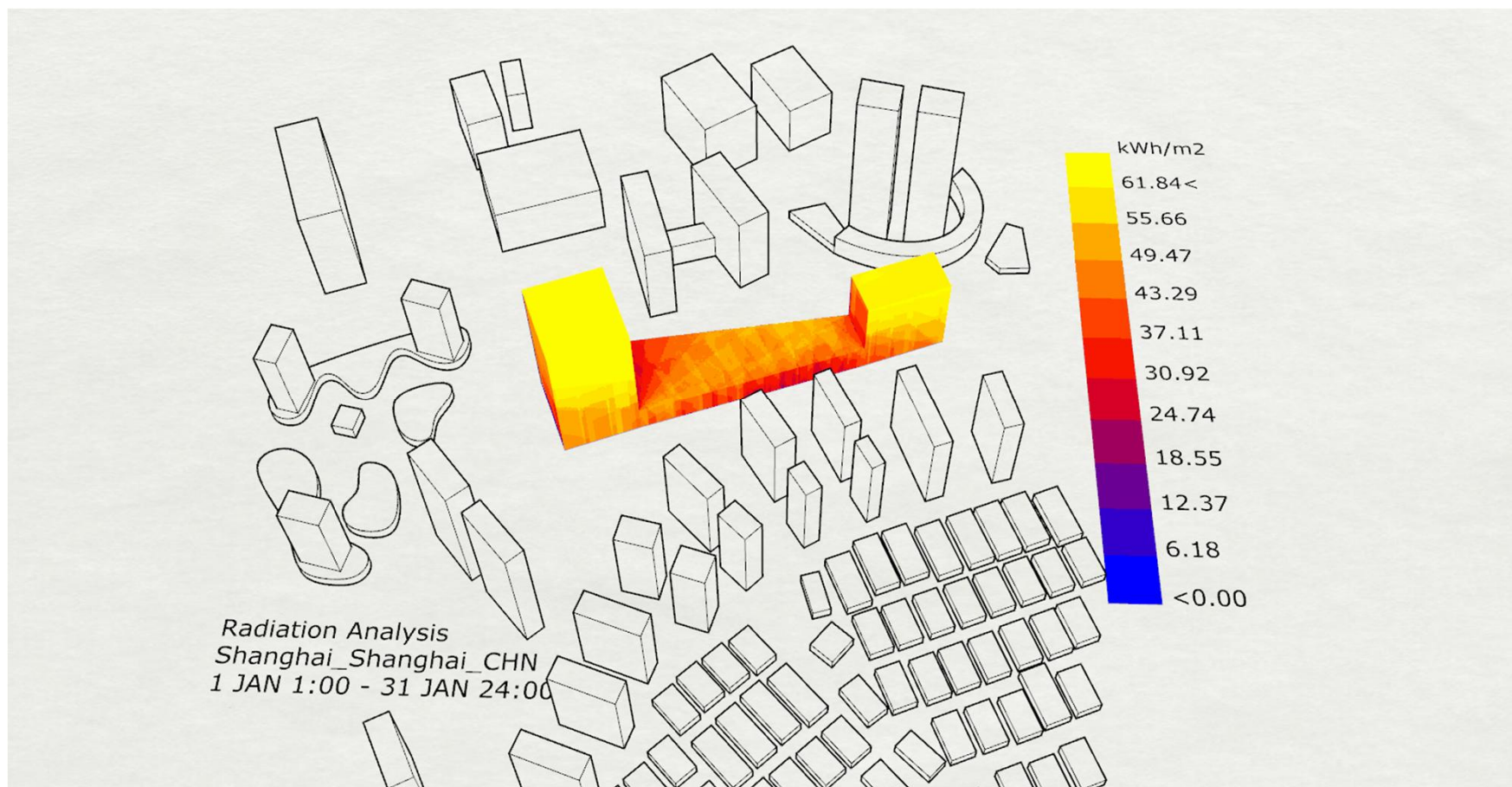


Ladybug室外热舒适指标UTCI计算

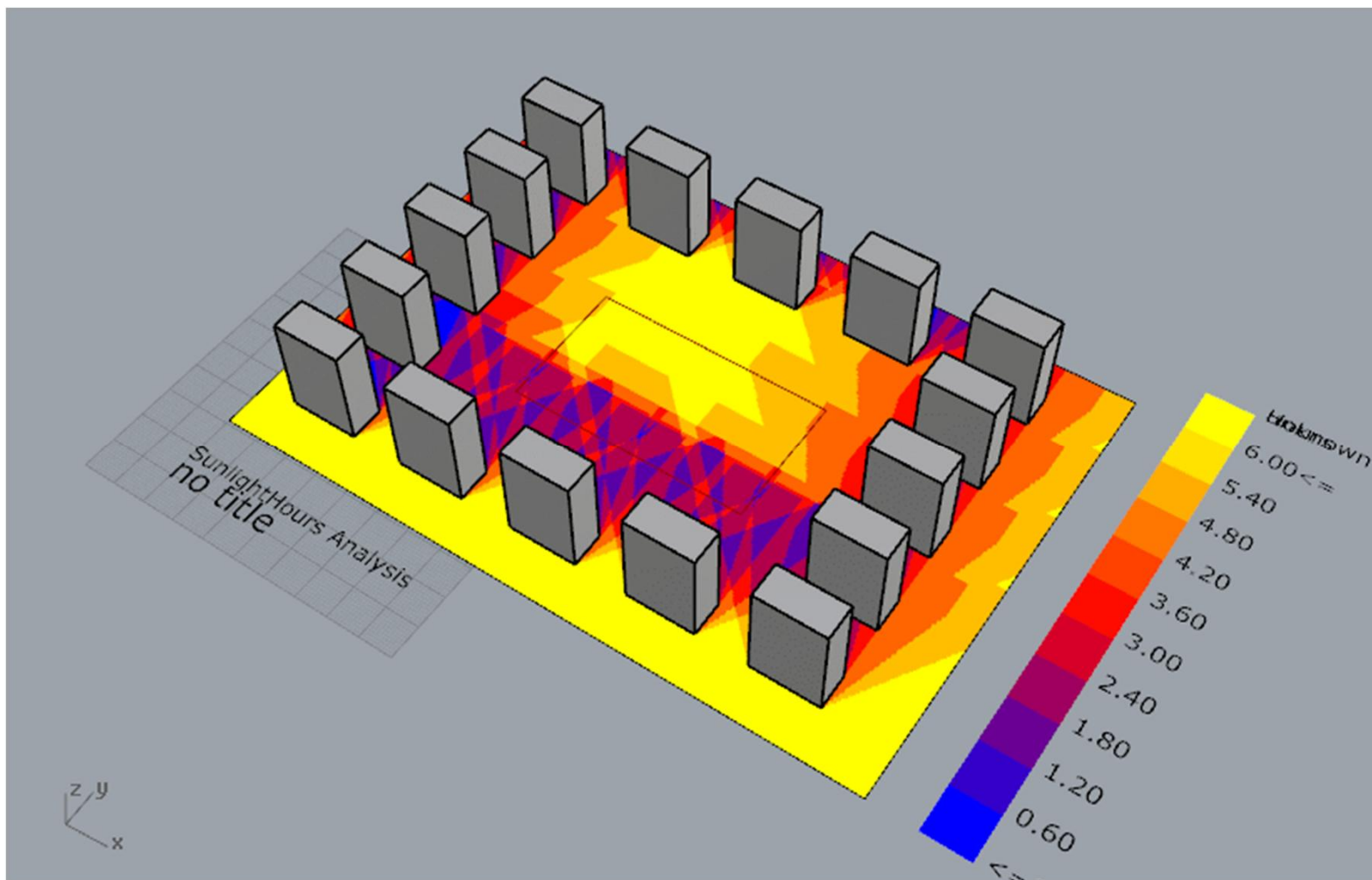




