

OpenStudio 1.5.0 Basic Workflow Guide

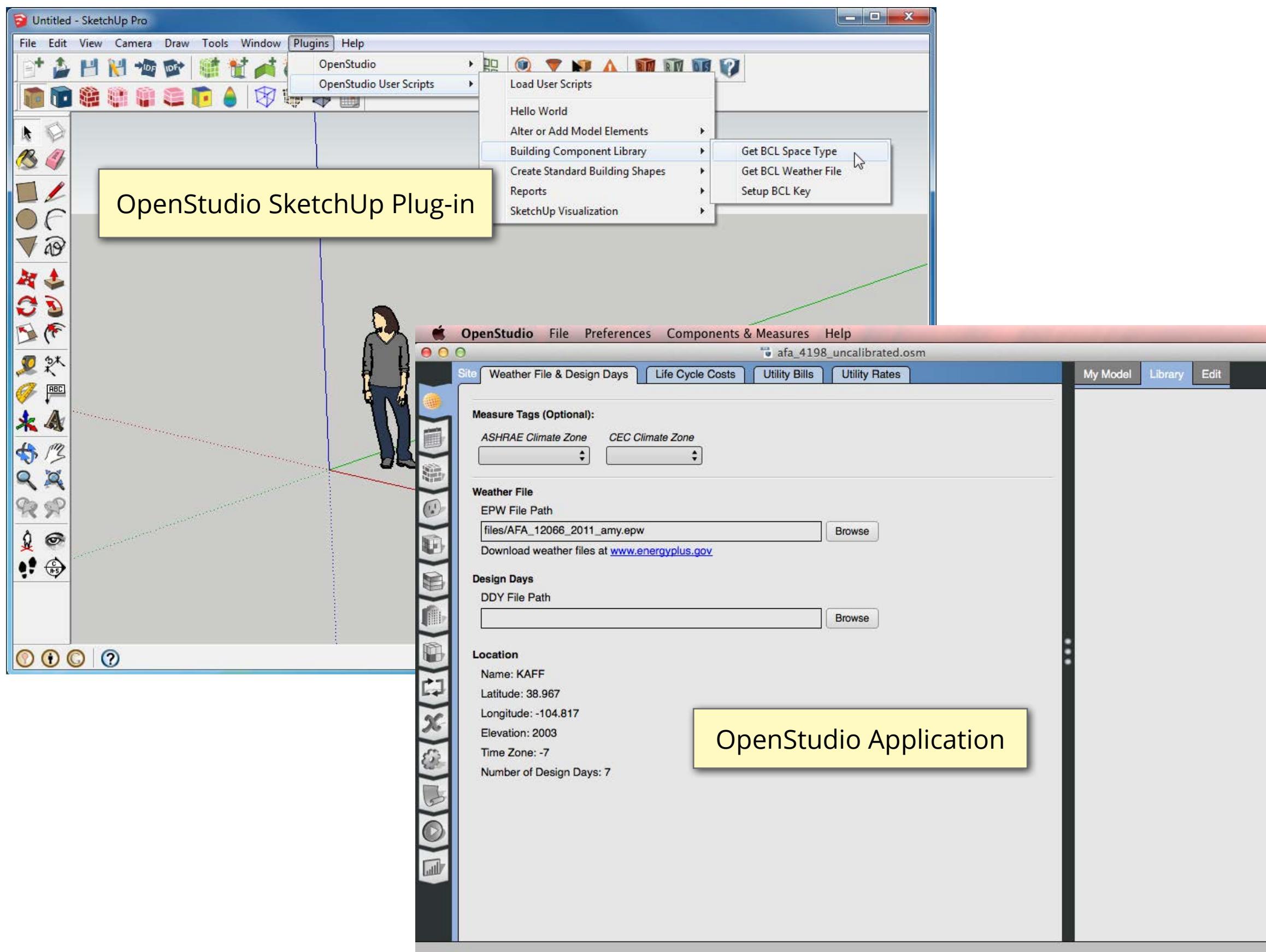
(October 2014)

Introduction

Notes

The basic workflow for OpenStudio starts in the SketchUp Plug-in creating the building envelope and assigning space attributes.

Next, the model is loaded in the OpenStudio application, shown on this page. You can step through the tabs from top to bottom. For a basic workflow the resource tabs and many others are not necessary. A minimum workflow is shown in the box to the right.



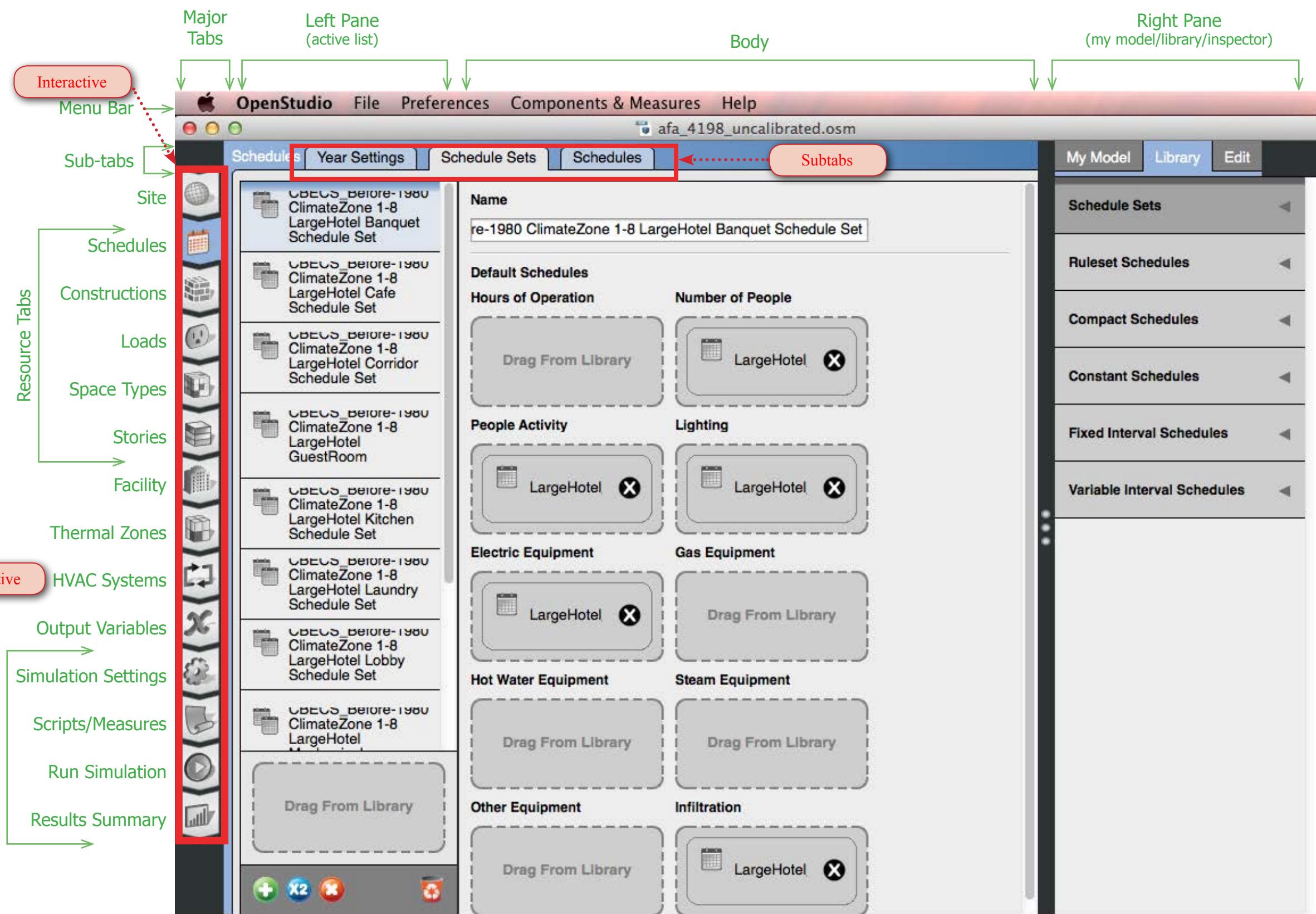
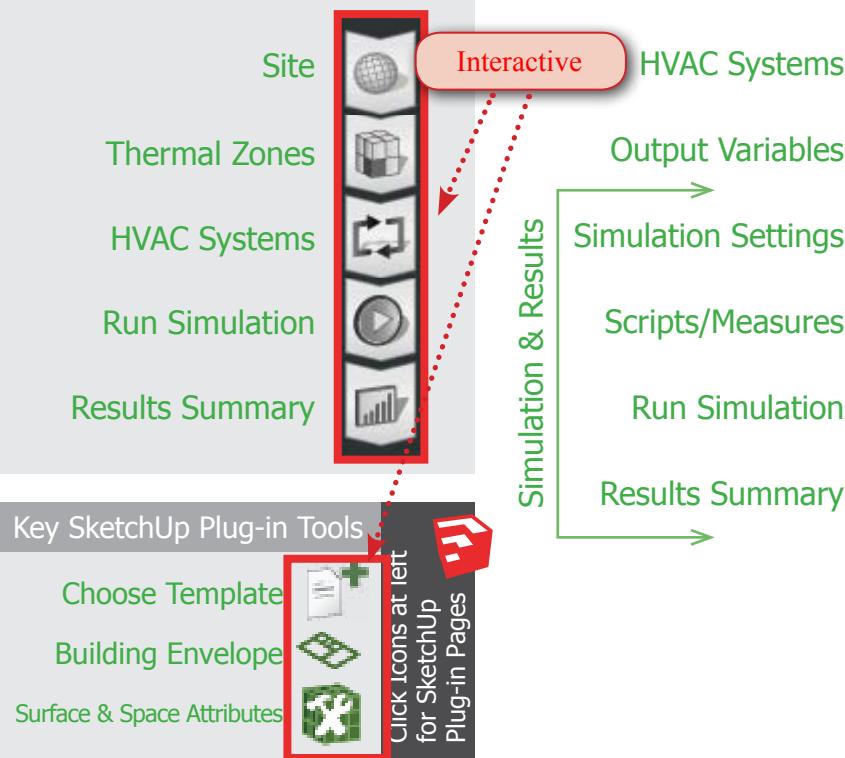
How to Use this Guide

Notes

This PDF is an interactive guide. Click on the SketchUp Plug-in icons below or the major tab icons at the right to jump to the appropriate pages. Subtabs menu items, and pink labels can also be clicked to jump to another view.

You can also navigate by using the PDF bookmarks.

Minimal Workflow Through OpenStudio Application



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SketchUp - Choose Template

Notes

Each of these building type-specific templates are loaded with construction, schedule, and internal load data for various vintages and for all U.S. climate zones.

If you plan to apply attributes only in the OpenStudio application, you can use the minimal template, which is the default when you first install OpenStudio. You can also use the "[Get BCL Space Type](#)" user script to generate and download spaces types into your current model.

Vintages and Climate Zones

Vintages:

- DOE Ref Pre-1980
- DOE Ref 1980-2004
- DOE Ref 2004
- 189.1-2009
- 90.1-2007

Climate Zones:

1-8 (see map)

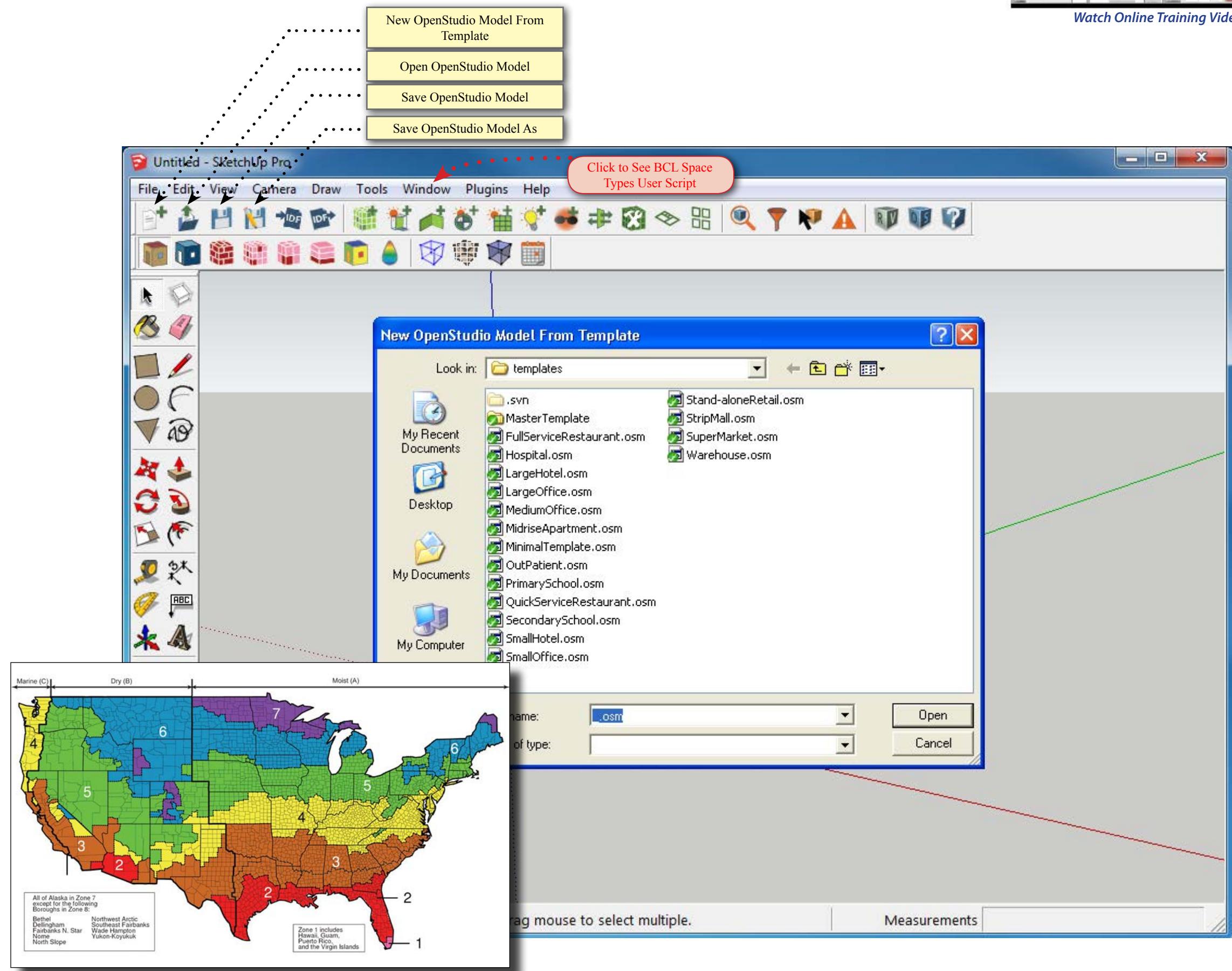
Key SketchUp Plug-in Tools

[Choose Template](#)



[Building Envelope](#)

[Surface & Space Attributes](#)





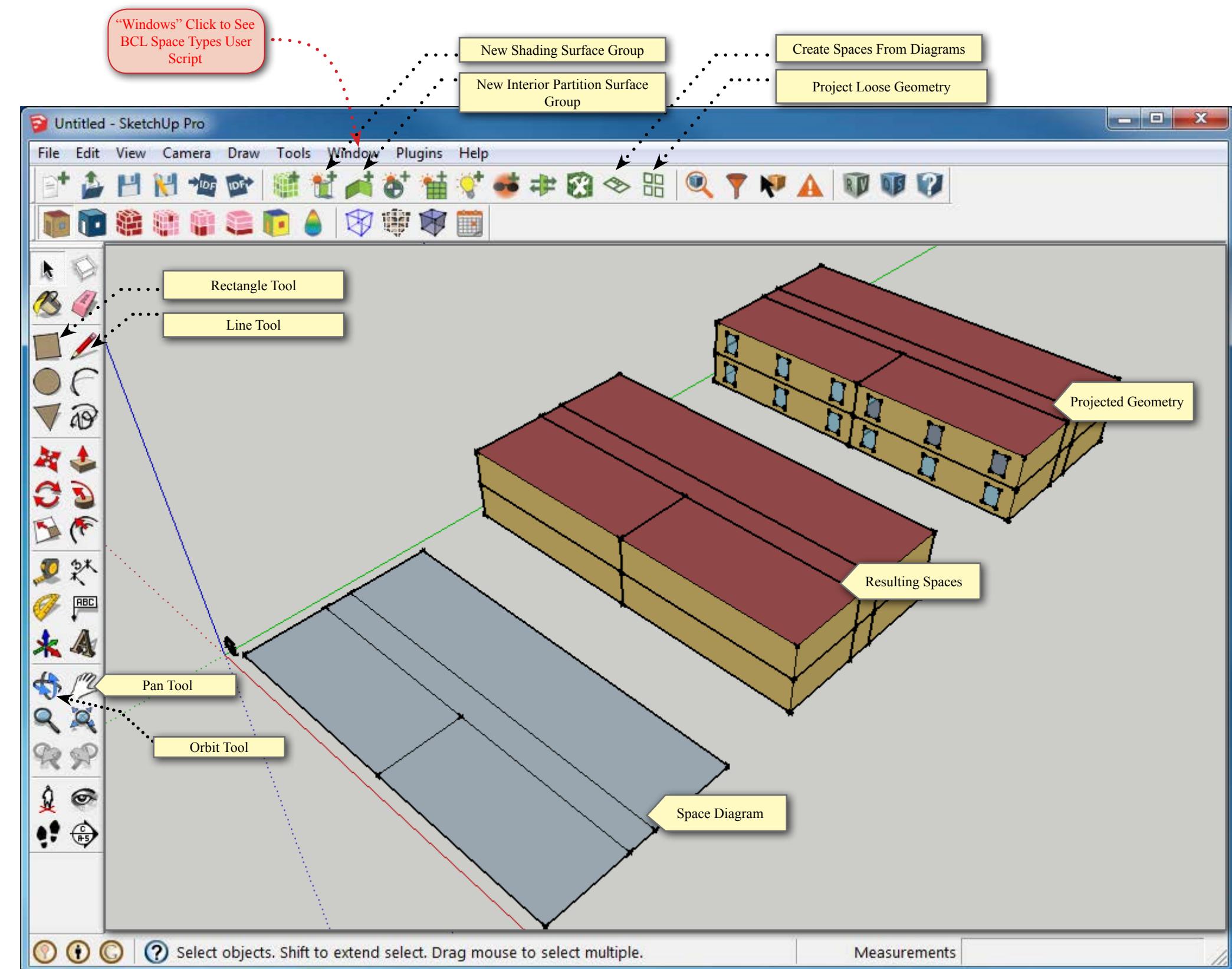
SketchUp - Building Envelope

Notes

After using native SketchUp tools to draw a space outline, you use the Spaces From Diagram tool to project the diagram into a multi-story building. Although the geometry is automatically generated from the diagram, you can edit it using standard SketchUp Tools.

You can take a similar approach for fenestration. Again draw loose geometry with native SketchUp tools, but this time use the Project Loose Geometry tool to apply the fenestration to the appropriate spaces. Optionally use the user scripts to create windows based on window to wall ratio or project overhangs based on a projection factor.

You can create additional model geometry using the Shading Surface Tool and the Interior Partition Surface Tool. Spaces can also be imported from gbXML.



Key SketchUp Plug-in Tools

Choose Template



Building Envelope

Surface & Space Attributes



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SketchUp - Surface & Space Attributes

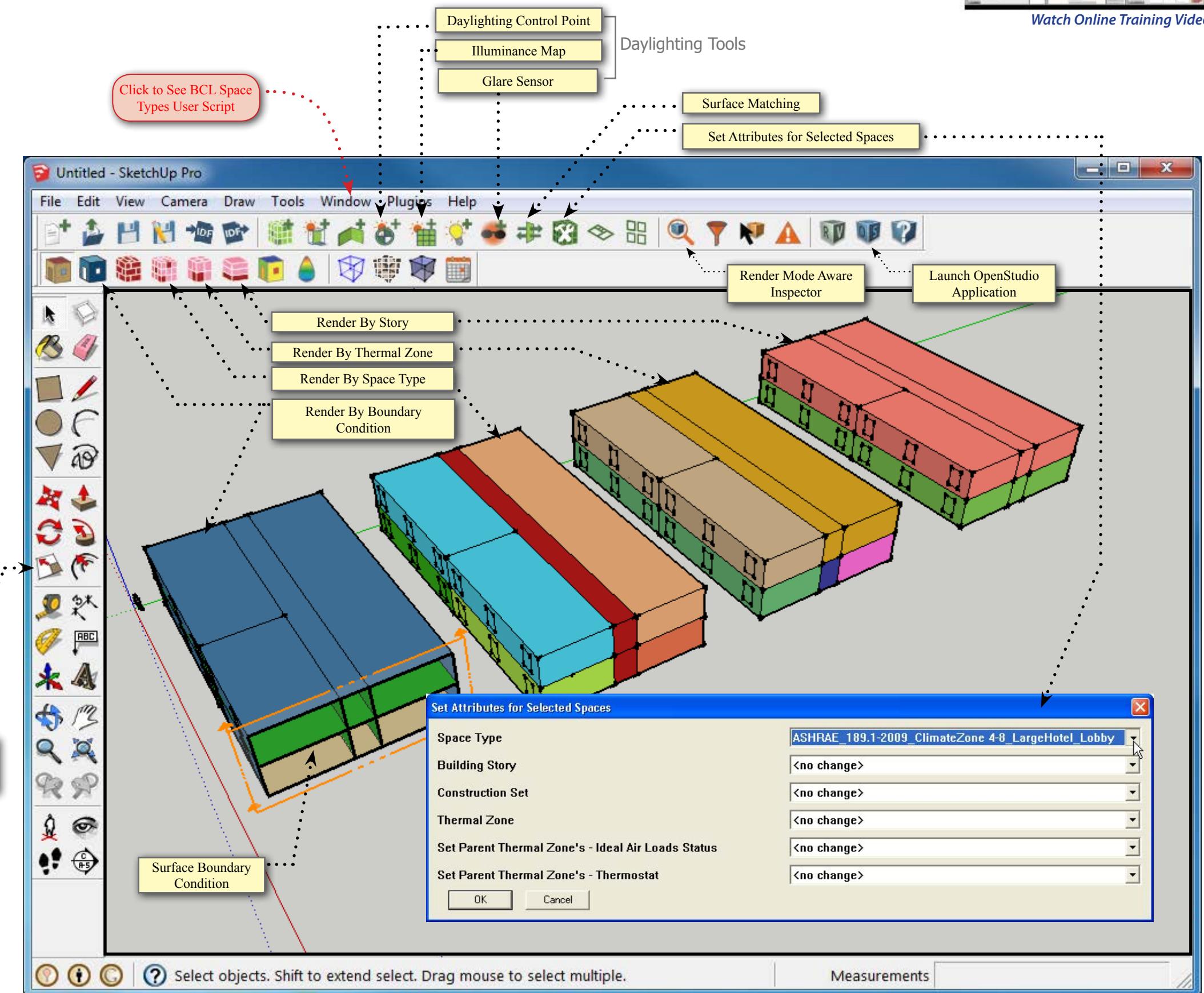
Notes

After defining the building envelope, you use the Surface Matching tool to set the boundary conditions. These will allow thermal connections between spaces and will inform OpenStudio about what construction to apply.

