

# Complete Streets in CityEngine

## Tutorial Overview

This tutorial applies the Complete Street ruleset in CityEngine. In this, you will generate two different street types while exploring the ruleset, its parameters, and the various ways that roads can be created and modified in CityEngine.

### Skills

By completing this tutorial, you will become comfortable with the following CityEngine skills:

- Freehand street creation
- Application of the Complete Street ruleset in CityEngine
- Road visualization options and reportings outputs

### Time Required

The following time is required to complete this tutorial:

- 45 minutes

## Part 1: Downloading and Installing Rules and Projects

The Complete Street ruleset was created to help visualize street and sidewalk designs and to generate reporting metrics associated with those designs. When implemented properly into a scene, this ruleset turns CityEngine into a powerful tool for road and sidewalk creation that can generate design scenarios that follow guidelines set out by the U.S. Department of Transportation's Manual on Uniform Traffic Control Devices, the American Association of State Highway and Transportation Officials, and the National Association of City Transportation Officials (*while the tool follows U.S.-based design guidelines, they can be easily overwritten or customized in the ruleset if needed for planning rules in other locations*).

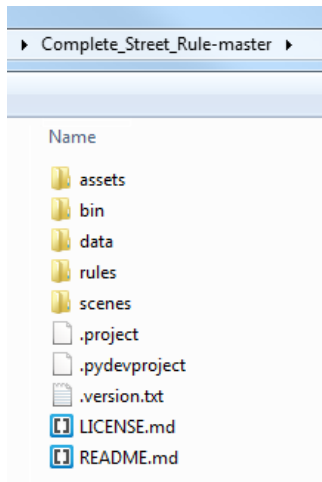
### Downloading the Complete Street Ruleset

Before starting CityEngine, you first need to download the Complete Street Ruleset. This can be downloaded here: <http://bit.ly/CompleteStreetsEsri> (note that is a direct download link to a file that is approximately 80mb in size)

You may also want to download the Complete Street documentation available here: <http://arcg.is/2n6XHic> and read about new updates and tips relating to this rule package here: <http://arcg.is/2mXOnPd>.

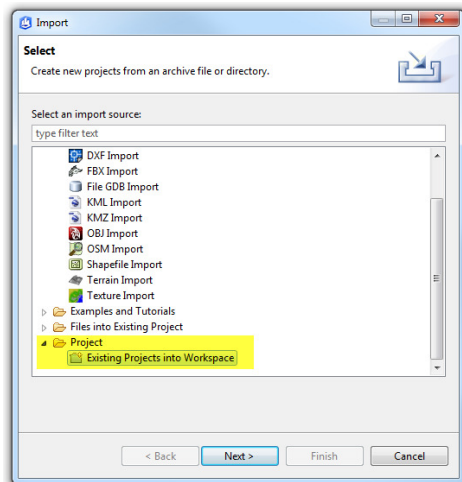
Once you have downloaded the file, unzip the folder. You should see a folder with a file structure that looks similar to other CityEngine projects.

You will now import this ruleset and project into CityEngine.