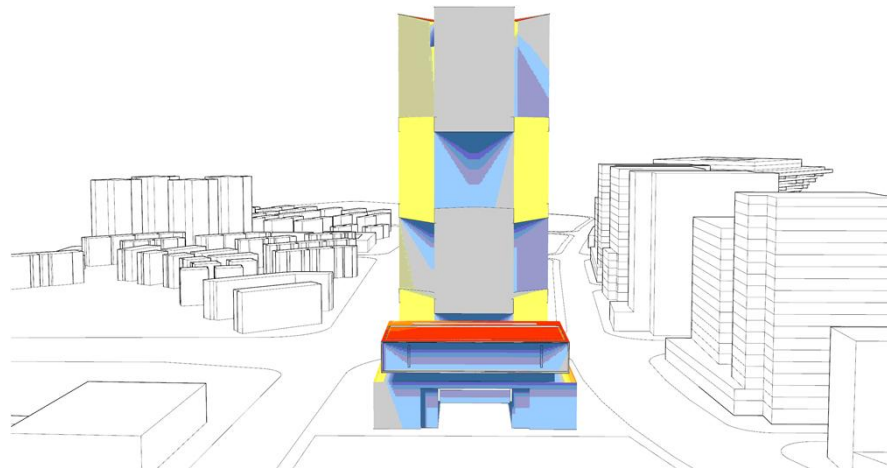
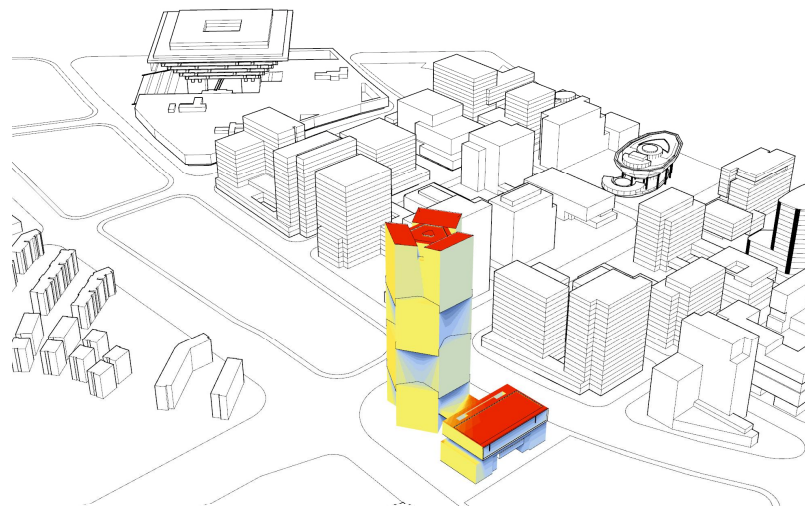
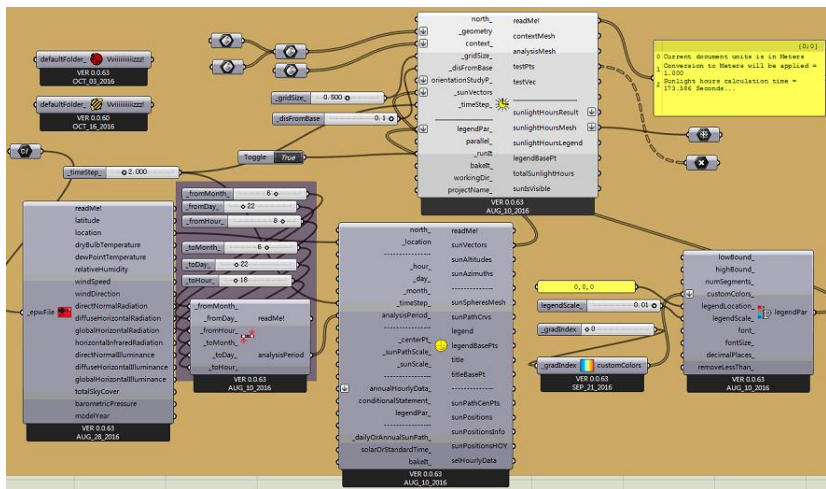
辐射分析