Then you can use the Space Attributes tool to assign various attributes to a space. There is a matching render mode for each space attribute. To apply space attributes, select one or more spaces, and then click the Space Attributes tool.

The image to the right shows a composite of the same model viewed in different render modes. In practice your entire model will render in a single mode at a given time. This example is just to demonstrate the render modes side by side.

To run your simulation click the OpenStudio button to Launch your model in OpenStudio and [then go to the Run tab](#).





SketchUp - User Scripts (BCL Space Type)

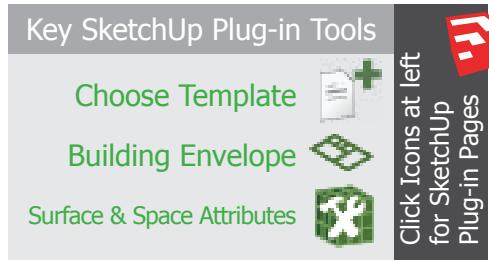
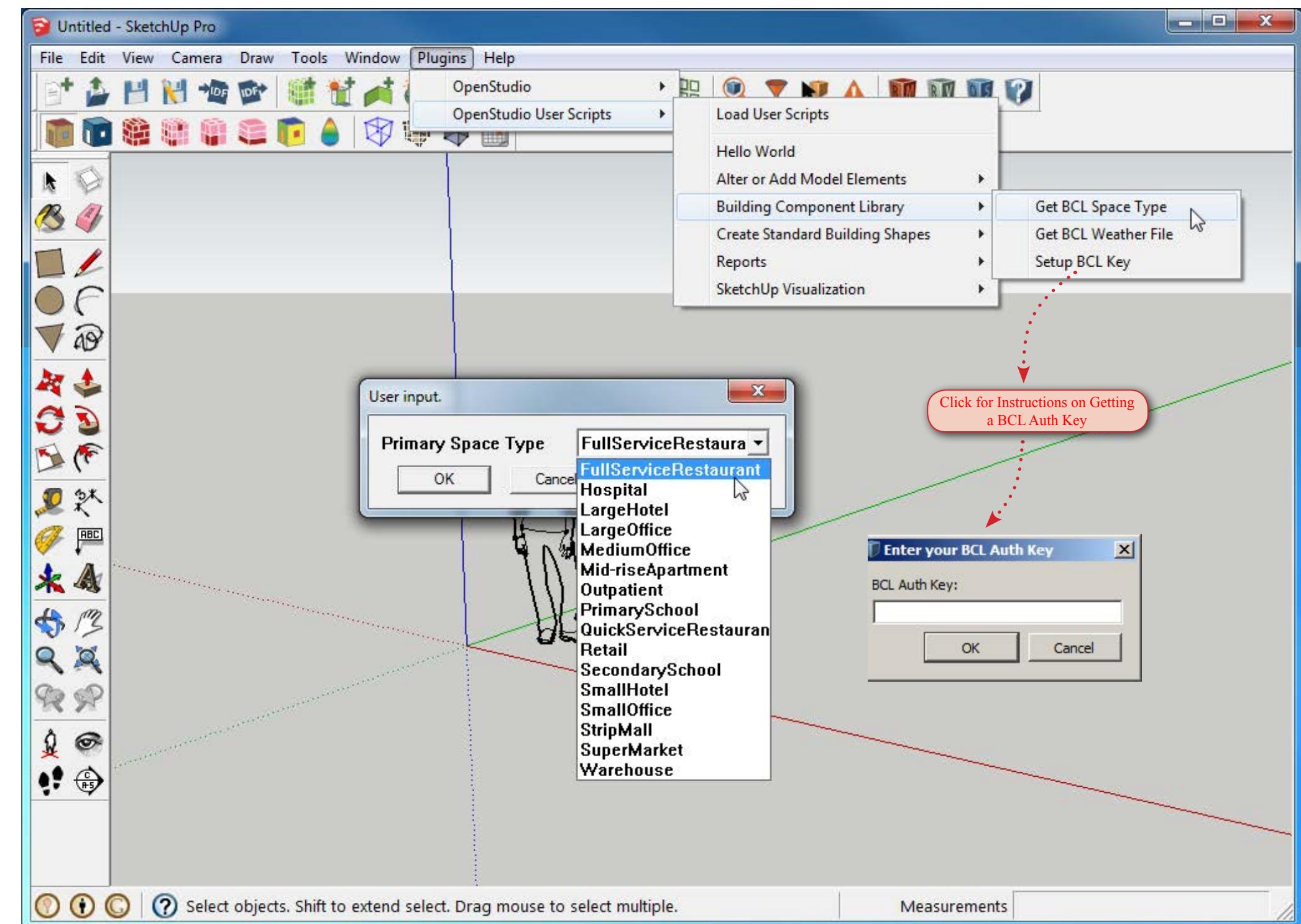
Notes

"Get BCL Space Type" will dynamically create OpenStudio spaces types from data on the Building Component Library (BCL) website based on user input related to vintage, climate zone, and building type.

The first time you request a specific combination of inputs it will take some time to download the component. The components are saved to your local database; they don't have to be downloaded next time you make the same request.

The first time you use this script or any other BCL functionality you will be prompted for a BCL API key. This PDF has a page that provides [instructions on obtaining a BCL key](#).

The user scripts menu contains many other additional example scripts.





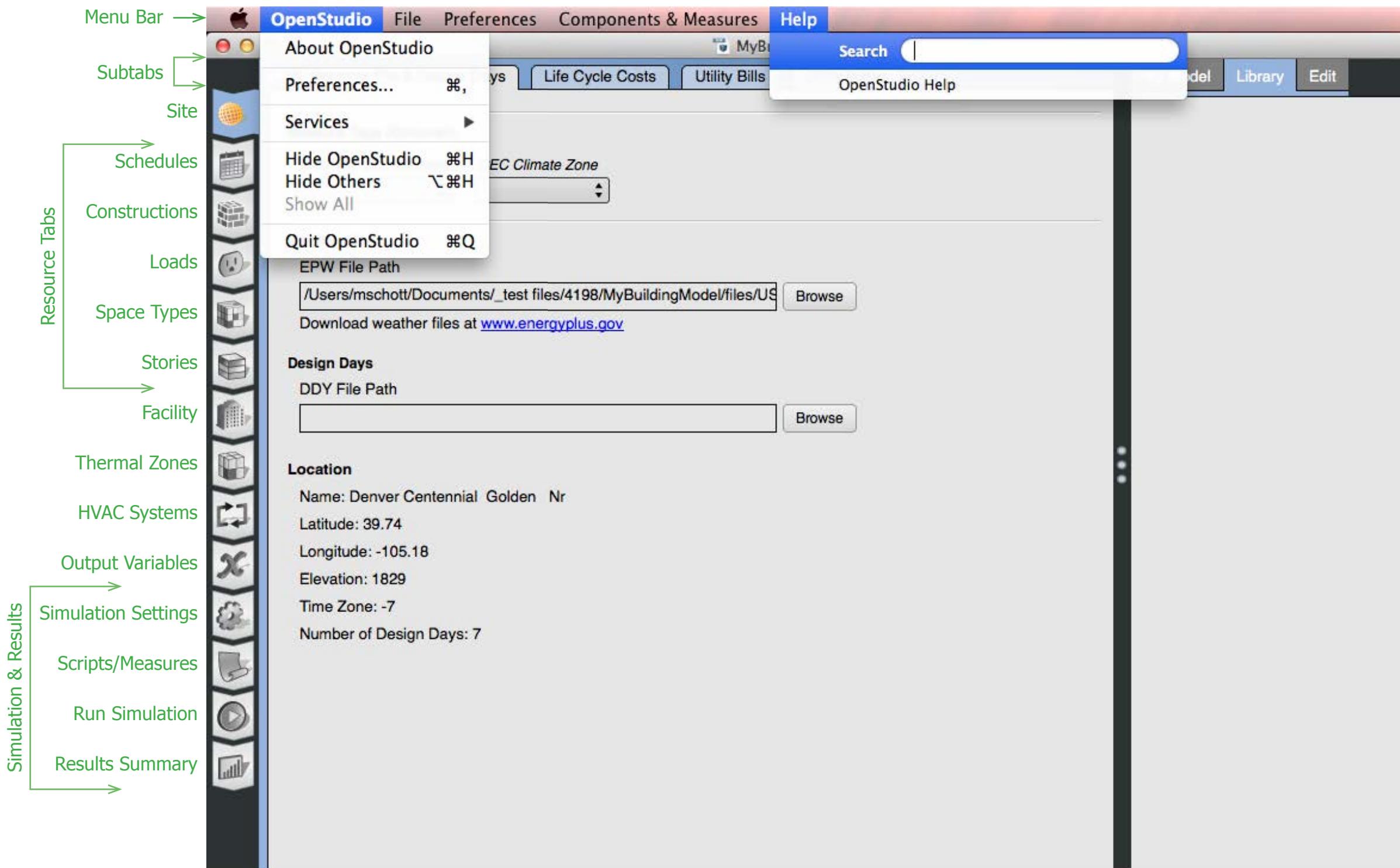
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OpenStudio and Help Menu

Notes

The OpenStudio menu contains the about OpenStudio information to check version numbers.

The help menu can take you to the OpenStudio website or you can search for topics.





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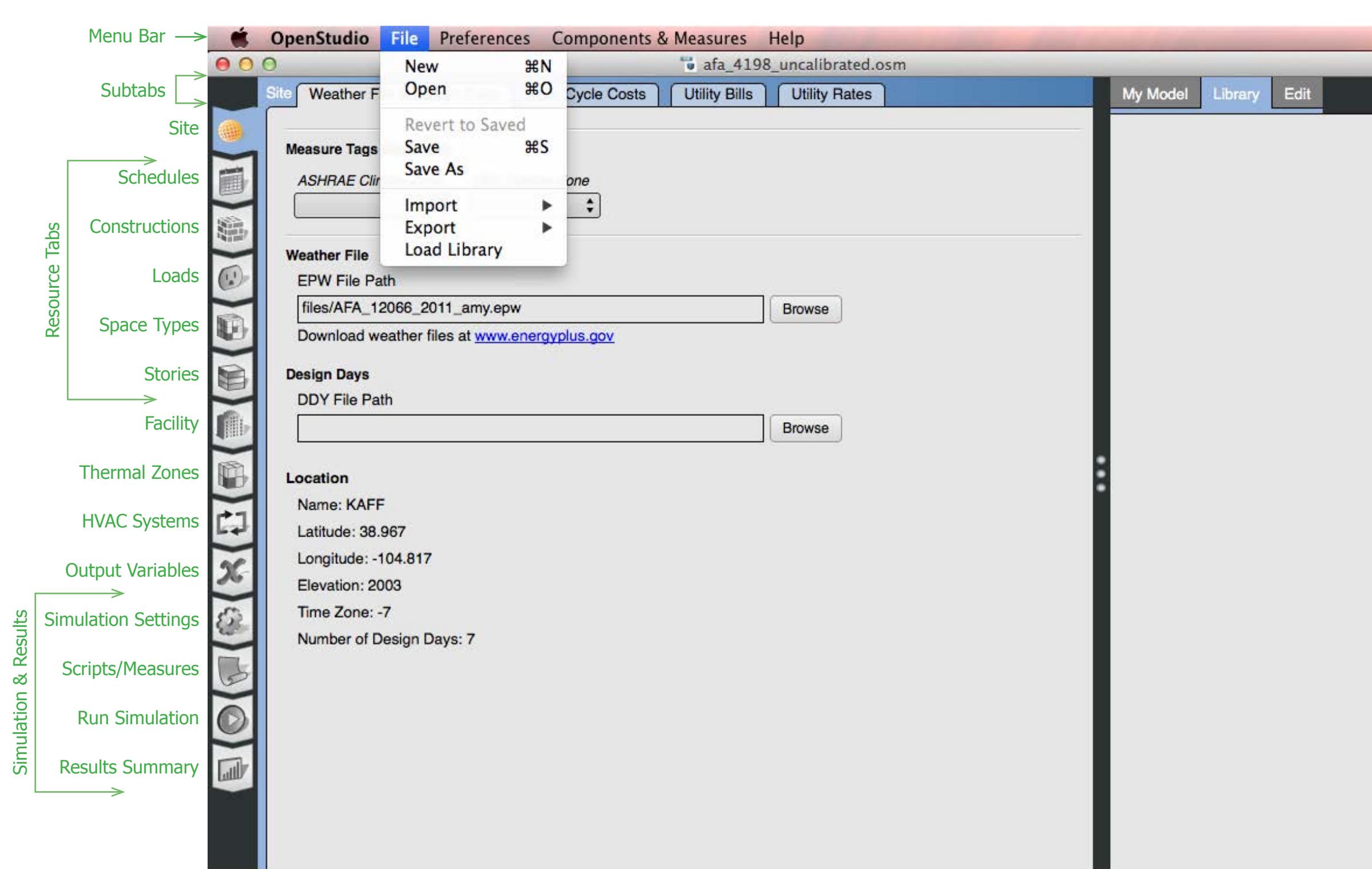
OpenStudio Application File Menu — File

Notes

If you launch the OpenStudio application from the SketchUp Plug-in, your open file will automatically open in the application. But to save the file or open a new file, select file open from the menu.

When you save an OSM model in the OpenStudio Application or the SketchUp Plug-in a folder is saved next to the OSM file. This folder contains external resources such as the weather file, scripts, and simulation results.

Load Library is also a very important feature. This allows you to load building component libraries for specific building types. These libraries are the same as those used in the SketchUp Plug-in templates.





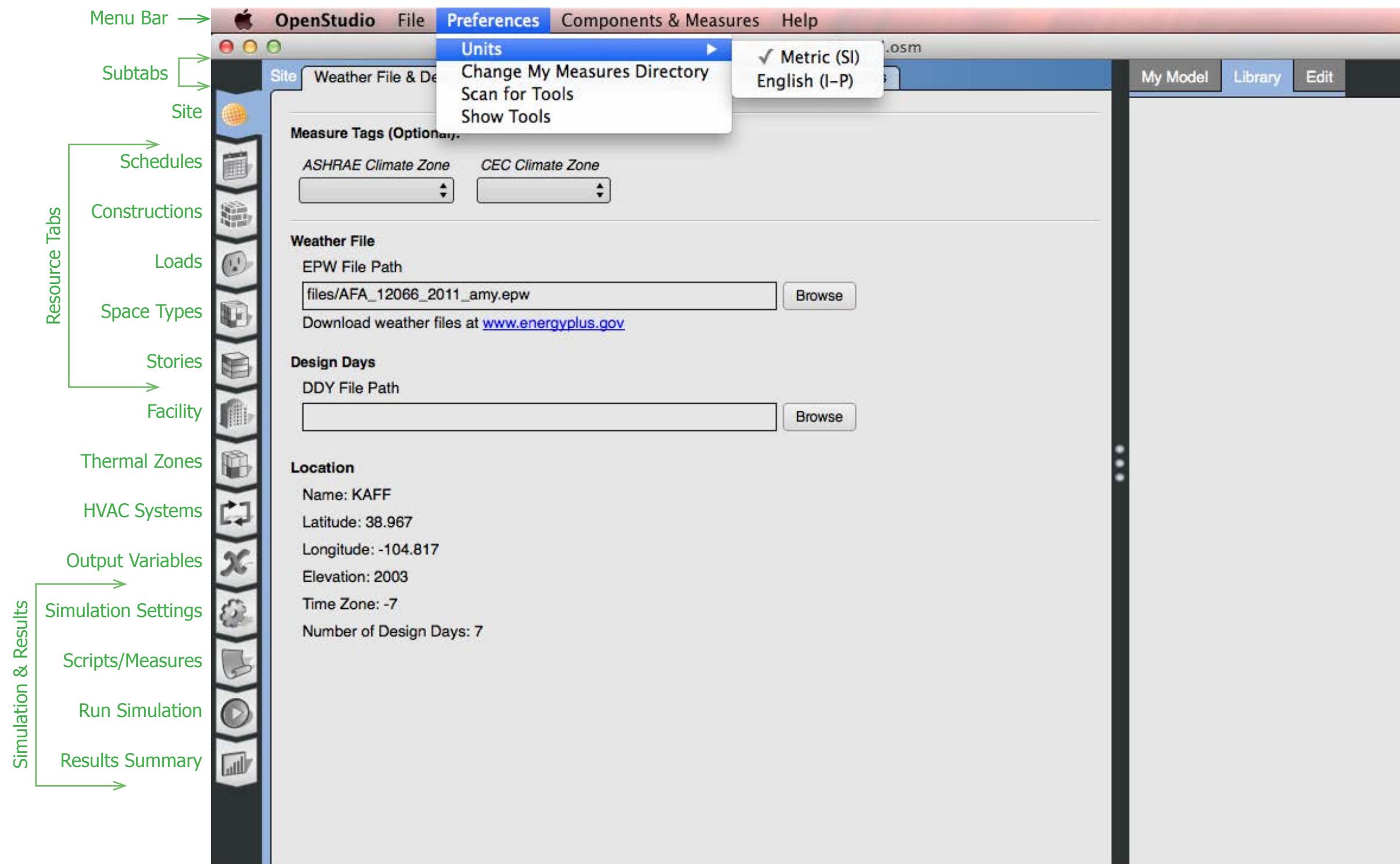
Preferences Menu

Notes

The Units menu lets you switch between SI and IP units. This affects both input fields and output data on the results tab. It does not currently affect standard EnergyPlus output files.

The SketchUp Plug-in has access to this as well under "Plugins/Open-Studio/Preferences".

Scan for Tools will look for Radiance, Ruby, and EnergyPlus installations. If you install those applications Prior to installing OpenStudio this shouldn't be necessary.



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Components & Measures

Menu: Apply Measure Now — Select a Measure

Notes

You can apply measures to your model at any time by going to the "Components and Measures" menu and selecting the "Apply Measures Now" option.

This will open a dialog that allows you to choose a measure from the library to apply, go to BCL to find a measure to apply, or even write your own measure and test it.

Once you select a measure you may edit the measure inputs on the right side of the dialog. Hit apply measure to start.

The screenshot shows the OpenStudio application window with the 'Components & Measures' menu open. The 'Apply Measure Now' option is selected, which opens a dialog titled 'OpenStudio'.

Resource Tabs:

- Subtabs: Site, Schedules, Constructions, Loads, Space Types, Stories, Facility, Thermal Zones, HVAC Systems, Output Variables.
- Simulation & Results: Simulation Settings, Scripts/Measures, Run Simulation, Results Summary.

Dialog Content:

- Measure Tags (Optional):** A text input field.
- Measures:** A list of measures categorized under 'Envelope' and 'Fenestration'.
 - Envelope:** Form (3), Opaque (1).
 - Fenestration:** Fenestration (5).
- BCL:** AEDG K12 - Fenestration and Daylighting (1), Add Overhangs by Projection Factor (highlighted in orange), My Add Overhangs by Projection Factor Copy, Replace Exterior Window Constructions with...
- Buttons:** Find Measures on BCL, Back, Apply Measure, Cancel.
- Inputs:** Name: Add Overhangs by Projection Factor, Description: Add overhangs by projection factor to specified windows. The projection factor is the overhang depth divided by the window height. This can be applied to windows by the closest cardinal direction. If baseline model contains overhangs made by this measure, Modeler Description: If requested then delete existing space shading surfaces. Then loop through exterior windows. If the requested cardinal direction is the closest to the window, then add the overhang. Name the shading surface the same as the window but append with "-Overhang". If a space shading surface of that name already exists, then delete it before making the new one. This measure has no life cycle cost arguments. You can see the economic impact of the measure by costing the construction used for the overhangs., Inputs: Projection Factor (overhang depth / window height) 0.5, Cardinal Direction.
- Note:** Only Available After Applying the Measure.

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Components & Measures

Menu: Apply Measure Now — Accept Changes

Notes

Once the measure is applied the dialog provides you with information on the changes made to the model.

You can choose to cancel or accept the changes to the model. If you choose to accept the model will be saved and reloaded into the application.

If the measure fails you will see an error log on the dialog.

Advanced output provides additional details.

Resource Tabs:

- Subtabs
- Site
- Schedules
- Constructions
- Loads
- Space Types
- Stories
- Facility
- Thermal Zones
- HVAC Systems
- Output Variables
- Simulation Settings
- Scripts/Measures
- Run Simulation
- Results Summary

Simulation & Results:

- Advanced Output

Measure Output:

Measure Output Location: /var/folders/18/hw36chr90t37zqb_x_0v9gch523hcs/T/qt_temp.Y83945/ApplyMeasureNow

Set Window to Wall Ratio by Facade 2014-Aug-19 15:37:06 Canceled 0 Warnings 0 Errors

Initial Condition: The model's initial window to wall ratio for South facing exterior walls was 0.15.

Final Condition: The model's final window to wall ratio for South facing exterior walls is 0.40. Window area increased by 351 (ft²). The material and construction costs increased by \$0.

Buttons:

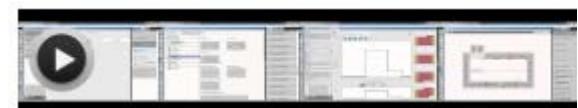
- Back
- Accept Changes
- Cancel

Callouts:

- Only Available After Applying the Measure (points to 'Accept Changes' button)
- Provides addition information on the application of the measure (points to 'Advanced Output' button)
- Opens dialog to Select and Run Measures on Model (points to 'Apply Measure Now' menu item)

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Components & Measures

Menu: Find Measures or Components

Notes

The BCL window gives you access to an online repository of building energy modeling data called the Building Component Library. Although you can access the [BCL website](#) on its own, OpenStudio has integrated access to the BCL from within the application. You can access this through the "Window" menu.

