ARCH 2431. Building Technology III

Building Information Modeling with Revit
Day 05

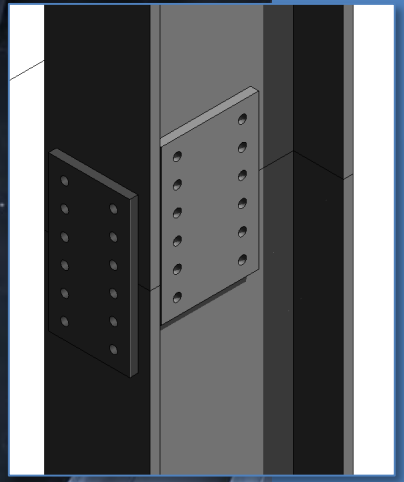
Steel Connections Details Assignment
Column Base Plates, Beam Connections

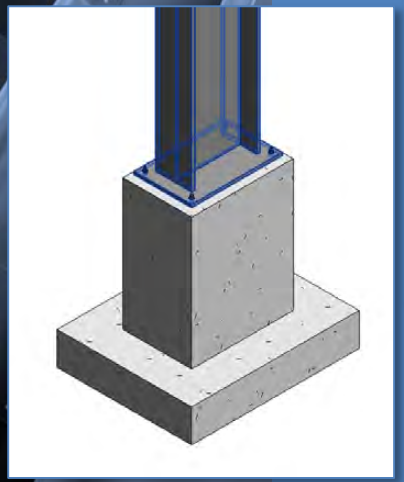
Professor Paul C. King, RA, AIA, ARA

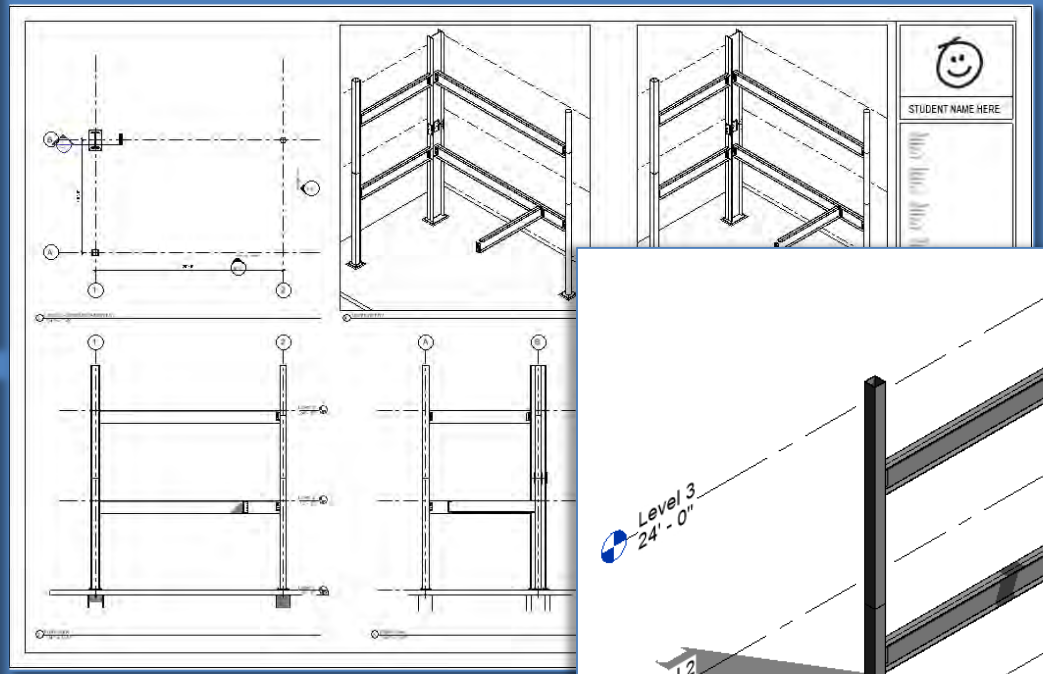
Prof.Paul.King@Gmail.com

Pking@CityTech.Cuny.Edu

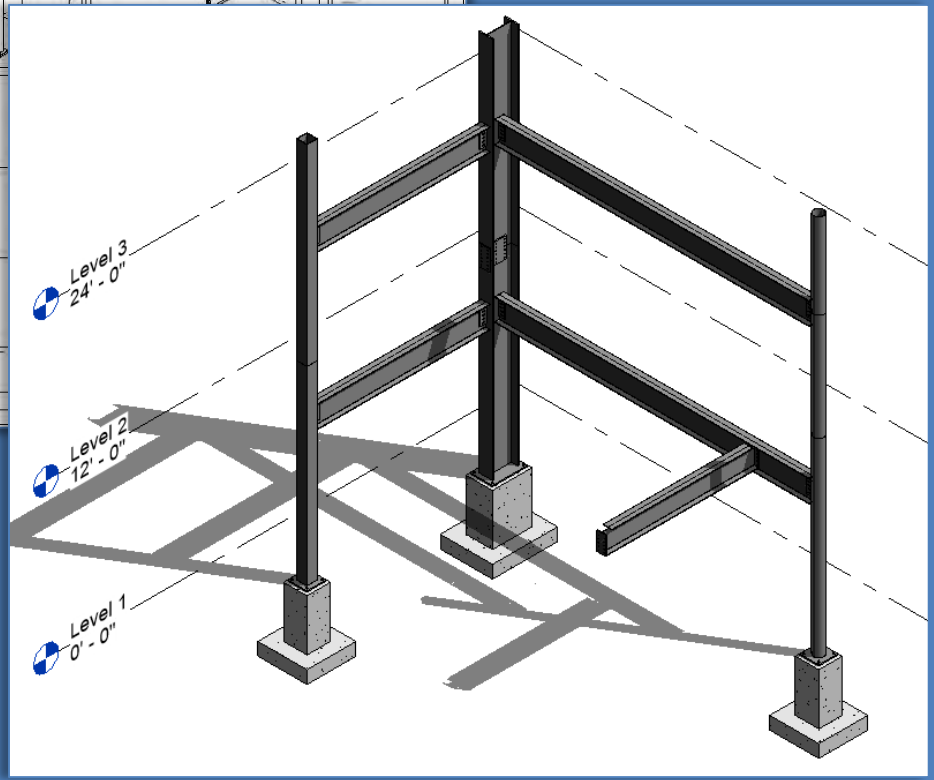
Steel Connection Detail Development







- *22 X 34 Sheet*
- *Coordinated Views & Isometrics*

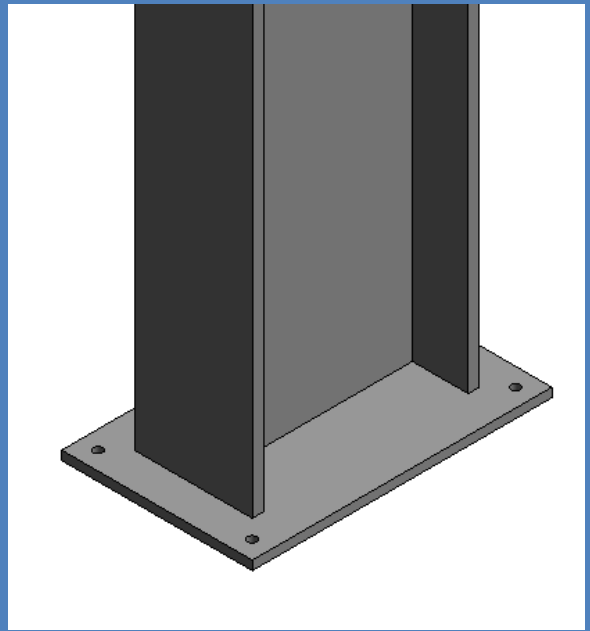


- *Base Plate & Footing*
- *Fin Plate Connection*
- *Splice Plate Connection*
- *Notched Beam with Bolting Plate*

Building Technology III

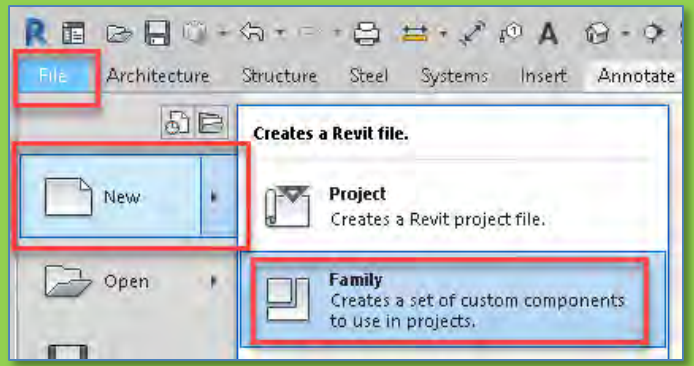
CityTech.CUNY.edu

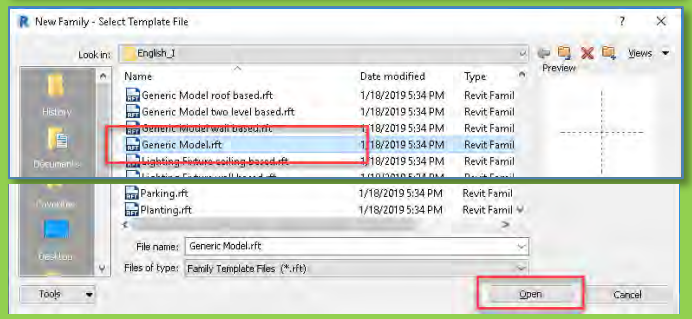
Steel Column Baseplate

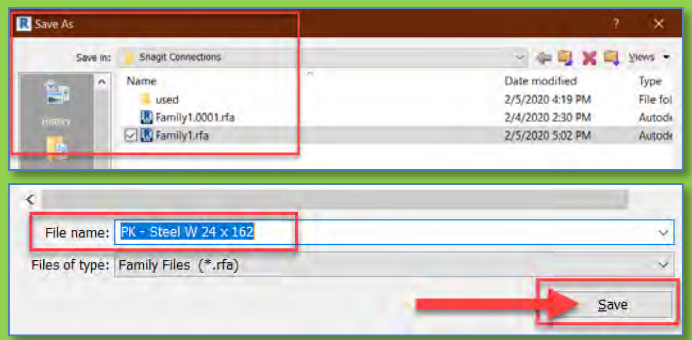


Prof. Paul C. King

Creating a new 3D Family File





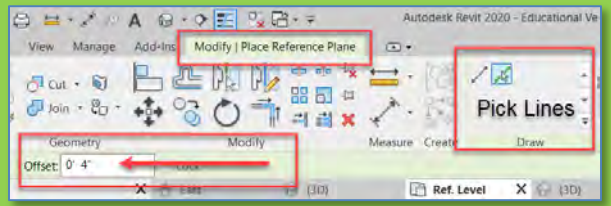


- We will repeat this for each component of the Steel Connection Assembly
- **Create a new Family**
  - File > New > Family
  - Generic Model Template
- **Save and Name the File**
- Select an appropriate directory
- Name the files as follows:
  - *Initials- Description*
  - *PK – Steel W 24 x 162 baseplate*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

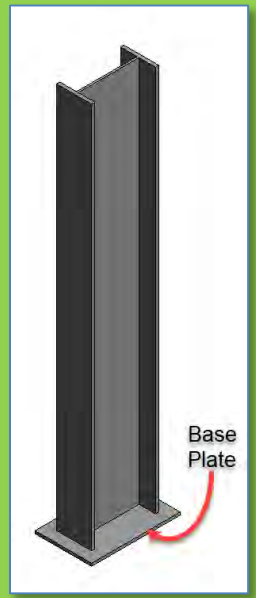
Prof. Paul C. King

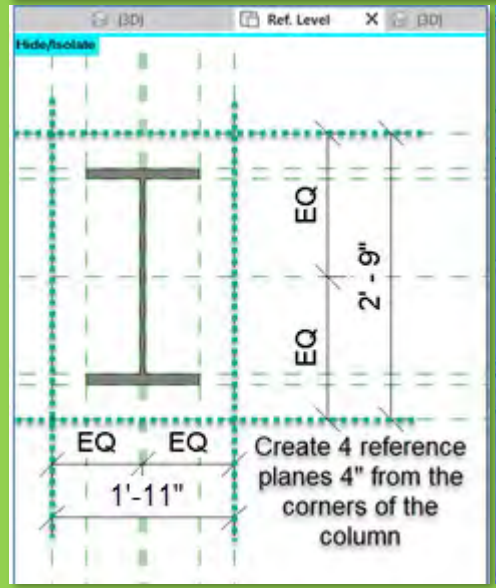
Add Base Plate to Wide Flange W 24 x 162

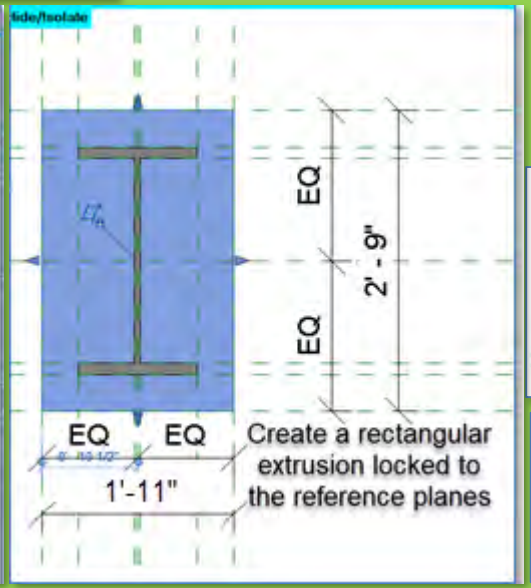
- *Open family*
  PK – Steel W 24 x 162
- *Save-as*
  PK – Steel W 24 x 162 baseplate

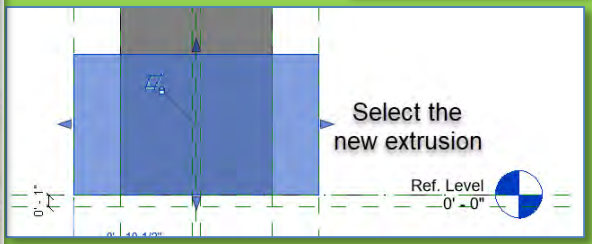


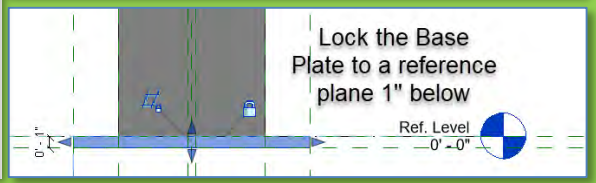
- *Create 4 reference planes –*
  - *4" from the corners of the column for the baseplate*
- *Create > Extrusion > Rectangle & lock to the reference planes*
- *Front View > Reference Plane @ 1"*
- *Edit Extrusion to snap to Ref. Level and Reference Plane for 1" Thickness*





