Bracing Systems

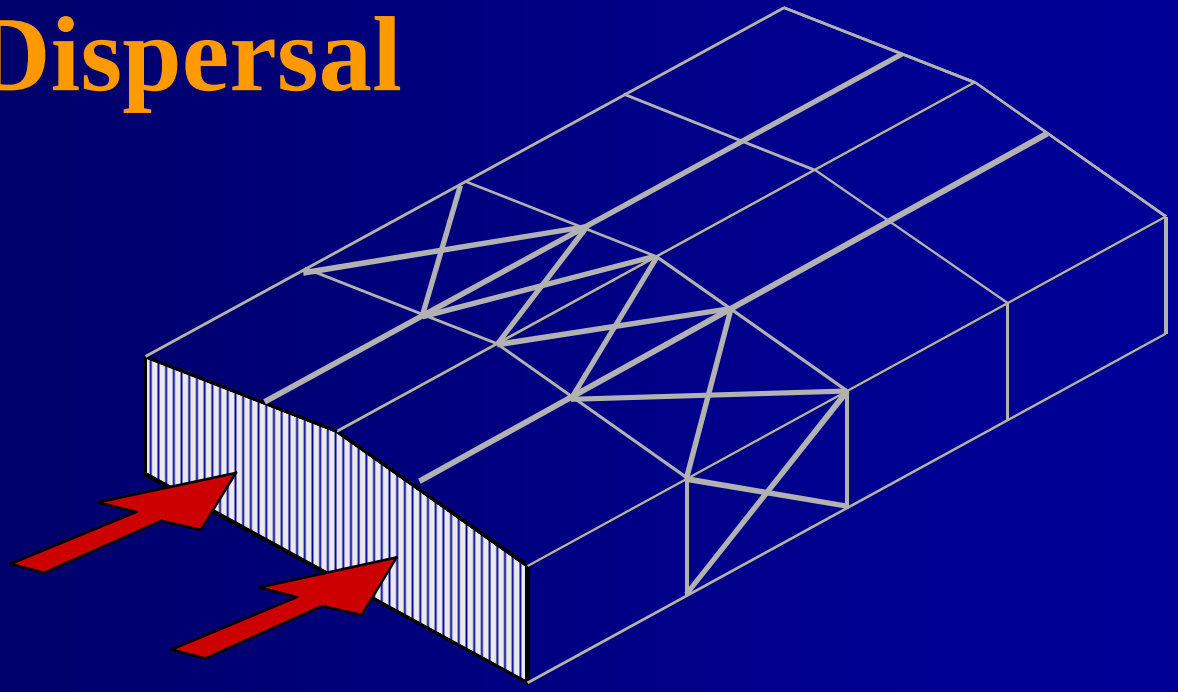
Rod Bracing

Wind Bracing Systems

HOW BRACING WORKS

Wind Bracing Systems

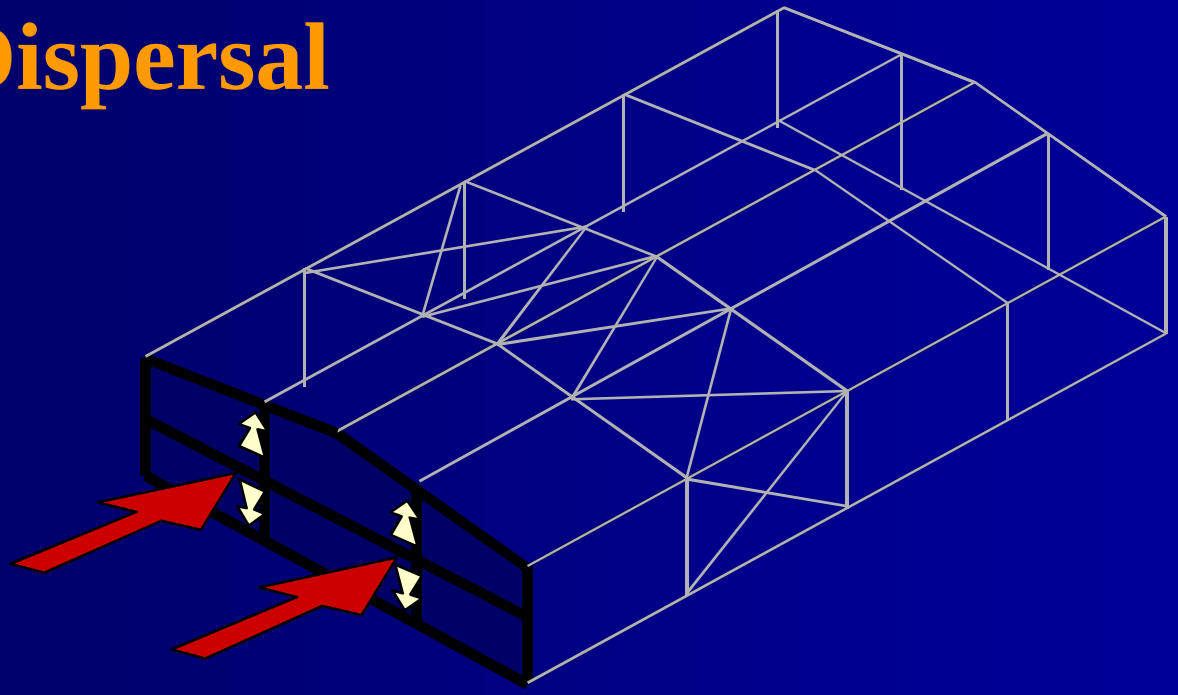
Load Dispersal



The WIND load on Endwall panels...

Wind Bracing Systems

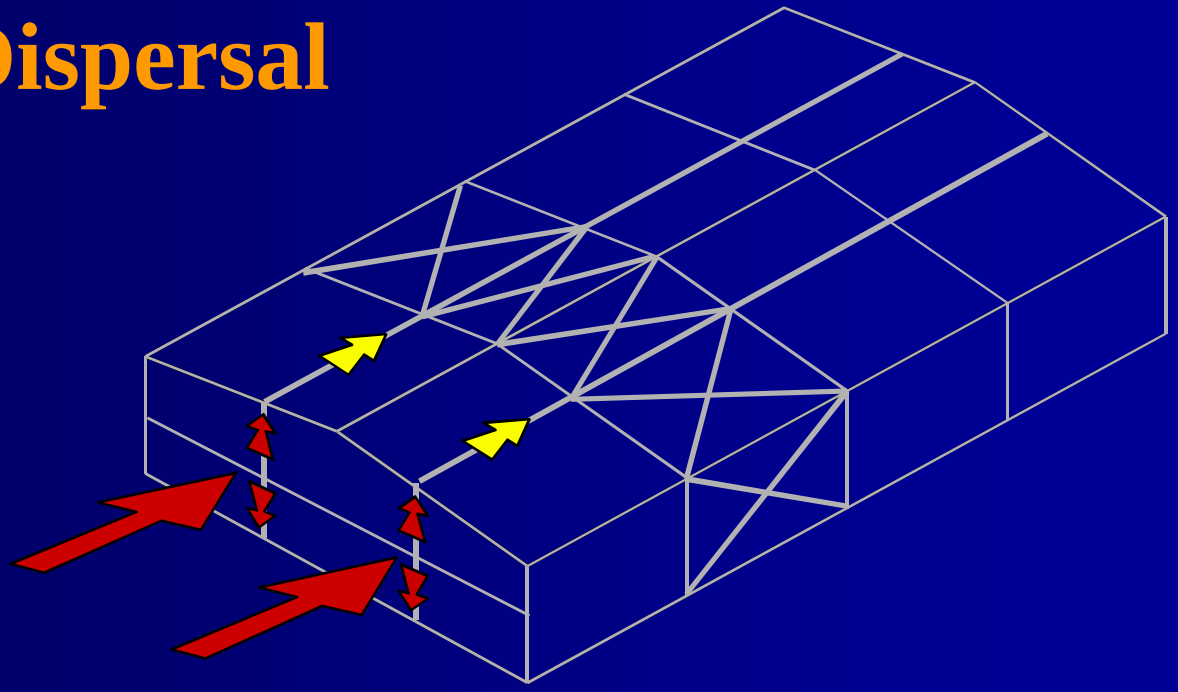
Load Dispersal



is dispersed through Endwall framing...

Wind Bracing Systems

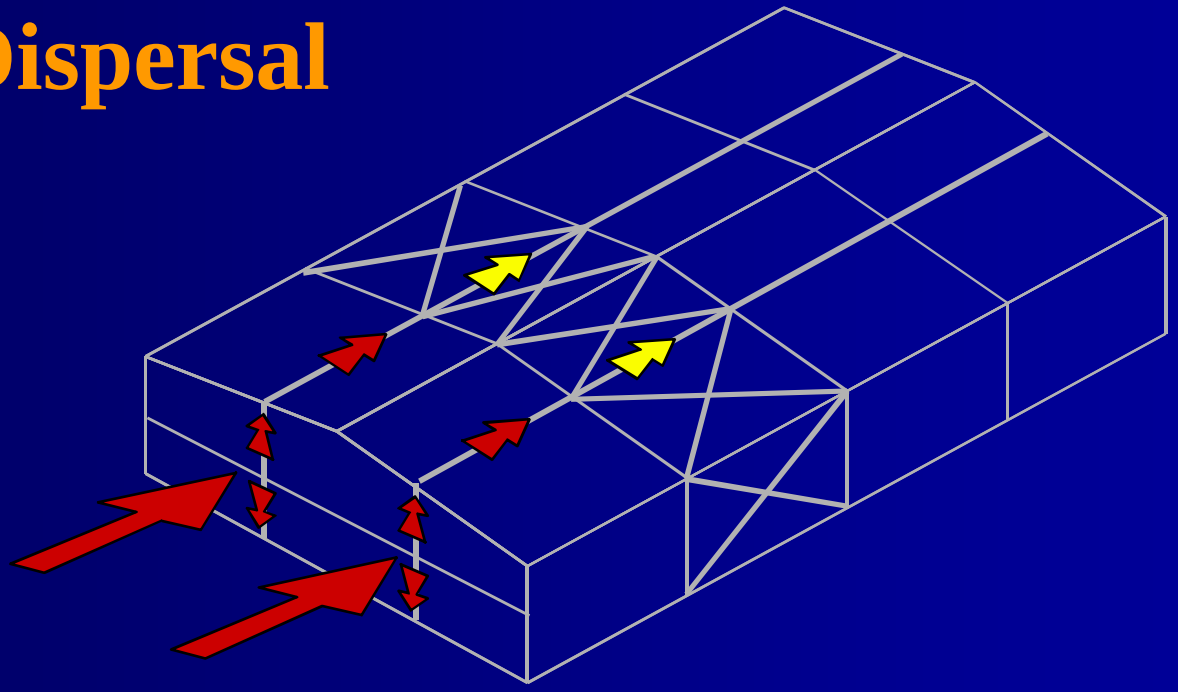
Load Dispersal



into the Continuous Purlin system.

Wind Bracing Systems

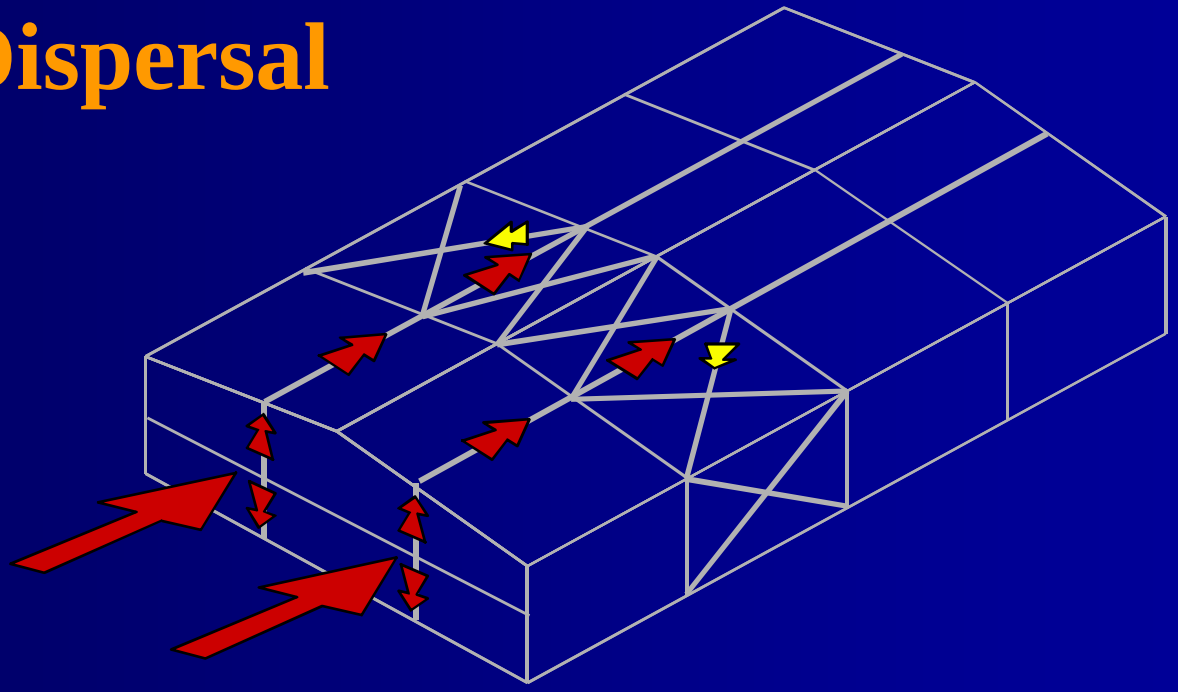
Load Dispersal



The Purlins transfer the load...

