

ARCH 2431. Building Technology III

Building Information Modeling with Revit

Steel Connections

#1 Introduction to Columns & Beams



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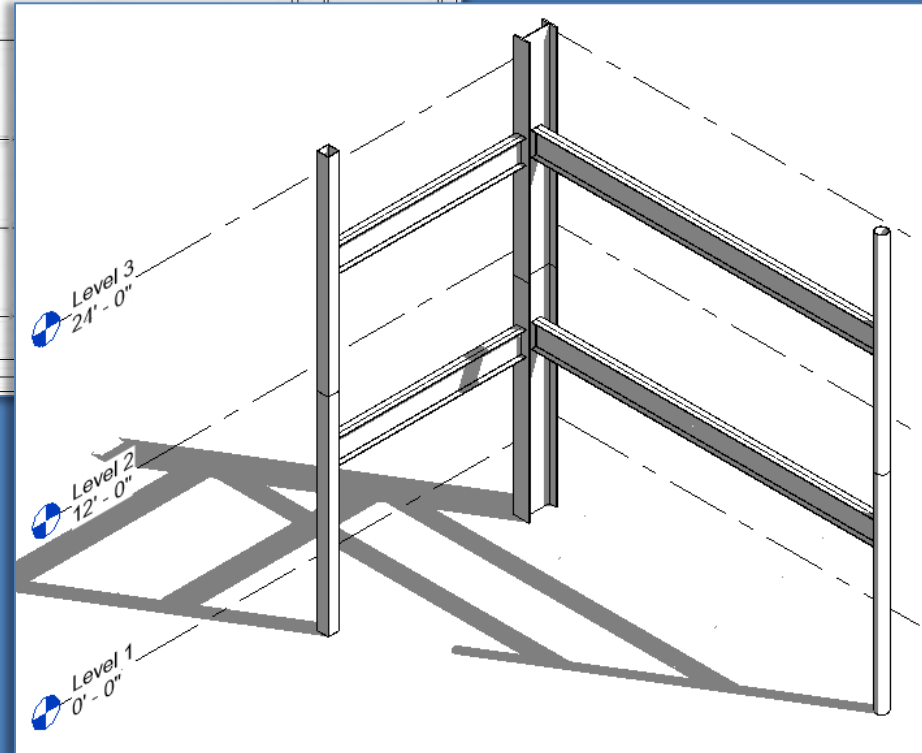
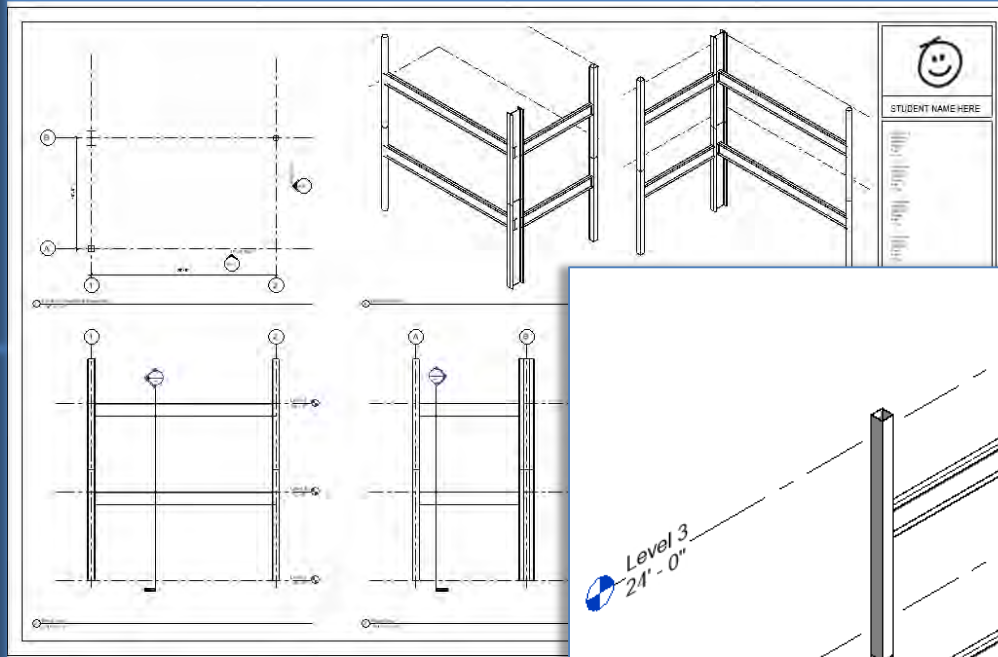
Professor Paul C. King, RA, AIA, ARA

Prof.Paul.King@Gmail.com

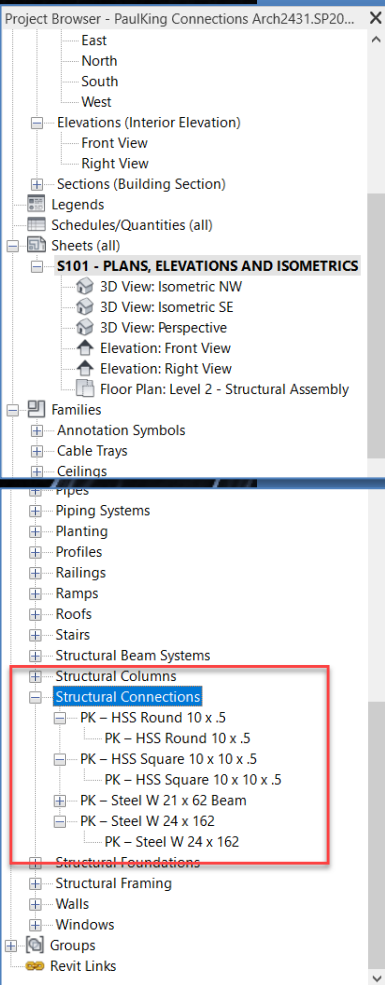
Pking@CityTech.Cuny.Edu

Introduction to Steel Connections

- 22 X 34 Sheet
- Coordinated Views & Isometrics



- Levels & Grids
- 3 Column Types
 - Wide Flange
 - Round
 - Square
- Beams



Connections Intro

- **Assignment Description**
- New Project File
 - Levels
 - Grids
 - Dimensions
- New 3D Family
 - W24 x 162 Column
 - Reference Planes
 - Parameters
 - Extrusion
 - Height Parameter
 - Family Category
- Load into Project
- New 3D Families
 - HSS Pipe Column
 - Formula Parameter
 - HSS Square Column
 - W 21 x 162 Beam
 - Place Beam
 - Snap, Align & Copy
 - Modify Round Column Family
- Project File Sheet

Introduction to Steel Connections Assignment

Creating 3D families build the 3D Revit model described in the assignment.

These 3d Families will be assembled in a project file named as follows:

FirstLastName-Connections-AR2431-SP20-Professor.rvt

As specified create families using modifiable parameters.

Format the assembly on a 22 x 34" titleblock. As before be certain your photo and name is on each sheet.

Create additional sets of coordinated views of assembly connections at enlarged scale along with an isometric.

Add annotation (notes and leaders) dimensions and detail items as necessary to clarify the details.

Review class readings and conduct additional research as needed to complete the assignment.



NEW YORK CITY
COLLEGE OF TECHNOLOGY
THE CITY UNIVERSITY OF NEW YORK

DEPARTMENT OF ARCHITECTURAL TECHNOLOGY

ARCH 2431 BUILDING TECH III

(#3A) STEEL CONNECTIONS

Steel Connections Study:

This assignment will introduce you to standard steel components used for beams and columns including Wide Flange Sections, Hollow Circular and Square Columns. Through this assignment we will investigate each of these types and look at how steel connections are made.

Steel Connection Types:

Steel connections are made using Rivets, Bolts or by Welding. The use of Rivets are less common today than they were before the introduction of standard size bolts. For this assignment we will consider connections made with bolts or by welding.

Drawings:

Note: *Multiple coordinated views (plan/front elevation, side elevation or section) are typically the same scale. At times we use a smaller scale for the isometric in order to fit it on the same sheet. Views must be clearly readable.*

The project will be completed in several stages.

Stage 1:

Create 3D families for three types of columns and one type of beam. Assemble these on a column grid 15' x 25'. Layout the entire assembly on a 22 x 34 sheet. Include coordinated views including a plan, 2 elevations and an isometric.

- W 24 x 162 for columns (depth 25", Width 15", Flange Thickness 1.22", Web Thickness .705")
- W 21 x 62 for Beams (depth 21", Width 8.24", Flange Thickness .615", Web Thickness .4")
- HSS Hollow Square Column (10" x 10" x ½" Thick)
- HSS Hollow Round Column (10" diameter x ½" Thick)

Stage 2:

Add additional 3D family's element to illustrate the following. Create callouts and add notes, leaders and dimensions. Add detail items as necessary to illustrate the drawings. Complete research as needed.

- The splice connection of two stacked columns
- Diagonal Bracing of the steel frame
- Base of Column to Concrete Footing Transition Connection

Grading: *Criteria for grading will include but not be limited to the following (Remember quality is more important than quantity)*

- A minimum of two sheets are required, one overall composition and one detail composition
- How well are the drawings composed & are the proper drawings included?
- Are appropriate annotation and dimensions included?
- Are the details well researched?
- Does the student demonstrate an understanding of what has been drawn graphically and verbally?

****This assignment is included in the 30% of grading listed Studio Lab Assignments in the syllabus**

Creating a New Project File

Connections Intro

Assignment Description

New Project File

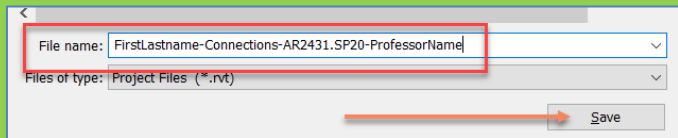
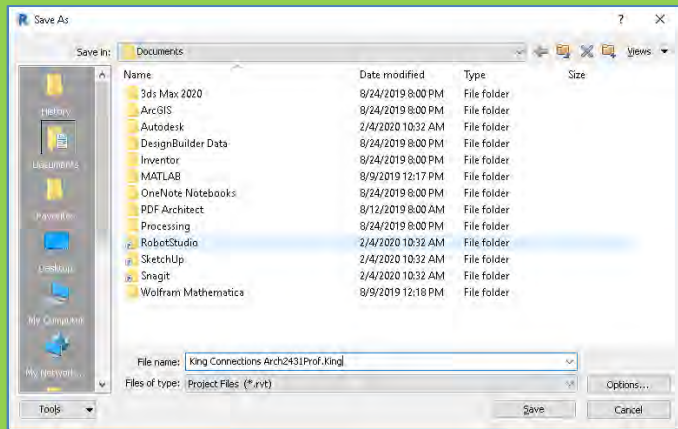
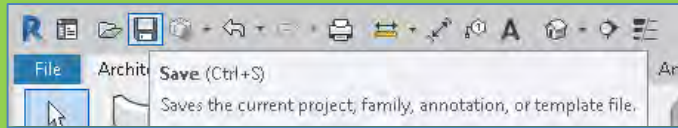
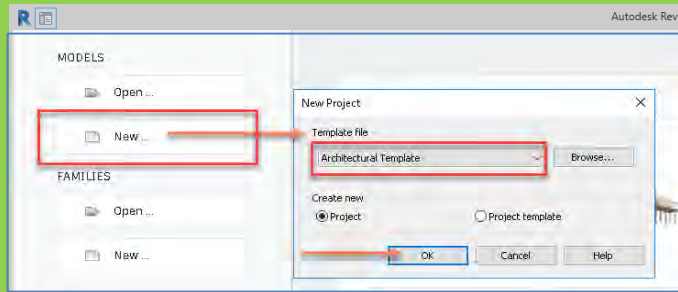
- Levels
- Grids
- Dimensions

- New 3D Family
- W24 x 162 Column
 - Reference Planes
 - Parameters
 - Extrusion
 - Height Parameter
 - Family Category

Load into Project

- New 3D Families
 - HSS Pipe Column
 - Formula Parameter
 - HSS Square Column
 - W 21 x 162 Beam
 - Place Beam
 - Snap/ Align & Copy
 - Modify Round Column Family

Project File Sheet

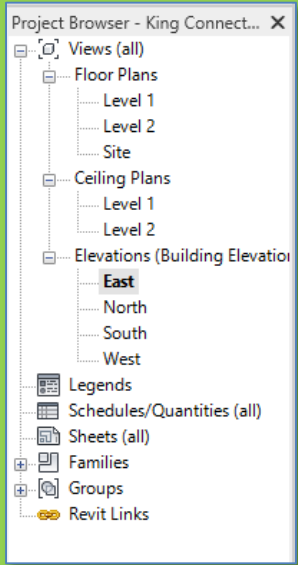


- Create a new Project File
 - Architectural Template
- Save and Name the File
- Select an appropriate directory
 - *(do not work from your USB! This will cause all backup files to be saved there and fill up your drive and potentially crash the program.)*
- Name the file as follows:
 - *FirstLastname-Connections-AR2431.SP20-ProfessorName.rvt*

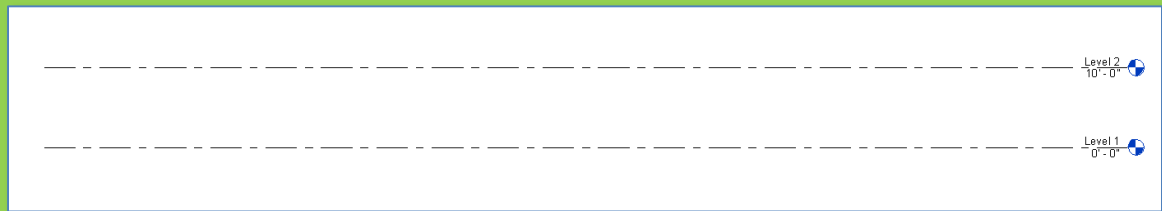
Modify Level 2 elevation from 10 to 12 feet

Connections Intro

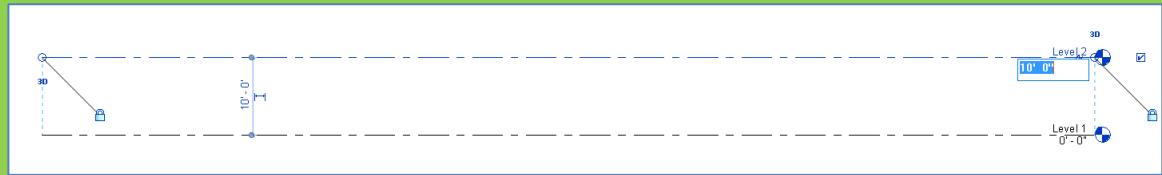
- Assignment Description
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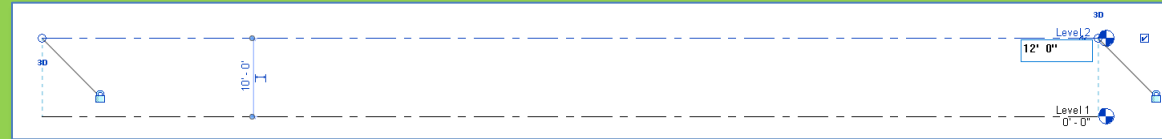
- Project Browser
 - Select the East Elevation



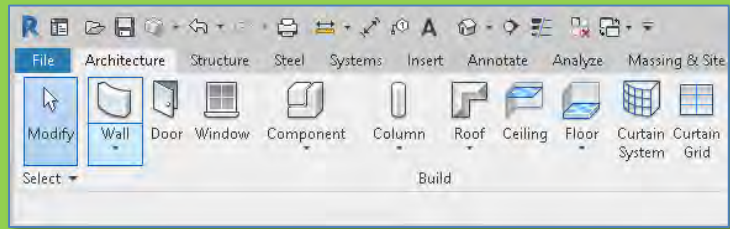
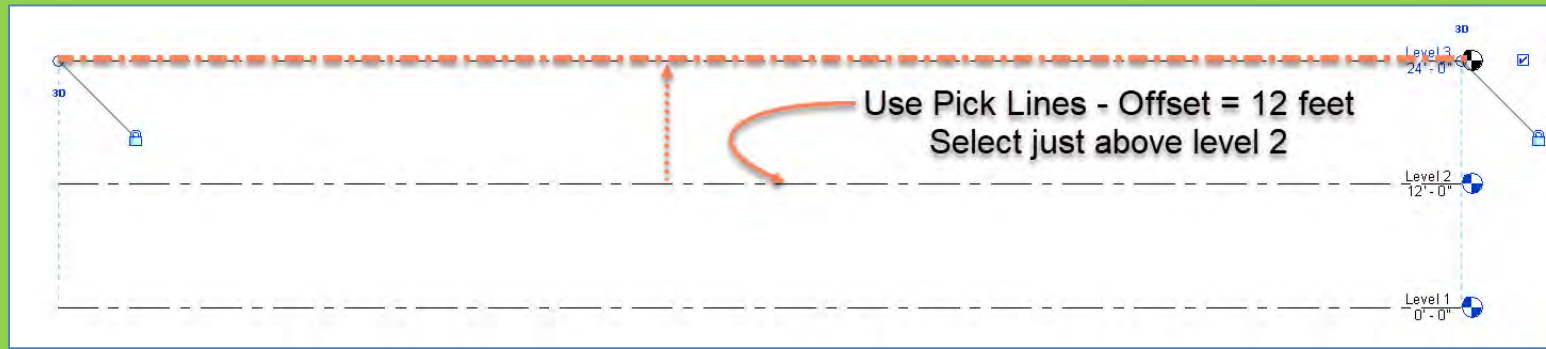
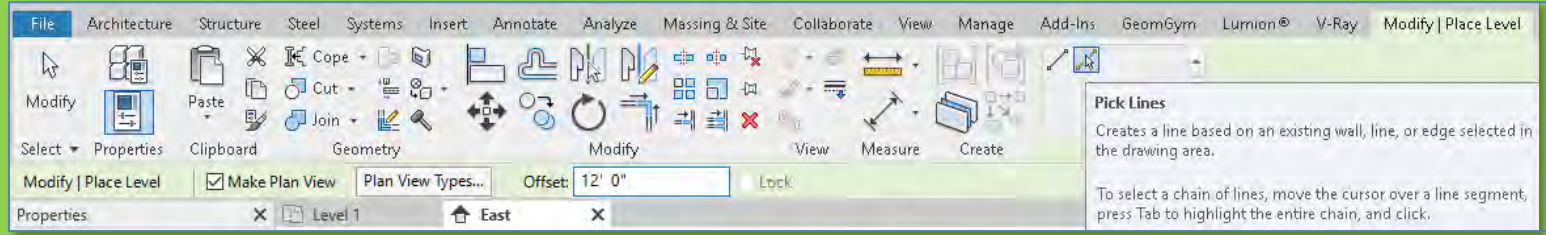
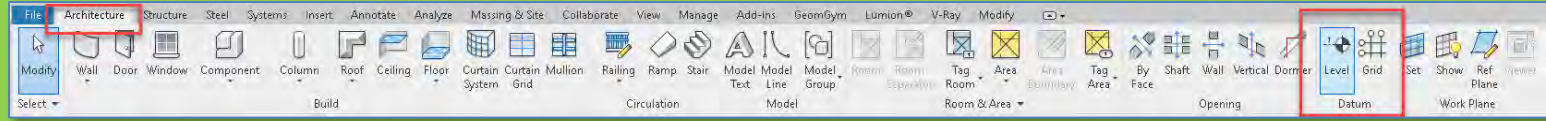
- Select Level 2
 - Highlight the Elevation [10'-0"]



