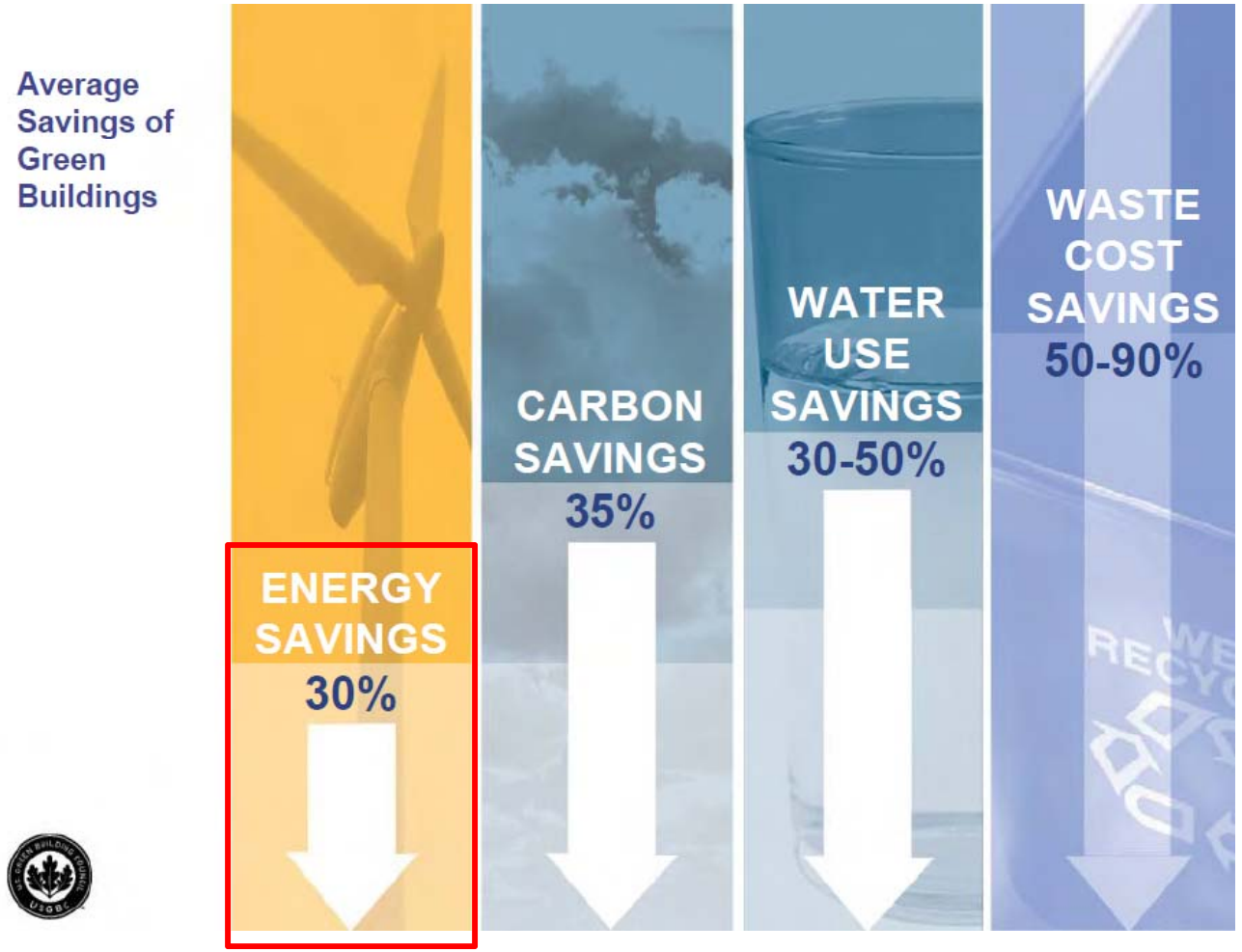
48-749 Parametric Modeling
Lecture 5

Carnegie Mellon University
School of Architecture

Lecture 5

- Bim used in Energy Simulation
  - Green Building Studio
- Families Continued
- 3D Families
  - Nested Family
  - Family category and Parameters
- Curtain Wall System
  - Mullion
  - Grid
  - Panel

Green Building Savings



LEED points

- Sustainable Design Categories (LEED NC 2.2)

Project Checklist — **69 points**

1.	**Sustainable Sites**	**14 points**
2.	Water Efficiency	5 points
3.	Energy & Atmosphere	17 points
4.	Materials and Resources	13 points
5.	Indoor Environmental Quality	15 points
6.	Innovation & Design Process	5 points

LEED energy credits

Achieved	P/Auto				
7 of 9	15				17 Points
100%	100%	Prereq 1	**Fundamental Building Systems Commissioning**		Required
100%	100%	Prereq 2	**Minimum Energy Performance**		Required
100%	100%	Prereq 3	**CFC Reduction in HVAC&R Equipment**		Required
0%	0%	Credit 1	**Optimize Energy Performance**		1 to 10
0%	0%			15% New Buildings or 5% Existing Building Renovations	1
0%	0%			20% New Buildings or 10% Existing Building Renovations	2
0%	0%			25% New Buildings or 15% Existing Building Renovations	3
0%	0%			30% New Buildings or 20% Existing Building Renovations	4
	0%			35% New Buildings or 25% Existing Building Renovations	5
	0%			40% New Buildings or 30% Existing Building Renovations	6
	0%			45% New Buildings or 35% Existing Building Renovations	7
	0%			50% New Buildings or 40% Existing Building Renovations	8
	0%			55% New Buildings or 45% Existing Building Renovations	9
	0%			60% New Buildings or 50% Existing Building Renovations	10
0%	0%	Credit 2.1	**Renewable Energy**, 5%		1
0%	0%	Credit 2.2	**Renewable Energy**, 10%		1
n/a	0%	Credit 2.3	**Renewable Energy**, 20%		1
n/a	100%	Credit 3	**Additional Commissioning**		1
100%	0%	Credit 4	**Ozone Depletion**		1
	100%	Credit 5	**Measurement & Verification**		1
100%	0%	Credit 6	**Green Power**		1

- Achieved
- Requires extension of objects
- Missing object
- Requires simulation results/ref

LEED energy credits-procedure

- Achieve increasing levels of energy performance above the baseline to reduce environmental impacts

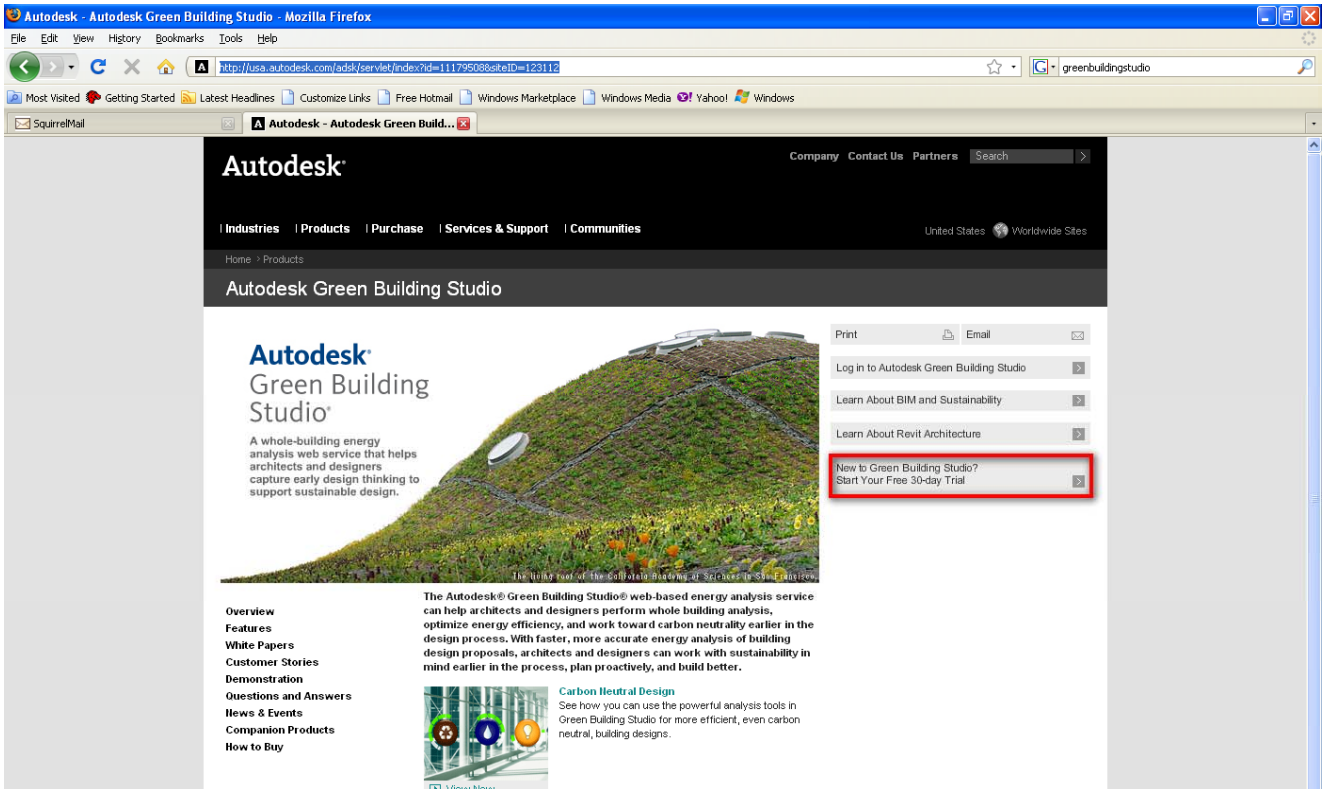
- Baseline building performance rating per ASHRAE/IESNA Standard 90.1-2004 by a whole building project simulation using the Building Performance Rating Method in Appendix G of the Standard.

Overview of Autodesk Green Building Studio

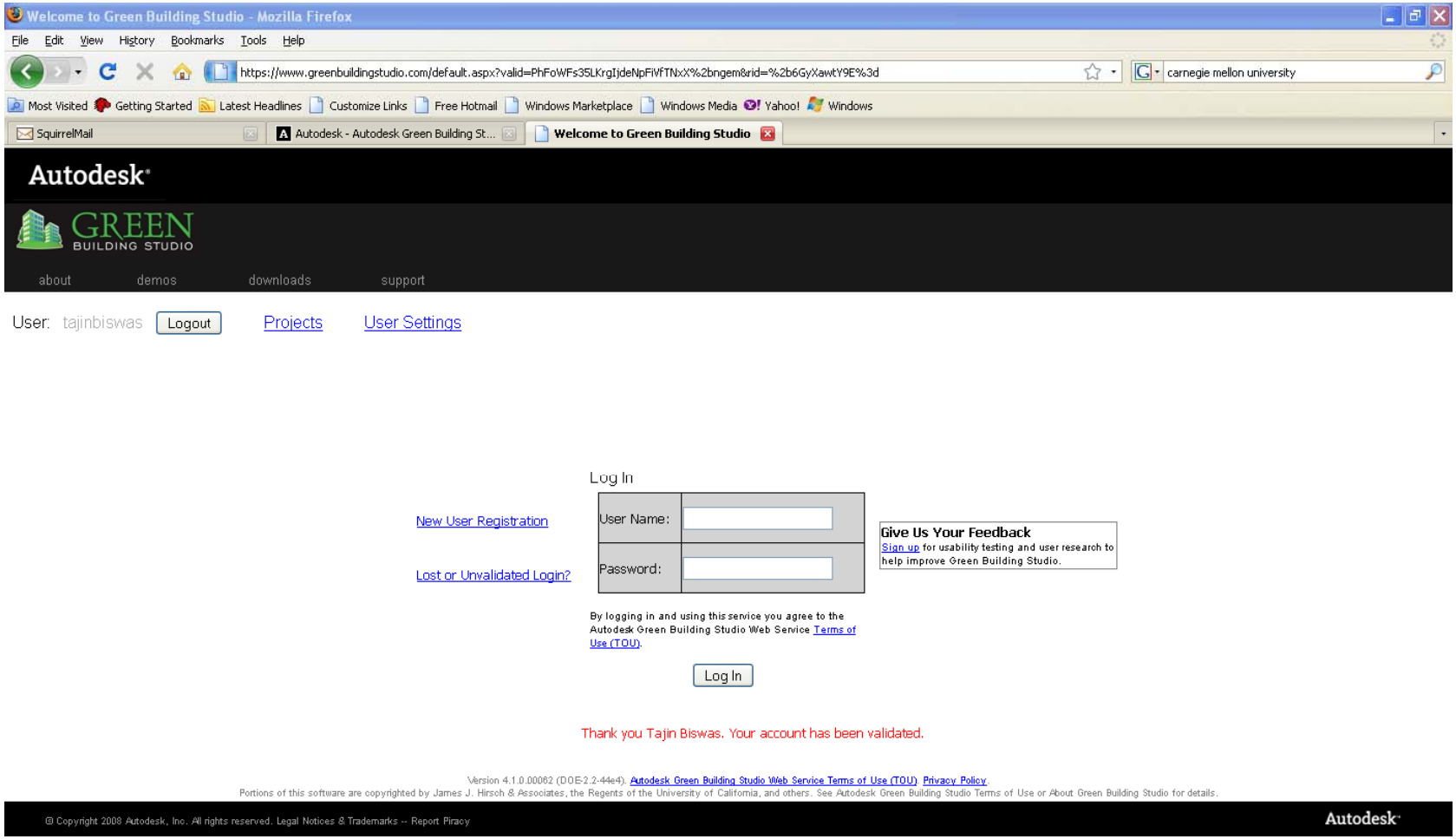
- Web Based platform that can be accessed directly from Revit Architecture and MEP
- Capture early sustainable design analysis to support the process of reducing negative environmental impacts
- Communicate among the extended building design team using Autodesk design applications, and other compatible energy and green analysis software
- Creates file formats for other energy simulation software like
  - DOE 2 for eQuest
  - Energy Plus

Energy Calculation

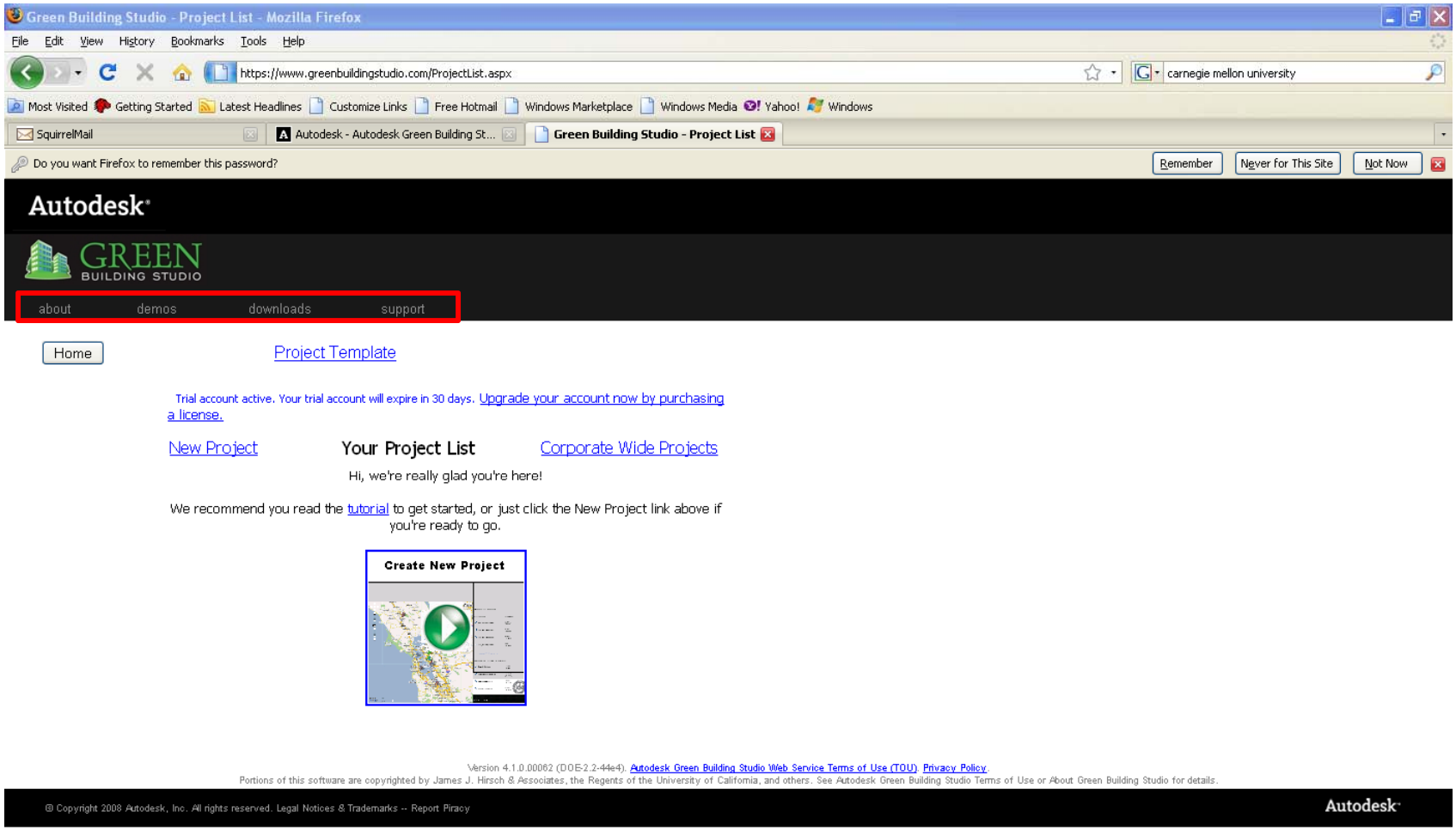
- Green Building Studio
- http://usa.autodesk.com/adsk/servlet/index?id=11179508&siteID=123112