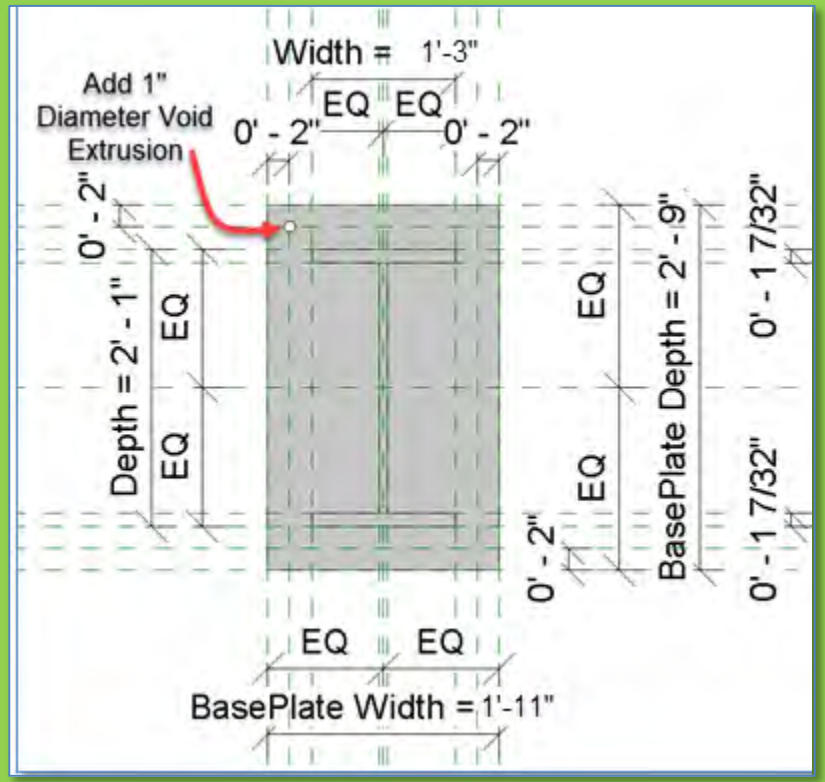


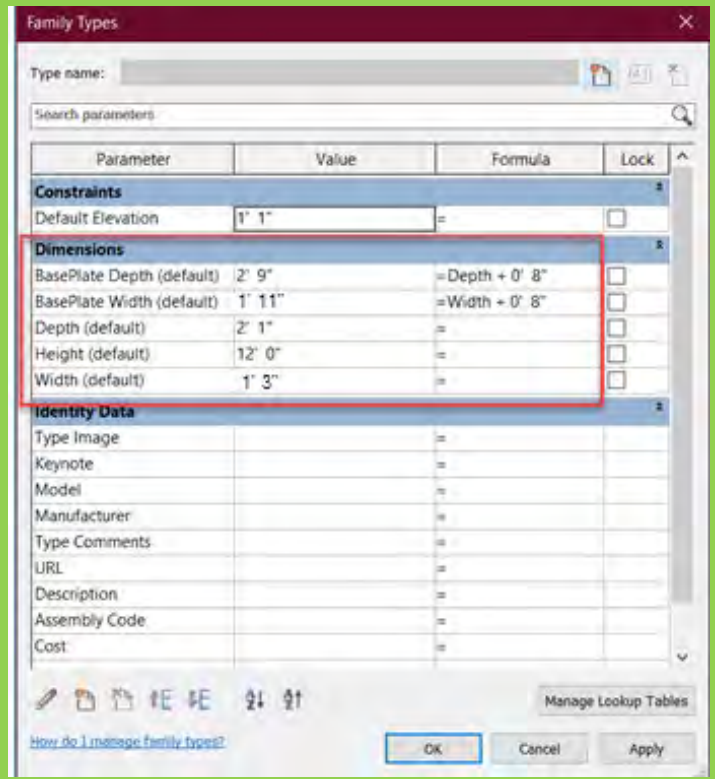




Prof. Paul C. King

Baseplate uses parameter formulas

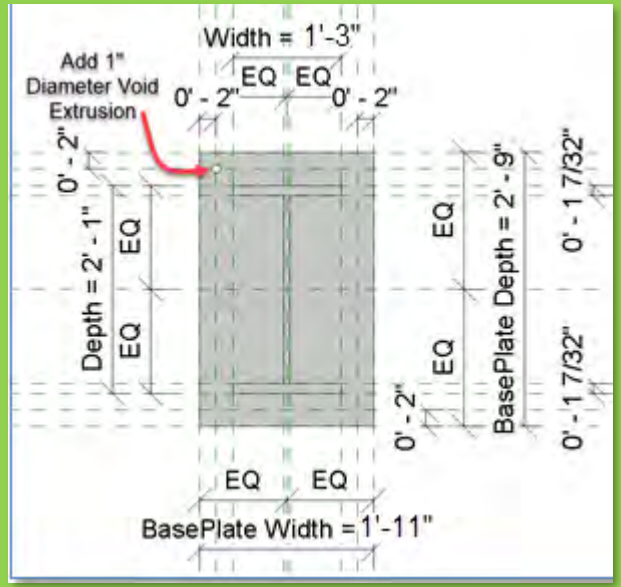


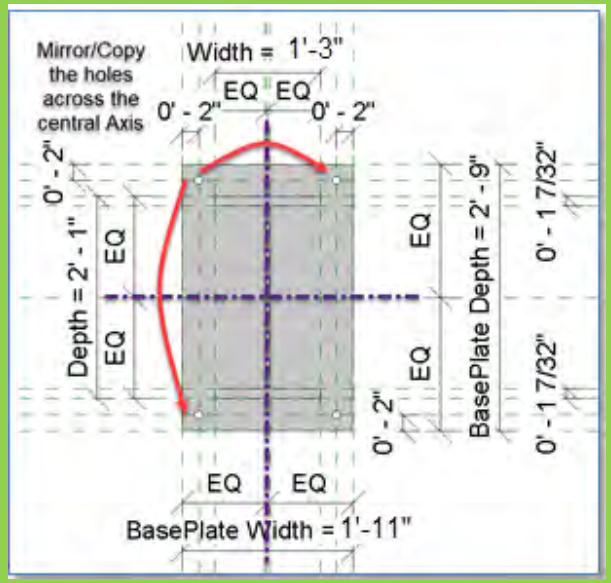


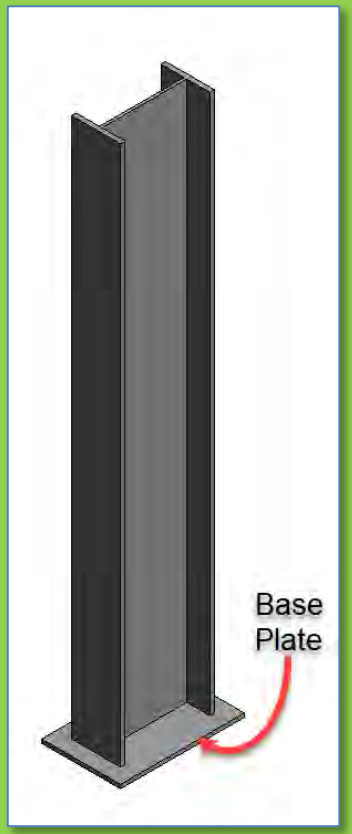
- *The base plate is 4” beyond the corners of the column and uses parameter formulas*
  - *BasePlate Depth = Depth + 0’ 8” 2’ 1” + 8” = 2’ 9”*
  - *BasePlate Width = Widtch + 0’ 8” 1’ 3” + 8” = 2’ 1”*

Prof. Paul C. King

Add holes for anchor bolt to footing connection

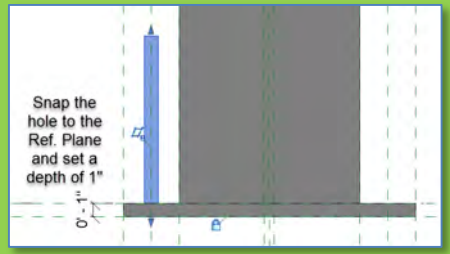


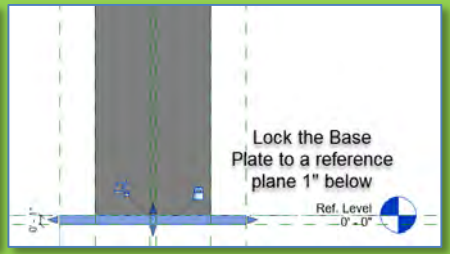




- *Create > Void Forms > 1" Diameter holes*
- *Snap to Reference Planes 2" from edge of base plate*

- *Mirror/Copy the holes across the center axis*

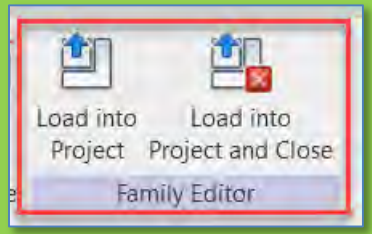




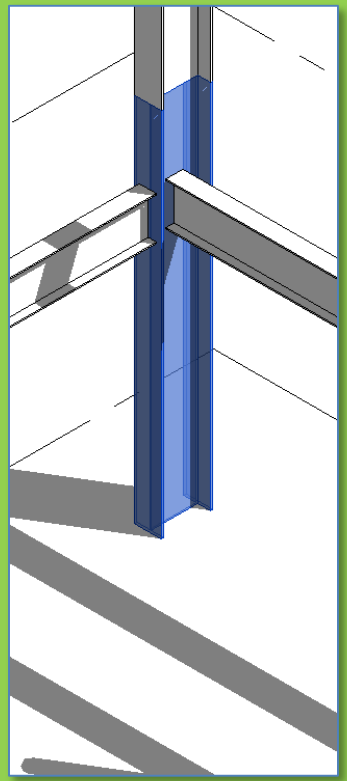
- *Snap the hole height to match the top and bottom of the baseplate*

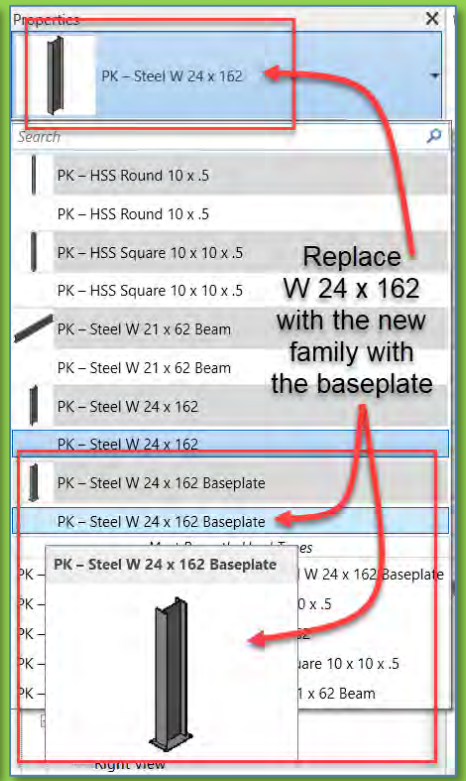
Prof. Paul C. King

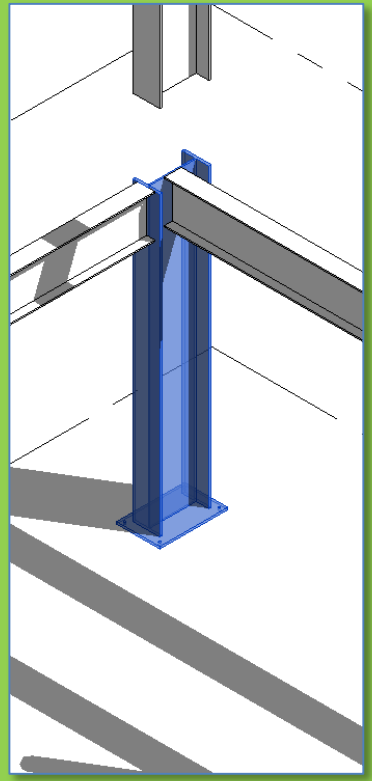
Load new *column with baseplate* into project

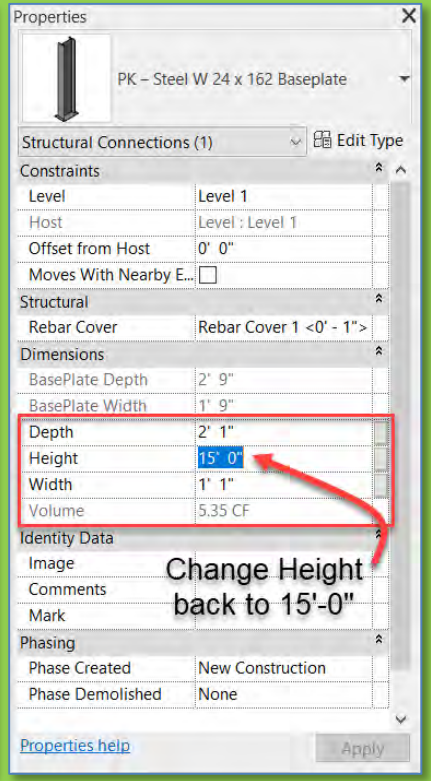


- *Load into Project*
- *Select the lower W 24 x 162 on Level 1*
- *Replace W 24x162 with the new family W 24x162 baseplate*
- *The height will revert to 12'-0". Change it back to 15'-0"*
- *Be certain your 3d View is not cropped and baseplate is visible!*