- Change the Elevation to [12'-0"]



Add Level 3

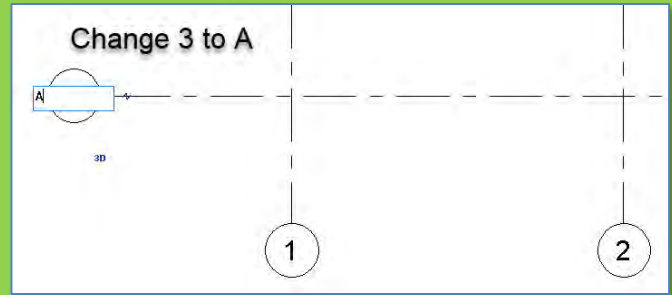
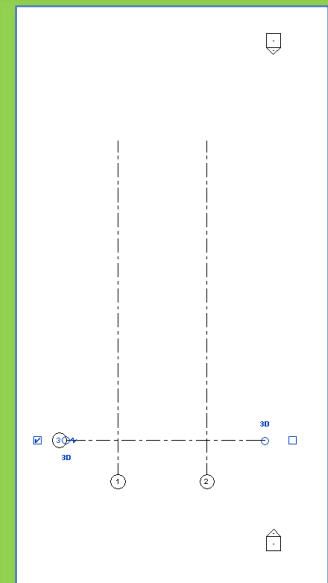
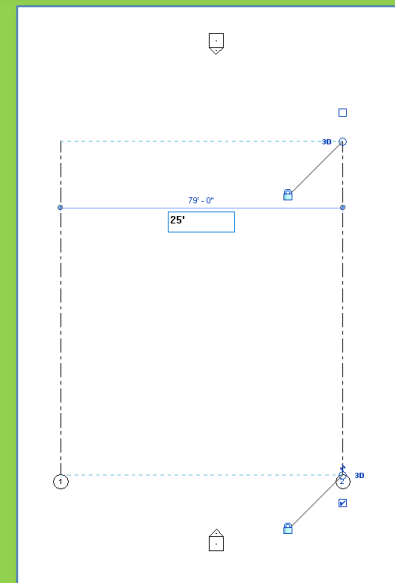
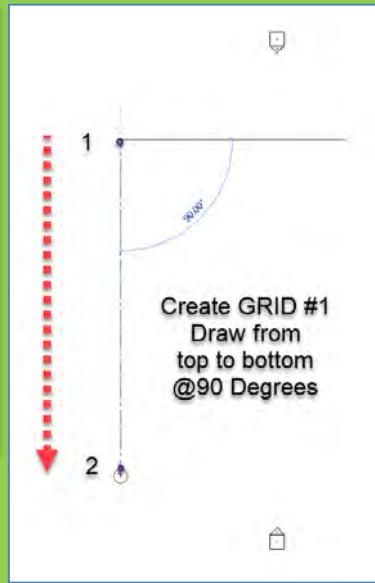
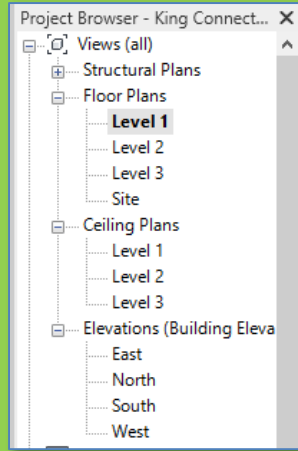
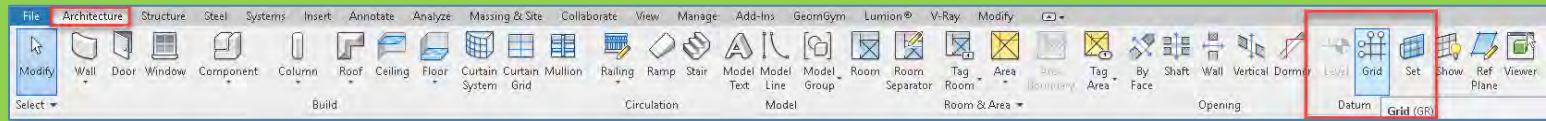


- **Architecture Ribbon**
 - Activate **East** view then select **Level**
 - Method = **Pick Lines**
- Set **Offset** to 12'-0" & [Yes] **Make Plan View**
 - Move cursor just above Level 2
 - Select and Level 3 will be created
- Select the **Modify** Button to end command

Connections Intro

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Add Column Grids on Level 1



- Set Level 1 as the current view
 - Architecture Ribbon > Grid
- Draw Vertical Grid 1 from top to bottom
- Draw Vertical Grid 2 from top to bottom
 - Modify Spacing to 25 feet
- Draw Horizontal Grid (will be numbered 3)
 - Change Name from 3 to A

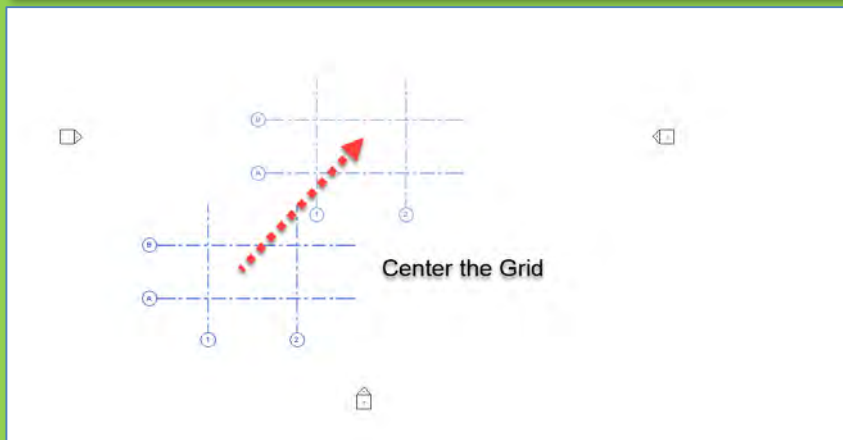
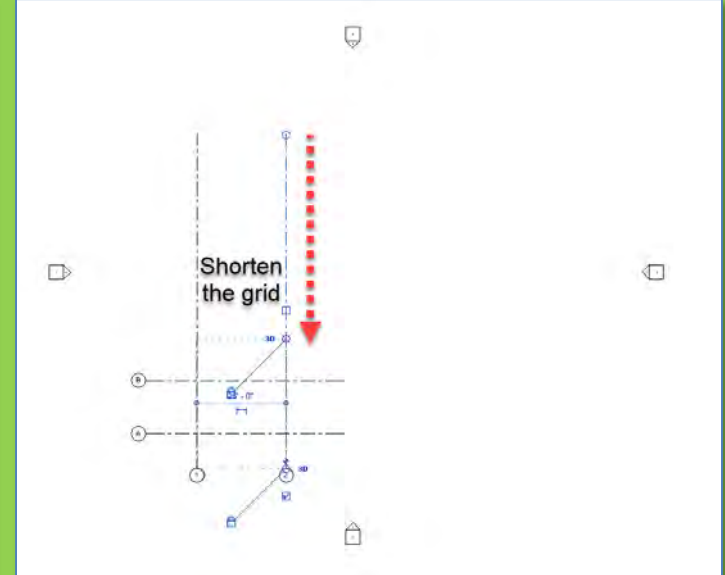
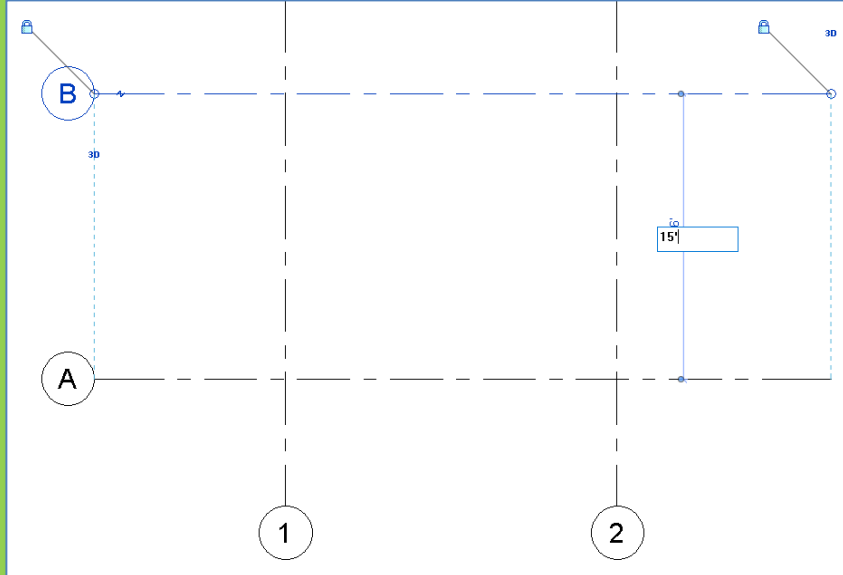
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Add Column Grids on Level 1

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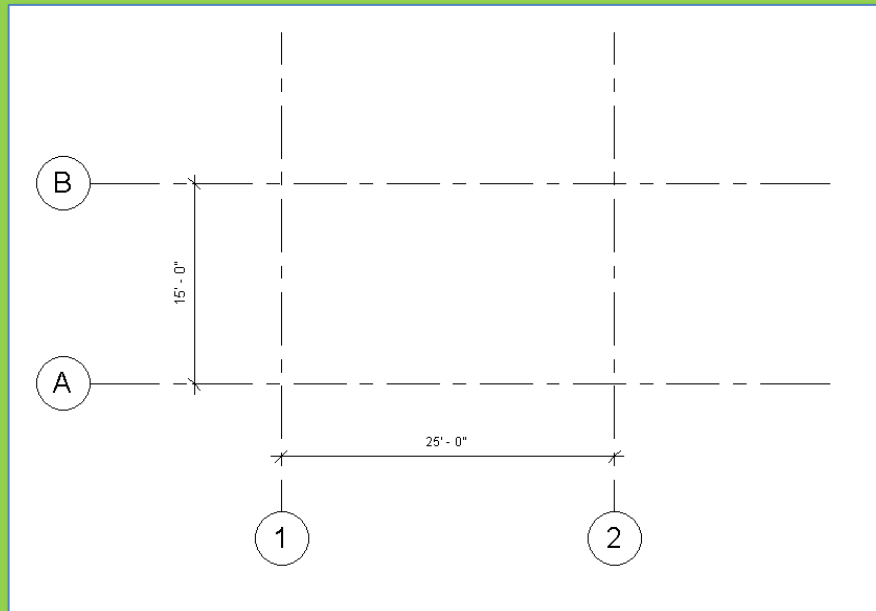
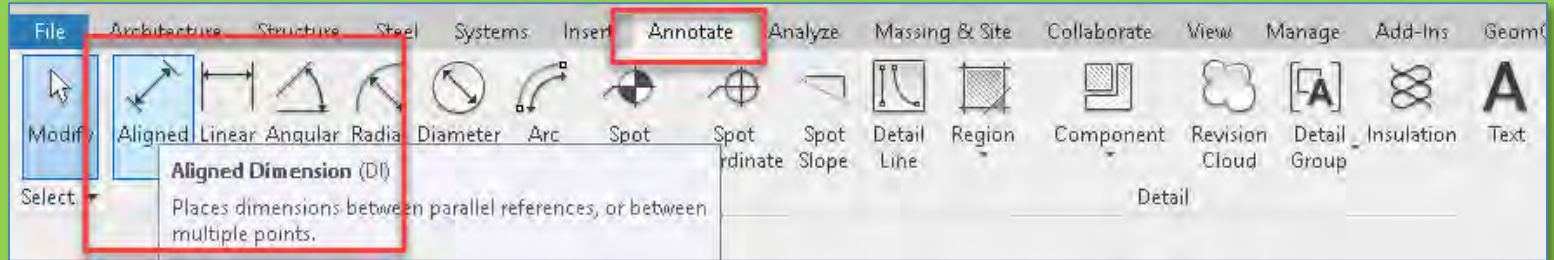


- Draw Grid Line B
 - Set Spacing to 15'-0"
- Shorten the Grid Lines
- Move & Center the Grid
 - Select Grid & Drag

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Add Dimensions

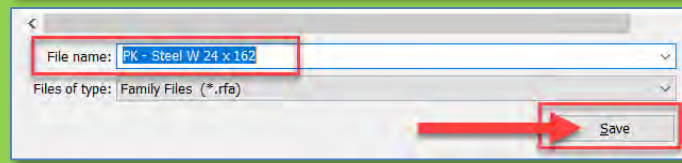
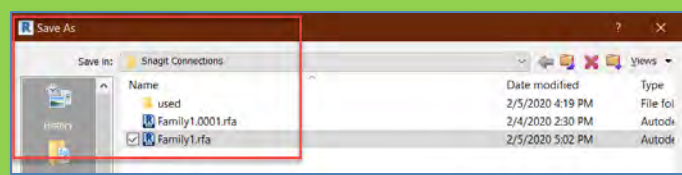
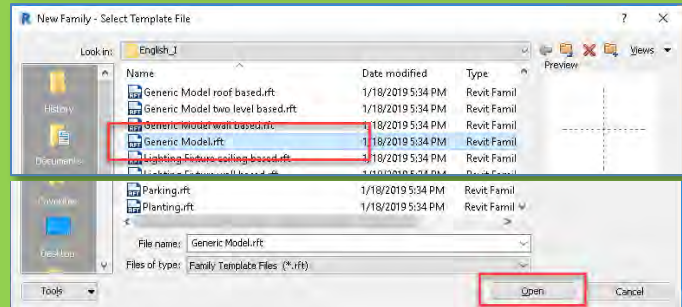
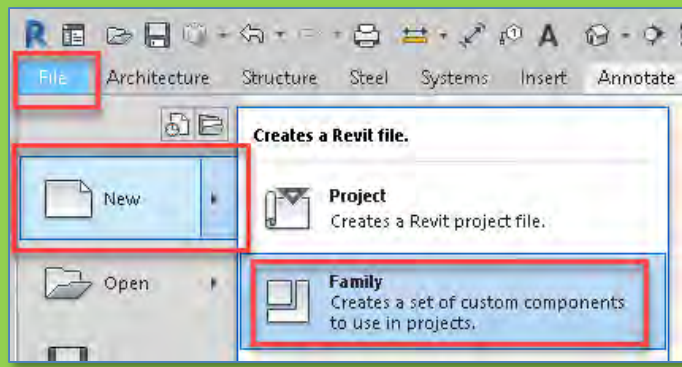


- Annotate Ribbon
 - Aligned Dimension
- Add vertical dimension
- Add Horizontal Dimension

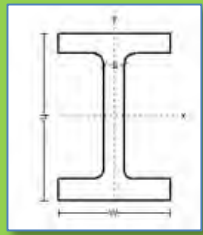
Creating a new 3D Family File

Connections Intro

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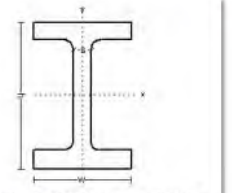
- We will repeat this for each component of the Steel Connection Assembly
- **Create a new Family**
 - File > New > Family
 - Generic Model Template
- **Save and Name the File**
- Select an appropriate directory
- Name the file as follows:
 - Initials- Description
 - PK – Steel W 24 x 162



Designation	Dimensions						
	Imperial (in x lb/ft)	Depth h (in)	Width w (in)	Web Thickness t _w (in)	Flange Thickness t _f (in)	Sectional Area (in ²)	Weight (lb/ft)
W 24 x 162		25	13	0.705	1.220	47.7	162
W 24 x 146		24.7	12.9	0.650	1.090	43.0	146

Wide Flange W 24 x 162

American Wide Flange Beams - W Beam
Dimensions of American Wide Flange Beams ASTM A6 - Imperial units

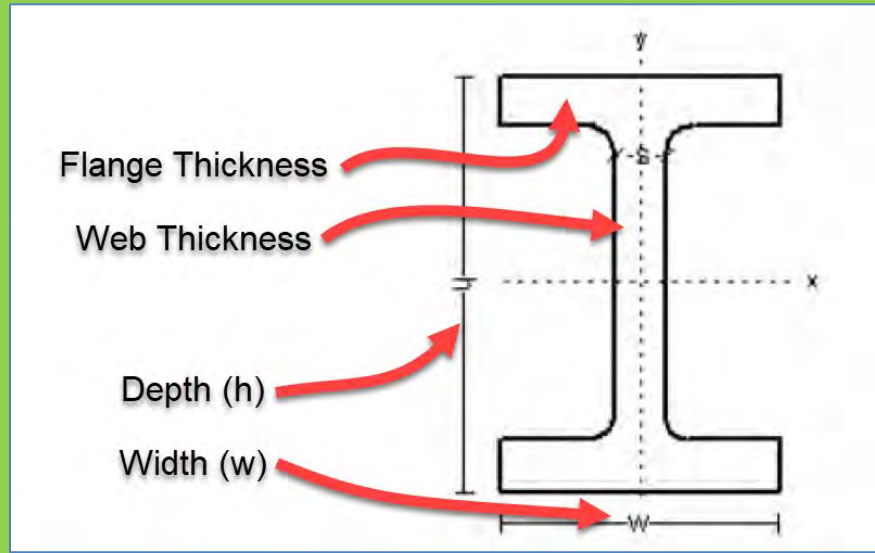


Properties in Imperial units of American Wide Flange Beams according ASTM A6 are indicated below.