Wind Bracing Systems

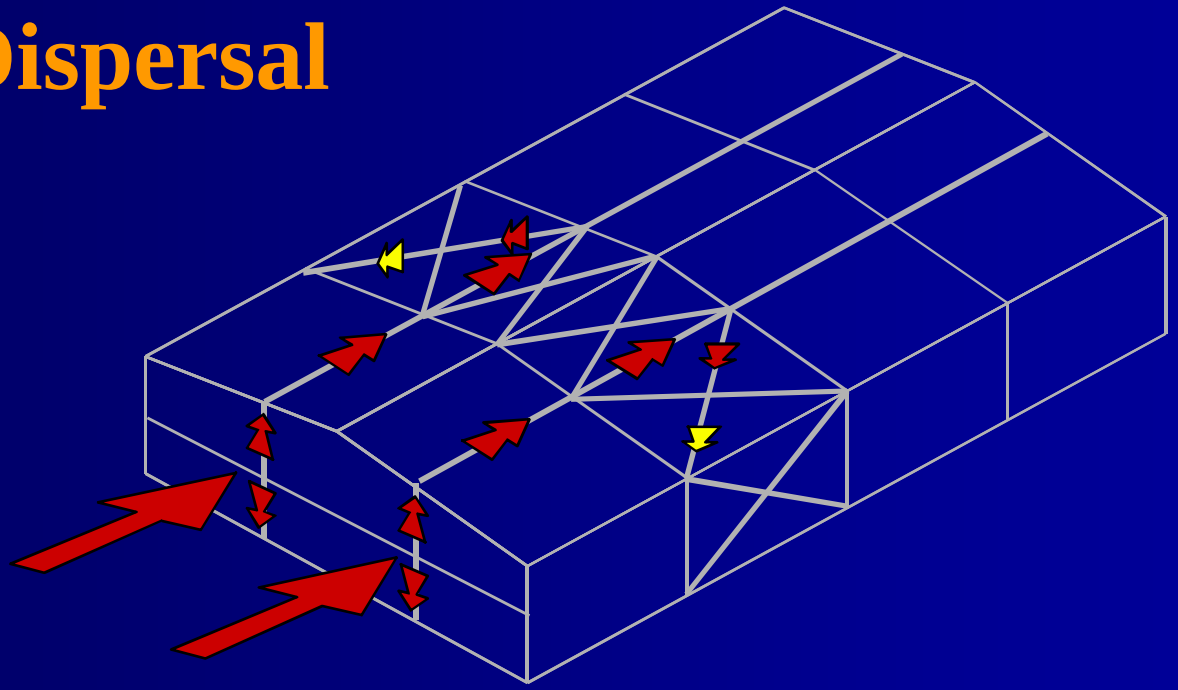
Load Dispersal



into the roof Brace Rods.

Wind Bracing Systems

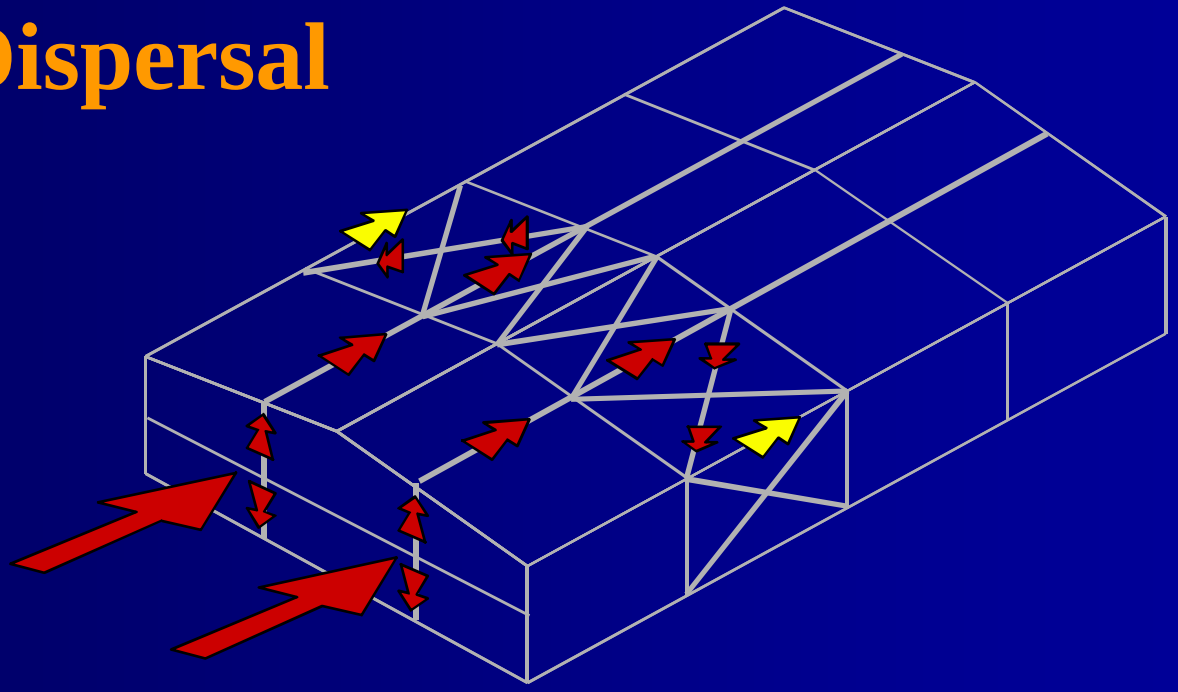
Load Dispersal



The load travels through the Roof bracing...

Wind Bracing Systems

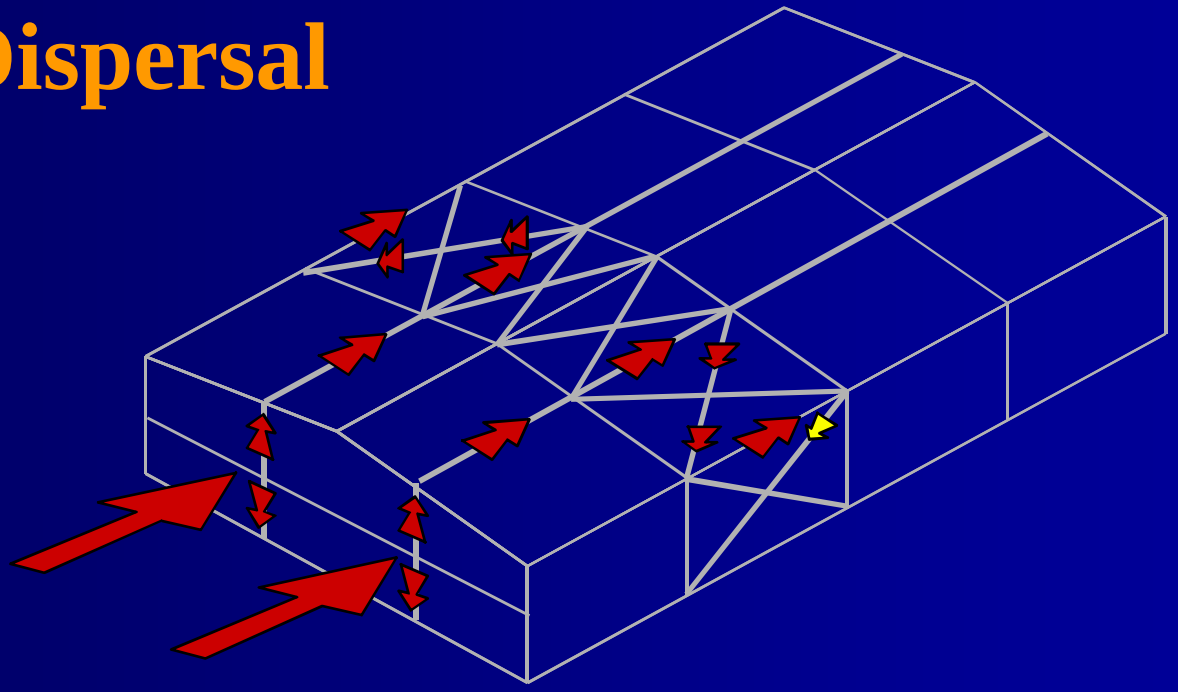
Load Dispersal



through the Eave Purlin ...

Wind Bracing Systems

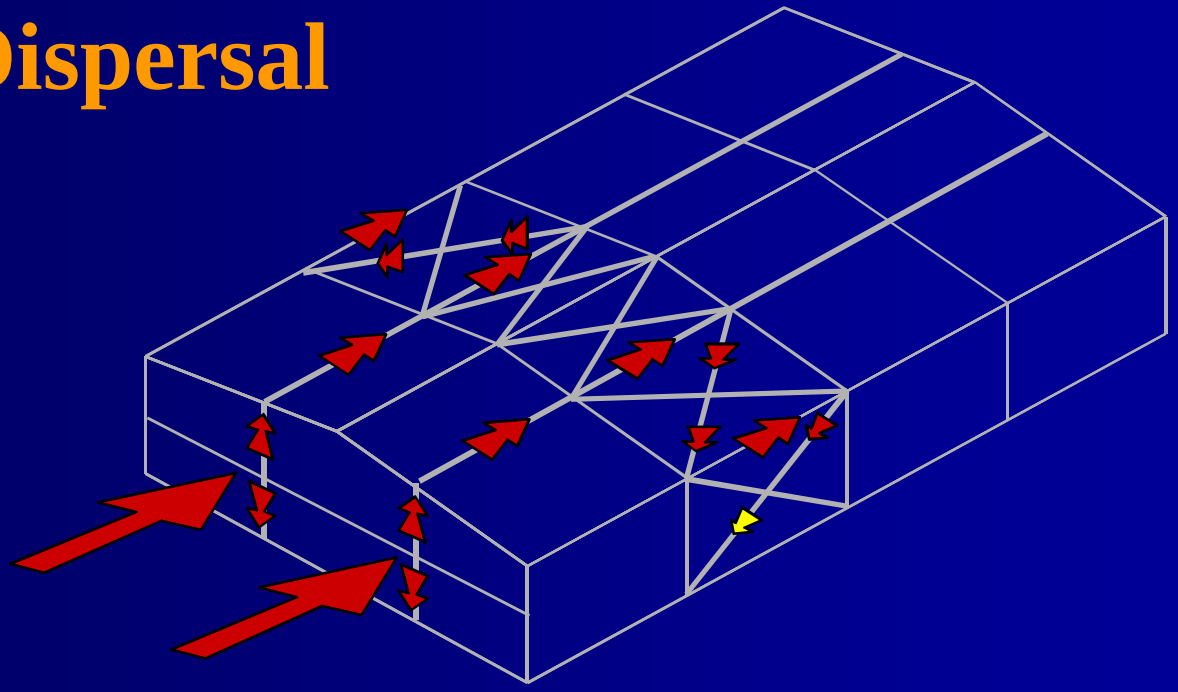
Load Dispersal



to the wall Diagonal Bracing ...

Wind Bracing Systems

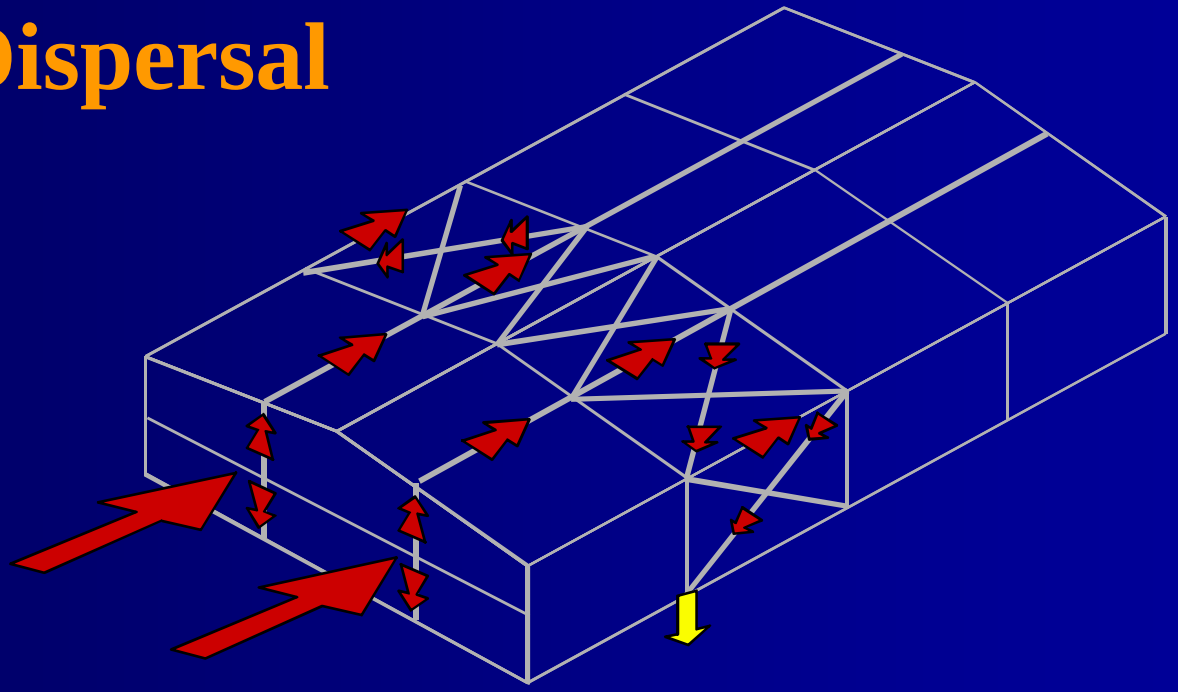
Load Dispersal



...(or auxiliary bracing)...

