CityEngine Example: Redlands Redevelopment

Example Overview

Redlands, California provides a template for showcasing urban planning and design capabilities using Esri® CityEngine®. This example includes CyberCity3D buildings along with a fully redeveloped site using new 3D City Design rules.

CityEngine is able to simulate the impact of design decisions in near real time, enabling decision makers to meet or exceed project goals, whether they be sustainability metrics, regulatory compliance or cost reduction.

This example scene addresses two main processes:

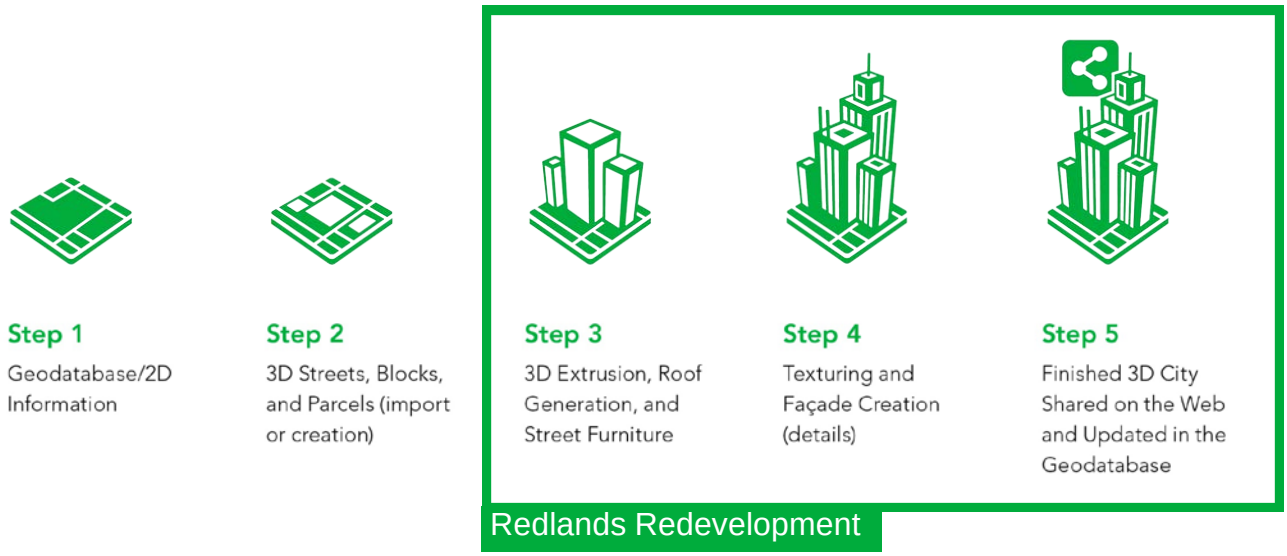
1. Modeling existing city conditions.
2. Leveraging Geodesign in 3D to create a new urban scenario supported by real-time reporting.

Objectives

The ultimate goal for the Redlands Example is to provide a set of rules that require little to no coding ability for use within other CityEngine projects. This example also demonstrates how smart, real-time reporting can support the creation of multiple redevelopment scenarios.

3D City Workflow

This example addresses steps 3 to 5 in the 3D City workflow and requires a basic understanding of CityEngine controls and capabilities.



Access and Use Constraints

Redlands, California

The specific ingredients of Urban Design projects will differ depending on the issues, participants, available data, information, knowledge, cultures, values, and geographic context.

The Redlands Example focuses on the site of an abandoned mall and proposes a scenario to redevelop the center of Redlands. Using CyberCity3D buildings and existing GIS data, the existing conditions of the downtown were quickly recreated inside CityEngine.

A number of redevelopment scenarios were created by altering the building dimensions and zoned functions within the rule Inspector.

These scenarios were then compared by taking the combined reports automatically generated during the modeling process into Excel for further analysis. The final design was chosen after comparing efficiency metrics to overall building cost and finally to the total floor area of entire site.

The final design scenario was then exported to a 3D Web Scene and is now being shared with the general public. The new commenting functionality of CityEngine Web Scenes provides an effective method for gathering additional feedback from local residents.

Compare the before and after by visiting the Web Scene here: www.arcgis.com/apps/CEWebViewer/viewer.html?3dWebScene=5269c26581a44014be86d5321bec1f82

Real-time Reporting

The Redlands Example showcases an advanced set of analytical tools in response to the growing need for measurable, performance-based design. By designing with defined performance targets in mind CityEngine enables the rapid launch of community design and implementation strategies.

Fundamental to the planning and urban design of a neighborhood, district, or city involves taking into account target eco-criteria and good building practice guidelines within the conditions for development. CityEngine's reporting window features real-time changes to estimated statistics while designing.