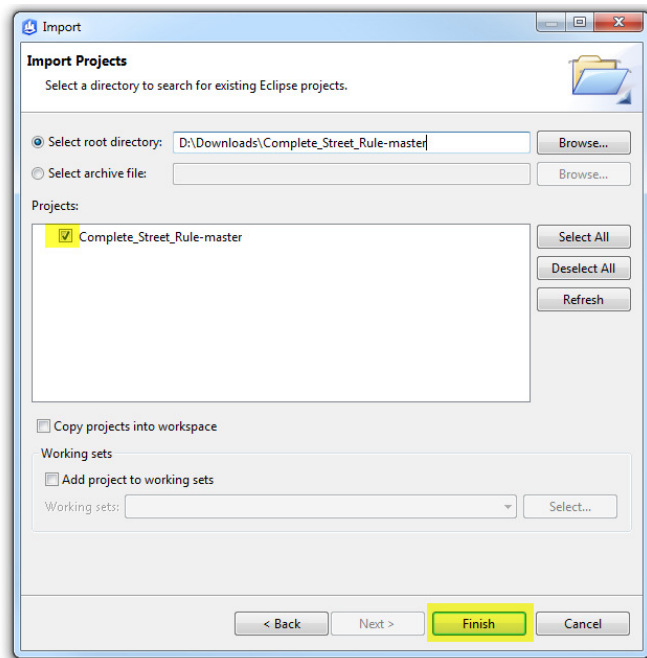


## Installing the Complete Street Ruleset

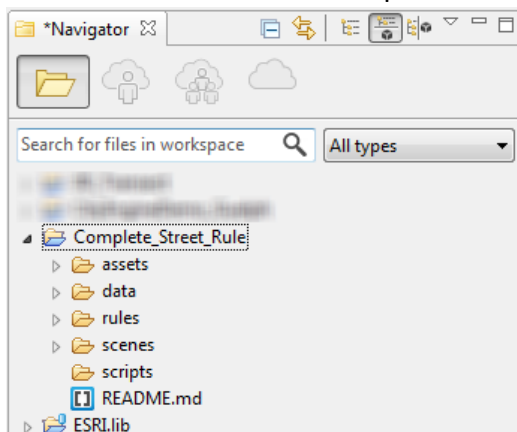
1. Open up CityEngine
2. Click **File > Import >** and select **“Existing Projects into Workspace”**



3. Select the **Browse...** button and select the folder that you unzipped containing the Complete Street rules and project. Ensure that the project is detected and has a checkmark next to its name. Then click Finish.



4. You should now see the Complete Street project folder appearing in your navigator window.



## Part 2: Creating a Multi-Lane Roadway

For this part of the lesson we will be recreating a scene similar to this busy road as seen here:

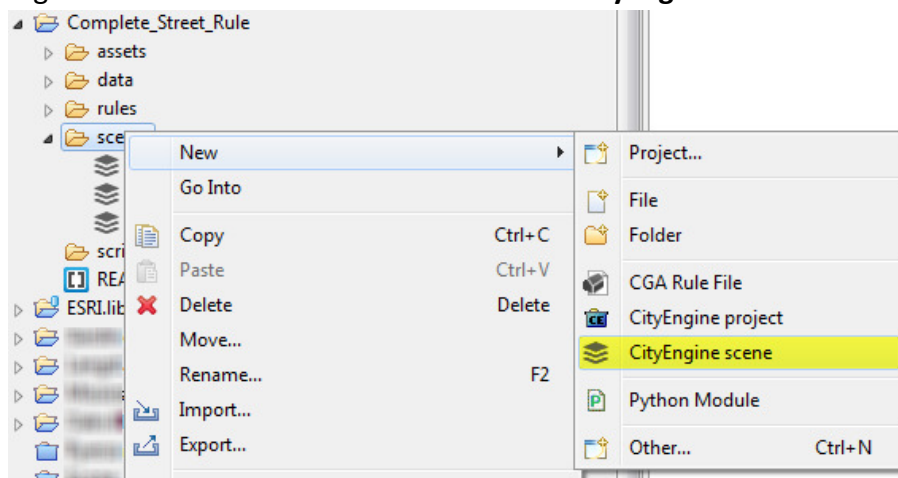


You will notice that there are quite a few components of this road scene:

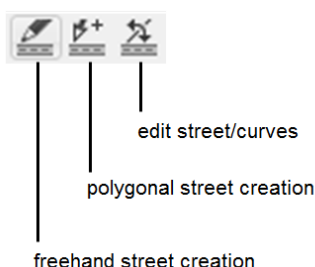
- Five lanes each of inbound and outbound traffic
- White traffic lines
- A median with low-level vegetation
- A high amount of traffic congestion, mainly comprised of cars, but with a few buses.
- A very small sidewalk.