Wind Bracing Systems

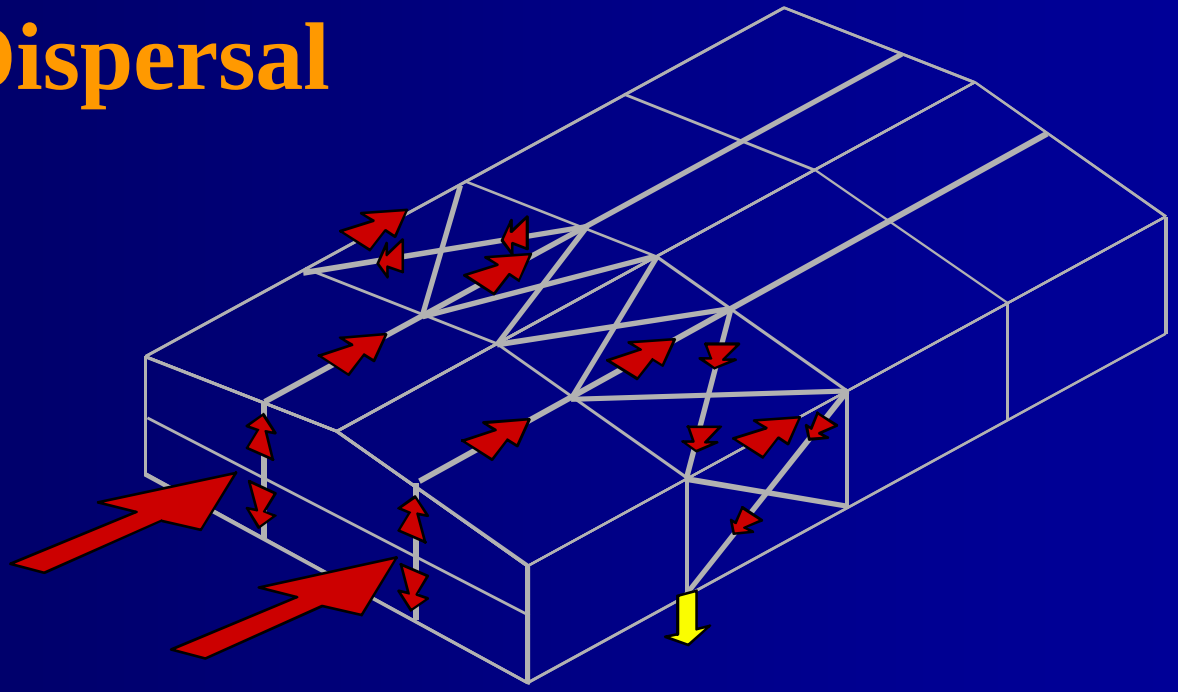
Load Dispersal



into the Building's foundation.

Wind Bracing Systems

Load Dispersal



into the Building's foundation.

Transverse (Perpendicular to Sidewall)

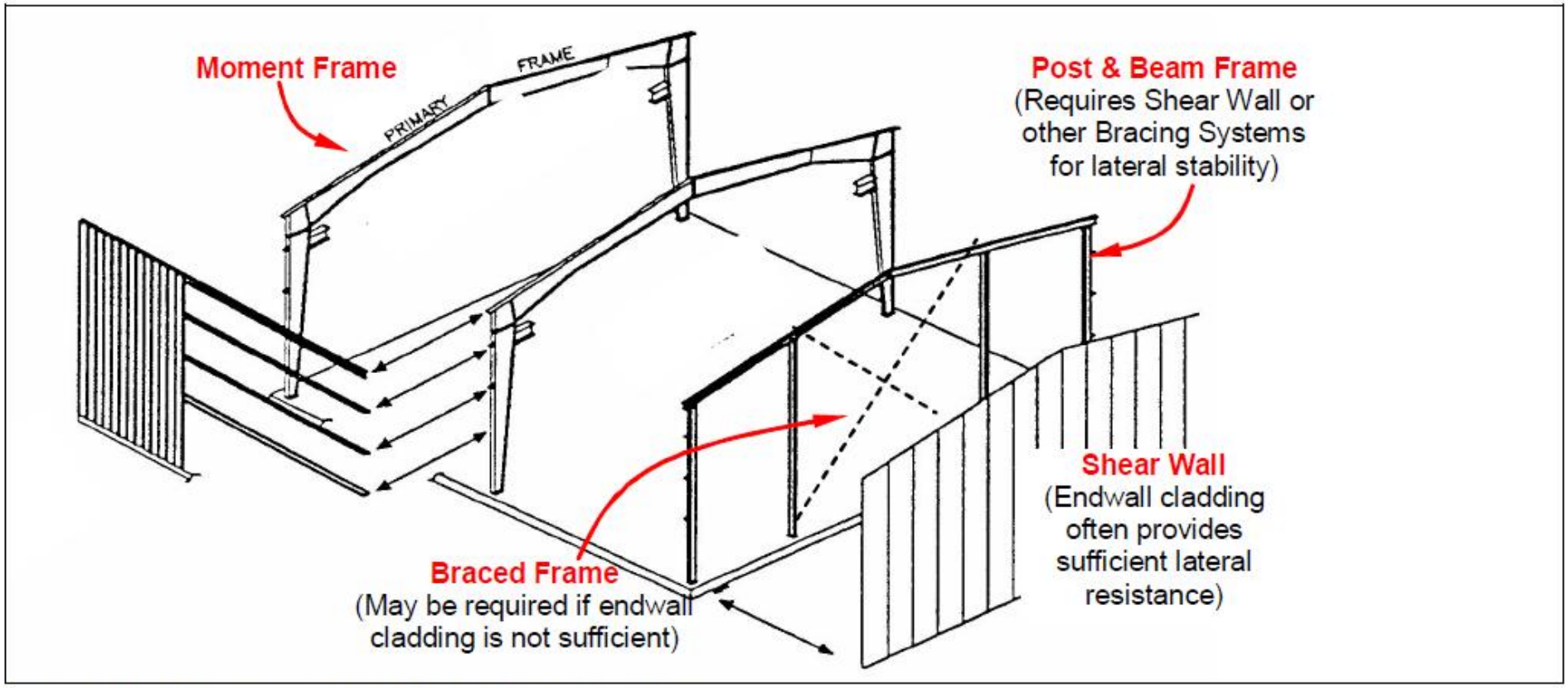


Figure 1 Transverse load resisting systems

Longitudinal (Perpendicular to Endwall)

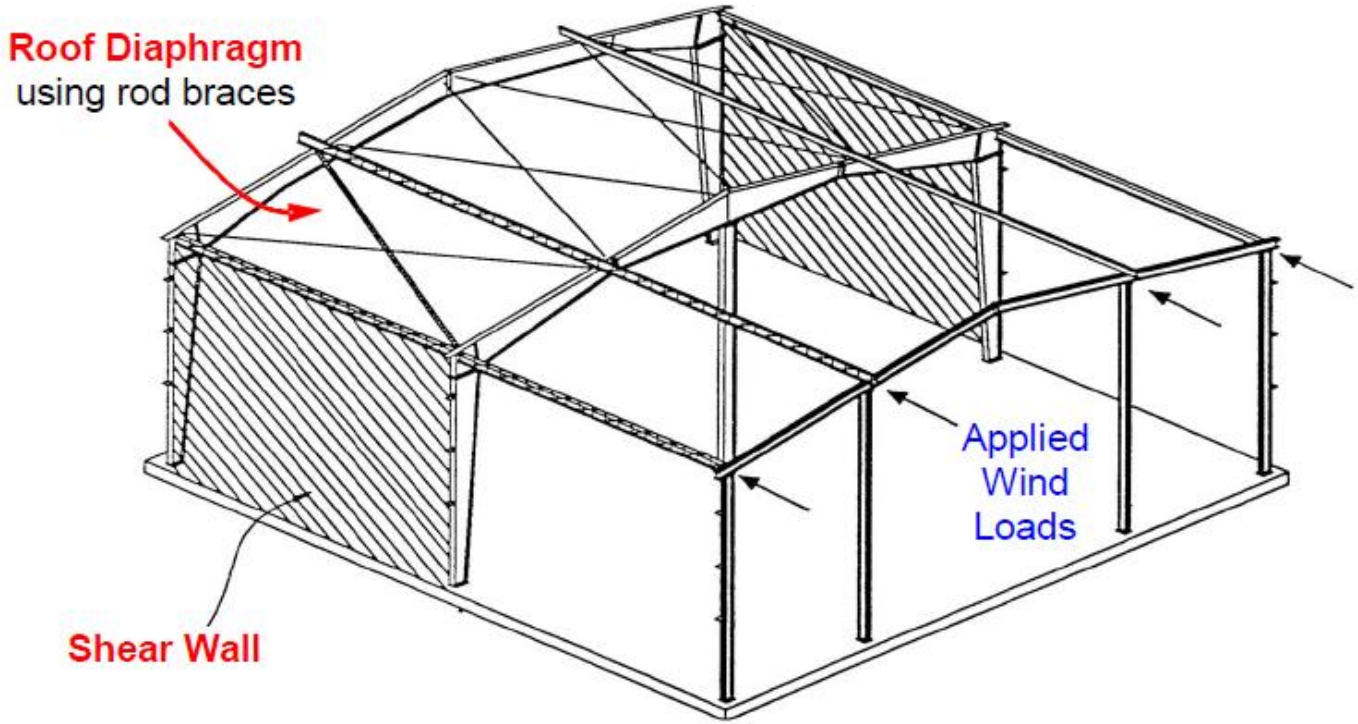
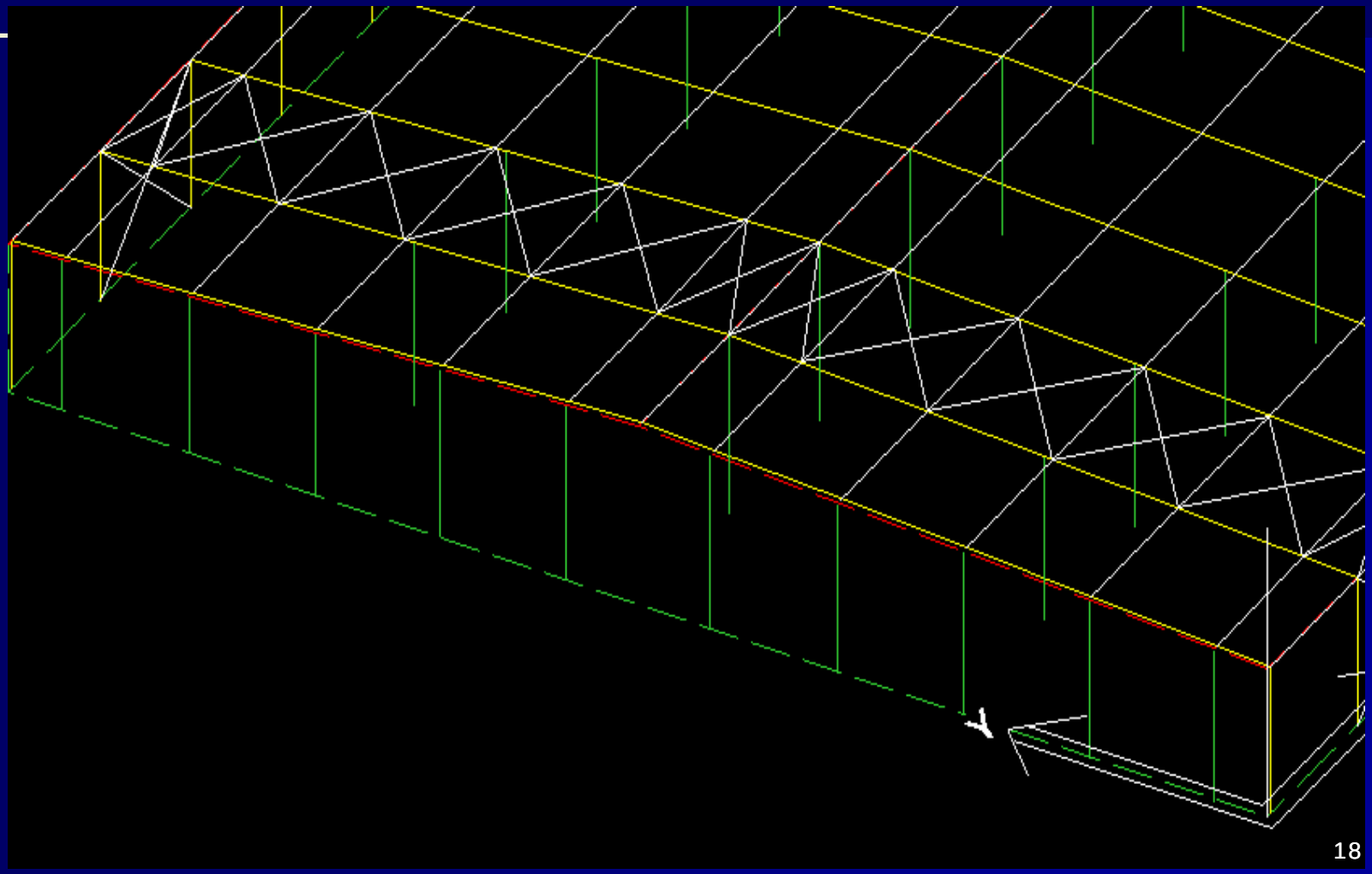