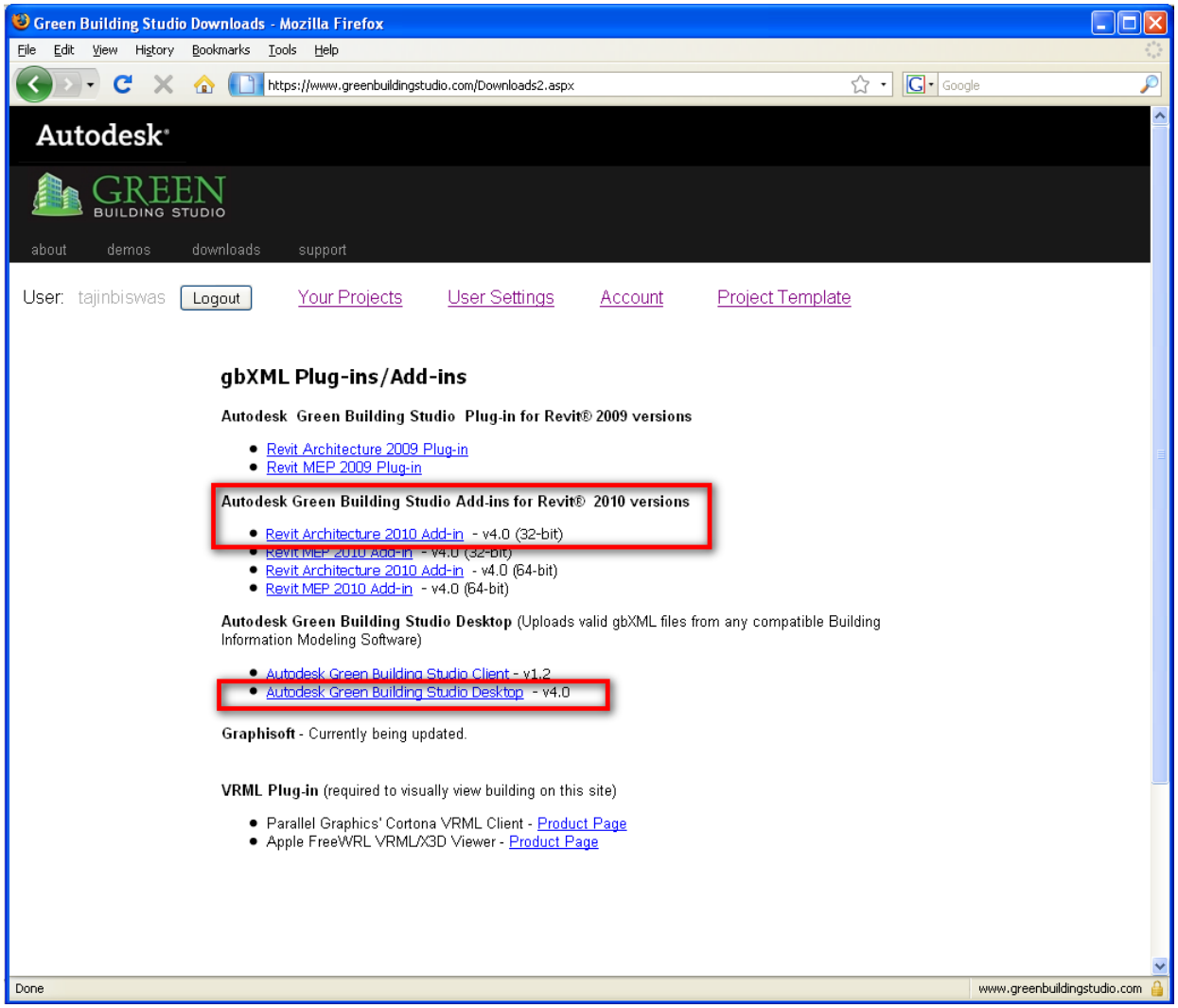
Energy Calculation-register for GBS



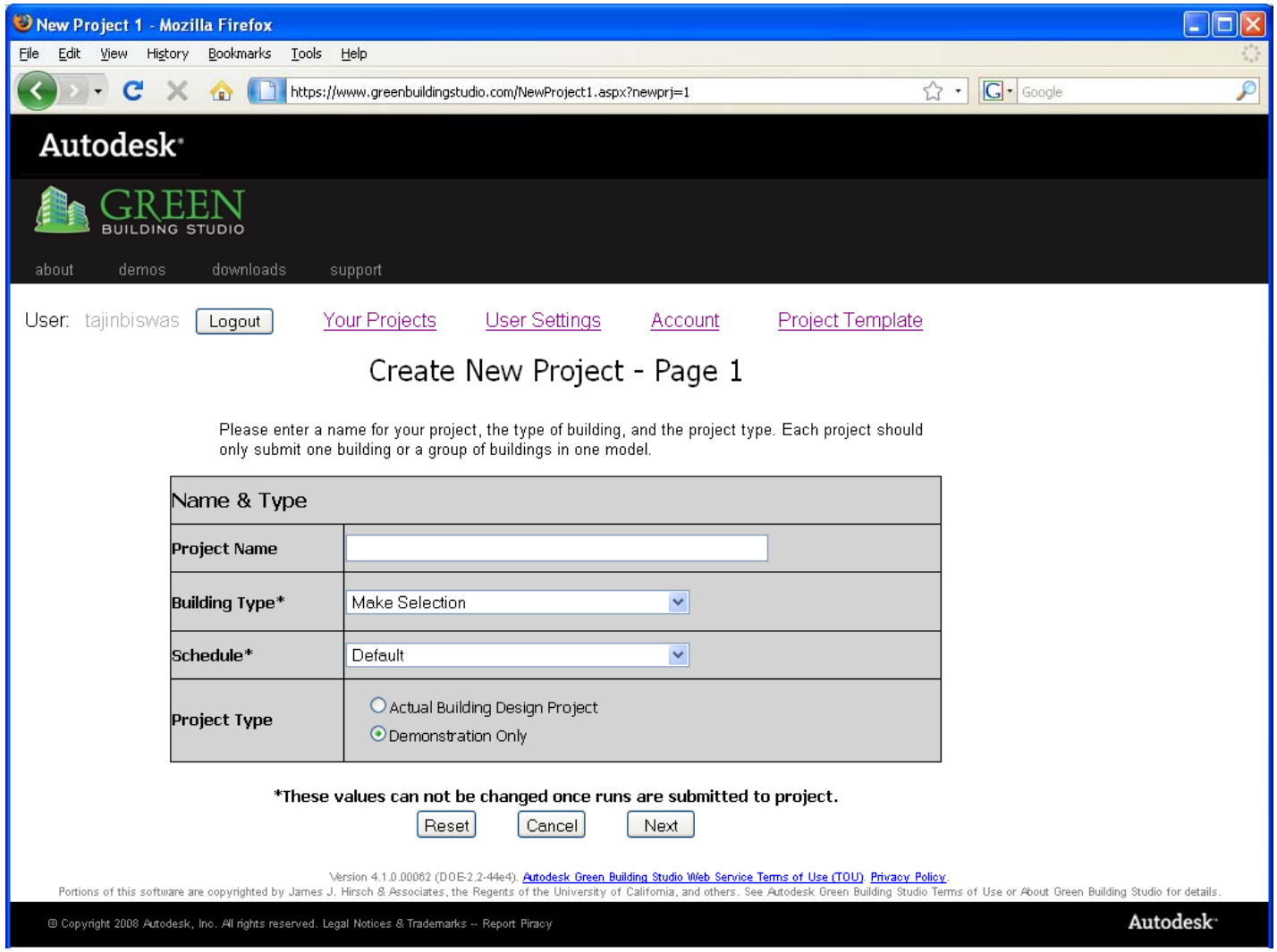
Energy Calculation –Go to downloads



Energy Calculation-Download Revit 2010 Add-in and GBS Desktop



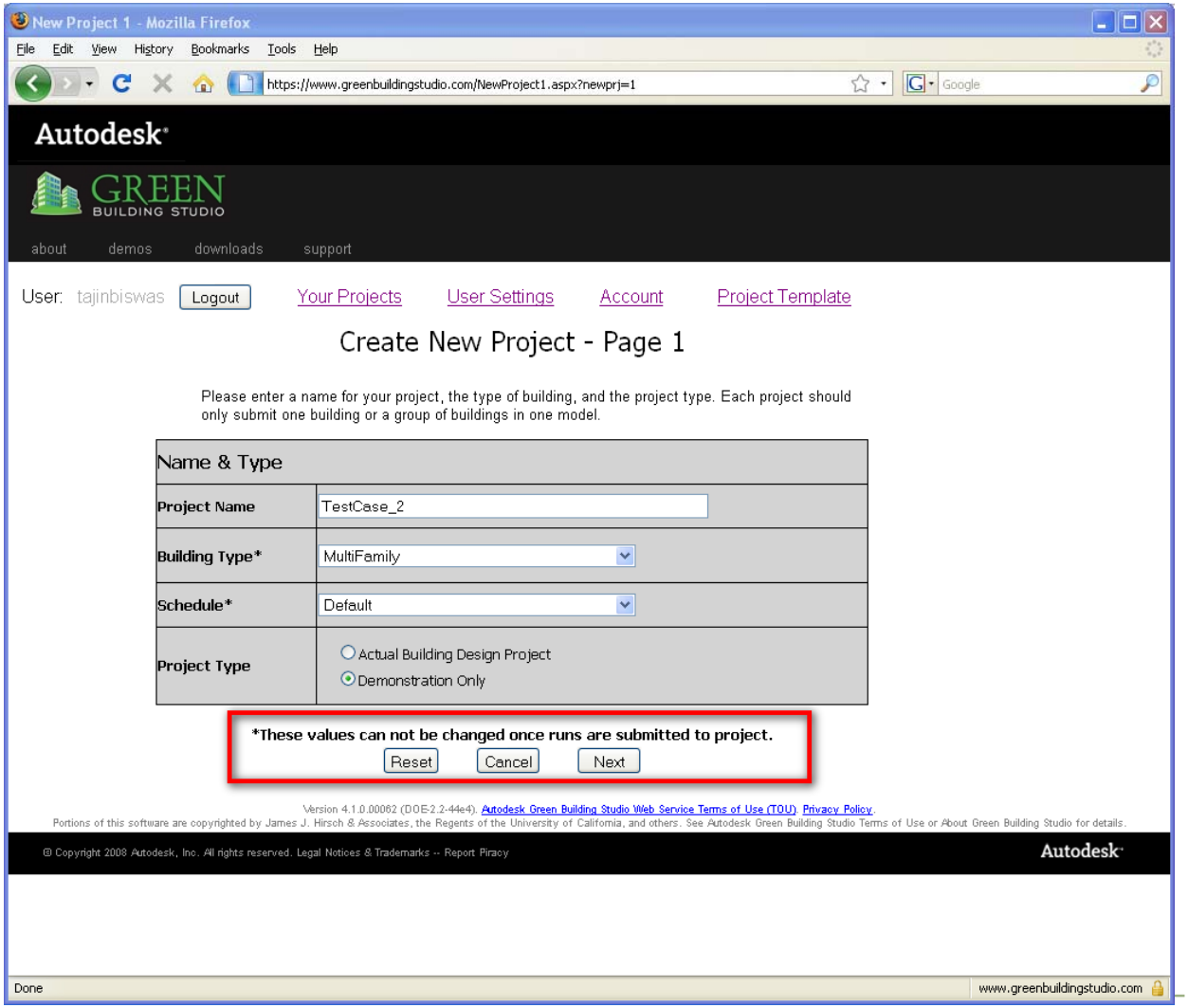
Energy Calculation-Create New Project in GBS



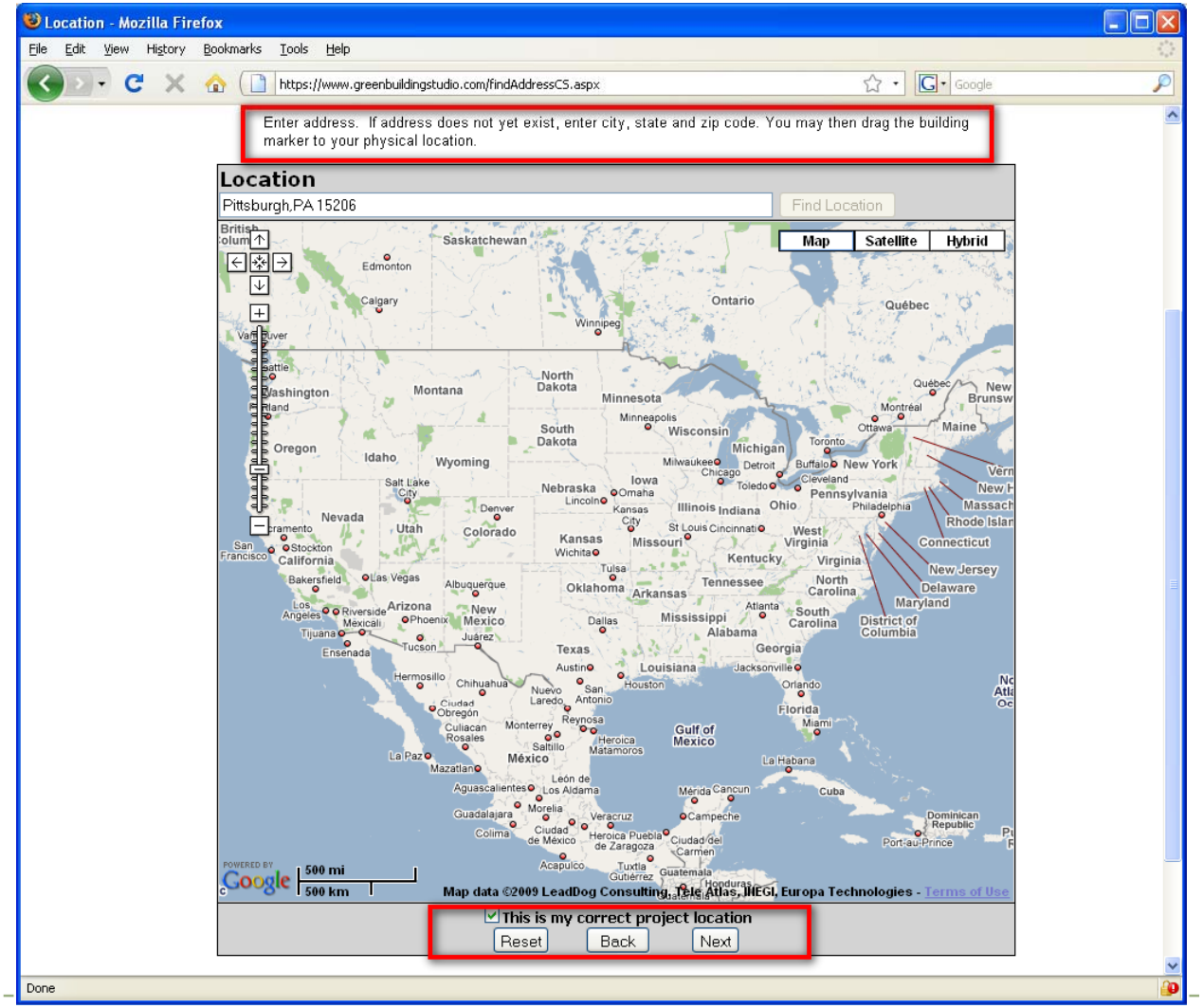
Energy Calculation in GBS- Process

- Create New Project in GBS
  - Select Type of project
  - Input and select the location of the project
  - Select the appropriate weather file
- Prepare Project in Revit Architecture 2010 for export to gbXML format
  - The rooms have to be tagged and Room Area, Volume Computation has to be enabled for gbXML export
- Once project is ready, go to Add-ins and choose GBS
  - This will export the current file to the project selected in GBS and will create a base run