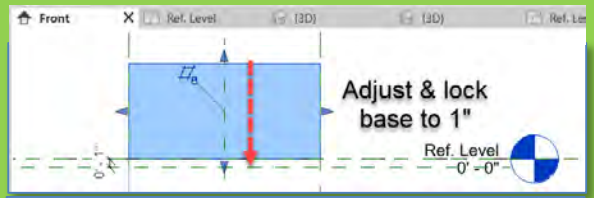


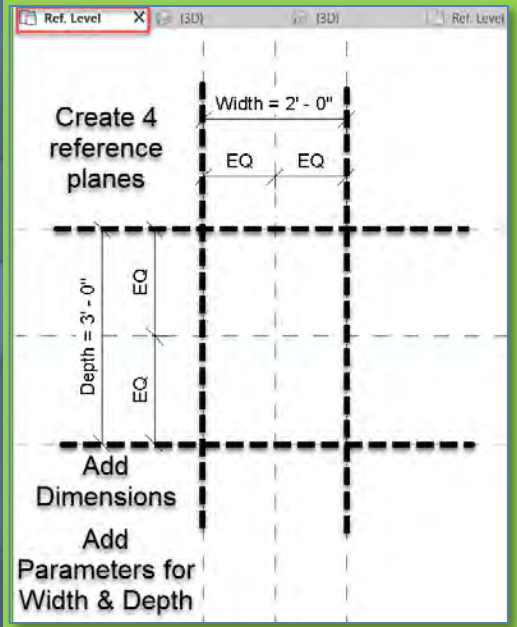


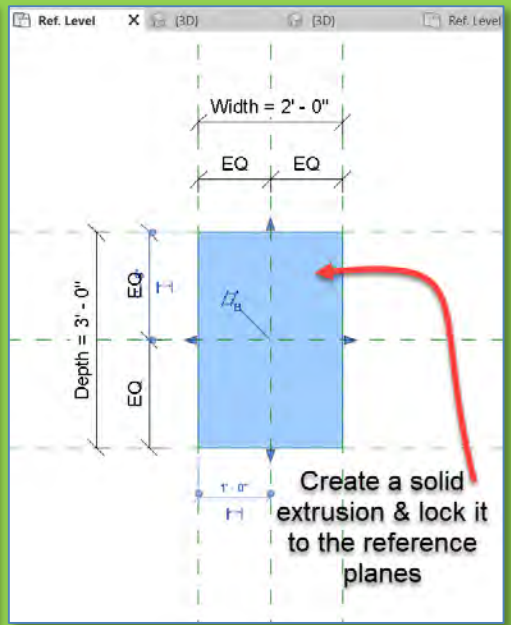
Prof. Paul C. King

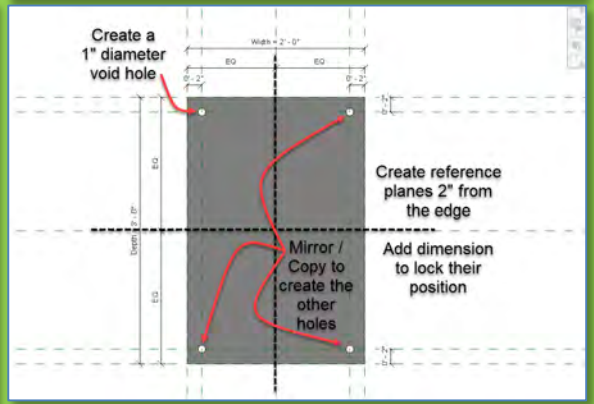
Creating an *independent base plate* with parameters

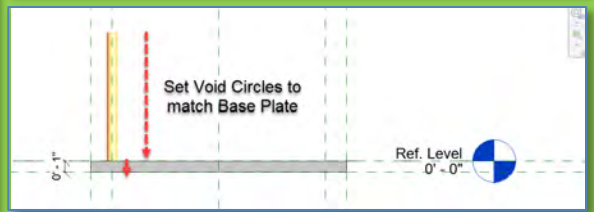
- *New Family > Generic Model*
- *Create > Reference Planes for edge of baseplate*
  - *Add Parameters for Width and Depth*
- *Create > Solid Extrusion > lock to Reference Planes*
- *Create > Reference Planes 2" in from edges*
- *Create > Void Forms > 1" Dia. Holes > lock to reference planes*
- *Mirror / Copy to create all 4 holes*







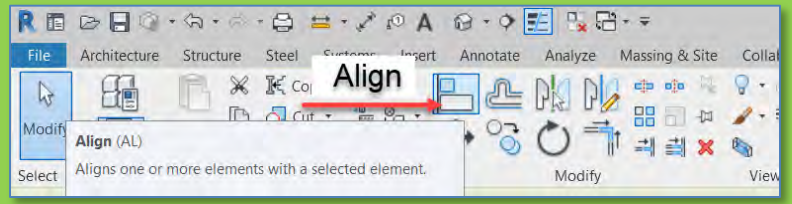


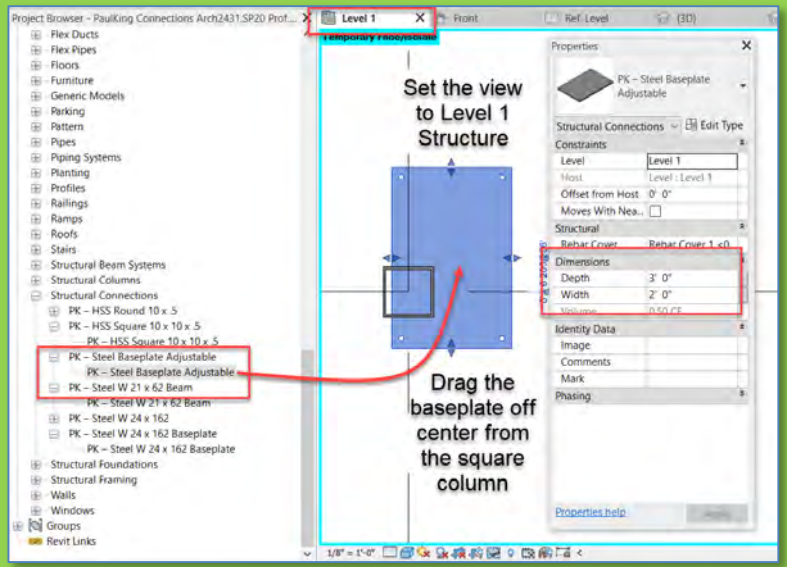


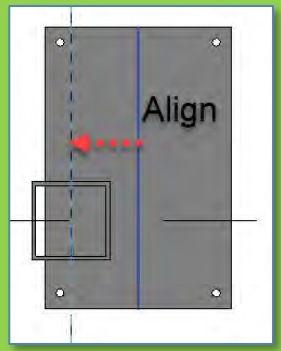
Prof. Paul C. King

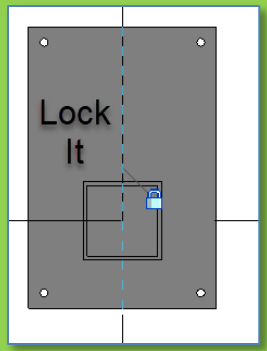
Add independent base plate for Square Column

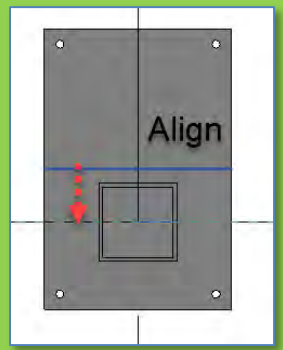
- *Make Leve 1 Structure the Current View*
- *Drag New Independent Baseplate close to the square column*
- *Locate it off-center to facilitate alignment*
- *Use Align to lock the baseplate to the center reference planes of the square column*
- *From side view align and lock to bottom of column*

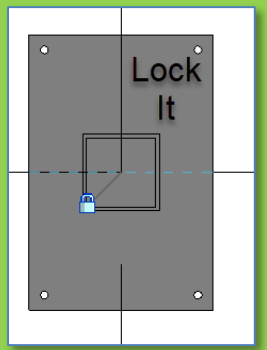








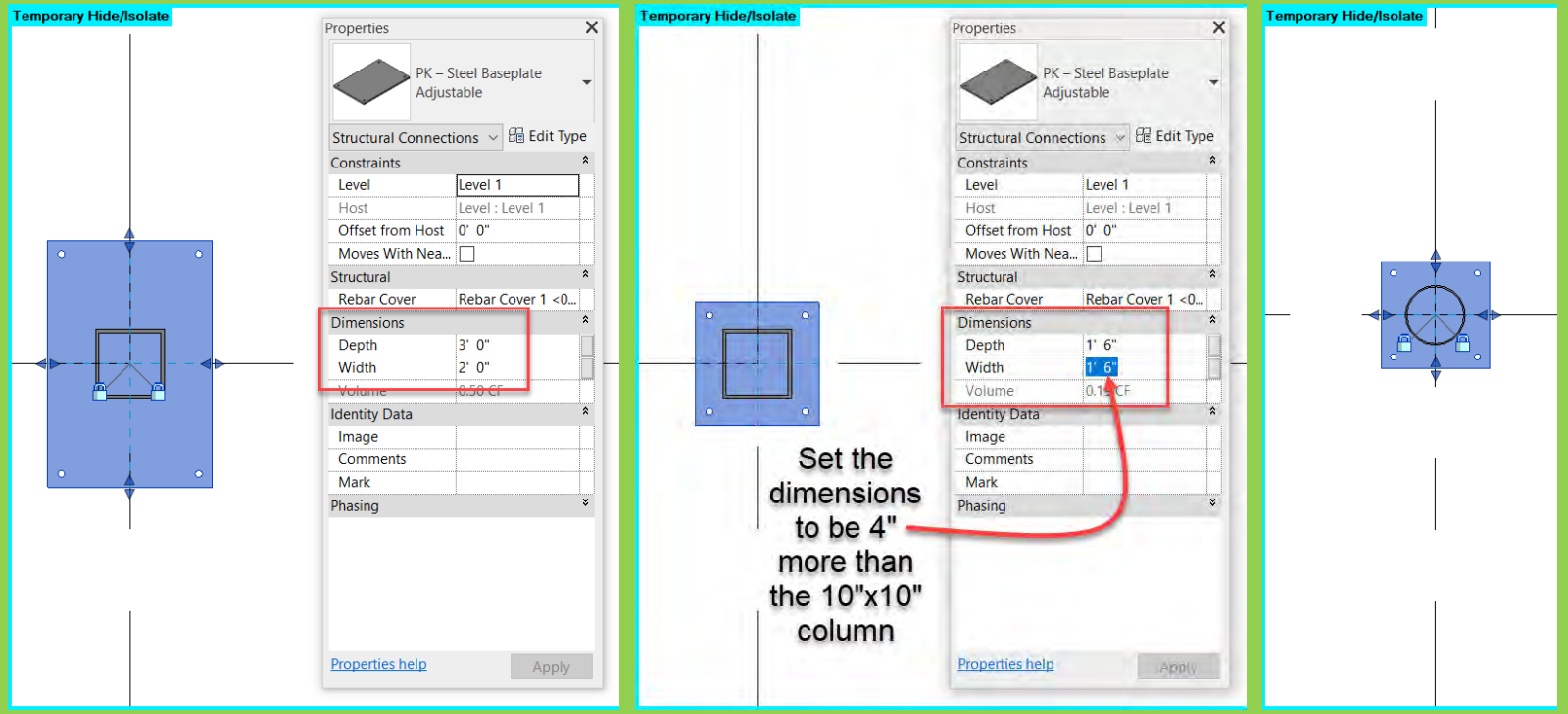




Prof. Paul C. King

Use the parameters to modify the baseplate size

- *Repeat the process and add a baseplate for the round column*
- *Align it with the center of the round column and lock it*
- *Resize the baseplate to be 4" larger on both sides (10"+4"+4"=18" [1'-6"])*



Prof. Paul C. King

Day 05
Connection Details

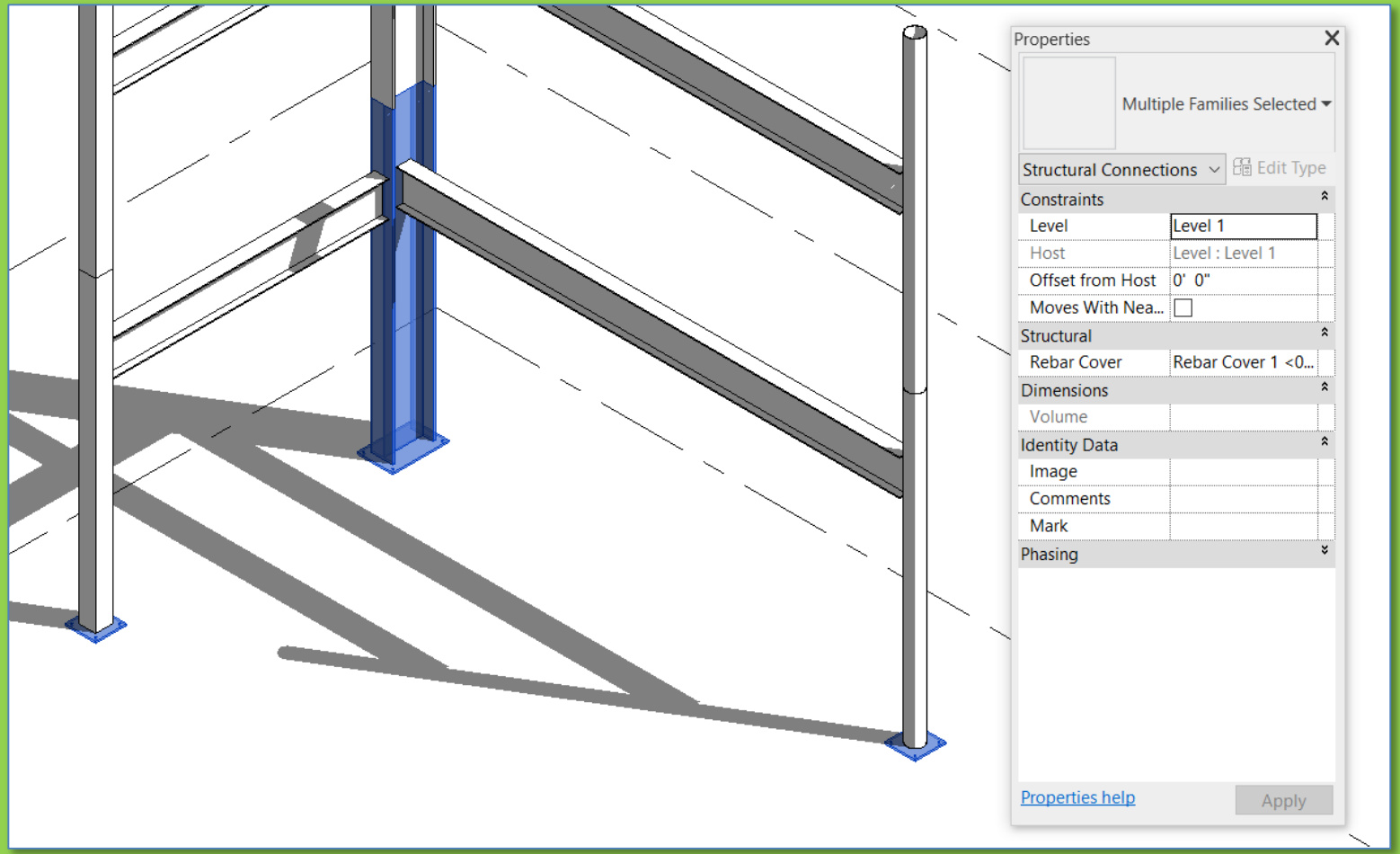
- New 3D Families
  - W24 x 162 with Baseplate
  - Independent Baseplate
- Connections
  - Videos
  - Detail Drawings
  - Photos
  - Bolts & Screws
- Concrete Footing
  - Cone Shaped Void
  - Threaded Rod
  - Nut & Washers
  - Assemble
  - Load into Project
- Add Slab
- Develop Details
- Fin & Splice Connections
- Notched Beam to Beam
- Project File Sheet
- Assignment Next Steps

Building Technology III

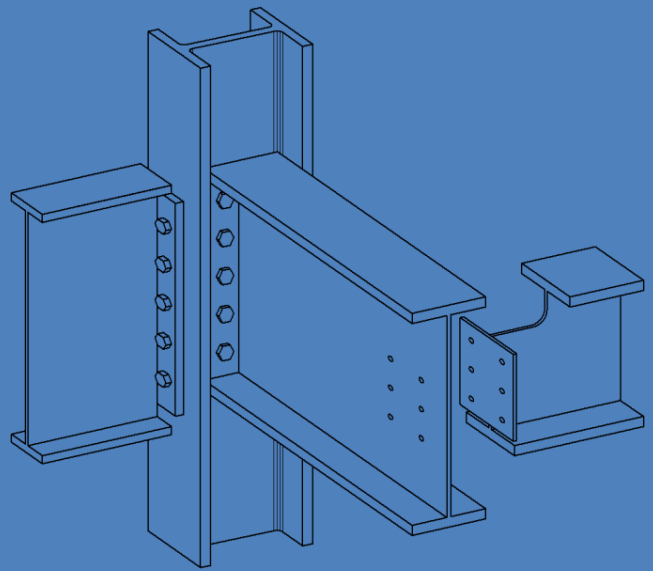
CityTech.CUNY.edu

Columns with base plates

Be certain your 3d View is not cropped and baseplate is visible!