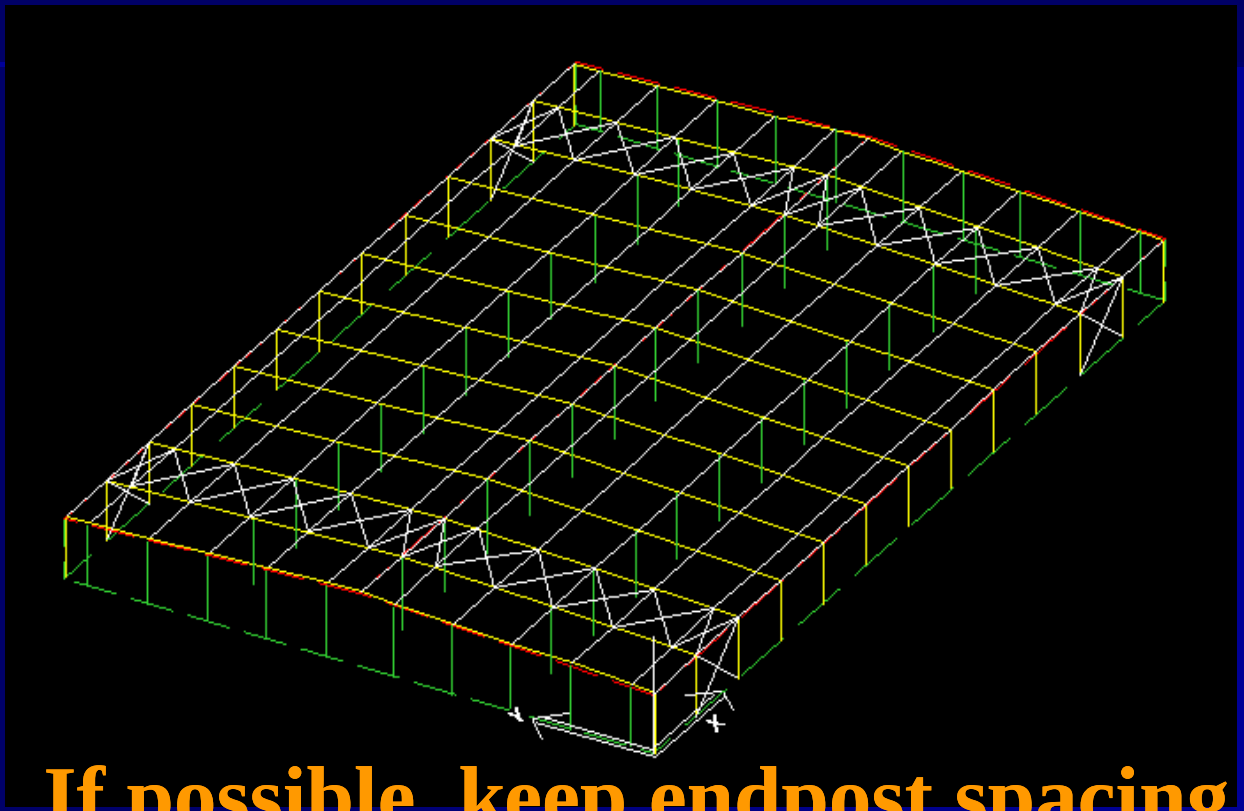
Figure 2 Longitudinal load resisting system

Standard EP Location

Roof Rods Break at Endpost(s)



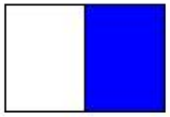
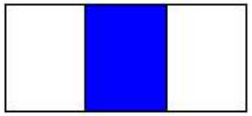
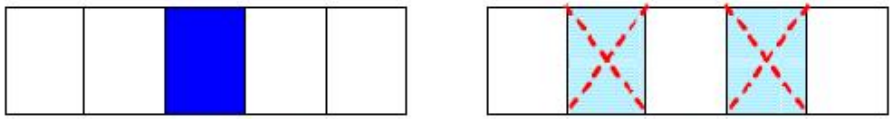
Wind Bracing



If possible, keep endpost spacing similar at each endwall for a more efficient bracing pattern.

Typical Rod Bracing Location

Table 2 Location of braced bays

Number of bays (n)	Braced Bays		Roof or Wall Plane
	Minimum (default)	Additional (if more than min. is required)	
< 3	any one		
3	middle		
4 - 7	middle	2, n-1	
8 - 12	2, n-1	3, n-2	
> 12	2, n-1	4, n-3	

Notes:

= Bay not braced

= Braced bay – primary locations. For available BBNA lateral-force resisting systems see DP 5.4. The same DP section also explains the permissible combinations of framing systems

= Braced bay location when additional bays of bracing are needed

Wind Bracing Systems

Standard Bracing Methods

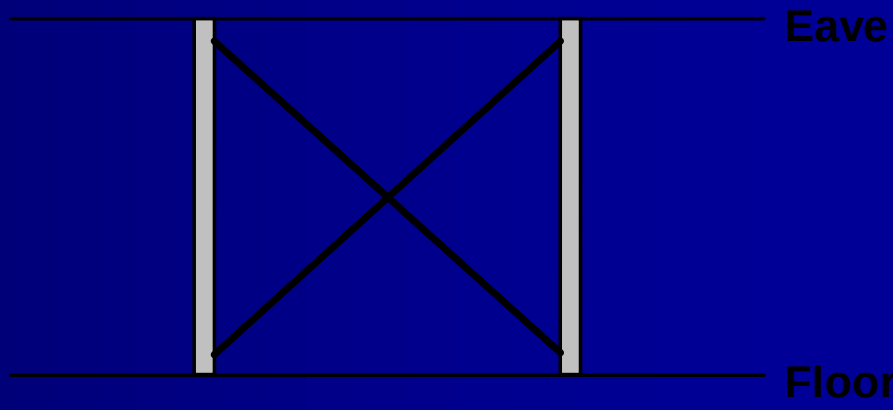
Diagonal Bracing

- VP standard bracing utilizes Diagonal Bracing in the Roof and Walls.
- The bracing design is determined by:
  - Building Loads & Code
  - Building Size
  - Building Location

Diagonal Rod Bracing

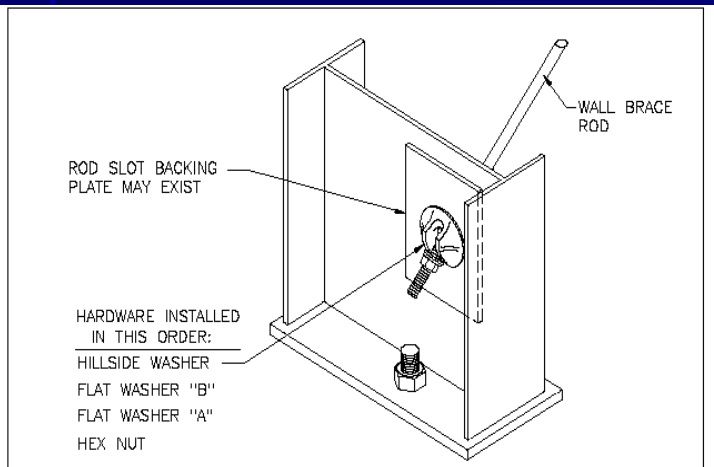
Notes about Diagonal Rod Bracing:

- Stiffest bracing system available
- Most economical bracing system



Diagonal Rods

Diagonal Rods

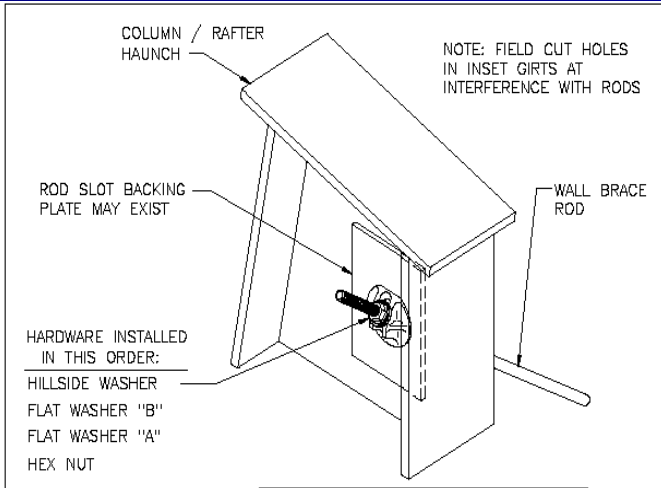


ROD DIA.	NUT	WASHERS A	WASHERS B	WASHERS HILLSIDE
3/8"	095321	096408	46040	043657
1/2"	095230	095872	095946	043657
5/8"	095233	095945	095946	043657
3/4"	095235	095946	095948	043658
7/8"	095237	095947	095948	043658
1"	095238	095948	095949	043659
1 1/8"	095239	095949	095949	043659

REV. DATE: 05/10/10 | REV. NO. 01

BR02H1

ROD BRACING THRU ROD SLOT
COLUMN SHOWN / RAFTER SIMILAR



ROD DIA.	NUT	WASHERS A	WASHERS B	WASHERS HILLSIDE
3/8"	095321	096408	46040	043657
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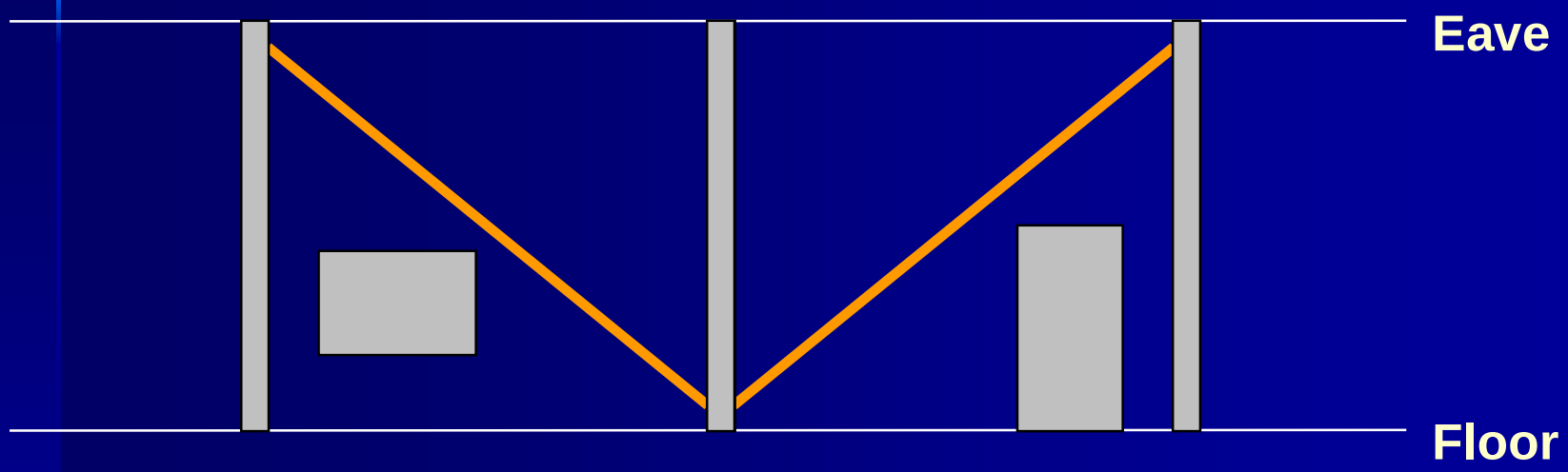
7/8"	095237	095947	095948	043658
1"	095238	095948	095949	043659
1 1/8"	095239	095949	095949	043659