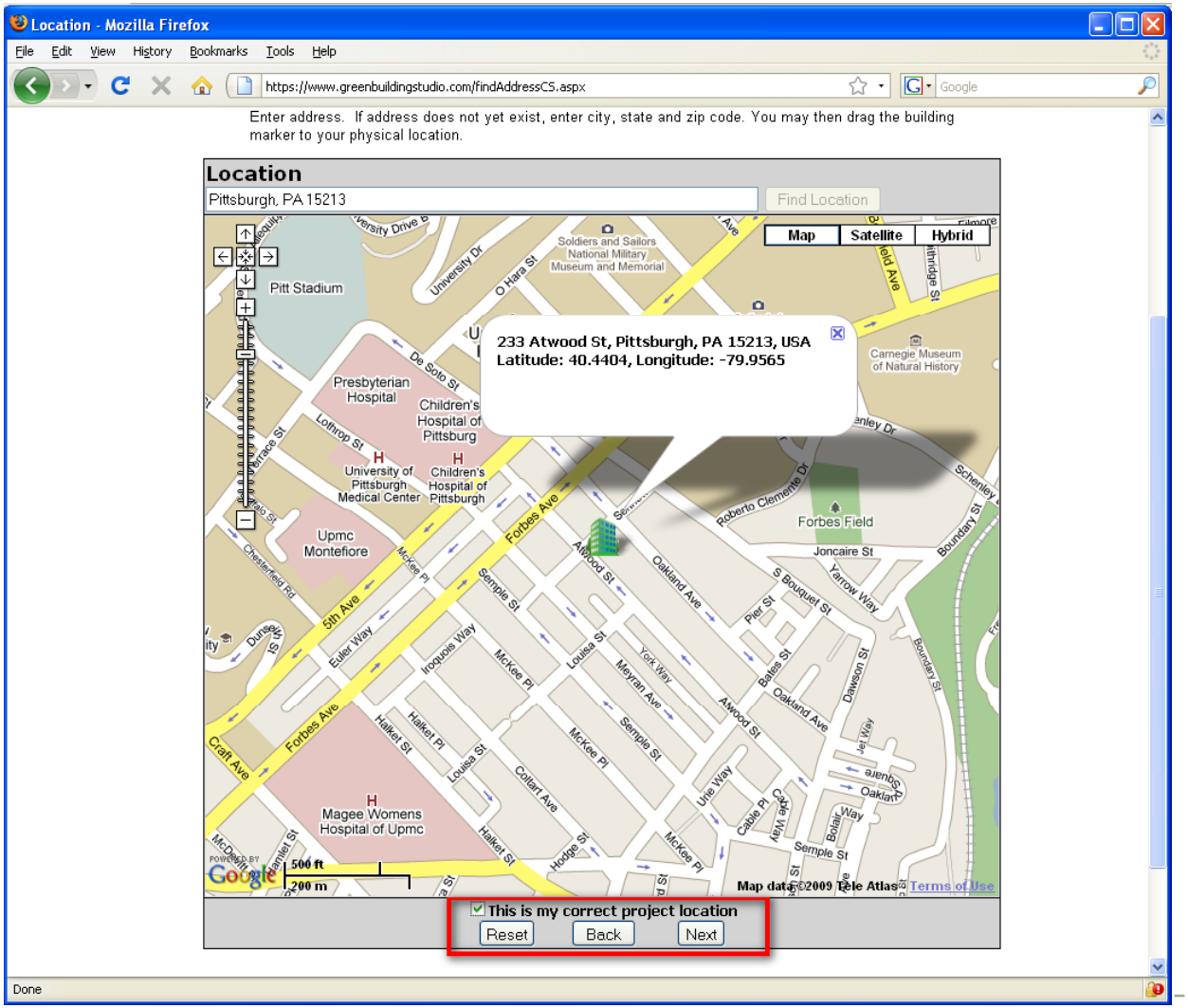
Energy Calculation in GBS – Create New Project in GBS



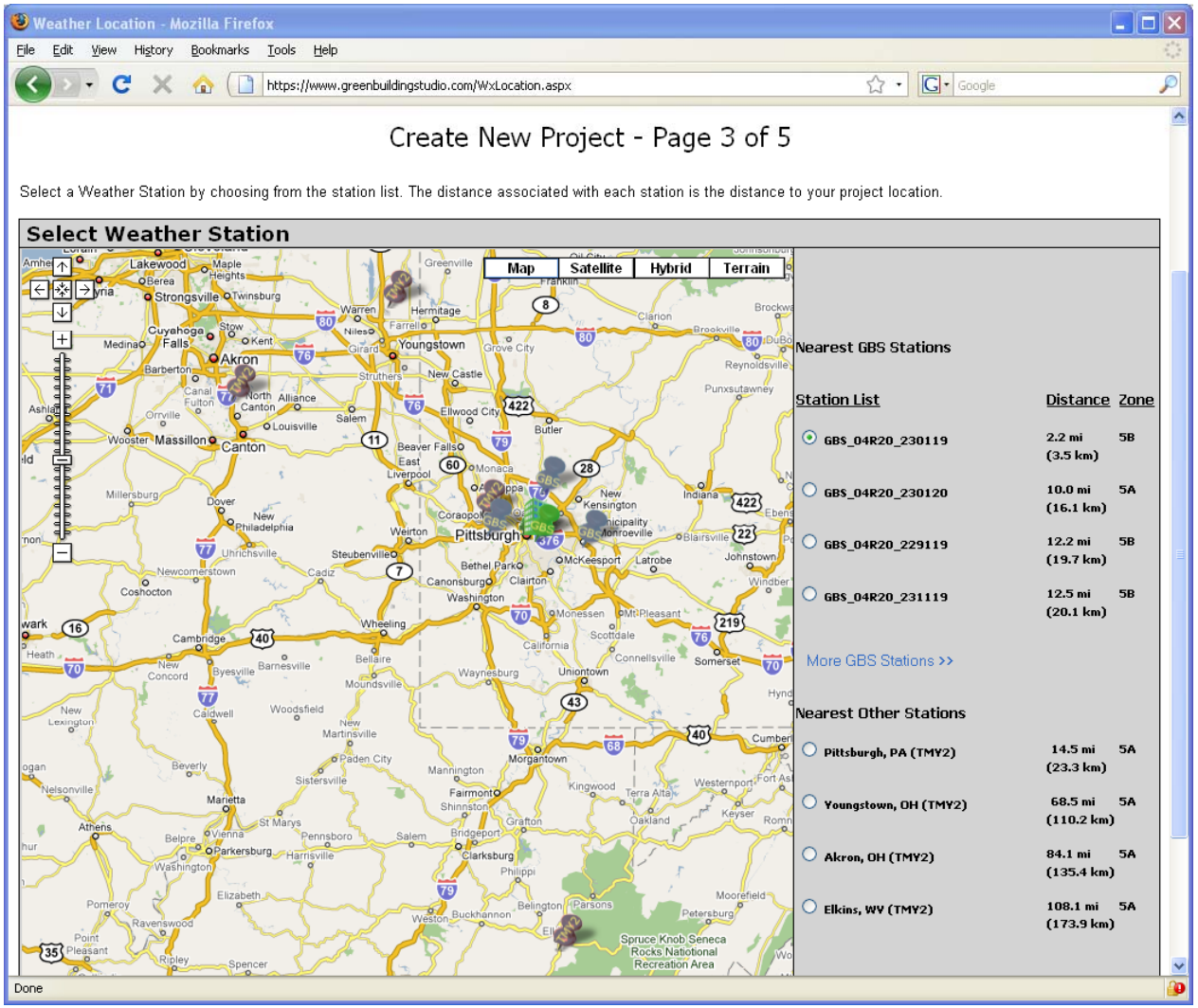
Energy Calculation in GBS – Create New Project in GBS



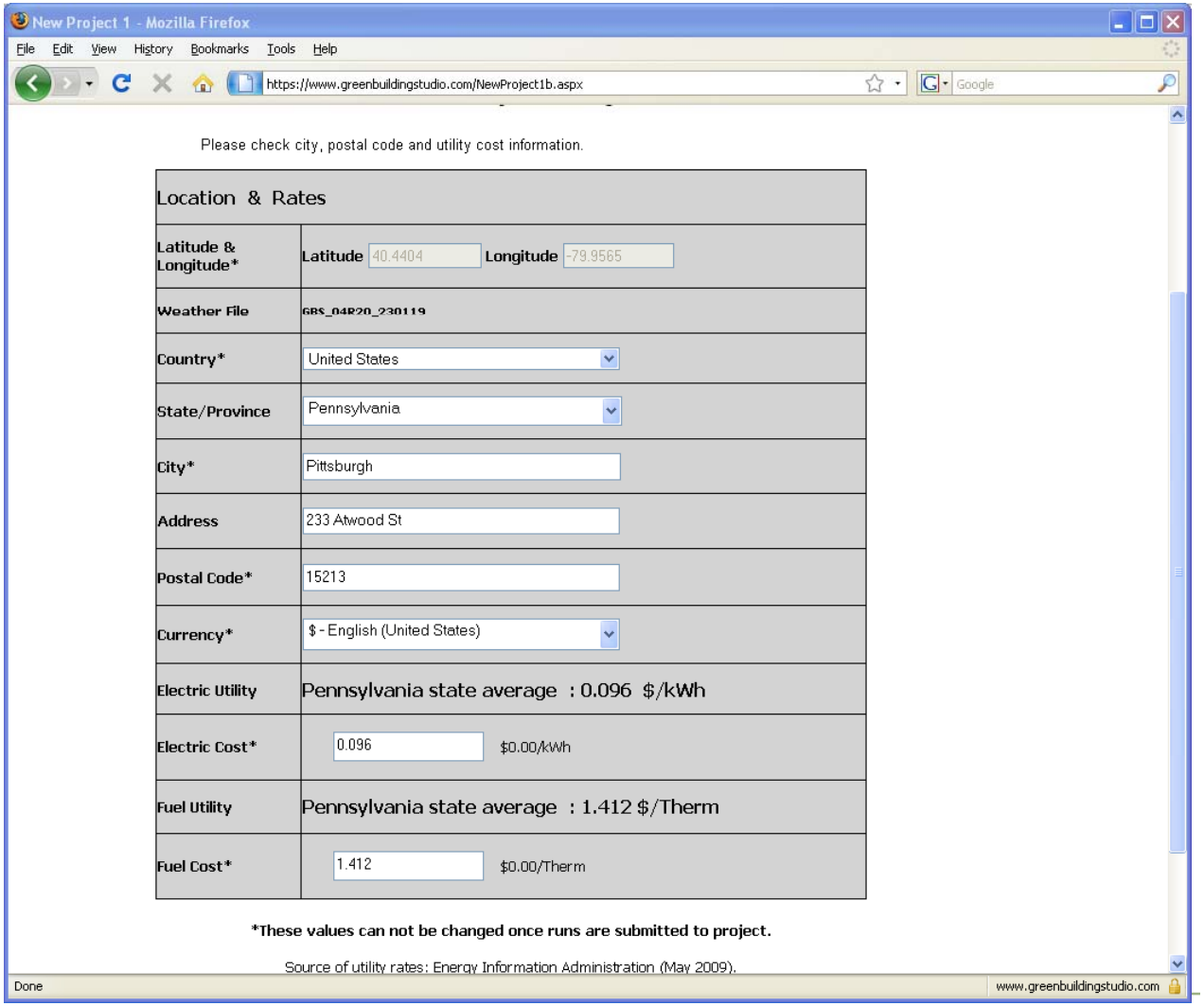
Energy Calculation in GBS – Create New Project in GBS



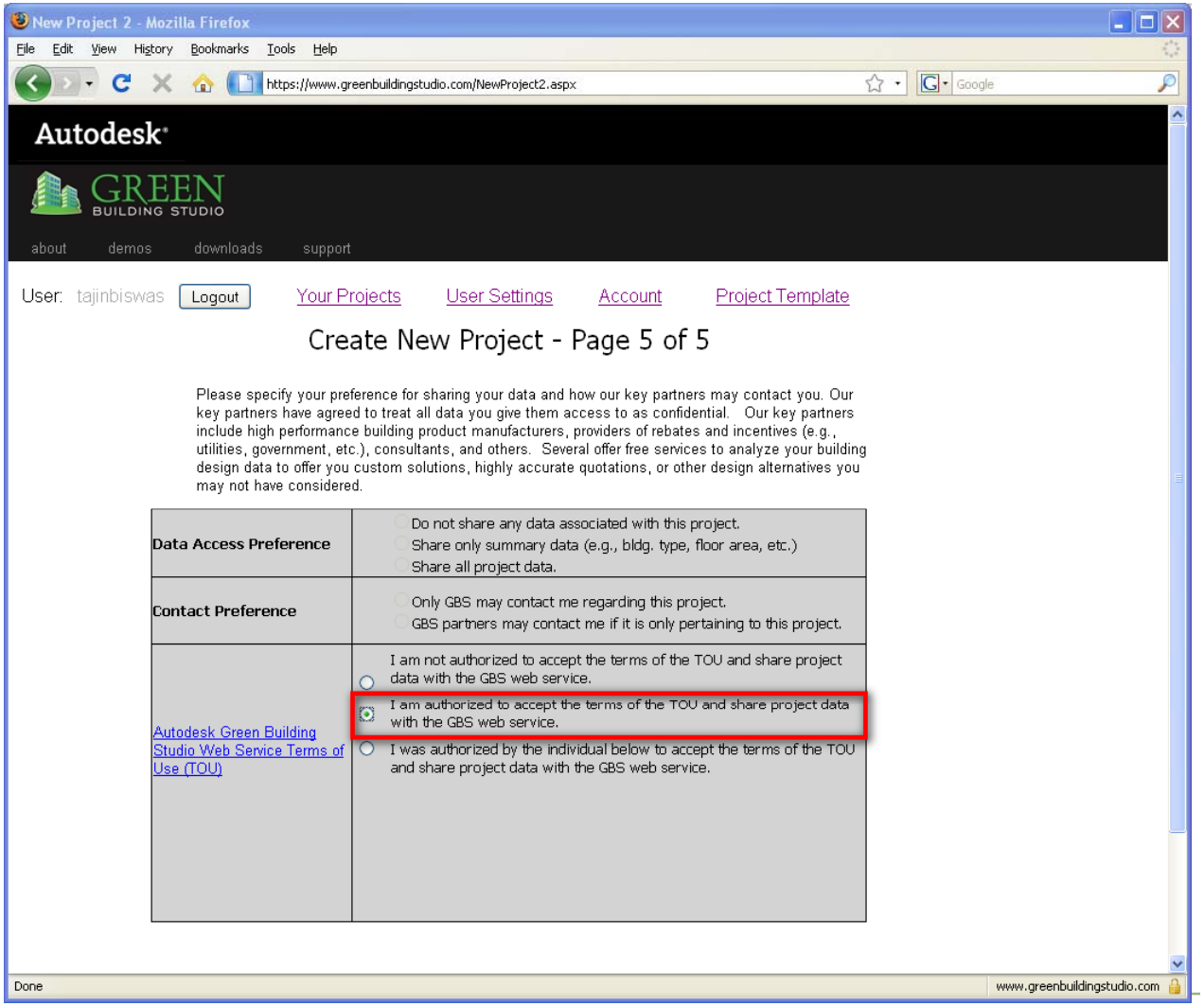
Energy Calculation in GBS – Create New Project in GBS