Steel Connections Bolts and Fasteners



Prof. Paul C. King

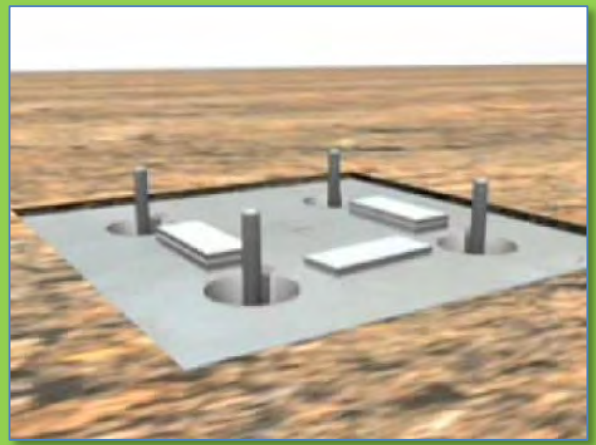
Day 05
Connection Details

- New 3D Families
  - W24 x 162 with Baseplate
  - Independent Baseplate
- Connections
  - Videos
  - Detail Drawings
  - Photos
  - Bolts & Screws
- Concrete Footing
  - Cone Shaped Void
  - Threaded Rod
  - Nut & Washers
  - Assemble
  - Load into Project
- Add Slab
- Develop Details
- Fin & Splice Connections
- Notched Beam to Beam
- Project File Sheet
- Assignment Next Steps

Building Technology III

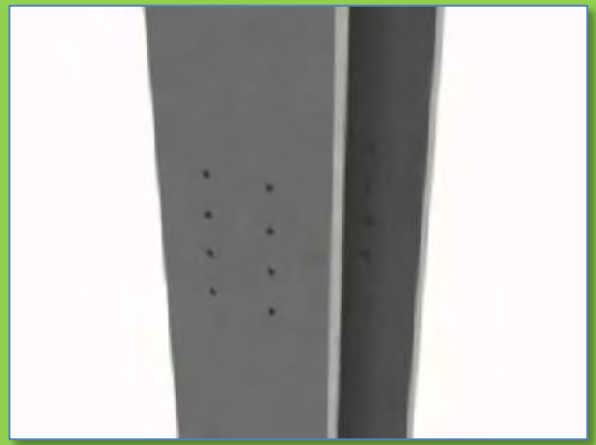
CityTech.CUNY.edu

Steel Column and Beam Connection Videos



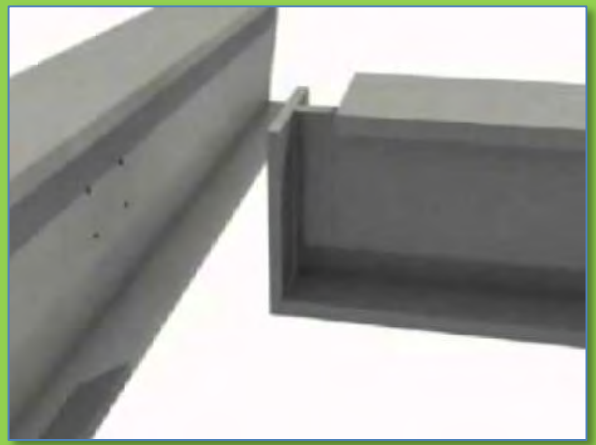
Column Base Plate to Foundation

Beam to Column Fin Plate Connection



Beam to Column Connection

Beam to Beam Connection



https://www.steelconstruction.info/Simple_connections#Joint_considerations

Prof. Paul C. King

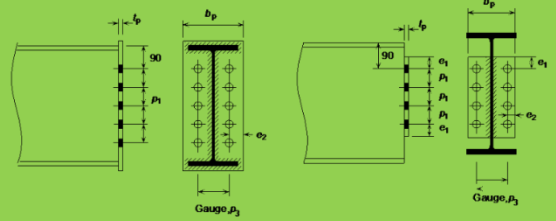
Day 05
Connection Details

- New 3D Families
  - W24 x 162 with Baseplate
  - Independent Baseplate
- Connections
  - Videos
  - Detail Drawings
  - Photos
  - Bolts & Screws
- Concrete Footing
  - Cone Shaped Void
  - Threaded Rod
  - Nut & Washers
  - Assemble
  - Load into Project
- Add Slab
- Develop Details
- Fin & Splice Connections
- Notched Beam to Beam
- Project File Sheet
- Assignment Next Steps

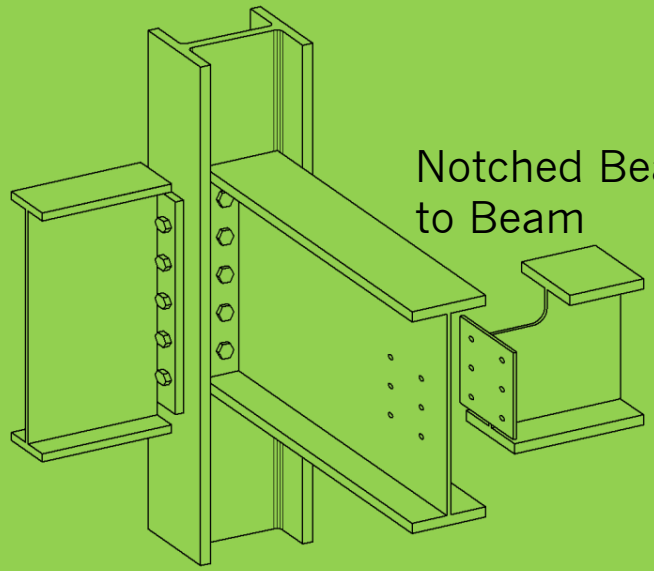
Building Technology III

CityTech.CUNY.edu

Steel Connection Drawings and Isometrics



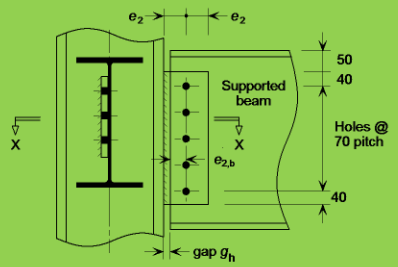
Beam with End Plate

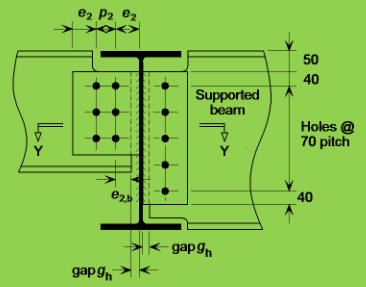


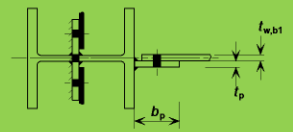
Notched Beam to Beam

Beam to Column

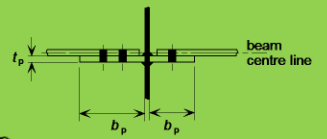
Fin Plate Connections



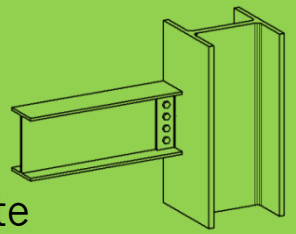


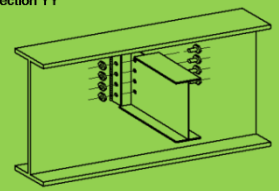


Section XX

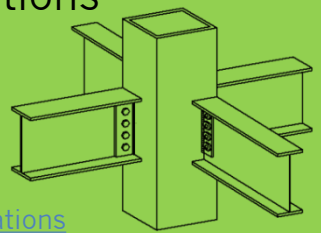


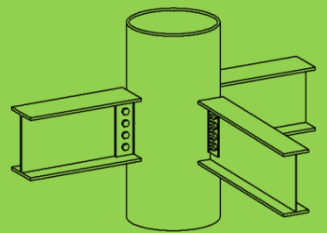
Section YY





Fin Plate Connections





https://www.steelconstruction.info/Simple_connections#Joint_considerations

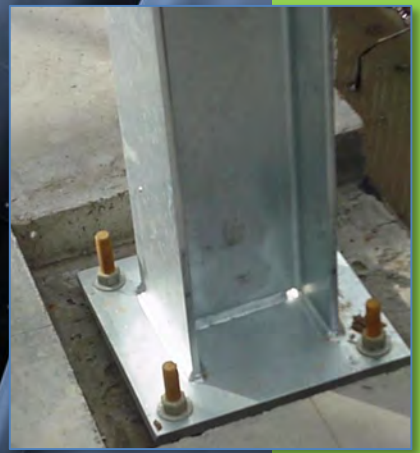
Connection Photographs

Photos by Paul King – NYC Seaport

https://skyciv.com/technical/bolts-vs-welds-vs-rivets-for-steel-connections/

https://amtecdesigns.com/struct/

Photos by Paul King – Corning Glass

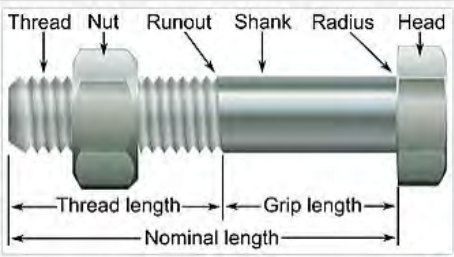


https://civil-engg-world.blogspot.com/2011/05/base-plate-for-steel-column.html

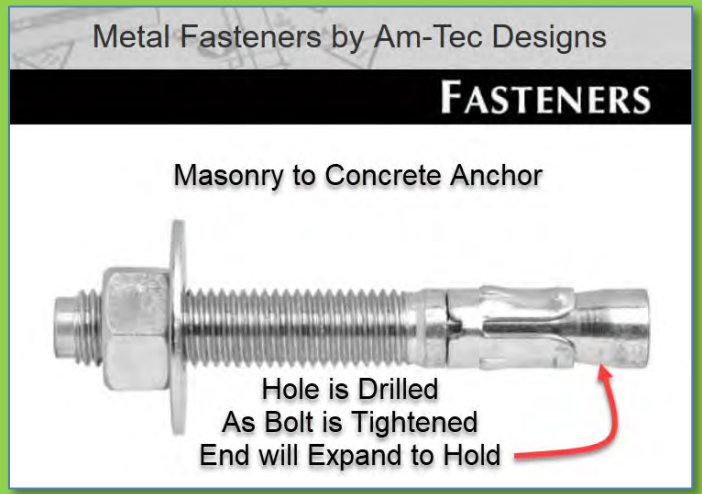
Bolts & Screws

https://en.wikipedia.org/wiki/Bolt_(fastener)

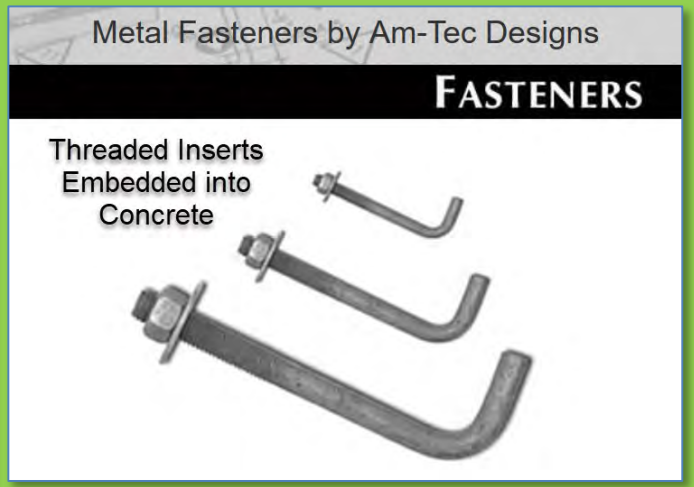
Nut and bolt



Parts and measurements.



https://amtecdesigns.com/struct/



A plain washer and a spring washer are placed on a bolt between the nut (on the threaded end) and the bolt head.