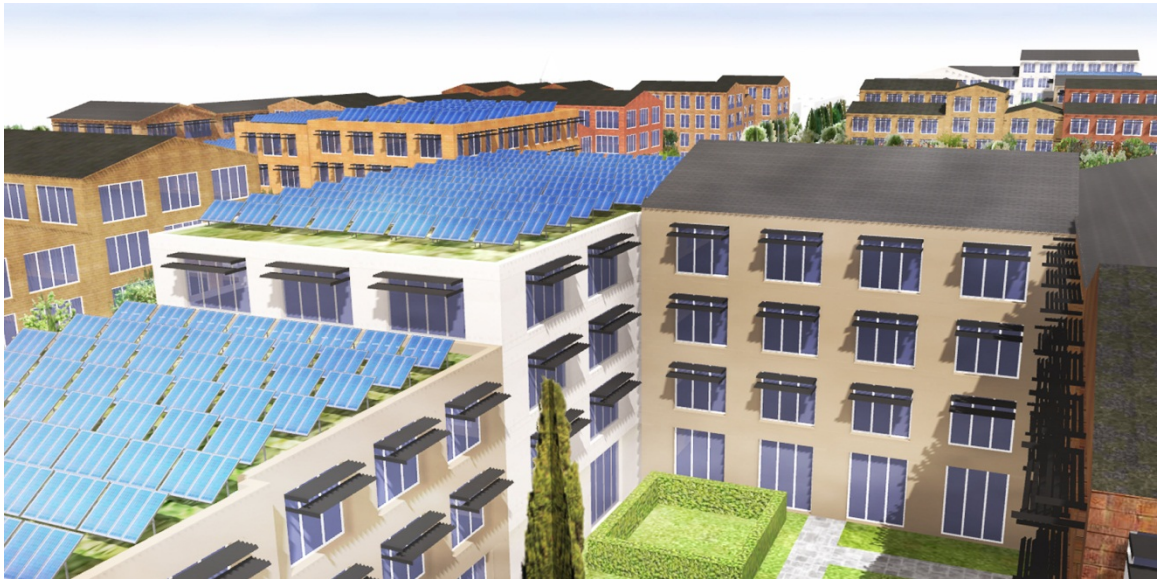
Increased building performance can be added to individual or groups of buildings in the Inspector. Custom configurations can also be saved as a style allowing for quick application i.e. LEED Silver, Gold, and Platinum standards.

Higher efficiency standards create additional costs. By harnessing the reporting power of CityEngine, upgrades to building efficiency can be represented in the overall building cost and displayed alongside savings for a better understanding of return on investment.

Monitoring performance creates a database for future development. The central task of monitoring is to study the attainment of target goals, particularly the realization of improved efficiency and environmental benefit at the lowest cost.

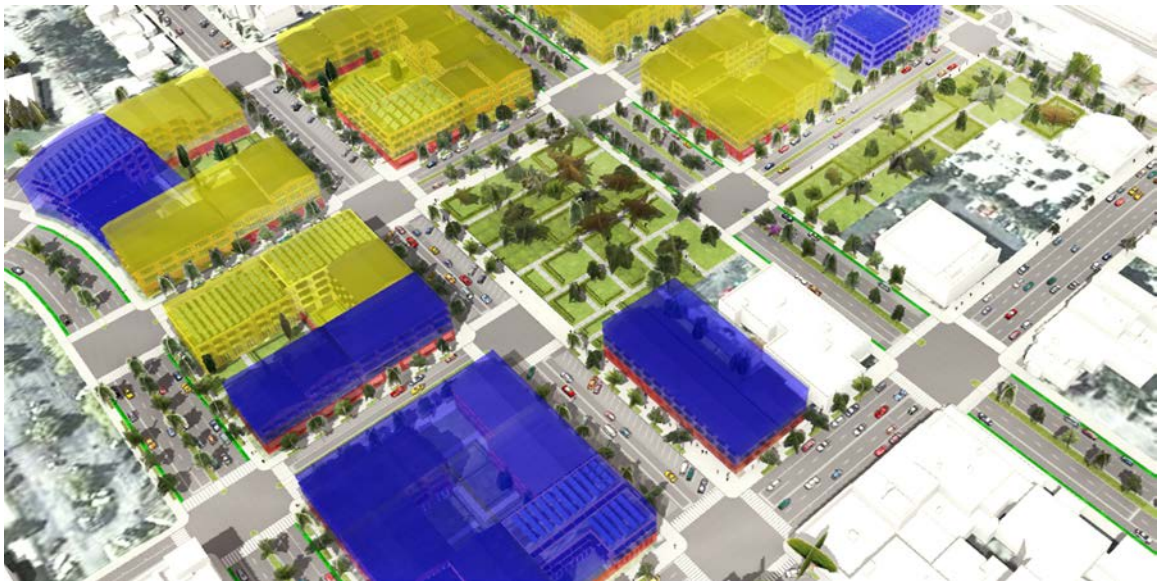
Building Construction Features

- Integrated 3D Zoning and reporting
- Thematic massing for drafting in 3D
- Additional façade features and roof styles
- Solar panels with potential electricity report
- A variety of pre-set material texture options