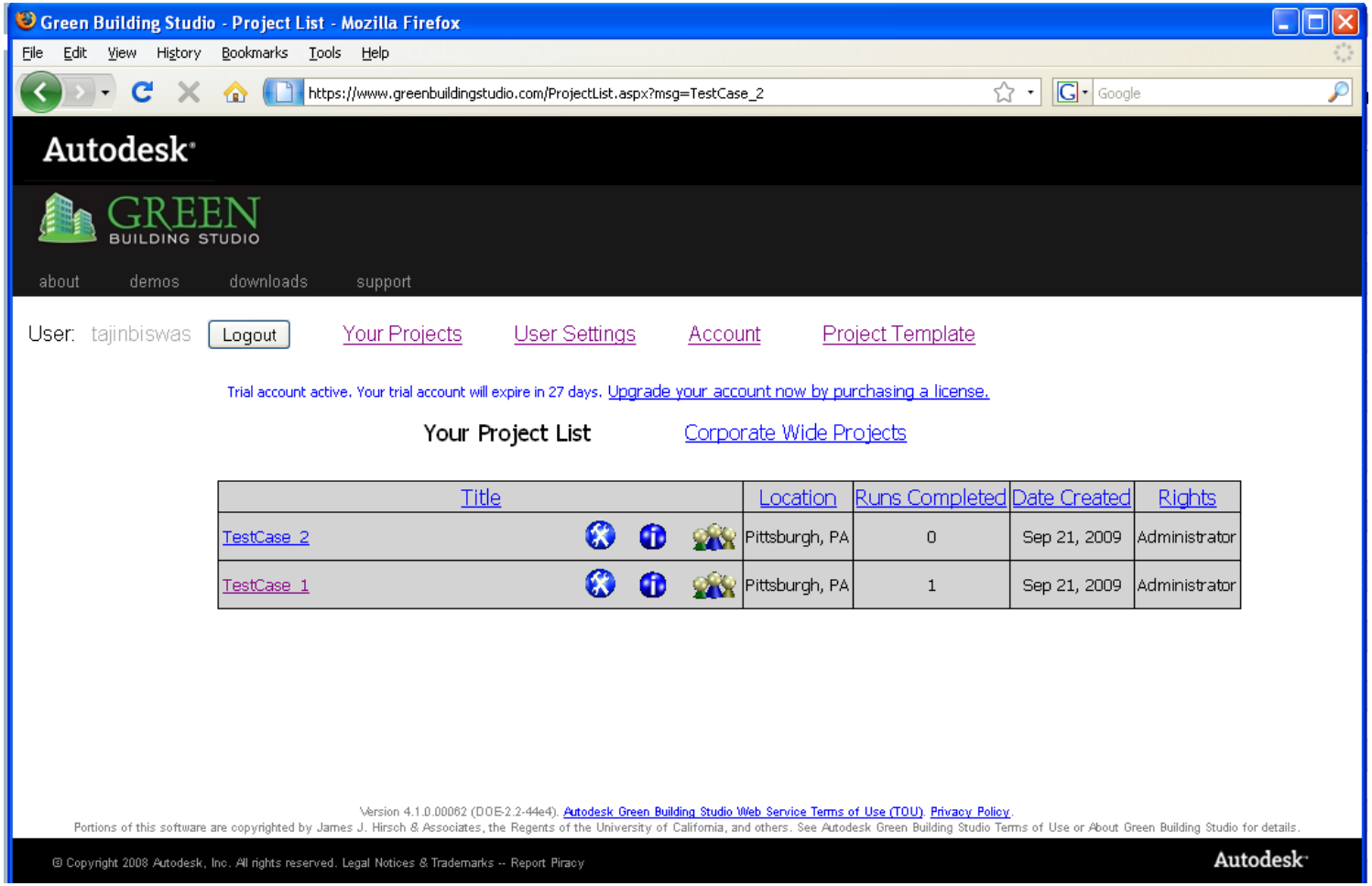
Energy Calculation in GBS – Create New Project in GBS



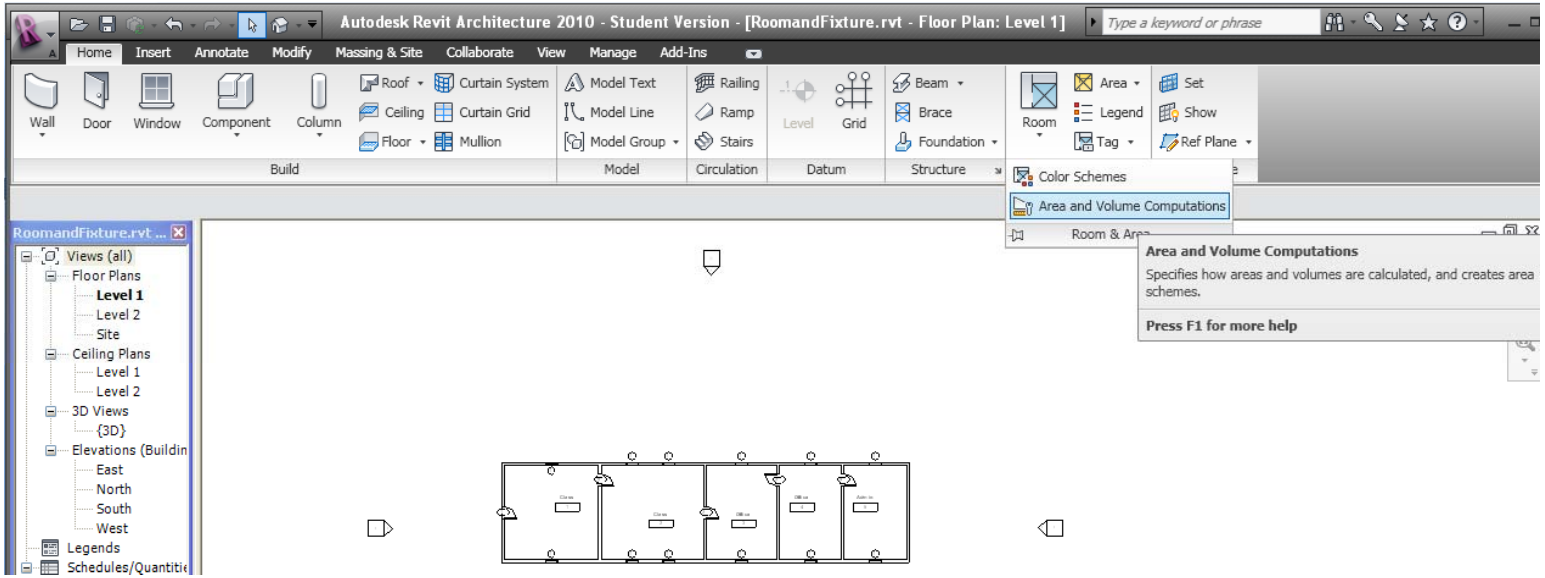
Energy Calculation in GBS – Create New Project in GBS



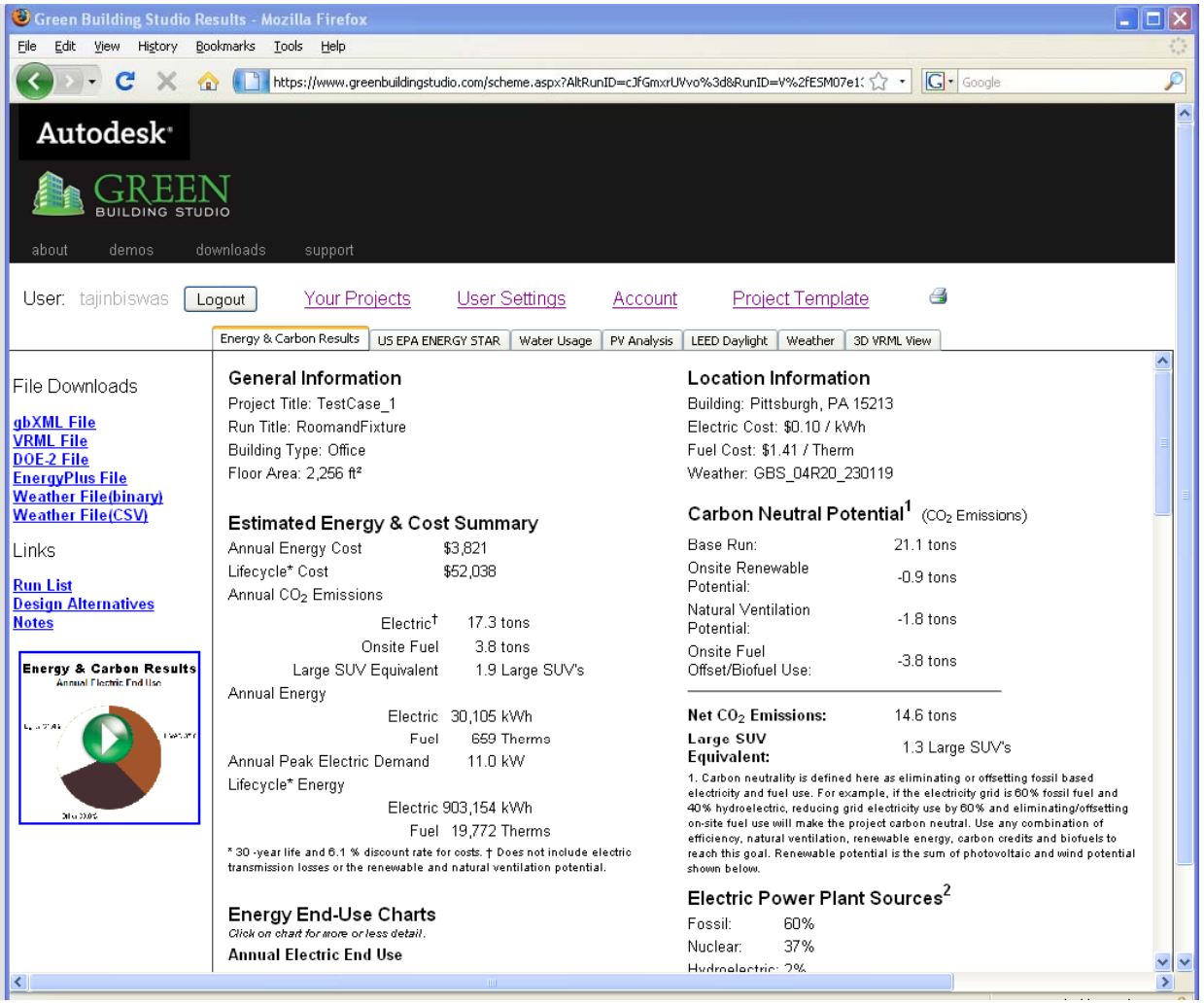
Energy Calculation in GBS – Create New Project in GBS



Energy Calculation in GBS- Process



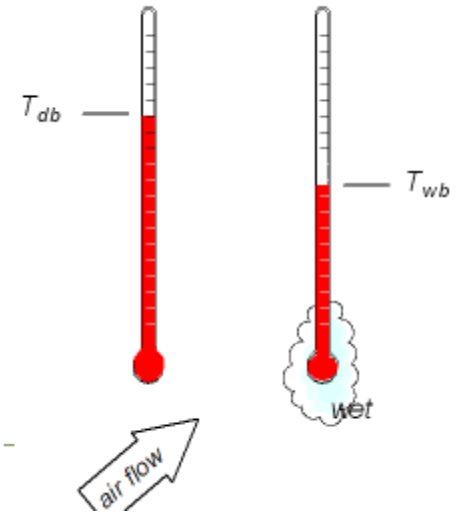
Energy Calculation in GBS- Report



Common Terms and Definitions

- Dry Bulb Temperature - Dry-bulb temperature - T_{db}, can be measured using a normal thermometer freely exposed to the air but shielded from radiation

- Wet Bulb Temperature - This is the temperature indicated by a moistened thermometer bulb exposed to the air flow. The rate of evaporation from the wet bandage on the bulb, and the temperature difference between the dry bulb and wet bulb, depends on the humidity of the air. The evaporation is reduced when the air contains more water vapor.



Common Terms and Definitions

- Relative Humidity- is a term used to describe the amount of water vapor that exists in a gaseous mixture of air and water.

$$RH = \frac{p_{(H_2O)}}{p^*_{(H_2O)}} \times 100\%$$

- *RH* is the relative humidity of the mixture being considered;
- $p_{(\mathrm{H_2O})}$ is the partial pressure of water vapor in the mixture;
- $p^*_{(\mathrm{H_2O})}$ is the saturated vapor pressure of water at the temperature of the mixture.

Common Terms and Definitions

- Cooling Degree Days - **Hot days**, which may require the use of energy for cooling, are measured in **cooling degree-days**.
  - On a day with a mean temperature of 80 degrees F, for example, 15 cooling degree-days would be recorded (80 – 65 base = 15 CDD).

- Heating Degree Days - **Cold days** are measured in **heating degree-days**.
  - For a day with a mean temperature of 40 degrees F, 25 **heating degree-days** would be recorded (65 base – 40 = 25 HDD). Two such cold days would result in a total of 50 heating degree-days for the 2-day period.

Common Terms and Definitions

- U Factor: U-Factor measures the heat transfer through a building element (window, door) and describes how well the product insulates or conducts heat.
  - The lower the U-Factor, the greater resistance to heat flow and the better its insulation value.
  - SI units W/(m²K) and US units of BTU/(h ° F ft²)
  - R value is the reciprocal of U factor R= 1/U

- Solar Heat Gain Factor - Solar Heat Gain Coefficient (SHGC) is the fraction of solar radiation admitted through a window, door, or skylight.
  - Expressed as a number between 0 - 0.87
  - The lower a window's SHGC, the less solar heat it transmits, and the greater its shading ability.

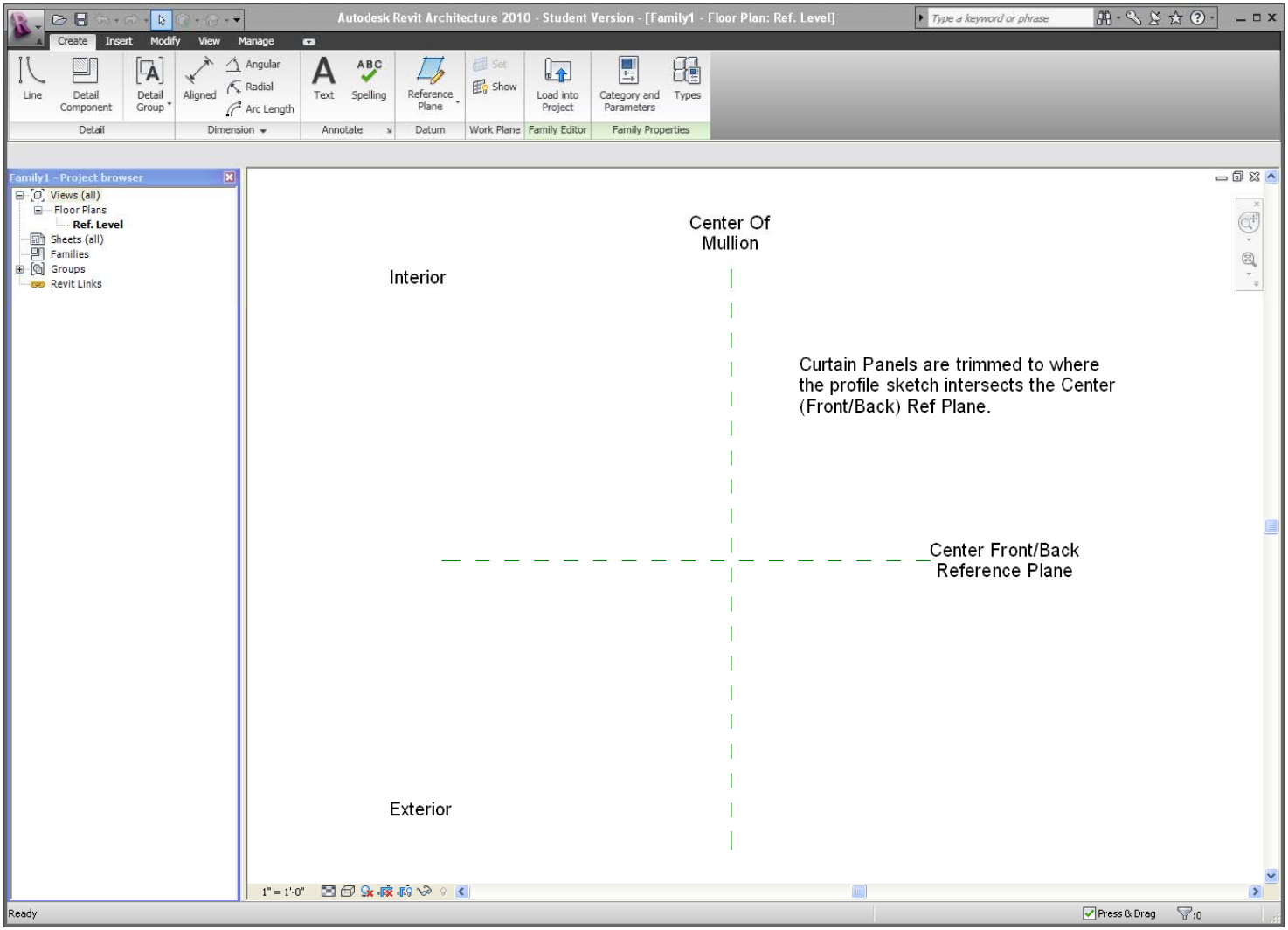
Families

- Host Based Families
- Profile Based Families
- 2D Line Based Families
- 3D Line Based Families
- Face Based and Work plane based Families
- Rich Photorealistic Content (RPC) Families
- Detailed Component Families
- 3D Families