日照分析

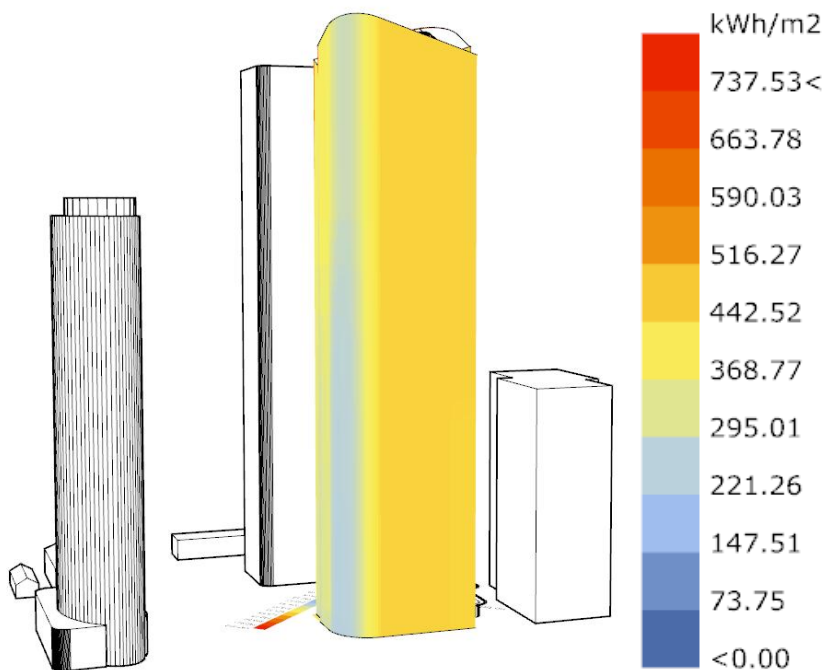


某办公楼方案分析



某方案遮阳优化分析

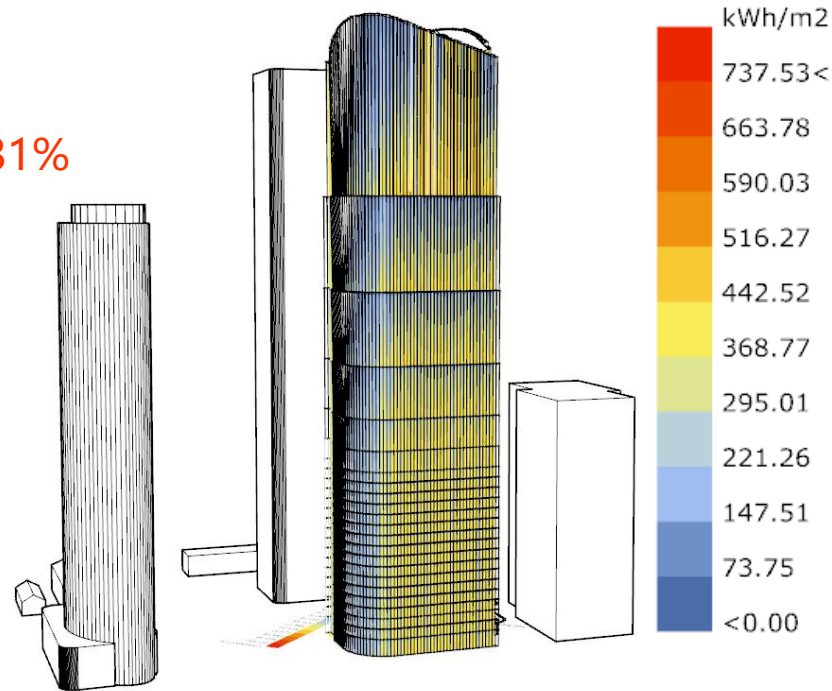
No Shading Panel 无遮阳板



Annual Average Solar Radiation: 373.77kWh/m²

With Shading Panel 有遮阳板

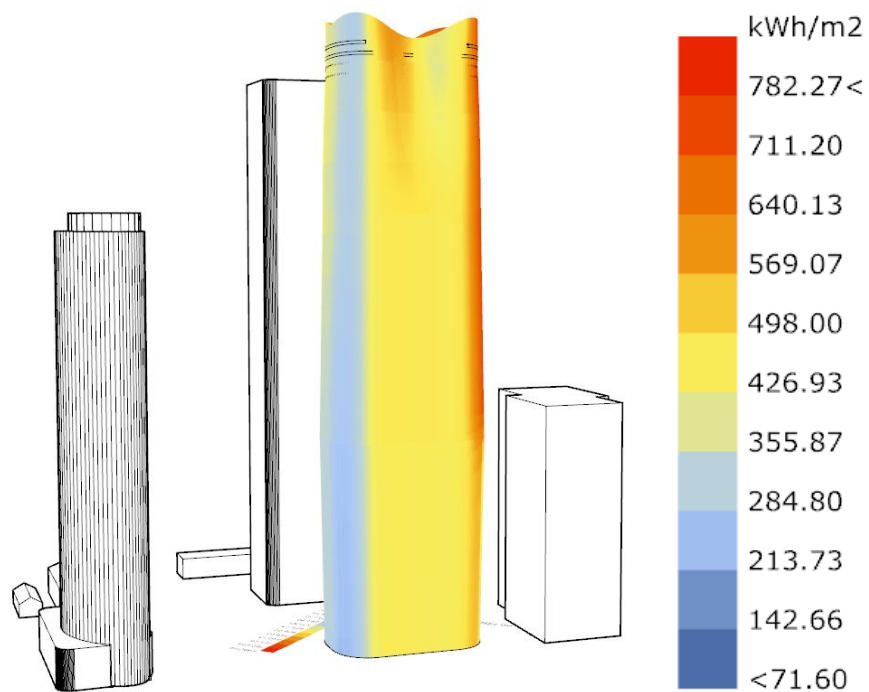
31.31%
↓



Annual Average Solar Radiation: 284.65kWh/m²

某方案遮阳优化分析

No Shading Panel 无遮阳板

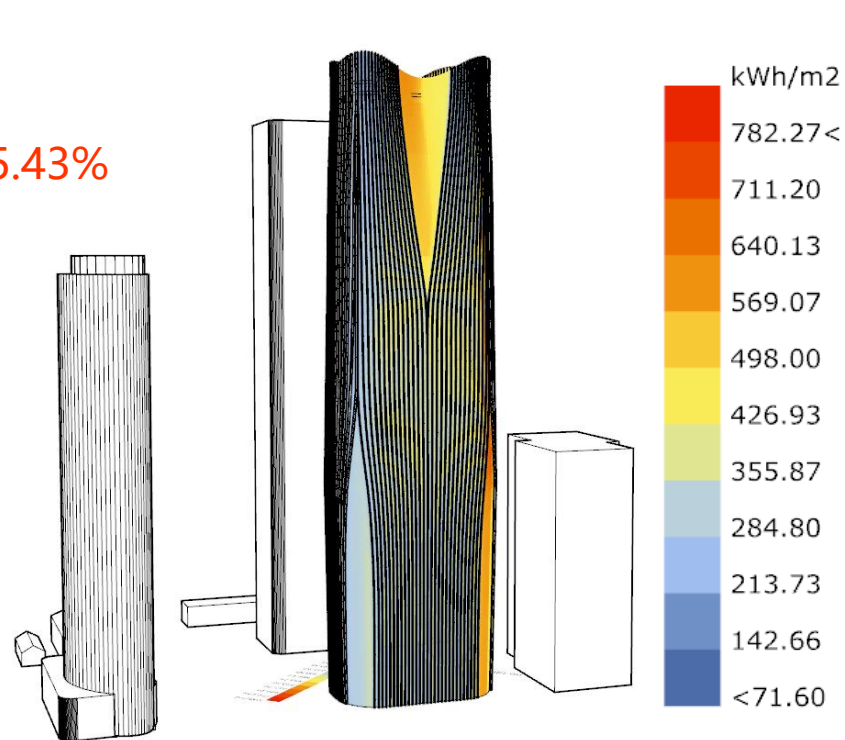


Annual Average Solar Radiation: 373.77kWh/m²

With Shading Panel 有遮阳板

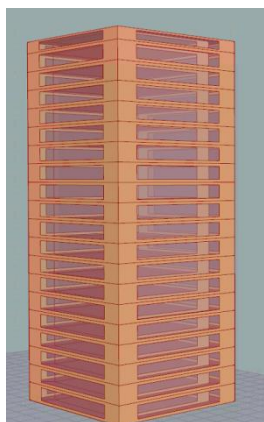
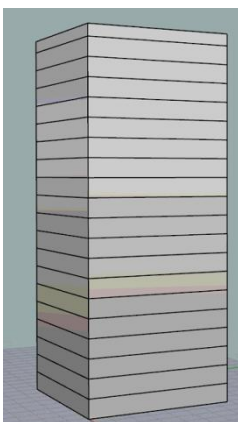
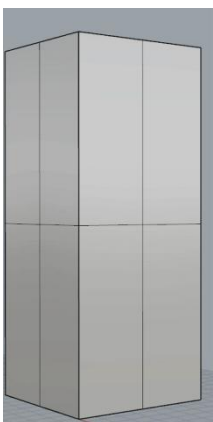
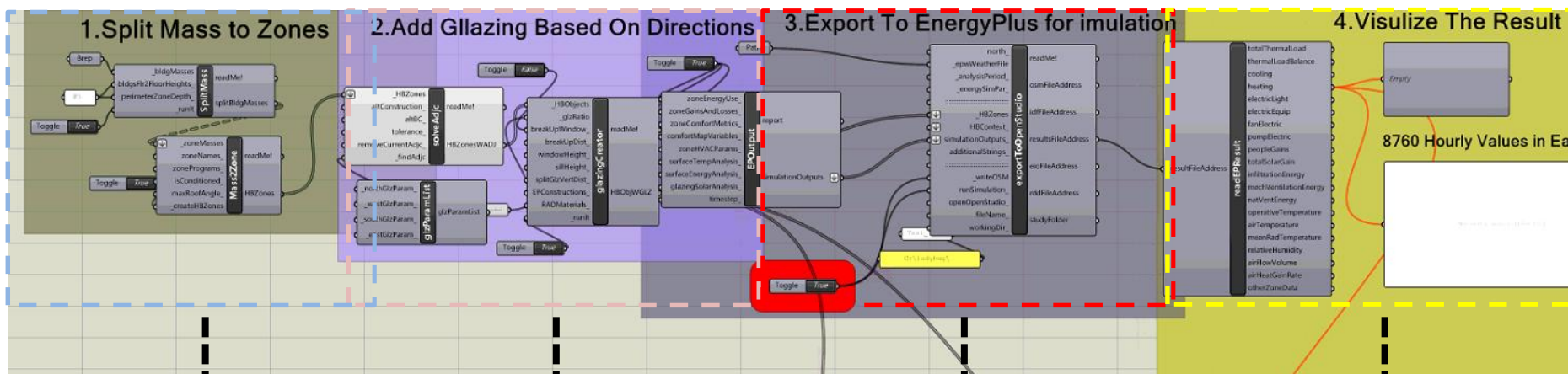