- American Wide Flange Beams according ASTM A6 - **Metric units**

- **W 24 x 162**
 - *Depth (h) = 25"*
 - *Width (w) = 15"*
 - *Web Thickness = .705"*
 - *Flange Thickness = 1.220"*

Designation	Dimensions					
	Imperial (in x lb/ft)	Depth h (in)	Width w (in)	Web Thickness tw (in)	Flange Thickness tf (in)	Sectional Area (in ²)
W 27 x 178	27.8	14.09	0.725	1.190	52.3	178
W 27 x 161	27.6	14.02	0.660	1.080	47.4	161
W 27 x 146	27.4	14	0.505	0.975	42.9	146
W 27 x 114	27.3	10.07	0.570	0.930	33.5	114
W 27 x 102	27.1	10.02	0.515	0.830	30.0	102
W 27 x 94	26.9	10	0.450	0.745	27.7	94
W 27 x 84	26.7	9.96	0.460	0.640	24.8	84
W 24 x 162	25	13	0.705	1.220	47.7	162
W 24 x 146	24.7	12.9	0.650	1.090	43.0	146



Source of Information:
https://www.engineeringtoolbox.com/american-wide-flange-steel-beams-d_1319.html

Additional Reference for steel components:
<http://products.anssteel.com/category/steel/>

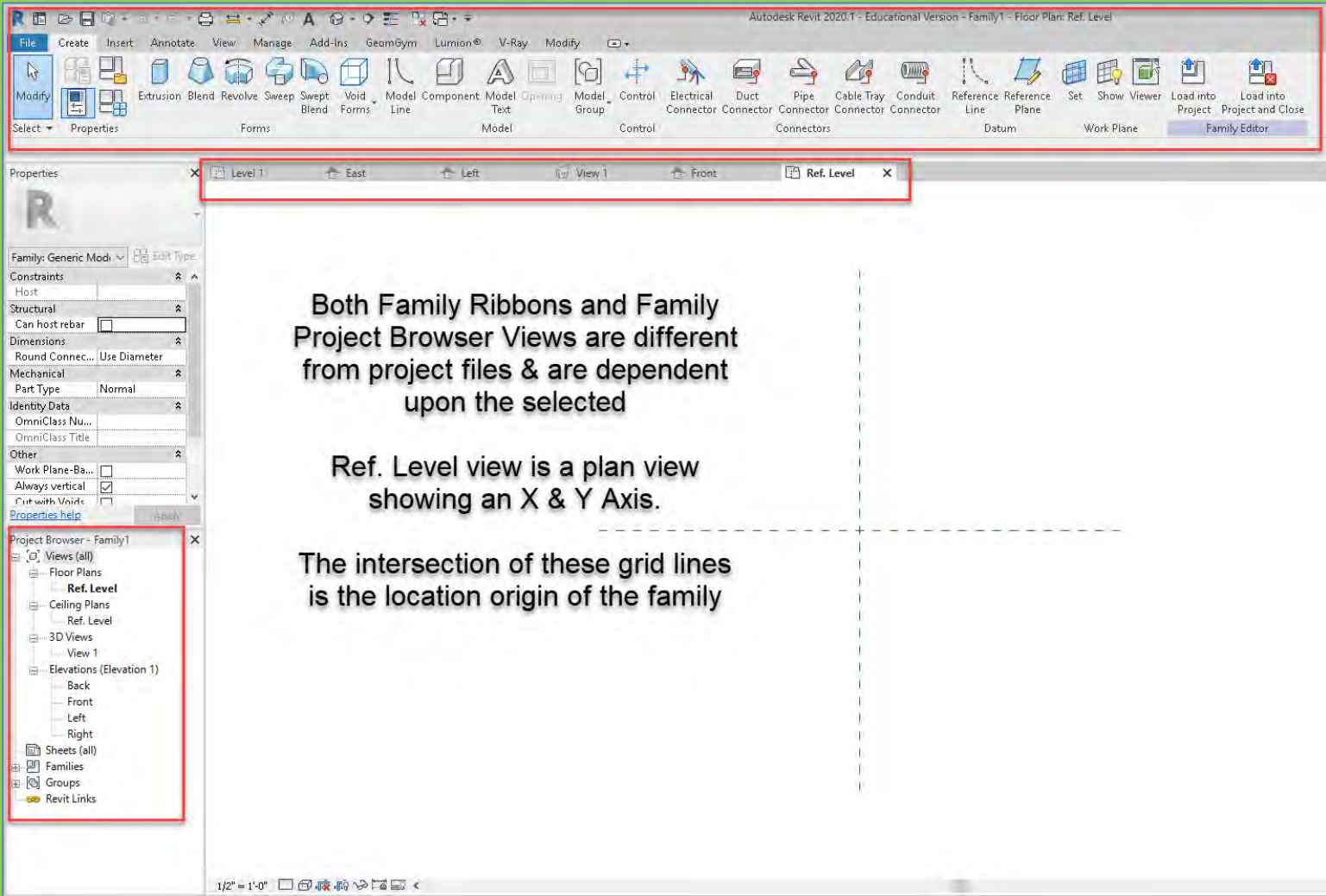
W 24 x 162	25	13	0.705	1.220	47.7	162
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Family Ribbons and Project Browser Views

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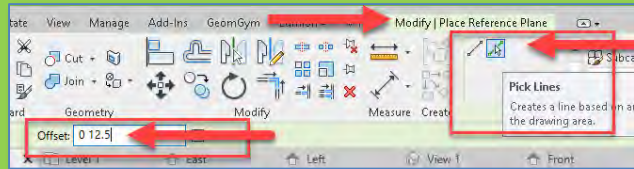
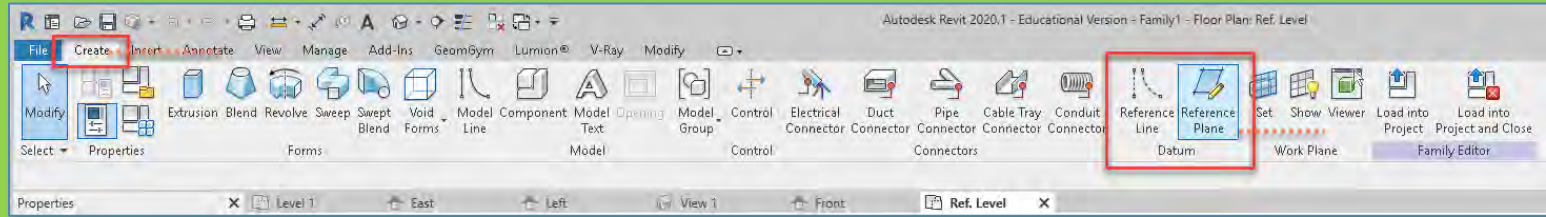


Both Family Ribbons and Family Project Browser Views are different from project files & are dependent upon the selected

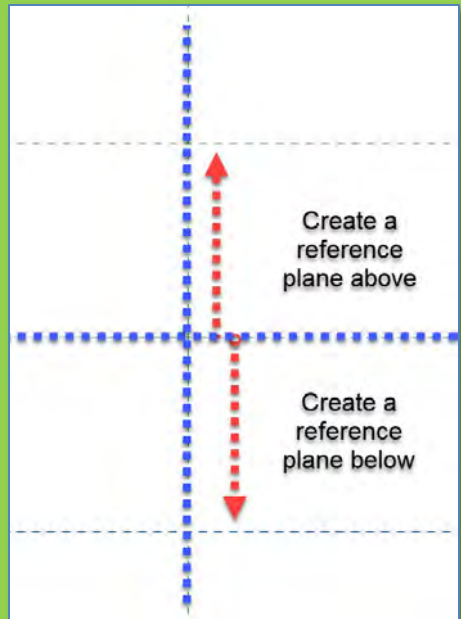
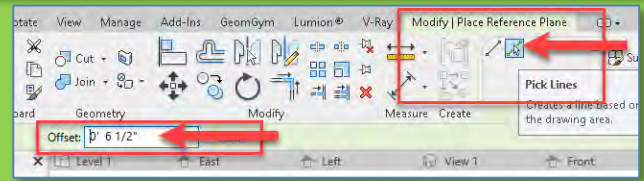
Ref. Level view is a plan view showing an X & Y Axis.

The intersection of these grid lines is the location origin of the family

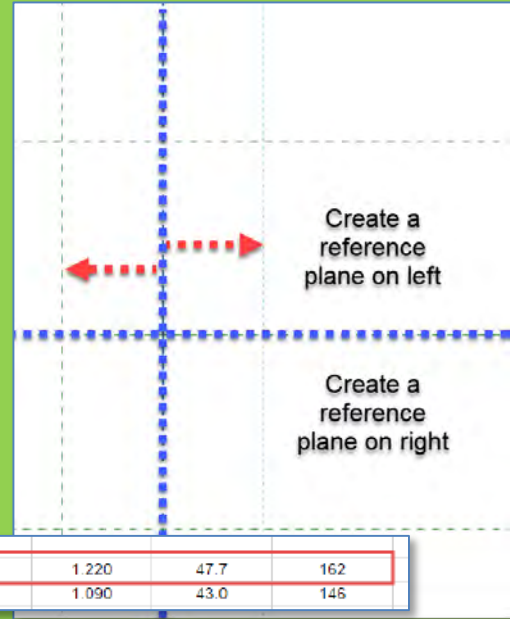
Add Reference Planes for the Depth & Width



- $W 24 \times 162$
- $Depth (h) = 25''$
- $Width (w) = 15''$



- Create Ribbon
 - Reference Plane
- Depth pick lines
Offset ($25/2 = 12.5''$)
 - Add two
- Width pick lines
Offset ($13/2 = 6.5''$)
 - Add two

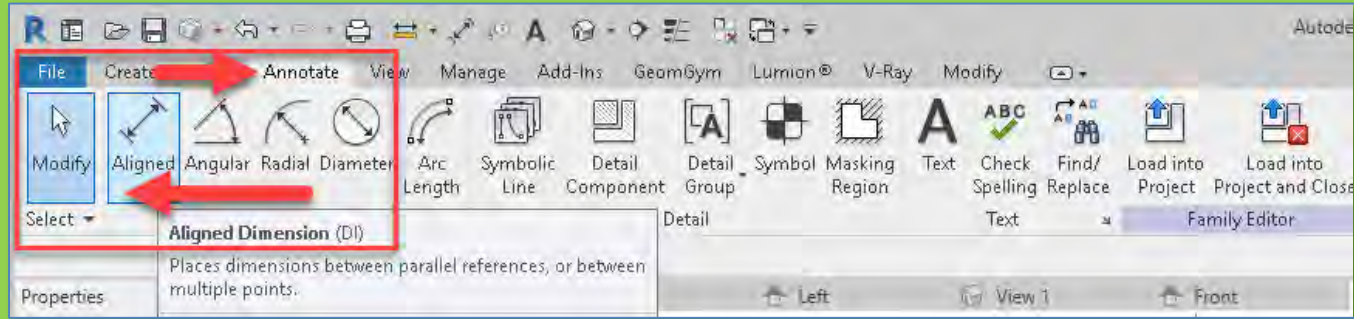


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Connections Intro

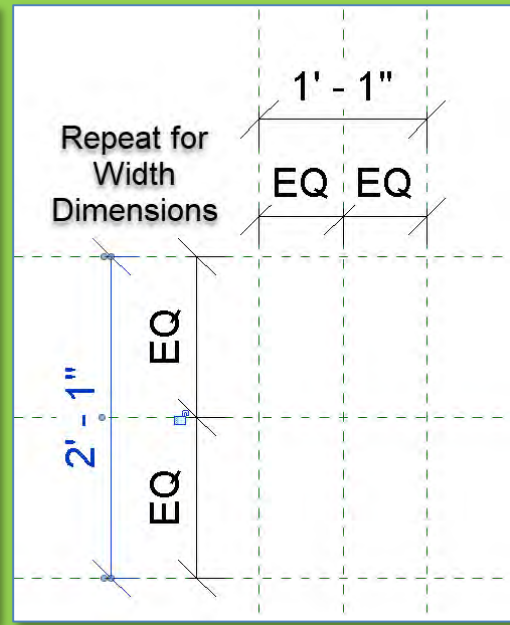
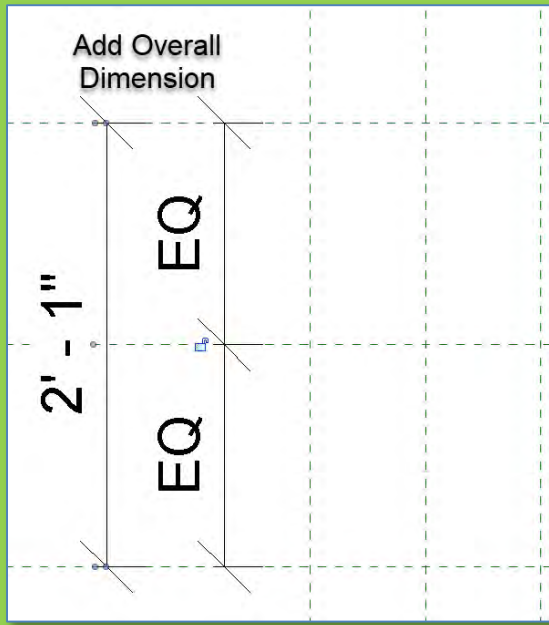
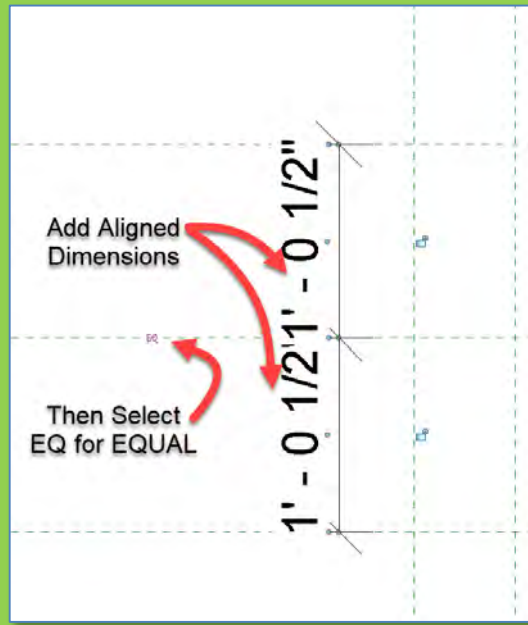
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Add Dimensions & define adjustable Parameters



- W 24 x 162
- Depth (h) = 25"
- Width (w) = 15"

- Annotate > Aligned (Add two dimensions then EQ) Then Overall & Repeat



Connections Intro

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Load into Project

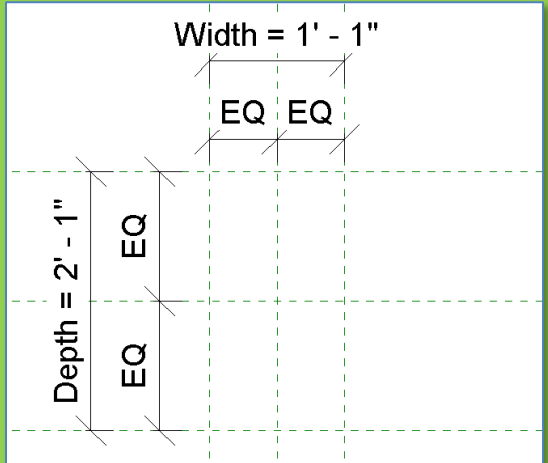
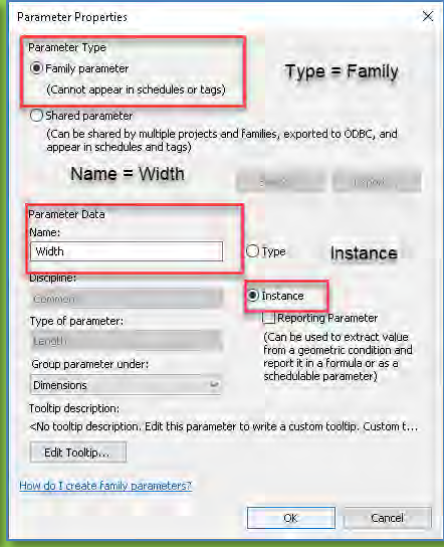
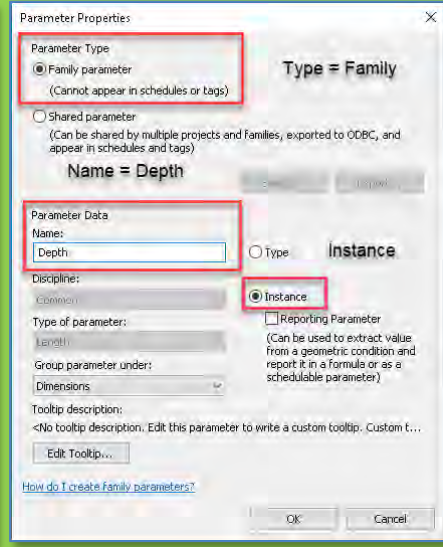
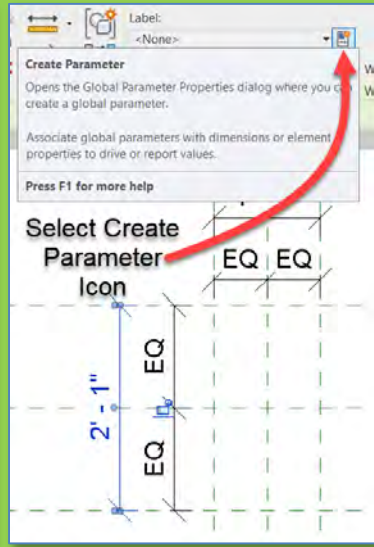
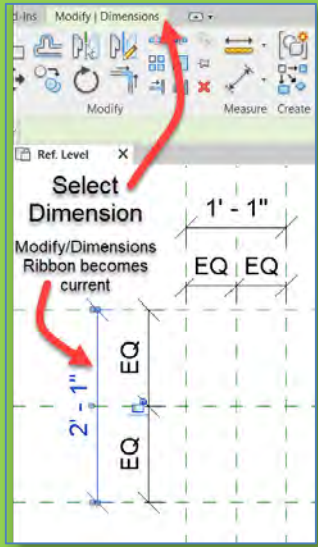
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Add Dimensions & *define adjustable Parameters*