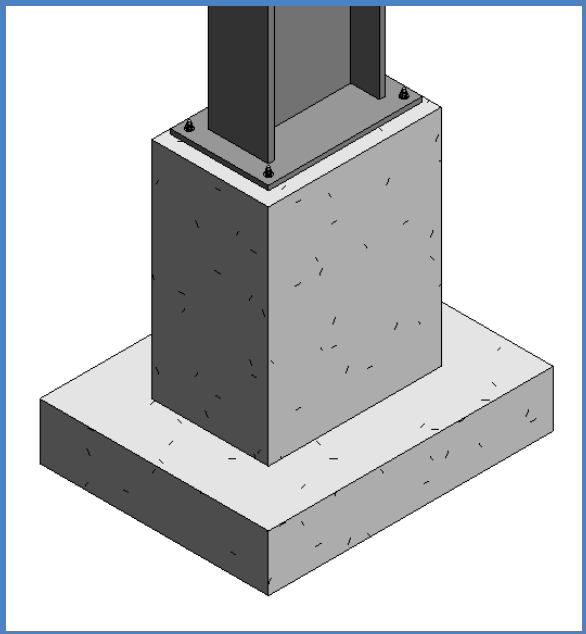
Assorted washers: flat, split, star and insulating

https://en.wikipedia.org/wiki/Washer_(hardware)

https://www.globalindustrial.com/p/fasteners/Self-Tapping-Screws/hex-head/self-tapping-screw-8-x-1-12-hex-head-pkg-of-280-itw-teks174-21308

Self Taping Screw

Concrete Footing to Baseplate Connection



Prof. Paul C. King

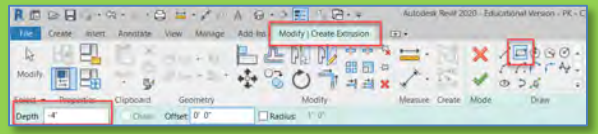
Day 05
Connection Details

- New 3D Families
  - W24 x 162 with Baseplate
  - Independent Baseplate
- Connections
  - Videos
  - Detail Drawings
  - Photos
  - Bolts & Screws
- Concrete Footing
  - Cone Shaped Void
  - Threaded Rod
  - Nut & Washers
  - Assemble
  - Load into Project
- Add Slab
- Develop Details
- Fin & Splice Connections
- Notched Beam to Beam
- Project File Sheet
- Assignment Next Steps

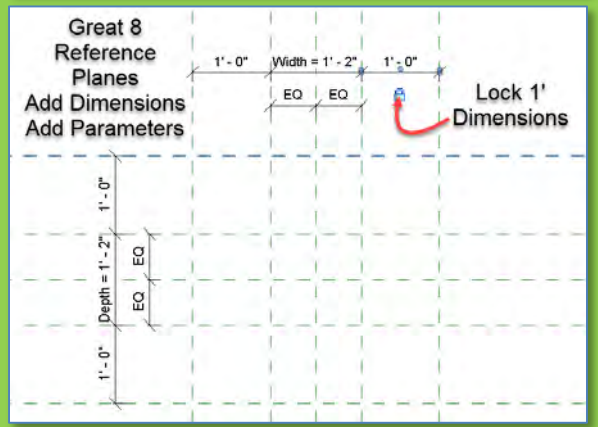
Building Technology III

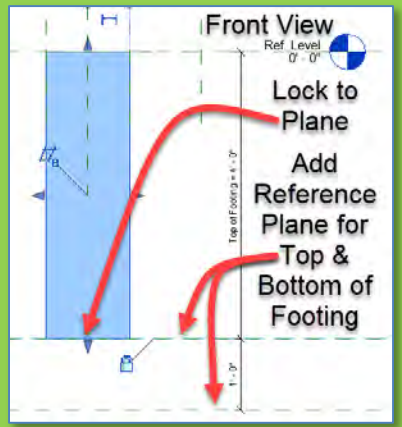
CityTech.CUNY.edu

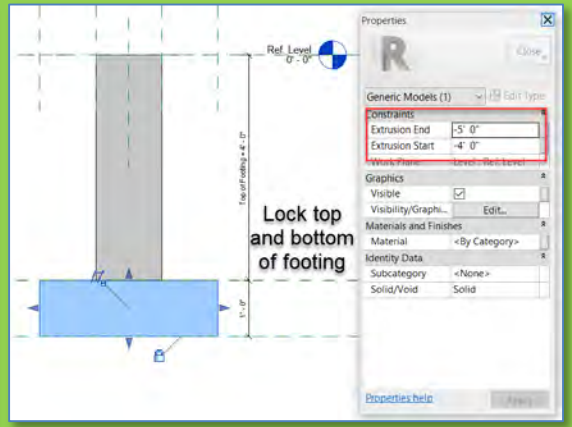
Concrete Isolated Footing with Hold Down Bolts

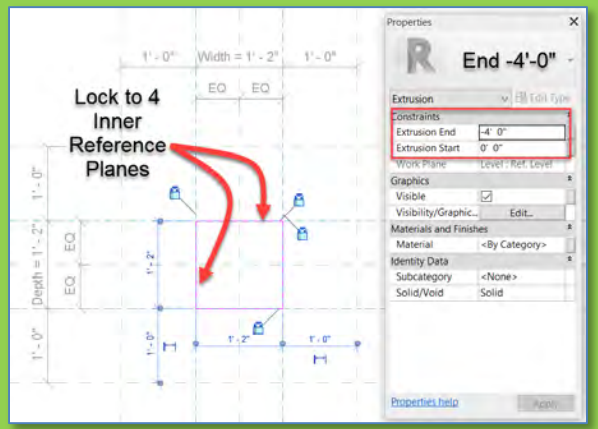


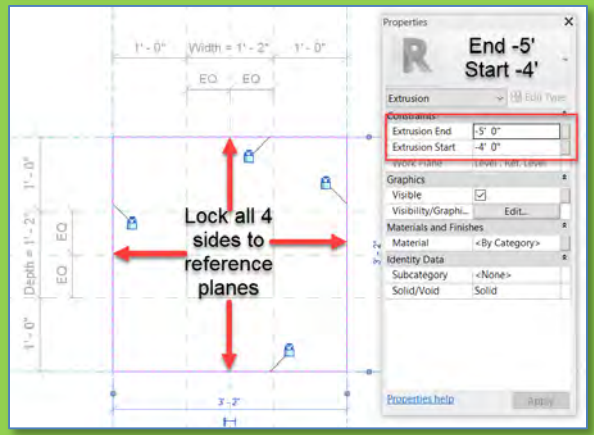
- *Create 8 reference Planes, Add Dimensions & Parameters*
- *Create > Extrusion (center of footing -4'-0" depth)*
- *Create > Extrusion (base of footing Start -4', End -5')*

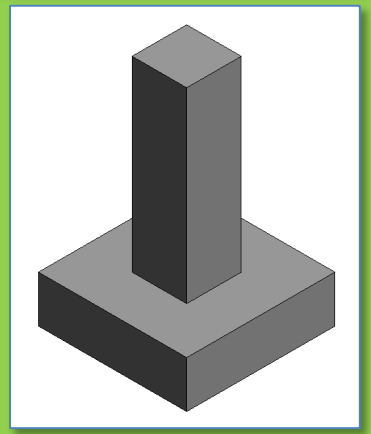












Prof. Paul C. King

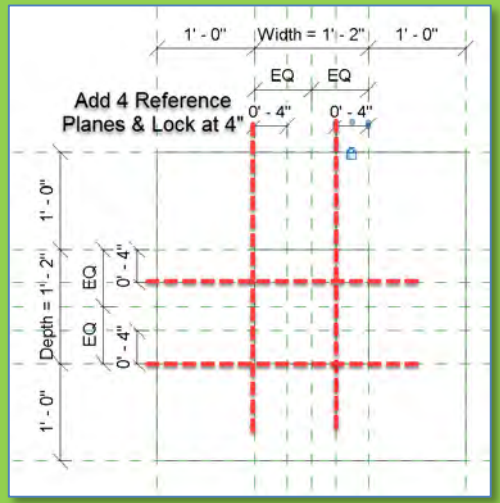
Concrete Isolated Footing with Hold Down Bolts

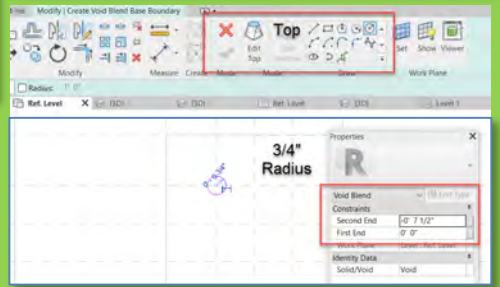
Day 05
Connection Details

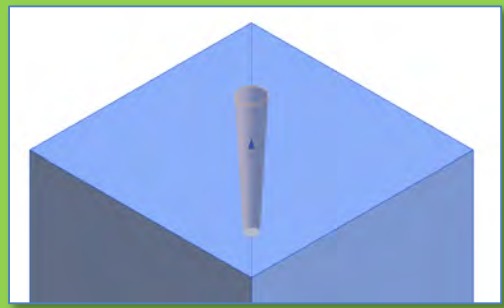
- New 3D Families
  - W24 x 162 with Baseplate
  - Independent Baseplate
- Connections
  - Videos
  - Detail Drawings
  - Photos
  - Bolts & Screws
- Concrete Footing
  - Cone Shaped Void
  - Threaded Rod
  - Nut & Washers
  - Assemble
  - Load into Project
- Add Slab
- Develop Details
- Fin & Splice Connections
- Notched Beam to Beam
- Project File Sheet
- Assignment Next Steps

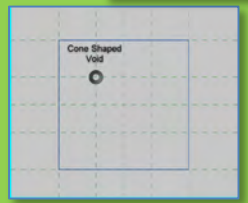
Building Technology III

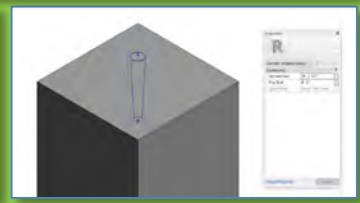
CityTech.CUNY.edu

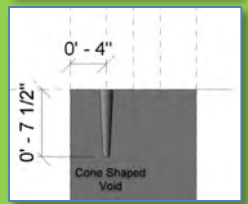


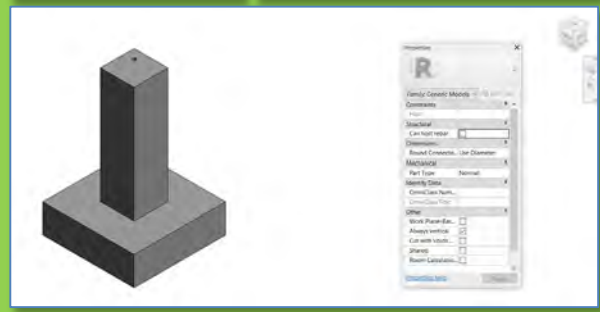












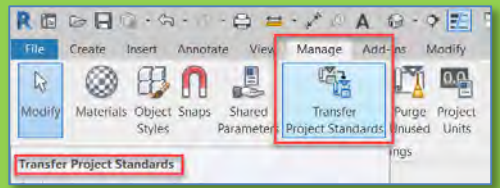
Create Cone Shaped Void

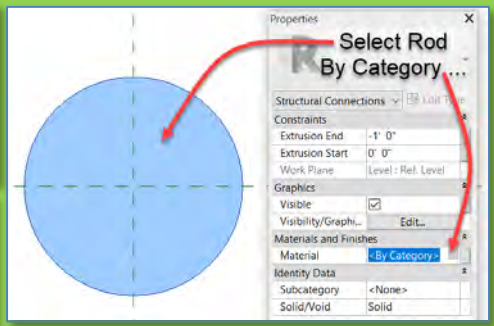
- *Create 4 Reference Planes & Lock at 4"*
- *Create > Void Blend*
  - *Top ¾" Radius*
  - *Base 3/8" Radius*
  - *First End 0'-0"*
  - *Second End -7 ½"*

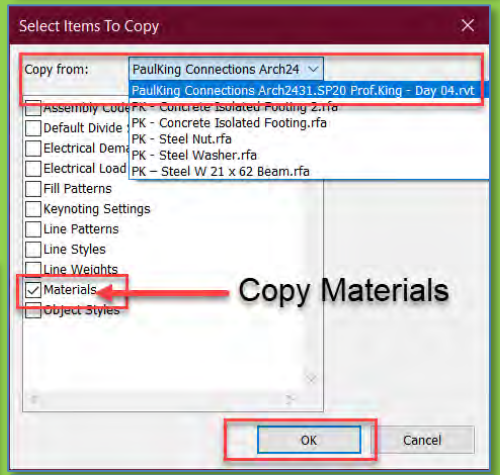
Prof. Paul C. King

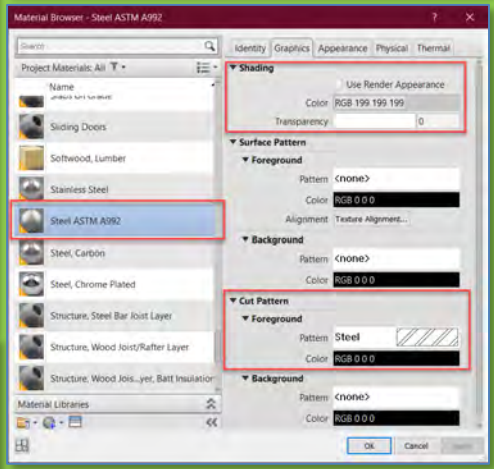
Create Threaded Rod, Nut and Washers - Import

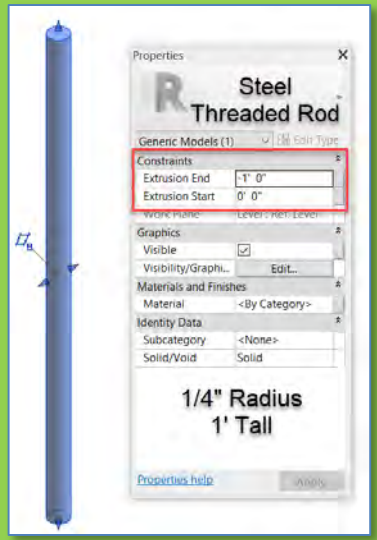
- *Create > Extrusion (1' rod)*
- *Transfer Project Standards*
- *(Copy from your project file)*
- *Import Materials Library*
- *Select "Rod" and set Material Category*
- *Steel ASTM A992*

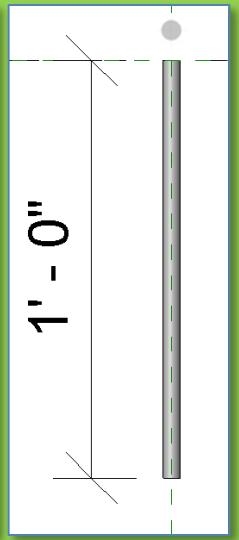


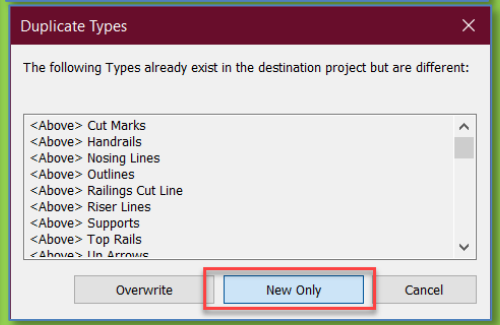












- *For all families get in the habit of assigning materials so they render and detail correctly*

Prof. Paul C. King

Day 05
Connection Details

- New 3D Families
  - W24 x 162 with Baseplate
  - Independent Baseplate
- Connections
  - Videos
  - Detail Drawings
  - Photos
  - Bolts & Screws
- Concrete Footing
  - Cone Shaped Void
  - Threaded Rod
  - Nut & Washers
  - Assemble
  - Load into Project
- Add Slab
- Develop Details
- Fin & Splice Connections
- Notched Beam to Beam
- Project File Sheet
- Assignment Next Steps

