HOK Analysis Visualization Framework

(Updated 2013-09-10 by Jinsol Kim)

Overview

This package of AVF tools is designed to visualize mapped data on parameterized faces, curves, or free points. This package was sorted by three main disciplines, Urban Planning, Architecture, and Interior Design. Several tools exist under each discipline with different default settings for input data, and with different ways of visualizing the data.

- Urban Planning: Mass Analysis (Released), FAR Calculator (Released), Topography , Building Network
- Architecture: Façade Analysis, Heat Map
- Interior Design: Radiance Analysis, Field of View

Common Features of Analysis Visualization Framework

The Revit API has ability to capture multiple associated values in each point, defining different names, descriptions and units on each data set of the Analysis Results. For example, if the analysis has time factors and its results vary depending on the point of time measured, the calculated values can be stored in multiple layers of dataset sorting them by times like 9:00 am, 12pm, 3pm, …. and so on.

One more option given to users is to control the appearance of the results. Users can create or modify the Analysis Display Style within the Revit UI and select a style that will be used for the current analysis results through the command windows of this AVF tool.

The results data is transient. The visualized data will last until the document is opened. After closing the document and reopening it, the data will be no longer to display in the view. It is recommended creating a screen cast before you loss the analysis data. For the current use, this tool is more supportive to two analysis display styles, Colored surface and Markers with texts.

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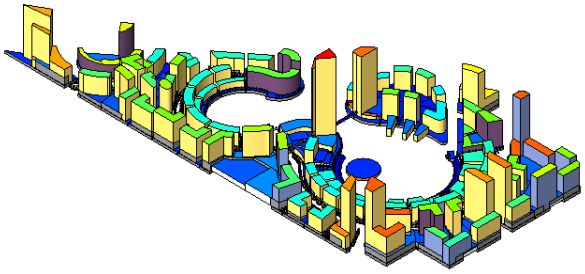
1. Urban Planning



This tool will allow visualizing indexed data of urban scale on top of colored surfaces of selected input elements. The results can be directly imported from parameters values, or can be internally calculated with predefined rules using the geometrical attributes of model elements.

Requirements

The model should be prepared with 3D Mass elements represented as buildings and area elements for plots on which building elements are placed.

Building Parameters (recommended)

Building Footprint – Area
Parking Standard – Area
Building Height – Length
District Area – Area
Plot Area – Area

District Code – Number
Plot Code – Number
Population Density – Number

Area Parameters (recommended)

Building Footprint – Area
Parking Standard – Area
Building Height – Length
District Area – Area
Plot Area – Area

District Code – Number
Plot Code – Number
FAR – Number
Population Density – Number
Required FAR - Number

1.1 Mass Analysis

In order to differentiate building elements by numeric values from a parameter of each building, by setting minimum and maximum values among the collected data, a range of colors according to the color index will be displayed on faces of building elements.

1.1.1 Default Settings

Settings	Values
Default Category	Mass
Category Options	Mass
Default Parameter Selection	Building Height
Displaying Face on	Top
Allowance to Set Reference	False
Reference Category	Null
Reference Description	Null
Default Units	meters

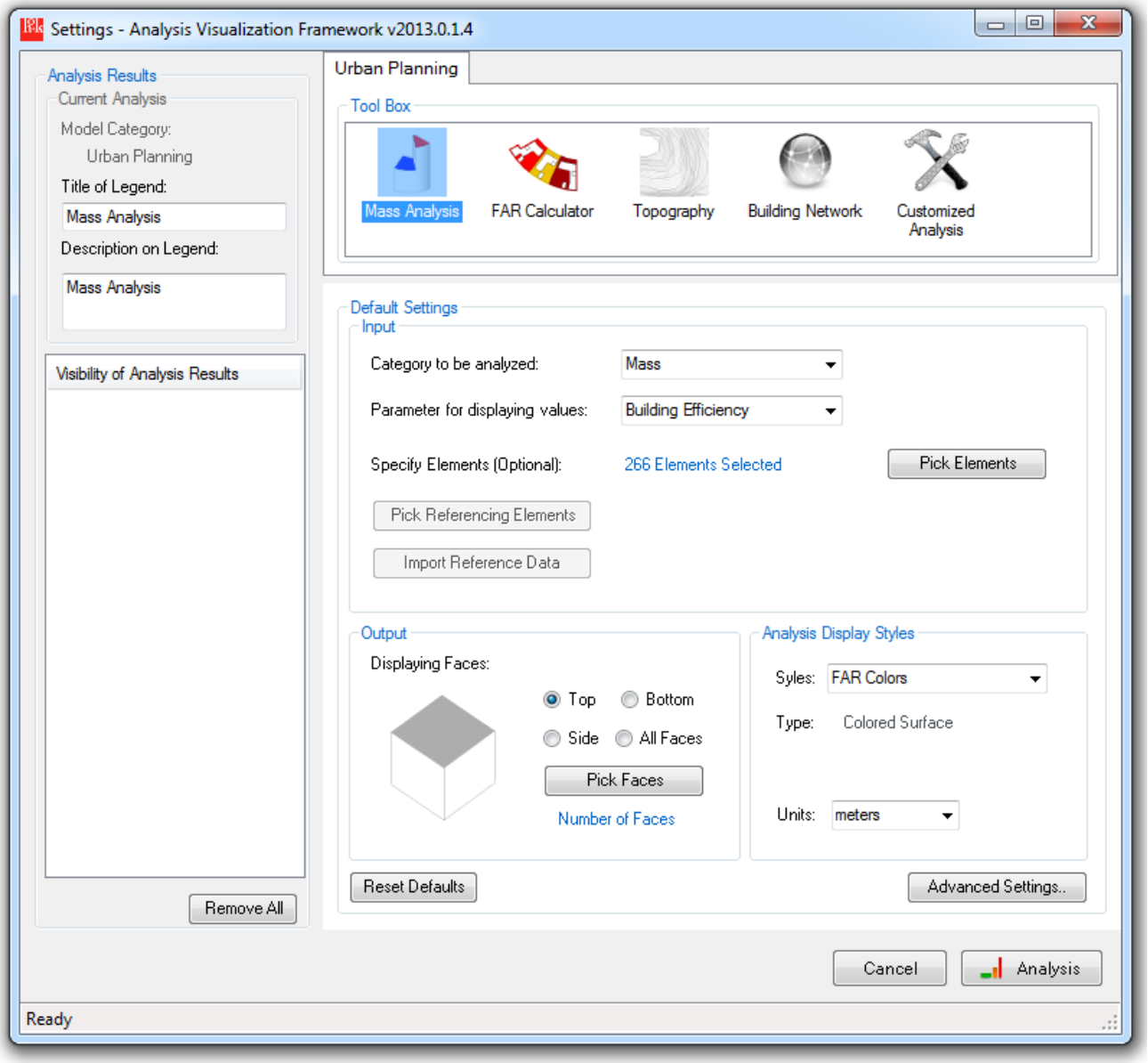
1.1.2 Walkthrough

- **Select a Revit category**: From the combo box, Category *to be analyzed*, select a category among the lists of categories. Mass Analysis provides only one category option, Mass.