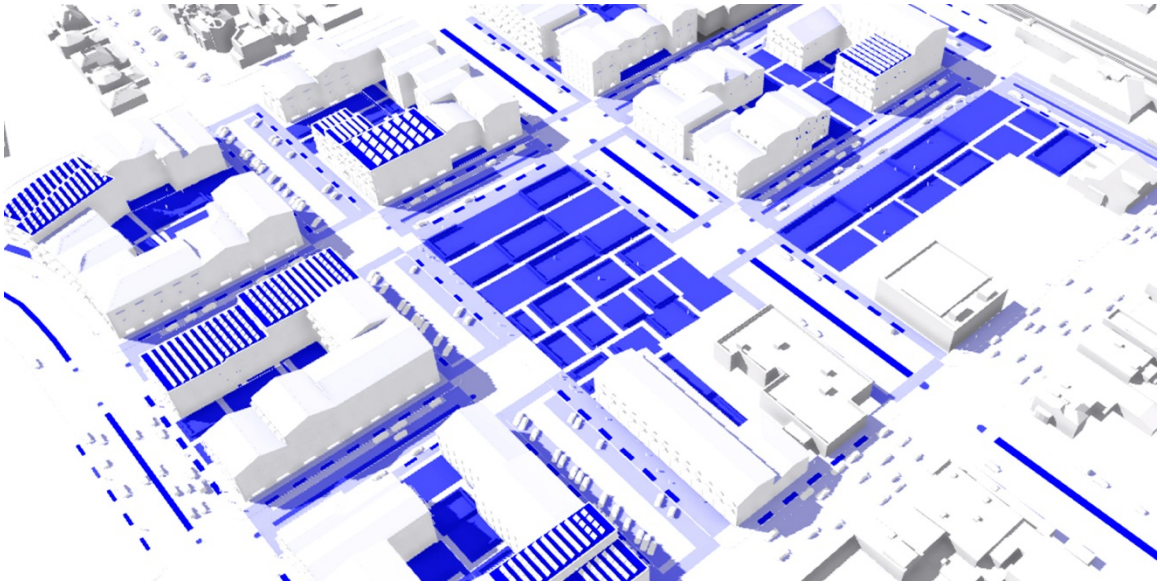


Additional facade components are available such as new roofs and awnings.

New 3D Zoning makes it simple to specify and visualize a building's functionality.



3D Zoning volumes can show the build out potential build out for a new site.



Thematic options unearth reporting variables during the modeling process.

Street Construction Features

- Improved lane controls
- Left-hand drive and right-hand drive directions
- Parking selection with angled nose in, angled back in, or parallel
- Bicycle lane options with bikers
- Thematic visualization

New street features can be combined to make the best streetscape.

Enable left-hand driving direction with a flip of a switch.

Green Space Construction Features

- Pre-set formal and informal styles
- Tree placement controls
- People placement
- Pre-set material texture options

Two alternative styles help control the look of procedurally generated parks.

The natural selection makes it easy to represent large open parks.

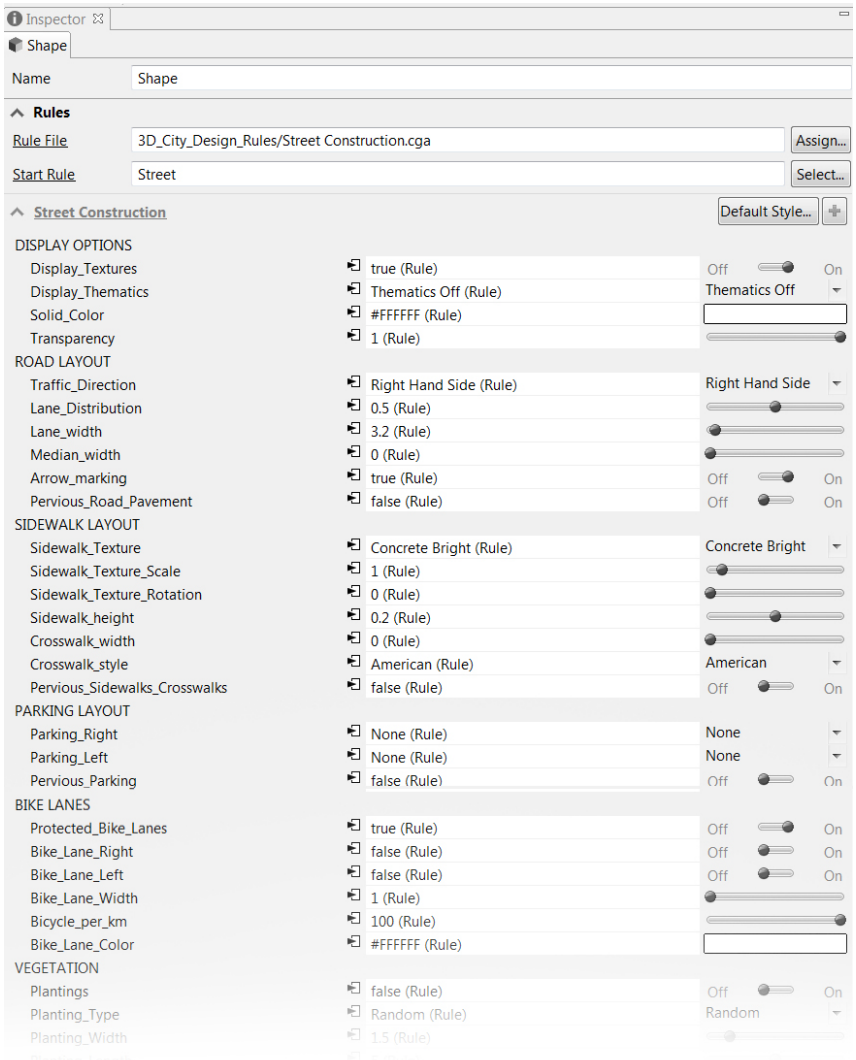
Inspector Basics

The "Inspector" is the main tool for viewing and modifying your 3D city model using various components within the inspector window. The arrangement of these elements forms the link between your design input and the model's response. The inspector interface within the different rules shares the same appearance so that you can move between them easily.

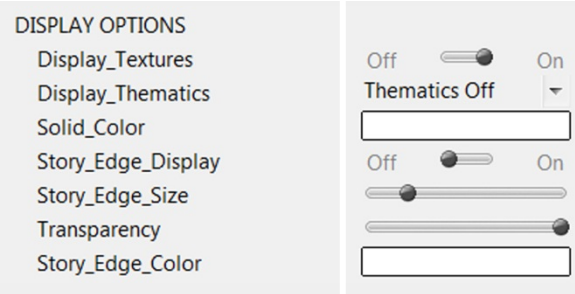
Although the default inspector layout varies in different rules, manipulating the components is much the same in all of them. The following pages will give a brief introduction to the capabilities within each rule featured in the Redlands Example.