55.43%



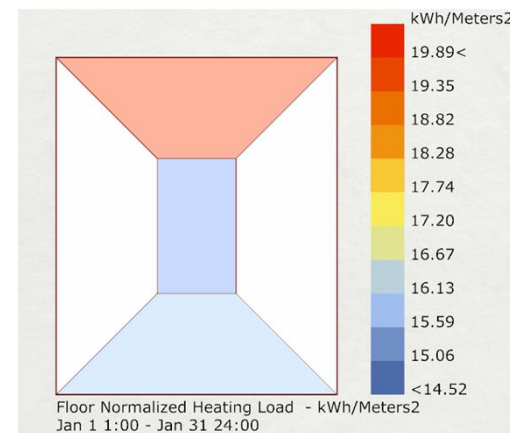
Annual Average Solar Radiation: 284.65kWh/m²

Honeybee模拟分析

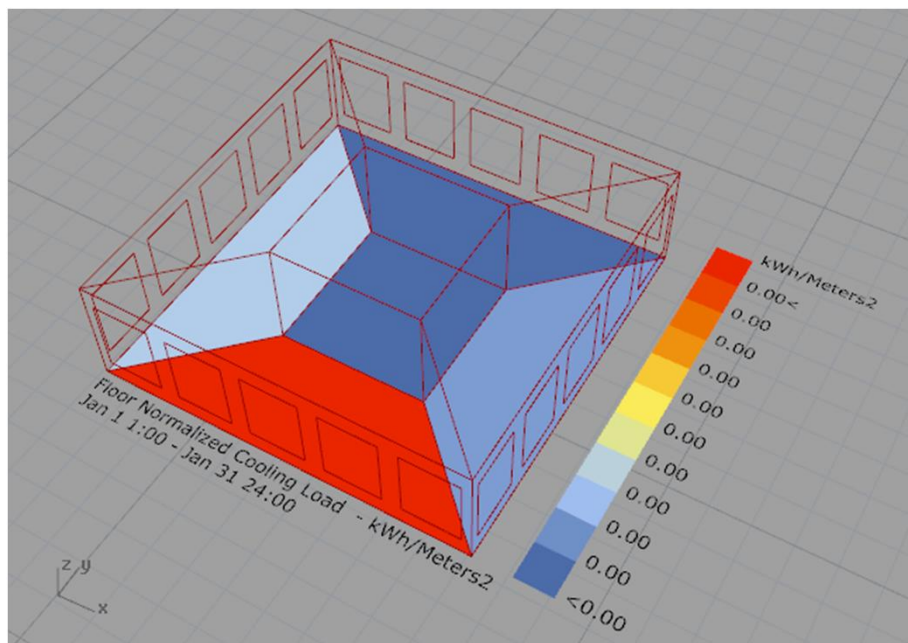


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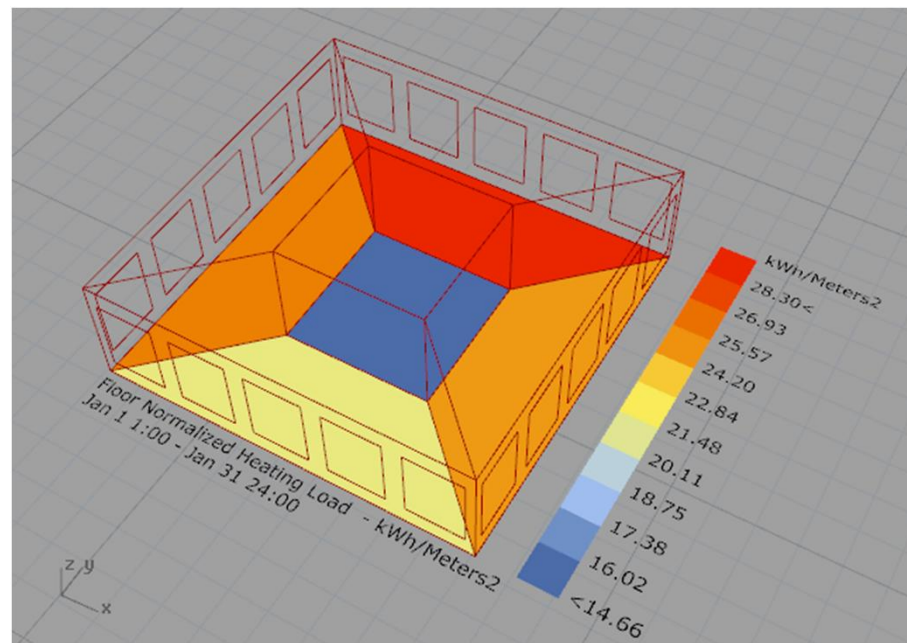
C:\Windows\system32\cmd.exe
Updating Beam-to-Beam Exterior Solar Reflection Factors
Continuing Simulation at 03/02 for RUN PERIOD 1
Updating Shadowing Calculations, Start Date=04/01
Updating Beam-to-Diffuse Exterior Solar Reflection Factors
Updating Beam-to-Beam Exterior Solar Reflection Factors
Continuing Simulation at 04/01 for RUN PERIOD 1
Updating Shadowing Calculations, Start Date=05/01
Updating Beam-to-Diffuse Exterior Solar Reflection Factors
Updating Beam-to-Beam Exterior Solar Reflection Factors
Continuing Simulation at 05/01 for RUN PERIOD 1
Updating Shadowing Calculations, Start Date=05/31
Updating Beam-to-Diffuse Exterior Solar Reflection Factors
Updating Beam-to-Beam Exterior Solar Reflection Factors
Continuing Simulation at 05/31 for RUN PERIOD 1
Updating Shadowing Calculations, Start Date=06/30
Updating Beam-to-Diffuse Exterior Solar Reflection Factors
Updating Beam-to-Beam Exterior Solar Reflection Factors
Continuing Simulation at 06/30 for RUN PERIOD 1
Updating Shadowing Calculations, Start Date=07/30
Updating Beam-to-Diffuse Exterior Solar Reflection Factors
Updating Beam-to-Beam Exterior Solar Reflection Factors
Continuing Simulation at 07/30 for RUN PERIOD 1
    