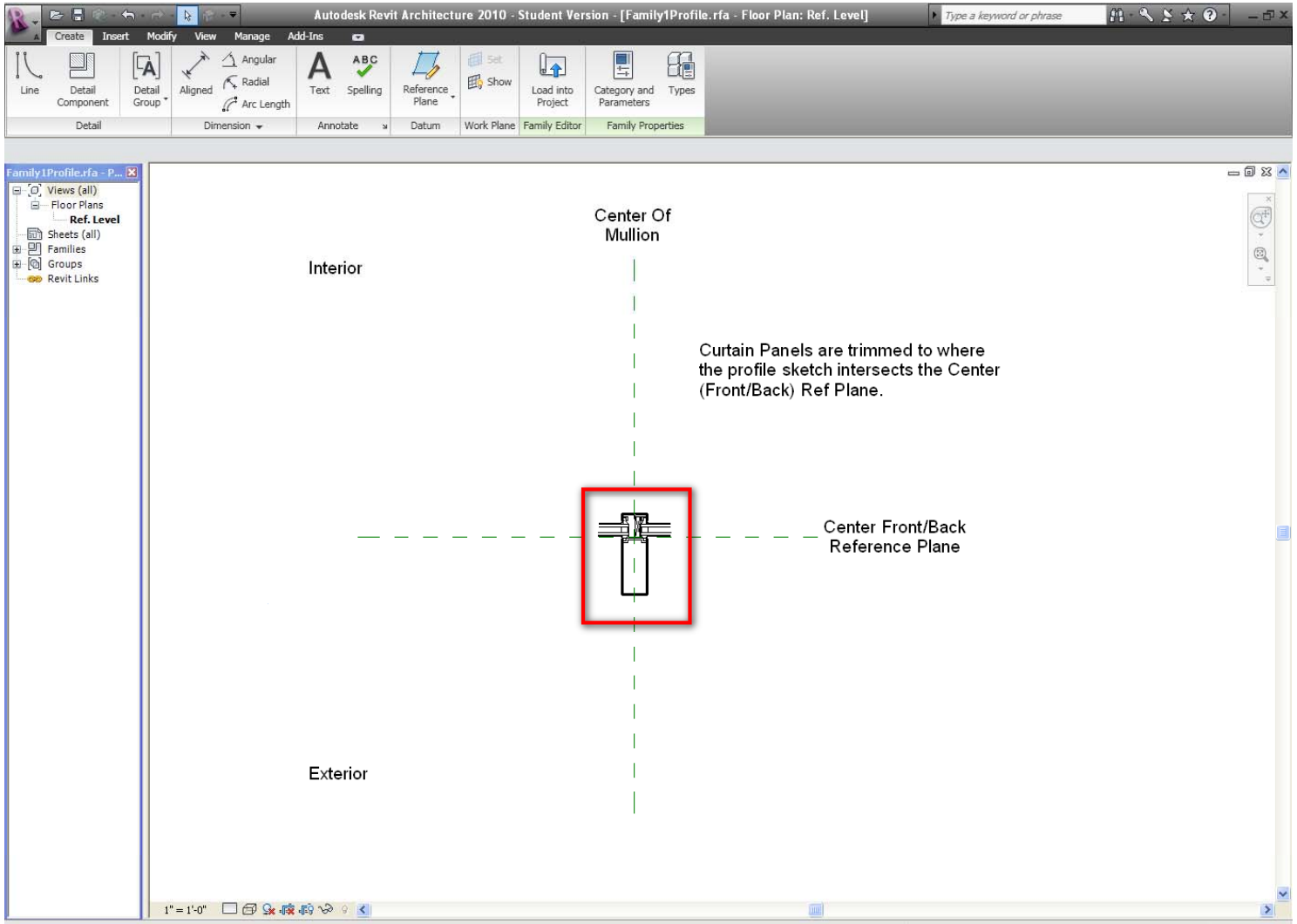
Families Profile Based

- Profile Based Families
  - Multiple lines may cause errors
  - Cannot have multiple loops in a profile family but can import a component that can mimic the representation

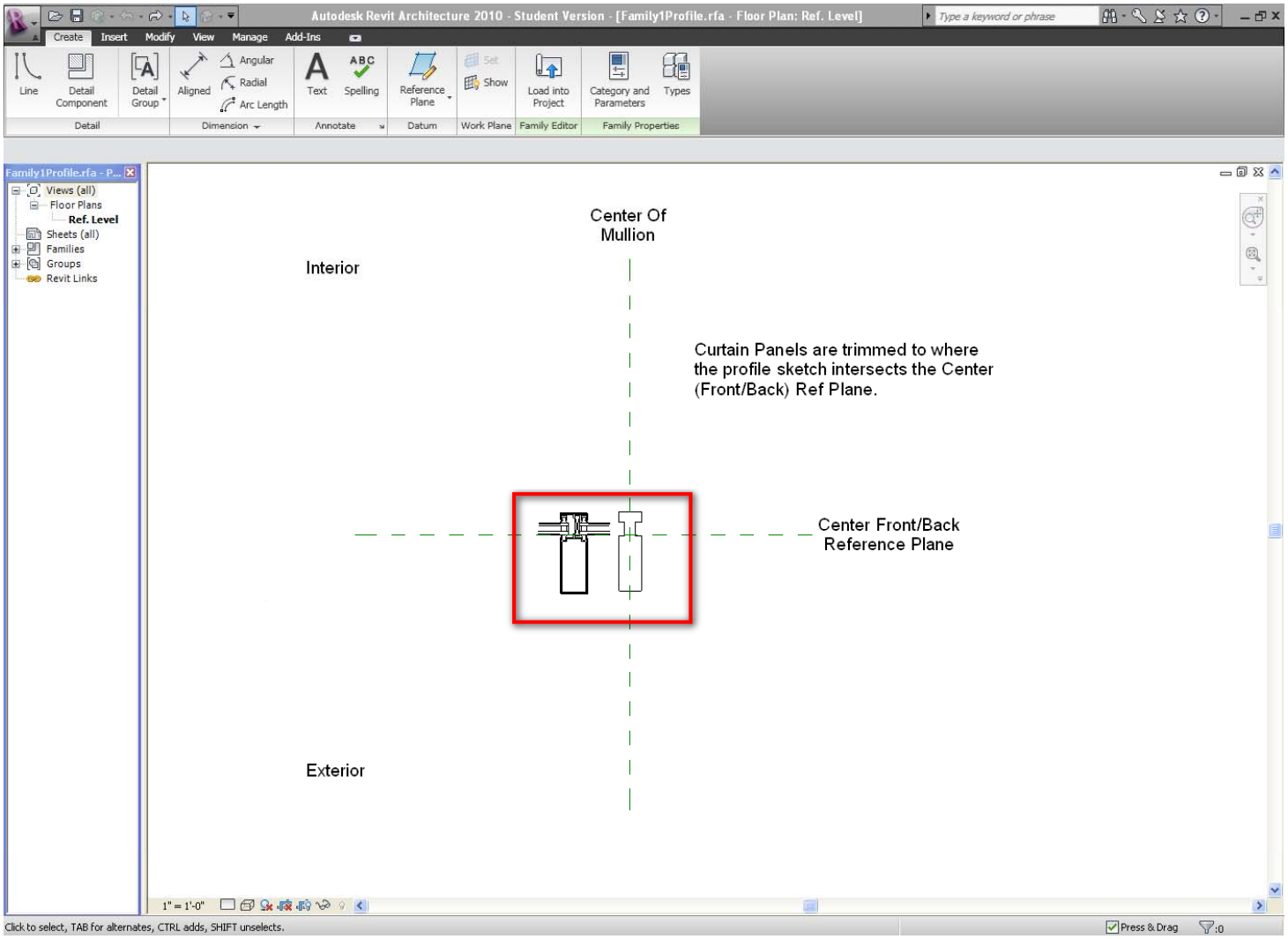
Families Profile Based Start a new family using the Profile-Mullion.rft family template



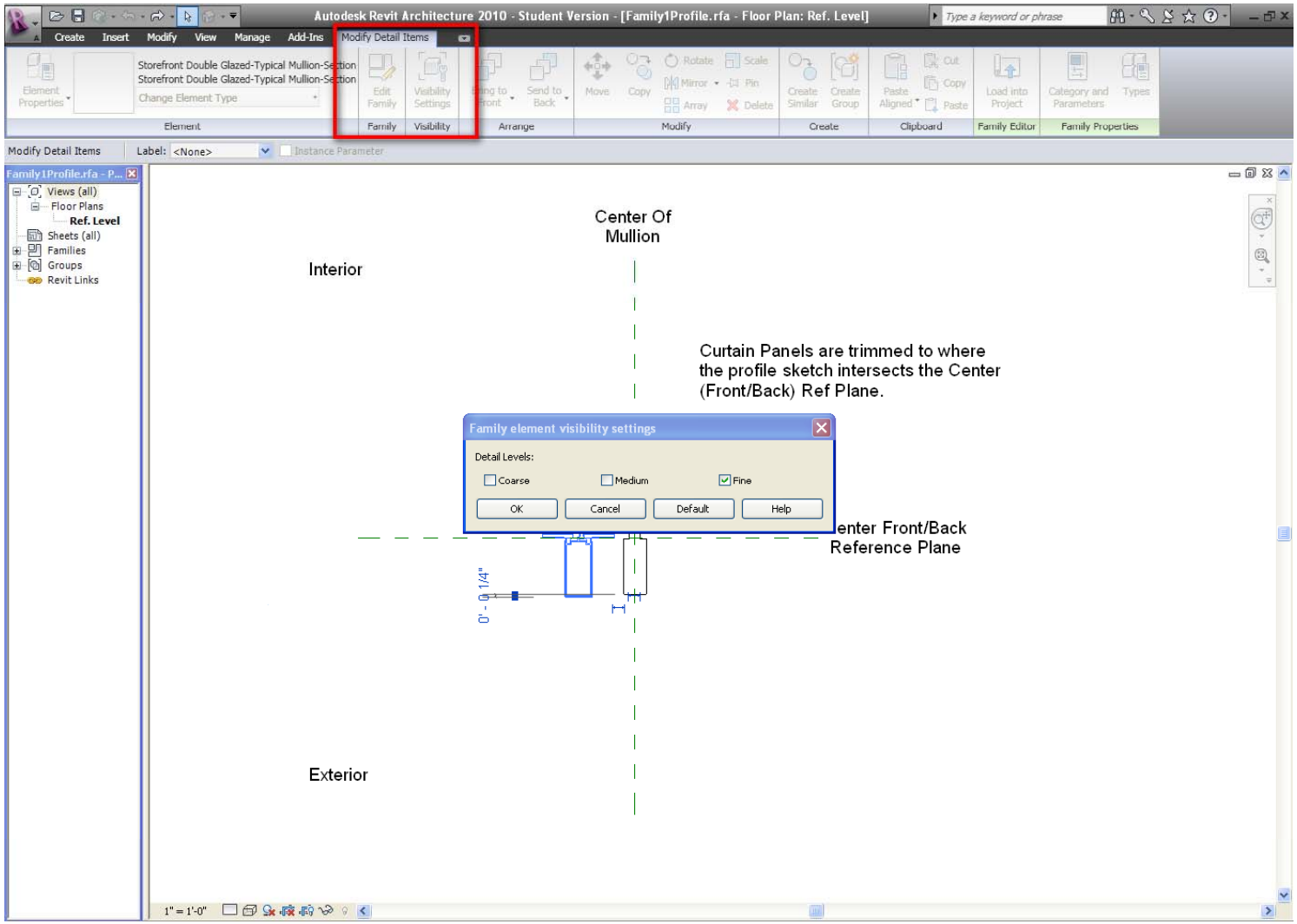
Families Profile Based: load in detailed profile from library – (Detailed components>Div 08 Openings>Storefronts>Typical Section)



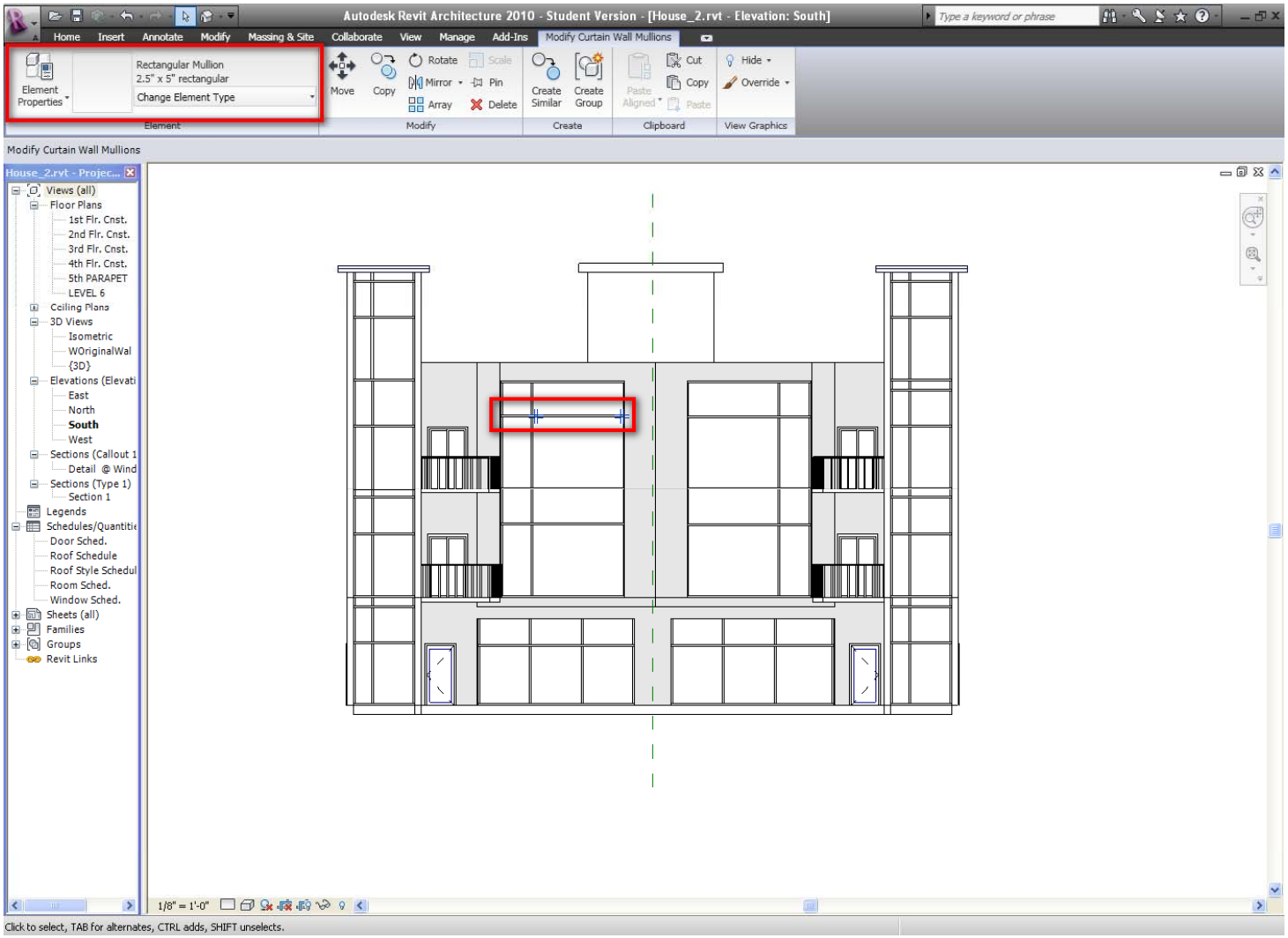
Families Profile Based – sketch profile in single loop