## Drawing a curved road segment

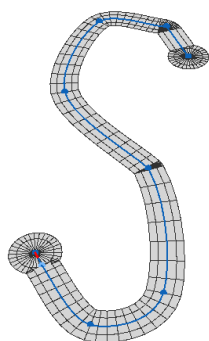
1. Expand Complete Street Rule project folder, and the Scene folder within the project.
2. Right-click the scene folder and select **New CityEngine scene**



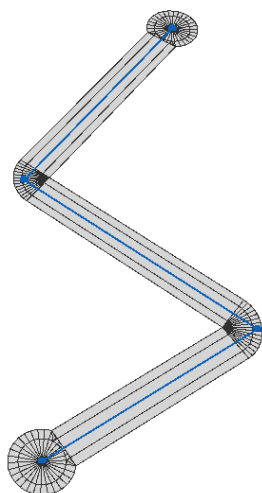
3. Give your scene a name such as HighTrafficRoad.cej and click Finish. *(make sure to leave the .cej extension after your scene name, or else CityEngine will not recognize your file as a newly created scene)*
4. The **road creation tools** located at the top of the screen allow you to draw various types of lines. Try using the **freehand street creation tool** to draw an S-shaped road.



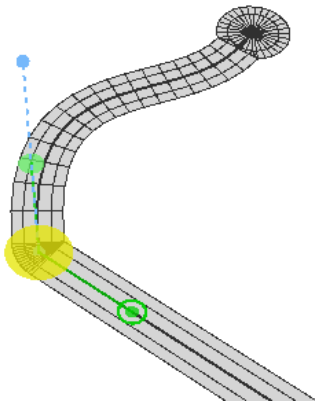
You will notice that while freehand provides you with full drawing flexibility, it is hard to keep your lines clean.



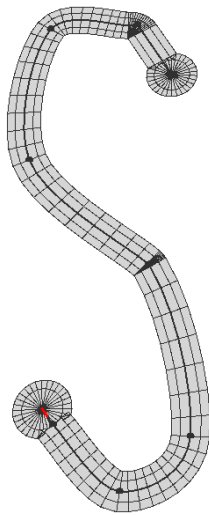
Instead, you can create a curved road using the **polygonal street creation tool**. Click to create four points, and to make an s-shape with sharp vertices.



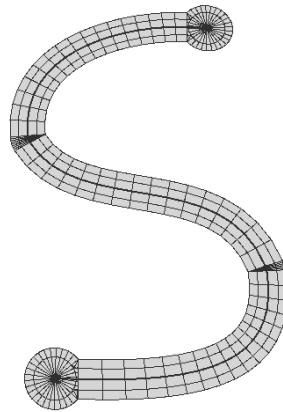
Now, using the **edit street/curve tool**, click on each vertex and drag the green handle to curve your street.



You will notice that the edit street/curve tool provides you with much greater control by editing and creating Bezier, or parametric curves. By adjusting the angles of each curve, you are able to create a much more accurate S-shaped road.




Freehand S-shaped road

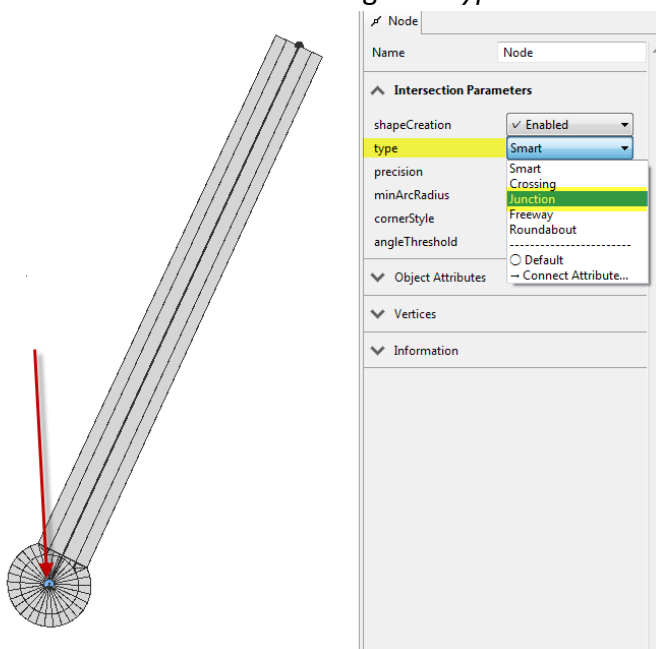


Polygonal road creation with curve edits

### Drawing a straight road segment

For this scenario, you don't need a curved road segment, so you will use the **polygonal street creation tool** to create a simple straight line.