Quick Start Guide is available in CityEngine:
Go to Help > Help Contents > Quick Start Guide

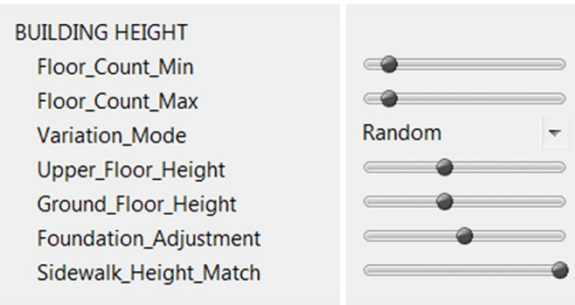
For More information please visit our CityEngine Resource Center:
http://resources.arcgis.com/en/communities/city-engine/



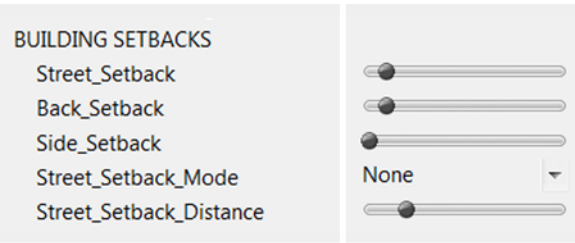
Building Construction



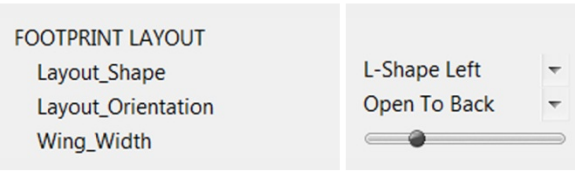
The display options of the rule can be manipulated from this centralized control group. The settings will affect the overall look of the model.



Building height settings can be adjusted to meet design criteria. Variations to the height can be set using the minimum and maximum number of floors and the unit width setting within the Footprint Partition group. The individual floor height can be controlled separately for the ground floor.

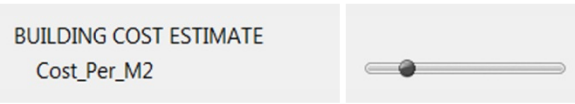


The setback controls the distance a building is positioned relative to the street. The default is determined by zoning settings within existing attributes or from customizing the zoning tab in this rule.



Control over the building's footprint layout allows for a variety of shape configurations. This can further be controlled using the Footprint Partition.

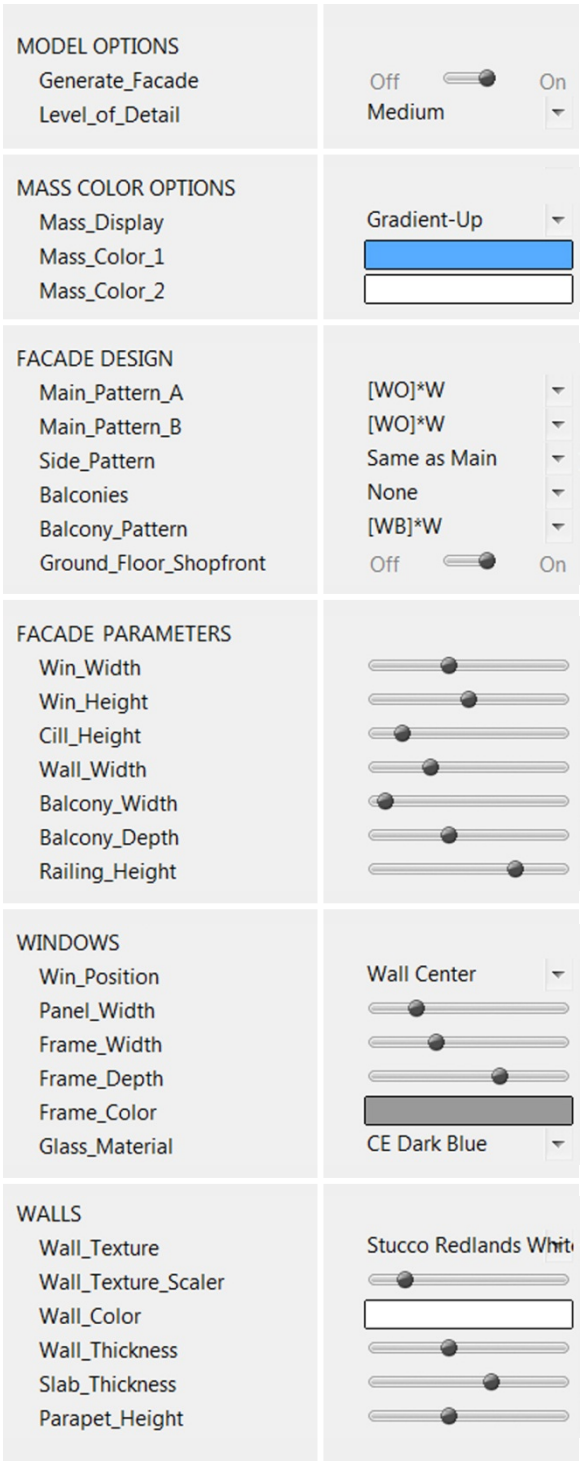
Unit width determines how the footprint is divided when using the floor variation mode and footprint offset mode.



The building cost per square meter is used in report calculations and should represent total estimated construction cost taking into account any selected eco-enhancements.