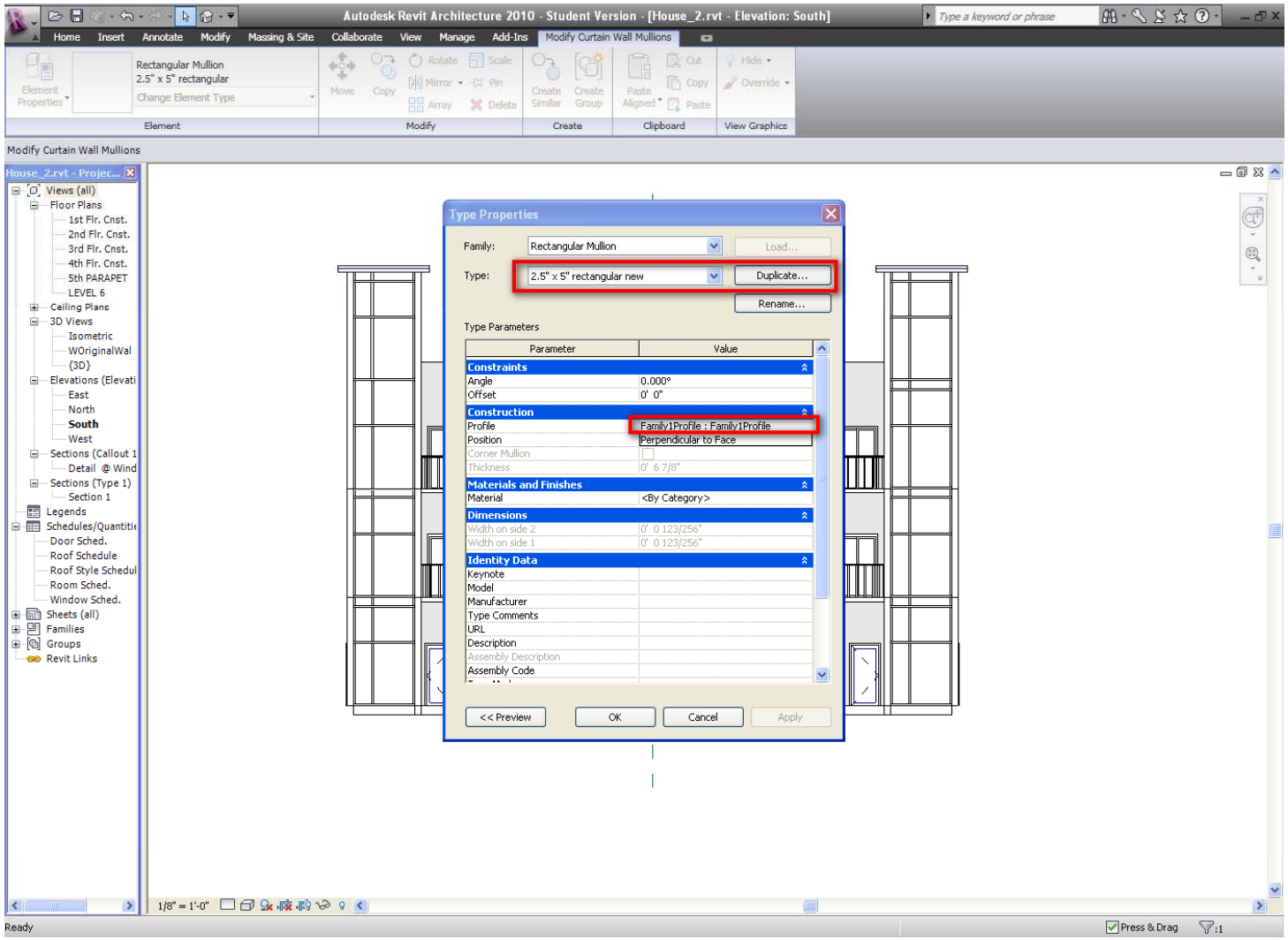
Families Profile Based – select line drawing and set visibility settings to fine



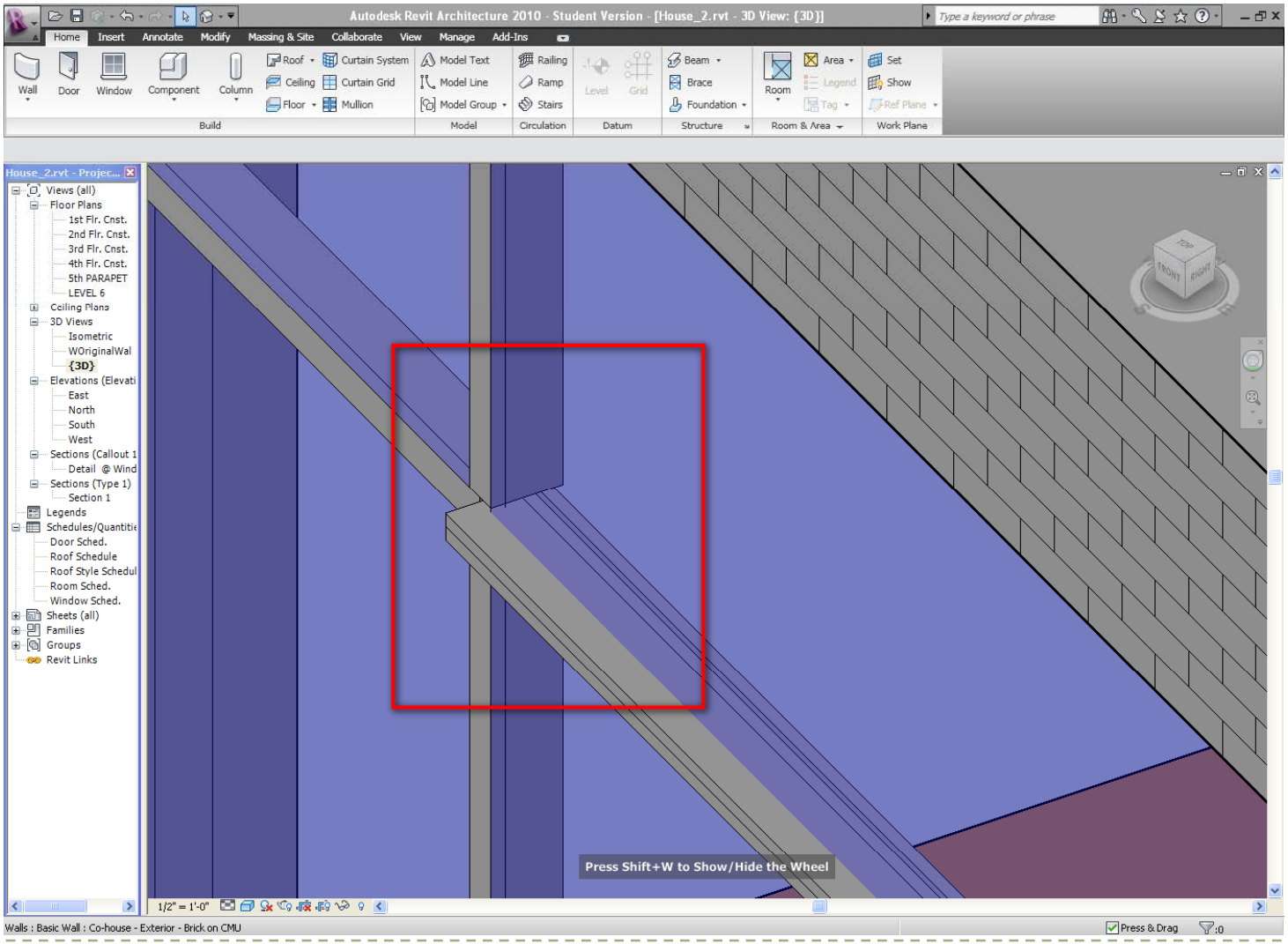
Families Profile Based – Select mullions to change profile and open element type properties



Families Profile Based – Duplicate the Type and rename, choose created profile



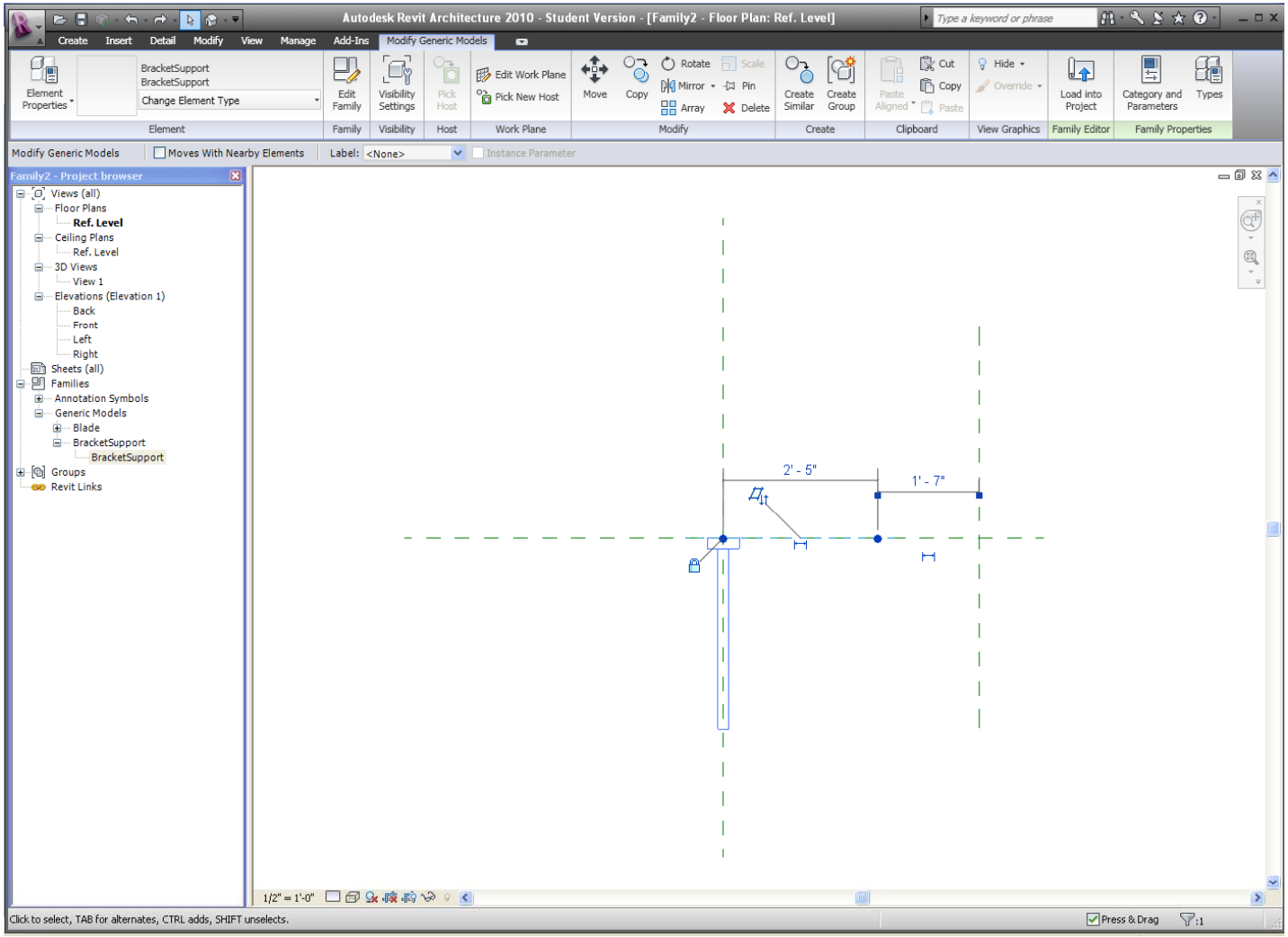
Families Profile Based – view profile loaded into project



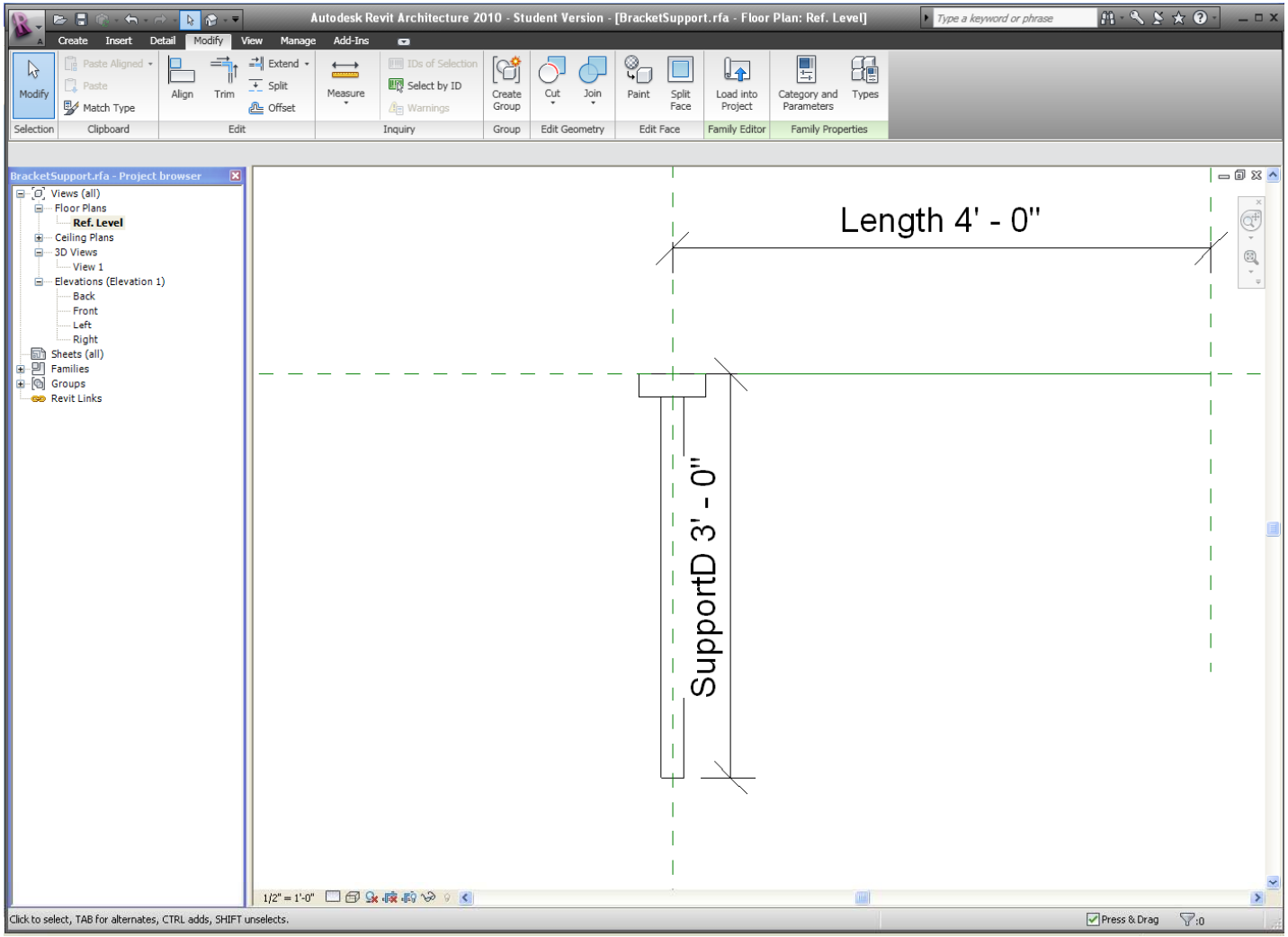
Families Nested – Creating sunshade

- Nest Families
- Create Extrusions for Support and Blade
- Create Array of blades
- Use formula to lock in design intent