1. Click to draw a start and end point for your road segment. Once you have completed your road segment, double click your mouse, or press enter or esc on the keyboard to complete the line.
2. You will notice that your roads are rounded at the end. You can fix this by using the Selection Tool  and clicking on the node point/vertex. Notice that the **Inspector Window** has updated to show Intersection Parameters. Change the *type* value from Smart to Junction for each node point.



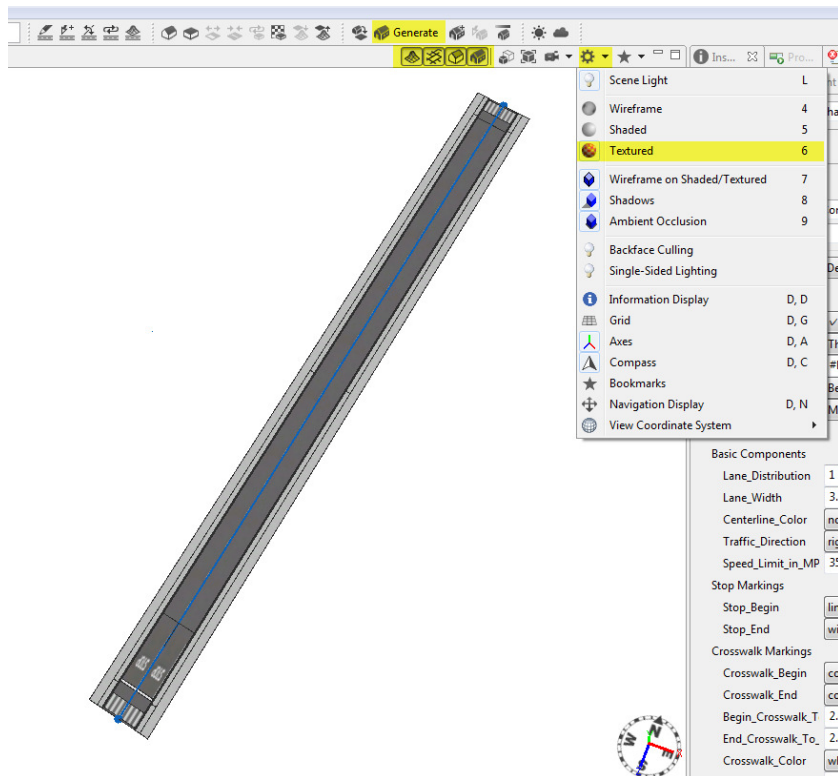
### Applying and Configuring the Complete Streets Rule

1. Select your road segment by using the **Selection tool** to drag a box around your shape.
2. Right-click on your selected road and choose **Assign Rule File...**
3. Select Complete\_Street.cga and click Open. If you do not see the rule file, then ensure that you have the correct project and rule folders open on the left-hand side of the dialog window.
4. Your road should now automatically show a default street and sidewalk visualization. If you do not see a road pattern as shown below, click and select the entire road again with the selection tool, and try clicking the **Generate button**.

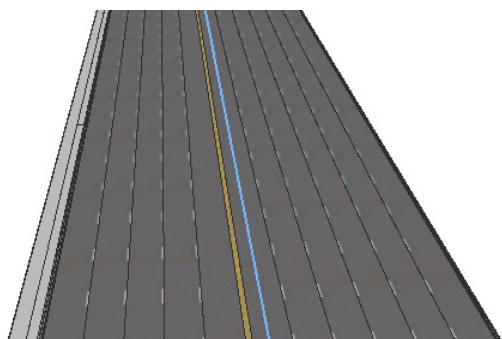
You will know that your rule has been applied to the road by visual inspection, as well as a change in the inspector window on the right to show Complete\_Street.cga in the rule file under the Shapes tab.