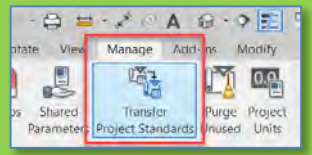
Building Technology III

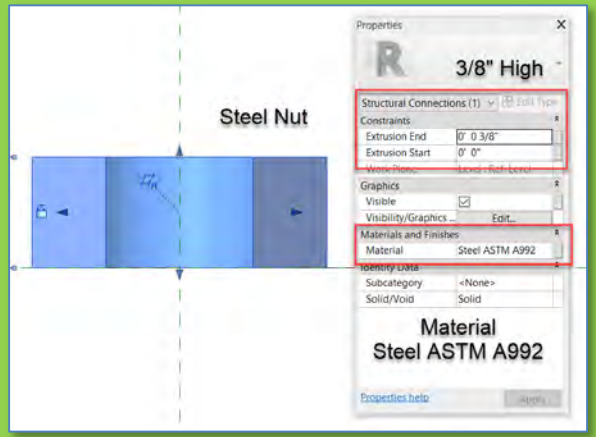
CityTech.CUNY.edu

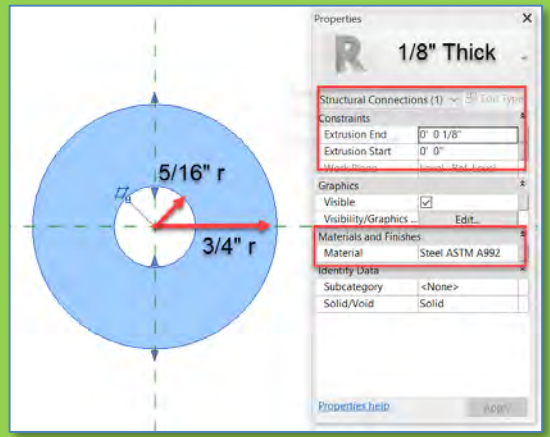
Create Threaded Rod, Nut and Washers - Import

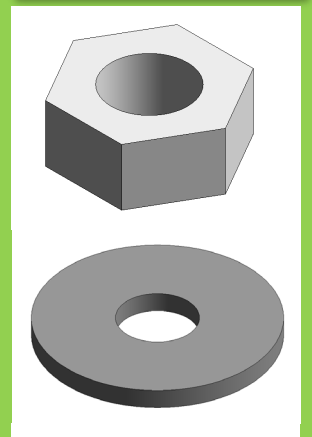
- *Steel Nut*
- *½" radius with ¼" radius hole x 3/8" high*

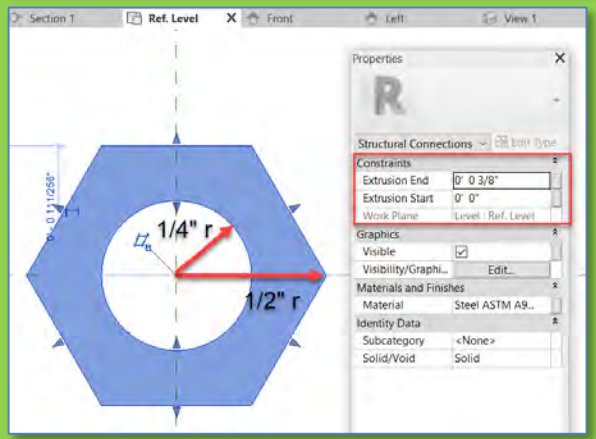
- *Steel Washer*
- *¾" radius with 5/16" radius hole x 1/8" high*

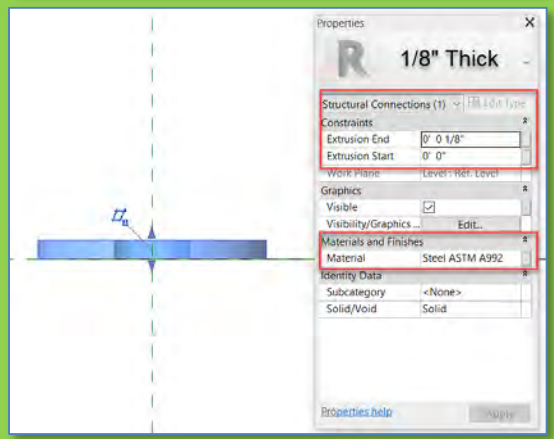


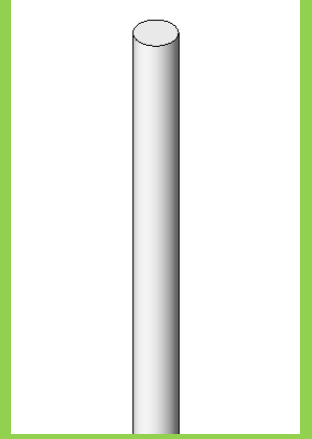












Prof. Paul C. King

Day 05
Connection Details

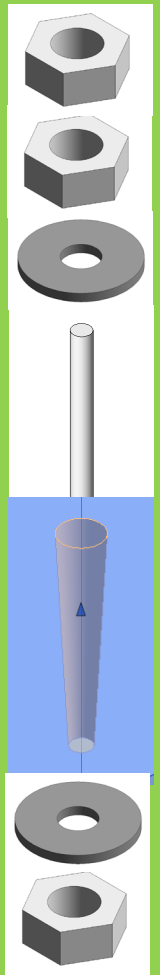
- New 3D Families
  - W24 x 162 with Baseplate
  - Independent Baseplate
- Connections
  - Videos
  - Detail Drawings
  - Photos
  - Bolts & Screws
- Concrete Footing
  - Cone Shaped Void
  - Threaded Rod
  - Nut & Washers
  - Assemble
  - Load into Project
- Add Slab
- Develop Details
- Fin & Splice Connections
- Notched Beam to Beam
- Project File Sheet
- Assignment Next Steps

Building Technology III

CityTech.CUNY.edu

Assemble Components in Concrete Footing Family

- *Load the Threaded Rod, Nut & Washer into the Concrete Footing Family*



Lock Nut

Nut

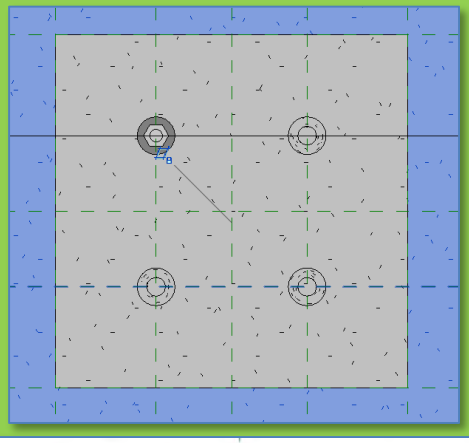
Washer

Threaded Rod

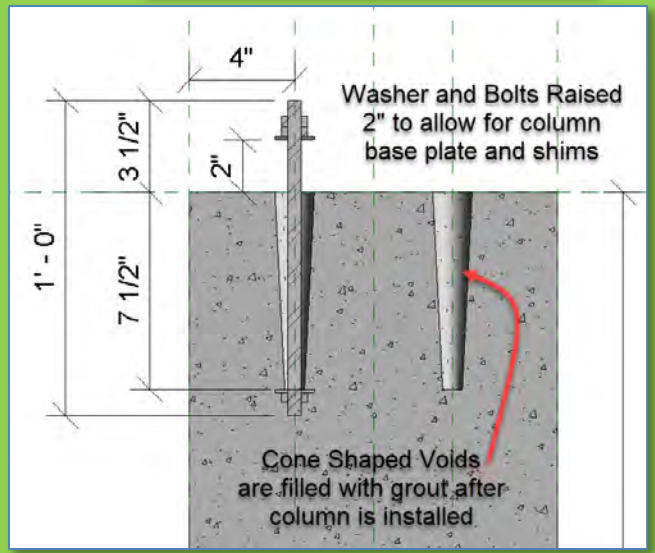
Cone Shaped Void

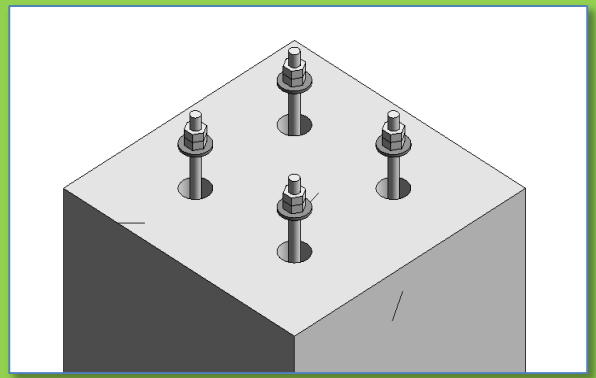
Washer

Nut



- *Locate each component and make certain each is locked to the correct reference planes*
- *Set the material for the footing to concrete, cast –in-place*
- *Load the Footing Family into the project file.*
- *All sub families will load as well*





Visible	☑
Visibility/Graphics Overrides	Edit...
Materials and Finishes	
Material	Concrete, Cast-in-Place gray
Identity Data	

Prof. Paul C. King

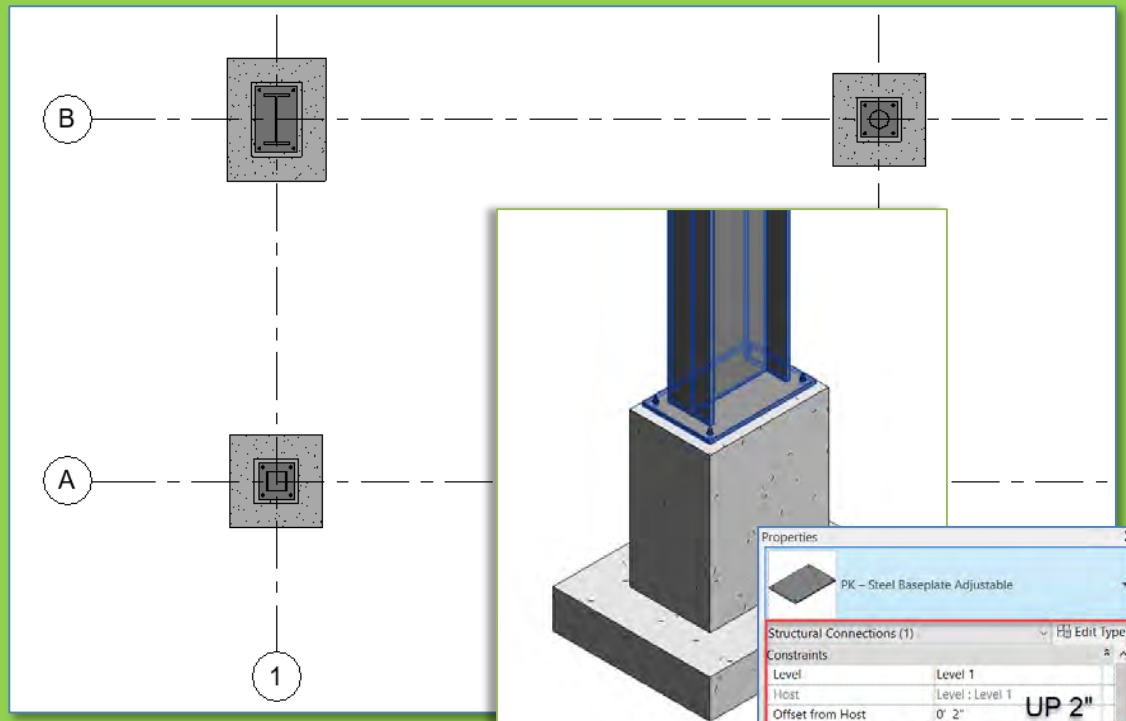
Day 05
Connection Details

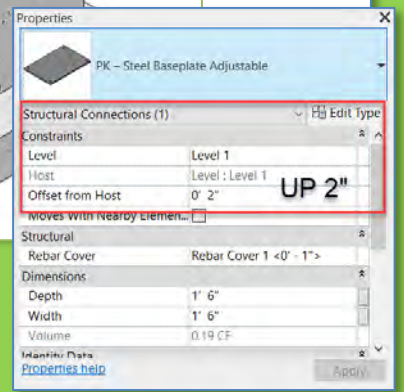
- New 3D Families
  - W24 x 162 with Baseplate
  - Independent Baseplate
- Connections
  - Videos
  - Detail Drawings
  - Photos
  - Bolts & Screws
- Concrete Footing
  - Cone Shaped Void
  - Threaded Rod
  - Nut & Washers
  - Assemble
  - Load into Project
- Add Slab
- Develop Details
- Fin & Splice Connections
- Notched Beam to Beam
- Project File Sheet
- Assignment Next Steps

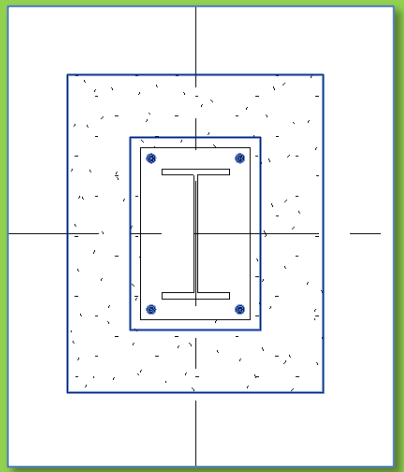
Building Technology III

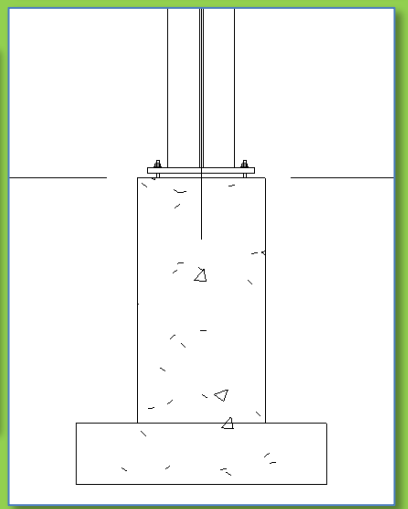
CityTech.CUNY.edu

Align and Lock the Concrete Footing to the Columns









- *Work on Structure Level 1*
- *Add Footings*
- *Align & Lock*
- *Top of Footing is at Level 1*

- *Base plate of column must be raised 2" to allow for shims and grout*
- *Column must be 2" shorter (from 15'-0" down to 14'-10")*

Prof. Paul C. King

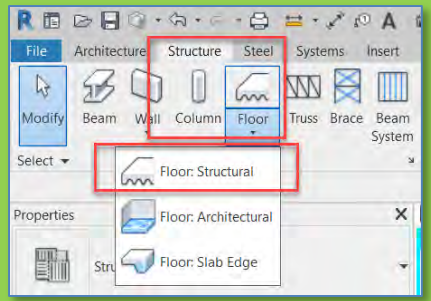
Day 05
Connection Details

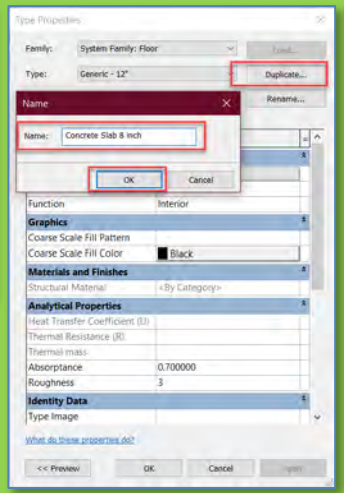
- New 3D Families
  - W24 x 162 with Baseplate
  - Independent Baseplate
- Connections
  - Videos
  - Detail Drawings
  - Photos
  - Bolts & Screws
- Concrete Footing
  - Cone Shaped Void
  - Threaded Rod
  - Nut & Washers
  - Assemble
  - Load into Project
- Add Slab
- Develop Details
- Fin & Splice Connections
- Notched Beam to Beam
- Project File Sheet
- Assignment Next Steps