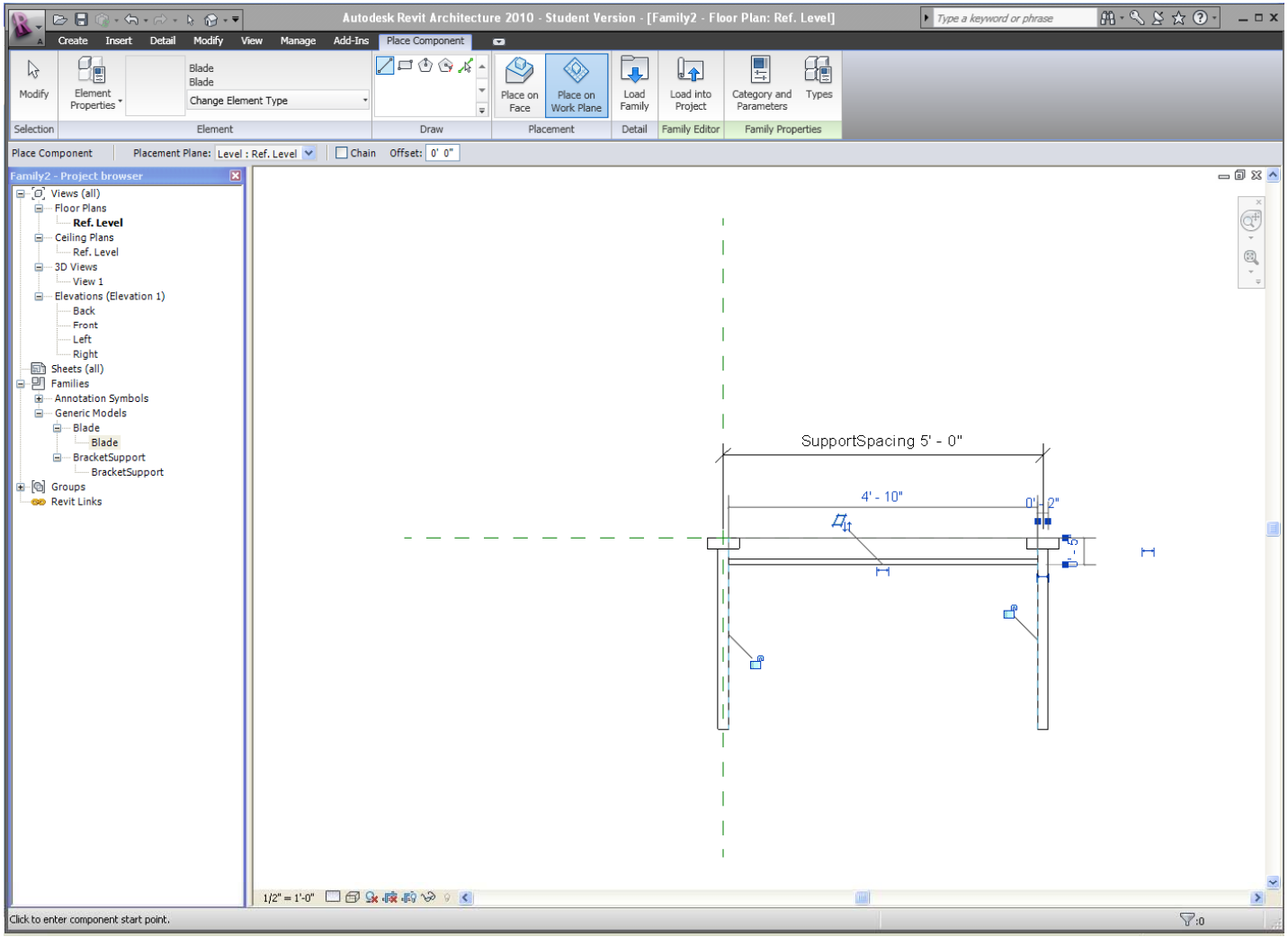
Families Nested – Creating sunshade- first create the bracket using a generic line based family



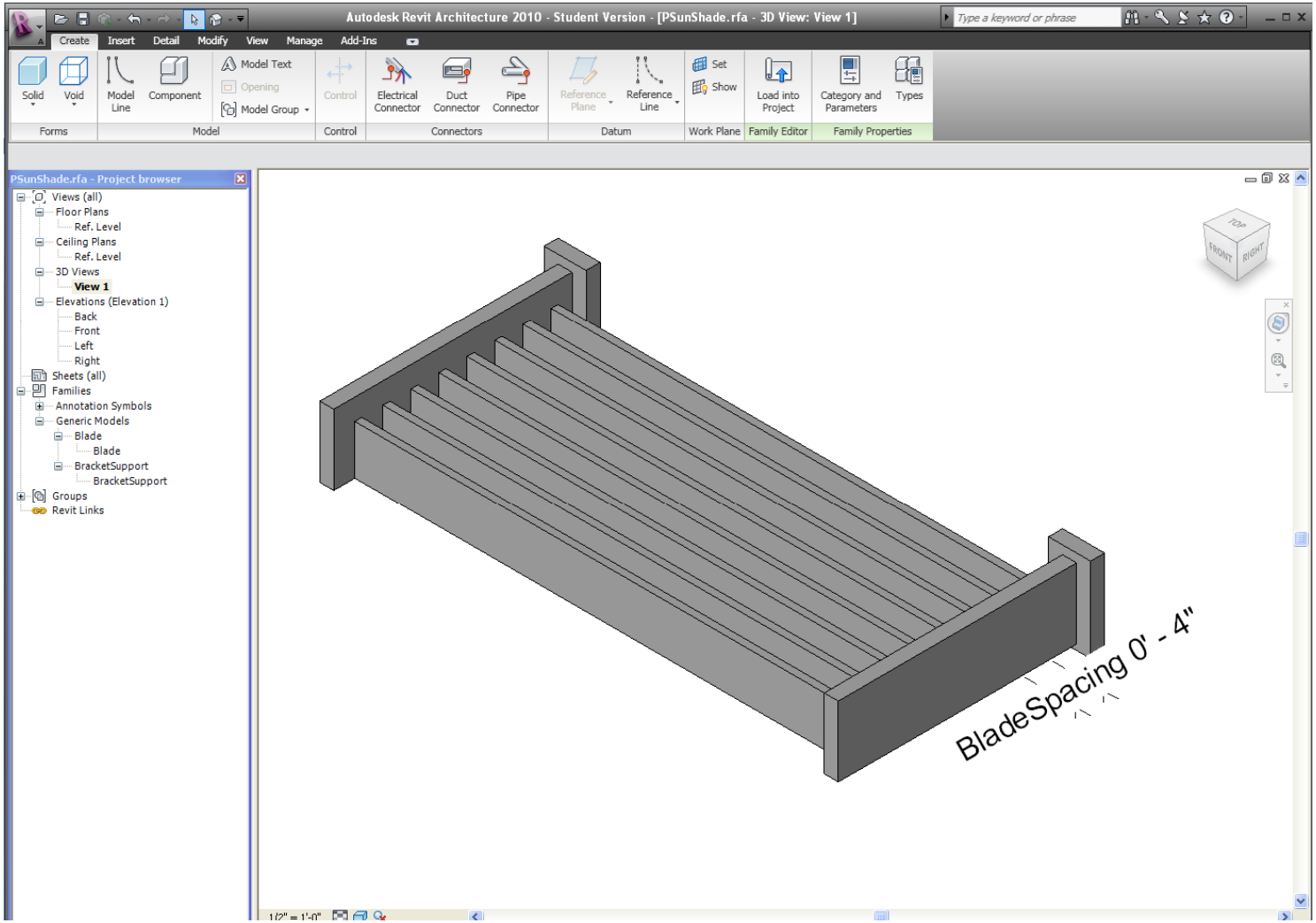
Families Nested – Creating sunshade- Augment the support family with parameters



Families Nested – Creating sunshade- Add blade family to the Support family



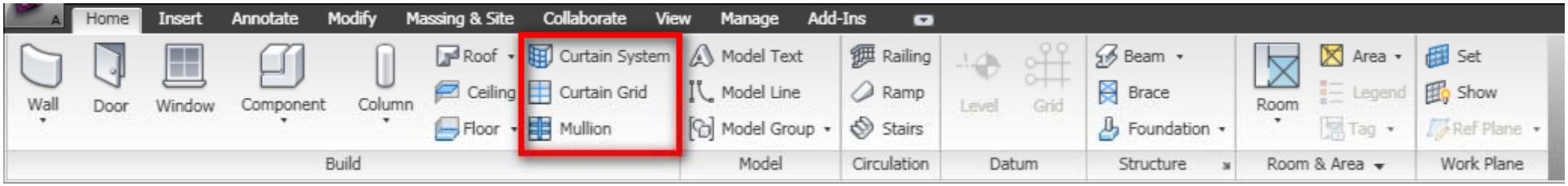
Families Nested – Creating sunshade- Array of blades controlled by formula



Curtain Wall Components

- A curtain wall system is composed of the following three components:
  - Curtain Grid
  - Mullions
  - Curtain Panel - *at least a curtain panel to start from*

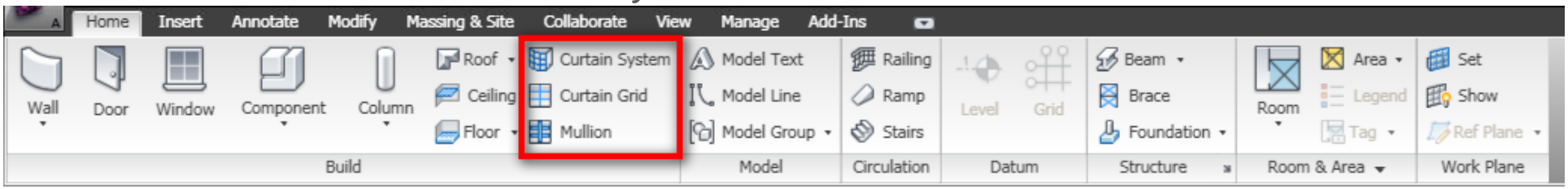
Functions related to Curtain Wall System:

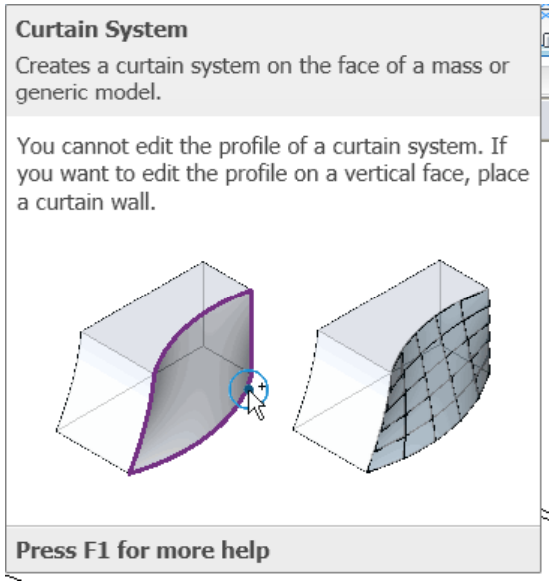


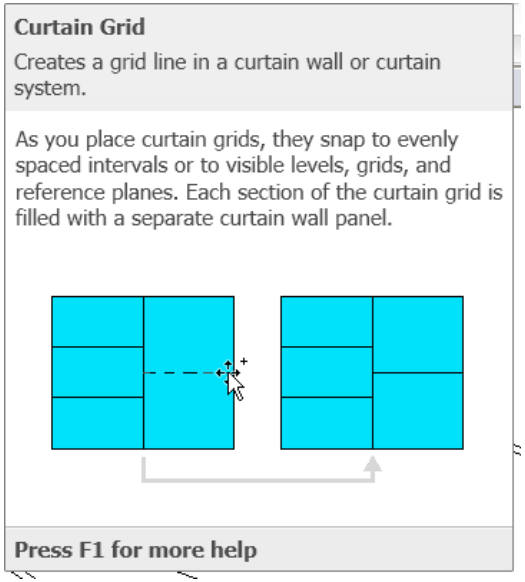
Home → Build →Curtain System
Home → Build →Curtain Grid
Home → Build →Curtain Mullion

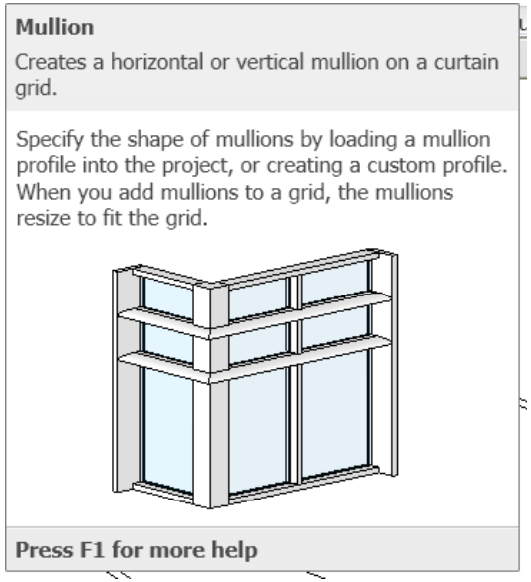
Curtain Wall Components

Functions related to Curtain Wall System:

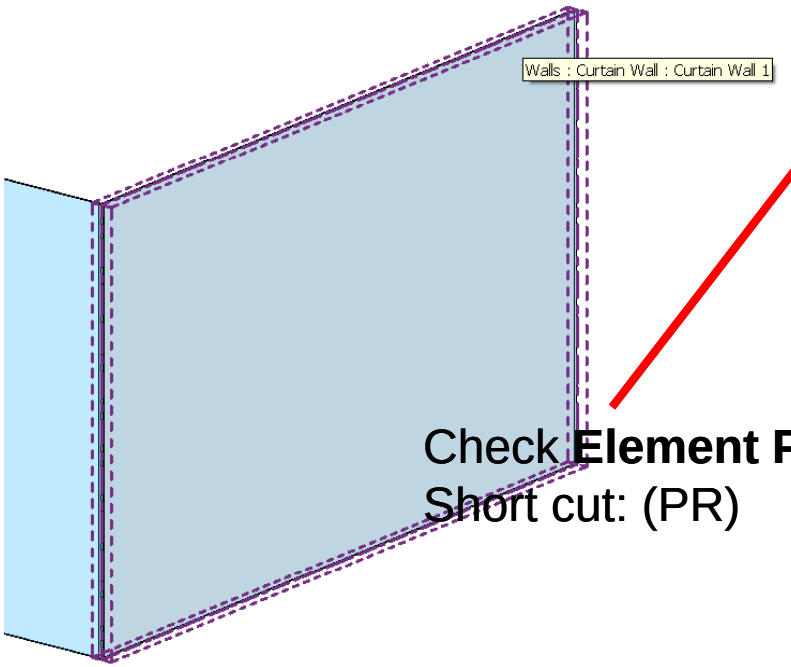




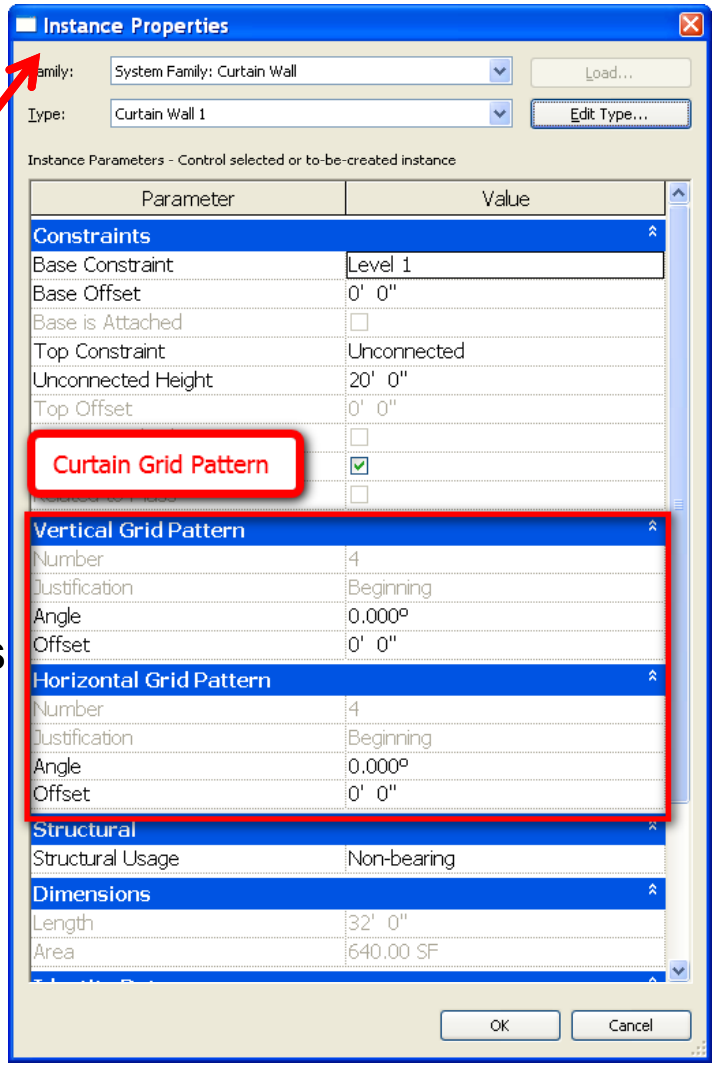




Create a Curtain Wall



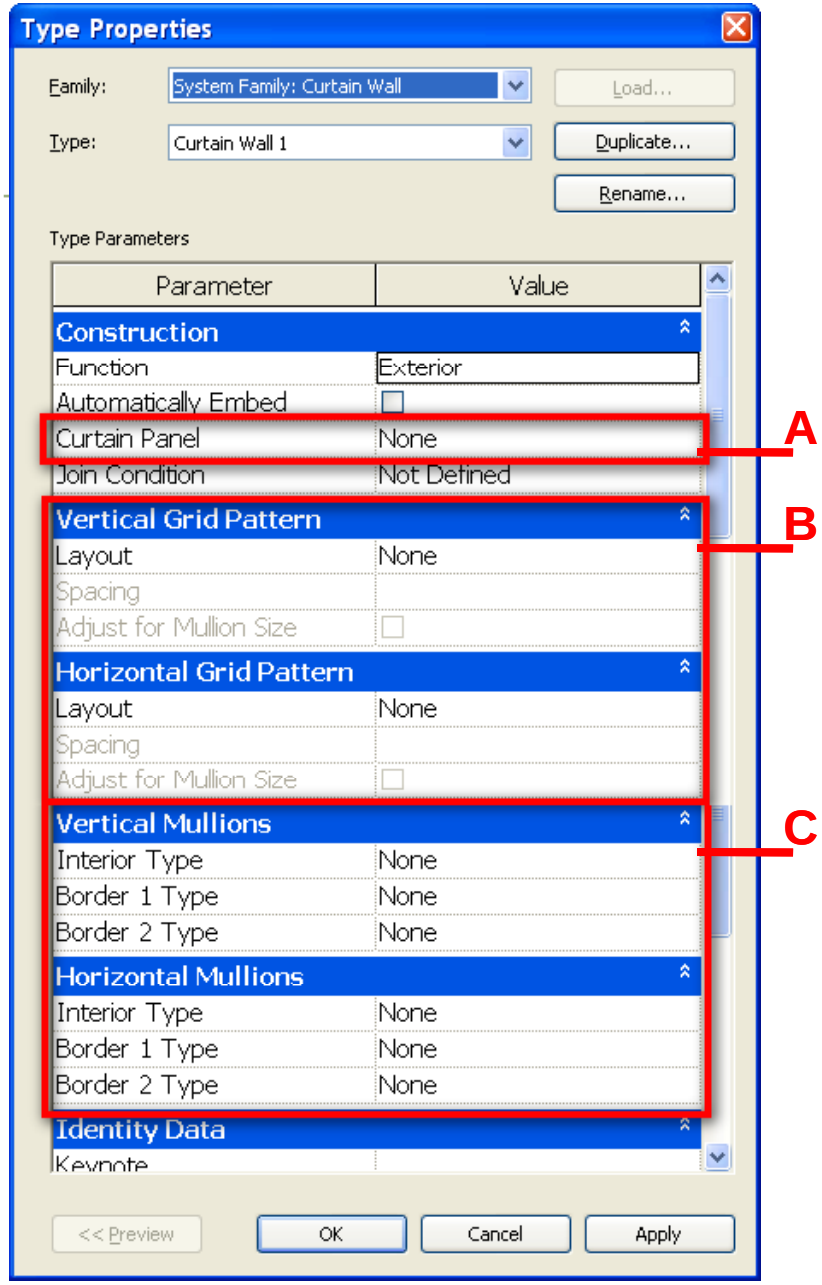
Check **Element Properties**
Short cut: (PR)



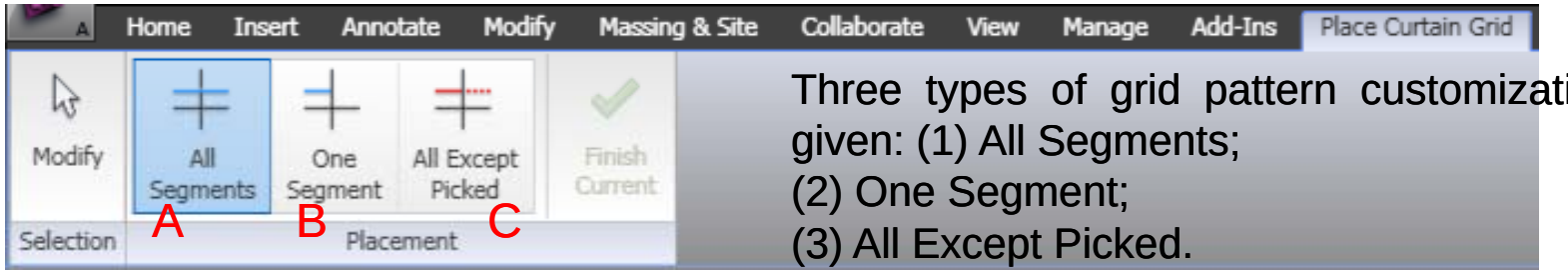
Curtain Wall Properties

A. Curtain Panel
B. Curtain Grid Pattern
C. Curtain Mullions

To specify/modify the values for each one of them, click on the value fields (none) and select the desired value from the pull-down menu.



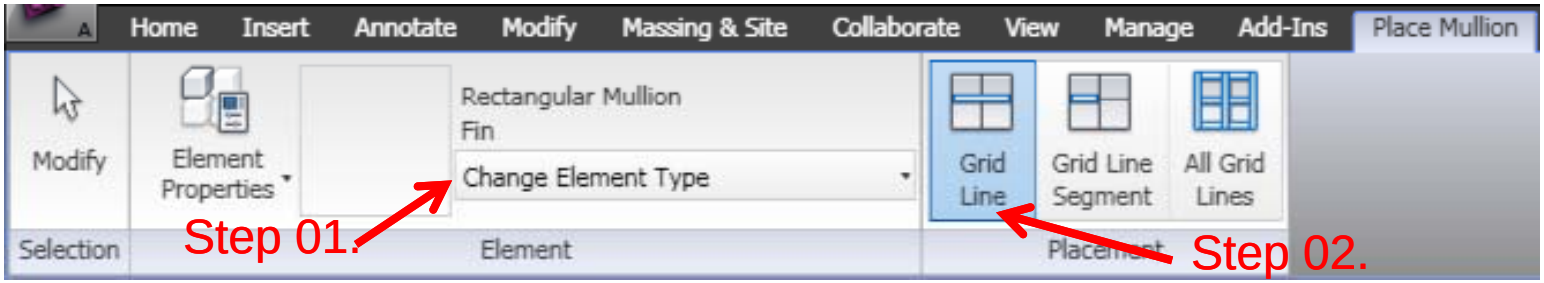
Curtain Wall Components_Curtain Grid



Three types of grid pattern customizations are given: (1) All Segments;
(2) One Segment;
(3) All Except Picked.

Curtain Wall Components_Mullion(1)

- You can initiate a mullion elements by selecting the curtain grid elements in your project.

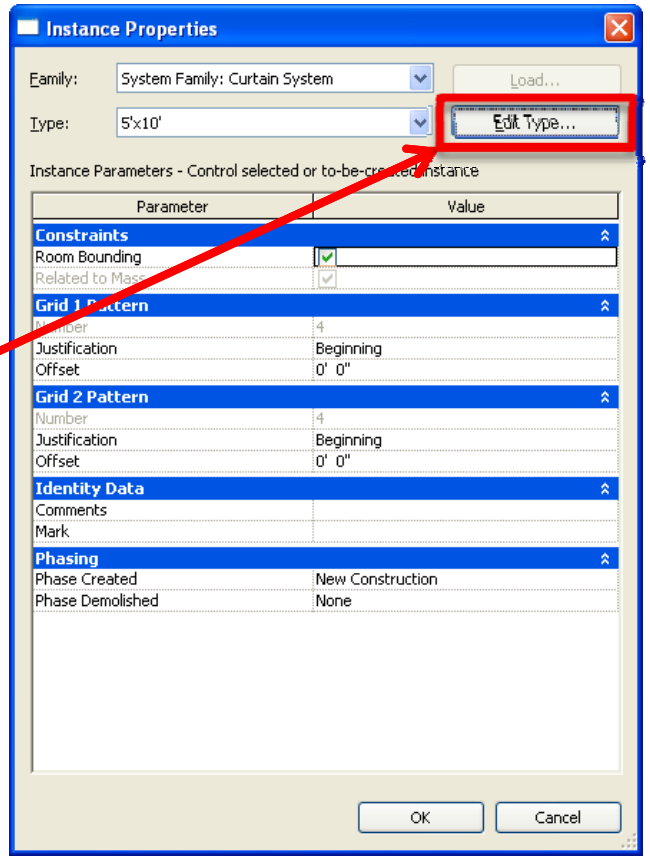


Step 01: Select the Mullion type
Step 02: Manually Placing a mullion element by Grid lines

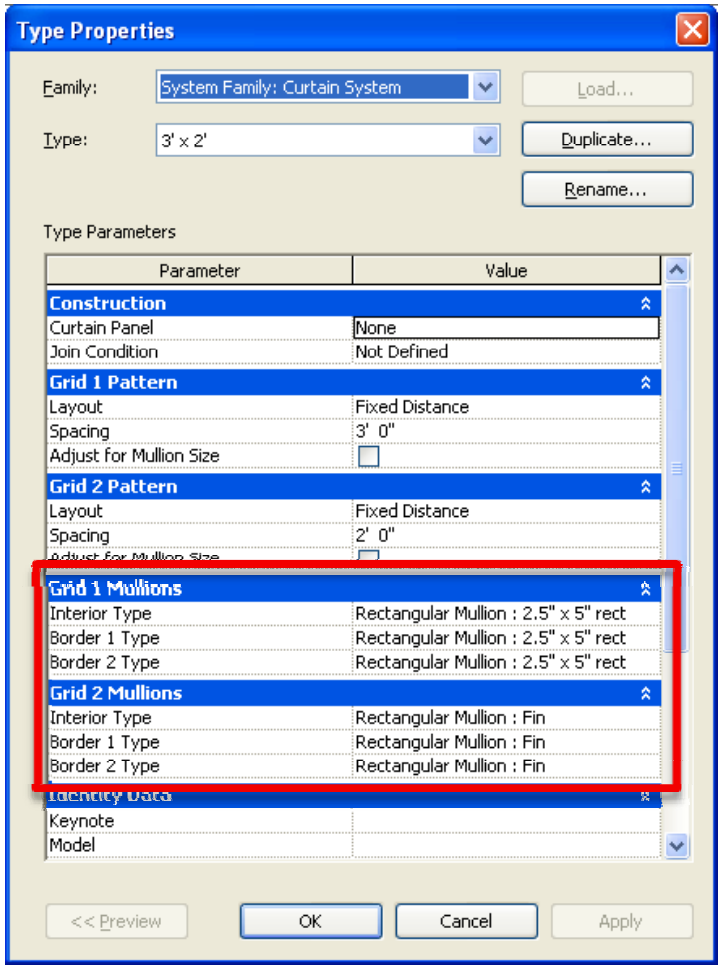
Curtain Wall Components_Mullion(2-1)

- You can also assign the Mullion types by changing the Elements Properties of a Curtain System.

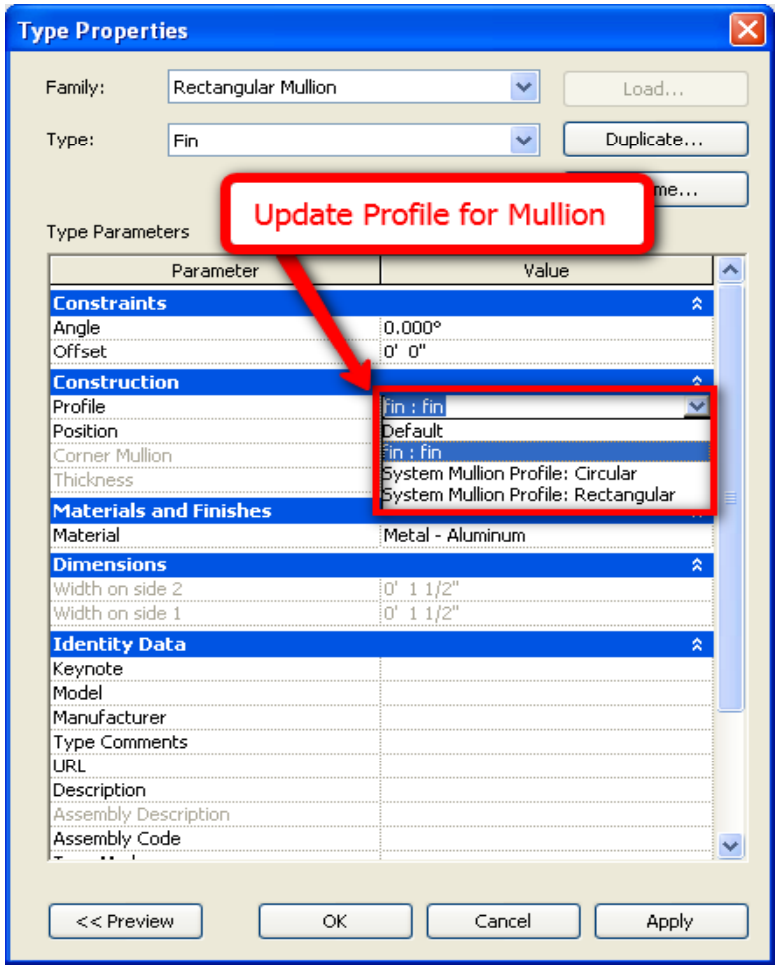
Step 01: Select the Curtain System you have created in your project.
Step 02: Click on Edit Type.. Button



Curtain Wall Components_Mullion(2-2)

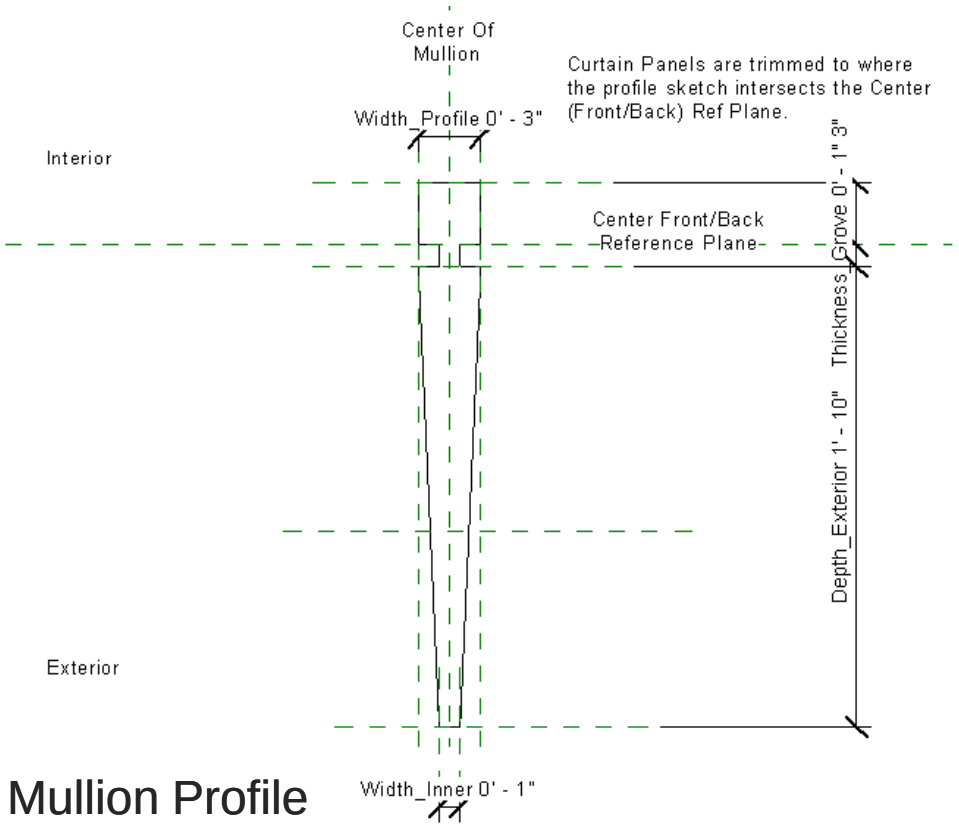


Step 03: Change the Mullion Profiles

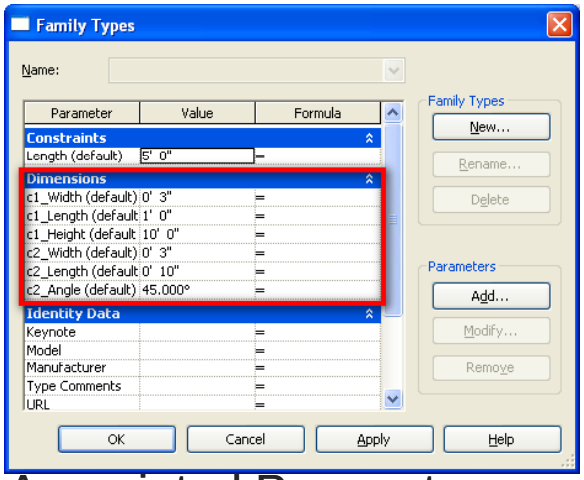


Step 03: Update Mullion Profile

Curtain Wall Components_Mullion Profile



Mullion Profile



Associated Parameters

Curtain Wall by Customized Mullion Profiles