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 - Grids
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- New 3D Family
 - W24 x 162 Column
 - Reference Planes
 - Parameters
 - Extrusion
 - Height Parameter
 - Family Category
- Load into Project
- New 3D Families
 - HSS Pipe Column
 - Formula Parameter
 - HSS Square Column
 - W 21 x 162 Beam
 - Place Beam
 - Snap/ Align & Copy
 - Modify Round Column Family
- Project File Sheet



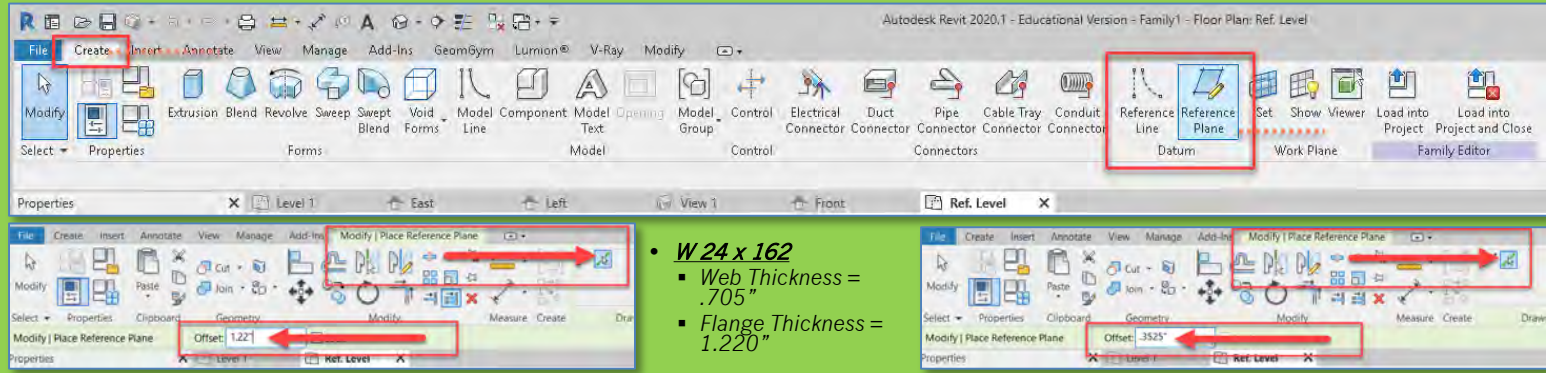
- Select Depth (2'-1") > Create Parameter
 - Type = Family
 - Name = Depth
 - Instance
- Select Width (1'-1") > Create Parameter
 - Type = Family
 - Name = Depth
 - Instance

- W 24 x 162
- *Depth (h) = 25"*
- *Width (w) = 15"*

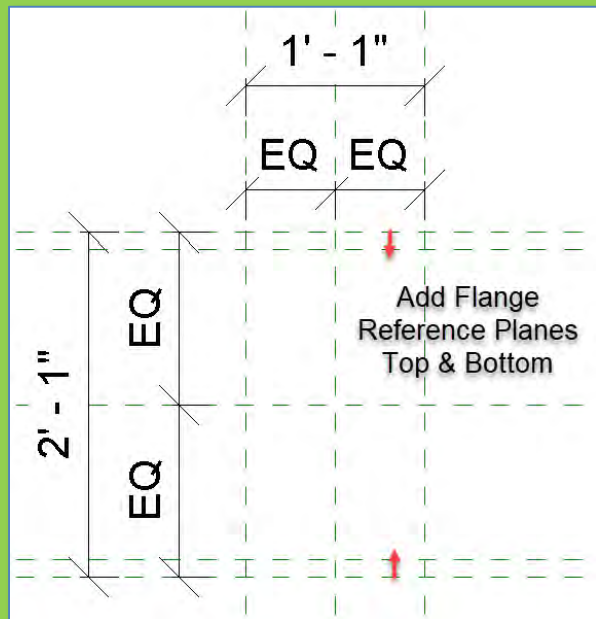
Add Reference Planes for Web & Flange

Connections Intro

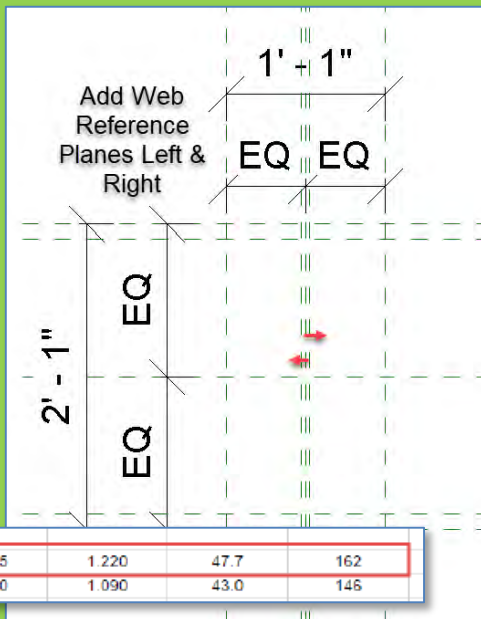
- Assignment Description
- New Project File
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- **W 24 x 162**
 - Web Thickness = .705"
 - Flange Thickness = 1.220"

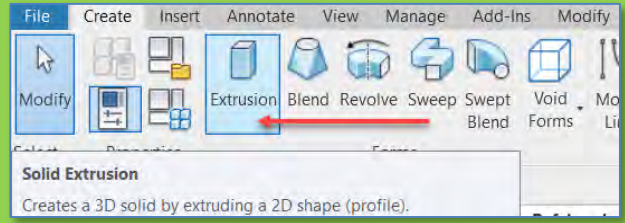


- Create Ribbon > Reference Plane
- Flange pick lines Offset (1.22")
 - Add both top and bottom
- Web pick lines Offset (.705/2 = .3525")
 - Add two left and right

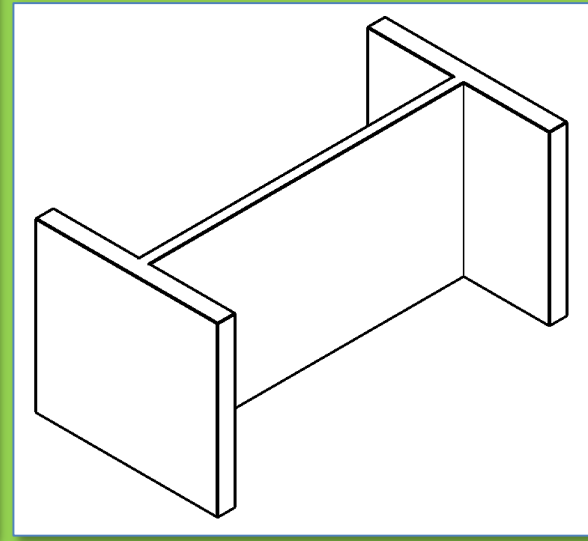
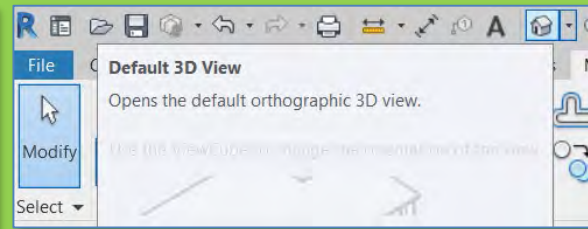
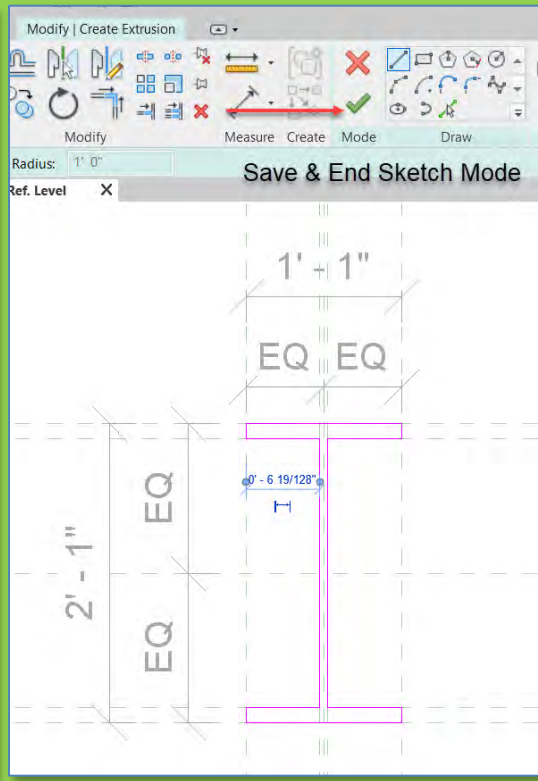
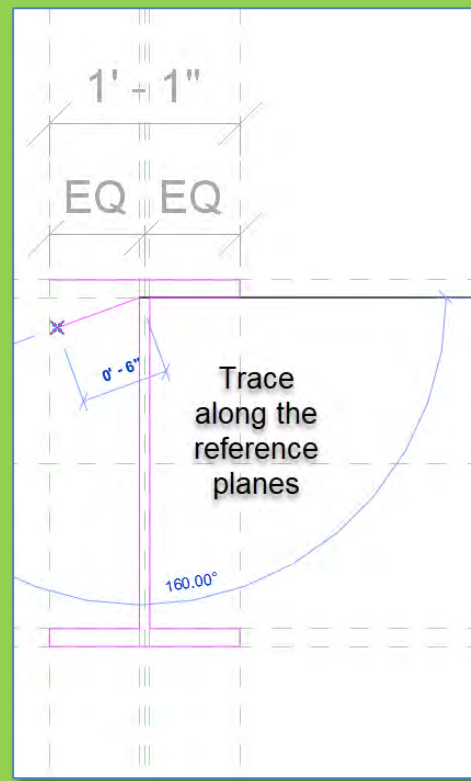


W 24 x 162	25	13	0.705	1.220	47.7	162
W 24 x 146	24.7	12.9	0.650	1.090	43.0	146

Create the Extrusion



- Create Ribbon > Extrusion (Solid)
 - Lines (trace the shape using reference planes)
 - Green Check (Save and end Sketch Mode)
 - Default 3D View

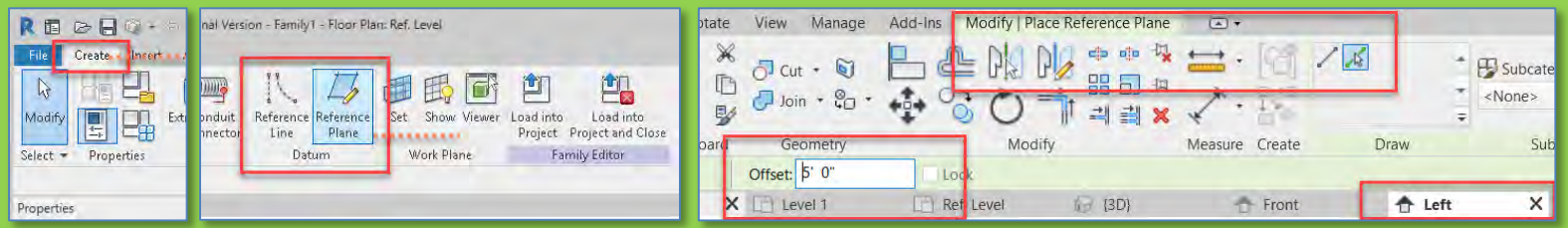


- Connections Intro
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 - W 21 x 162 Beam
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 - Project File Sheet
- Building Technology III
- CityTech.CUNY.edu

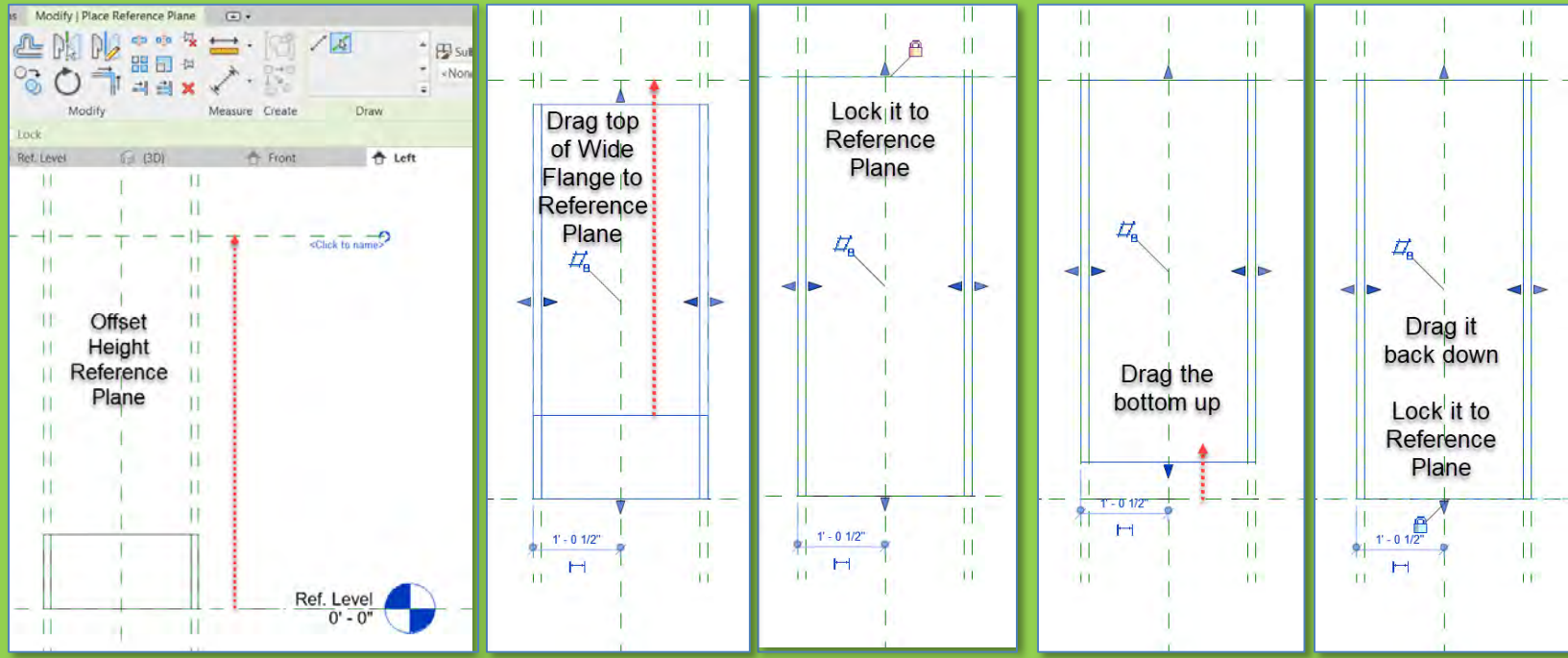
Add Reference Plane for Height & Lock Top & Bottom

Connections Intro

- Assignment Description
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- Left View > Create > Reference Plane
- Drag top to reference plane and lock it
- Pick Lines (offset 5'-0")
- Drag bottom up then back down and lock it



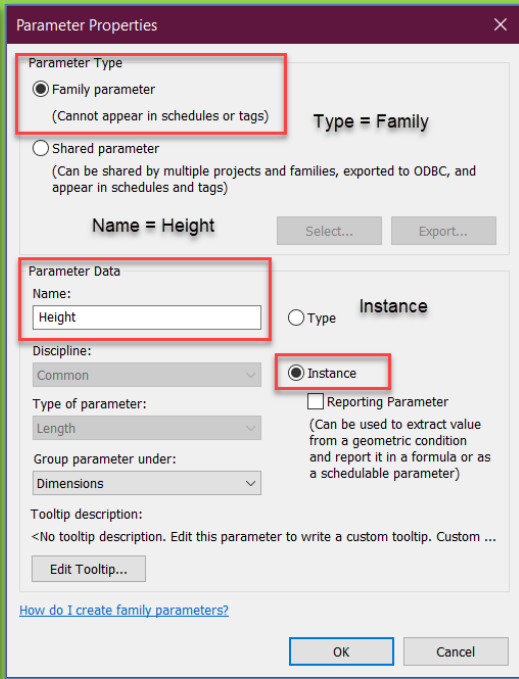
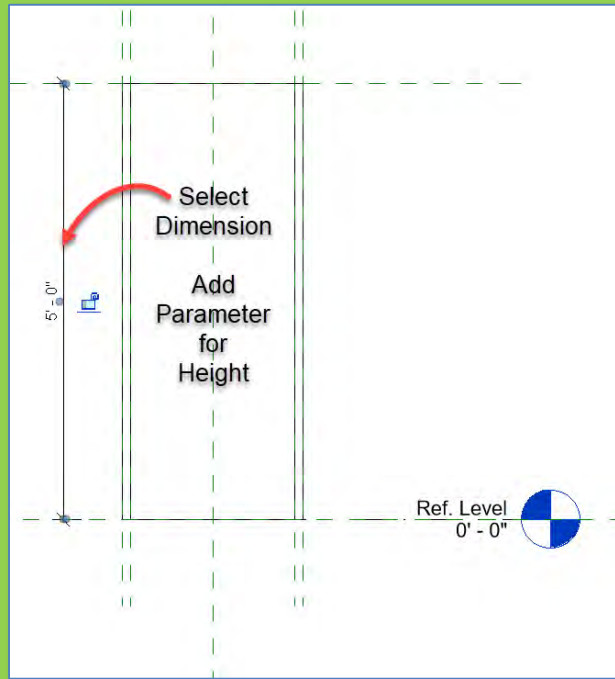
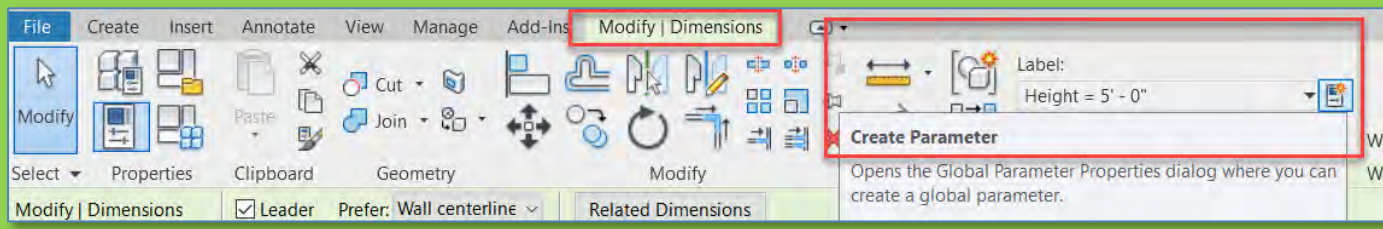
Add Dimension and Parameter for Height