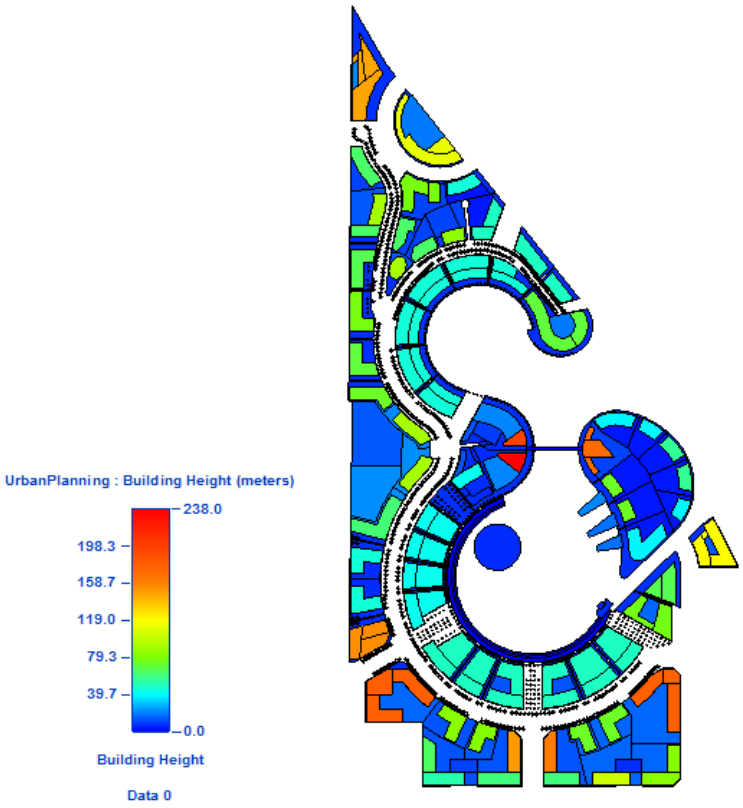
- **Select a Parameter**: From the combo box, *Parameter for displaying values*, select a parameter that contains *double type* values (*). These values are extracted by the tool and mapped with corresponding colors depending on the numeric values. (*) since only numeric values can be utilized for the data visualization, only double types of parameters will be displayed in the lists of the combo box.

- **Pick Elements**: If you want to specify elements for the analysis, you can simply click the Pick Elements button and start selecting Mass elements from the Revit UI. Analysis results will be displayed on those selected elements.

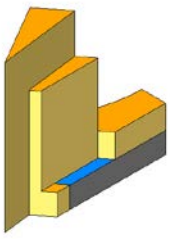
- **Select a Type of Displaying Face**: You can define a displaying face of mass element that will be colored on. Select an option in the output group box among Top, Bottom, Side, or All Faces.



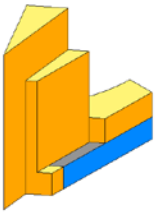
1.1.3 Analysis Result



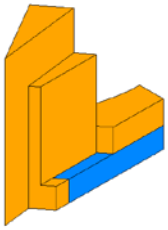
1.1.4 Displaying Options



Option 1. Top Faces



Option 2. Side Faces

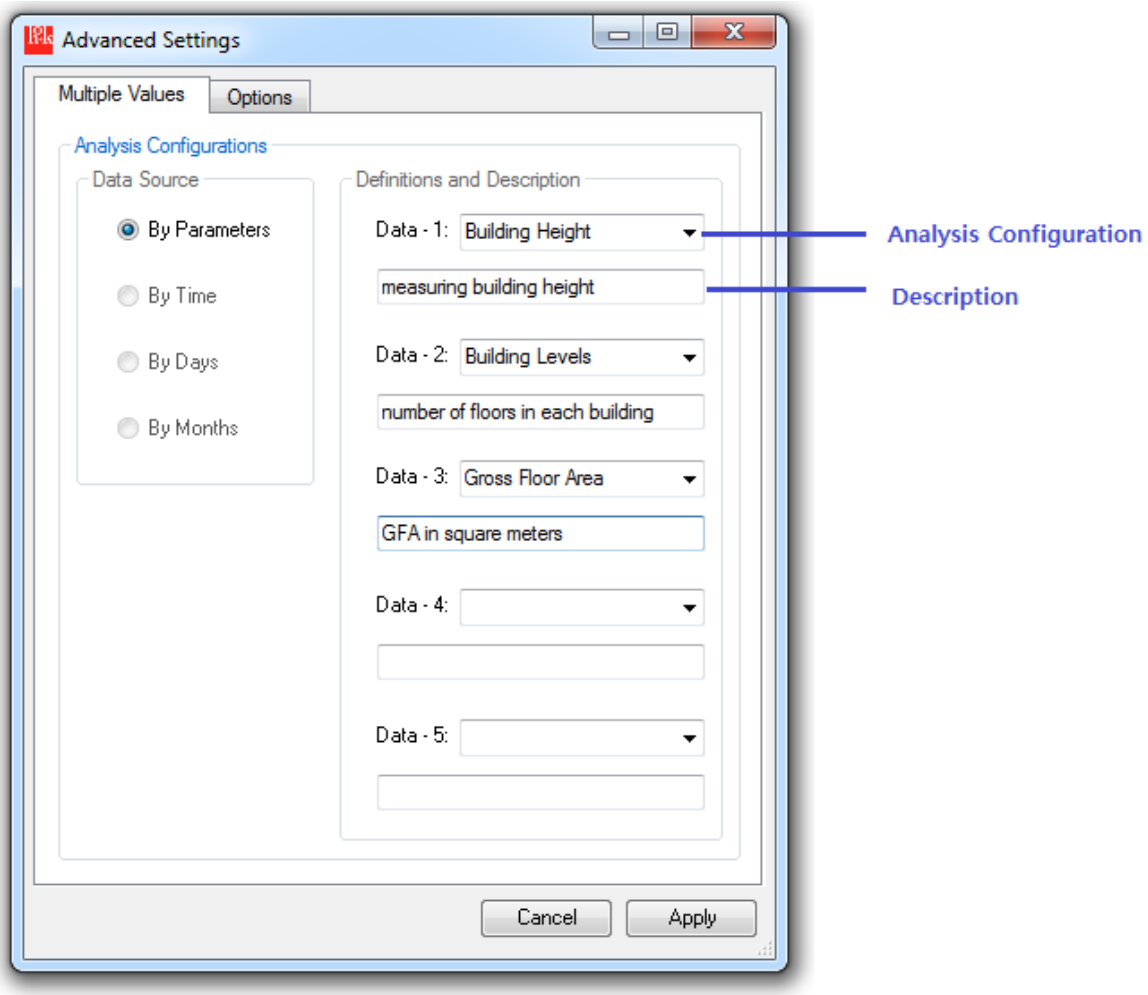


Option 3. All Faces

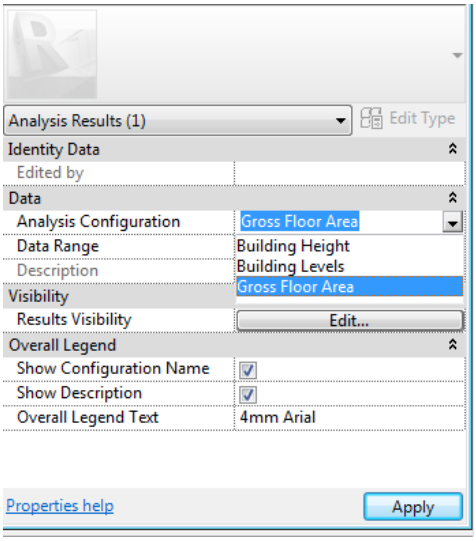
1.1.5 Advanced Settings

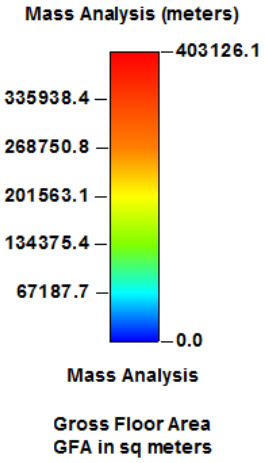
If you want to create multiple sets of values and visualizing the data into different layers of the analysis result, go to the advanced settings and manipulate the parameters through the UI. These multiple sets of values will be accumulated on each singular UV point.