The first time you open this window you will be prompted for an API key, unless you have already used BCL functionality in the SketchUp Plug-in.

The Online BCL window currently exposes construction and material objects. You can choose a category and you can also search for a text string. Next you can check and download one or more of the resulting components. The pane on the right shows attributes for the currently selected component. Once downloaded, these components are stored in a local database on your computer.

Within OpenStudio, components downloaded from the BCL have visual tags to indicate their origins.

Click for Instructions on Getting a BCL Auth Key

Enter your BCL Auth Key

BCL Auth Key:

OK Cancel

Components & Measure

Apply Measure Now

Find Measures

Find Components

Utility Rates

Site Weather File & Design Days

Online BCL

Categories

- Construction Assembly
 - Fenestration
 - Door
 - Skylight
 - Tubular Daylighting Device
 - Window
 - Floor
 - Attic Floor
 - Exposed Floor
 - Exterior Slab
 - Interior Floor
 - Floor Above Crawlspace
 - Floor Above Uncond Bsmt
 - Floor Above Uncond Garage
 - Roof Ceiling
 - Attic Roof
 - Exterior Roof
 - Interior Ceiling
 - Crawlspace Ceiling
 - Uncond Bsmt Ceiling
 - Uncond Garage Ceiling
 - Wall
 - Below Grade Wall
 - Exterior Wall
 - Interior Wall

Choose Category and Type of Construction or Material

Simulation Settings

Scripts/Measures

Run Simulation

Results Summary

Search Input Box

Construction Assembly

Check All

767

Name: 189.1-2009 Res 3A Ext Wall Mass
Type: OS:Construction

Name: 189.1-2009 Res 3A Ext Wall Metal Building
Type: OS:Construction

Name: 189.1-2009 Res 3A Ext Wall Steel-Framed
Type: OS:Construction

Name: 189.1-2009 Res 3A Ext Wall Wood-Framed and Other
Type: OS:Construction

Name: 189.1-2009 Res 4B Ext Wall Mass
Type: OS:Construction

Name: 189.1-2009 Res 4B Ext Wall Metal Building
Type: OS:Construction

Name: 189.1-2009 Res 4B Ext Wall Steel-Framed
Type: OS:Construction

Name: 189.1-2009 Res 4B Ext Wall Wood-Framed and Other
Type: OS:Construction

Name: 189.1-2009 Res 5B Ext Wall Mass
Type: OS:Construction

Name: 189.1-2009 Res 5B Ext Wall Metal Building
Type: OS:Construction

Attributes

Effective R-value	1.81 ...
Film Coefficients	false
Insulation Minimum R-value (ft ² F h/Btu)	R-11....
Construction Type	Mass
Construction	Exteri...
Climate Zone	ASH...
OpenStudio Type	OS:C...
Standard	ASH...
Standard Type	Resid...

Files

- 189.1-2009 Res 3A Ext Wall Mass_v7.1.0.idf
- 189.1-2009 Res 3A Ext Wall Mass_v0.9.3.osm
- 189.1-2009 Res 3A Ext Wall Mass_v0.9.3.osc

Sources

Tags

Construction Assembly,Wall.Exterior Wall

Progress Bar Will Appear Here

Download Checked Components

Download

Close Window when Done

Page Through Results

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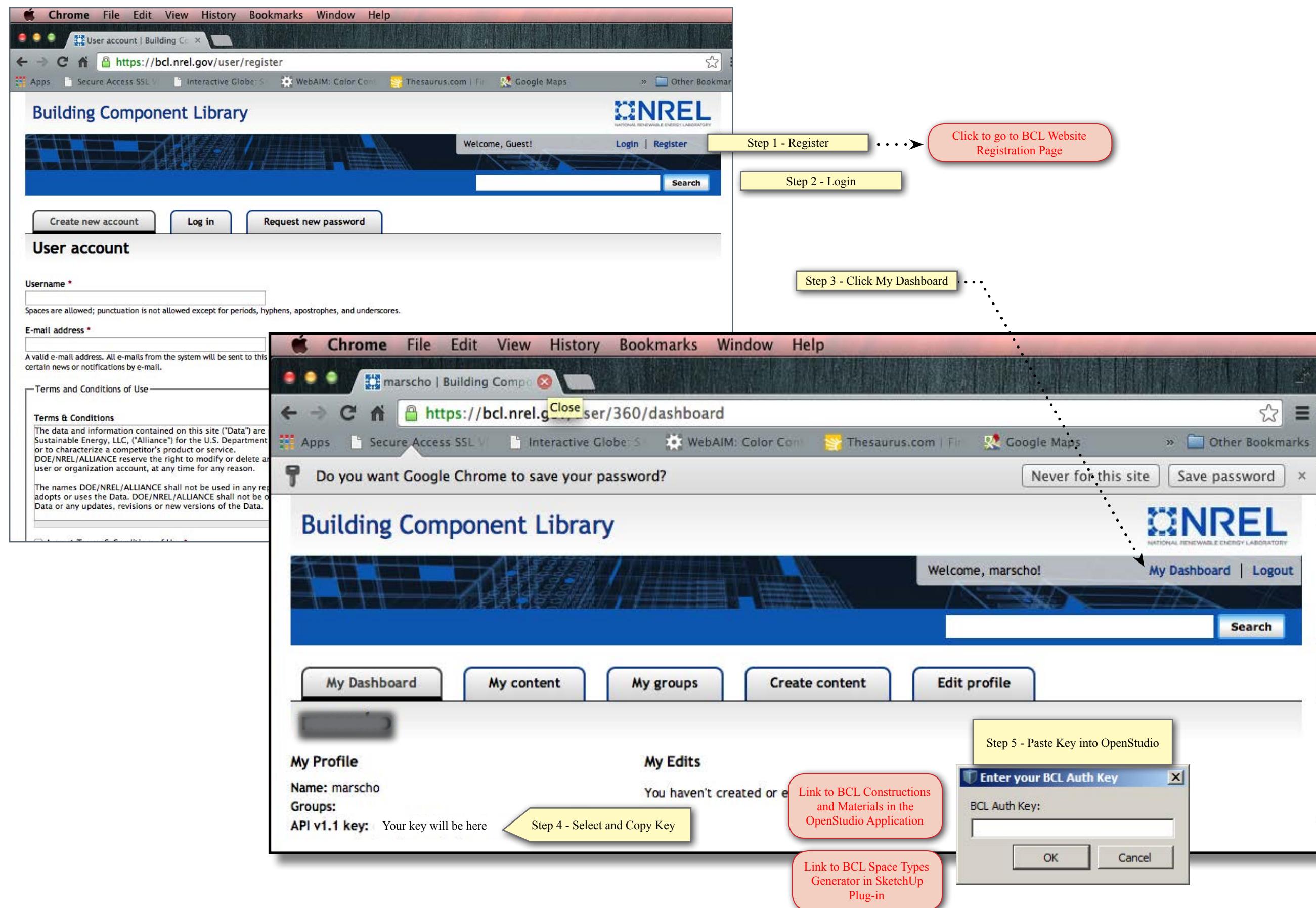
BCL Account Page bcl.nrel.gov

Notes

To use the BCL features in OpenStudio, you need to register on the Building Component Library website and setup an "API Key." This is a separate site from the OpenStudio website. The steps to setup an account and obtain a key follow.

1. Go to <https://bcl.nrel.gov/user/register> and follow the registration instructions.
2. Check your email for the confirmation to activate your account, then login.
3. Click "My Dashboard"
4. Select and copy the Key.
5. Return to OpenStudio and paste the key into the input box.

Your key will be remembered when you Upgrade OpenStudio so you should only have to do this once, unless you get a new computer, then you will have to go through steps 3-6 to retrieve your key.



The screenshot illustrates the workflow for obtaining a BCL API key:

- Step 1 - Register:** The user navigates to <https://bcl.nrel.gov/user/register>. A red callout box points to the "Register" link in the top right corner of the page header.
- Step 2 - Login:** After registration, the user logs in to their account. A yellow box highlights the "Log in" button.
- Step 3 - Click My Dashboard:** Once logged in, the user clicks on "My Dashboard". A yellow box highlights the "My Dashboard" button in the top navigation bar.
- Step 4 - Select and Copy Key:** On the dashboard, the user selects and copies the "API v1.1 key". A yellow box highlights the "Select and Copy Key" button, and a red callout box points to the copied key text: "Link to BCL Constructions and Materials in the OpenStudio Application". Another red callout box points to the "Link to BCL Space Types Generator in SketchUp Plug-in" text.
- Step 5 - Paste Key into OpenStudio:** The user returns to OpenStudio and pastes the copied key into the "BCL Auth Key" field of the "Enter your BCL Auth Key" dialog box. A yellow box highlights the "Paste Key" action, and a red callout box points to the "OK" button.



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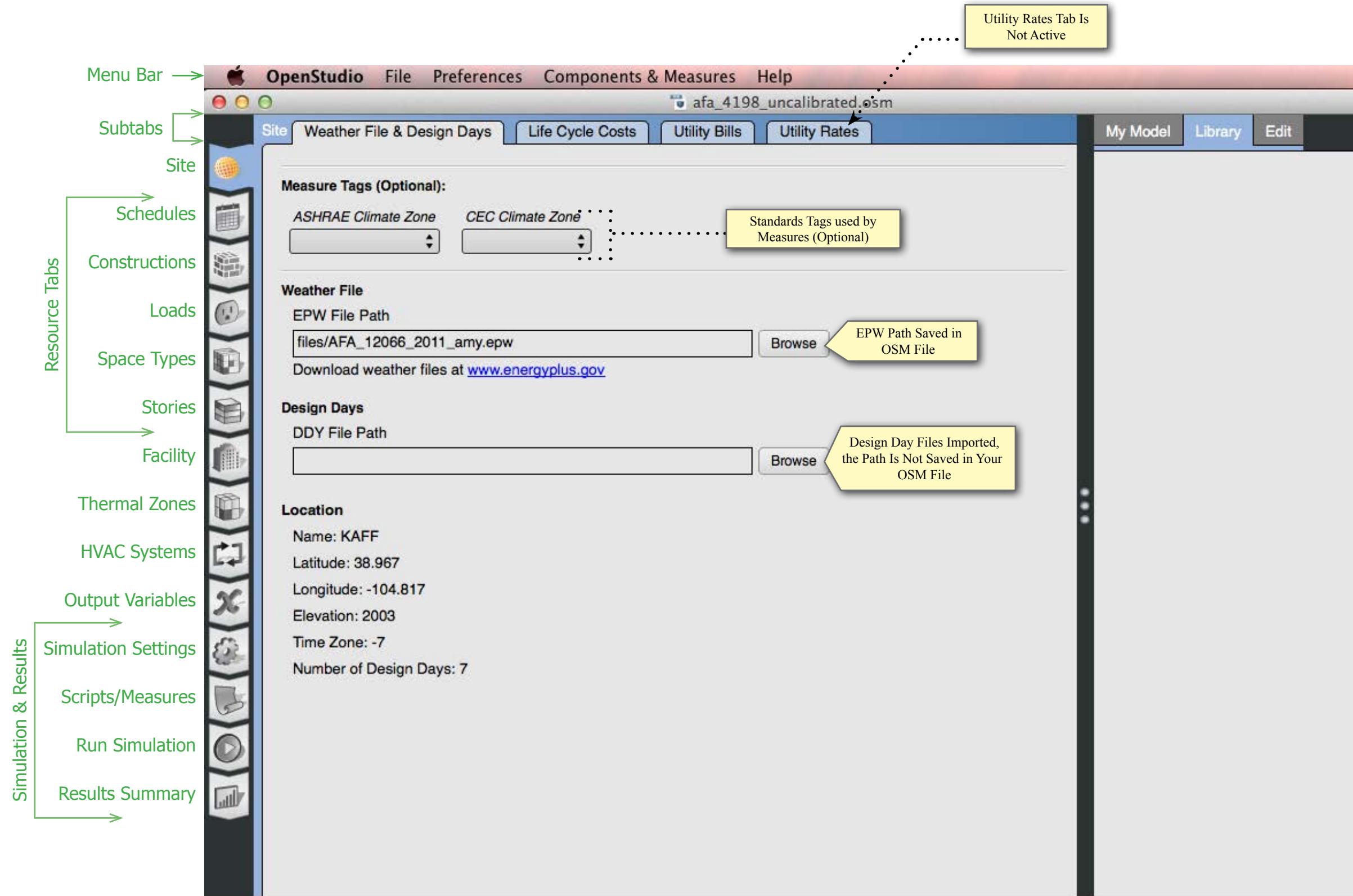
Site - Weather File & Design Days

Notes

The Site tab allows you to set the path of the EPW weather file that you want to use for your simulation and for loading design day files.

The weather file is stored in the OSM file as a path. When you re-open a model you will still see that path displayed. Design days are a little different. They are loaded into your model. The path they were loaded from is not saved, so when you reopen your model you will not see a path in the DDY file path box.

The Utility Rates sub-tab is not yet functional. For this release you can use the "ImportImfSection.rb" script in the Scripts tab to load these.





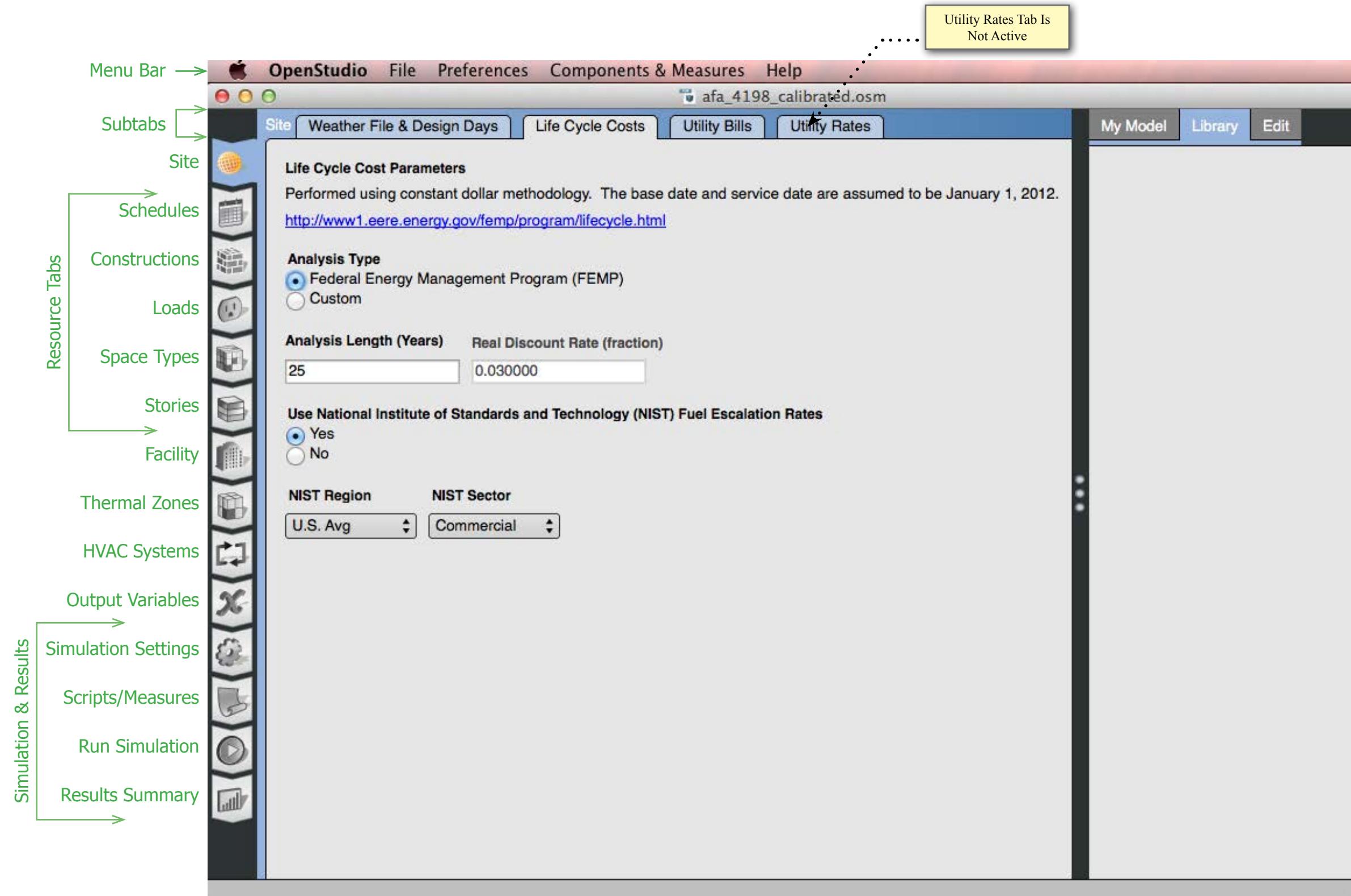
Life Cycle Cost

Notes

The most basic parameters needed for a life cycle cost analysis are the analysis period length and the discount rate. A longer analysis period accumulates more energy cost savings than a shorter period; giving energy conservation measures a better pay back relative to their initial costs. A higher discount rate devalues future energy cost savings relative to money spent on capital improvements in the present; giving energy conservation measures a lower pay back relative to their initial costs. This tab allows users to set these parameters on their baseline model.

In the ParametricAnalysisTool measures, downloaded from BCL, can be used to calculate life cycle costs for different design alternatives.

OpenStudio Life Cycle Costing Examples are available at <http://openstudio.nrel.gov/openstudio-life-cycle-examples>





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Site — Utility Bills

Notes

Add utility bills for calibration on the Utility Bills Tab under Site.

You must select a weather file and go to the schedules tab under year and select the year for the rates.

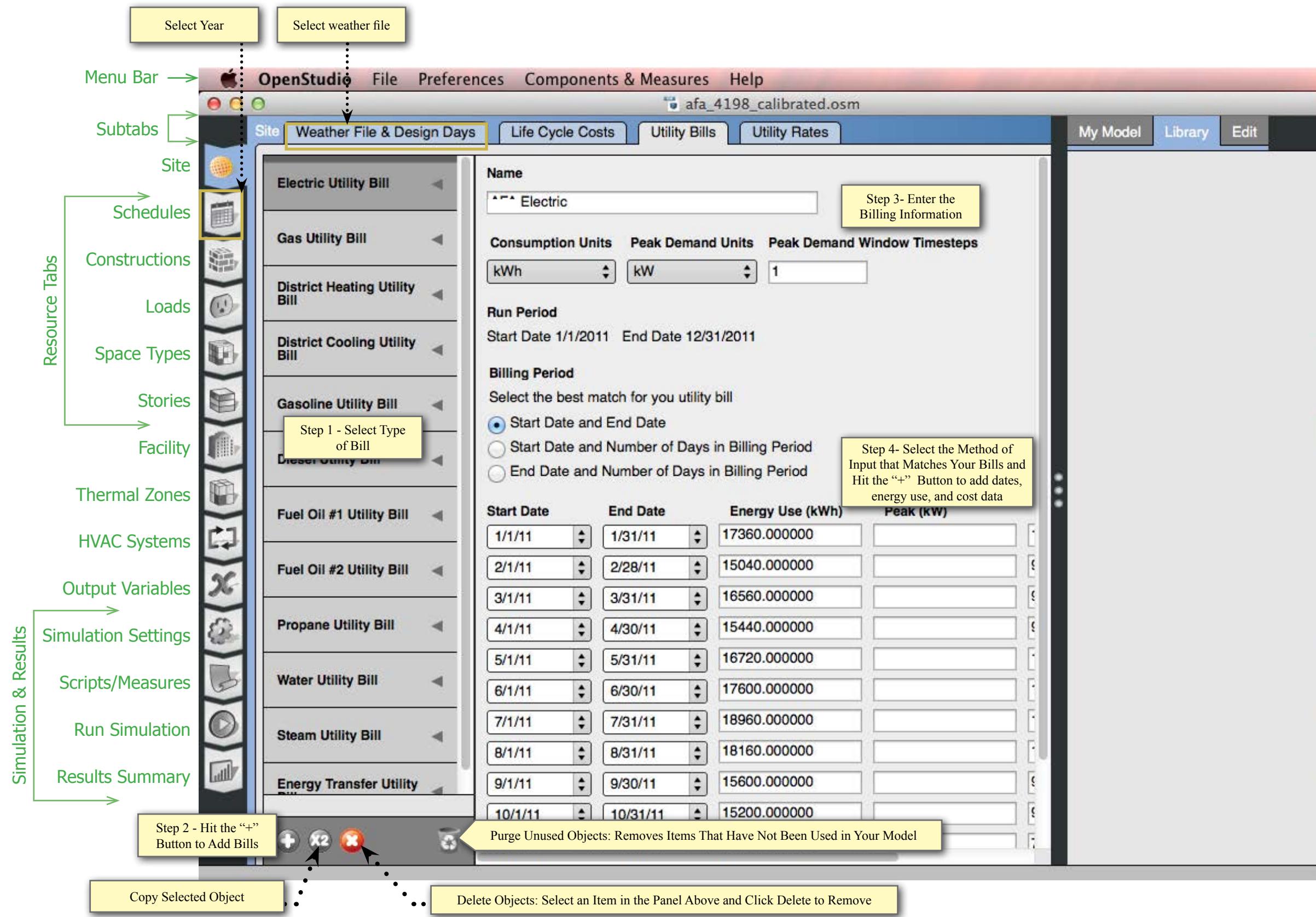
Step 1- select the type of utility on the left.

Step 2- hit the plus button to add bills.

Step 3- name the Bill and complete the units fields.

Step 4- select the billing period inputs and hit the plus sign to add a bill.

To calibrate to the ASHRAE 14-2002 or FEMP standard the file must contain all utility data for one year and real weather data. Check the guidelines for additional requirements.