*Note: If you are still unable to see your generated road, then ensure that the following options are enabled on your viewport: Maps, Graph Networks, Shapes and Models (the four buttons below the generate button). You can also click on the View Settings button (the gear icon), and enable textured in your view. If all else fails, select your road and press the “F” key on your keyboard to frame the road into view, and then zoom into your road until you can see road and sidewalk detail.*



- Now it is time to change the road settings to match your case study image. First, you want to make the road and sidewalk geometries correct in width. Click on the road center line and you should see **Street Parameters** in the **Inspector Window**. Assume that street lane width is 2.5 metres. Since you have 10 lanes in total and a median (assume the median is 2.5m as well), then you can set the street width to 27.5 metres. You can also give a 2 metre left sidewalk width value and a 0.2 metre right sidewalk to create a curb.



Street Parameters	
shapeCreation	✓ Enabled
streetWidth	27.5
streetOffset	0
sidewalkWidthLeft	2
sidewalkWidthRight	0.2
precision	0.5
laneWidth	2.5
Object Attributes	
Vertices	

- Now, click on the road paving asphalt to change the inspector window values to show **Complete Street Parameters**. You will notice that there are many options to choose from to change your road to suit your needs. While you can test out many of these settings, you may notice that some changes that you make are not visually adjusted in your viewport. This is either because the changed parameter has adjusted a numeric output that doesn't require an updated visual representation, or because the value that you have adjusted had exceeded the allowable parameters for the setting that you are changing. This can cause the rule to "break". You can easily correct this by clicking on the dropdown arrow next to the parameter and selecting "Rule Default".

7. With the road surface still selected, change the following parameters:

#### ROAD LAYOUT

Basic Components

Lane\_Width: **2.5**

#### CENTER SECTION LAYOUT

Basic Attributes

Center\_Type: **Median**

Center\_Width: **2.5**

Median Plantings

Median\_Ground\_Cover: **Grass Thick**

Median\_Planting\_Length: **3**

Median\_Tree\_1\_Type: **Random**

Basic Components

Median\_Street\_Lamps: **None**

#### POPULATION


Vehicles\_Per\_KM: **50** *(try increasing this range to 100 or even 200, but it will likely slow down your computer while loading)*

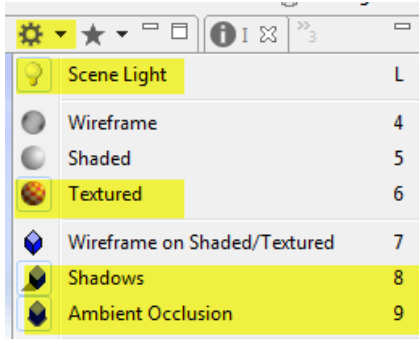
Mixed\_Traffic\_Bus\_Percentage: **0.1**

#### TREE *(this is right at the bottom of the rule set. Click the arrow to expand the rule)*

Name: **Huckleberry Shrub**

Height: **2**

8. Now click on the **View Settings** (the gear icon)  and ensure that **Scene Light**, **Textured**, **Shadows**, and **Ambient Occlusion** are turned on. Also turn off **Wireframe on Shaded/Textured**.