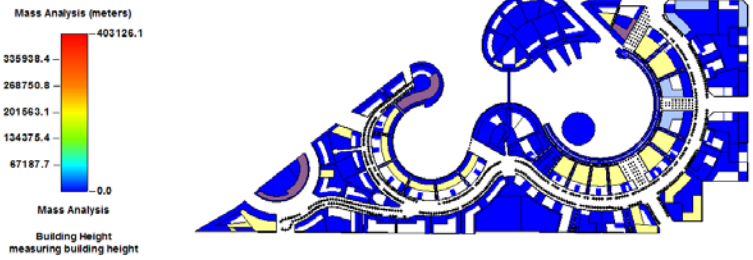
- Select Parameters: Define multiple parameters to be stored on the visualized result as different layers.

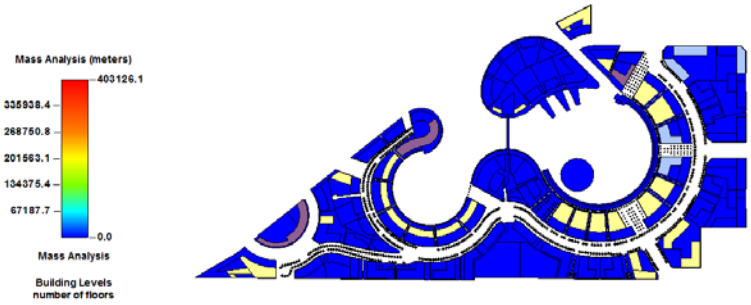


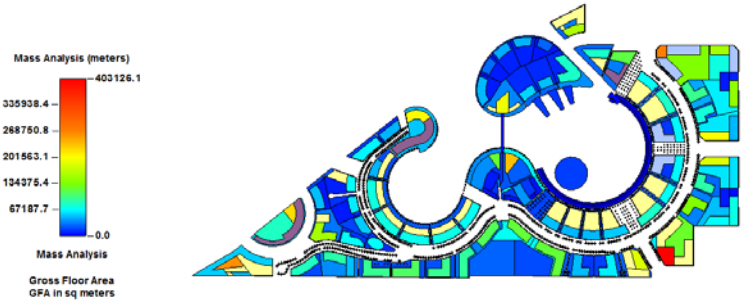
- Choose an Analysis Configuration: in the previous example, three parameters will make three layers of the analysis result. When you select the analysis result, and drop down the Analysis Configuration parameter, you will see the three configuration names on the lists, Building height, Building Levels, Gross floor Area. Depending on the selection of the analysis configuration, the title and description of the legend will be updated accordingly.


Analysis Results (1)
Edit Type
Identity Data
Edited by
Data
Analysis Configuration
Gross Floor Area
Data Range
Building Height
Building Levels
Description
Gross Floor Area
Visibility
Results Visibility
Edit...
Overall Legend
Show Configuration Name
Show Description
Overall Legend Text
4mm Arial
Properties help
Apply


Mass Analysis (meters)
403126.1
335938.4
268750.8
201563.1
134375.4
67187.7
0.0
Mass Analysis
Gross Floor Area
GFA in sq meters


Mass Analysis (meters)
403126.1
335938.4
268750.8
201563.1
134375.4
67187.7
0.0
Mass Analysis
Building Height
measuring building height


Mass Analysis (meters)
403126.1
335938.4
268750.8
201563.1
134375.4
67187.7
0.0
Mass Analysis
Building Levels
number of floors


Mass Analysis (meters)
403126.1
335938.4
268750.8
201563.1
134375.4
67187.7
0.0
Mass Analysis
Gross Floor Area
GFA in sq meters

1.1.6 Limitation

Setting multiple values on the same point would be not appropriate for the variation of parameter, if their type of units and range of double values vary.

For example, let's assume we have selected three parameters, Building Height, Building Level, Gross Floor Area, like above. Once the display setting define the maximum value within the result of Gross Floor Area, it may not be recovered back for Building Height and Building Level which has much smaller maximum value than Gross Floor Area. As a result, results that have narrow range of values cannot be differentiated by different colors.

The best scenario is to differentiate the values by time factors, because the range of values will be consistent.

1.2 FAR Calculator

This tool will calculate Floor Area Ratio (FAR), the ratio of a building's total floor area to the size of the parcel of land, and the store the calculated values in the FAR parameter of each Area element created for the parcel of land. The Analysis tool will use these FAR values to display the data with gradient colored surfaces.

1.2.1 Default Settings

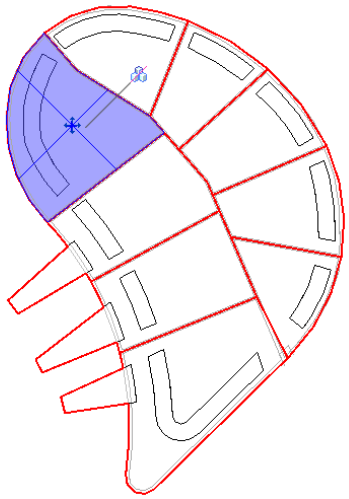
Settings	Values
Default Category	Areas
Category Options	Areas, Mass
Default Parameter Selection	FAR
Displaying Face on	Top
Allowance to Set Reference	False
Reference Category	Null