These settings are directly linked to object attributes that determine model parameters. It is best not to manipulate these through the inspector but rather in the attribute window.

Facade Construction



When designing building form it is useful to have the ability to turn off and on the facade detail and reveal a more simple massing.

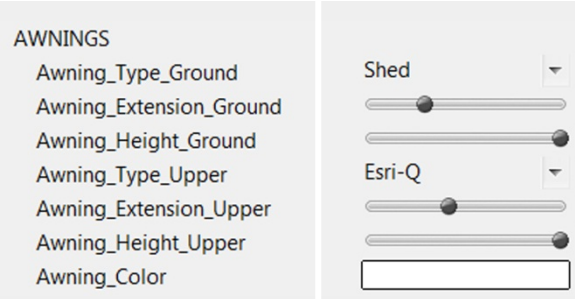
The mass color options will depict a color ramp based on two color choices.

Facade design is the first teir of configuration. A series of programmed patterns have been made to streamline model construction. Adding balconies and ground floor shopfronts will further change the look of the building.

The second tier of facade construction parameters offer more detailed control over the size and spacing of components. This will not change the overall selected pattern but rather refine the components themselves.

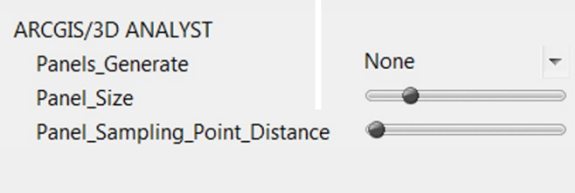
Window settings can change to suit the design. This represents the final third tier of facade construction.

Wall settings enable different material textures to be chosen within a customized dropdown menu. A color hue can be added to the selected texture to further refine the wall material texture. Be careful when applying color to a texture as it causes an increase in the file size. The height of the building parapet can be manipulated when a flat roof is specified.



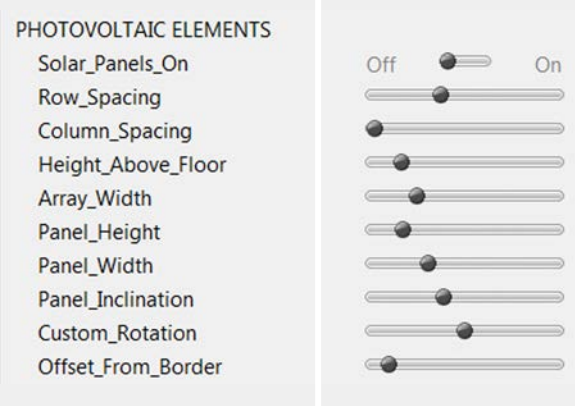
Sunny climates often call for awnings to be placed on buildings. Options for the ground floor allow awnings to be placed above shopfronts separate from the upper floors.

Programmed roof styles can be chosen from a custom dropdown menu. Material textures can then be specified for either flat or sloped roof form. The roof height, angle, and overhang can be easily changed.



CityEngine makes it easy to export models directly into ArcGIS® for advanced 3D analysis. Window pannels can be automatically generated inside of CityEngine for sightline analysis.

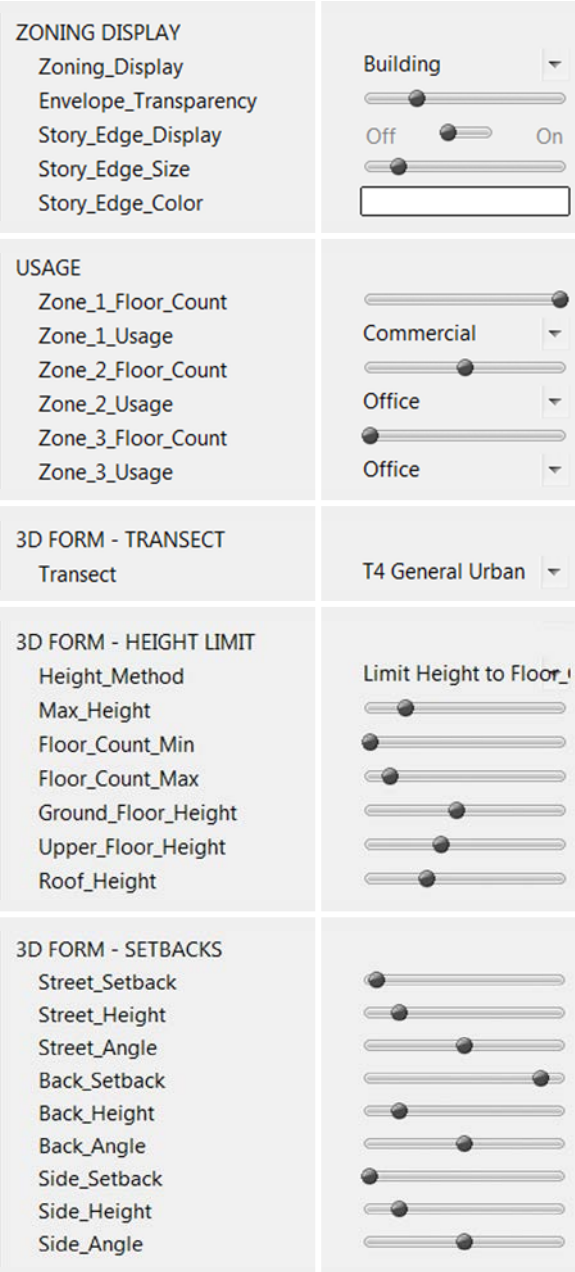
Photovoltaic Roof



Photovoltaic panels can be placed on building when a flat roof is selected within the facade controls. The size, spacing, and cost of the panels can be programmed and saved as styles.