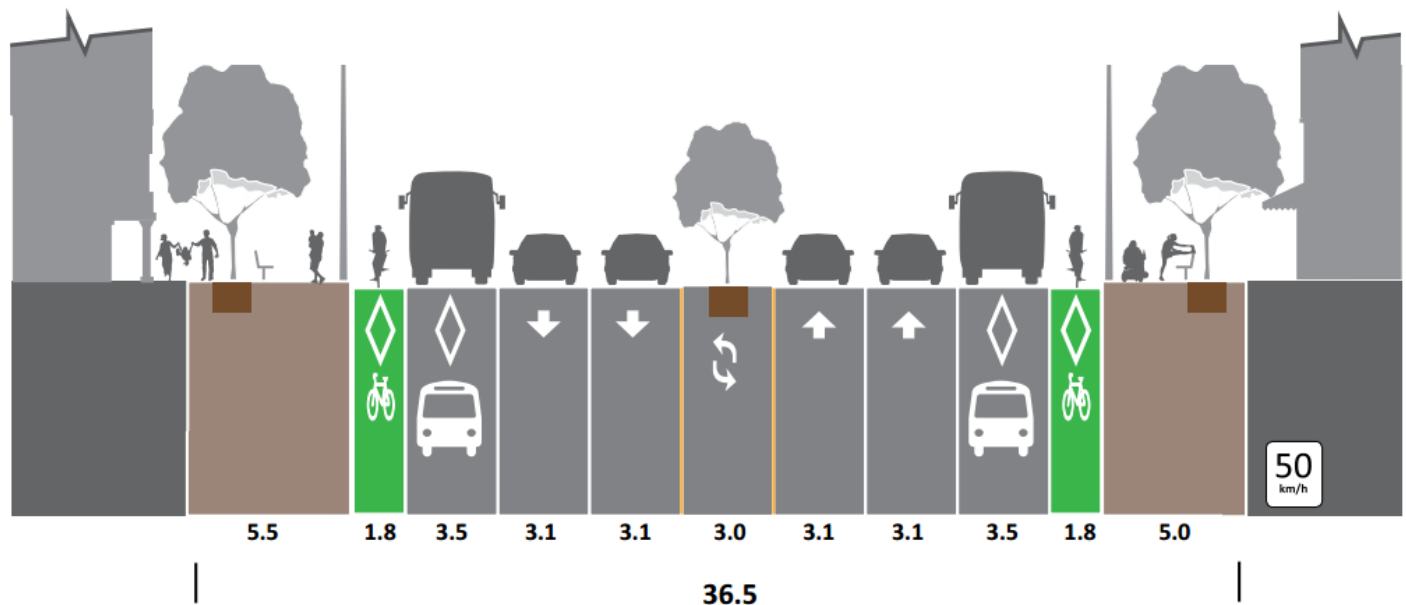


9. You have now completed the first scenario! Your final visualization should look similar to the street shown below:



## Part 3: Creating a Complete Street Roadway

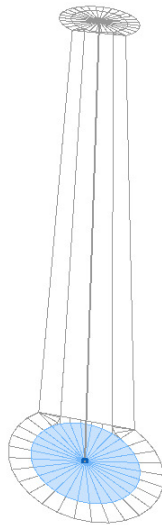
For this part of the lesson you will be creating a complete street scenario based off of the following street section diagram:



Source: Complete Street Section. Digital image. Complete Streets by Design. Toronto Centre for Active Transportation, 2012. <http://www.tcat.ca>.

### Drawing a straight road segment

1. Like before, we will create a road segment using the **Polygonal Street Creation** tool.
2. In order to compare this new road relative to the previous one, draw the road segment next to the previously completely road.
3. Once again, you will select the end points of the road and change their **Intersection type to Junction**, so that the end points are squared off.



Name	Shape
<b>Shape Parameters</b>	
Intersection Parameters	
shapeCreation	Enabled
type	Smart
precision	0.5
minArcRadius	3
cornerStyle	Arcs
angleThreshold	35
<b>Rules</b>	
Rule File	
Start Rule	Roundabout
<b>Reports</b>	
<b>Object Attributes</b>	
<b>Vertices</b>	
<b>Information</b>	

- Since the road dimensions are provided this time, you will change the **Shape Parameters** to the following values:  
 streetWidth: **25** (we don't include the sidewalk values, as those are entered in the sidewalk parameters)  
 sidewalkWidthLeft: **5.5**  
 sidewalkWidthRight: **5**

*Note: Street orientation is based off of the direction that the street is drawn. If you notice that your left sidewalk is actually on the right of the road, you can redraw the road line in the opposite direction so that the sidewalk orientation corrects itself.*

### Applying and configuring the Complete Streets Rule

- Select your road with the **selection tool**, and right click on it to assign the Complete\_Street.cga rule file.
- Your rule should apply and generate a road texture automatically. If this does not happen, click the **Generate button** or press Ctrl G, (Command G on Mac OS X).