```



Honeybee模拟分析



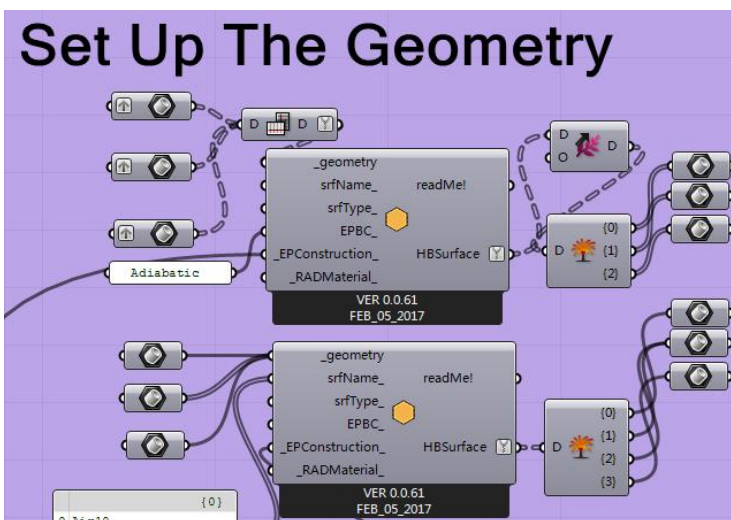
逐月冷负荷



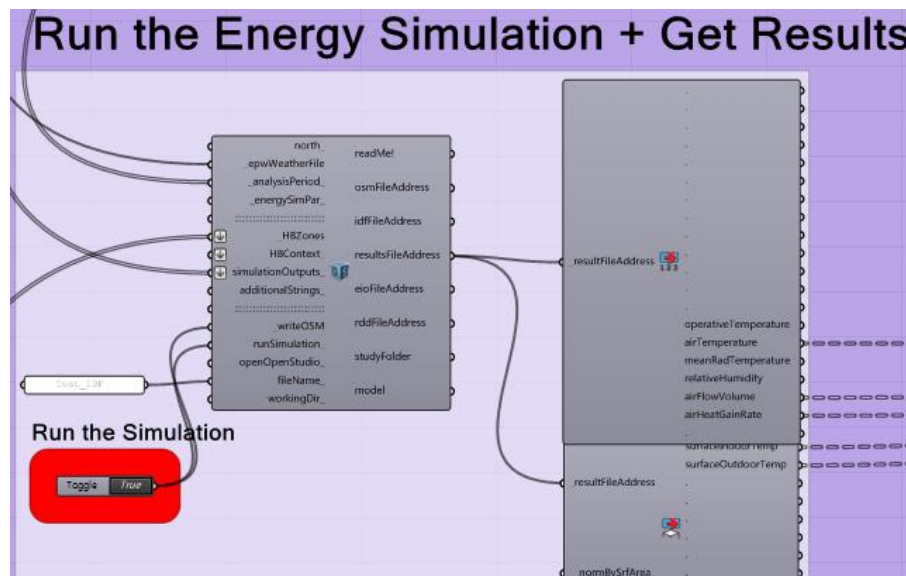
逐月热负荷

Ladybug计算室内热舒适

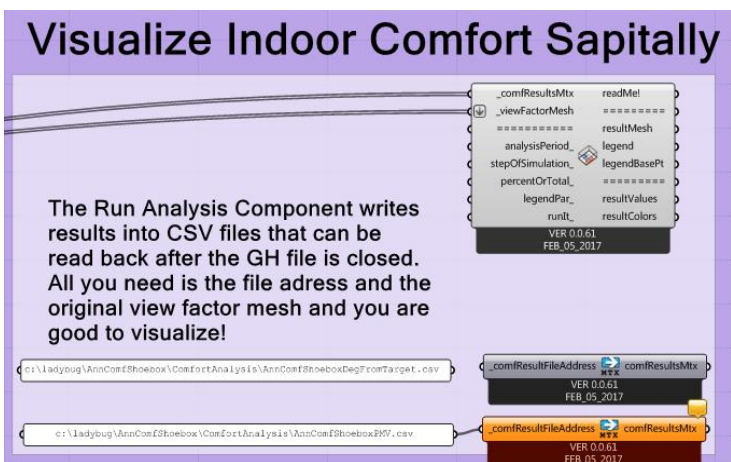
Set Up The Geometry



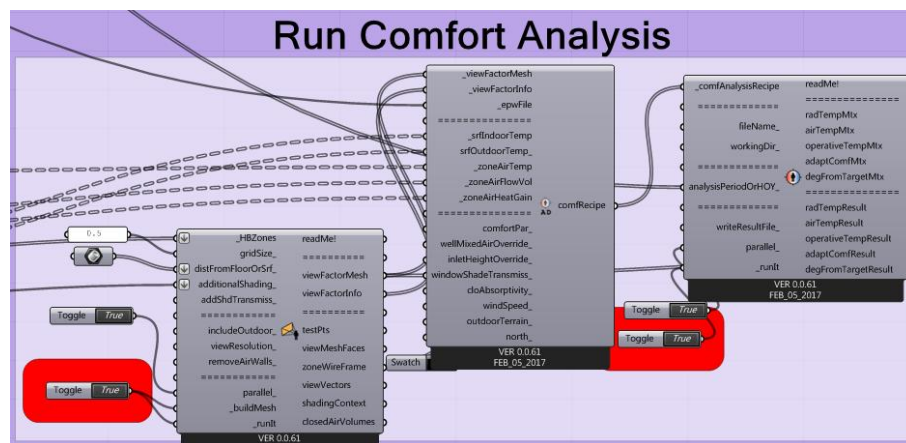
Run the Energy Simulation + Get Results



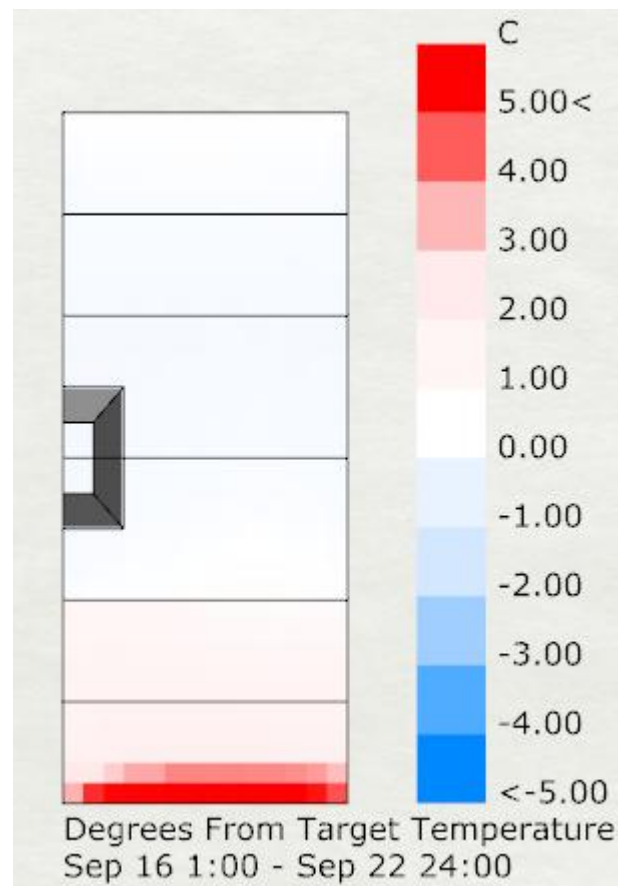
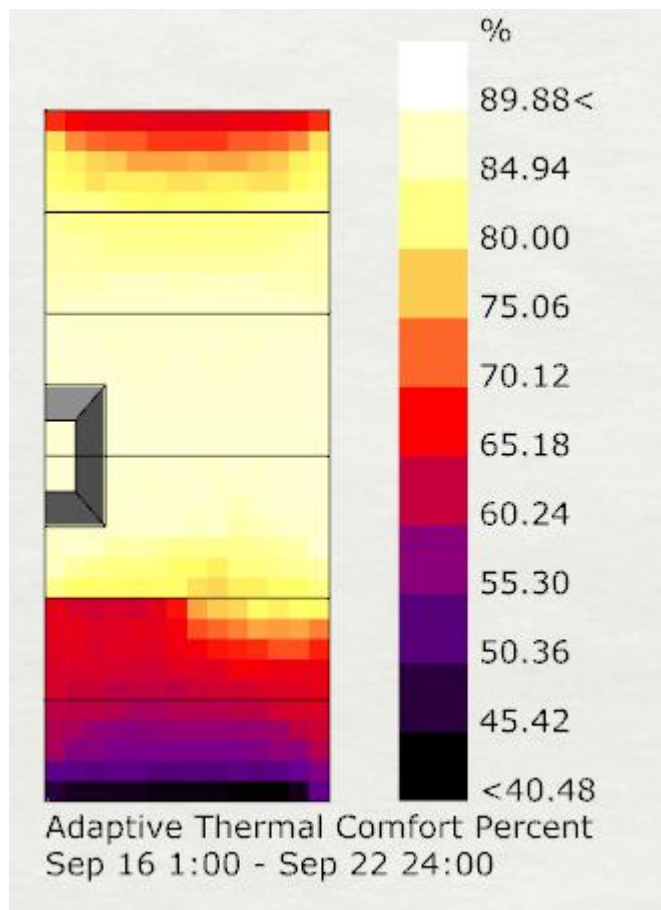
Visualize Indoor Comfort Spatially



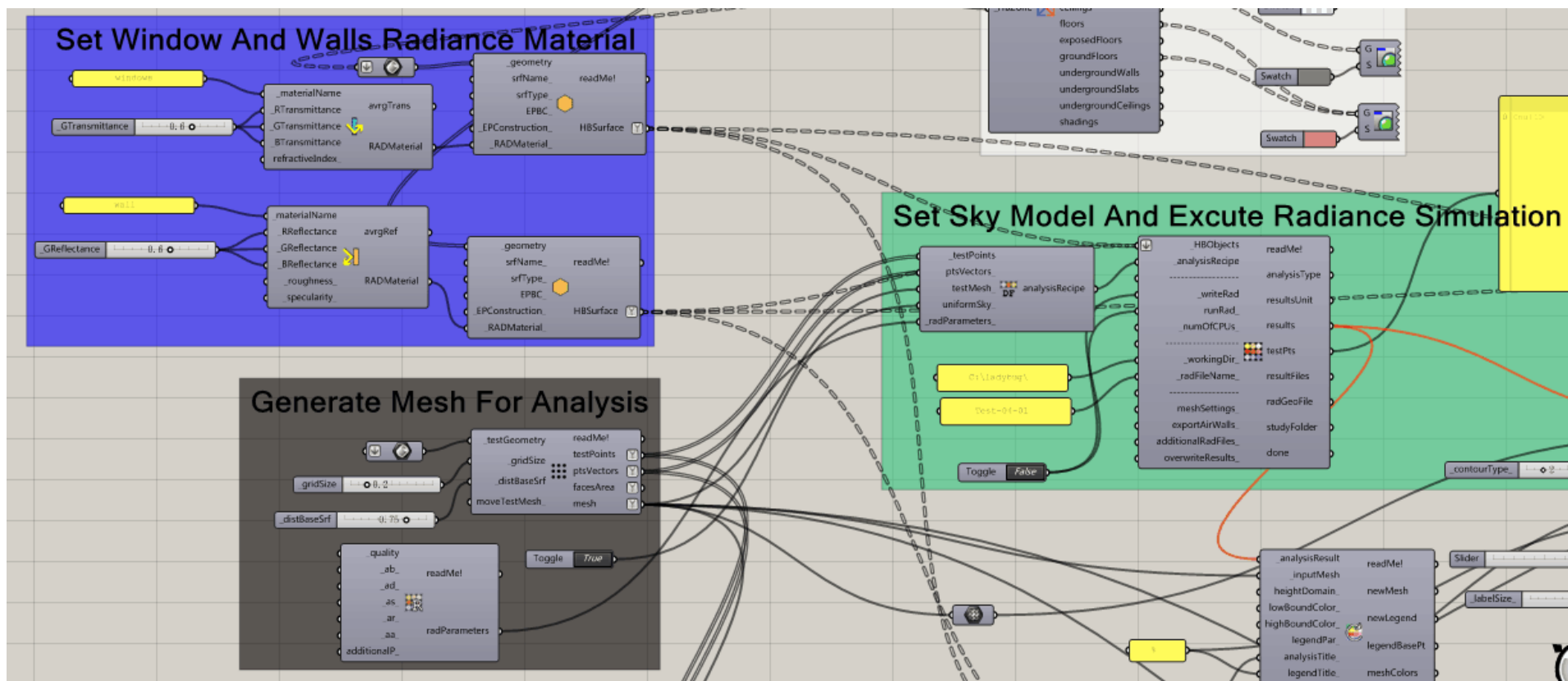
Run Comfort Analysis



室内热舒适



Honeybee模拟分析

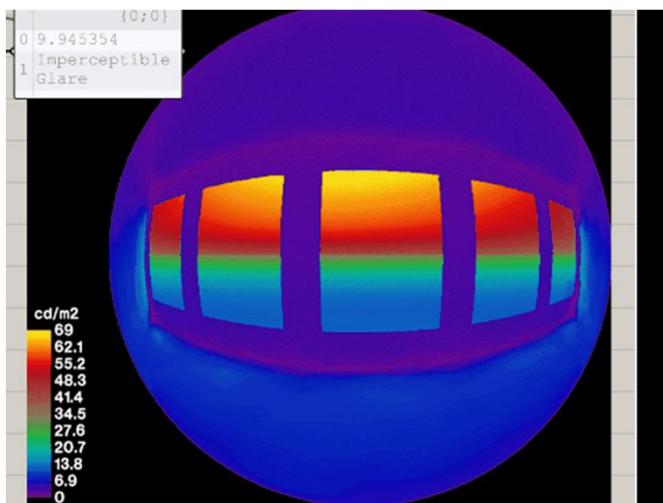