Reporting is available for the total cost of pannel installation based upon the cost per square meter. This makes it simple to compare cost to energy output for an estimated return on investment.

Zoning



The display options of the rule can be manipulated from this centralized control group. The settings will affect the overall look of the model.

Usage parameters will enable multiple zones within a single building. When the floor count on Zone 1 is set to zero, it is assumed that the entire volume is Zone 1 usage. This multiple use zoning also contributes to the more accurate building performance in the report window.

When planning a new development it is important to adher to local code for setbacks and hieght requirements. Pre-set transect configurations based on SmartCode make it easy to build your own code profiles.

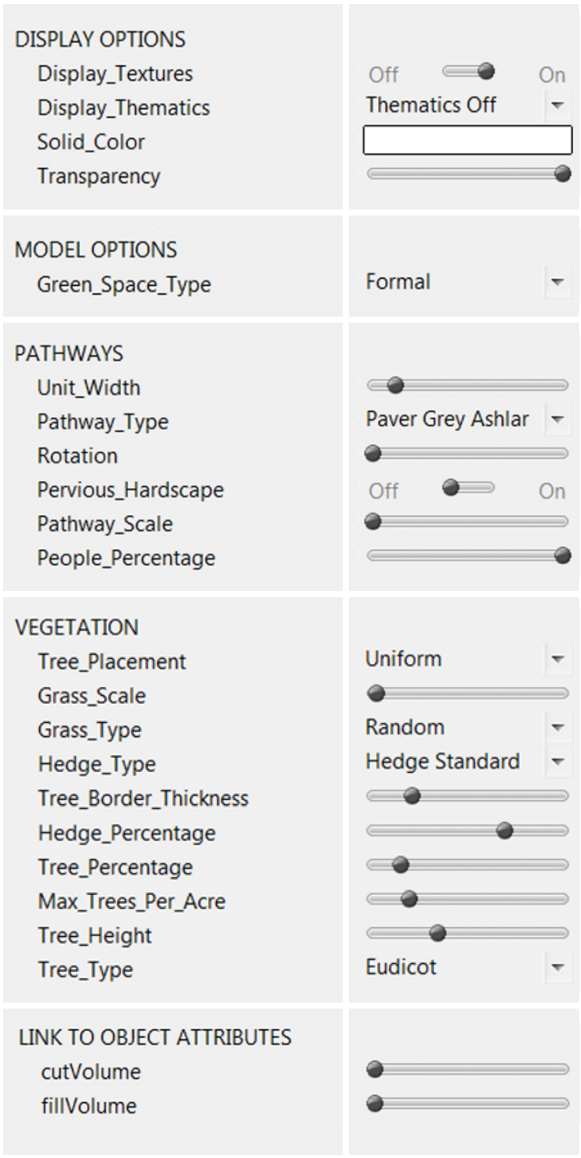
There are two ways to zone for height either by floor number or by total height. This makes it easy to link directly to existing attributes. When the height and setback selection in Building Construction is set to defult, these values are automatically translated to the maximum build out volume.

Determining the shape of the potential bulid out volume is the distict advantage of zoning in 3D. The setback controls make it easy to not only specify distance but volume height and angle.

Building Performance

Projected post-construction efficiency savings are determined as a percent reduction from the user specified baseline within the Zoning Settings. This replicates the planned technology to be incorporated into the building. Styles can be saved that reflect specific standards (i.e. LEED Certification Standards). The building cost estimate should reflect any specified increase in efficiency.

Green Space Construction



The display options of the rule can be manipulated from this centralized control group. The settings will affect the overall look of the model.

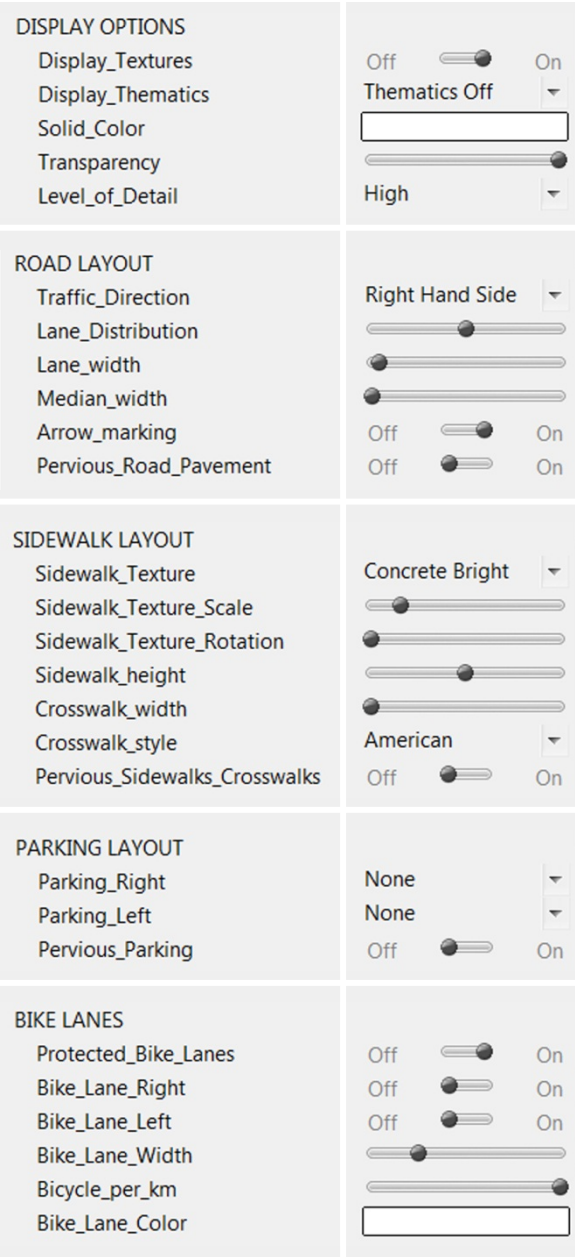
The model options provide easy access to two types of green space: Formal and Natural.