3. Select the road surface (asphalt) and notice that the **inspector window** has updated to display complete street parameters. Let's change the following parameters:

ROAD LAYOUT

Basic Components

Lane\_Width: **3.1**CENTER SECTION LAYOUT

Basic Attributes

Center\_Type: **Median**Center\_Width: **2**WalkWay\_Width: **0.5**Planting\_and\_Walkway\_Layout: **Walk:Plant:Walk**

Median Plantings

Median\_Ground\_Cover: **Light Rye**Median\_Planting\_Length: **15**

Basic Components

Median\_Street\_Lamps: **None**MULTIMODAL LANES LAYOUT

Bus and HOV Lanes

Transit\_Lane: **Bus Lane**Transit\_Lane\_Width: **3.5**Bus\_Lane\_Color: **black**

Bike Lanes

Left\_Bike\_Lane\_Width: **1.8**Right\_Bike\_Lane\_Width: **1.8**Bike\_Lane\_Type: **Sharrow**POPULATIONVehicles\_Per\_KM: **40**Mixed\_Traffic\_Bus\_Percentage: **0**Bus\_Lane\_Buses\_Per\_KM: **30**Bicycles\_Per\_KM: **60**

4. Now that you have the road completed, you want to work on the sidewalk features. Click on the left sidewalk paving. You will see the same parameters as the road rule, however you will not be able to change any road settings. You can only change the settings for the selected sidewalk since CityEngine views the road and adjacent sidewalks as separate objects.

5. Change the following parameters to make the sidewalk more pedestrian friendly:

#### SIDEWALK LAYOUT

##### Sidewalk Attributes

Sidewalk\_Texture: **Brick Varied Brown Running Bond.jpg**

(click Browse... and choose a texture from

/Workspace/Complete\_Street\_Rules/assets/Complete\_Streets/Sidewalks)

Sidewalk\_Texture\_Scale: **1**

Sidewalk\_Texture\_Rotation: **90**

Sidewalk\_Height: **0.3**

##### Sidewalk Plantings

Sidewalk\_Ground\_Cover: **St Augustine 2**

Sidewalk\_Planted\_Width: **1.5**

Sidewalk\_Planting\_Spacing: **10**

Sidewalk\_Tree\_1\_Type: **Black Locust**

##### Sidewalk Components

Sidewalk\_Benches: **Both**

#### POPULATION

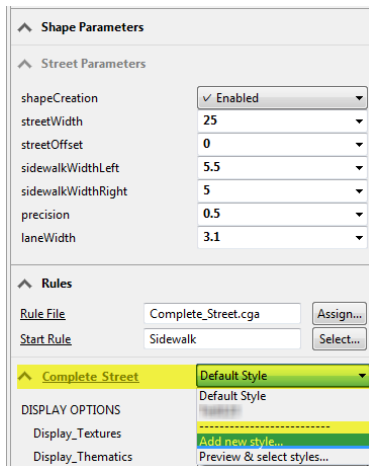
People\_Percentage: **1**

6. Now that you have completed the left sidewalk, you want to replicate the sidewalk on the right-hand side. To do this, you can either manually enter the parameters again as you did in step 5, or you can create a style by following the next steps.