Reference Description	Null
Default Units	none

1.2.2 Model Requirements

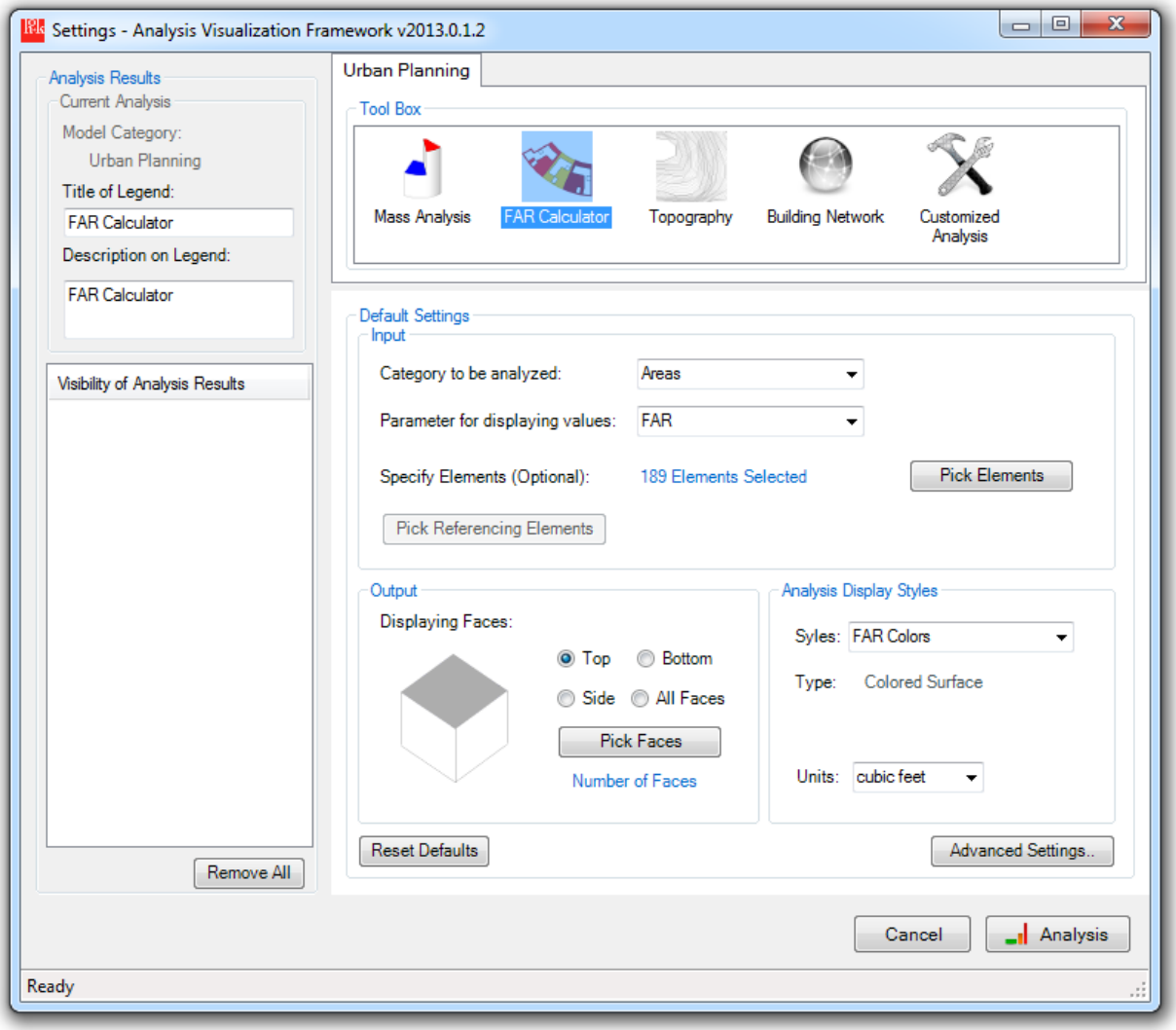
- Area Parameters: District Code (filled in), Plot Code (filled in), FAR (to be filled)
- Mass Parameters: District Code (to be filled), Plot Code (to be filled)

Areas (1)	Edit Type
Constraints	
Level	GROUND LEVEL
Dimensions	
Area	5731.237 m²
Perimeter	308.2361
Building Footprint	
Parking Standard	
District Area	
Plot Area	
Computation Height	1.2000
Identity Data	
Workset	Areas
Number	51
Name	Area
Comments	
District Code	1
Plot Code	1.1.9
Land Use	
Open Space Type	
FAR	
Population Density	
Required FAR	
Edited by	
Other	
Area Type	Building Common Area



1.2.3 Walkthrough

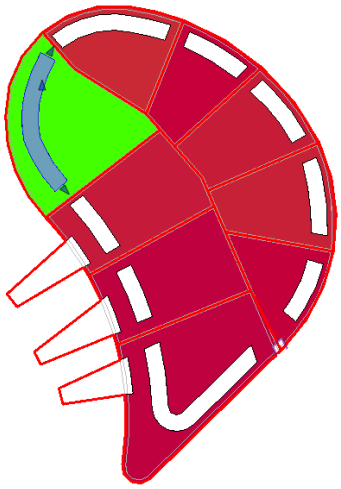
- **Fill in Parameters**: make sure you have an appropriate urban design project that has plot areas and building masses with the appropriate plot information (Plot Code and District Code) filled in.
- **Run with Default Settings**: Select the FAR calculator in the tool box and click the Analysis button remaining the default setting. (do not modify the settings for this version, more options and flexibility will be added for future development)



1.2.4 Analysis Result

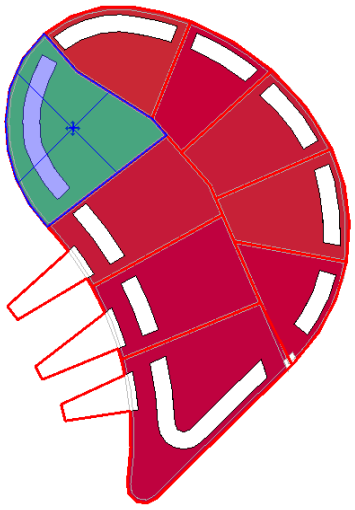
- Mass Parameters: This tool will find building Mass elements placed on each plot Area elements, and transfer the value of District Code and Plot Code from the area element to the mass element. This transaction will be based on the geometry of the model elements, therefore each building element should be placed on top of an appropriate area element.

Mass (1)	Edit Type
Constraints	
Moves With Nearby Elements	☐
Materials and Finishes	
Building Function	Residential
Dimensions	
Mass Floors	Edit...
Gross Floor Area	58865.532 m^2
Gross Surface Area	29532.184 m^2
Gross Volume	205474.653 m^3
Building Footprint	
Parking Standard	80.000 m^2
Building Height	171.5000
District Area	
Plot Area	
Identity Data	
Building Levels	49.000000
Comments	
Mark	
Building Efficiency	0.700000
District Code	1
Plot Code	1.1.9
Land Use	
Population Density	
Floors	
Workset	Mass - Residential
Edited by	jinsol.kim
Phasing	
Phase Created	Phase 5
Phase Demolished	None



- Area Parameters: Calculated FAR values will be written in the Area parameters.

Areas (1)	Edit Type
Constraints	
Level	GROUND LEVEL
Dimensions	
Area	5731.237 m^2
Perimeter	308.2361
Building Footprint	
Parking Standard	
District Area	
Plot Area	
Computation Height	1.2000
Identity Data	
Workset	Areas
Number	51
Name	Area
Comments	
District Code	1
Plot Code	1.1.9
Land Use	
Open Space Type	
FAR	12.140089
Population Density	
Required FAR	
Edited by	jinsol.kim
Other	
Area Type	Building Common Area

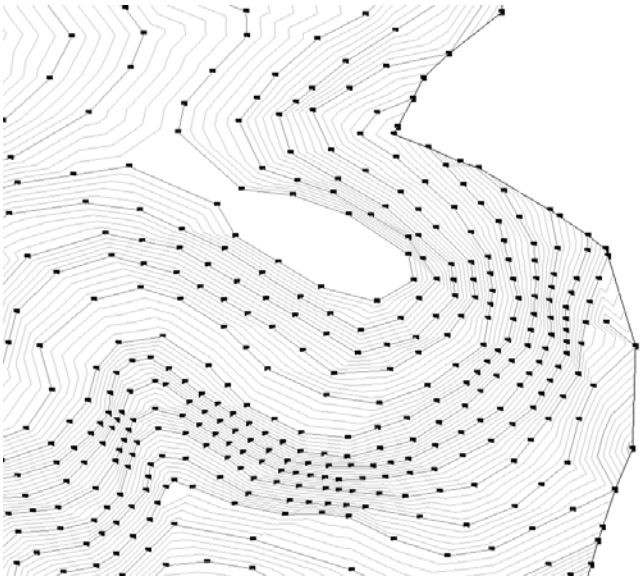


*1.3 **Topography** (For Future Development)*

In Revit, a topography surface consists of interior points, boundary points and geometric meshes. All interior points defined by users contain elevation values of each point. Using these values, the result of slope and aspect analysis will be displayed on top of the topography surface.