Resource Tabs

- Site
- Schedules
- Constructions
- Loads
- Space Types
- Stories
- Facility
- Thermal Zones
- HVAC Systems
- Output Variables
- Simulation Settings
- Scripts/Measures
- Run Simulation
- Results Summary

Simulation & Results

Step 1 - Select Type of Bill

Step 2 - Hit the "+" Button to Add Bills

Step 3- Enter the Billing Information

Step 4- Select the Method of Input that Matches Your Bills and Hit the "+" Button to add dates, energy use, and cost data

Purge Unused Objects: Removes Items That Have Not Been Used in Your Model

Delete Objects: Select an Item in the Panel Above and Click Delete to Remove



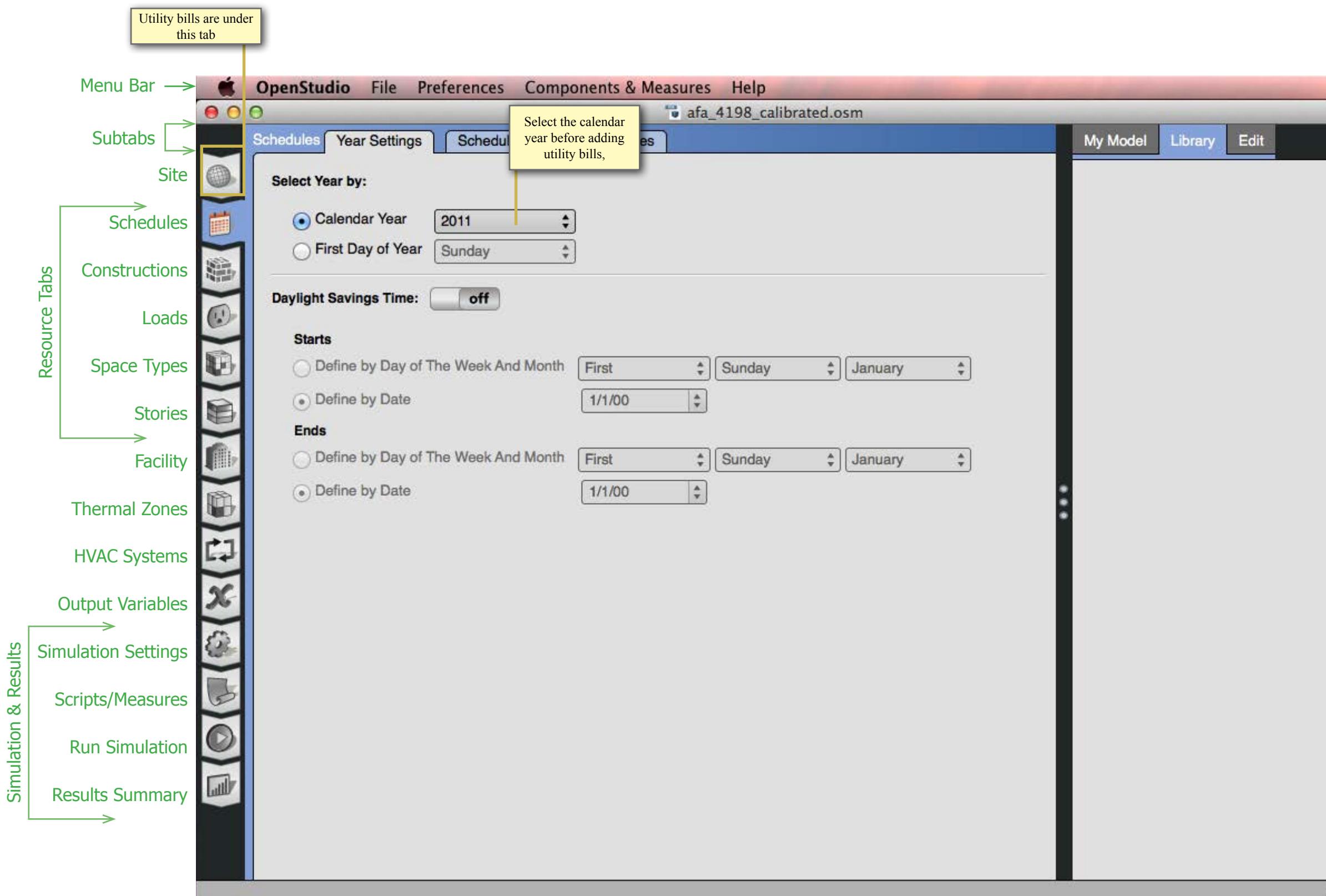
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Schedules - Year Settings

Notes

The Year Settings sub-tab lets you set the day of the week the simulation should start. Define using Calendar Year or First Day Of Year buttons and pull-downs.

The tab can also be used to configure and turn Daylight Savings Time on and off.



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Schedules - Schedule Sets

Notes

A Schedule Set is a collection of schedules for building activities or elements.

A schedule set can be applied to an entire building, a story, a space type, or an individual space.

This sub-tab has two kinds of drop zones. You can drop schedule sets from My Model or Library into the bottom of the left pane, or you can drop individual schedules into the drop zones in the main body.

Resource Tabs:

- Menu Bar →
- Subtabs →
- Site
- Schedules
- Constructions
- Loads
- Space Types
- Stories
- Facility
- Thermal Zones
- HVAC Systems
- Output Variables
- Simulation Settings
- Scripts/Measures
- Run Simulation
- Results Summary

Central Workspace (Schedule Sets Tab):

- Text Field to Rename Active Object in Left Pane:** Located at the top right of the workspace.
- My Model and Library Tabs Will Populate with Object Types Appropriate for Drop Zones in Left Pane and Body:** A callout pointing to the tabs above the workspace.
- The Edit Tab is Only Used in Specific Tabs, This Tab is Not One of Them:** A callout pointing to the top right corner of the interface.
- Drop Zones Accepts Objects of Appropriate Type from "My Model" or "Library":** Points to the drop zones in the main body.
- Number of People:** A section with a slider and a drop zone containing "LargeHotel".
- People Activity:** A section with a drop zone containing "LargeHotel".
- Lighting:** A section with a drop zone containing "LargeHotel".
- Electric Equipment:** A section with a drop zone containing "LargeHotel".
- Gas Equipment:** A section with a drop zone containing "LargeHotel".
- Hot Water Equipment:** A section with a drop zone containing "LargeHotel".
- Steam Equipment:** A section with a drop zone containing "LargeHotel".
- Accepts Object of Type Shown in Active List Above:** Points to the "LargeHotel" entry in the "Number of People" drop zone.
- Purge Unused Objects: Removes Items That Have Not Been Used in Your Model:** Points to the "Purge" button in the bottom toolbar.
- Delete Objects: Select an Item in the Panel Above and Click Delete to Remove:** Points to the "Delete" button in the bottom toolbar.
- Create New Object:** Points to the "Create New Object" button in the bottom toolbar.
- Copy Selected Object:** Points to the "Copy Selected Object" button in the bottom toolbar.

Right Pane (Schedule Sets List):

- My Model
- Library
- Edit

Callout Text:

- "My Model" displays items that are part of your model already.
- "Library" includes components and measures that come with the application or are downloaded from the Building Component Library (BCL).
- "Edit: allows you to select certain components and edit the settings for that component. It is used in the HVAC tab to edit component settings, assign thermal zones to loops, and to add plenums.



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Schedules - Schedules

Notes

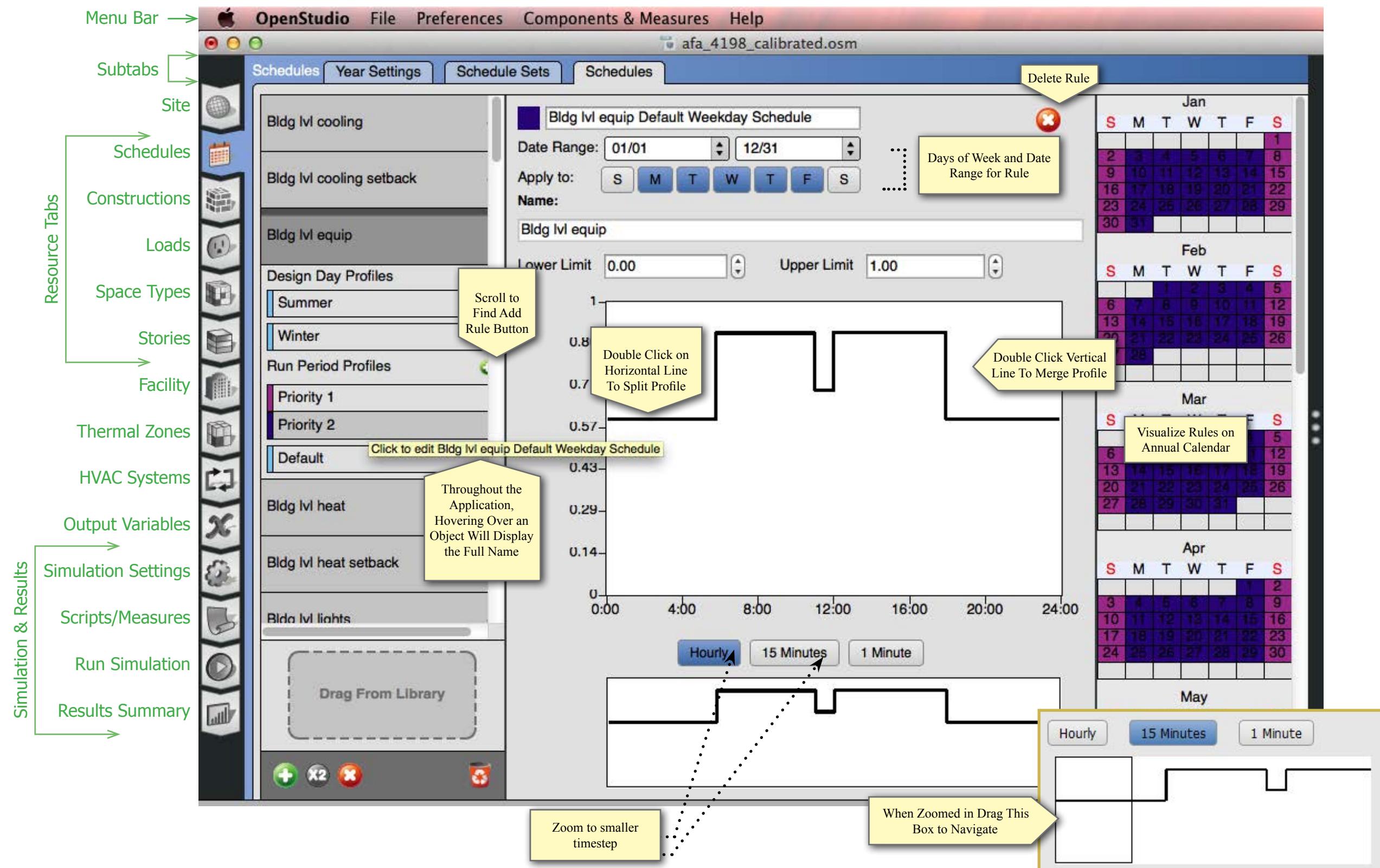
This tab is a visual editor for Ruleset Schedules. As the name implies, a schedule consists of a series of rules. Each rule or profile can be applied for a specific date range and for specific days of the week.

If two rules appear on the same day, the one with a higher priority is used. You can use the rule colors to visually scan the entire year in the calendar on the right of the body to see what rule is applied for a specific day.

A new profile starts as a flat line. Double click to split the profile and then drag one segment up or down. Vertical sections can also be dragged left or right. Click Set Limits to change the vertical limits of your profile. To type precise values for a profile, mouse over the profile and enter a value with your keyboard.

Although you can use Compact and other schedule types in your model, you can visualize and edit only Ruleset Schedules in the OpenStudio application.

The lower profile view is a navigation for when you are zoomed to 15-minute or 1-minute time steps.





Constructions — Construction Sets

Notes

A Construction Set object is structured very much like the Schedule Set. It can contain constructions for different surface types and boundary conditions.

A construction set can be applied to an entire building, a story, a space type, or an individual space.

Construction sets do not have to be complete sets. For example, you can have a construction set assigned to a story that has only an exterior wall. For the rest of the surface types, constructions will be inherited from the building object.

Resource Tabs

- Menu Bar →
- Subtabs →
- Site
- Schedules
- Constructions
- Loads
- Space Types
- Stories
- Facility
- Thermal Zones
- HVAC Systems
- Output Variables
- Simulation Settings
- Scripts/Measures
- Run Simulation
- Results Summary

Simulation & Results

Link to BCL Constructions and Materials in the OpenStudio Application

Model Objects Downloaded from the BCL Have a Visual Indicator

Components & Measures

Construction Sets

My Model

Library

Edit

Interior Door

Interior Floor

Interior Partition

Interior Wall

Interior Window

189.1-2009 Nonres 1A Ext Wall Mass

189.1-2009 Nonres 1A Ext Wall Metal Building

189.1-2009 Nonres 1A Ext Wall Steel-Framed

Internal Source Constructors

C-factor Underground Wall Constructors

F-factor Ground Floor Constructors

Window Data File Constructors



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Constructions — Constructions

Notes

The Constructions sub-tab lists construction objects that are in your model. You can drag additional constructions here from the library. Constructions download using the Online BCL window will appear in the library with a "BCL" flag.

A construction consists of one or more material layers. You can add materials by dragging them from My Model or the Library to the drop zone. You can only add new materials to the bottom which represents the inside of the wall. You can delete any material by clicking the "x" next to the name.

The screenshot shows the OpenStudio interface with the 'Constructions' tab selected. On the left, a vertical sidebar lists 'Resource Tabs' including Site, Schedules, Constructions, Loads, Space Types, Stories, Facility, Thermal Zones, HVAC Systems, Output Variables, Simulation Settings, Scripts/Measures, Run Simulation, and Results Summary. The main workspace displays a construction object named '189.1-2009 Nonres 1A Ext Wall Mass'. This object contains several material layers: '1IN Stucco', '8IN Concrete HW', 'Wall Insulation [31]', and '1/2IN Gypsum'. A callout box with the text 'Drop Material Layers onto Construction From My Model or Library' points to the bottom of the construction object's list. To the right of the construction object, there is a list of available materials: Metal Decking, Metal Roofing, Roof Insulation [18], Roof Insulation [21], Roof Insulation [25], Roof Insulation [26], Roof Membrane, Wall Insulation [31], Wall Insulation [35], and Wall Insulation [36]. A yellow box highlights the 'Standards Tags used by Measures (Optional)' field.



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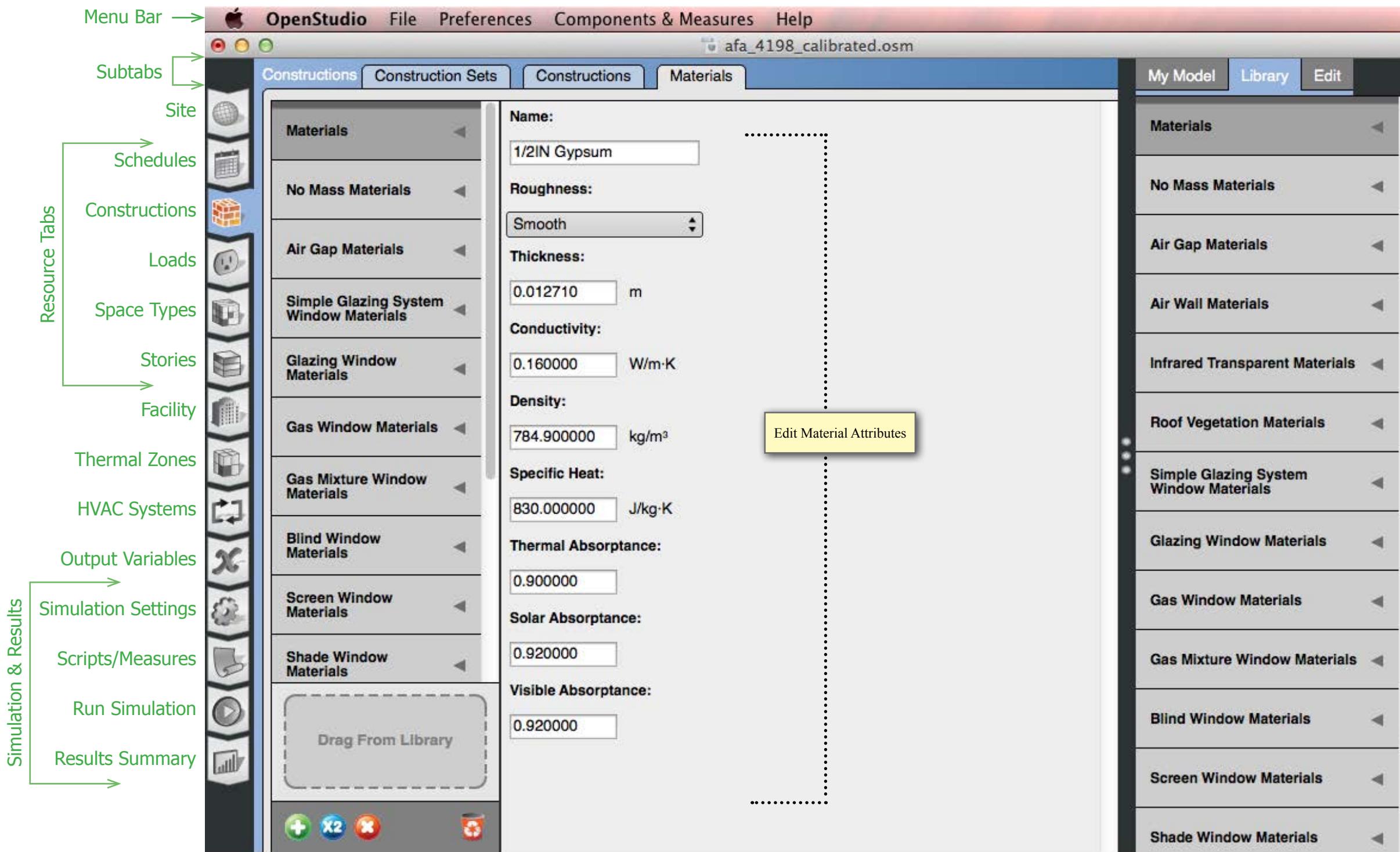
Constructions — Materials

Notes

Constructions are made of one or more layers of materials. The Materials sub-tab lets you inspect and edit those materials.

There are various classes of material objects. When you add a new material, first select the heading for the type of material you want to add and then click the "+" icon at the bottom of the left pane.

Different types of material will have different data fields available.



The screenshot shows the OpenStudio interface with the 'Materials' sub-tab selected in the top navigation bar. The left sidebar lists various resource tabs: Site, Schedules, Constructions, Loads, Space Types, Stories, Facility, Thermal Zones, HVAC Systems, Output Variables, Simulation Settings, Scripts/Measures, Run Simulation, and Results Summary. The main workspace displays material properties for '1/2IN Gypsum'. The right sidebar shows a list of materials, including 'No Mass Materials', 'Air Gap Materials', 'Simple Glazing System Window Materials', 'Glazing Window Materials', 'Gas Window Materials', 'Gas Mixture Window Materials', 'Blind Window Materials', 'Screen Window Materials', and 'Shade Window Materials'. A callout box labeled 'Edit Material Attributes' points to the 'Edit' button in the bottom right corner of the main workspace.

Name:	1/2IN Gypsum
Roughness:	Smooth
Thickness:	0.012710 m
Conductivity:	0.160000 W/m·K
Density:	784.900000 kg/m ³
Specific Heat:	830.000000 J/kg·K
Thermal Absorptance:	0.900000
Solar Absorptance:	0.920000
Visible Absorptance:	0.920000



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Loads

Notes

The Loads tab contains internal load objects. The fields in the body will change appropriately when you pick a different type of load.

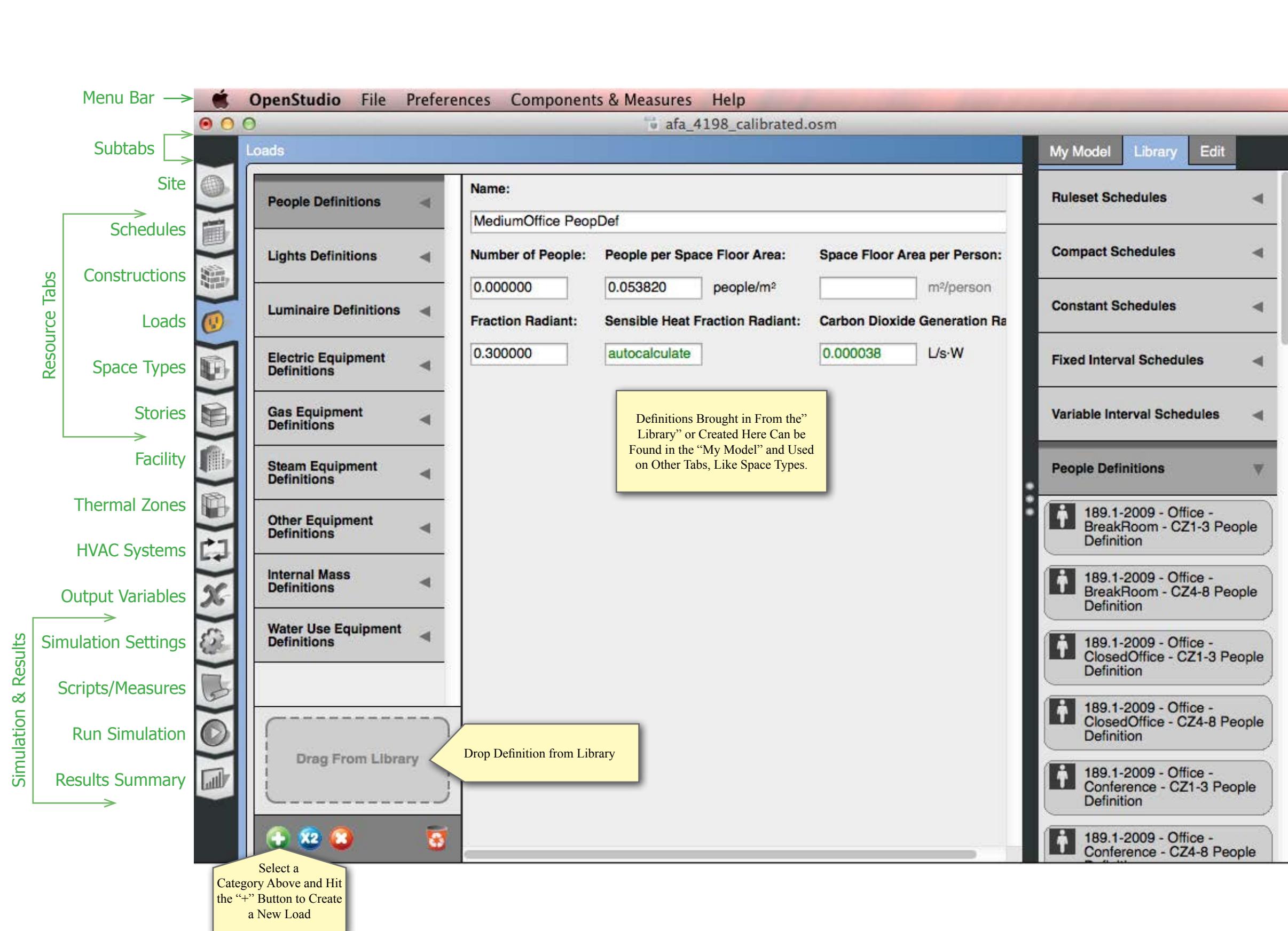
You can assign loads to a space type or directly to a space, except for Water Use Equipment.