Connections Intro

- Assignment Description
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 - Family Category

Load into Project

- New 3D Families
 - HSS Pipe Column
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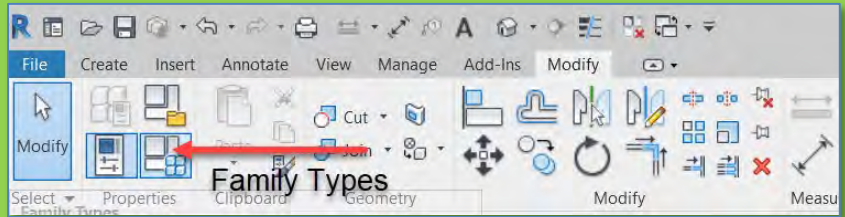
- Select Dimension
- Create Parameter
 - Type = Family
 - Name = Height
 - Instance

Using Parameters to Control the 3D extrusion

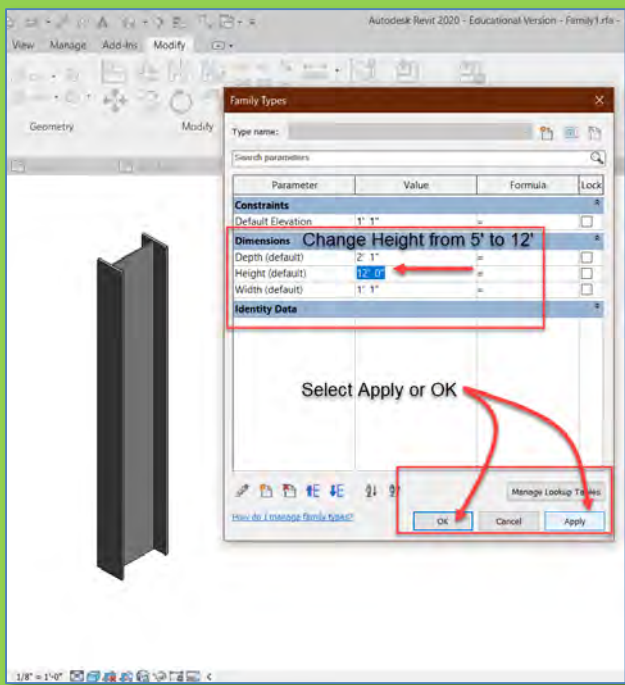
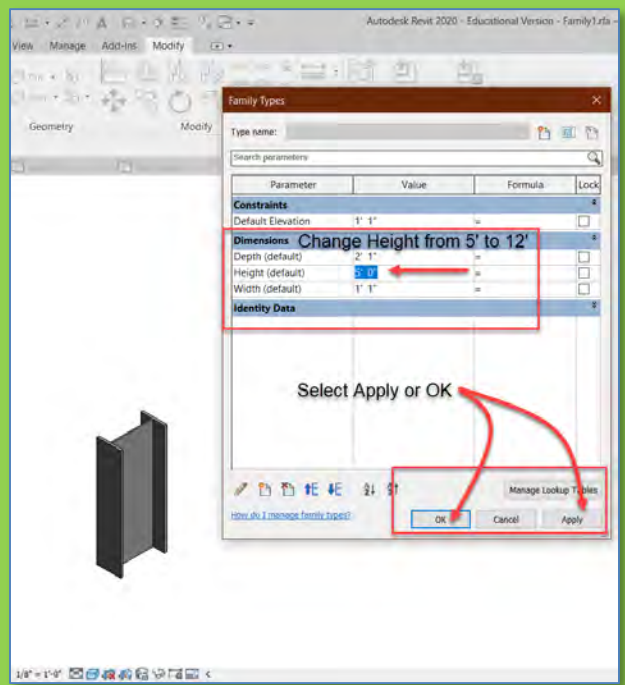
Connections Intro

- Assignment Description
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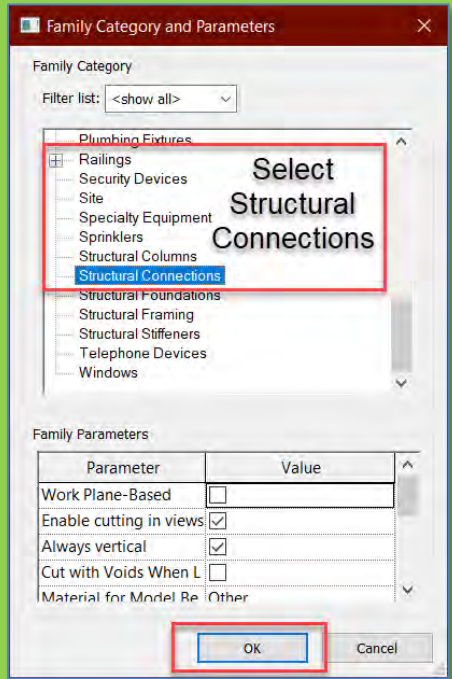
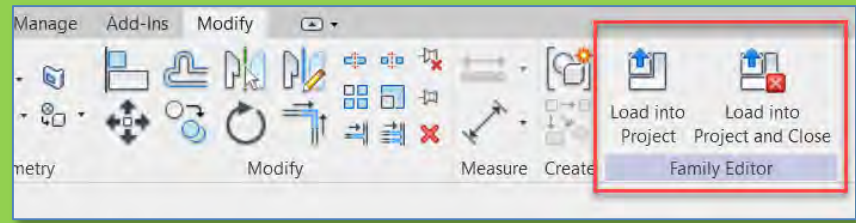
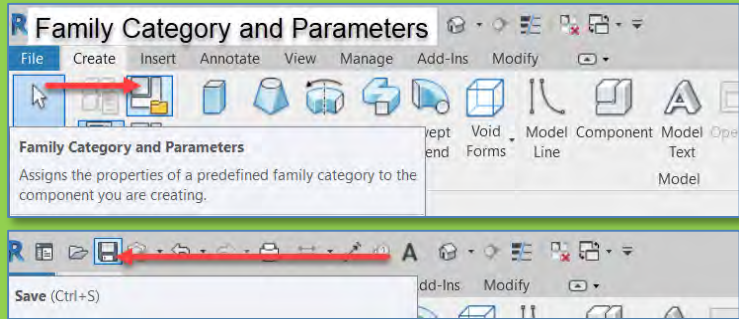
- Properties > Family Type
 - Notice the list of parameters
- Change Height from 5' to 12'
 - Notice the 3D model updates



Set Family Category to Structural Connections

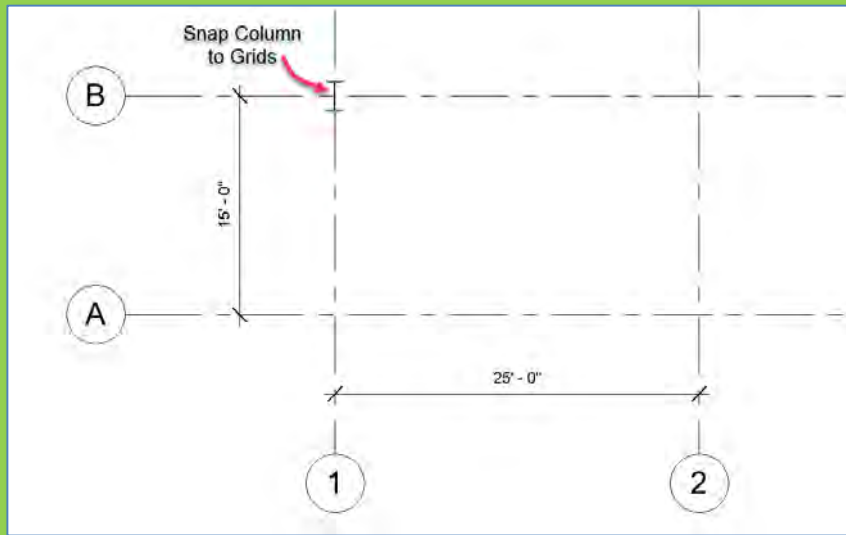
Connections Intro

- Assignment Description
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- Family Category & Parameters
- Select Structural Connections
- Save the file
- Load into Project
- Snap to Column Grids B & 1

- Load into Project
 - (family file remains open)
- Load into Project and Close
 - (family file will close)
- The family is saved inside the project file

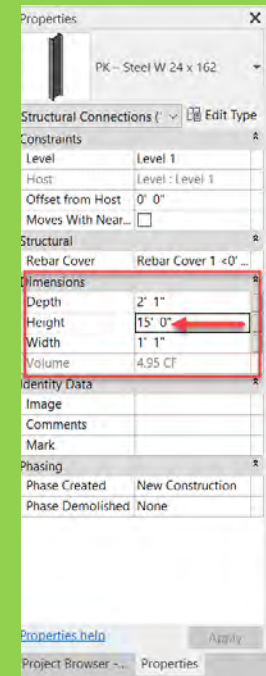
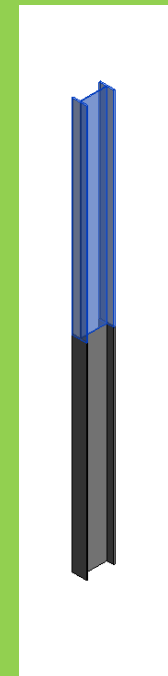
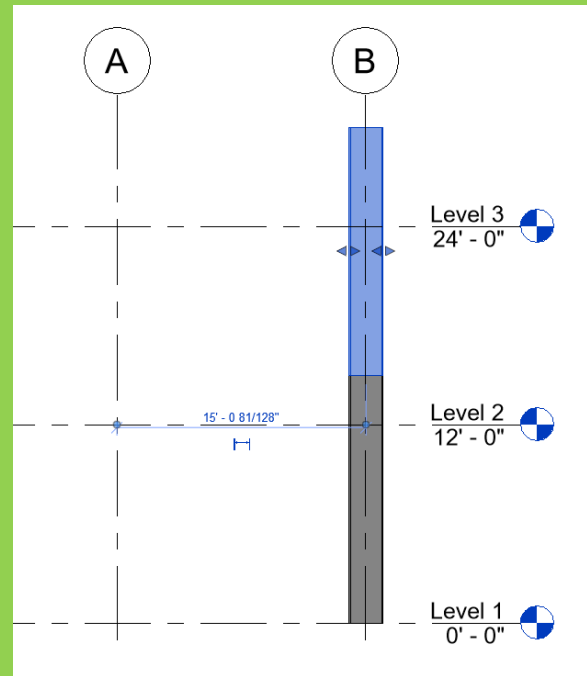
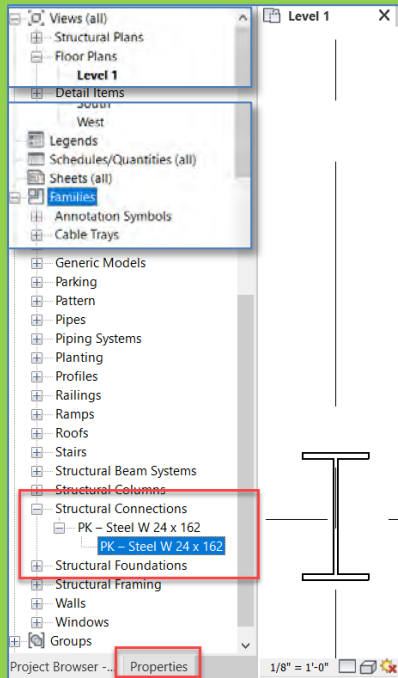


Connections Intro

- Assignment Description
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Look under Family Category for Structural Connections

- In the project browser the family will show in the category “Structural Connections”
- To create additional copies either copy the one already in the project or drag it from the project browser into the project
- Modify the height of the first column to 15'-0" (12' for the Level + an extra 3 feet)
- Make a copy 15 feet above the first column



HSS High Strength Steel Pipe Columns

Steel Pipe Columns - Allowable Loads

Allowable concentric loads for steel pipe columns

The tables belows indicates allowable concentric loads for steel pipe columns:

Standard Steel Pipe

Nominal Pipe Diameter (inches)	Wall Thickness (inches) (mm)	Effective Length of Column (feet) (m)							
		6	8	10	12	14	16	18	20
		Allowable Concentric Loads (10 ³ lb) (kN)							
3	0.216	38	34	28	22	16	12	10	
3 1/2	0.226	48	44	38	32	25	19	15	12
4	0.237	59	54	49	43	36	29	23	19
5	0.257	83	78	73	68	61	55	47	39
6	0.280	110	106	101	95	89	82	75	67

Extra Strong Steel Pipe

Nominal Pipe Diameter (inches)	Wall Thickness (inches) (mm)	Effective Length of Column (feet) (m)							
		6	8	10	12	14	16	18	20
		Allowable Concentric Loads (10 ³ lb) (kN)							
3	0.300	52	45	37	28	21	16	12	

• *For Round Column HSS 10 Outside Diameter 10" Thickness = .5"*

8	0.500	259	251	243	234	224	214	203	191
10	0.500	332	325	318	309	301	291	281	271
12	0.500	400	394	387	379	371	363	353	344

Note that the effective column length depends on the column configuration. The values above is valid for columns with rotation free and translation fixed in both ends.

Source of Information: https://www.engineeringtoolbox.com/american-wide-flange-steel-beams-d_1319.html
 Additional Reference for steel components: <http://products.anssteel.com/category/steel/>

- Connections Intro
- Assignment Description
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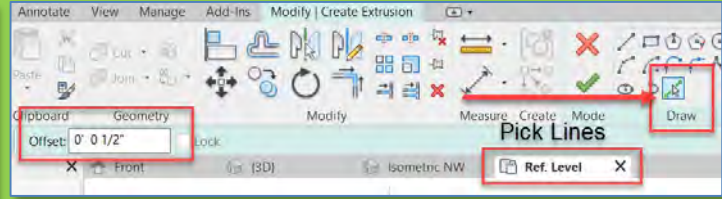
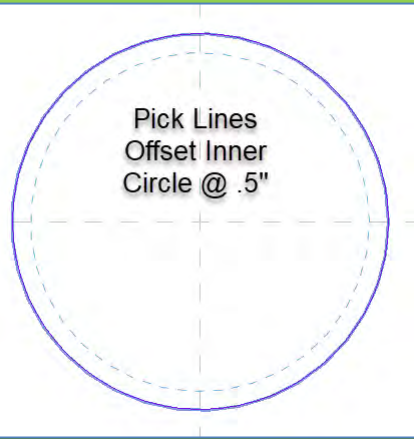
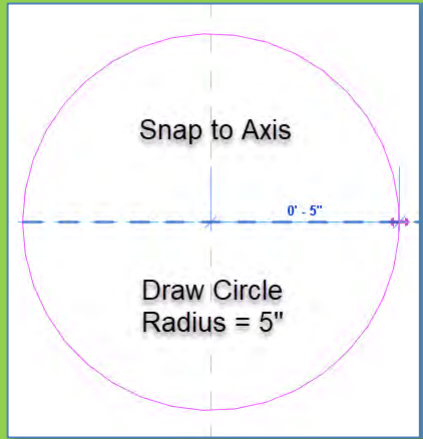
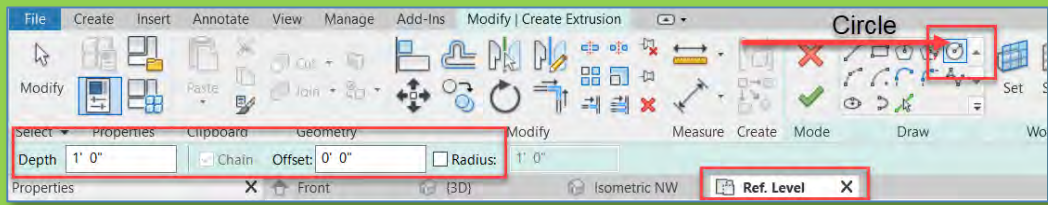
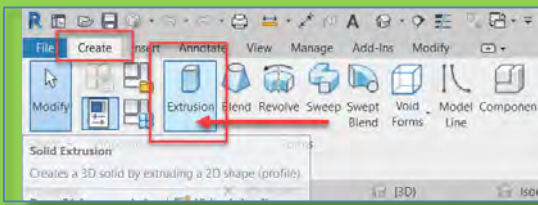
HSS High Strength Steel Pipe Columns (Create)