REV. DATE: 05/10/10 | REV. NO. 02

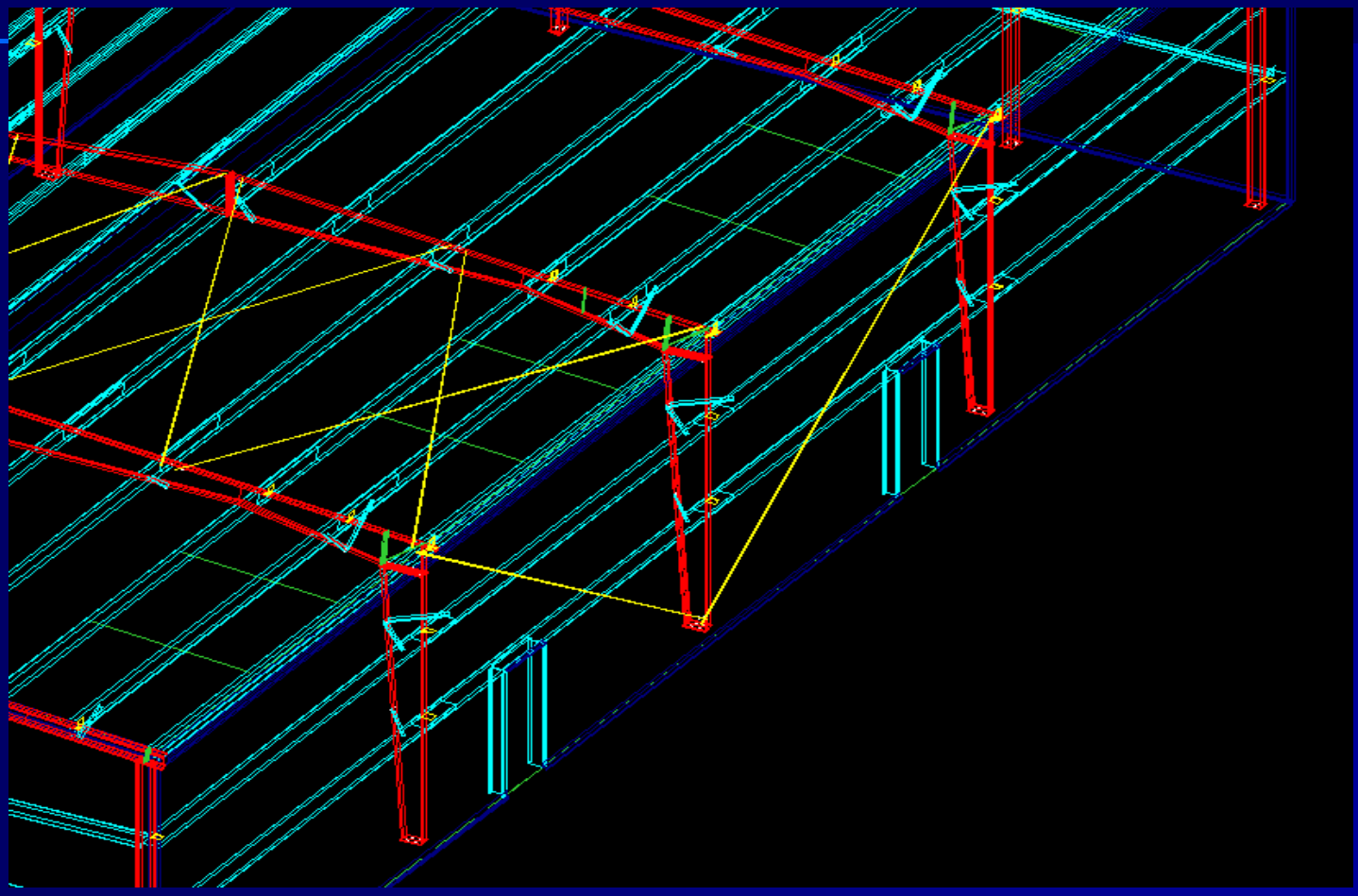
BR02J1

ROD BRACING THRU ROD SLOT
SIDEWALL COLUMN SHOWN / RAFTER SIMILAR

Diagonal Bracing Options (Rods)

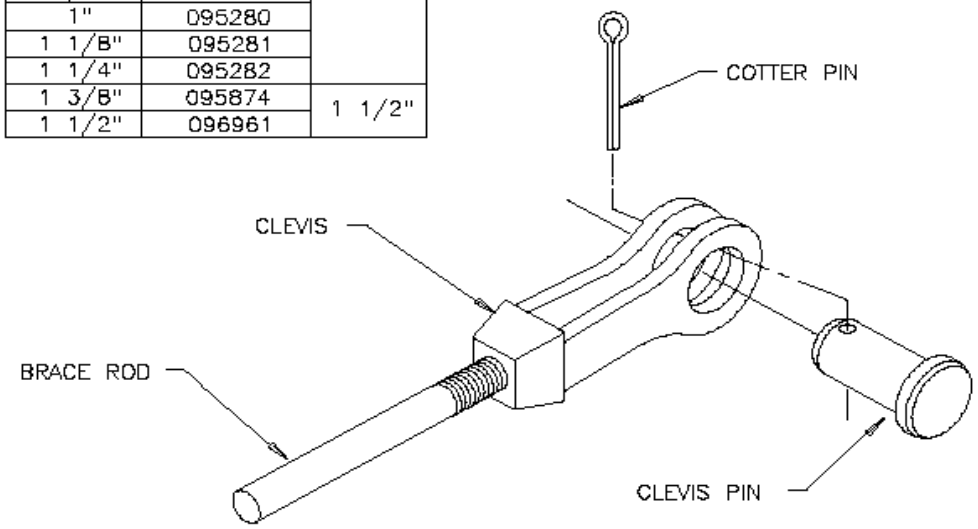


Alternate Diagonal Bracing



Rod Brace Assembly

ROD DIA.	CLEVIS MARK NO.	CLEVIS PIN DIA.
3/8"	097572	1 1/4"
1/2"	097573	
5/8"	095277	
3/4"	095278	
7/8"	095279	
1"	095280	
1 1/8"	095281	
1 1/4"	095282	
1 3/8"	095874	1 1/2"
1 1/2"	096961	



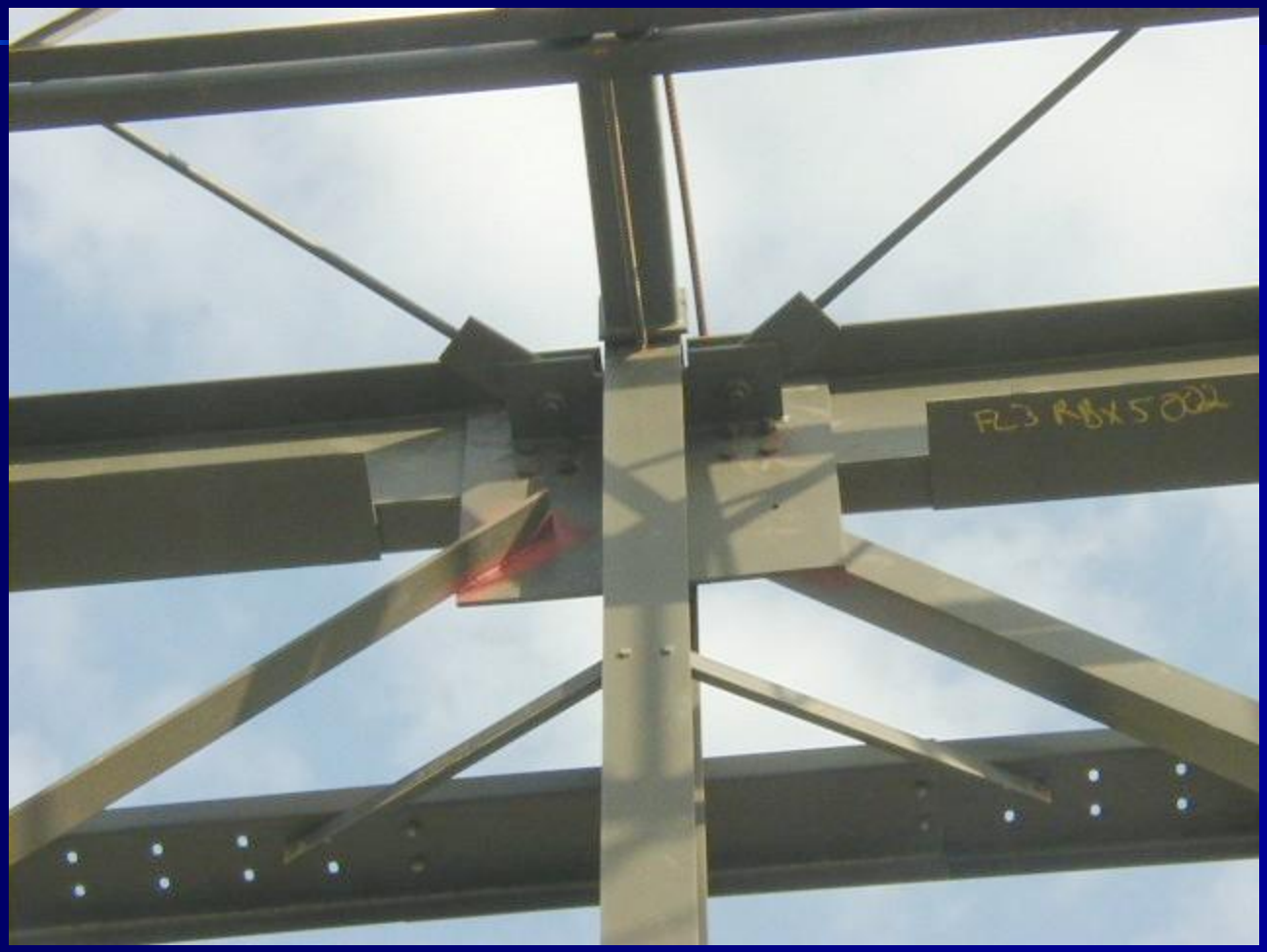
REV. DATE: 06/08/10	REV. NO. 01	ROD BRACING CLEVIS ASSEMBLY
BR02K1		