自然采光系数计算

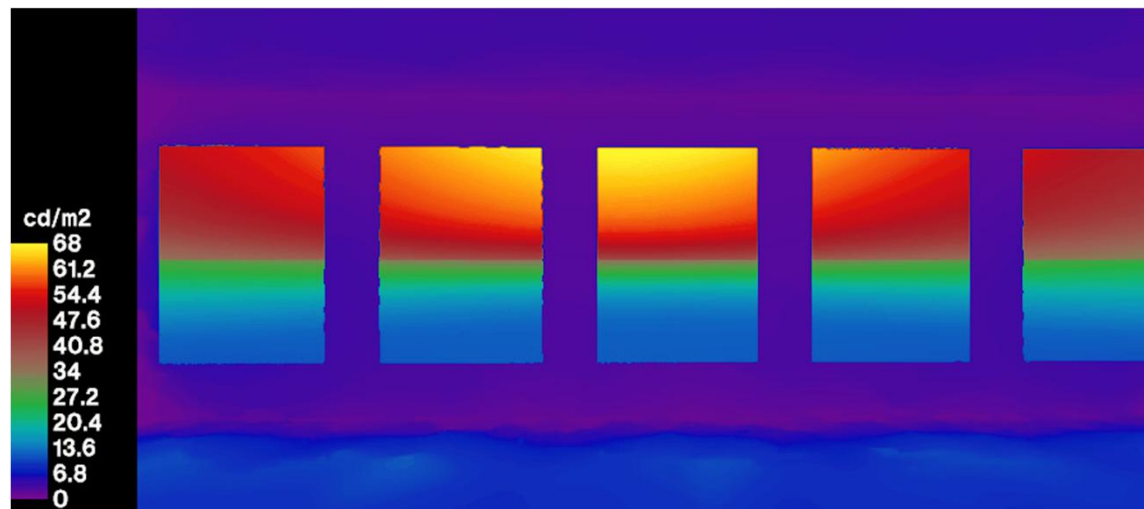
自然采光计算

评价指标Daylight Glare Index

- Daylight Glare Index表示某一时刻从室内看到窗户平均亮度与室外亮度的比值。
- 计算时需要调用Radiance



夏至日6-18点 室内眩光变化 (鱼眼视图)

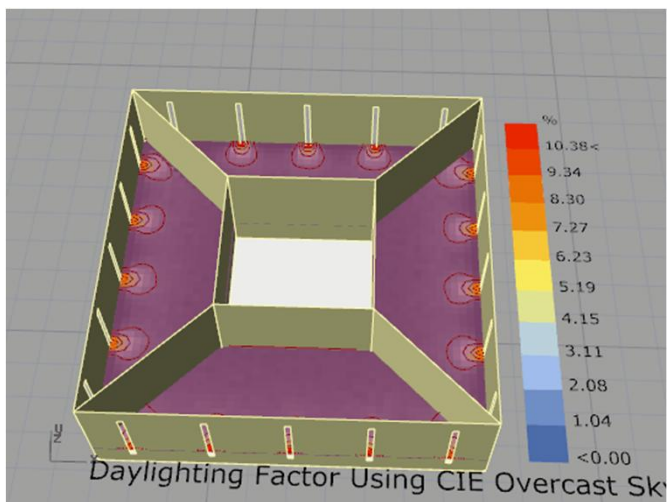


夏至日6-18点 室内亮度变化 (透视视图)

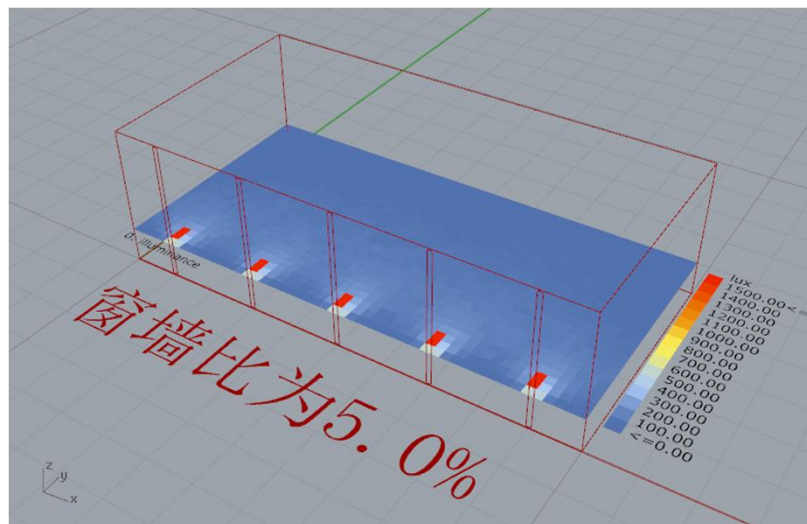
自然采光计算

评价指标Daylight Factor

- Daylight Factor 表示全阴天天空模型下，建筑内某一点的照度值与室外天空照度的比值
- 计算时需要调用Radiance



不同窗墙比下 室内采光系数的变化



单个房间

全年动态自然采光计算

评价指标Daylight Autonomy

- Daylight Autonomy 表示全年工作时间内，建筑内某一点单独依靠自然采光就能达到最小照度要求的时间百分比
- 计算时需要调用Daysim