• For Round Column HSS 10 Outside Diameter 10" Thickness = .5"

8	0.500	259	251	243	234	224	214	203	191
10	0.500	332	325	318	309	301	291	281	271
12	0.500	400	394	387	379	371	363	353	344

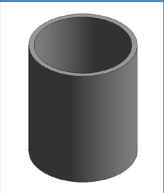
- New > Family > Generic Model Save_as Initials-HSS-Round 10 x .5
- Create > Extrusion > Circle (radius 5") > Pick Lines (.5")

- Connections Intro
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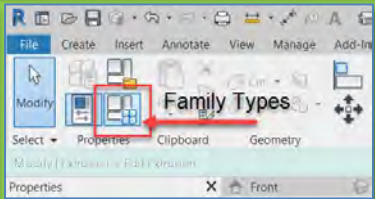
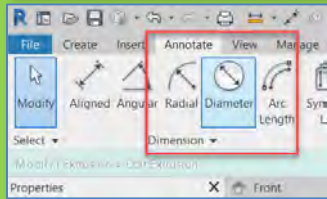
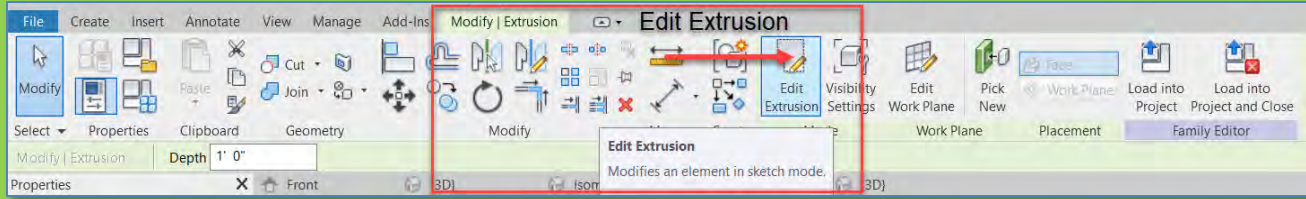
Set Family Category to Structural Connections

HSS High Strength Steel Pipe Columns (Parameters)

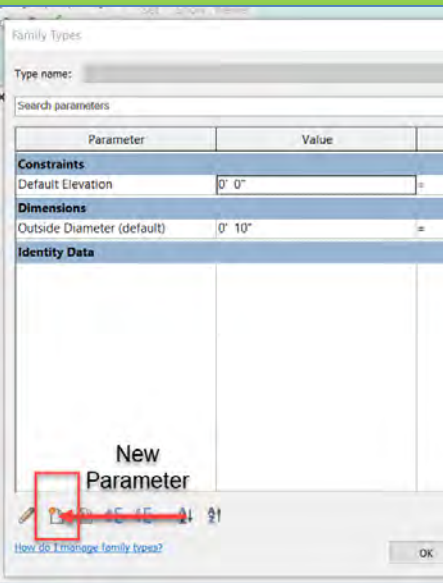
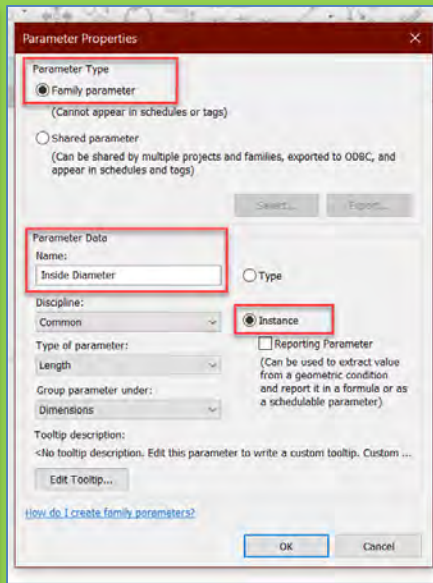
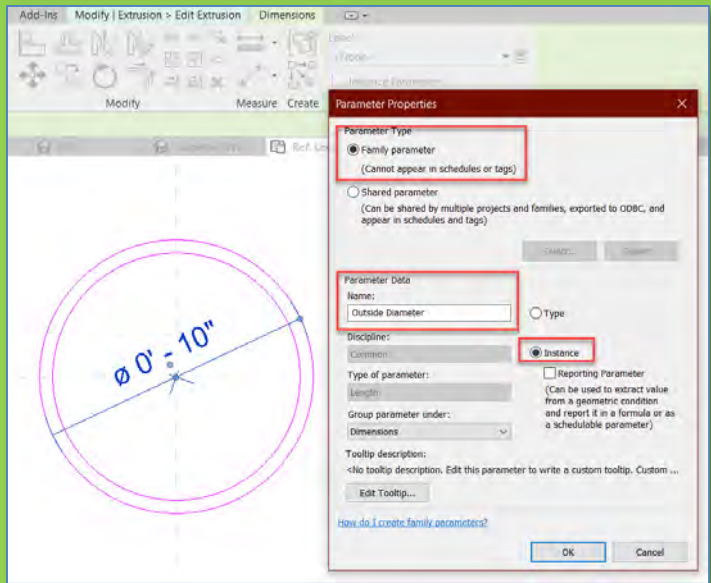


Connections Intro

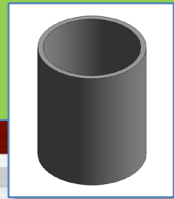
- Assignment Description
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- Edit Extrusion > Annotate > Diameter
- Add Parameter (Outside Diameter)
- Family Type > New Parameter (Inside Diameter)



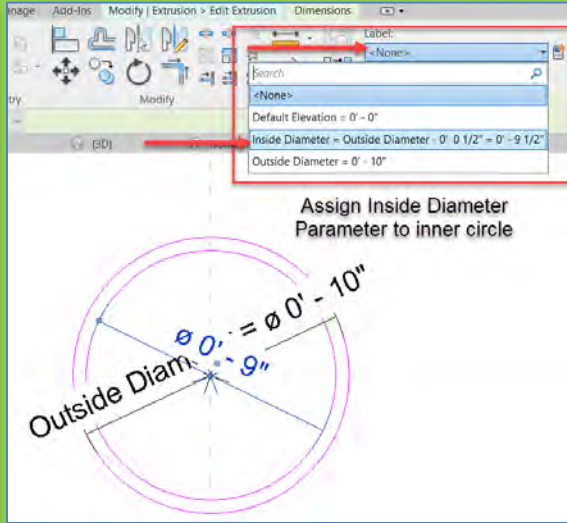
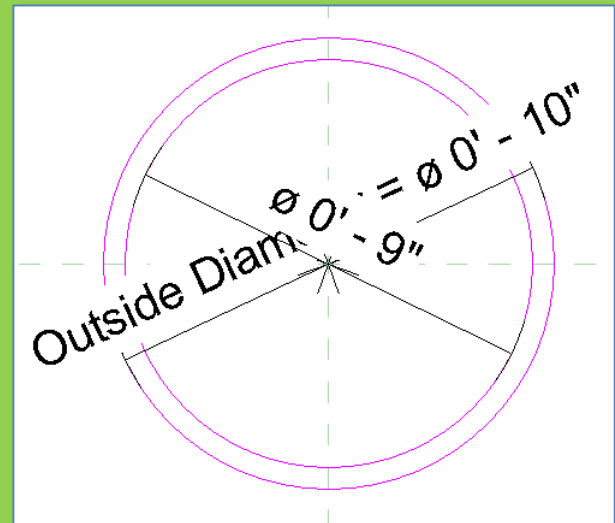
Add Formula to Parameter



Connections Intro

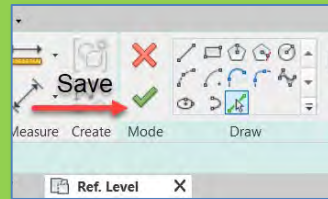
- Assignment Description
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- Inner circle is dependent on outer
- = Outside Diameter - .5"
- Annotate > Diameter (inner circle)
- Assign Parameter to Inner Circle



Diameter

- Add additional reference plane and parameter to control the height
- Save and Load into Project file



HSS Square Hollow Structural Sections

Square Hollow Structural Sections - HSS

Weight, cross sectional area, moments of inertia - Imperial units

• 1 in = 25.4 mm

Nominal Size ³⁾	Weight	Wall Thickness	b/t ¹⁾	h/t ¹⁾	Cross Sectional Area ²⁾	I ¹⁾	S ¹⁾	r ¹⁾	Z ¹⁾	Torsional Stiffness Constant J	Torsional Shear Constant C	Surface Area
(in x in x in)	(lb/ft)	(in)	-	-	(in ²)	(in ⁴)	(in ³)	(in)	(in ³)	(in ⁴)	(in ³)	(ft ² /ft)
32 x 32 x 5/8	259.83	0.625	48.2	48.2	76.4	12300	771	12.7	890	19700	1230	10.34
32 x 32 x 1/2	210.72	0.500	61.0	61.0	61.9	10100	634	12.8	727	15900	991	10.45
32 x 32 x 3/8	159.37	0.375	82.3	82.3	46.8	7750	485	12.9	553	12000	750	10.51
30 x 30 x 5/8	242.82	0.625	45.0	45.0	71.4	10100	673	11.9	778	16200	1070	9.68
30 x 30 x 1/2	197.11	0.500	57.0	57.0	57.9	8320	555	12.0	637	13000	869	9.79
30 x 30 x 3/8	140.16	0.375	77.0	77.0	42.8	6370	424	12.1	485	9870	658	9.84

• For Square Column 10 x 10 x .5 Outside Dimension 10" x 10" Thickness 0.5"

12 x 12 x 3/8	58.10	0.349	31.4	31.4	16.0	357	59.5	4.73	69.2	561	94.6	3.90
12 x 12 x 5/16	48.86	0.291	38.2	38.2	13.4	304	50.7	4.76	58.6	474	79.7	3.92
12 x 12 x 1/4	39.43	0.233	48.5	48.5	10.8	248	41.4	4.79	47.6	384	64.5	3.93
10 x 10 x 5/8	76.33	0.581	14.2	14.2	21.0	304	60.8	3.80	73.2	498	102	3.17
10 x 10 x 1/2	62.46	0.465	18.5	18.5	17.2	256	51.2	3.86	60.7	412	84.2	3.20
10 x 10 x 3/8	47.90	0.349	25.7	25.7	13.2	202	40.4	3.92	47.2	320	64.8	3.23
10 x 10 x 5/16	40.35	0.291	31.4	31.4	11.1	172	34.5	3.94	40.1	271	54.8	3.25
10 x 10 x 1/4	32.63	0.233	39.9	39.9	8.96	141	28.3	3.97	32.7	220	44.4	3.27
10 x 10 x 3/16	24.73	0.174	54.5	54.5	6.76	108	21.6	4.00	24.8	167	33.6	3.28
9 x 9 x 1/2	55.66	0.465	16.4	16.4	15.3	182	40.6	3.45	48.4	296	67.4	2.87
9 x 9 x 3/8	42.70	0.349	22.9	22.9	11.8	145	32.3	3.51	37.8	221	52.1	2.90

Source of Information: https://www.engineeringtoolbox.com/american-wide-flange-steel-beams-d_1319.html

Additional Reference for steel components: <http://products.anssteel.com/category/steel/>

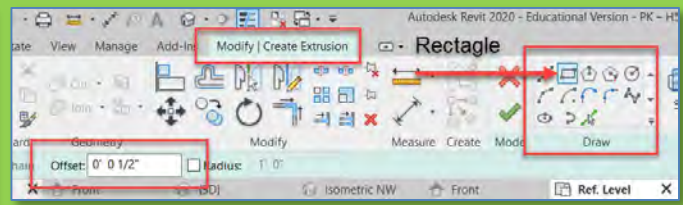
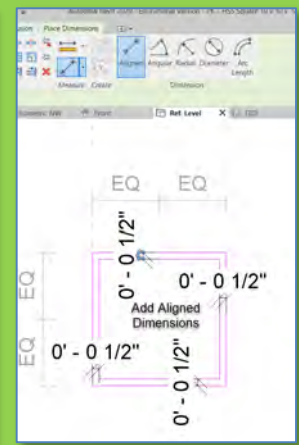
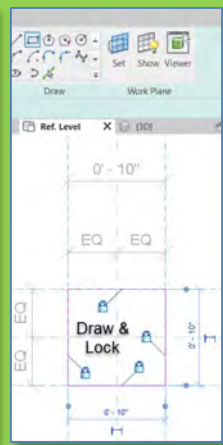
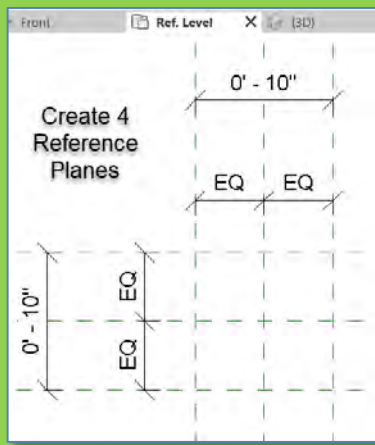
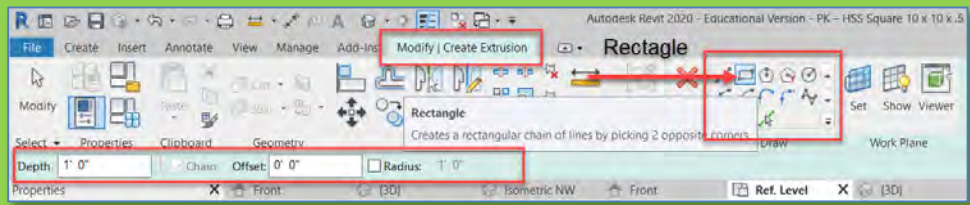
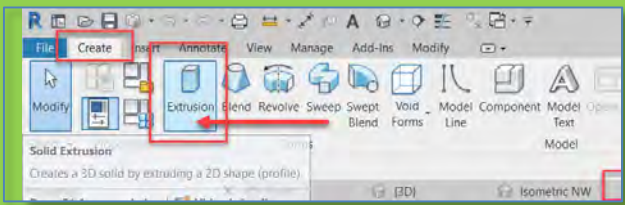
- Connections Intro
- Assignment Description
- New Project File
 - Levels
 - Grids
 - Dimensions
- New 3D Family
 - W24 x 162 Column
 - Reference Planes
 - Parameters
 - Extrusion
 - Height Parameter
 - Family Category
- Load into Project
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 - HSS Pipe Column
 - Formula Parameter
 - HSS Square Column
 - W 21 x 162 Beam
 - Place Beam
 - Snap, Align & Copy
 - Modify Round Column Family
- Project File Sheet

HSS Square Hollow Structural Columns (Create)

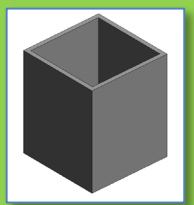
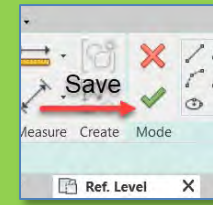
• *For Square Column 10 x 10 x .5 Outside Dimension 10" x 10" Thickness 0.5"*

10 x 10 x 5/8	76.33	0.581	14.2	14.2	21.0	304	60.8	3.80	73.2	408	102	3.17
10 x 10 x 1/2	62.46	0.465	18.5	18.5	17.2	256	51.2	3.86	60.7	412	84.2	3.20
10 x 10 x 3/8	47.90	0.349	26.7	26.7	13.2	202	40.4	3.92	47.2	320	64.8	3.23

• *New > Family > Generic Model Save as Initials-HSS-Square 10 x10x.5*
 • *Create > Extrusion > Rectangle (10x10") >Rectangle Offset .5"*



- *Draw & Lock to Reference Planes*
- *Add aligned dimension for inner rectangle*



Connections Intro

Assignment Description

New Project File

- Levels
- Grids
- Dimensions

New 3D Family

- W24 x 162 Column
- Reference Planes
- Parameters
- Extrusion
- Height Parameter
- Family Category

Load into Project

New 3D Families

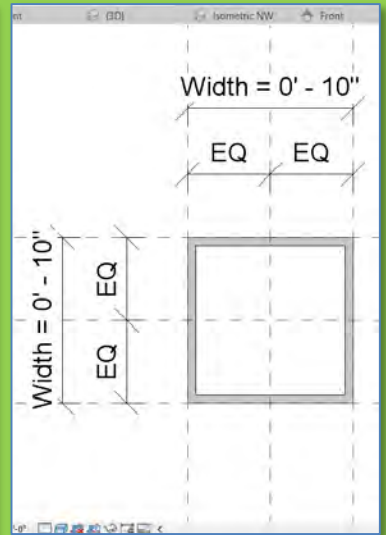
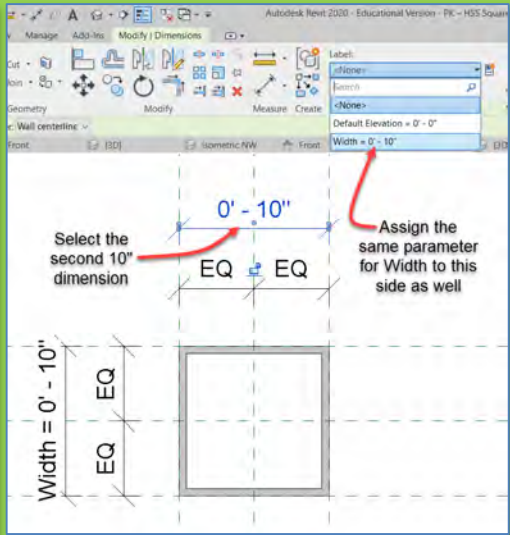
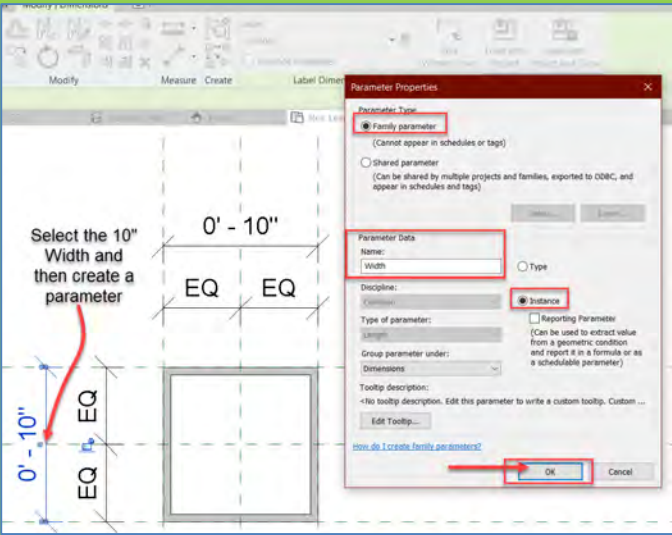
- HSS Pipe Column
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- HSS Square Column
- W 21 x 162 Beam
- Place Beam
- Snap, Align & Copy
- Modify Round Column Family