The types of loads that can be added in this tab follow.

- People
- Lights
- Luminaires
- Electric Equipment
- Gas Equipment
- Steam Equipment
- Other Equipment
- Internal Mass
- Water Use Equipment

Internal mass is different than the other loads in that it does not use fuel; rather, it stores heat and then dissipates the heat over time. The inputs require a surface area assigned to a construction object.

Water Use Equipment is also unique in that it takes schedules, and is not part of a space type. Water Use Equipment is applied in the HVAC Systems Tab.



The screenshot shows the OpenStudio software interface with the "Loads" tab selected. The left sidebar lists various resource tabs: Site, Schedules, Constructions, Loads, Space Types, Stories, Facility, Thermal Zones, HVAC Systems, Output Variables, Simulation Settings, Scripts/Measures, Run Simulation, and Results Summary. The "Loads" tab is highlighted with a green arrow. The main workspace displays a "People Definitions" dialog box with fields for Name (MediumOffice PeopDef), Number of People (0.000000), People per Space Floor Area (0.053820 people/m²), Space Floor Area per Person (m²/person), Fraction Radiant (0.300000), Sensible Heat Fraction Radiant (autocalculate), and Carbon Dioxide Generation Rate (0.000038 L/s·W). A yellow callout box points to the "Definitions Brought in From the 'Library' or Created Here Can be Found in the 'My Model' and Used on Other Tabs, Like Space Types." At the bottom of the workspace, there is a "Drag From Library" button and a "Select a Category Above and Hit the '+' Button to Create a New Load" instruction. The right side of the interface features a library panel with sections for Ruleset Schedules, Compact Schedules, Constant Schedules, Fixed Interval Schedules, Variable Interval Schedules, and People Definitions, each listing several definitions with icons and names like "189.1-2009 - Office - BreakRoom - CZ1-3 People Definition".



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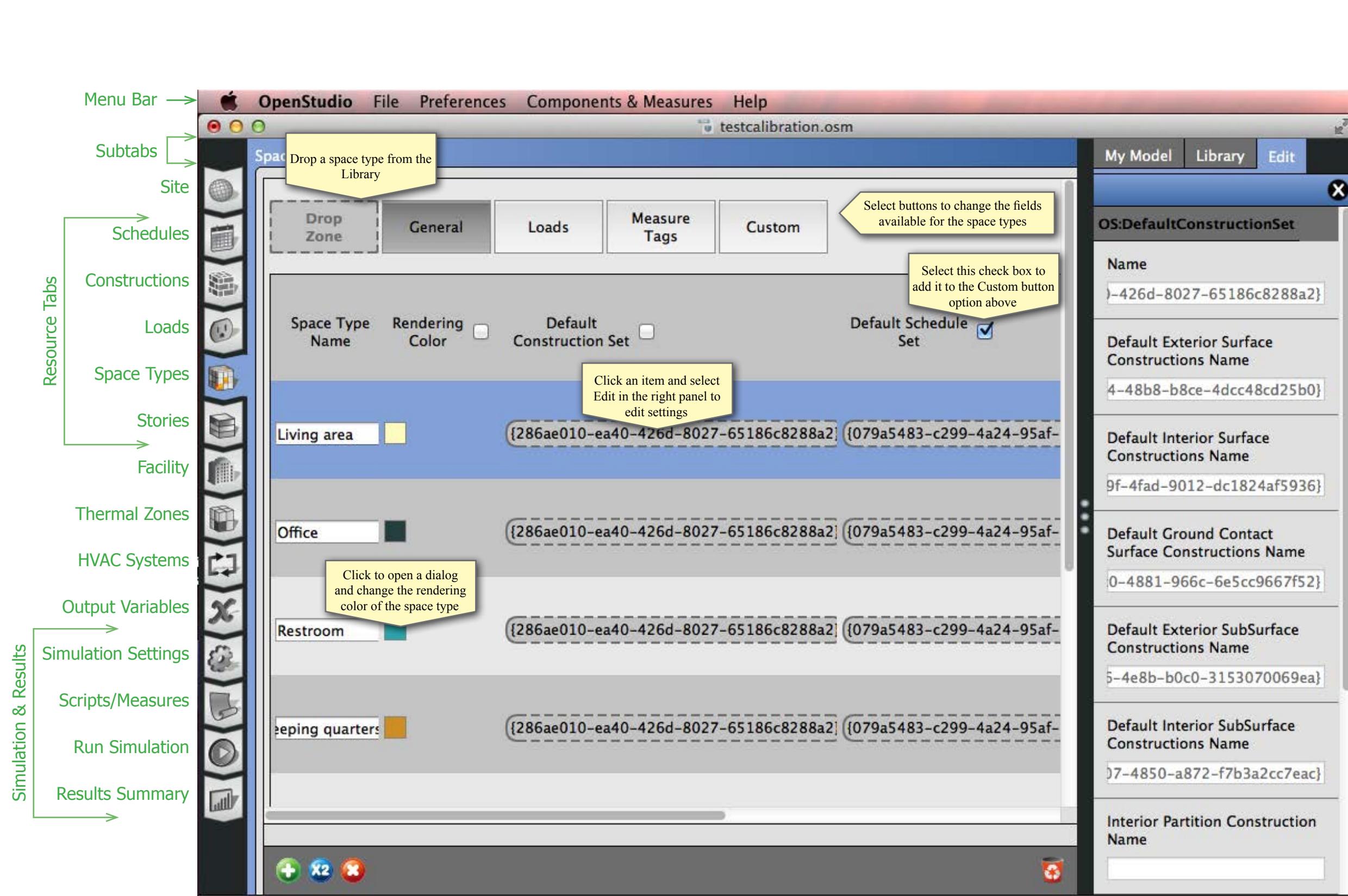
Space Types — General

Notes

Space types are the work horses of the resources in OpenStudio. Space types can define internal loads, schedule sets, and construction sets.

Space types define specific spaces or groups of specific spaces in your model. The spaces inherit all objects of the space type. If you redefine a space type, or an underlying object, it will affect all spaces using that space type.

The space types tab in the OpenStudio application is organized into a grid view. You can look through all your space types and edit the settings.



Resource Tabs

- Menu Bar →
- Subtabs →
- Site
- Schedules
- Constructions
- Loads
- Space Types
- Stories
- Facility
- Thermal Zones
- HVAC Systems
- Output Variables
- Simulation Settings
- Scripts/Measures
- Run Simulation
- Results Summary

Main Workspace (Space Types Tab)

Drop a space type from the Library

Select buttons to change the fields available for the space types

Select this check box to add it to the Custom button option above

Default Schedule Set

Click an item and select Edit in the right panel to edit settings

Click to open a dialog and change the rendering color of the space type

Right Panel (OS:DefaultConstructionSet)

- Name: -426d-8027-65186c8288a2
- Default Exterior Surface Constructions Name: 4-48b8-b8ce-4dcc48cd25b0
- Default Interior Surface Constructions Name: 9f-4fad-9012-dc1824af5936
- Default Ground Contact Surface Constructions Name: 0-4881-966c-6e5cc9667f52
- Default Exterior SubSurface Constructions Name: 5-4e8b-b0c0-3153070069ea
- Default Interior SubSurface Constructions Name: 07-4850-a872-f7b3a2cc7eac
- Interior Partition Construction Name: (empty)



Space Types — Loads

Notes

If you select the “Loads” button in the Space Type tab, you will see a drop zone to create new loads. You can have multiple loads of the same type.

The space types define loads such as lighting or electric equipment as simple area weighted power densities (e.g., W/ft²). However, you can add loads in several possible ways. For example, a space type could contain multiple types of lighting. You might define one lighting load for general lighting using a W/ft² and then add another lighting load for decorative lighting using another W/ft².

Space Type Name	Load Name	Multiplier	Definition	Schedule	Activity Schedule (People Only)
Living area	People 1	1.000000	mediumOffice PeopDef	Bldg lvl occ fire station	Medium Office Activity 1
	Lights 2	1.000000	iumOffice LightsDef 2	Bldg lvl lights	
	Equipment 4	1.000000	MediumOffice ElecDef	Bldg lvl equip	
	Equipment 7	1.000000	Seasonal Process Load	Seasonal Process Load	
	umOffice Infil				Always On Discrete
Office	People 2	1.000000	mediumOffice PeopDef	Bldg lvl occ fire station	Medium Office Activity 1
	Lights 3	1.000000	iumOffice LightsDef 3	Bldg lvl lights	
	Equipment 2	1.000000	ediumOffice ElecDef 1	Bldg lvl equip	
	nOffice Infil 1				Always On Discrete



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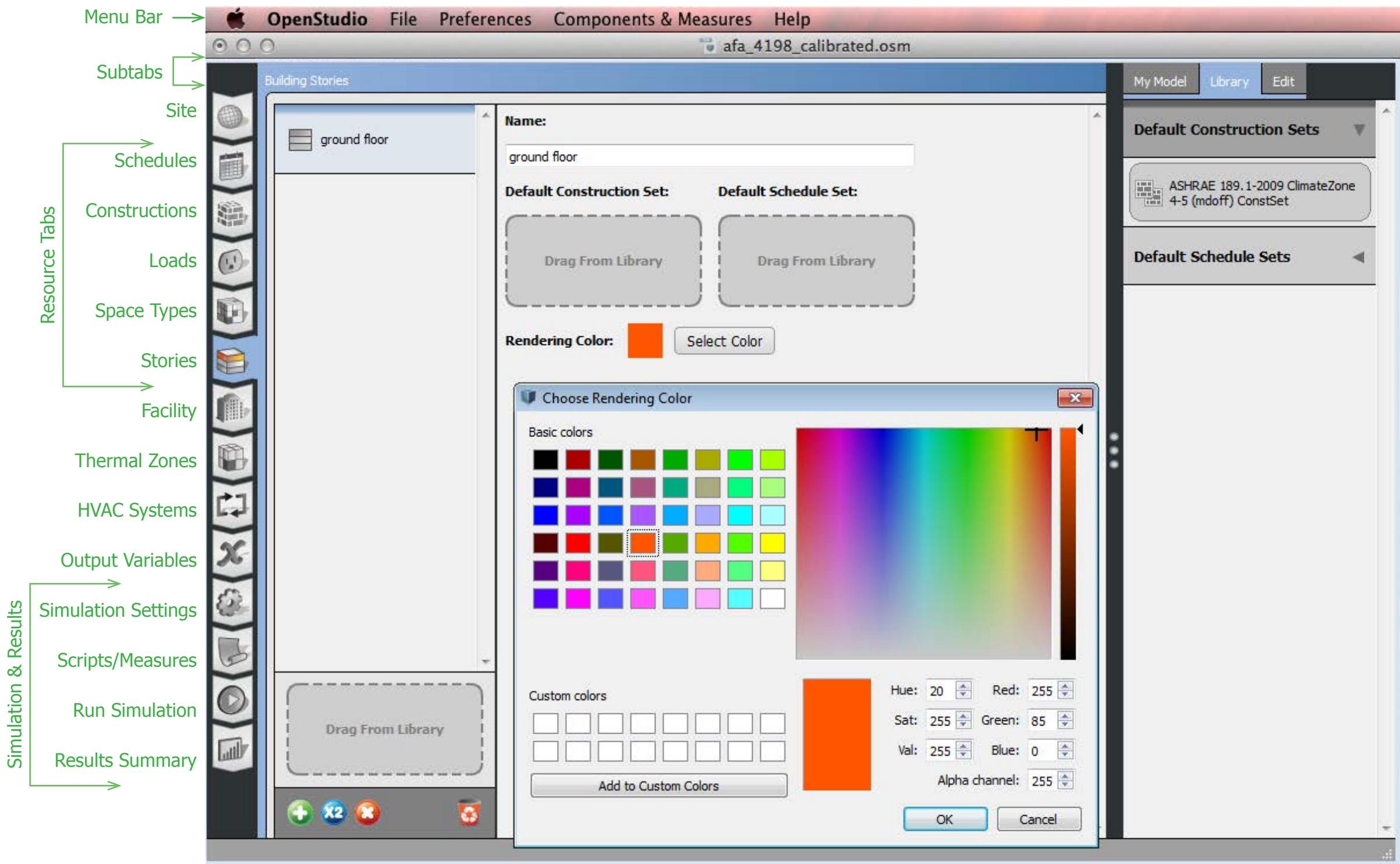
Building Stories

Notes

A Building Story is a container that can hold a collection of space objects. This can be used to change constructions or schedules based on the building story.

You can also use the story assignments to generate reports that summarize data by story.

The "Rendering Color" can be changed by clicking on the "Select Color" button. Then using the SketchUp Plug-in the model can be rendered.





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Facility — Space Type

Notes

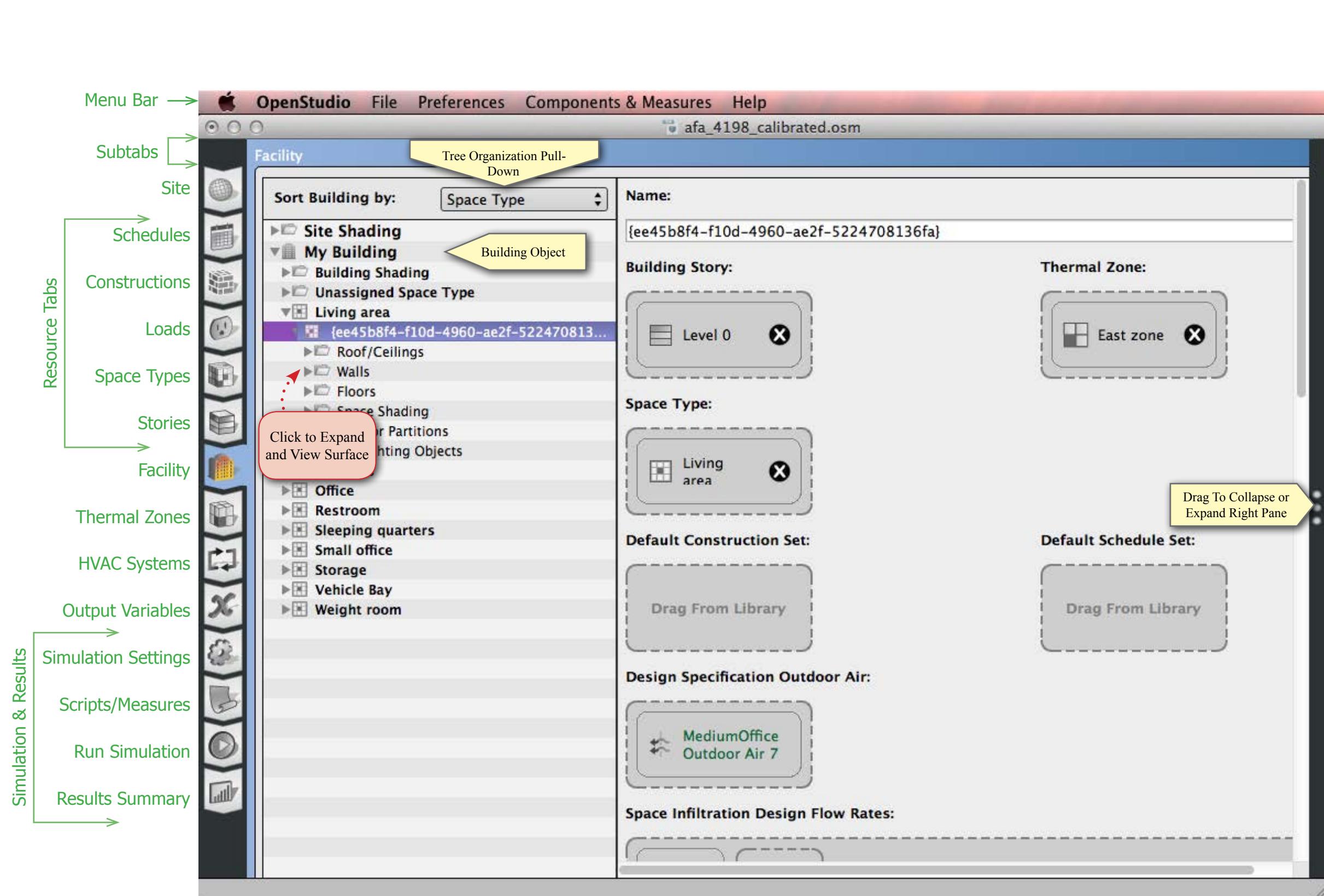
The Facility tab serves a number of functions. First, it allows you to see a hierarchical tree of your model. This tree can be organized by building story, thermal zone, or as shown here, space type.

If you are viewing the tree by space type, and a space does not have a space type assigned, it would appear under Unassigned Space Type. A similar pattern is followed for Thermal Zone and Story.

The Facility tab is also where you can select spaces and assign a building story, thermal zone, and space type. This is also where you can add loads to a space. These loads would be on top of loads inherited from the space type.

You can also drill down to inspect individual surfaces or subsurfaces.

Lastly, it lets you pick the Building object. This contains top level construction, schedule, or space type assignments, and sets the rotation for the building.





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Facility — Surface & Subsurface

Notes

This screenshot of the Facility tab shows a surface selected.

Although you will generally work with the SketchUp Plug-in to define the building envelope, having a surface or subsurface selected in the Facility tab will allow you inspect and edit most attributes. Only the vertices are locked down.

Spaces and surfaces cannot be deleted or created. You need to use the SketchUp Plug-in to do that.

Resource Tabs

- Menu Bar →
- Subtabs →
- Site →
- Schedules →
- Constructions →
- Loads →
- Space Types →
- Stories →
- Facility →
- Thermal Zones →
- HVAC Systems →
- Output Variables →
- Simulation Settings →
- Scripts/Measures →
- Run Simulation →
- Results Summary →

Tree Organization Pull-Down

Name: {ee45b8f4-f10d-4960-ae2f-5224708136fa} Above Ceiling Plenum Wall 1

Surface Type: Wall

Construction: Int wall

Outside Boundary Condition: Surface

When Outside Boundary Condition Is Surface, This Will Have A Matching Surface.

Outside Boundary Condition Object: {b5201d71-f3ed-4a30}

Drag To Collapse or Expand Right Pane

Sun Exposure: NoSun

Wind Exposure: NoWind

Vertices:

Number	x (m)	y (m)	z (m)
1	-2.45378	-9.66617	3.6576
2	-2.45378	-9.66617	3.048
3	0.619263	-8.85931	3.048
4	0.619263	-8.85931	3.6576

Click to Expand and View Surface

Construction Can Be Inherited from Space, Space Type, Story, or the Construction Can Be Set for a Specific Surface.



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[Online Training: Exhaust, VRF, and Refrigeration](#)

Thermal Zones

Notes

The Thermal Zones tab has four main functions.

1. The application allows you to turn ideal air loads on and off. This is a basic way to get heating and cooling load set points without having to define a detailed HVAC system.
2. It allows you to attach zone equipment to your zone, for example a Packaged Terminal Air Conditioner.
3. It allows you to assign thermostats to your thermal zone.
4. Set Sizing Parameters

If you click on an object in the Zone Equipment list, you will be able to inspect and edit it in the Edit tab on the right pane.

Tip

A Thermal Zone can't have ideal air loads on and have an Air Loop or Zone Equipment at the same time. If you try to use both, the previously selected system will be disabled.

If Thermal Zone Is On An Air Loop, Ideal Air Loads Will Be Turned Off

Select from these buttons to edit thermal zone settings

Multiple Zone Equipment Objects Can Be Attached to a Thermal Zone

Name	Turn On Ideal Air Loads	Air Loop Name	Zone Equipment	Cooling Thermostat Schedule	Heating Thermostat Schedule
East zone	<input type="checkbox"/>	AV with Reheat	Refrigerant Flow 1	Bldg lvl cooling	Bldg lvl heat
Hallway spaces	<input type="checkbox"/>	AV with Reheat	Refrigerant Flow	Bldg lvl cooling	Bldg lvl heat
Living	<input type="checkbox"/>	AV with Reheat		Bldg lvl cooling	Bldg lvl heat
North vehicle bay	<input checked="" type="checkbox"/>	None		Vehicle Cooling Schedule	Bldg lvl heat
South zone	<input checked="" type="checkbox"/>	None		Bldg lvl cooling	Bldg lvl heat

Resource Tabs: Subtabs, Site, Schedules, Constructions, Loads, Space Types, Stories, Facility, Thermal Zones, HVAC Systems, Output Variables, Simulation Settings, Scripts/Measures, Run Simulation, Results Summary.

Simulation & Results: Simulation Settings, Scripts/Measures, Run Simulation, Results Summary.

Right pane: My Model, Library, Edit. OS:Coil:Heating:Water. Checkboxes: Condenser Water Loop, Hot Water Heating Loop, **Hot Water Loop**, Chilled Water Loop, Hot Water Loop 1.

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HVAC Systems - Air Loop

Notes

The HVAC Systems tab is used to create, inspect, and edit air and plant loops. The green "+" at the top left is used to add template or empty loops, and the "x" next to it will delete them. The pull-down at the top right of the body is to select which loop to is displayed.

The top half of the loop is for supply-side objects, the bottom half is for demand. Thermal Zones and other objects can be dragged onto drop zones or nodes. Optionally you can select the splitter or mixer to bring up a list of Thermal Zones, checking the ones you want included in the loop.