```

C:\Windows\system32\cmd.exe

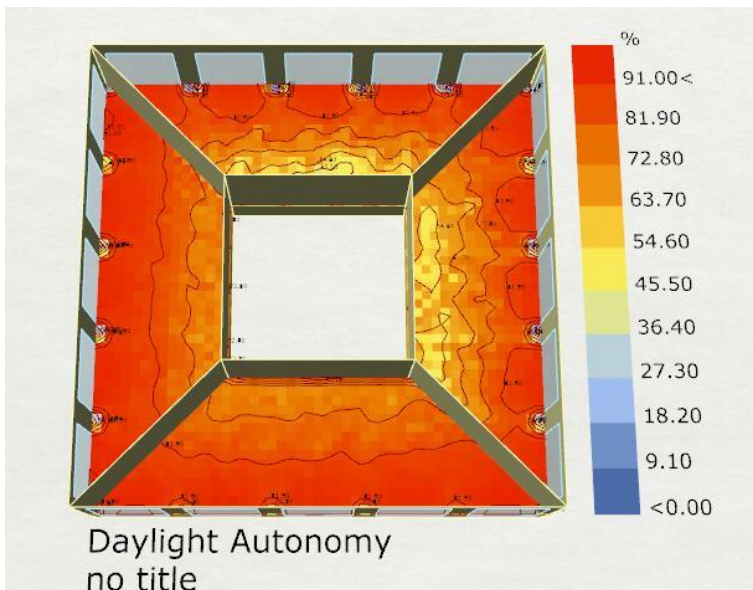
C:\Program Files\Rhinoceros 5 (64-bit)\System>SET RAYPATH=.;C:\Radiance\Lib;C:\DAYSIM\bin;C:\DAYSIM\Lib;

C:\Program Files\Rhinoceros 5 (64-bit)\System>PATH=C:\Radiance\bin;C:\DAYSIM\bin;C:\DAYSIM\Lib;PATH

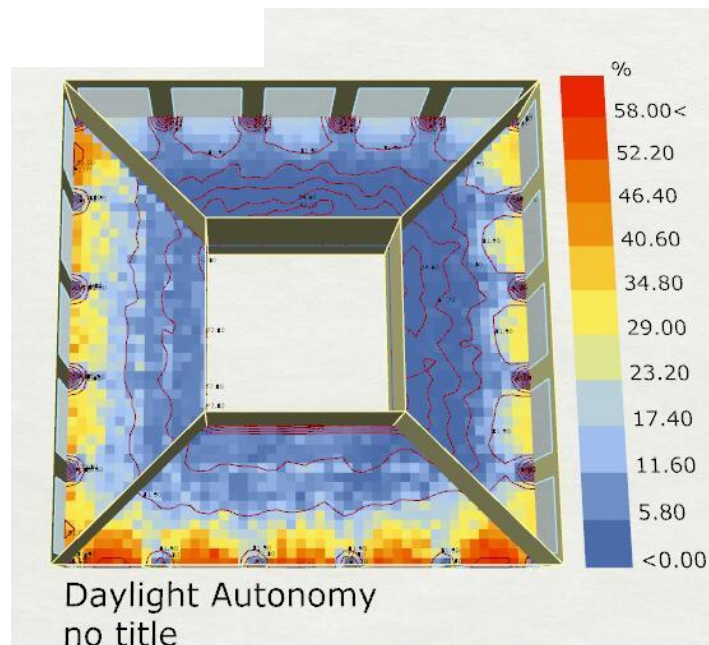
C:\Program Files\Rhinoceros 5 (64-bit)\System>gen_dc C:\ladybug\Test0401\annual3\imulation\Test0401_0.hea -dif
=====
gen_dc: calculate diffuse daylight coefficients =
(ignore WARNING: no light sources found) =
(this simulation may take several minutes to hours) =
=====
calculate diffuse daylight coefficients for variant no_blind...
rtrace_dc: warning - no light sources found

C:\Program Files\Rhinoceros 5 (64-bit)\System>gen_dc C:\ladybug\Test0401\annual3\imulation\Test0401_0.hea -dir
=====
gen_dc: calculate direct daylight coefficients =
(this simulation may take several minutes to hours) =
=====
calculate 61 direct daylight coefficients for variant no_blind...
    