Project File Sheet

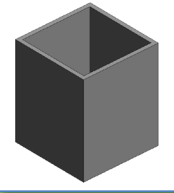
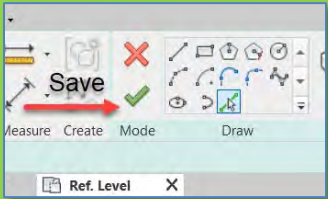
HSS Square Hollow Structural Columns (Parameters)

- For Square Column 10 x 10 x .5 Outside Dimension 10" x 10" Thickness 0.5"
- Select one of the 10" dimensions > Create Parameter (Width, Instance)
- Select the second 10" dimension > assign the same parameter

- Connections Intro
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- Add additional reference plane and parameter to control the height
- Set Height to 12'
- Save and Load into Project file



Set Family Category to Structural Connections

Create the W 21 x 62 Beam (use front view)

For the Column use W 24 x 162 and for the Beam use @ 21 x 62

Designation	Dimensions						Static Parameters			
	Imperial (in x lb/ft)	Depth h (in)	Width w (in)	Web Thickness t _w (in)	Flange Thickness t _f (in)	Sectional Area (in ²)	Weight (lb/ft)	Moment of Inertia		Elastic Section Modulus
I _x (in ⁴)								I _y (in ⁴)	W _x (in ³)	W _y (in ³)
W 27 x 178	27.8	14.09	0.725	1.190	52.3	178	6990	555	502	78.8

• For Column W 24 x 162 Depth = 25" Width = 13" Web = 0.4" Flange = 1.22"

W 27 x 84	26.7	9.96	0.460	0.640	24.8	84	2850	106	213	21.2
W 24 x 162	25	13	0.705	1.220	47.7	162	5170	443	414	68.4
W 24 x 146	24.7	12.9	0.650	1.090	43.0	146	4580	391	371	60.5
W 24 x 131	24.5	12.9	0.605	0.960	38.5	131	4020	340	329	53.0
W 24 x 117	24.3	12.8	0.55	0.850	34.4	117	3540	297	291	46.5
W 24 x 104	24.1	12.75	0.500	0.750	30.6	104	3100	259	258	40.7

• For Beam W 21 x 62 Depth = 21" Width = 8.24" Web = 0.4" Flange = .615"

W 21 x 68	21.1	8.27	0.430	0.685	20.0	68	1480	64.7	140	15.7
W 21 x 62	21	8.24	0.400	0.615	18.3	62	1330	57.5	127	13.9
W 21 x 57	21.1	6.56	0.405	0.550	16.7	57	1170	30.6	111	9.4
W 21 x 50	20.8	6.53	0.360	0.535	14.7	50	984	24.9	94.5	7.6
W 21 x 44	20.7	6.5	0.350	0.450	13.0	44	843	20.7	81.6	6.4

Source of Information: https://www.engineeringtoolbox.com/american-wide-flange-steel-beams-d_1319.html

Additional Reference for steel components: <http://products.anssteel.com/category/steel/>

Connections Intro

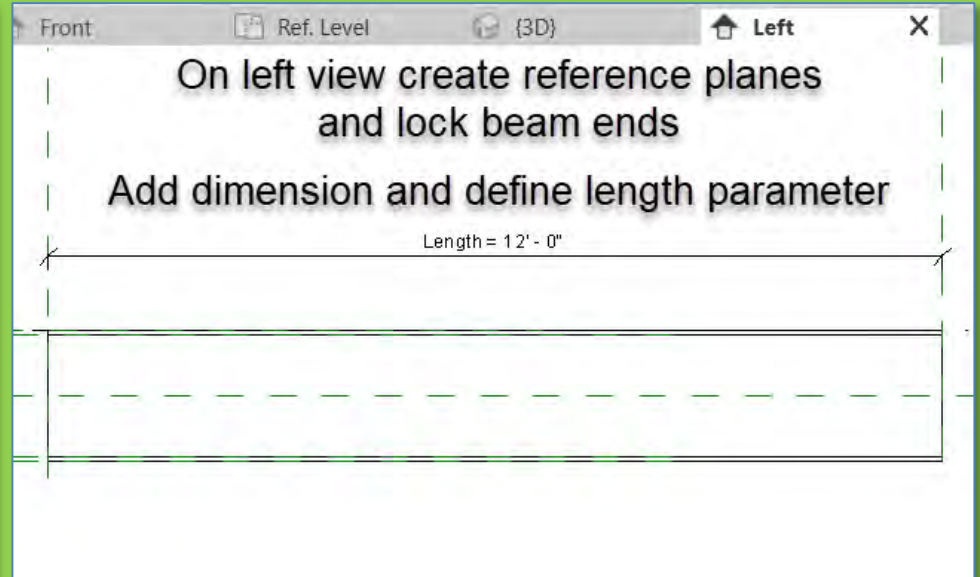
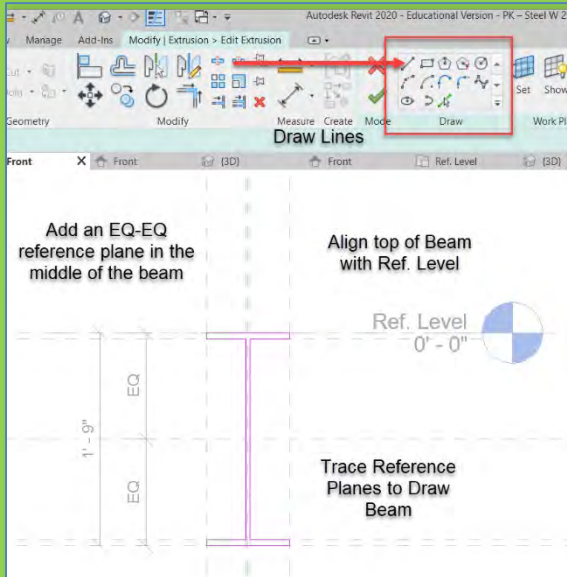
- Assignment Description
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 - Modify Round Column Family
- Project File Sheet

Create the Beams (use front view)

• *For Beam W 21 x 62* Depth = 21" Width = 8.24" Web = 0.4" Flange = .615"

W 21 x 68	21.1	8.27	0.430	0.685	20.0	68	1480	64.7	140	16.7
W 21 x 62	21	8.24	0.400	0.615	18.3	62	1330	57.5	127	13.9
W 21 x 57	21.1	6.56	0.405	0.650	16.7	57	1170	30.6	111	9.4
W 21 x 50	20.8	6.53	0.360	0.535	14.7	50	984	24.9	94.5	7.6
W 21 x 44	20.7	6.5	0.350	0.450	13.0	44	843	20.7	81.6	6.4

- *New > Family > Generic Model* *Save_as Initials-Steel Beam W 21x62*
- *Draw from front view – align top of beam with ref. level*
- *Add Reference Plans same as for W 24 x 162 column – add extra plane at center of beam*
- *Create > Extrusion > Lines*
- *Add reference planes, add dimension and define parameter for length*
- *Save and Load into Project File*



Connections Intro

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To Place the Beams add Structural Plan Views

Connections Intro

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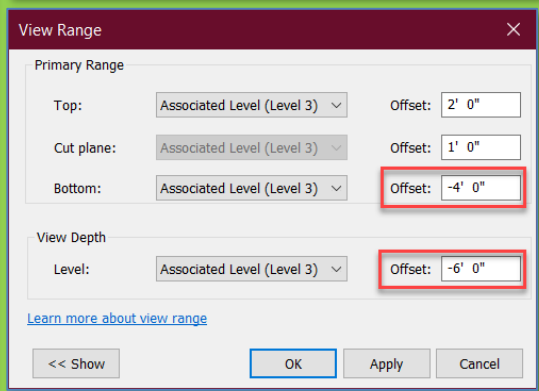
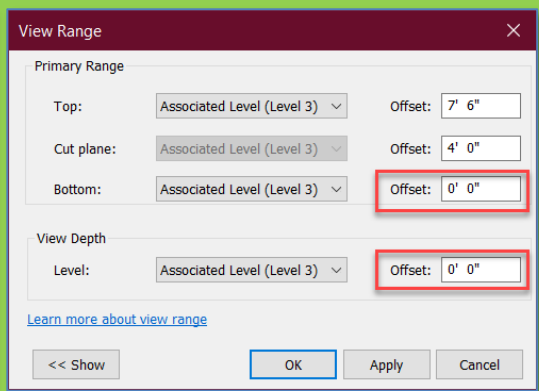
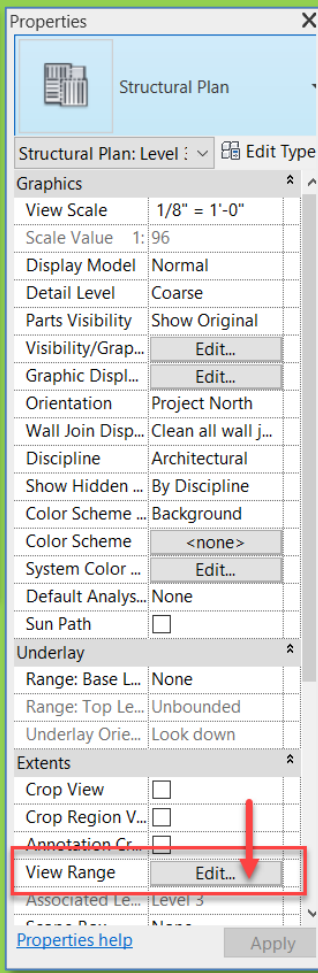
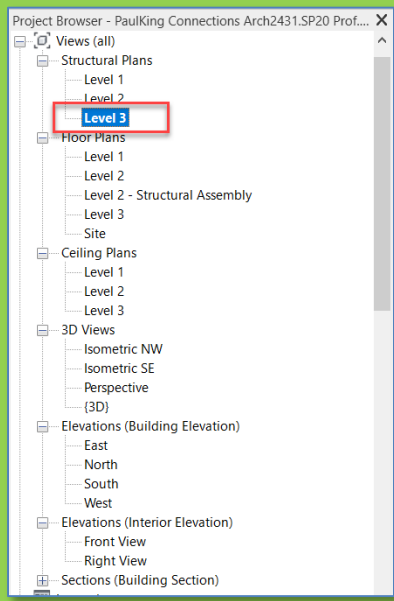
The screenshot shows the Revit software interface with the 'Plan Views' ribbon active. The 'New Structural Plan' dialog box is open, and 'Level 1' and 'Level 2' are selected. The project browser shows 'Structural Connections' and 'Structural Plans'.

- Review the project browser
- The families we created are located under “structural connections”
- A structural plan only exists for Level 3, the new level we added to the project file
- Add the missing structural views as follows:
 - View Ribbon > Plan Views > Structural Plan
 - Select Level 1 & Level 2 > OK
 - The new structural levels will show in the project browser
 - Make Level 3 Structural the current view

Compare Floor Plans vs Structural Plans

Connections Intro

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• From the project browser compare the “view range” properties of a plan view vs a structural view

- View Range Floor Plan
- Bottom and View Depth Offsets are 0

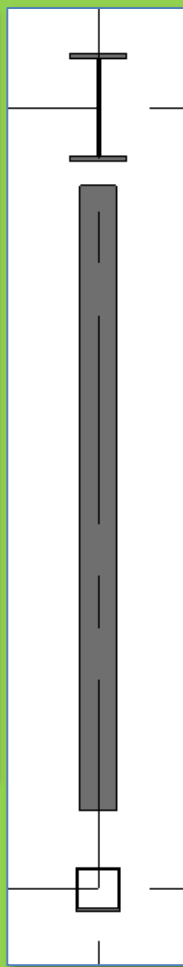
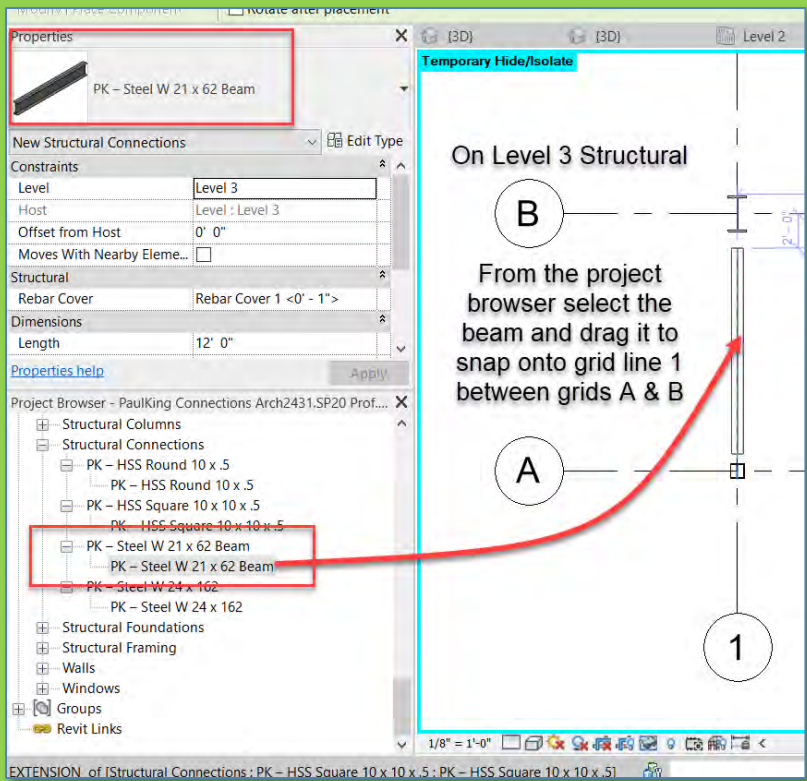
- View Range Structural Plan
- Bottom Offset -4'0"
- View Depth Offset -6'-0"

• We will work from the structural views – as they allow us to see below the selected level. Remember beams are below the floor.

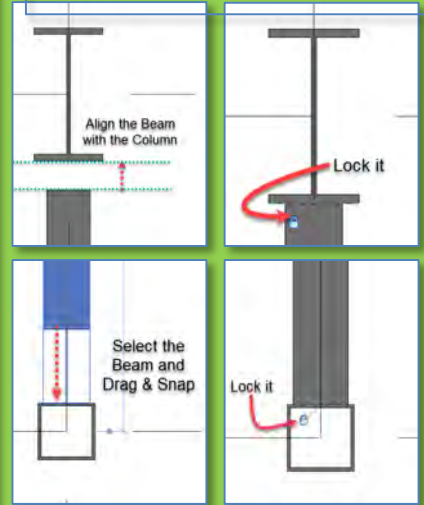
Add the Beams to Level 3 – Grid Line 1 (A to B)

Connections Intro

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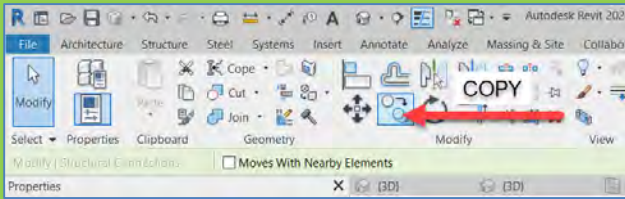
• *Align and snap the end of the beam to the column at Grid B*



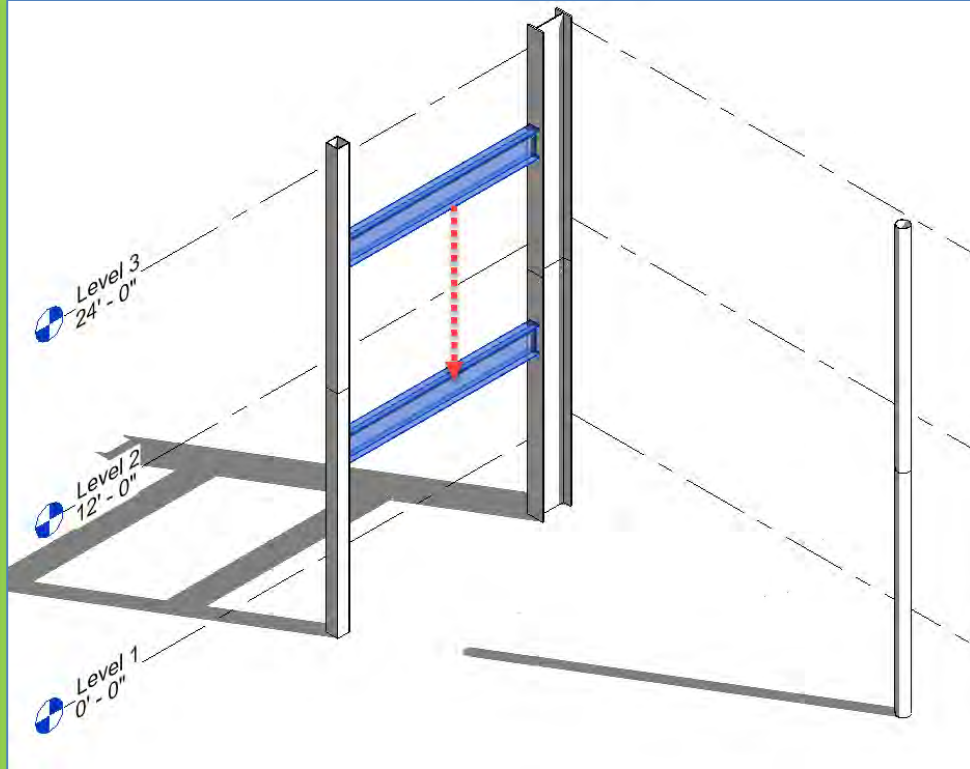
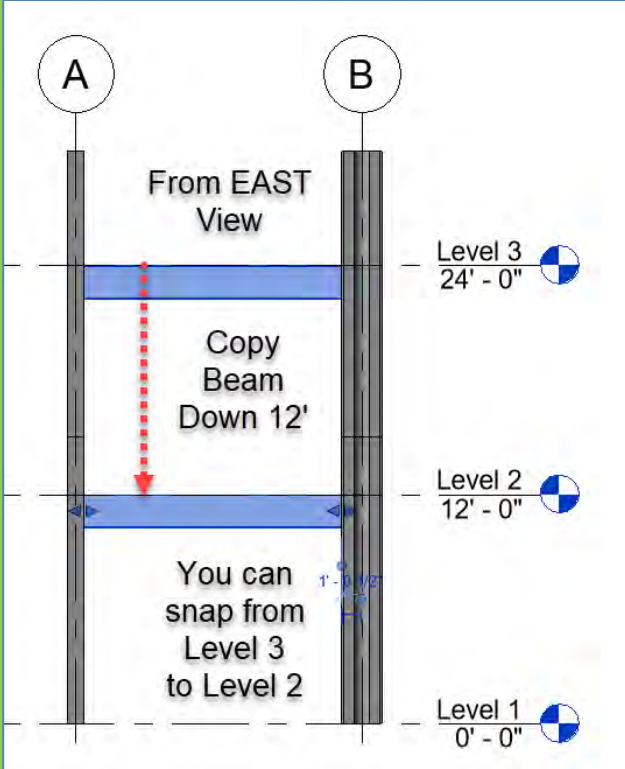
• *From the project browser select the beam and drag it to snap onto Grid line 1 between Grids A & B*