Pathway options while generic offer a variety of modifications when the Formal green space is chosen. The unit width will alter the divisions of the space significantly. People can also be easily placed throughout the model.

Vegetation options are important for any green space. Settings can be changed for the grass surface, hedges, and trees. The tree type chosen should relate to the surrounding environment. These selections link to the ‘Vegetation’ folder found within the project asset folder. The ‘Random’ setting can be customized by adding your own random mix of trees to the ‘Random’ folder.

These settings are directly linked to object attributes that determine model parameters. It is best not to manipulate these through the inspector but rather in the attribute window.

Street Construction



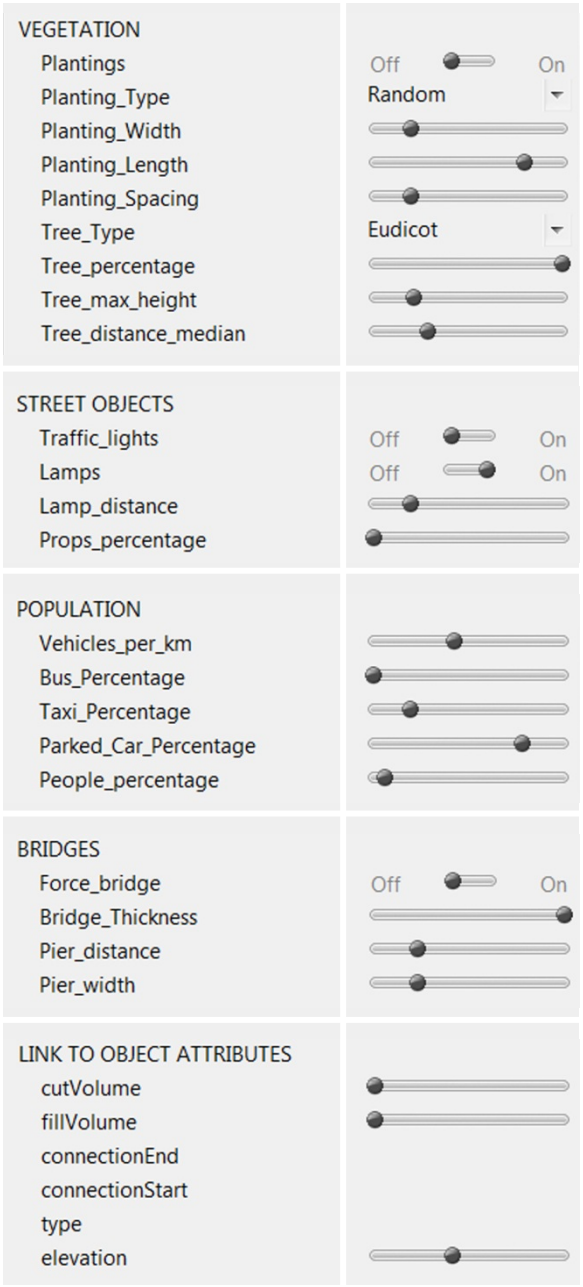
The display options of the rule can be manipulated from this centralized control group. The settings will affect the overall look of the model.

Street width is defined in the Shape Parameters. These shape dimensions provide the bounds of any layout configuration. The Road Layout settings offer direct control over the driving surface to match local existing or designed requirements.

Each sidewalk width is defined in the Shape Parameters. These shape dimensions provide the bounds of any layout configuration. Custom sidewalk material textures can be applied, scaled and rotated to meet design requirements. Control over crosswalk width and type will further enable local styling.

On street parking comes in many forms. The parking layout group will make it easier to choose your style depending on the street space available.

Bike lanes settings come with custom color options, width and two configuration alternatives with the parking layout.



The vegetation settings will add planting areas and trees to both the sidewalks and median when turned on. Spacing and size options are provided for the planting areas in addition to the height and quantity of trees. Control over the tree type is given to extend realism. These selections link to the ‘Vegetation’ folder found within the project asset folder. The ‘Random’ setting can be customized by adding a random mix of trees to the ‘Random’ folder.

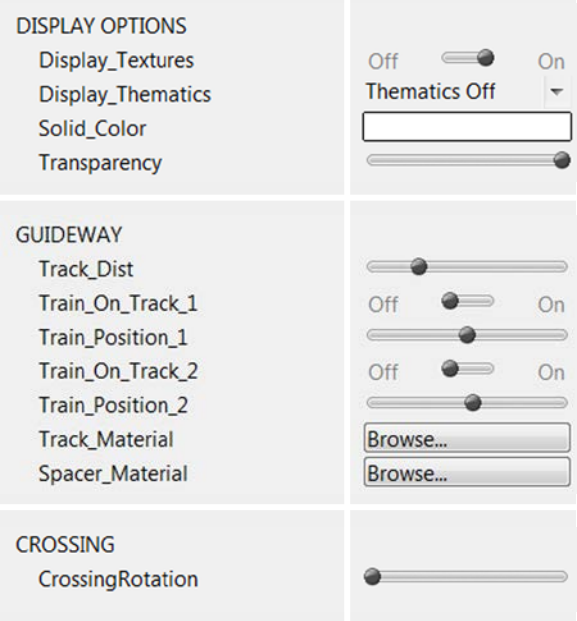
Every street has its supporting objects. The street object group manages these optional assets.