Coupling Nuts

Angle Bracing

- Bracing may be single rods or angles depending upon loading/design

Angle Bracing



Angle Bracing

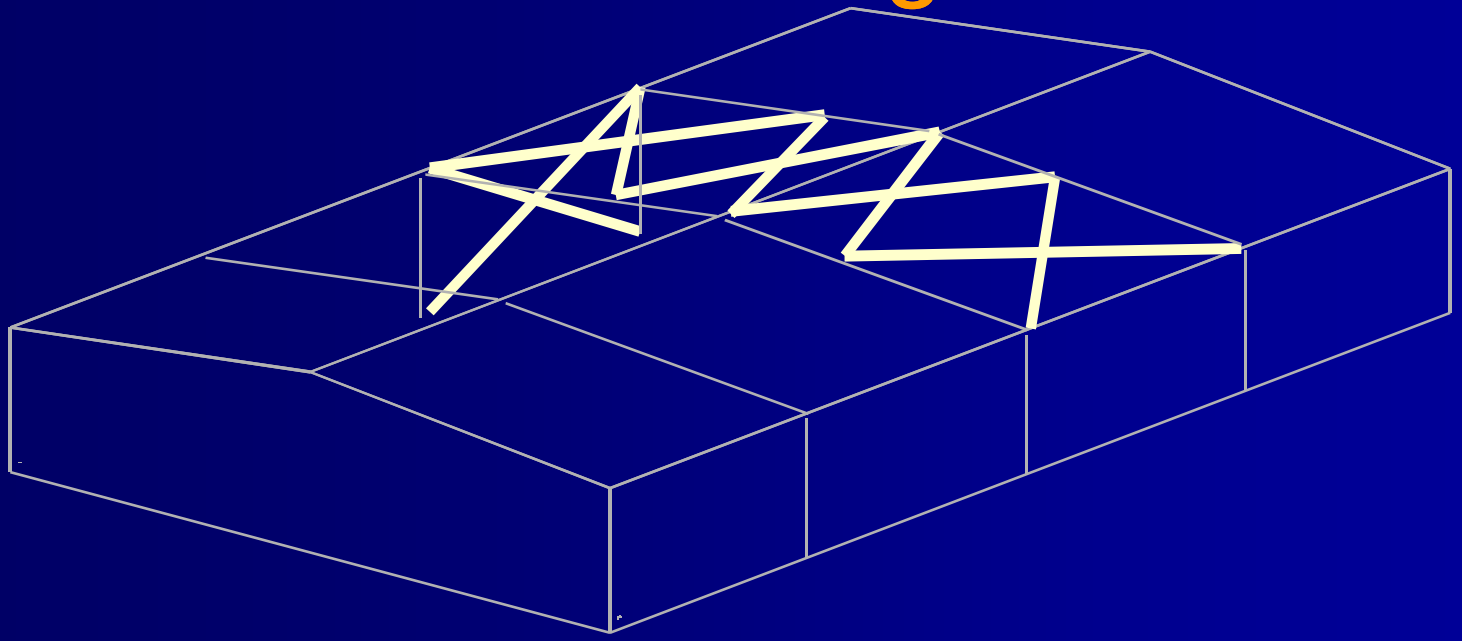
Angle Bracing

Wind Bracing Systems

Alternative Bracing Methods

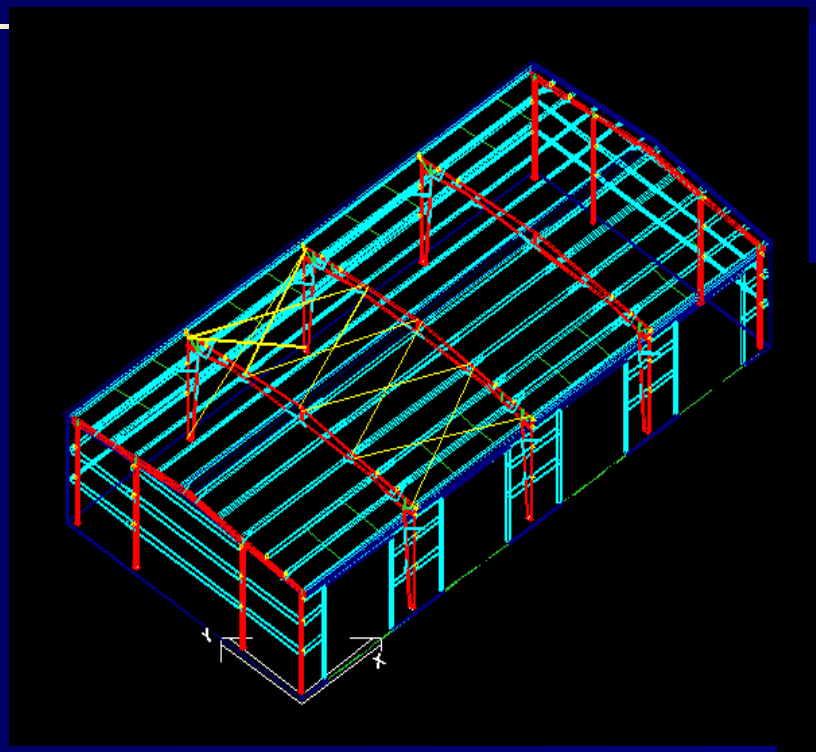
Alternative Bracing Methods

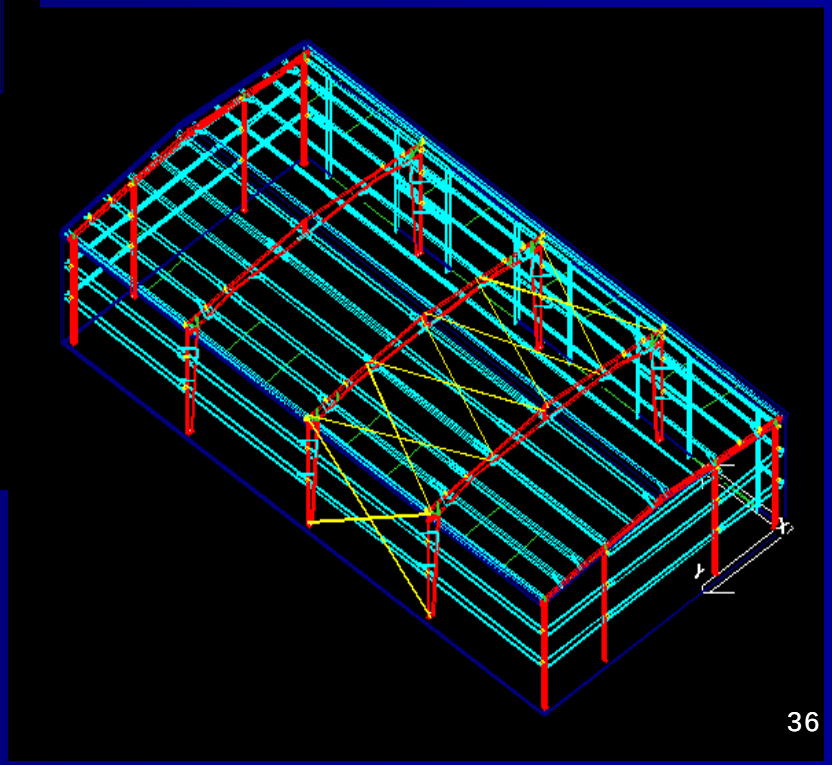
Torsional Bracing



Rods are omitted from one sidewall.

Torsional Bracing





No Torsional Allowed if...

Torsion bracing Geometry/Environmental Limitations:

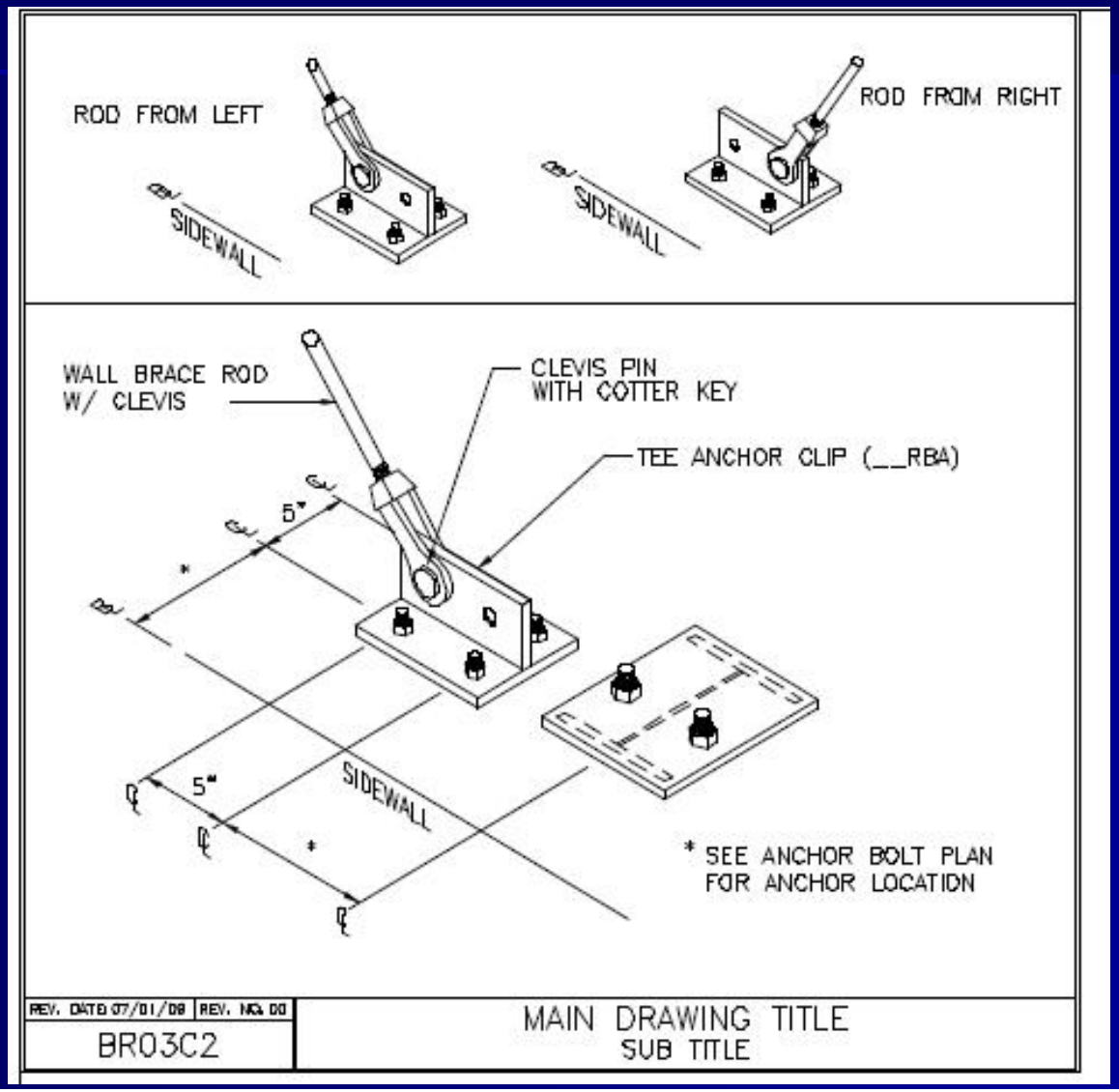
- Non-rectangular shape (maximum of 4 walls)
- Span exceeds 50 ft.
- Eave height exceeds 16 ft.
- Roof pitch exceeds 1:12
- Have less than 3 bays
- Portal braces
- Portal frames
- Cantilevered columns (fixed base wind posts)
- Partial height rods
- Have lean-to frames
- Has a mezzanine
- Has a crane
- Brittle finishes
- Facades
- Wind speed exceeds 110 mph
  - For Canadian jobs: Basic wind pressure exceeds 32 psf
- High Seismic Applications (IBC/ASCE: SDC D, e or F).
  - For Canadian jobs: $I_E F_a S_{a(0.2)} > 0.35$, and all post-disaster buildings

Alternative Bracing Methods

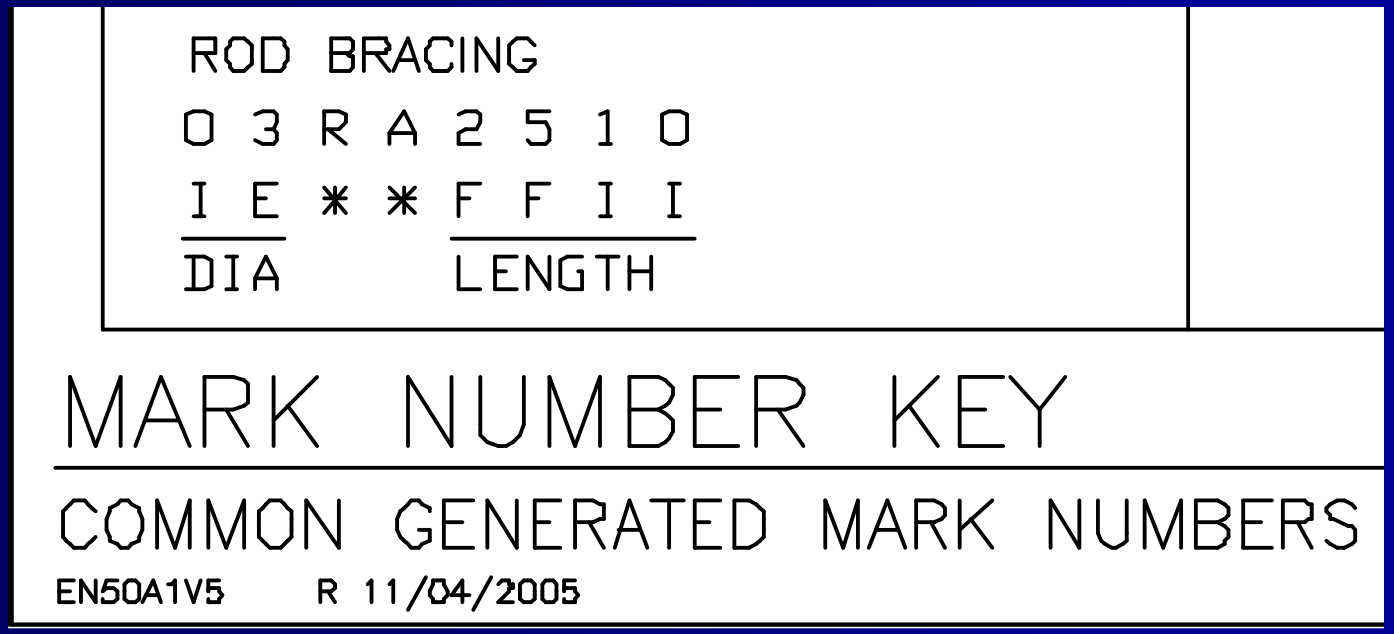
Notes About Torsional Bracing

- Inexpensive
- Maximum building width of 50’
- Maximum eave height of 18’
- 100 mph maximum wind speed
- Minimum 3 bays
- *Call your Service Center if close to these parameters*