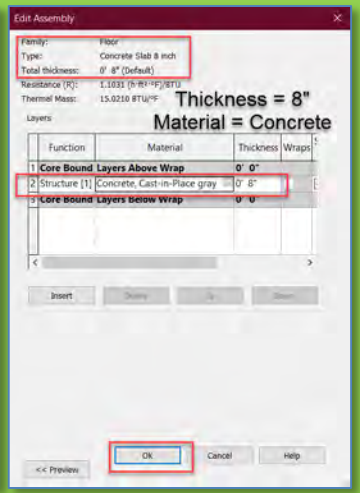
Building Technology III

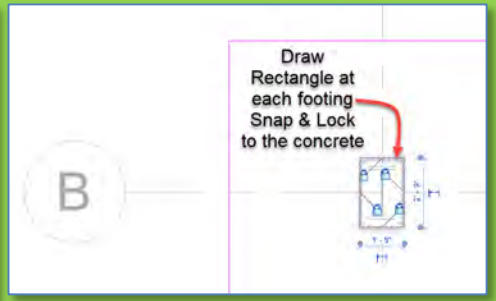
CityTech.CUNY.edu

Draw a concrete floor slab on Level 1 Structural



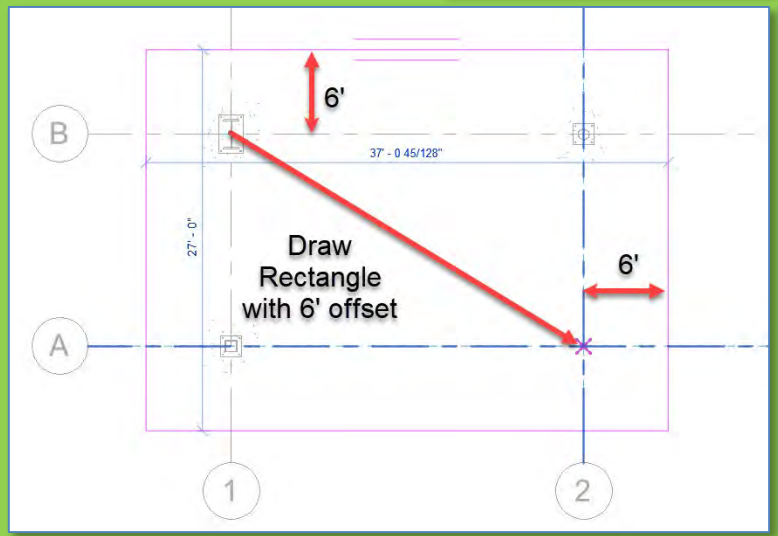


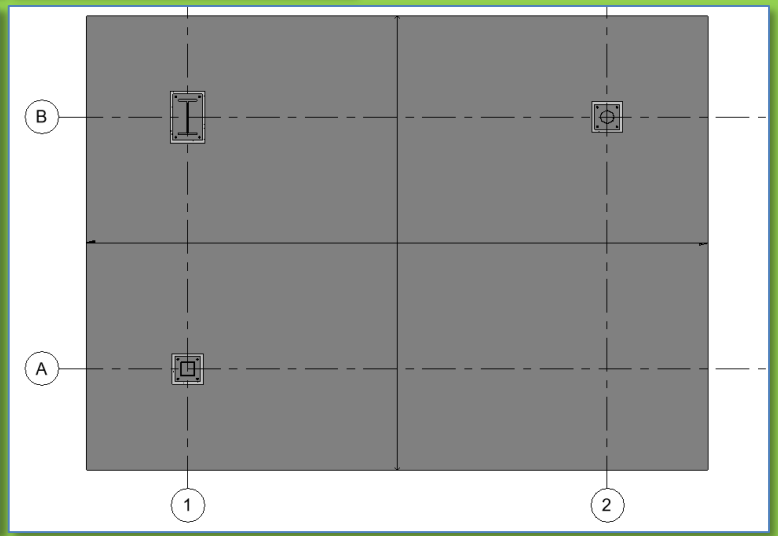




- *Create a Structural Floor*
- *Select Generic 12"*
- *Duplicate > Concrete Slab 8 inch*
- *Structure > Thickness = 8"*
- *Material = Concrete*

- *Draw Rectangle with 6' offset from grid intersection to grid intersection*
- *(use space to flip offset direction)*
- *Add Rectangle at each footing – snap & lock to the concrete – not the steel*





Prof. Paul C. King

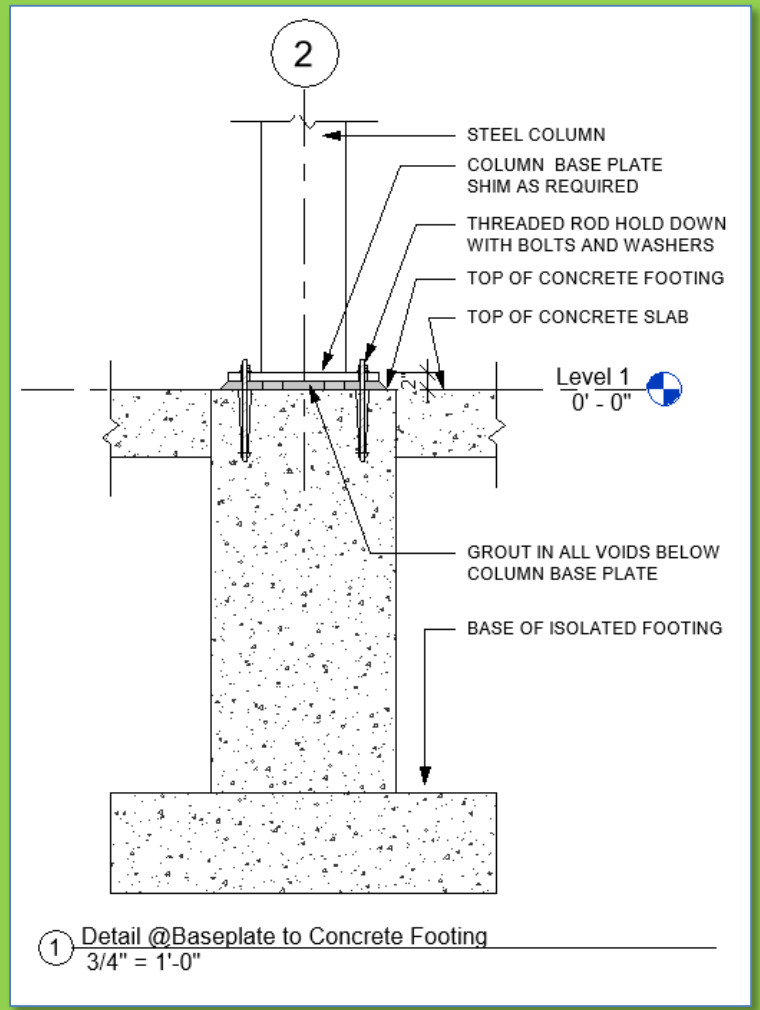
Day 05
Connection Details

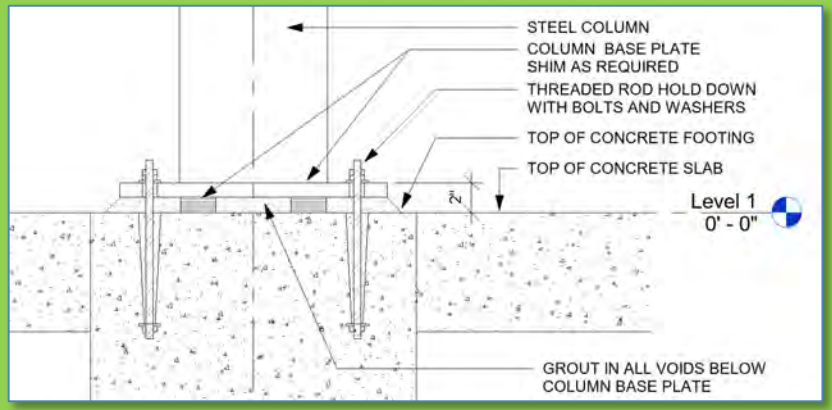
- New 3D Families
  - W24 x 162 with Baseplate
  - Independent Baseplate
- Connections
  - Videos
  - Detail Drawings
  - Photos
  - Bolts & Screws
- Concrete Footing
  - Cone Shaped Void
  - Threaded Rod
  - Nut & Washers
  - Assemble
  - Load into Project
- Add Slab
- Develop Details
- Fin & Splice Connections
- Notched Beam to Beam
- Project File Sheet
- Assignment Next Steps

Building Technology III

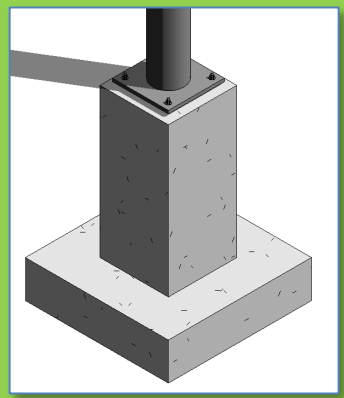
CityTech.CUNY.edu

Modify Base Plate Elevations as needed – add details

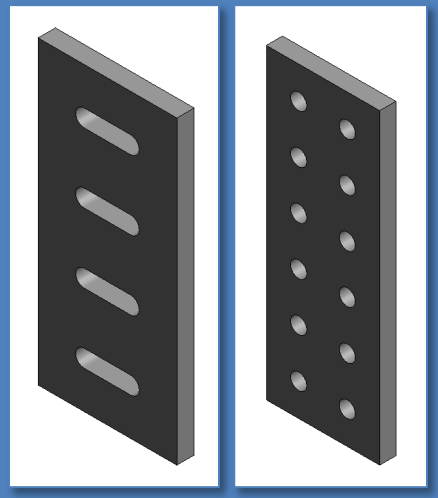


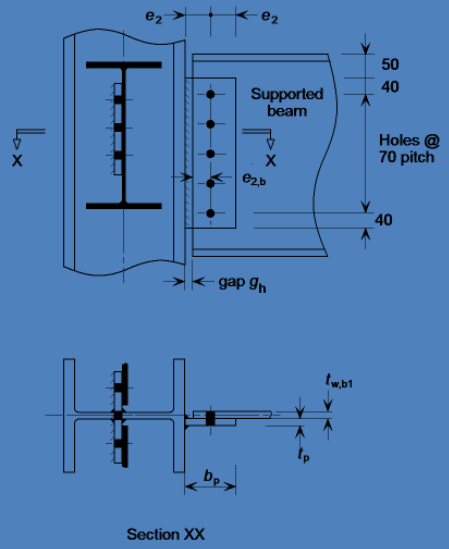


- *Develop a detail of the footing condition*
- *Top of Footing can also be recessed to allow for finish flooring to cover*

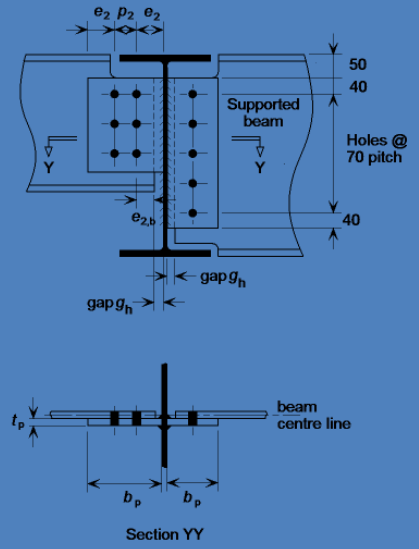


Fin & Splice Plate Connections





Section XX



Section YY

Prof. Paul C. King

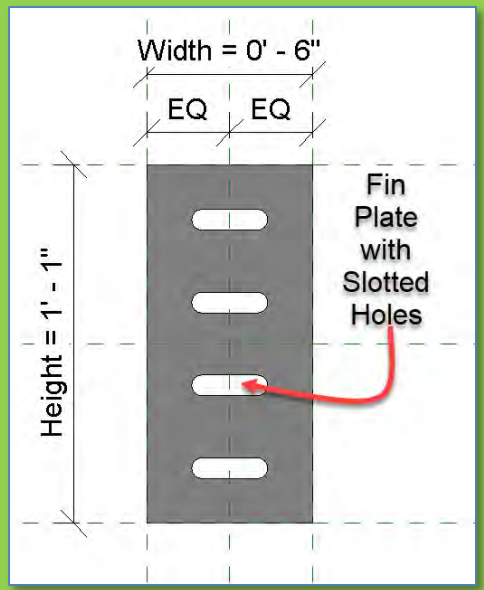
Fin Plates & Splice Plates for Column Connections

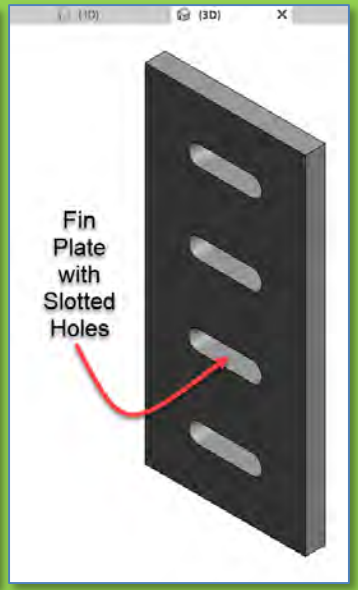
Fin Plate

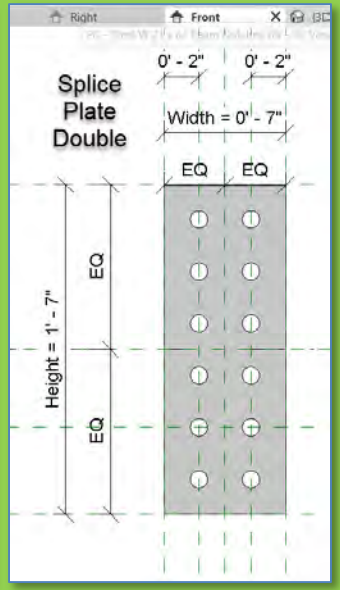
- Welded to columns or beams for connecting beams
- Slotted holes allow forhorizontal adjustment

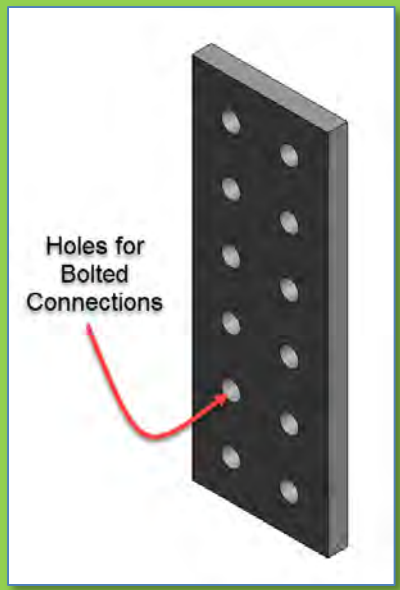
Splice Plates

- Used for vertical connections from column to column
- Holes allow for bolted connections