When adding a template loop, there are four images within the icon. From left to right they represent the type of cooling, heating, fan, and terminal unit, in the template. The example below has cold and hot water, a variable speed fan, and a hot water reheat terminal unit.



Resource Tabs

- Menu Bar →
- Subtabs →
- Site
- Schedules
- Constructions
- Loads
- Space Types
- Stories
- Facility
- Thermal Zones
- HVAC Systems
- Output Variables
- Simulation Settings
- Scripts/Measures
- Run Simulation
- Results Summary

OpenStudio Interface Overview

The interface shows the HVAC Systems tab selected. A callout box points to the "HVAC Systems" subtab in the sidebar. Another callout box points to the "VAV with Reheat" dropdown menu item.

Component & Measures Tab

A callout box points to the "Components & Measures" tab in the menu bar. A callout box points to the "Chilled Water Loop" option in the dropdown menu.

Toolbar

A callout box points to the "Layout", "Control", and "Grid" buttons in the toolbar.

Loop View

A callout box points to the "Zoom Loop View" button in the toolbar.

Component Properties

A callout box points to the "OS:Coil:Cooling:Water" component properties panel on the right. It highlights the "Name" field set to "Coil Cooling Water 1". Other settings include "Autosized" for Design Water Flow Rate and "Autosize" for Design Air Flow Rate.

Loop Diagram

The main workspace displays a VAV with Reheat loop diagram. Labels include "Outdoor Air", "Cooling Coil", "Heating Coil", and "Fan". A callout box points to the "Click to Edit Air Loop Controls" button. Another callout box points to the "Only Available for Refrigeration" note. A callout box points to the "Click to View Cold Water Plant Loop" and "Click to View Hot Water Plant Loop" buttons.

Equipment Selection

A callout box points to the "Supply Equipment" and "Demand Equipment" sections. A callout box points to the "Select Line To Rename Loop" button. A callout box points to the "NEW: Select Zone to Add Plenums to Your HVAC System" note. A callout box points to the "Thermal Zone" and "Terminal" components.

Component Management

A callout box points to the "Click 'x' To Delete Component" button. A callout box points to the "Drag From Library" button. A callout box points to the "Optional Select Zone Splitter Or Zone Mixer To Batch Add Thermal Zones to a Loop" note.

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HVAC Systems — Controls View

Notes

The controls view is only available for the air loops. With an air loop selected in "Layout" view you can switch to "Control" view.

In this view you can edit the time of operation, night cycle, supply air temperature, and mechanical ventilation.

Resource Tabs

- Menu Bar →
- Subtabs →
- Site
- Schedules
- Constructions
- Loads
- Space Types
- Stories
- Facility
- Thermal Zones
- HVAC Systems
- Output Variables
- Simulation Settings
- Scripts/Measures
- Run Simulation
- Results Summary

Control Tab

Only Available for Air Loops

Only Available for Refrigeration

Callout Boxes:

- You May Click on This List to Navigate HVAC
- Click to Return to Layout View

Control View Content:

Packaged Rooftop VAV with Reheat

Cooling Type: DX Cooling Heating Type: Unclassified Heating Type

Time of Operation

HVAC Operation Schedule

Always On Discrete

Use Night Cycle

Follow the HVAC Operation Schedule

Supply Air Temperature

Supply temperature is controlled by a "SingleZoneReheat" setpoint manager.

Mechanical Ventilation

Economizer: No Economizer

Demand Controlled Ventilation: off

Results Summary

- Bldg lvl cooling
- Bldg lvl equip
- Bldg lvl heat
- Bldg lvl lights
- Bldg lvl occ fire station
- Bldg lvl water
- Bldg Lvl Water Vehicle Bay
- DHW Mixed Water Temperature
- Hot Water Temperature
- Hot_Water_Temperature 1

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HVAC Systems — Cold Water Loop

Notes

In the cold water loop the cooling coil that had been a supply side object on the air loop is now a demand object.

The supply side has a pump and a water cooled chiller. The adiabatic pipes are a necessary part of the loop. There are no attributes to set for the pipes.

You can click on the chiller to drill down further to the condenser loop. Or you can click on the cooling coil to go back to the air loop.



Resource Tabs

- Menu Bar →
- Subtabs →
- Site →
- Schedules →
- Constructions →
- Loads →
- Space Types →
- Stories →
- Facility →
- Thermal Zones →
- HVAC Systems →
- Output Variables →
- Simulation Settings →
- Scripts/Measures →
- Run Simulation →
- Results Summary →

Chilled Water Loop

Only Available for Air Loops

Only Available for Refrigeration

Zoom Loop View

Chilled Water Loop

Pump

Adiabatic Pipe

Drag From Library

Supply Equipment

Demand Equipment

Select Line To Rename Loop

Chilled Water Loop

Cooling Coil

Click to View Condenser Loop

Click to View Air Loop

You May Click on This List to Navigate HVAC

OS:PlantLoop

Name: Chilled Water Loop

Fluid Type: Water

User Defined Fluid Type: Most Loop Components Can Be Edited

Loop Temperature Setpoint Node Name: Node 28

Setpoint Manager

Maximum Loop Temperature: 100.0 C

Minimum Loop Temperature: 0.0 C

Maximum Loop Flow Rate: Hard Sized m³/s

Autosized: Autosize

Minimum Loop Flow Rate: 0.0 m³/s

Changing the Plant Name in the "Edit" panel will Change the Default Name in the Dropdown

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HVAC Systems — Condenser Loop

Notes

In the condenser loop the chiller that had been a supply side object on the cold water loop is now a demand object.

The supply side has a pump and a cooling tower. As with the cold water loop the adiabatic pipes are a necessary part of the loop.

You can click on the chiller to drill to go back to the cold water loop.



Menu Bar → OpenStudio File Preferences Components & Measures Help

Subtabs → Site Schedules Constructions Loads Space Types Stories Facility Thermal Zones HVAC Systems Output Variables Simulation Settings Scripts/Measures Run Simulation Results Summary

Resource Tabs → Add And Delete Air and Plant Loops Only Available for Air Loops Only Available for Refrigeration Zoom Loop View

Condenser Water Loop Chilled Water Loop Condenser Water Loop Hot Water Loop VAV with Reheat Service Hot Water Refrigeration VRF

Click to View Cold Water Plant Loop

Pump Cooling Tower Adiabatic Pipe Supply Equipment Demand Equipment Chiller Setpoint Manager

Drag From Library Drag From Library

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My Model Library Edit

VRF Terminal

VRF System

AirTerminal Single Duct VAV NoReheat

AirLoopHVAC Outdoor Air System

AirTerminal Single Duct Uncontrolled

AirTerminal Single Duct VAV Reheat

AirTerminal Single Duct Constant Volume Reheat

AirTerminal Single Duct VAV Reheat

Air Terminal Chilled Beam

Boiler Hot Water

Coil Cooling Water To Air HP

Coil Cooling DX SingleSpeed

Coil Cooling DX TwoSpeed

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HVAC Systems — Hot Water Loop

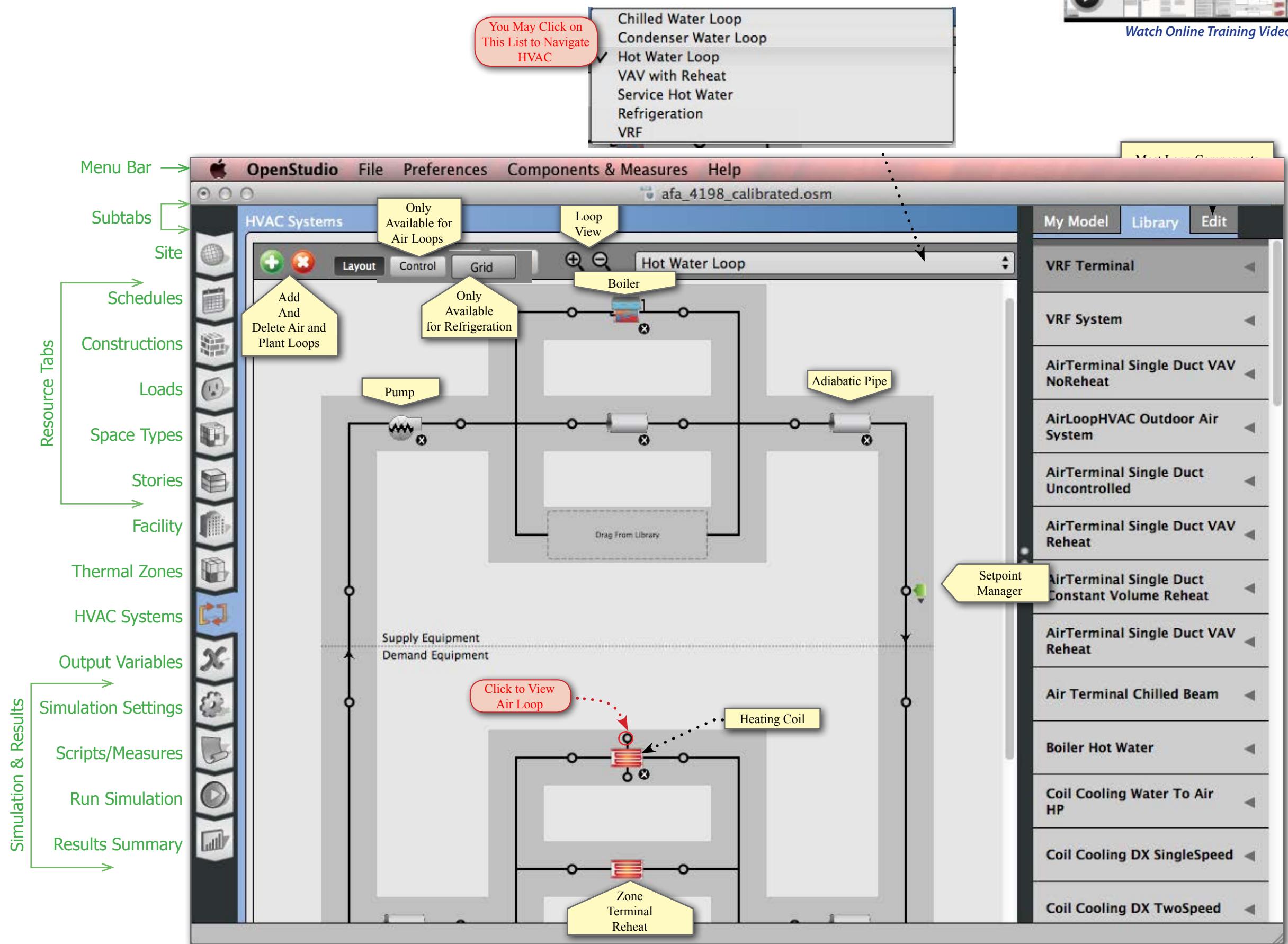
Notes

In the hot water loop the heating coil that had been a supply side object on the air loop is now a demand object.

The supply side has a pump and a boiler. The boiler can use a variety of fuels. The adiabatic pipes are a necessary part of the loop. There are no attributes to set for the pipes.

You can click on the heating coil to go back to the air loop.

The heating coils without links represent the reheat terminals for each connected Thermal Zone.



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HVAC Systems — Plenums

Notes

To add supply and return plenum zones:

1. To access the plenum editor, select the zone on the layout view.
2. Select the Edit tab on the right panel and click on the plenum icon on the blue bar.
3. Choose a plenum from the drop down list or create a new plenum zone but selecting the green add button. The zones available to be plenums will be selectable in a dialog. Create new zones for plenums in the Thermal Zones tab on the left.

Shared plenums will be colored the same and will match the color selected for the plenum zone on the Thermal Zones tab.

The screenshot shows the OpenStudio interface with the following annotations:

- Resource Tabs:** A vertical list of tabs on the left: Notes, HVAC Systems — Plenums, Site, Schedules, Constructions, Loads, Space Types, Stories, Facility, Thermal Zones, HVAC Systems, Output Variables, Simulation Settings, Scripts/Measures, Run Simulation, and Results Summary.
- Menu Bar:** Shows "OpenStudio" as the active application.
- Subtabs:** Under the "HVAC Systems" tab, there are three sub-tabs: "Layout" (selected), "Control", and "Grid".
- Toolbar:** Includes "Add And Delete Air and Plant Loops", "Zoom Loop View", and a dropdown set to "VAV with Reheat".
- Layout View:** Displays a piping network diagram with various components like Supply Equipment, Demand Equipment, and valves. Labels include "Return Plenum", "Shared Supply Plenum", and "Plenum Zone 3".
- Dialog Box:** A modal window titled "Dialog for New Return Plenum" with the following content:
 - Text: "Choose an available zone to use as a plenum. Only zones that are not conditioned by an air system or zone equipment are displayed."
 - Dropdown: "Plenum Zone 3"
 - Buttons: "Apply" and "Cancel"
- Top Right Overlay:** A red callout box says "You May Click on This List to Navigate HVAC". Below it is a list of HVAC loop types: Chilled Water Loop, Condenser Water Loop, Hot Water Loop, VAV with Reheat (checked), Service Hot Water, Refrigeration, and VRF.
- Right Panel:** Shows "My Model" selected in the library. It includes sections for "Select Supply Plenum" (Thermal Zone 2), "New Supply Plenum", "Select Return Plenum" (Ducted Return - No Plenum), and "New Return Plenum".

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HVAC Systems —Water Mains Editor

Notes

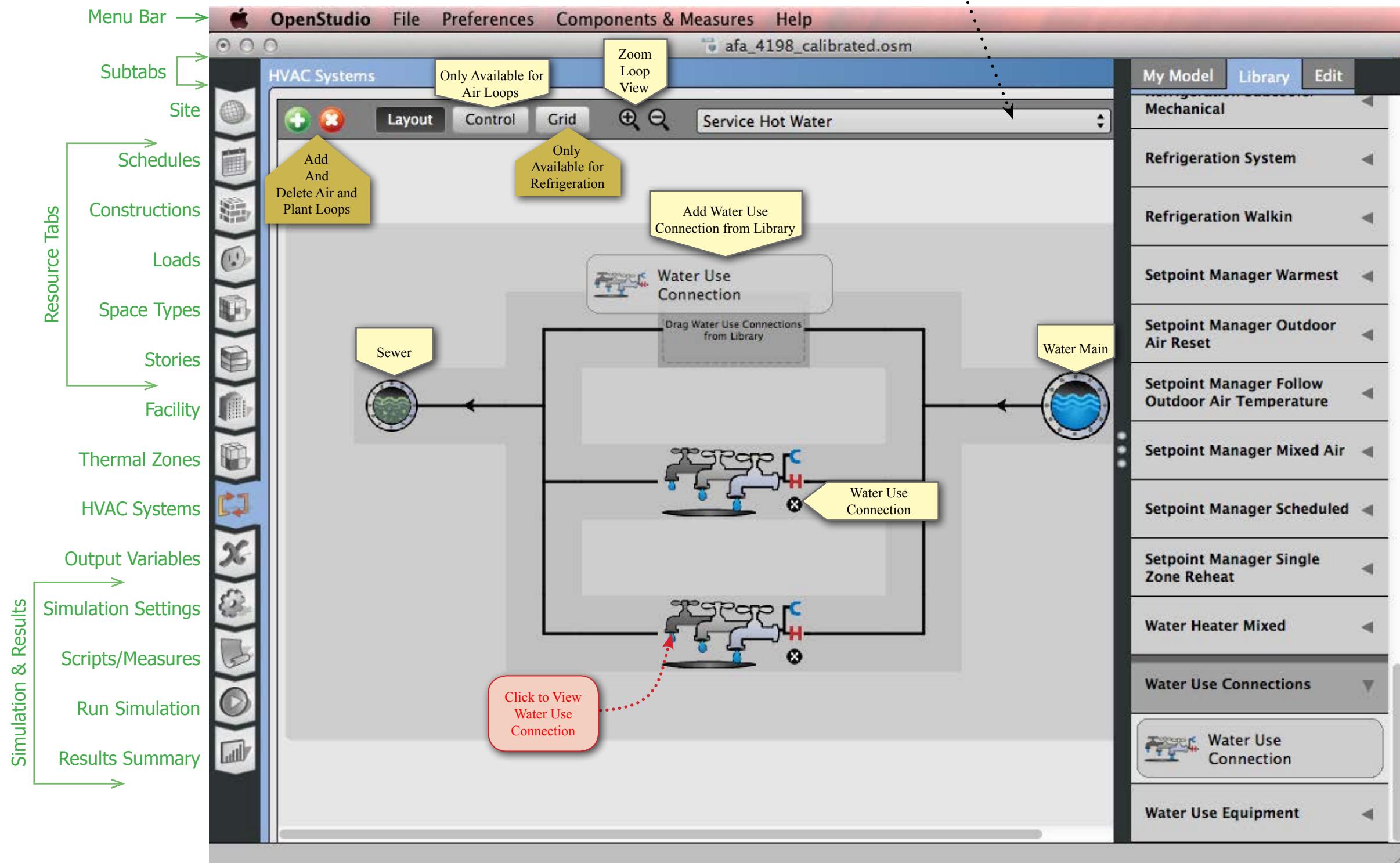
New to OpenStudio 0.9.0 are tools to model service hot water. The first view into the HVAC tab will be the water mains editor, which shows as "Service Water" on loops pulldown list.

Water enters the system at the right and leave at the Sewer on the left. One or more water use connections can be added in the middle.

Clicking a water use connection will take you to a model window where you can add water use equipment.

You May Click on
This List to Navigate
HVAC

- Chilled Water Loop
- Condenser Water Loop
- Hot Water Loop
- VAV with Reheat
- Service Hot Water
- Refrigeration
- VRF



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HVAC Systems — Water Use Connection

Notes

Dragging a water use equipment object into the water use connection will create an instance of that definition. Much like lights, people and other loads, there is a fractional schedule to define usage patterns.

Optionally you can associate the equipment with a space. There is no direct energy use to the space, but heat from the equipment will be added to the space.

The equipment can be anything that uses water, hot or cold. The definition contains a peak flow rate and a target temperature schedule. Hot and cold water will mix to reach the target temperature at the fixture.

Click the water main, sewer, or makeup water to go back to the water mains editor. If you have a plant loop associated with the water use connection the "Loop" button will take you to the loop.

You May Click on This List to Navigate HVAC

- Chilled Water Loop
- Condenser Water Loop
- Hot Water Loop
- VAV with Reheat
- Service Hot Water
- Refrigeration
- VRF

Menu Bar → OpenStudio File Preferences Components & Measures Help

Subtabs → Site Schedules Constructions Loads Space Types Stories Facility Thermal Zones HVAC Systems Output Variables

Resource Tabs → Simulation Settings Scripts/Measures Run Simulation Results Summary

Click to View Service Hot Water Loop

Click to View Service Hot Water Loop

Click to View Water Mains Editor

OS:WaterUse:Equipment

Name: Water Use Equipment 1

Water Use Equipment Definition Name: 3 showers

Space Name: {250c8647-2e78-43e6-a512}

Flow Rate Fraction Schedule Name: Bldg lvl water

Most Components Are Editable

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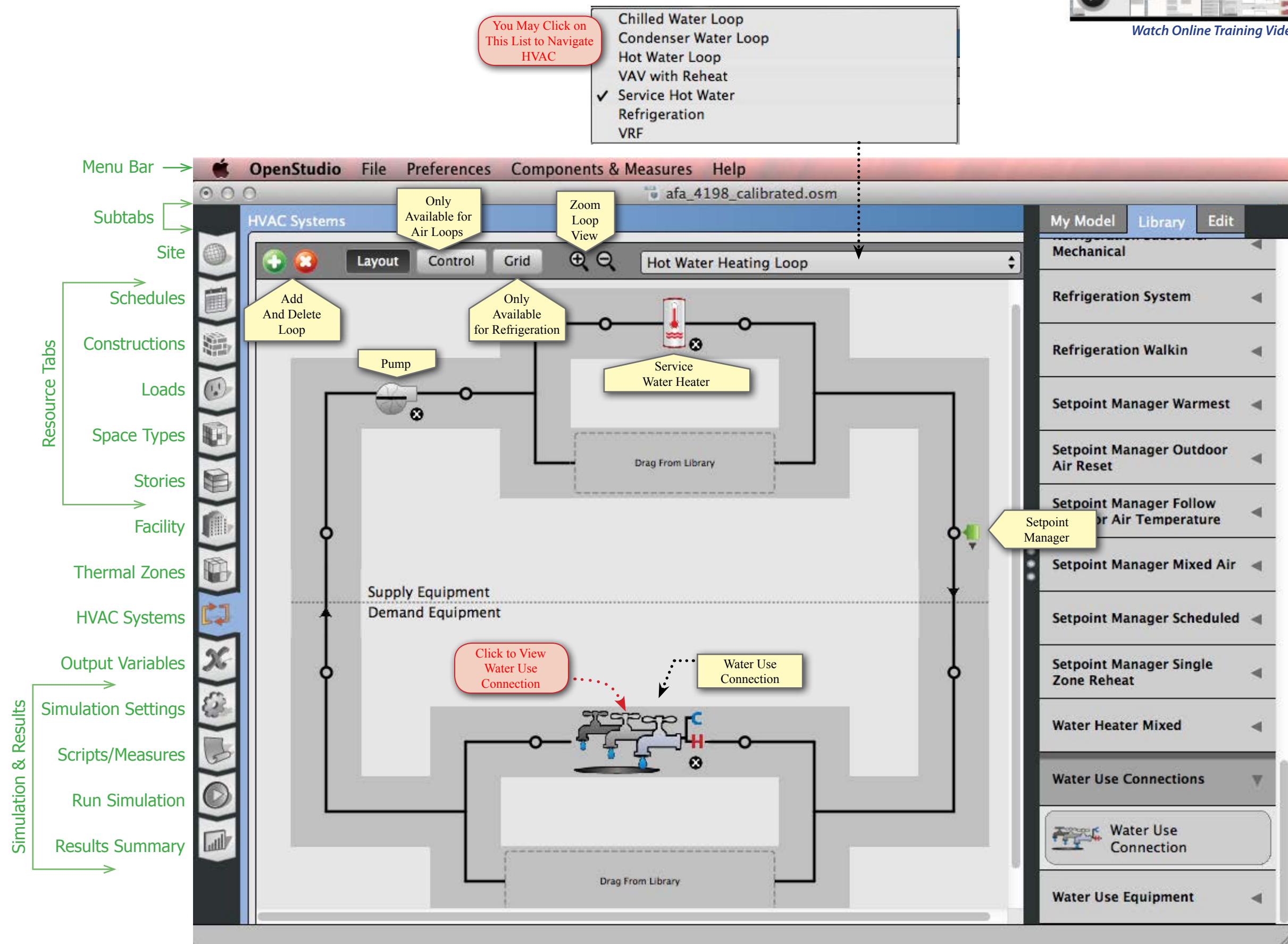
HVAC — Service Water Heater Loop

Notes

The service water heater loop starts off just like any other plant loop, but unlike the ones serving an air loop, this plant loop as water use connections on the demand side, and a hot water heater, vs. a boiler on the supply side. A pump and setpoint manager are also necessary.