Rod Brace to Floor

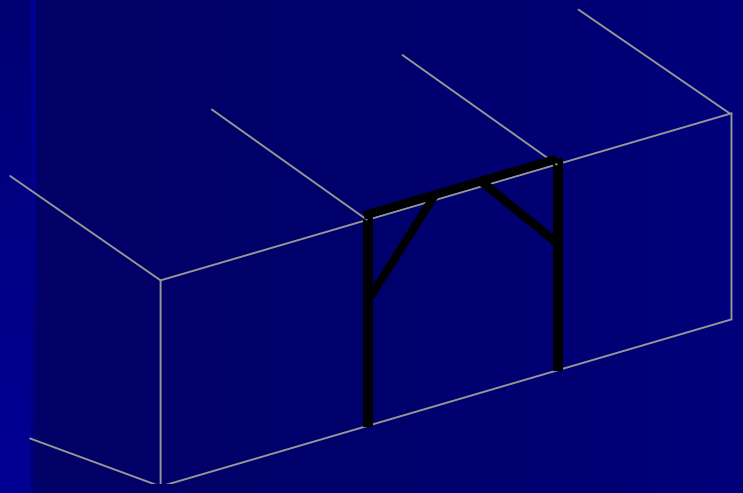


Rod Mark Numbers



Alternative Bracing Methods

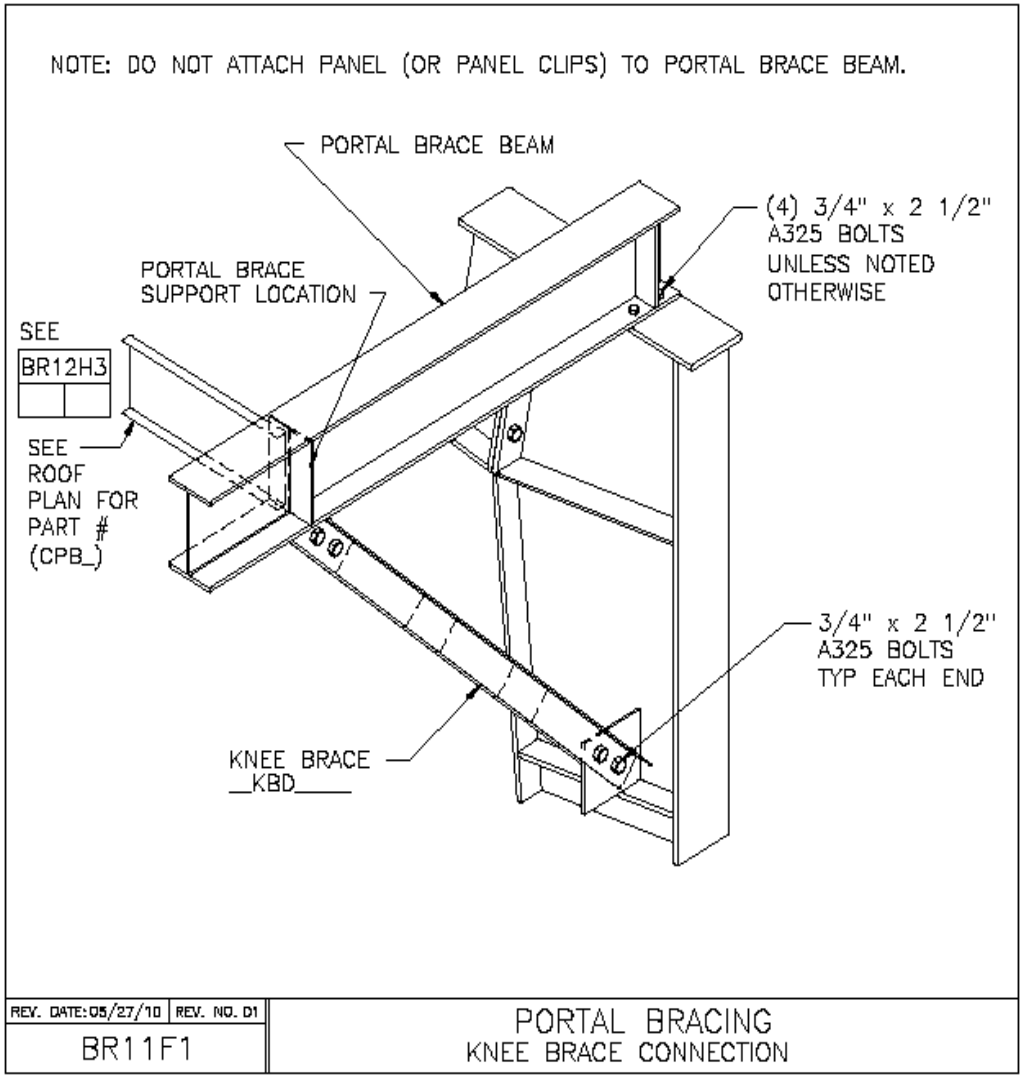
Portal Bracing



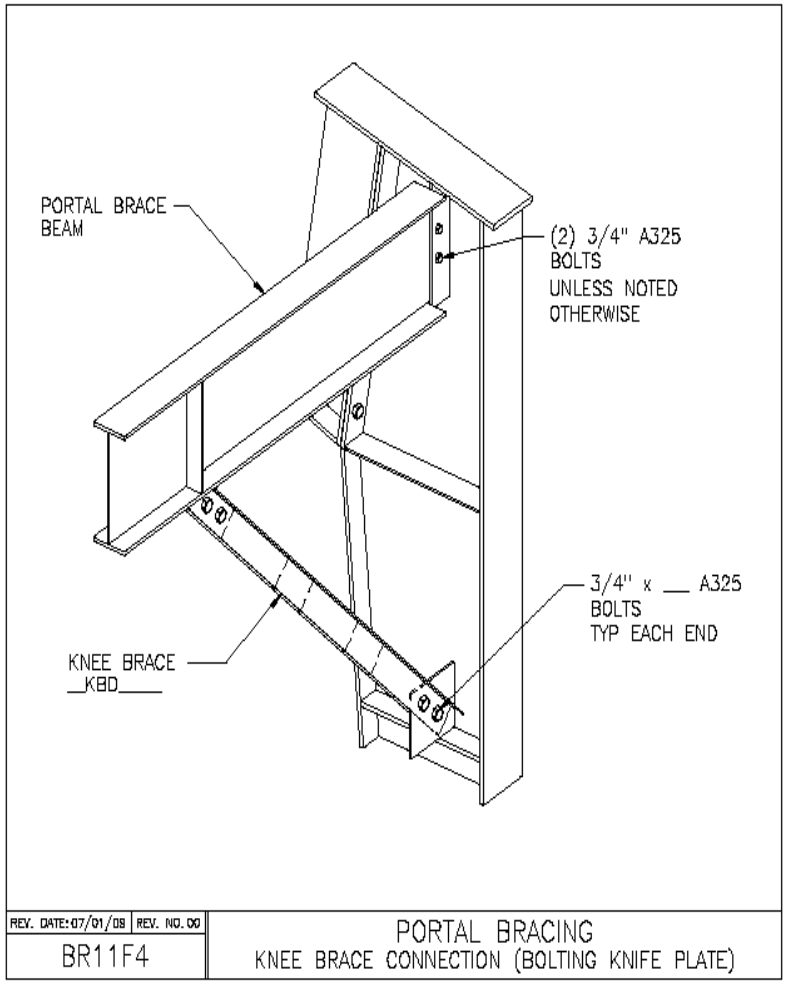
Portal Brace Includes:

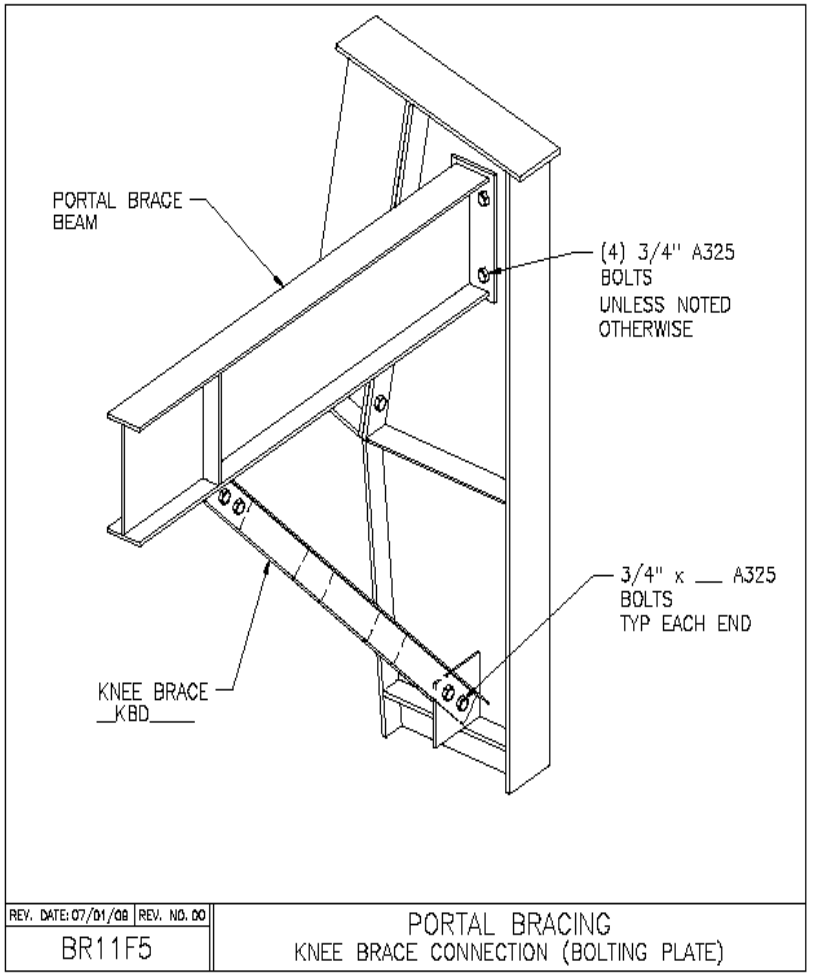
- Portal Beam
- Knee Braces
- Additional column support

Portal Bracing



Portal Bracing



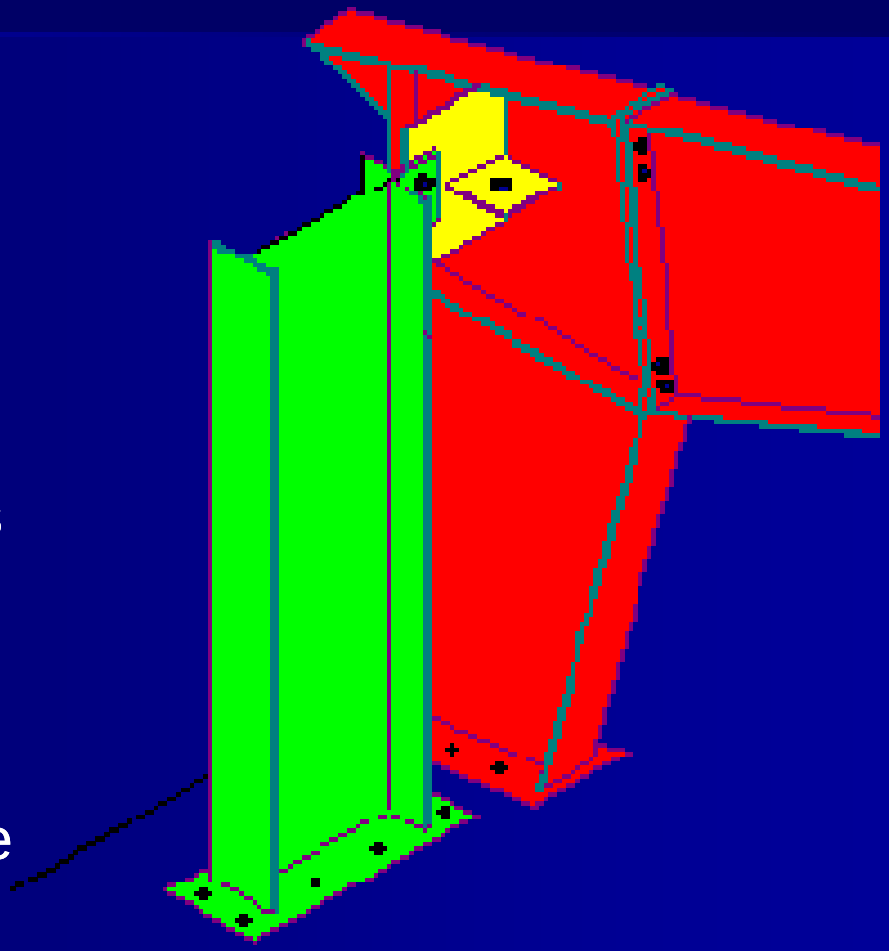


Bracing-Wind Posts

Bracing

New Bracing Option

- Fixed Base Wind Post (with automated Wind Post Base Plate Design)
- Use at sidewalls or endwalls
- 35’-0” max. eave height
- Max. 24” column depth
- Connection at main frame is similar to that of portal frame



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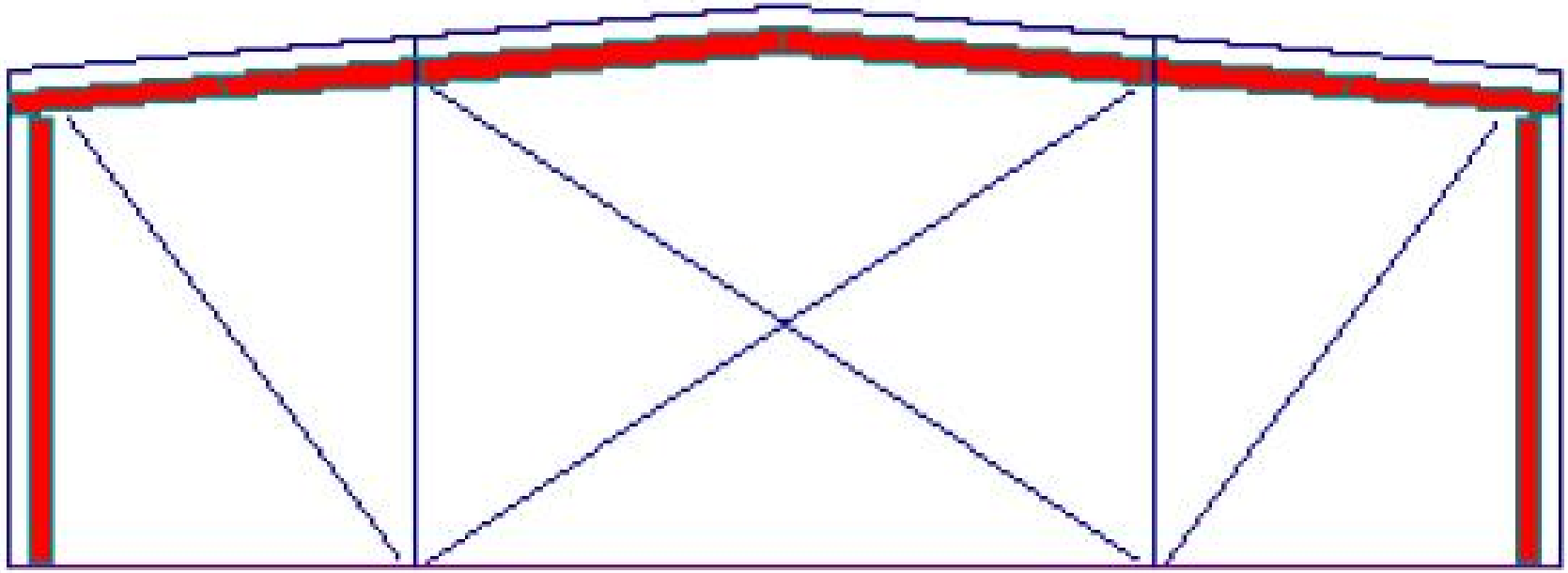
Post and Beam Stability