1.3.1 Default Settings

Settings	Values
Default Category	Topography
Category Options	Topography, Mass, Generic Models
Default Parameter Selection	Null
Displaying Face on	Top
Allowance to Set Reference	False
Reference Category	Null
Reference Description	Null
Default Units	none

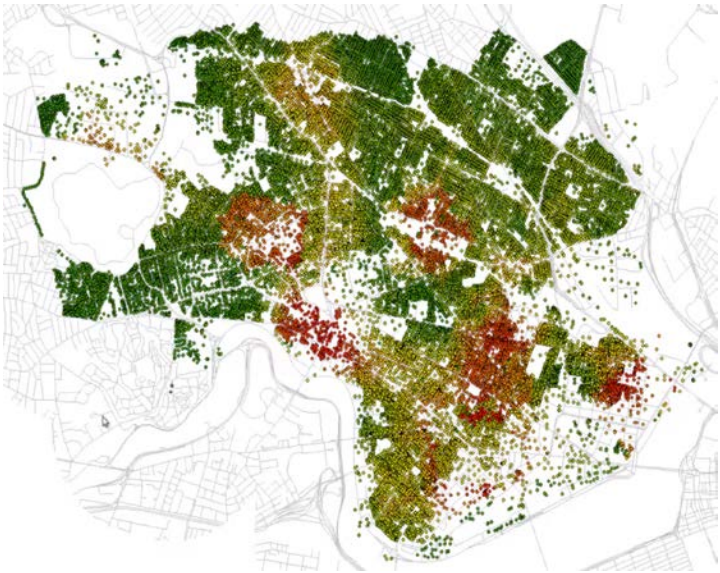


1.4 ***Building Network*** *(For Future Development)*

This tool will be suited for spatial analysis on urban street networks. The analysis result will be computed by either metric distance or topological distance.

1.4.1 Default Settings

Settings	Values
Default Category	Mass
Category Options	Mass, Generic Models
Default Parameter Selection	Null
Displaying Face on	Top
Allowance to Set Reference	False
Reference Category	Null
Reference Description	Null
Default Units	none



Reference:

City Form Lab, Urban Network Analysis: A Toolbox for ArcGIS 10

http://cityform.mit.edu/projects/urban-network-analysis.html

2. Architecture

2.1 Façade Analysis *(for Future Development)*

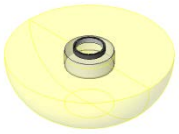
In curtain wall system, individual panels will be painted with gradient colors to indicate the result of the structural analysis such as the pressure of wind.

2.2 Heat Map *(for Future Development)*

The average temperature of rooms will vary depending on the number of lighting fixtures installed, human factor, area of windows and the direction of windows facing. Each individual room will be colored by the temperature.

3. Interior Design

3.1 Radiance Analysis



This tool will support data visualization with analysis results obtained from Diva for Rhino onto Revit model. The DIVA for Rhino is a day lighting and energy modeling plug-in for the Rhino. Once model elements are built in Revit, the geometric information can be imported to Rhino to run the radiance analysis using DIVA for Rhino. Meanwhile, the result of analysis will be formatted as .dat which contains locations of xyz data points including the calculated values, so then this tool will import those values and distribute them onto the corresponding point of the location when creating a gradient colored surface.

Website: http://diva4rhino.com/

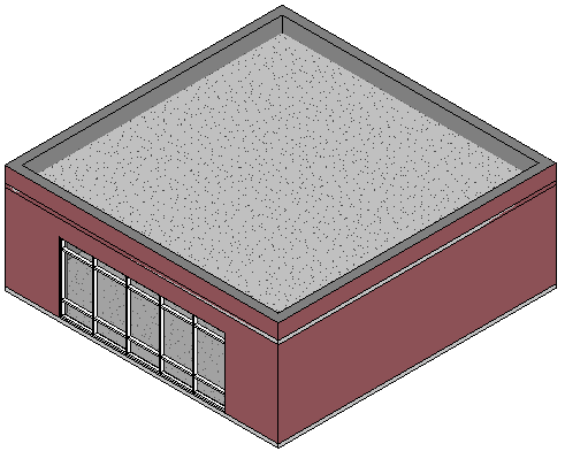
3.1.1 Default Settings

Settings	Values
Default Category	Rooms
Category Options	Rooms, Floors, Spaces
Default Parameter Selection	Null
Displaying Face on	Bottom
Allowance to Set Reference	True
Reference Category	Null
Reference Description	Specify lighting fixtures, otherwise it will include all as default.
Default Units	none

3.1.2 Model Requirements

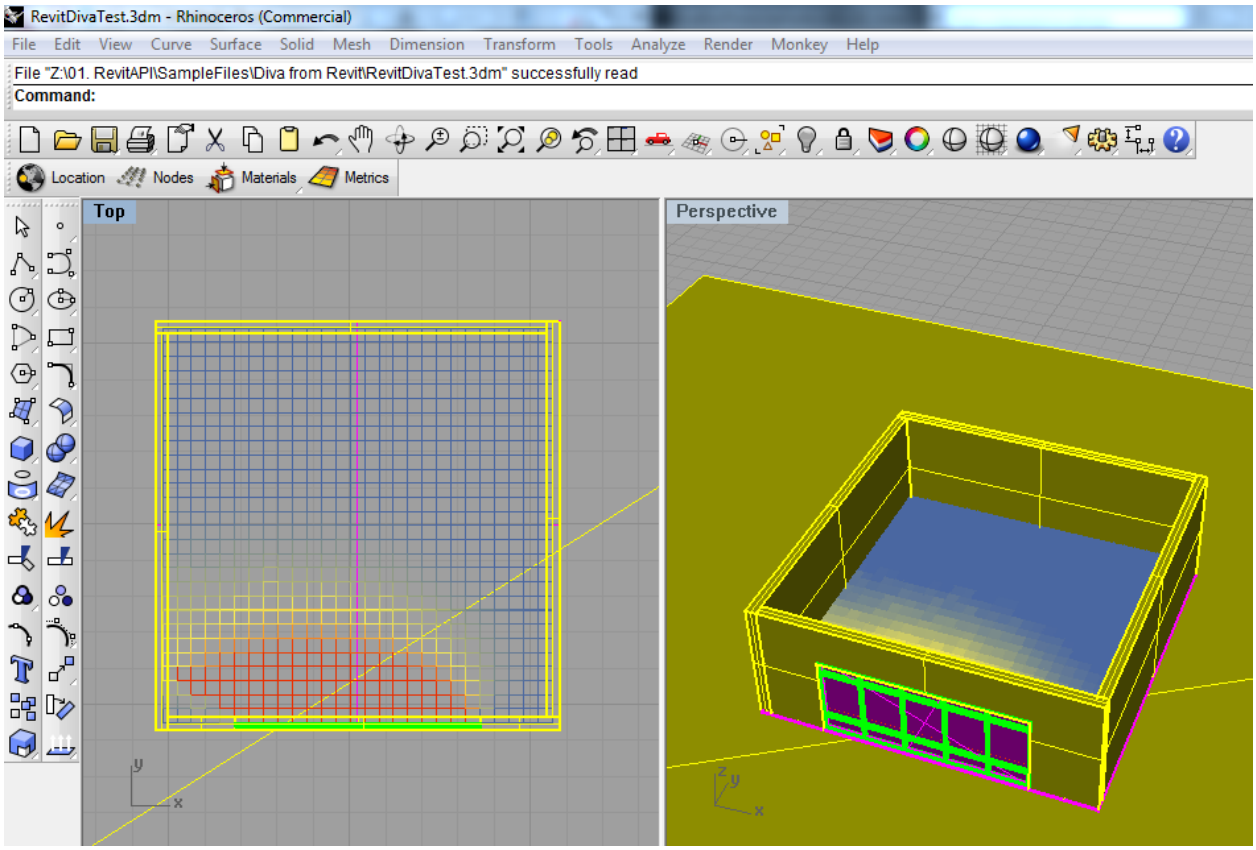
Revit Model

An appropriate room with walls, windows, floors and ceiling should be defined.