```

调用Daysim

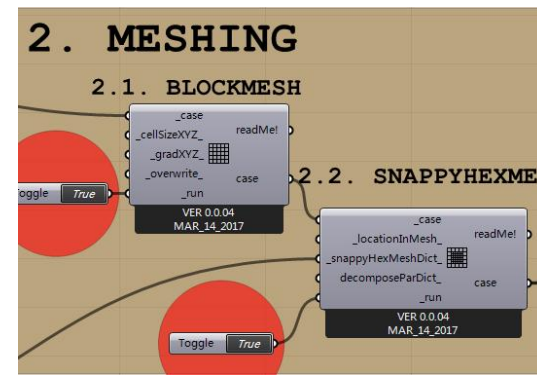
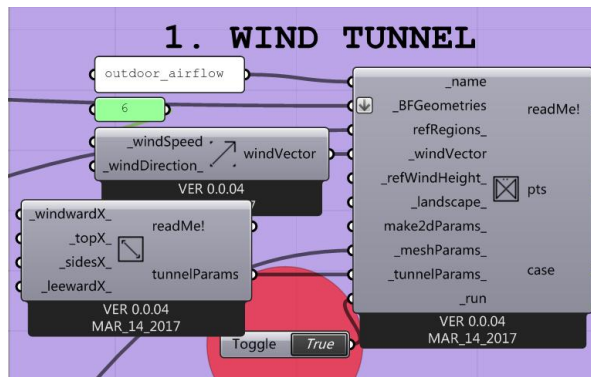
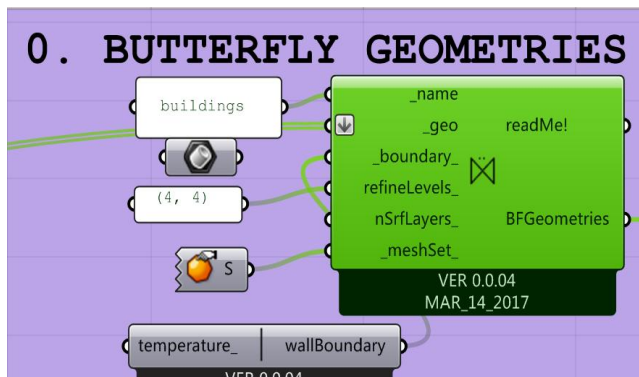


Daylight Autonomy 300lux

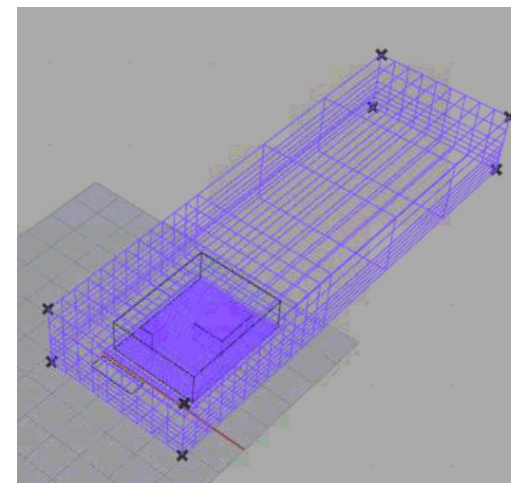
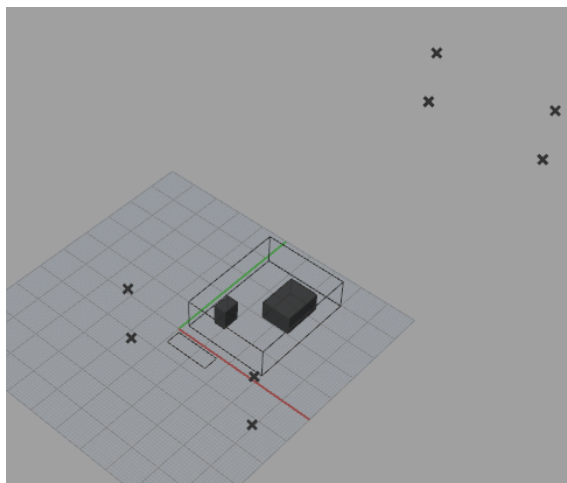


Daylight Autonomy 超过2000lux

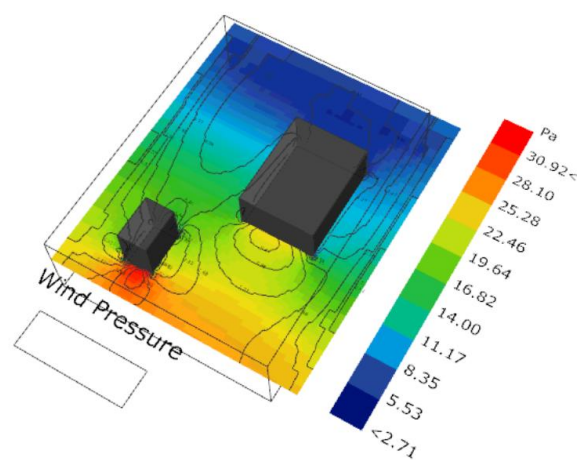
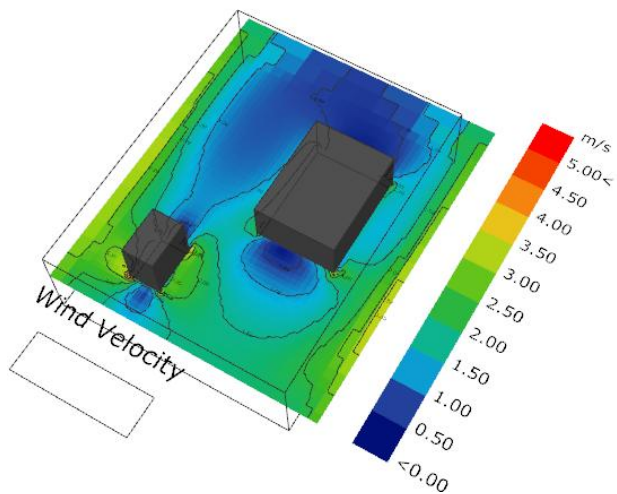
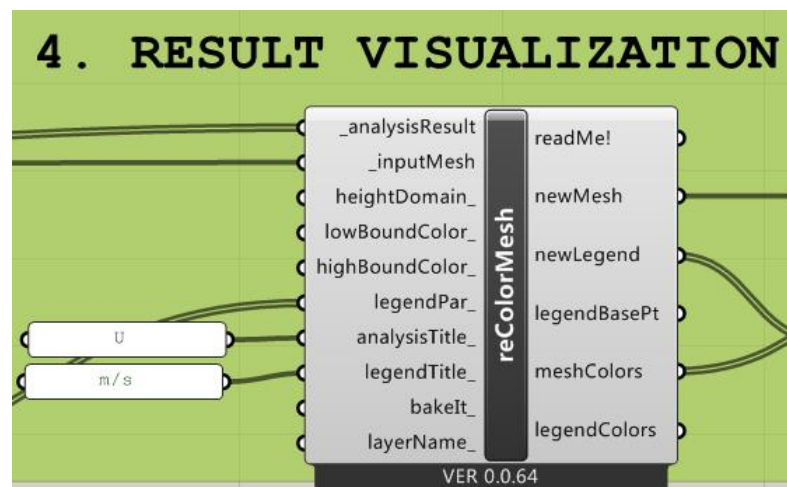
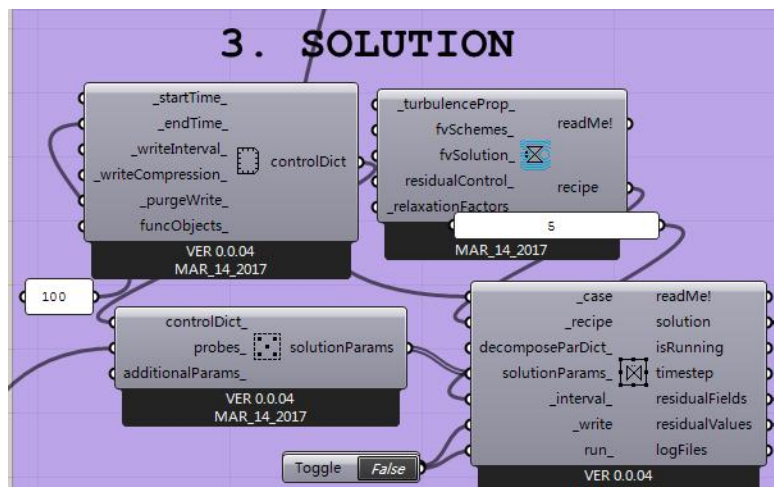
Butterfly进行CFD模拟分析



```
管理员: OpenFOAM_Start
C:\Program Files (x86)\ESI\OpenFOAM\1606>"C:\Program Files (x86)\ESI\OpenFOAM\1606\Windows\Scripts\of_start_container.exe" -arguments "C:\Program Files\Git\bin"
Starting "default"...
(default) Check network to re-create if needed...
(default) Waiting for an IP...
Machine "default" was started.
Waiting for SSH to be available...
Detecting the provisioner...
Started machines may have new IP addresses. You may need to re-run the 'docker-machine env' command.
of_plus_1606
[ofuser@default ~]$
```



Butterfly进行CFD模拟分析



THE
FUTURE
BY
DESIGN



The End
THANKS