When a street is modeled the population group will place realistic assets throughout it.

Bridges are automatically constructed when the street elevation is above ground level. The bridge settings give additional control over this adaptive feature.

These settings are directly linked to object attributes that determine model parameters. It is best not to manipulate these through the inspector window.

Rail Guideway



The display options of the rule can be manipulated from this centralized control group. The settings will affect the overall look of the model.

Guideway width can be defined in the Shape Parameters. These shape dimensions provide the bounds of any layout configuration. The guideway settings will customize the distance between the tracks, material textures, and train position.

This rule can be assigned to street intersections for a continuous rail guideway.

Points to Trees

By assigning this rule to existing tree points, automatic tree models will be placed according to a common name attribute. Pre-set folders offer specific types to be placed at random.

Reports

Building Construction:

Report	N	Sum
Building Performance, Energy, Electrical Consumption (kWh/yr)	5	1366886.96
Building Performance, Energy, Heating Consumption (kWh/yr)	5	1082118.87
Building Performance, Waste, Domestic (kg/yr)	5	210728.41
Building Performance, Water, Consumption (l/yr)	5	17086087....
Building Performance, Water, Produced Blackwater (l/yr)	5	7859600.21
Building Performance, Water, Produced Greywater (l/yr)	5	9226487.07
Building Performance, Water, Recycled Greywater (l/yr)	5	0.00
Building, Footprint Area (m2)	1	569.54
Building, Gross Floor Area (m2)	5	2847.68
Construction, Building Cost	5	5695362.43
Construction, Cut/Fill, Cost	3	0.00
Construction, Cut/Fill, Cut Volume (m3)	3	0.00
Construction, Cut/Fill, Fill Volume (m3)	3	0.00
Construction, Grass Area (m2)	1	2.59
Construction, Grass Cost	1	25.95
Construction, Hardscape Area (m2)	3	103.67
Construction, Hardscape Cost	3	2591.80
Construction, Waste (kg)	5	42715.22
Parcel, Area (m2)	1	675.92
Parcel, Coverage (%)	1	84.26
Parcel, Floor Area Ratio (Density)	5	4.21
Parcel, Green Space Area (m2)	2	106.27
Site Conditions, Slope (%)	1	0.01
Site Conditions, Stormwater Runoff (m3/hr)	11	60450.05

Greenspace Construction:

Report	N	Sum
Construction, Cut/Fill, Cost	1	0.00
Construction, Cut/Fill, Cut Volume (m3)	1	0.00
Construction, Cut/Fill, Fill Volume (m3)	1	0.00
Construction, Grass Area (m2)	5	502.55
Construction, Grass Cost	5	5025.54
Construction, Hardscape Area (m2)	7	168.27
Construction, Hardscape Cost	7	4206.76
Construction, Tree Cost	2	400.00
Site Conditions, Slope (%)	1	0.01
Site Conditions, Stormwater Runoff (m3/hr)	12	4959.03

Street Construction:

Report	N	Sum
Construction, Cut/Fill, Cost ($)	1	4570.14
Construction, Cut/Fill, Cut Volume (m3)	1	272.79
Construction, Cut/Fill, Fill Volume (m3)	1	320.62
Site Conditions, Slope (%)	1	0.00
Site Conditions, Stormwater Runoff (m3/hr)	137	27137.78
Street, Lanes Area, Impervious	13	819.52
Street, Lanes Area, Pervious	1	0.00
Street, Lanes Area, Total	13	819.52
Street, Parking Area, Impervious	1	0.00
Street, Parking Area, Pervious	33	519.99
Street, Parking Area, Total	33	519.99
Street, Parking Spot Count	32	32.00
Street, Plantings Area (m2)	19	183.13
Street, Sidewalk Area, Impervious	94	213.44
Street, Sidewalk Area, Pervious	1	0.00
Street, Sidewalk Area, Total	94	213.44

Building Performance

Projected building performance is measured using the user provided baseline within the Zoning Settings. This provides default usage by function which is then multiplied by the total floor area. ‘N’ gives the number of floors used in the calculation. The eco-criteria if modified will further reduce the report value of that building based upon a percent reduction from baseline.

Construction

Default estimates are set up in the Environment Settings and should be replaced by values relative to the project location. The default building cost estimate can be set directly in the Building Construction inspector. Cut/Fill calculations are made automatically when the appropriate box is selected within the Align Terrain to Shapes window. This value can be further modified in the Object Attributes.

Parcel

Area measurements are displayed for the parcel along with hard and soft surfaces. The Floor Area Ratio is the total covered area on all floors of all buildings on a certain parcel divided by the area of the parcel.

Site Conditions

Site conditions will summarize the environment and is particularly useful when multiple model components are selected (i.e. several buildings and streets).The ‘N’ variable within Stormwater Runoff represents the total number of surfaces each with a distinct coefficient used in the calculation.

Street

Street reporting summarizes four general areas in the selected model: sidewalks, parking, plantings, and lanes. This makes it easy to compare pervious to impervious surface area while determining a street’s parking capacity.

When Selecting Multiple Objects
Reports that have identical names will be combined automatically when multiple objects are selected.