Rhino Model

The geometry of Revit model should be imported to Rhino in order to run the radiance analysis using Diva for Rhino. After the completion of the analysis, you will get the .dat file.



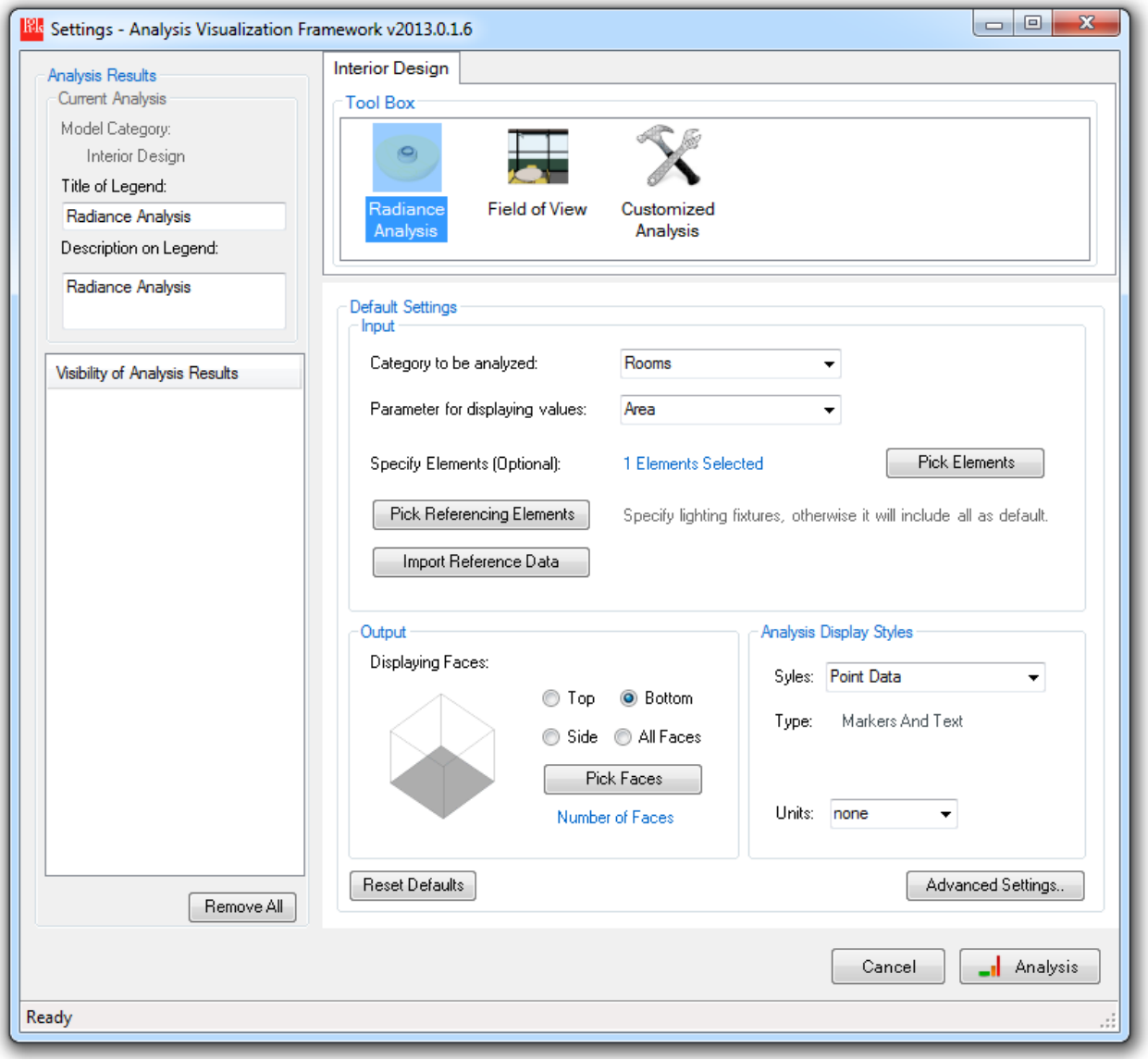
RevitDivaTest.clsky092109.dat - Notepad

File Edit Format View Help

```
-14.971 -0.315 0.85 0 0 1 1.654886e+000 1.653374e+000   1.651106e+000
-14.971 0.076 0.85 0 0 1 2.753970e+000  2.748293e+000   2.739779e+000
-14.971 0.466 0.85 0 0 1 4.193008e+000  4.183426e+000   4.169051e+000
-14.971 0.857 0.85 0 0 1 5.889062e+000  5.874409e+000   5.852431e+000
-14.971 1.247 0.85 0 0 1 6.470533e+000  6.453657e+000   6.428333e+000
-14.971 1.638 0.85 0 0 1 5.910552e+000  5.900006e+000   5.884187e+000
-14.971 2.028 0.85 0 0 1 5.680861e+000  5.659907e+000   5.628479e+000
-14.971 2.419 0.85 0 0 1 5.156697e+000  5.132155e+000   5.095338e+000
-14.971 2.809 0.85 0 0 1 4.608216e+000  4.580880e+000   4.539875e+000
-14.971 3.2 0.85 0 0 1 4.181019e+000    4.158728e+000   4.125294e+000
-14.971 3.59 0.85 0 0 1 3.715383e+000   3.686077e+000   3.642118e+000
-14.971 3.981 0.85 0 0 1 3.147091e+000  3.123480e+000   3.088066e+000
-14.971 4.371 0.85 0 0 1 2.505490e+000  2.483228e+000   2.449835e+000
-14.971 4.762 0.85 0 0 1 2.485304e+000  2.472780e+000   2.453995e+000
-14.971 5.152 0.85 0 0 1 2.154445e+000  2.142798e+000   2.125325e+000
-14.971 5.543 0.85 0 0 1 2.187148e+000  2.172178e+000   2.149723e+000
-14.971 5.933 0.85 0 0 1 1.732769e+000  1.717592e+000   1.694827e+000
-14.971 6.324 0.85 0 0 1 1.561121e+000  1.542361e+000   1.514218e+000
-14.971 6.714 0.85 0 0 1 1.502372e+000  1.476976e+000   1.438880e+000
-14.971 7.105 0.85 0 0 1 1.439292e+000  1.418881e+000   1.388266e+000
-14.971 7.496 0.85 0 0 1 1.260332e+000  1.242138e+000   1.214846e+000
-14.971 7.886 0.85 0 0 1 1.144739e+000  1.126909e+000   1.100160e+000
-14.971 8.277 0.85 0 0 1 9.674709e-001  9.454856e-001   9.125074e-001
```