• *Select and drag the other end and snap to the column at Grid A*

Add the Beams to Level 3



- Set EAST as the current View
- Select the Beam on Level 3
- Copy it down to Level 2

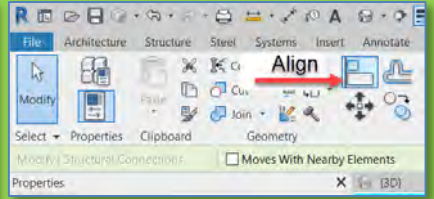
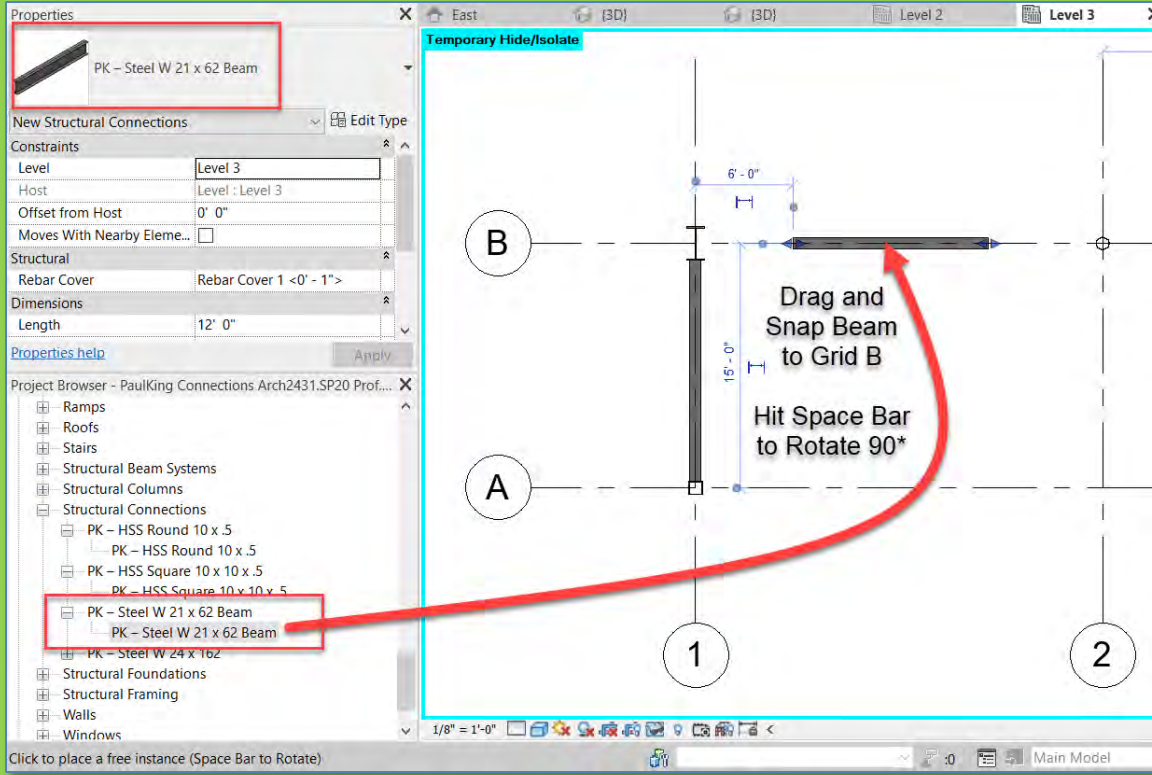


- Connections Intro
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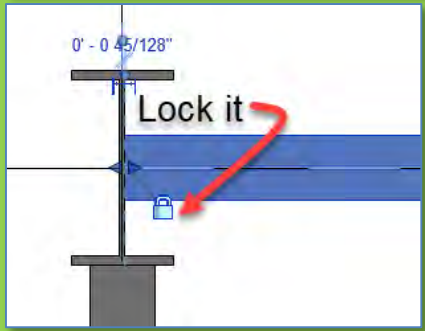
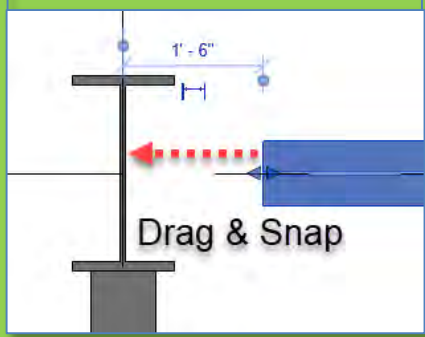
Add the Beams to Level 3 – Grid Line B (1 to 2)

Connections Intro

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• *Align and Snap the end of the beam to the column at Grid 1*

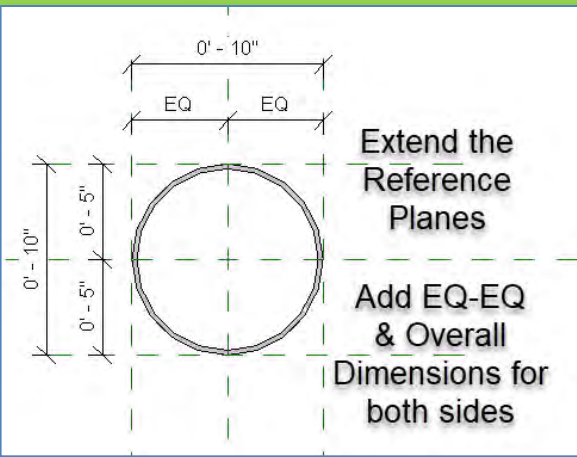
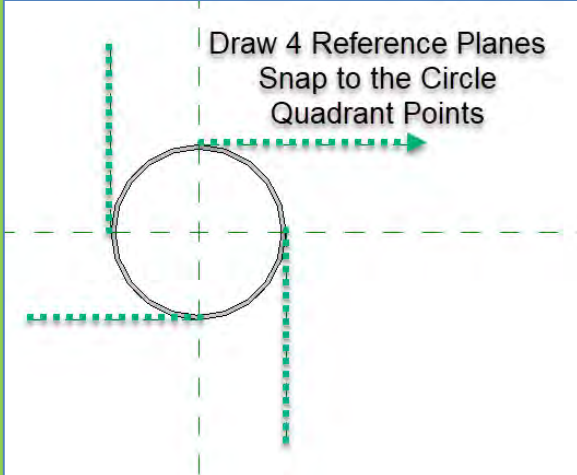


• *We will not be able to snap to the round column without first modifying the column family to include reference planes for snapping*

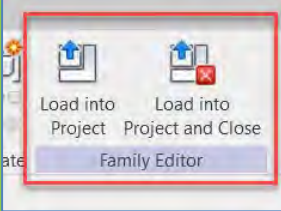
Edit the Column Family (PK – HSS Round 10 x .5)

Connections Intro

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Select Both 10" Dimensions and set them to the Outside Diameter Parameter



The single parameter ***Outside Diameter*** will control the ***column size*** & the ***distance between the reference planes*** and by formula the ***inside diameter***.

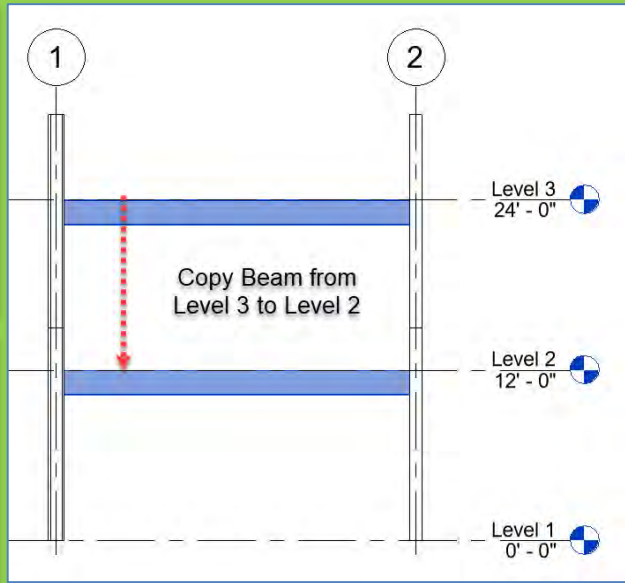
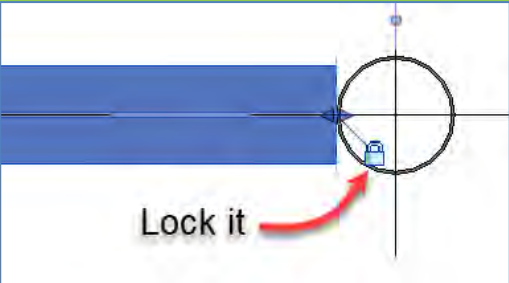
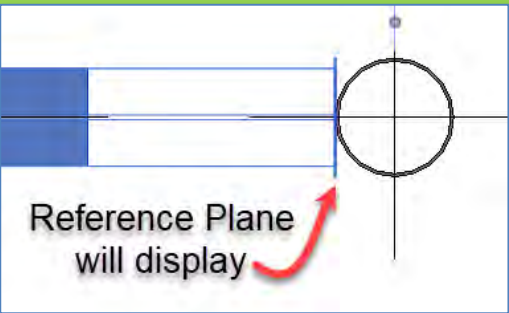
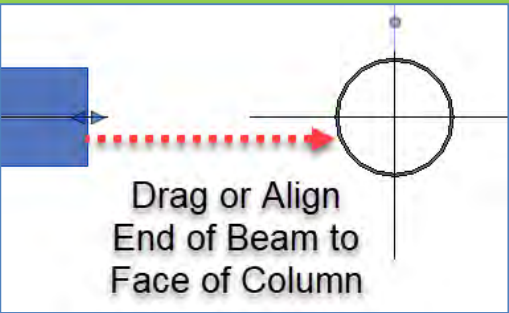
- Draw 4 Reference Planes snapping to quadrant points
- Extend the reference planes and add dimensions
- Assign the Outside Diameter Parameter to the two overall dimensions
- Load into Project

→ Overwrite the existing version and its parameter values

Align the end of the Beam to the Column

Connections Intro

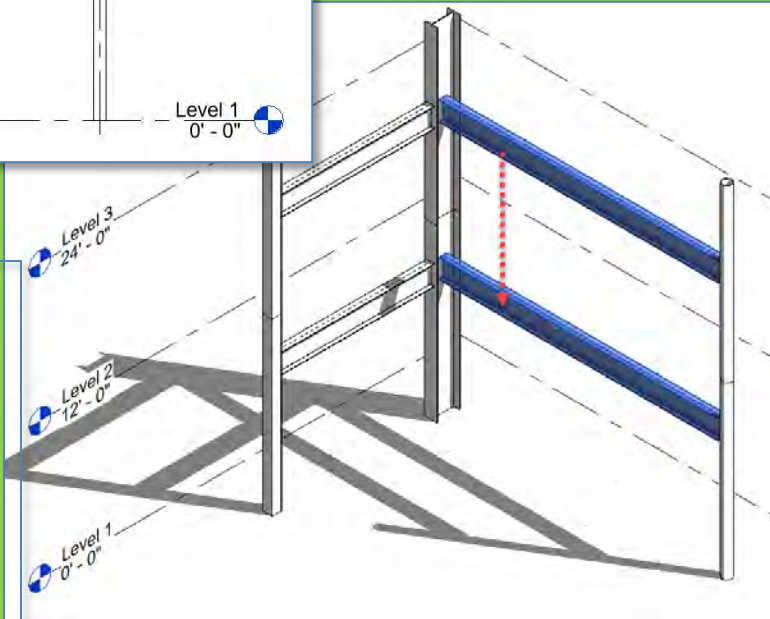
- Assignment Description
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- Copy the Beam from Level 3 down to Level 2

- Drag or Align the end of Beam to Face of Column

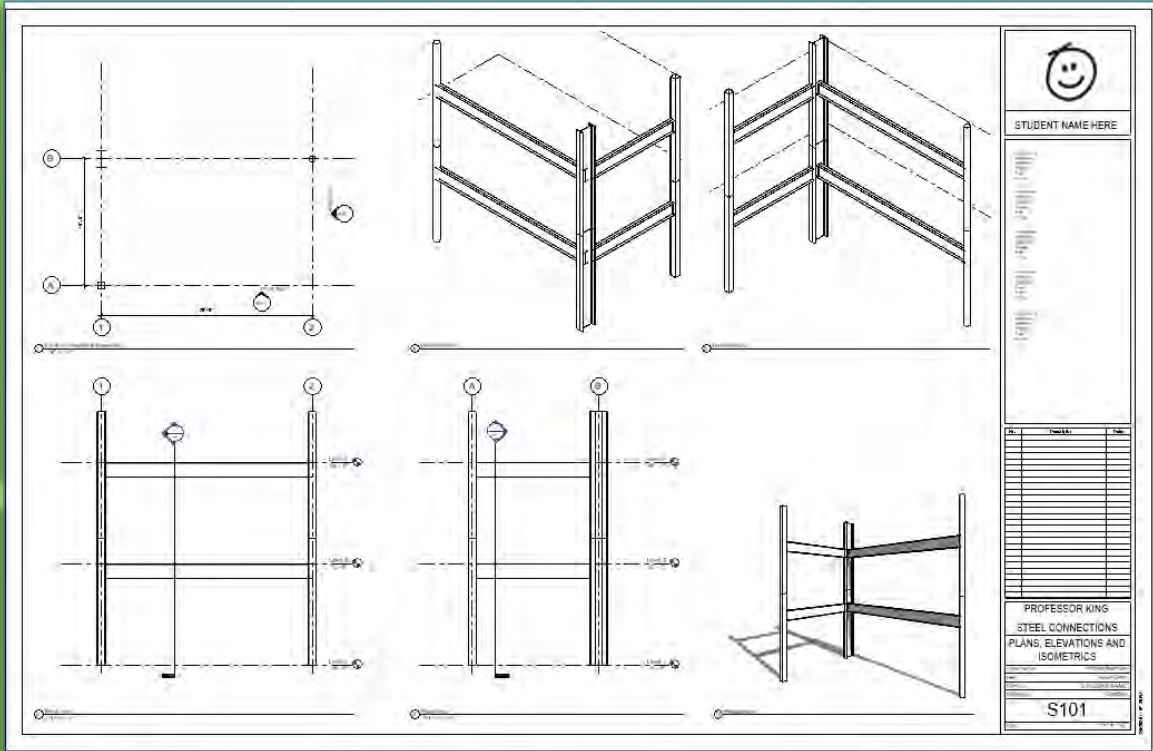
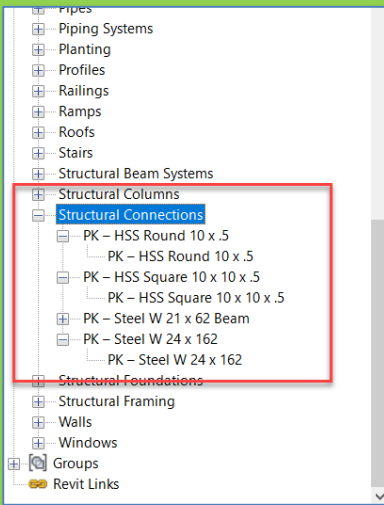
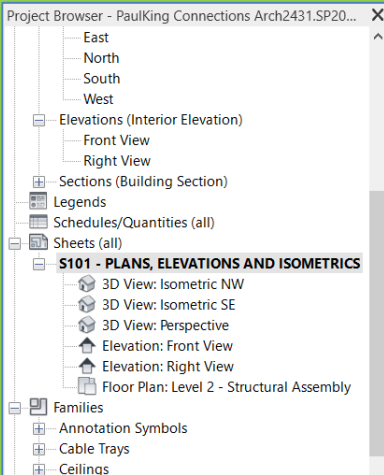
- Lock it



Sheet layout 22 x 34

Connections Intro

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- Plan View
- Front Elevation
- Side Elevation

- SE Isometric
- NW Isometric
- Perspective

ARCH 2431. Building Technology III

Building Information Modeling with Revit

Steel Connections

#1 Introduction to Columns & Beams



R AUTODESK® REVIT®

The End

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