Both the hot water heater and the setpoint manager require a temperature schedule. Generally these should use the same schedule, which should have a temperature high enough to meet the setpoints at the water use equipment objects.

The energy that goes into the hot water heater will show up in the results page as "Water Systems". The pump is not included in this. The results page does not show water usage, but you can look at the Annual Building Utility Performance Summary (ABUPS) report in ResultsViewer to see water usage.



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HVAC — Add Refrigeration System

Notes

The refrigeration system interface can be accessed by selecting refrigeration from the drop down menu.

To add a refrigeration system select one from the library and add drag it to the drop zone.

Click on the zoom button by the name of the refrigeration system to go to a view of that system, add components from the library.

Drop Refrigeration System

Resource Tabs

- Menu Bar →
- Subtabs →
- Site
- Schedules
- Constructions
- Loads
- Space Types
- Stories
- Facility
- Thermal Zones
- HVAC Systems
- Output Variables
- Simulation Settings
- Scripts/Measures
- Run Simulation
- Results Summary

Grid View of Refrigeration

Chilled Water Loop
Condenser Water Loop
Hot Water Loop
VAV with Reheat
Service Hot Water
✓ Refrigeration
VRF

You May Click on This List to Navigate HVAC

Refrigeration System Template

Refrigeration Condenser Air Cooled
Refrigeration Condenser Evaporative Cooled
Refrigeration Condenser Water Cooled
Refrigeration Condenser Cascade
Refrigeration Compressor
Refrigeration Subcooler Liquid Suction
Refrigeration Subcooler Mechanical
Refrigeration System
Cascade System
Refrigeration System
Refrigeration Walkin
Setpoint Manager Warmest

Drop Refrigeration System

Summary View of Cases

Add by Dragging a Refrigeration System from Library

Add Cascade or Secondary System

Drag and Drop Cases
Display Cases
Walkin Cases

Drag and Drop Compressor
2
1

Not Used in Refrigeration
Only Available for Air Loops

Grid

Refrigeration

Zoom in to Single Refrigeration System

Delete Refrigeration System

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HVAC — Edit Refrigeration System in Layout View

Notes

This zoomed in view provides the layout view of one refrigeration rack. You may add cases by dragging them on to the "Drag and Drop Cases" drop zone.

Drop zones are provided to accommodate systems with a mechanical subcooler and an Suction Line Heat Exchanger (SLHX).

The small arrow at the bottom of the refrigeration case summary will open and expanded view of cases. Each case can be selected and edited in the Edit panel on the right.

Cascade systems can be added by dragging the from "My Model" or the "Library."

An alternate view of the refrigeration systems is provided by the grid view.

Resource Tabs

- Menu Bar →
- Subtabs →
- Site →
- Schedules →
- Constructions →
- Loads →
- Space Types →
- Stories →
- Facility →
- Thermal Zones →
- HVAC Systems →
- Output Variables →
- Simulation Settings →
- Scripts/Measures →
- Run Simulation →
- Results Summary →

Grid View of Refrigeration

You May Click on This List to Navigate HVAC

Chilled Water Loop
Condenser Water Loop
Hot Water Loop
VAV with Reheat
Service Hot Water
✓ Refrigeration
VRF

Not Used in Refrigeration
Only Available for Air Loops
Zoom out to multiple refrigeration systems view

Add refrigeration cases in drop zone

Click arrow to expand the view and inspect individual cases

The Zoom Will Open a View of the Cascade System

OS:Refrigeration:Condenser:WaterCo

Name: Refrigeration Condenser Water Co

Rated Effective Total Heat Rejection Rate: 58000

Rated Condensing Temperature: 29.4

Rated Subcooling Temperature Difference: 0

Edit Components by Selecting Them in Layout View and Select "Edit"

Rated Water Flow Rate: 10

Water Inlet Node Name:

Water Outlet Node Name:

Water-Cooled Loop Flow Type: ConstantFlow

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HVAC — Edit Refrigeration Systems in Grid View

Notes

The refrigeration grid view provides a method for entering case settings in a spreadsheet style. Cases can be added, assigned to racks, and edited in this view.

There are two major divisions, one for Display Cases and another for Walk-ins. Under each division a drop box is available to add new cases. There are also buttons to move through the case settings and enter the data on each case.

Create your own custom view of this information by checking the box on the right of the column header. Checked columns will show up under the Custom button.

Tips

User-selected, custom fields will be saved when the application is closed, and will automatically load when the application is next started.

In the initial release of the grid view, no provision was made to delete a case or walk in; they must be assigned to a rack, and deleted from the layout view. This functionality omission will be corrected in the next OpenStudio release.

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Menu Bar → OpenStudio File Preferences Components & Measures Help

Toolbar Buttons:

- Drop Case
- General
- Operation
- Cooling Capacity
- Fan
- Lighting
- Case Anti-Sweat Heaters
- Defrost And Restocking
- Custom

Contextual Menus:

- Drop cases here to add to add new cases to a system
- Return to Layout View of Refrigeration
- You May Click on This List to Navigate HVAC
- Chilled Water Loop
Condenser Water Loop
Hot Water Loop
VAV with Reheat
Service Hot Water
✓ Refrigeration
VRF
- Click on the Buttons to Fill in the
- Check this box to make this field show up in the Custom section
- When selecting a model object in a combo box, the available list of model objects has been filtered to only list valid objects for that particular application.
- Buttons Selected Change Input Fields for Cases
- Drop walk-in cases here to add to add new cases to a system
- Assign cases to racks under the General Section

Right Panel:

- Cooled
- Refrigeration Condenser Evaporative Cooled
- Refrigeration Condenser Water Cooled
- Refrigeration Condenser
- Refrigeration Compressor
- Refrigeration Subcooler Liquid Suction
- Refrigeration Subcooler Mechanical
- Refrigeration System
- Refrigeration Walkin
- Refrigeration Walk In
- Setpoint Manager Warmest
- Setpoint Manager Outdoor Air Reset
- Setpoint Manager Follow Outdoor Air Temperature

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HVAC - Add Variable Refrigerant Flow (VRF) System

Notes

Variable refrigerant flow (VRF) systems can be added by dragging them onto the large drop zone from the library.

This view provides a view of all the VRF systems in the model. The zoom icon by the name of the system will open a detailed view of that system. This single system view is shown on the next page.

Resource Tabs

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- Subtabs →
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Drop VRF System

For VRF Only the Layout View is Available

Click to Open a Detailed View of the System

Delete the VRF System

Number of Terminals and Zones

0 Terminals 0 zones 0 Zones

Library

- Chilled Water Loop
- Condenser Water Loop
- Hot Water Loop
- VAV with Reheat
- Service Hot Water
- Refrigeration
- ✓ VRF

You May Click on This List to Navigate HVAC

My Model

- VRF Terminal
- VRF System
- Air Conditioner Variable Refrigerant Flow
- AirTerminal Single Duct VAV NoReheat
- AirLoopHVAC Outdoor Air System
- AirTerminal Single Duct Uncontrolled
- AirTerminal Single Duct VAV Reheat
- AirTerminal Single Duct Constant Volume Reheat
- AirTerminal Single Duct VAV Reheat
- Air Terminal Chilled Beam
- Boiler Hot Water
- Coil Cooling Water To Air HP
- Coil Cooling DX SingleSpeed

OpenStudio 1.5.0 Basic Workflow Guide

(October 2014)



HVAC - Edit Variable Refrigerant Flow (VRF)

Notes

To create your VRF system, start by dropping a terminal from the "Library" onto the drop zone. Then add thermal zones from "My Model." When a thermal zone is added a new VRF terminal will automatically be created.

Set the terminal settings by selecting the terminal and editing in the "Edit" tab on the right.

More than one terminal can connect with the same zone. Just drag the zone to the drop area again to add another connection.

Tip

Add one thermal zone and edit the settings in the "Edit" tab and when you add a new zone to the system, the settings from that terminal will be applied to the new one.

You May Click on This List to Navigate HVAC

- Chilled Water Loop
- Condenser Water Loop
- Hot Water Loop
- VAV with Reheat
- Service Hot Water
- Refrigeration
- VRF

Menu Bar → OpenStudio File Preferences Components & Measures Help

Subtabs → Site Schedules Constructions Loads Space Types Stories Facility Thermal Zones HVAC Systems Output Variables

Resource Tabs → HVACS Layout Control Grid VRF Go Back to View of All VRF Systems

Simulation & Results → Simulation Settings Scripts/Measures Run Simulation Results Summary

For VRF Only the Layout View is Available

Add One Terminal When Starting and Then Add Zones

Add Thermal Zone from "My Model"

Drop VRF Terminal

Drop Thermal Zone South zone

Delete Zone From System

Hallway spaces

Delete Terminal From System

East zone

Schedules

Chiller Electric EIR

Coil Cooling Water

Coil Heating Water

Refrigeration Condenser Water Cooled

Refrigeration System

Thermal Zone

East zone

Hallway spaces

Living

North vehicle bay

South zone



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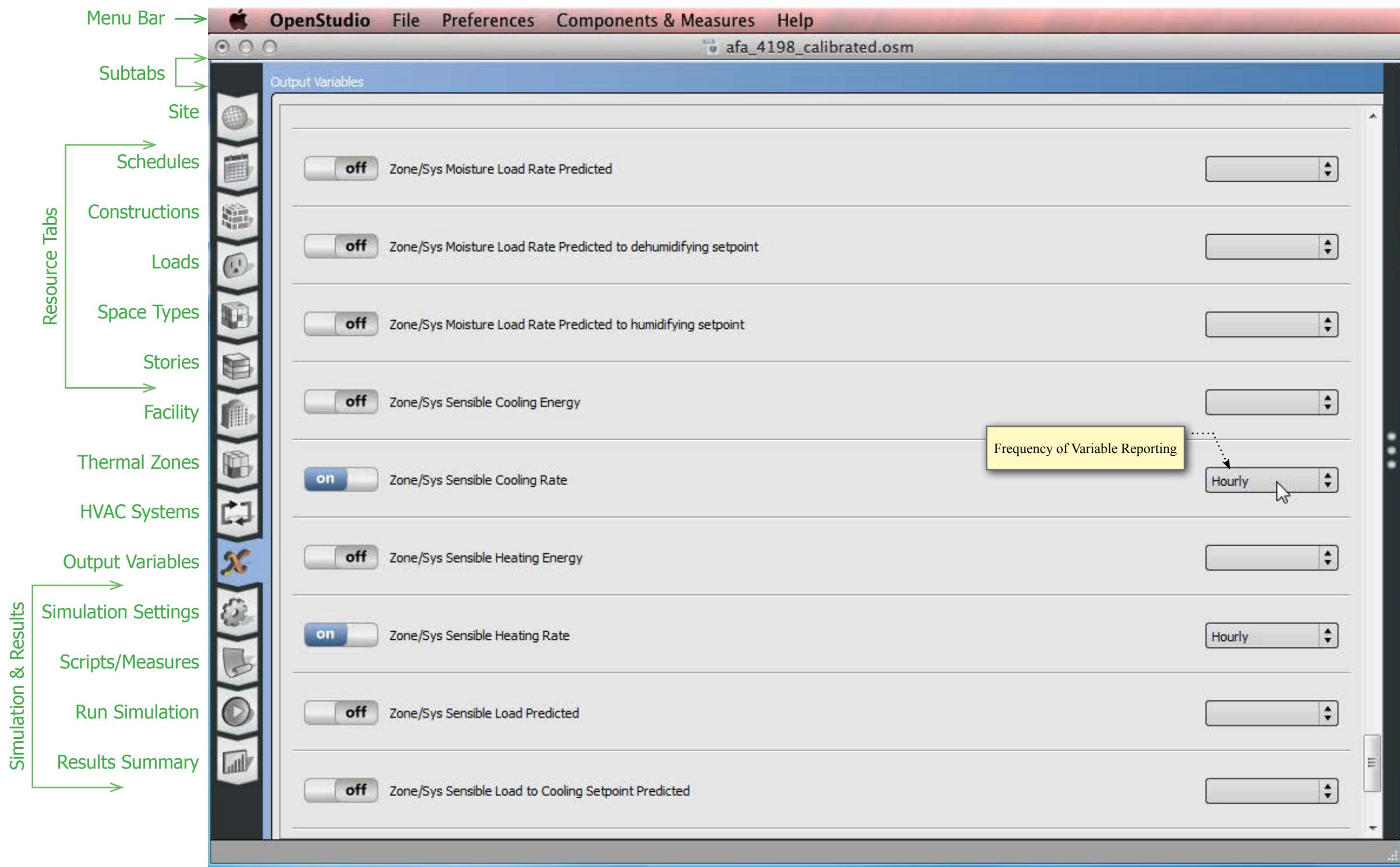
Output Variables

Notes

The Output Variables tab creates a list of variables based on the type of objects you have in your model. You can then turn them on or off and set the frequency of reporting.

These variables populate the SQL file generated by EnergyPlus with annual time series results data. You can view them in ResultsViewer. The Results Summary tab in this application is not affected by the variable requests.

It will not offer a comprehensive list of variables. If you want to add a variable that is not here or name a specific object to report, you can accomplish this by injecting raw IDF text in the Scripts tab.





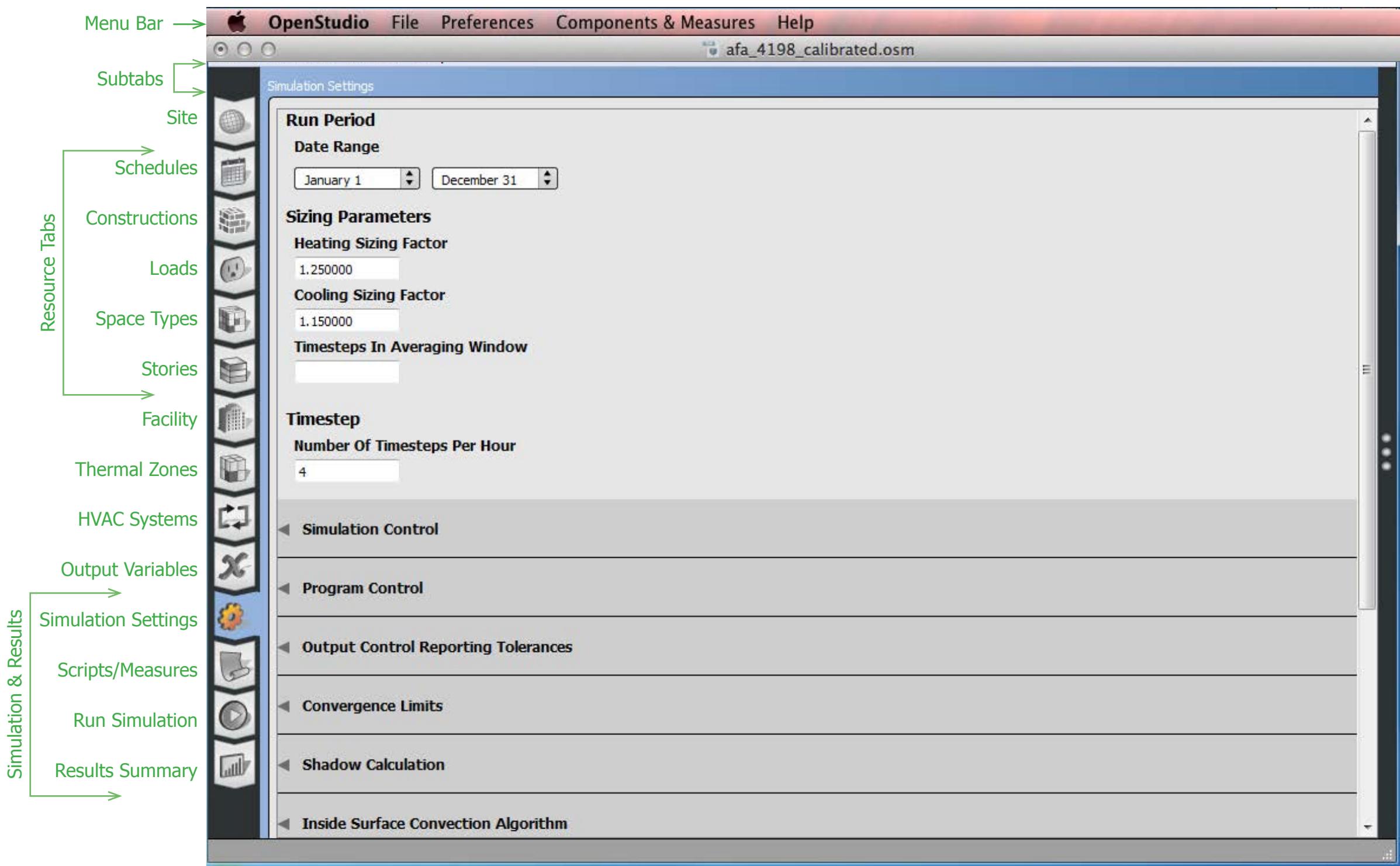
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Simulation Settings

Notes

The Simulation Settings tab lets you inspect and customize many of the simulation settings used by EnergyPlus. Soon Radiance configuration settings will also be added. Below is a list of settings included in OpenStudio 0.10.0.

- RunPeriod
- SimulationControl
- SizingParameters
- ProgramControl
- Timestep
- OutputControlReportingTolerances
- ConvergenceLimits
- ShadowCalculation
- SurfaceConvectionAlgorithmInside
- SurfaceConvectionAlgorithmOutside
- HeatBalanceAlgorithm
- ZoneAirHeatBalanceAlgorithm
- ZoneAirContaminantBalance
- ZoneCapacitanceMultipleResearchSpecial





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Measures or Scripts

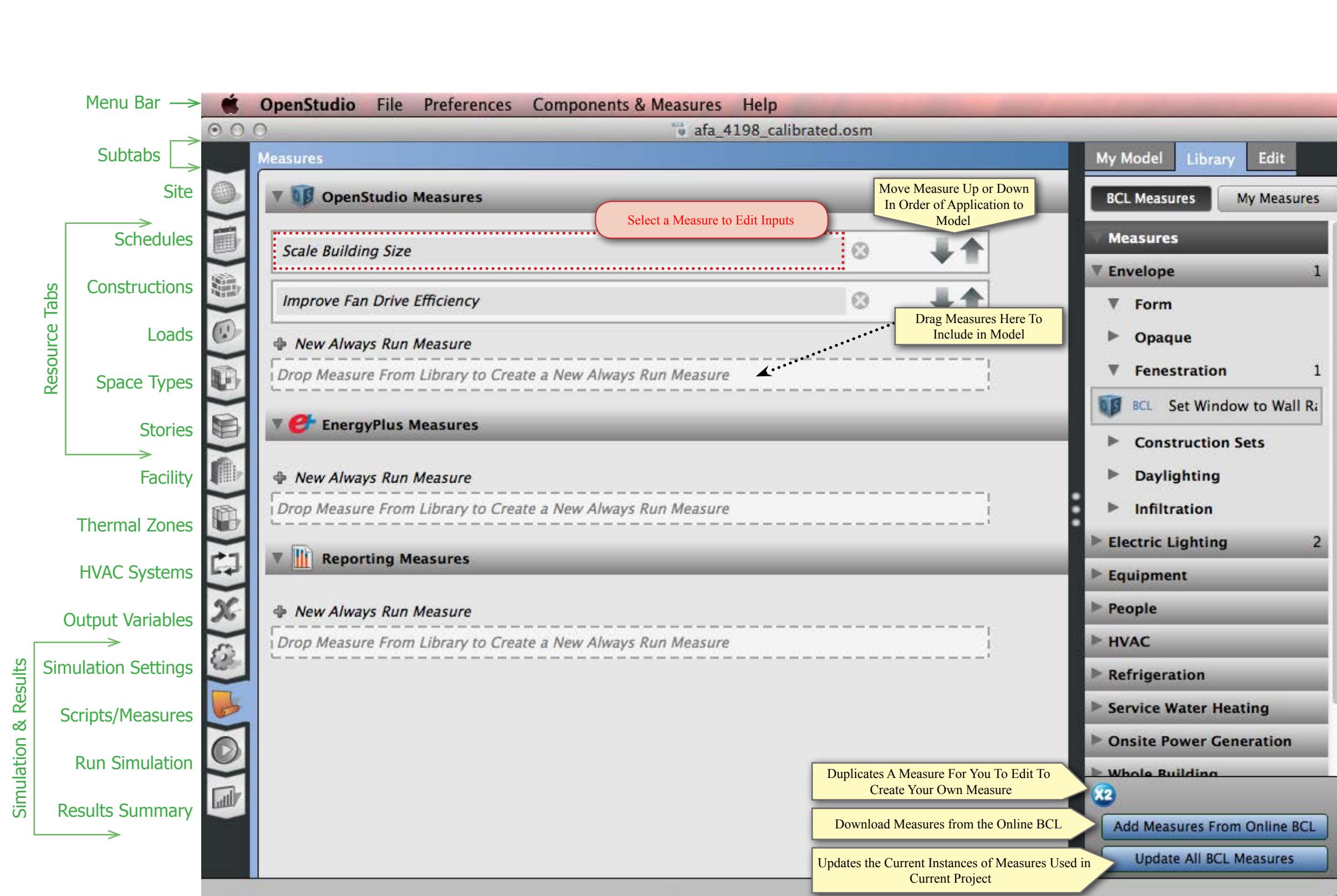
Notes

The Measures/Scripts tab is a very powerful tool that allows you to extend the functionality of OpenStudio. To use this tab you need to have Ruby installed on your machine. Ruby is not automatically installed as part of OpenStudio. The OpenStudio website has instructions for installing ruby on Windows and Linux. Mac has Ruby installed by default.