#### Create a Rule Style

1. With your completed sidewalk still selected, scroll up to the top of the inspector window and click on the **Default Style** dropdown. Click **Add new style...**

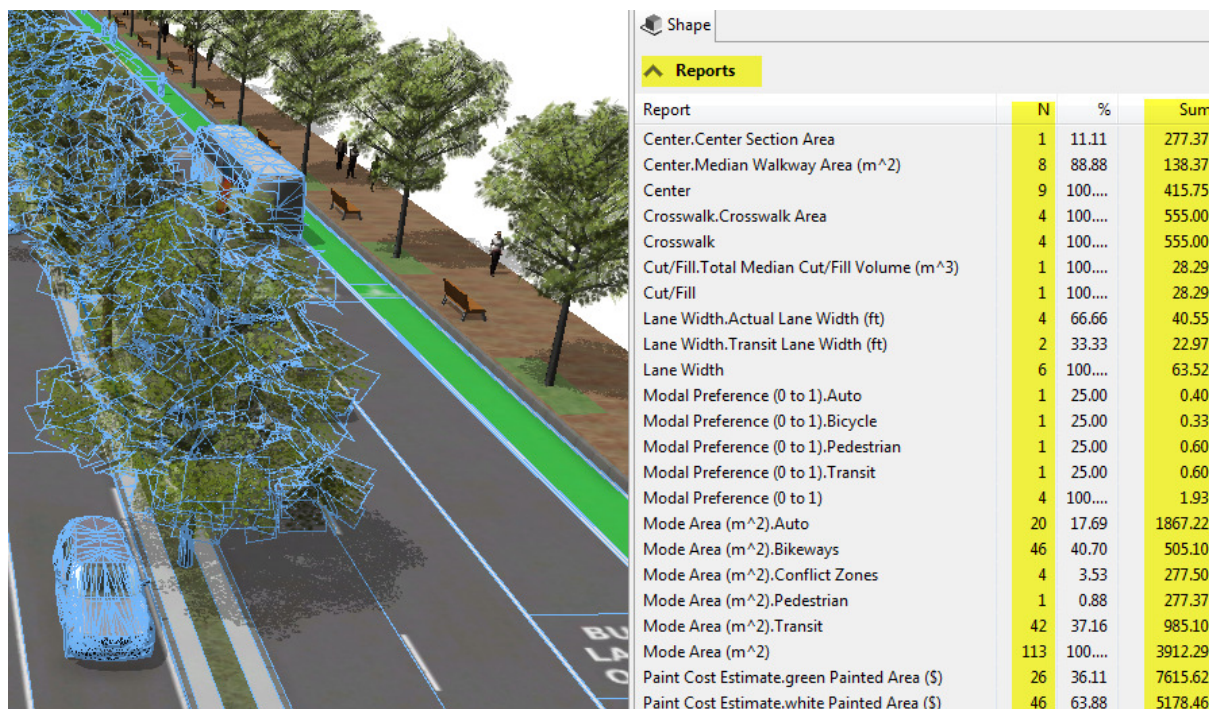




2. Give your style a name and description. For example, you can call it SidewalkStyle\_Red\_Brick. Click OK.
3. Now select the other sidewalk. This time, scroll down to the Default Style dropdown and select the newly named style that you created. You should now have an exact copy of the sidewalk applied to both sides of the road.

## Visualizing Metrics

1. Click on your road surface again.
2. In the **Inspector Window**, scroll all the way down to the bottom and expand the section called **Reports**
3. Notice all of the metric outputs that were automatically generated while you were creating your street scene. CityEngine provides you with useful reporting metrics based off of the calculations embedded in the Complete Street ruleset.



- In the report output, the N column represents the number of objects that have been counted in the calculation. This is generally useful when you are trying to count the number of vehicles or items in a scene. The sum column is useful for providing totaled values. For example, in the above image you can see that painting the bike lanes green will cost \$7,615, and the land volume required to be cut from the ground to make room for the road and tree plantings is approximately 28m<sup>3</sup>.

*Note: If you want to change the reporting outputs, or understand more about each reported variable, you may do so by editing the Complete Street Ruleset. To do this, refer to the Complete Street Documentation available here: <http://arcg.is/2n6XHic>*

You have now completed your complete street designs. Your final visualizations should look similar to this:



You now have the ability to export your models to other 3D formats or even publish your model through an interactive web scene in ArcGIS Online through **File > Export Models**. You can also export a static image of your scene by selecting the dropdown arrow next to the **Bookmarks Tool** (the star image at the top-right of the screen), and selecting **Save Snapshot**.

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