Prof. Paul C. King

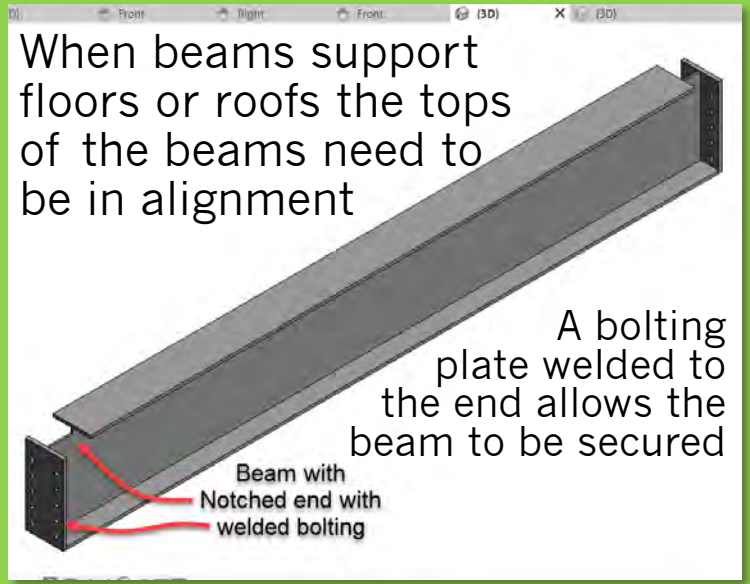
Day 05
Connection Details

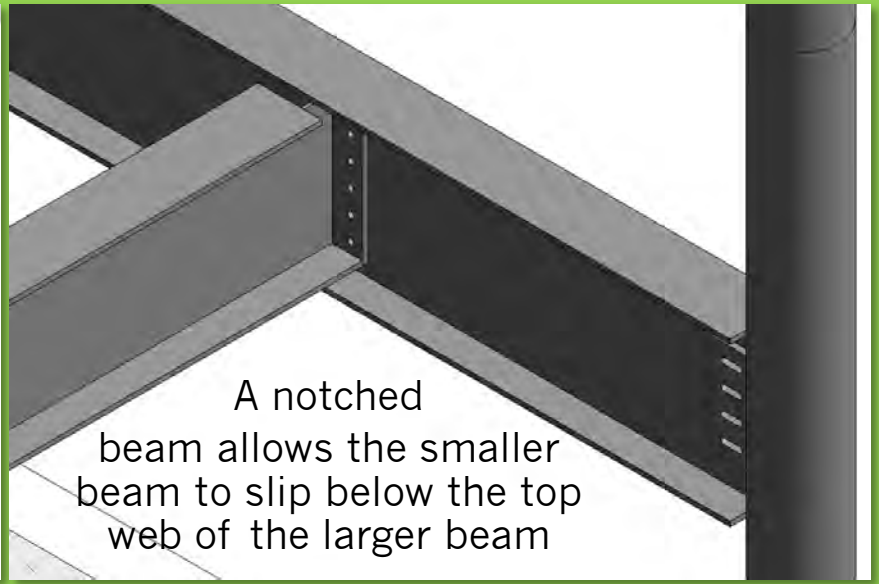
- New 3D Families
  - W24 x 162 with Baseplate
  - Independent Baseplate
- Connections
  - Videos
  - Detail Drawings
  - Photos
  - Bolts & Screws
- Concrete Footing
  - Cone Shaped Void
  - Threaded Rod
  - Nut & Washers
  - Assemble
  - Load into Project
- Add Slab
- Develop Details
- Fin & Splice Connections
- Notched Beam to Beam
- Project File Sheet
- Assignment Next Steps

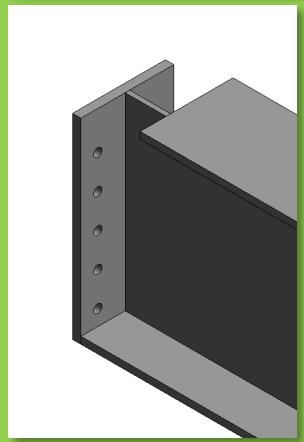
Building Technology III

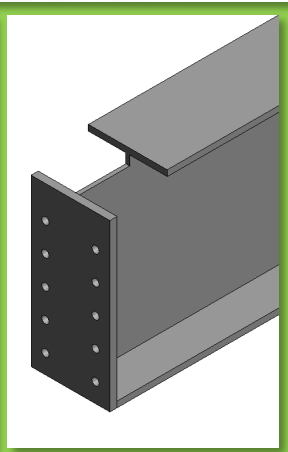
CityTech.CUNY.edu

Notched Beam with Bolting Plate









Use W 18 x 119 Notched Beam with Bolting plate

Designation 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_f/ft)	Static Parameters: Moment of Inertia I_x (in^4)	Moment of Inertia I_y (in^4)	Elastic Section Modulus S_x (in^3)	Elastic Section Modulus S_y (in^3)
W 27 x 178	27.8	14.09	0.725	1.190	52.3	178	6990	555	502	78.8
W 27 x 161	27.6	14.02	0.660	1.080	47.4	161	6280	497	455	70.9
W 18 x 119	19	11.27	0.655	1.060	35.1	119	2190	253	231	44.9
W 18 x 106	18.7	11.2	0.590	0.940	31.1	106	1910	220	204	39.4
W 18 x 97	18.6	11.15	0.535	0.870	28.5	97	1750	201	188	36.1

Depth = 19” **Width=11.27**
Web .655” **Flange = 1.060”**

Prof. Paul C. King

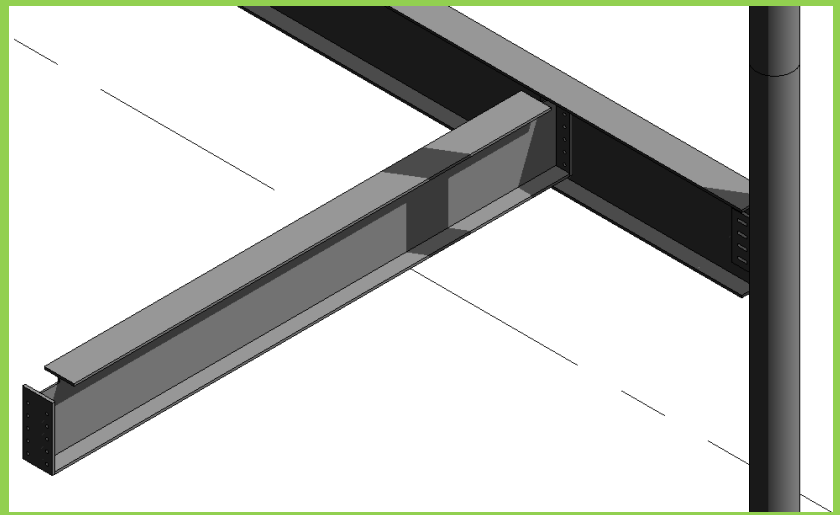
Day 05
Connection Details

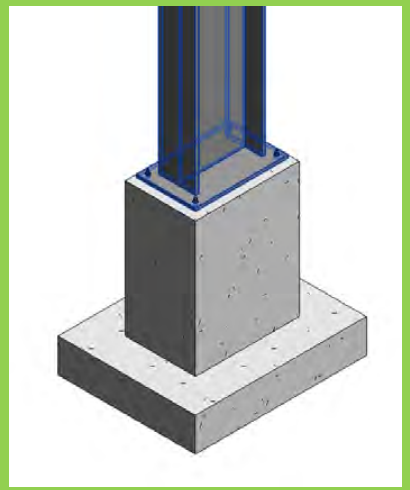
- New 3D Families
  - W24 x 162 with Baseplate
  - Independent Baseplate
- Connections
  - Videos
  - Detail Drawings
  - Photos
  - Bolts & Screws
- Concrete Footing
  - Cone Shaped Void
  - Threaded Rod
  - Nut & Washers
  - Assemble
  - Load into Project
- Add Slab
- Develop Details
- Fin & Splice Connections
- Notched Beam to Beam
- Project File Sheet
- Assignment Next Steps

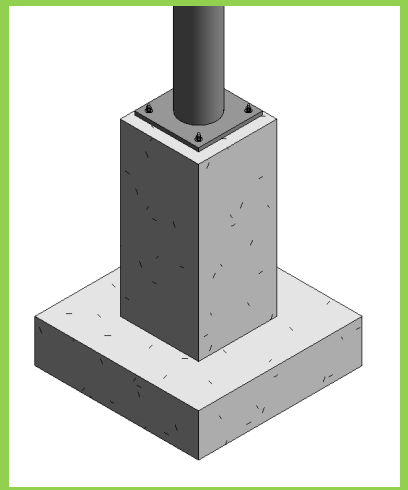
Building Technology III

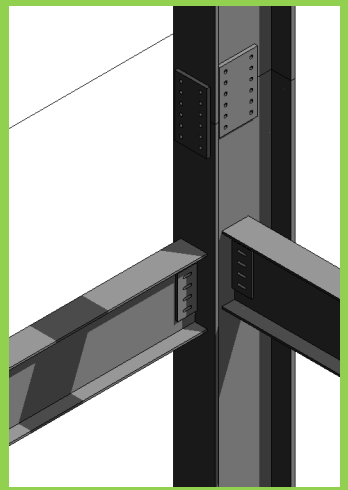
CityTech.CUNY.edu

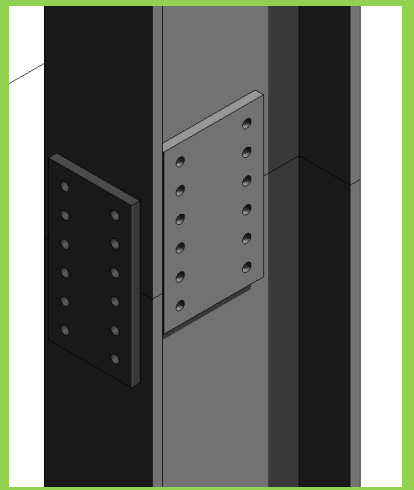
Isometric Views of the Project File











Prof. Paul C. King

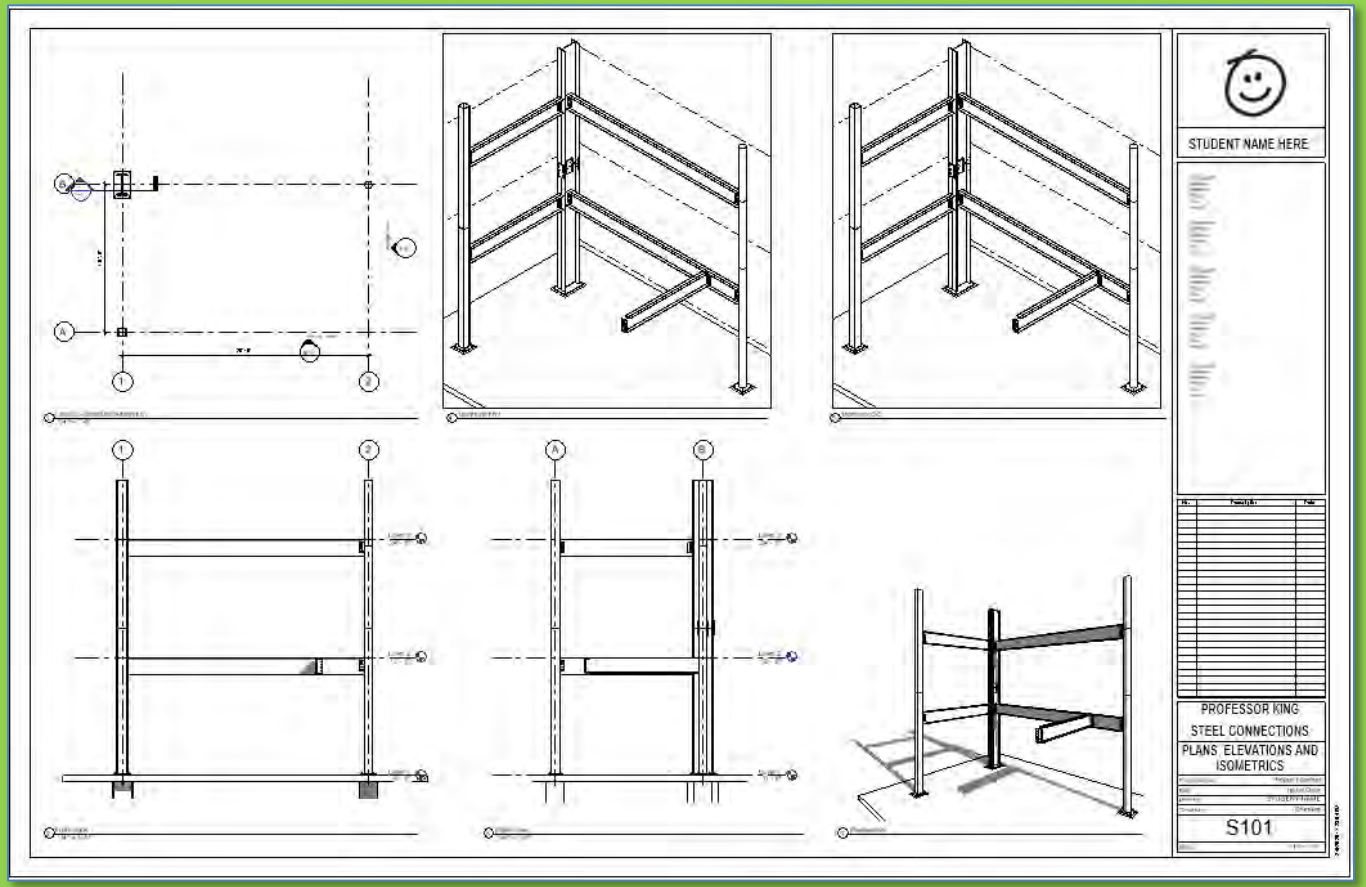
Day 05
Connection Details

- New 3D Families
  - W24 x 162 with Baseplate
  - Independent Baseplate
- Connections
  - Videos
  - Detail Drawings
  - Photos
  - Bolts & Screws
- Concrete Footing
  - Cone Shaped Void
  - Threaded Rod
  - Nut & Washers
  - Assemble
  - Load into Project
- Add Slab
- Develop Details
- Fin & Splice Connections
- Notched Beam to Beam
- Project File Sheet
- Assignment Next Steps

Building Technology III

CityTech.CUNY.edu

Updated Sheet - Add Additional Sheets



- Create additional sets of 4 views of connections & develop details
- Annotate with Notes & Leaders, Dimensions, Hatch & Detail Items

ARCH 2431. Building Technology III

Building Information Modeling with Revit
Day 05

Steel Connections Details Assignment
Column Base Plates, Beam Connections

Professor Paul C. King, RA, AIA, ARA

Prof.Paul.King@Gmail.com

Pking@CityTech.Cuny.Edu