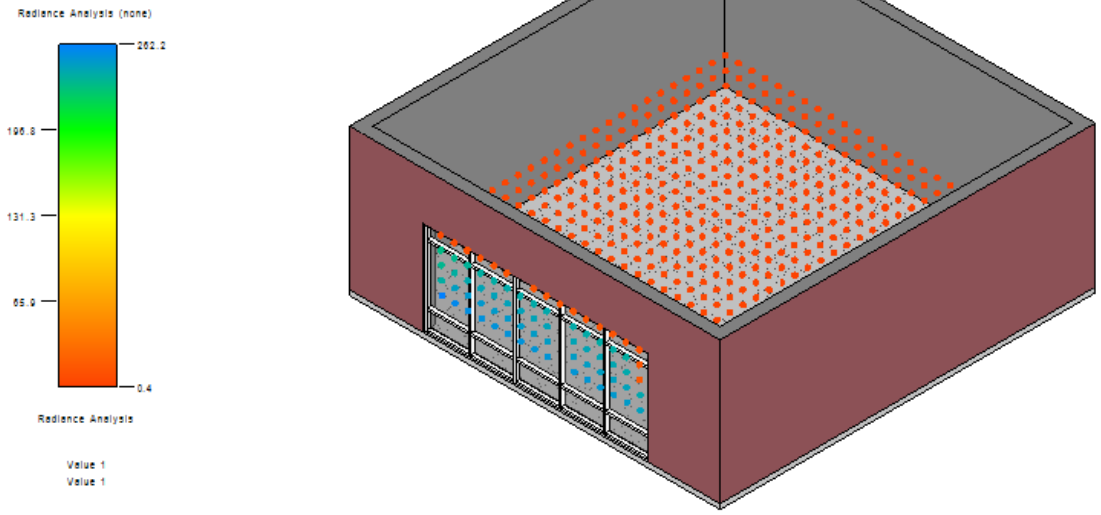
3.1.3 Walkthrough

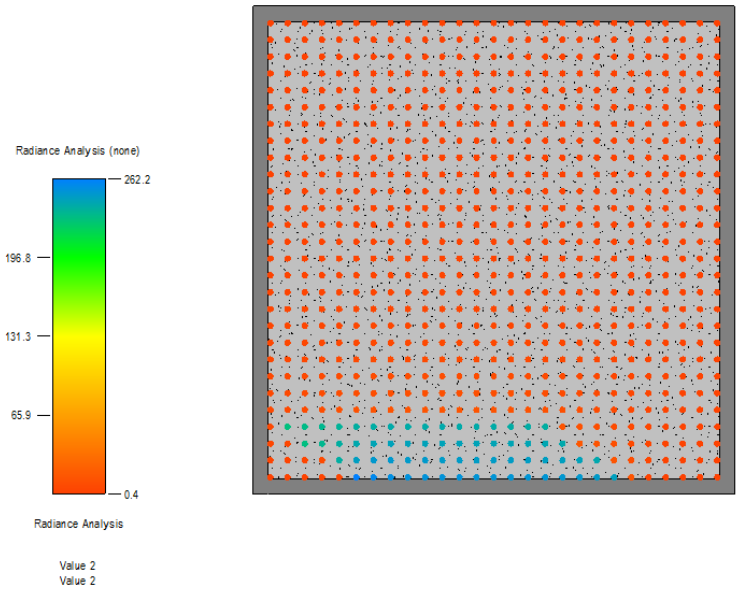
- **Import Reference Data:** an open file dialog will ask you to assign the .dat file that contains the result data originally generated from the current Revit model.
- **Remain the Default Setting (recommended)**



3.1.4 Analysis Result

You can get colored points either in 3D views or 2D plans.





3.2 Field of View

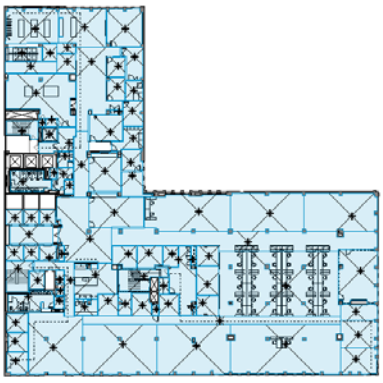
This tool is developed for the visibility analysis that defines isovist field (Benedikt 1979) – the volume of space visible from a given point in space, together with a specification of location of that point. Even though currently Ecotect has the similar functionality of doing this analysis, this tool was introduced for the seamless data transfer in Revit platform having more flexibility of the modification of model geometry with more simplified workflow.

3.2.1 Default Settings

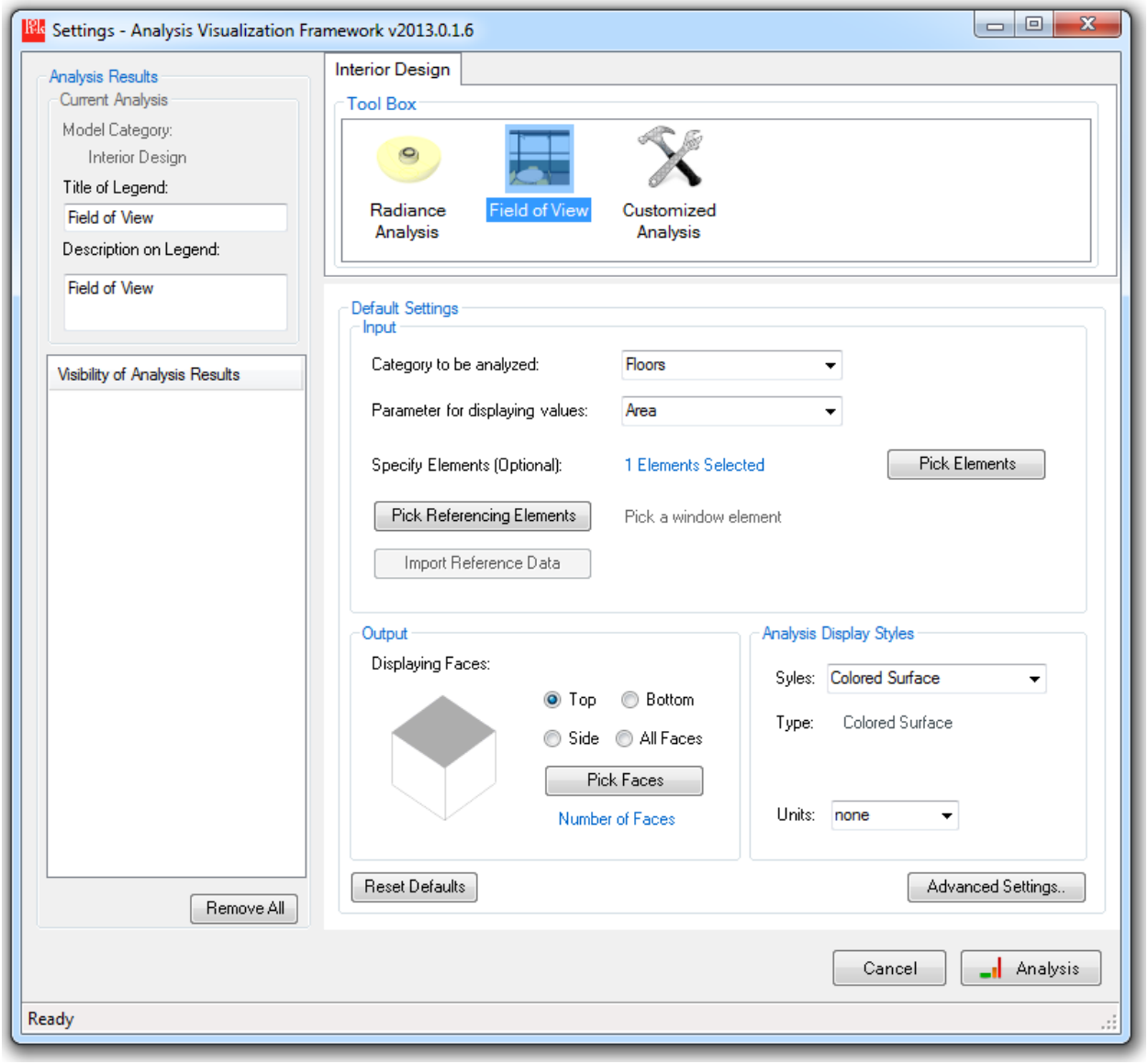
Settings	Values
Default Category	Floors
Category Options	Floors, Rooms
Default Parameter Selection	Null
Displaying Face on	Top
Allowance to Set Reference	True
Reference Category	Windows
Reference Description	Pick a window element
Default Units	none