An important thing to understand about the Measures tab is when scripts can be run in the simulation workflow. The normal workflow for running a simulation is to convert the OSM (OpenStudio Model) to an IDF (Input Data File), then that IDF is handed to EnergyPlus to run a simulation.

Model Measures are run on the OSM model before it is converted to an IDF. EnergyPlus measures are run on the IDF file before it is handed to EnergyPlus.

Some measures such as the example shown here take arguments. These arguments and the scripts are saved alongside your OSM file.





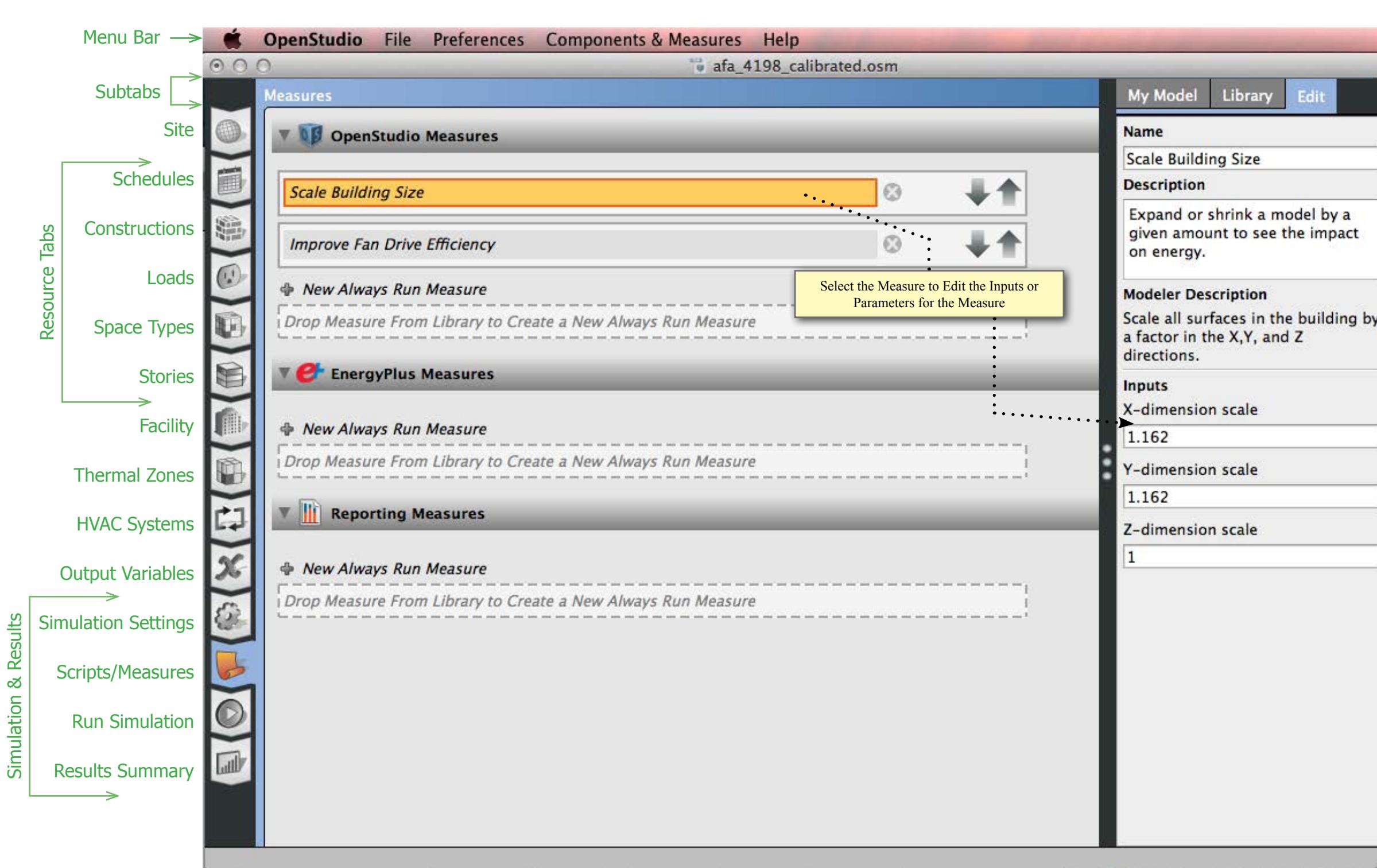
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Add Measures or Scripts to Run With Simulation

Notes

By selecting the measure and selecting the right "Edit" tab, inputs for the measure can be entered and adjusted.

Write your own measures by studying the guide on the OpenStudio site at: <http://openstudio.nrel.gov/openstudio-measure-writing-guide>.



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Simulation & Results

- Scripts/Measures
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Menu Bar → OpenStudio File Preferences Components & Measures Help

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Measures

OpenStudio Measures

Scale Building Size

Improve Fan Drive Efficiency

New Always Run Measure

Drop Measure From Library to Create a New Always Run Measure

EnergyPlus Measures

New Always Run Measure

Drop Measure From Library to Create a New Always Run Measure

Reporting Measures

New Always Run Measure

Drop Measure From Library to Create a New Always Run Measure

Name: Scale Building Size

Description: Expand or shrink a model by a given amount to see the impact on energy.

Modeler Description: Scale all surfaces in the building by a factor in the X,Y, and Z directions.

Inputs:

- X-dimension scale: 1.162
- Y-dimension scale: 1.162
- Z-dimension scale: 1



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Run Simulation — Output

Notes

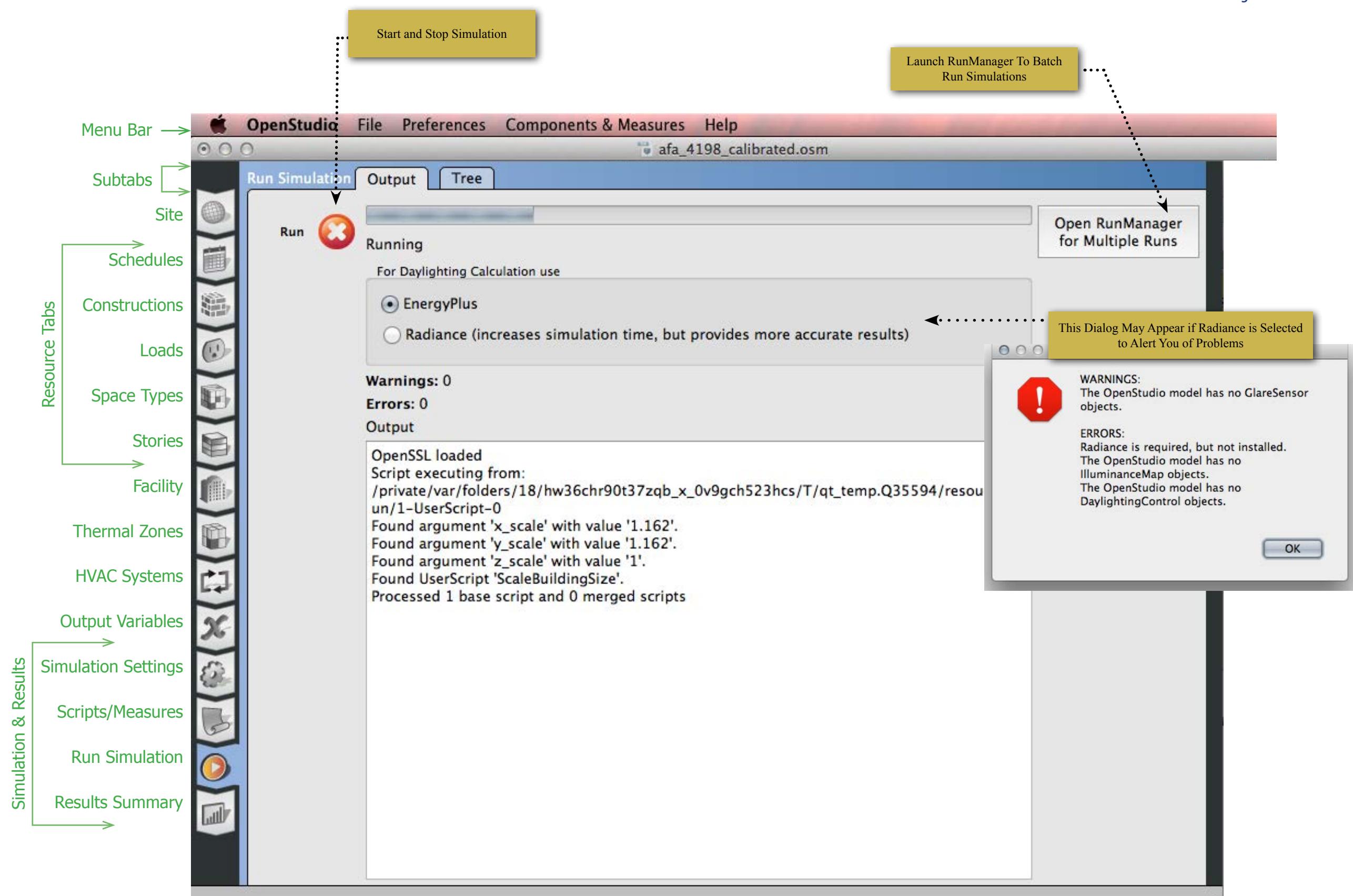
The Run Simulation tab is used to run a simulation. Clicking the green arrow starts the simulation. When the progress bar reaches 100% it is done.

New to OpenStudio 0.9.0 is a check box to use Radiance for daylighting calculations. [Using Radiance within OpenStudio requires installation of a number of other tools](#). Look on OpenStudio for videos (coming soon) demonstrating a workflow for using Radiance.

The output window shows standard output that you can look at to follow the simulation's progress.

If you want to run multiple jobs at once, there is a button to launch the standalone RunManager application.

Click the Tree sub-tab in the screenshot to the right to see the RunManager job workflow and to see how to access results files.





Run Simulation — Tree

Notes

The top right table in the screenshot shows the jobs that ran as part of the simulation run.

If you have any measure scripts setup in the Scripts/Measures tab, they will show on this tree. At the end are a few EnergyPlus jobs, the last of which generated the output files.

You can right click on the EnergyPlus job to open the directory containing the output files.

Right Click Here To Open Directory With Output Files

Menu Bar → OpenStudio File Preferences Components & Measures Help

Subtabs → Run Simulation Output Tree

Site

Schedules

Constructions

Loads

Space Types

Stories

Facility

Thermal Zones

HVAC Systems

Output Variables

Simulation Settings

Scripts/Measures

Run Simulation

Results Summary

Workflow Description

Null Job->UserScript (UserScriptAdapter....)

Job Description	Warnings	Errors	Last Run	Status
stdout (2014-Mar-31 14:43:07)				
Mo... 52	0	0	2014-Mar-31 14:43:07	Idle
Output Files				
in.idf (removed)				
... 0	0	0	2014-Mar-31 14:43:09	Idle
Output Files				
stdout (2014-Mar-31 14:43:10)				
0	0	0	2014-Mar-31 14:43:10	Idle
Output Files				
out.idf (2014-Mar-31 20:43:11)				
37	0	0	2014-Mar-31 20:43:11	Idle
Output Files				
Energy+.ini (2014-Mar-31 20:43:11)				
eplusout.audit (2014-Mar-31 20:43:11)				

Rerun

Show Job Warnings And Errors

Cleanup Job Output

Open / Edit File

Open Directory

Workflow Errors: 0

Workflow Warnings: 89

Output Directory:

/var/folders/18/hw36chr90t37zqb_x_0v9gch523hcs/T/qt_temp.dQ2905/resources/run/0-Null

Weather File:

s/18/hw36chr90t37zqb_x_0v9gch523hcs/T/qt_temp.dQ2905/resources/files/AFA_12066_2011_amy.epw

Jobs In Queue: 8

Local Jobs Running: 0

Remote Jobs Running: 0

Completed Jobs: 8

Failed Jobs: 0



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Results Summary

Notes

The Results Summary tab is populated with data after you run a simulation. The standard reports available are:

- Results | OpenStudio
- Calibration | Openstudio
- EnergyPlus Results

You can create custom reporting measures. Check out the measure writing guide at <http://openstudio.nrel.gov/openstudio-measure-writing-guide>.

The “Results | OpenStudio” displays monthly and annual end use summary data for electricity and natural gas. It also shows in table form district heating and cooling, which you would use if you ran your model with ideal air loads.

The button at the top right corner of the interface will load the SQL file in the OpenStudio ResultsViewer application. ResultsViewer allows you to create time series line and flood plots for variables that you requested in the Output Variables tab.

When you reopen a previously run simulation, it will populate this tab with previous results.

Menu Bar → OpenStudio File Preferences Components & Measures Help
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Subtabs → Site Schedules Constructions Loads Space Types Stories Facility Thermal Zones HVAC Systems Output Variables

Resource Tabs → Simulation Settings Scripts/Measures Run Simulation Results Summary

✓ Results | OpenStudio Calibration | OpenStudio EnergyPlus Results

Reports: Results | OpenStudio Select the Report Type Here Launch ResultsViewer to View Time Series Variables Open ResultsViewer for Detailed Reports

Electricity Consumption

kWh

Fans: 304.54

Natural Gas Consumption

Million Btu

Electricity Consumption (kWh)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heating	—	—	—	—	—	—	—	—	—	—	—	—
Cooling	—	—	—	0.02	0.064	359.414	665.047	328.178	45.077	—	—	—
Interior Lighting	5,735.917	5,180.833	5,735.917	5,550.889	5,735.917	5,550.889	5,735.917	5,735.917	5,735.917	5,550.889	—	—
Exterior Lighting	—	—	—	—	—	—	—	—	—	—	—	—



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Results Summary: Calibration

Notes

To calibrate to the ASHRAE 14-2002 or FEMP standard the file must contain all utility data for one year and real weather data. Check the guidelines for additional requirements.

By selecting the "Calibration | OpenStudio" report you can compare the model and actual utility bills.

The report provides ASHRAE 14-2002 calibration standard and the FEMP calibration standard options.

Results | OpenStudio
✓ Calibration | OpenStudio
EnergyPlus Results

Launch ResultsViewer to View Time Series Variables

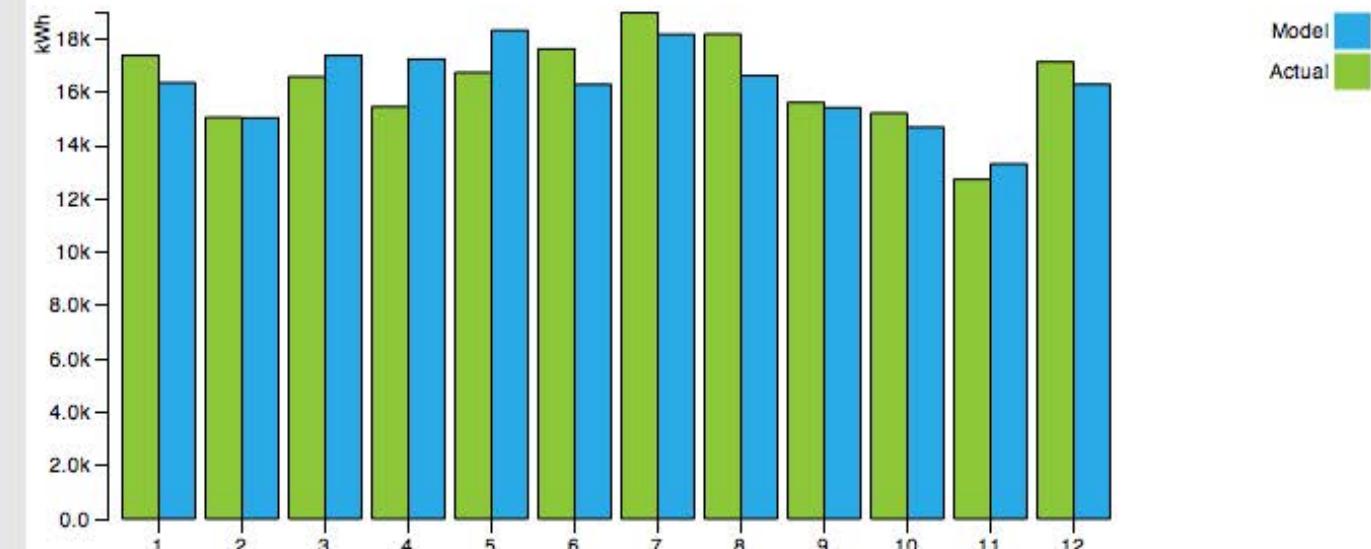
Open ResultsViewer for Detailed Reports

Select the Report Type Here

Calibration Method
✓ ASHRAE 14-2002
FEMP

Electricity Consumption (kWh)
CV(RMSE) = 6.77
NMBE = 0.87

kWh



Month	Actual (kWh)	Model (kWh)
1	~17.2k	~16.5k
2	~14.8k	~14.5k
3	~16.2k	~16.5k
4	~15.2k	~16.2k
5	~16.2k	~17.2k
6	~17.2k	~16.2k
7	~18.2k	~17.2k
8	~17.2k	~16.2k
9	~15.2k	~15.2k
10	~14.8k	~14.5k
11	~13.2k	~13.2k
12	~16.2k	~15.2k

Model
Actual

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Simulation & Results

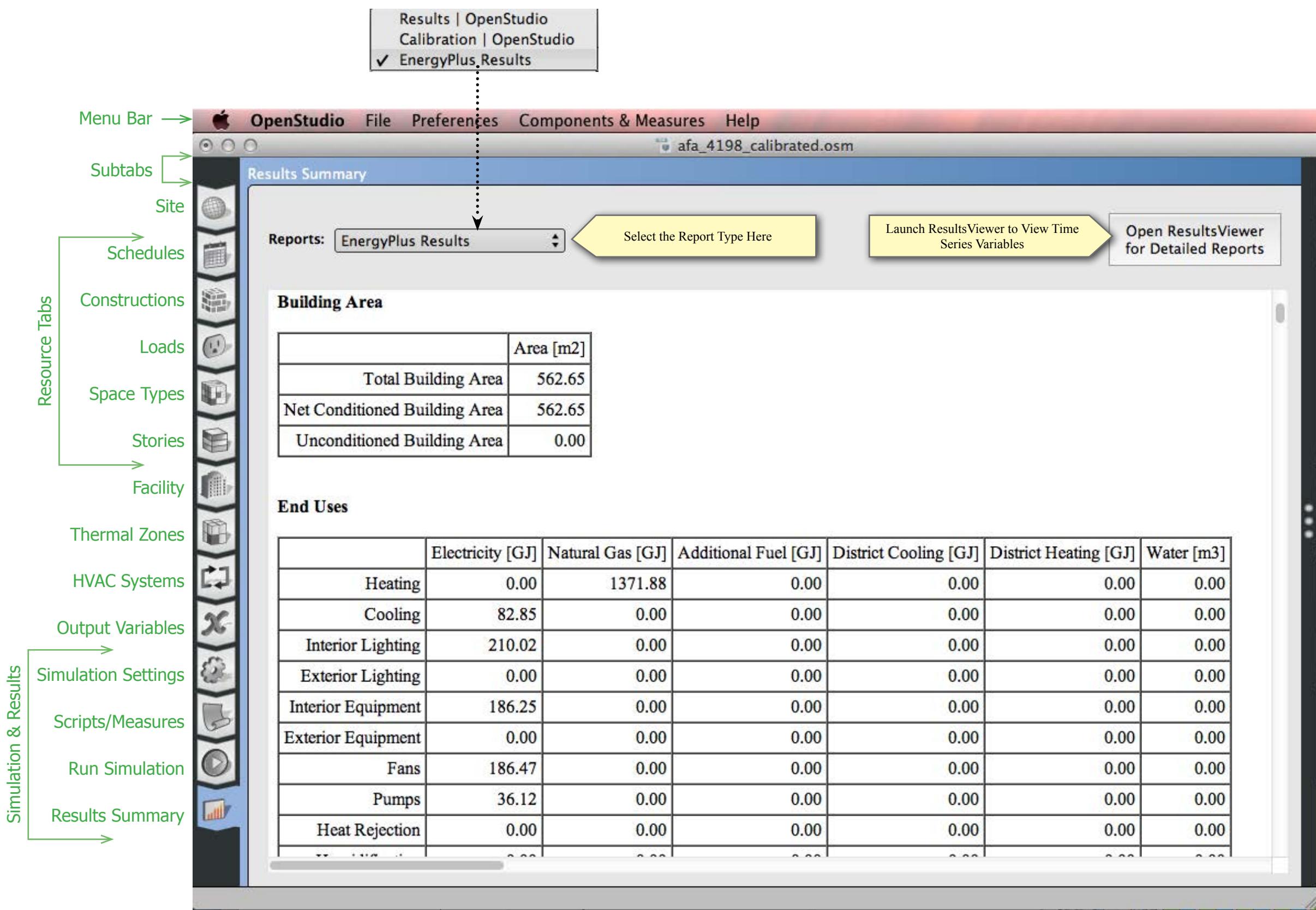


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Results Summary: EnergyPlus Results

Notes

The HTML view of the EnergyPlus report is available through the drop down report menu.



Results | OpenStudio
Calibration | OpenStudio
✓ EnergyPlus Results

OpenStudio File Preferences Components & Measures Help
afa_4198_calibrated.osm

Results Summary

Reports: EnergyPlus Results Select the Report Type Here

Launch ResultsViewer to View Time Series Variables

Open ResultsViewer for Detailed Reports

Building Area

	Area [m ²]
Total Building Area	562.65
Net Conditioned Building Area	562.65
Unconditioned Building Area	0.00

End Uses

	Electricity [GJ]	Natural Gas [GJ]	Additional Fuel [GJ]	District Cooling [GJ]	District Heating [GJ]	Water [m ³]
Heating	0.00	1371.88	0.00	0.00	0.00	0.00
Cooling	82.85	0.00	0.00	0.00	0.00	0.00
Interior Lighting	210.02	0.00	0.00	0.00	0.00	0.00
Exterior Lighting	0.00	0.00	0.00	0.00	0.00	0.00
Interior Equipment	186.25	0.00	0.00	0.00	0.00	0.00
Exterior Equipment	0.00	0.00	0.00	0.00	0.00	0.00
Fans	186.47	0.00	0.00	0.00	0.00	0.00
Pumps	36.12	0.00	0.00	0.00	0.00	0.00
Heat Rejection	0.00	0.00	0.00	0.00	0.00	0.00

Resource Tabs

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Simulation & Results