3.2.2 Model Requirements

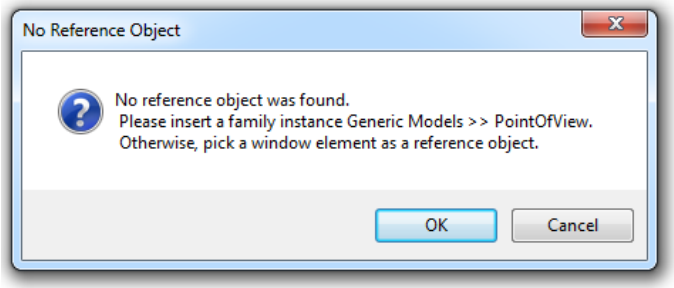
Interior rooms should be bounded by exterior or interior walls.



3.2.3 Walkthrough



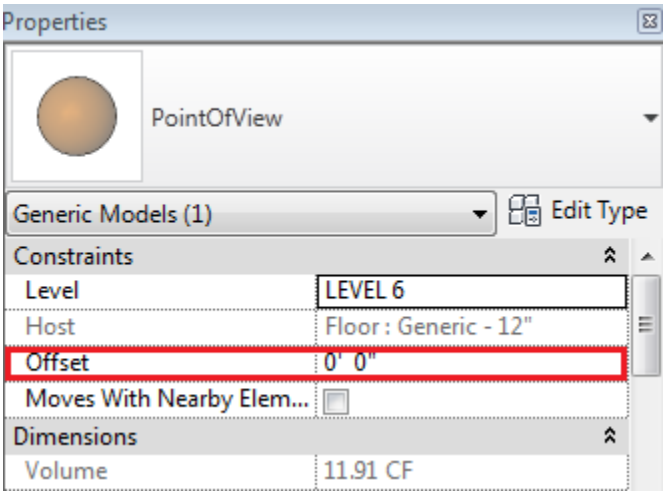
- ***Place the point of view:*** If you haven't placed a family instance to define the point of view, you will be asked to insert an instance in the model.



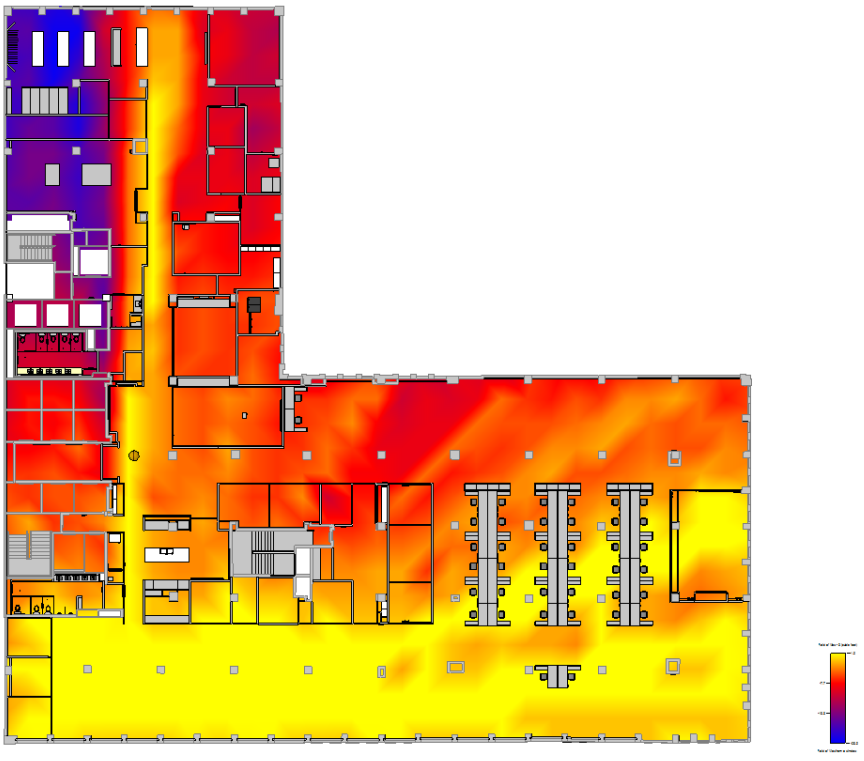
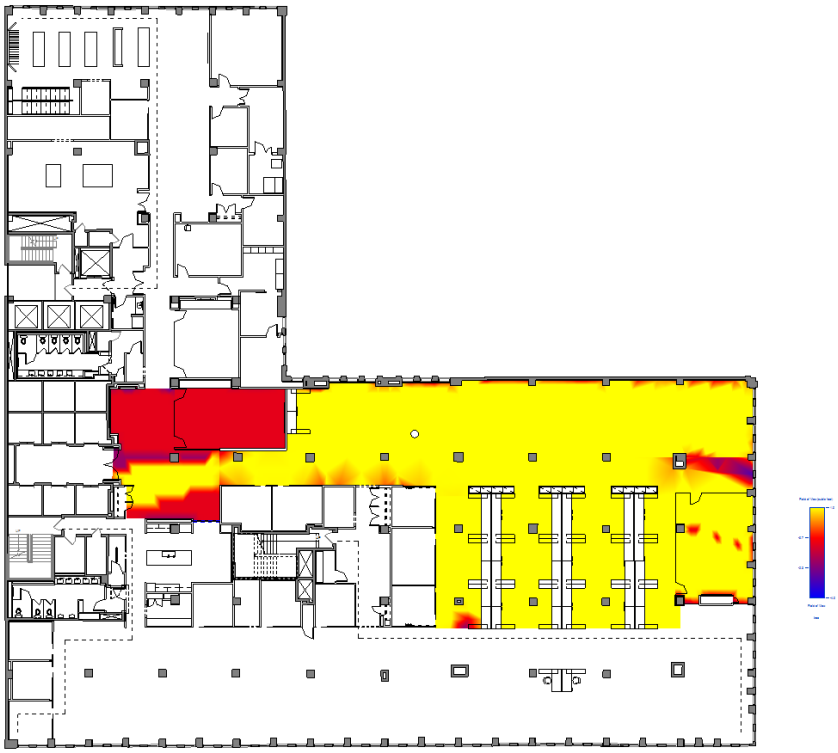
-

This tool will automatically load the family, so you will be able to find the family named PointOfView in Generic Models.

Make sure the level is same as the level of rooms. You may need to adjust the offset parameter to define the height of the view.



- ***Select a Category:*** Select one of category options between Floors and Rooms.
- ***Pick Elements:*** If you want to confine the input, select some rooms or floors depending on what you select from the category.
- ***Pick Referencing Elements:*** Pick a window element if that should be set as the point of view.

3.2.4 Analysis Result

In order to measure the depth of the visibility, it will count the number of intervening walls from the point of view to a parameterized point on the field. Only one exception will be made when the invisible line pass through transparent walls like curtain walls, then it won't be counted as an intervening wall. For the material standpoint, this mechanism should be developed further.