- Automated diaphragm check
- If fails Rods may automatically be designed
- Initially at interior bay
- Then at endbay

Post and Beam Stability



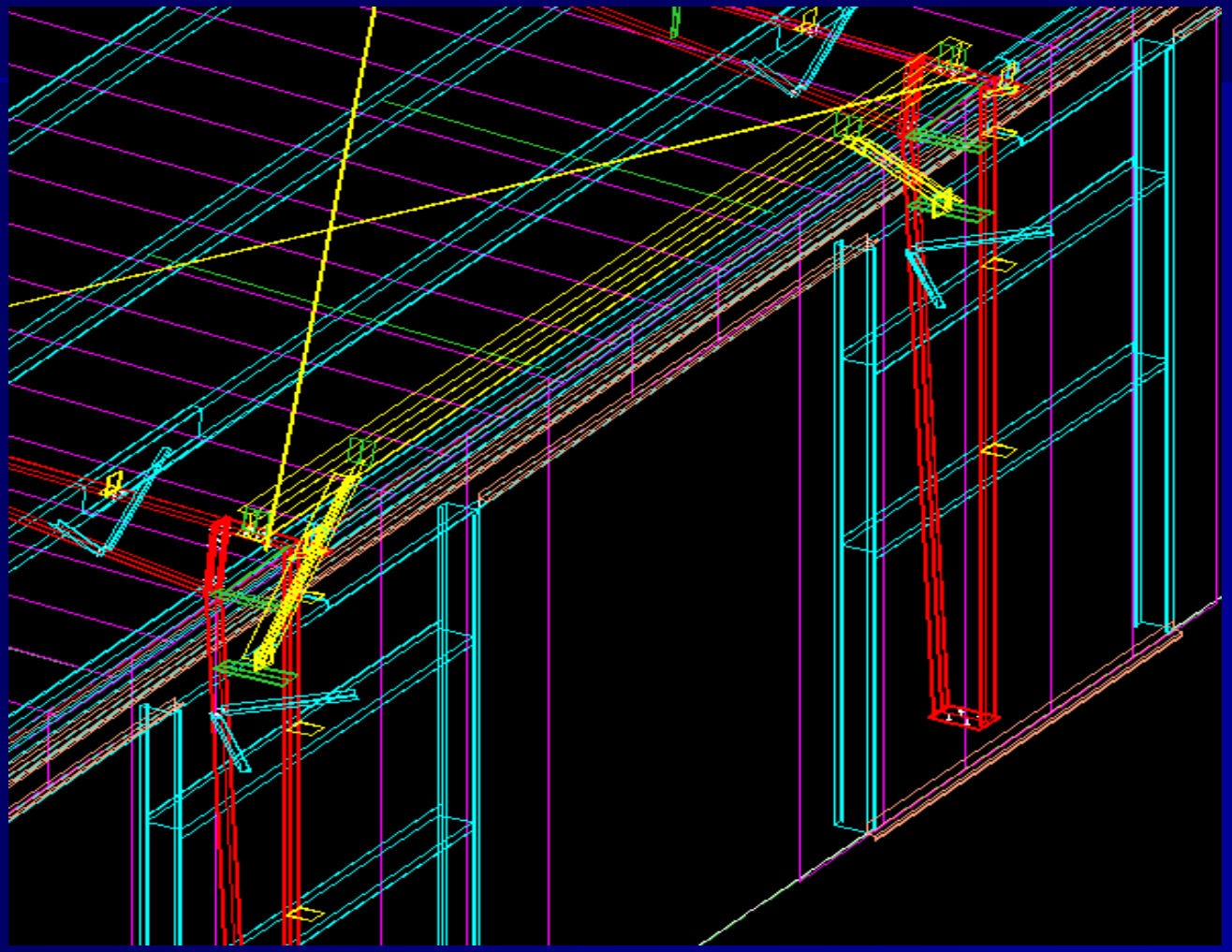
Alternative Bracing Methods

Notes About Portal Bracing

- More expensive than rod
- Flexible, not as stiff as diagonal bracing
- Maximum eave height of 20’
- Special clearances possible

Portal Bracing

Portal Bracing



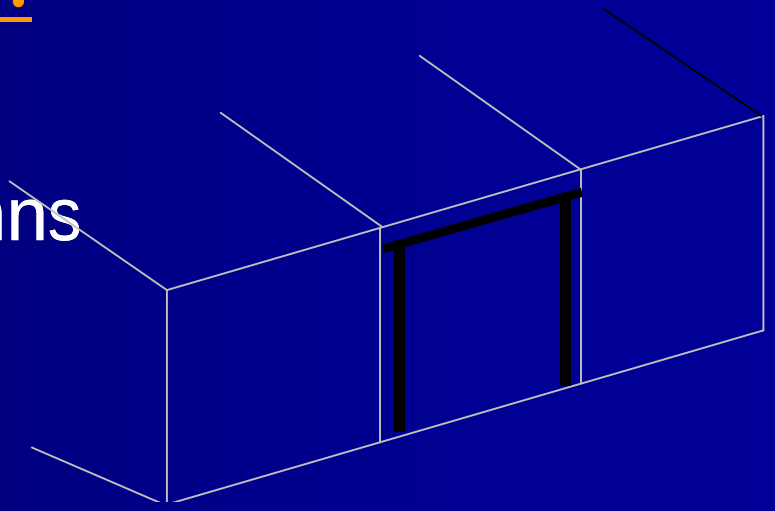
Portal Bracing???

Alternative Bracing Methods

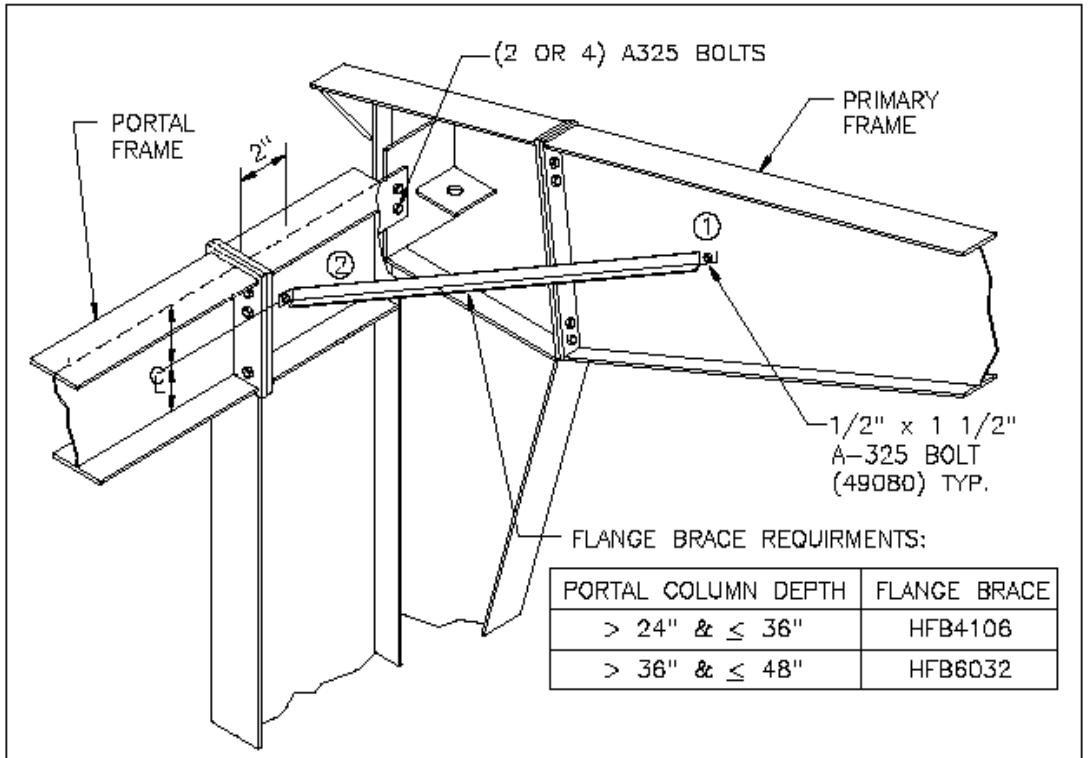
Portal Frames

Portal Frame Includes:

- Portal Frame Beam
- Portal Frame Columns
- Load Transfer Clips
- Bolts and Nuts



Portal Frame



FLANGE BRACE REQUIRMENTS:

PORTAL COLUMN DEPTH	FLANGE BRACE
> 24" & ≤ 36"	HFB4106
> 36" & ≤ 48"	HFB6032

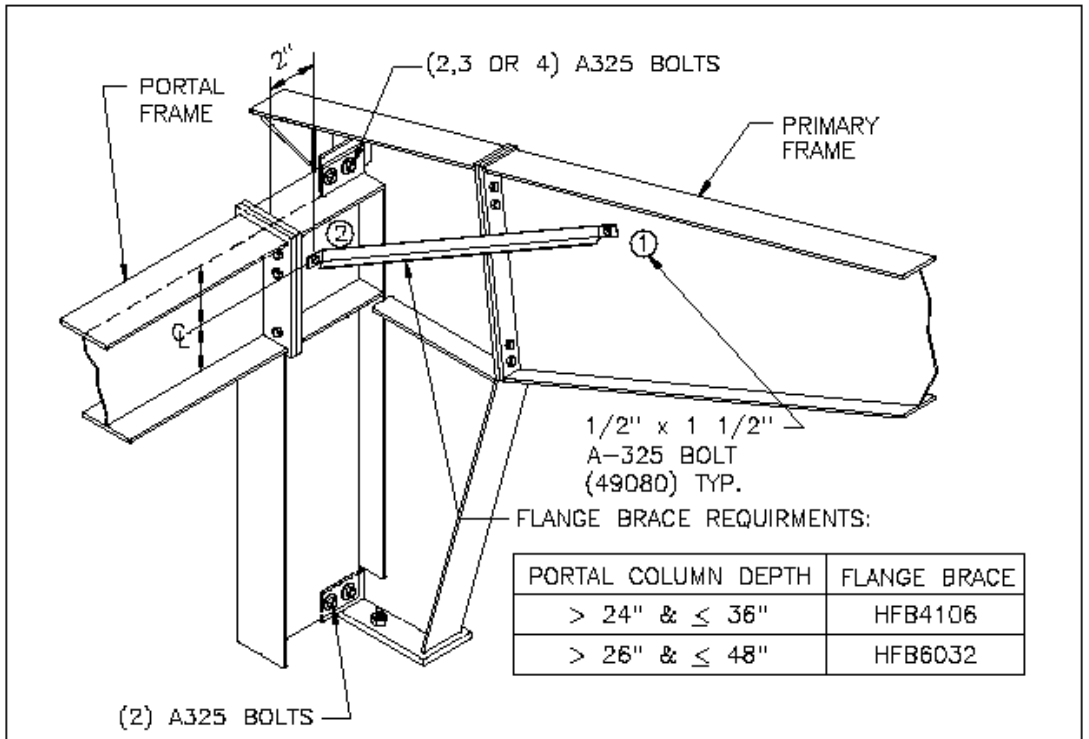
NOTES:

① FIELD DRILL 9/16" HOLES IN PRIMARY AND PORTAL FRAME WEBS FOR FLANGE BRACE CONNECTIONS.

② DRILL 9/16" HOLE IN PORTAL FRAME COLUMN WEB APPROX. 2" FROM BOLTING PLATE ⊕ BEAM ℄.

REV. DATE: 07/01/08	REV. NO. 00	PORTAL FRAME DETAIL CONNECTION TO FRAME
BR12J1		

Portal Frame (1/2” offset)



PORTAL COLUMN DEPTH	FLANGE BRACE
> 24" & ≤ 36"	HFB4106
> 26" & ≤ 48"	HFB6032

NOTES:

① FIELD DRILL 9/16" HOLES IN PRIMARY AND PORTAL FRAME WEBS FOR FLANGE BRACE CONNECTIONS.

② DRILL 9/16" HOLE IN PORTAL FRAME COLUMN WEB APPROX. 2" FROM BOLTING PLATE @ BEAM ℄.

REV. DATE: 07/01/08	REV. NO. 00
BR12K1	FLUSH PORTAL FRAME CONNECTION FLANGE BRACE CONNECTION AND LOCATION

Portal Frame

Portal Frame

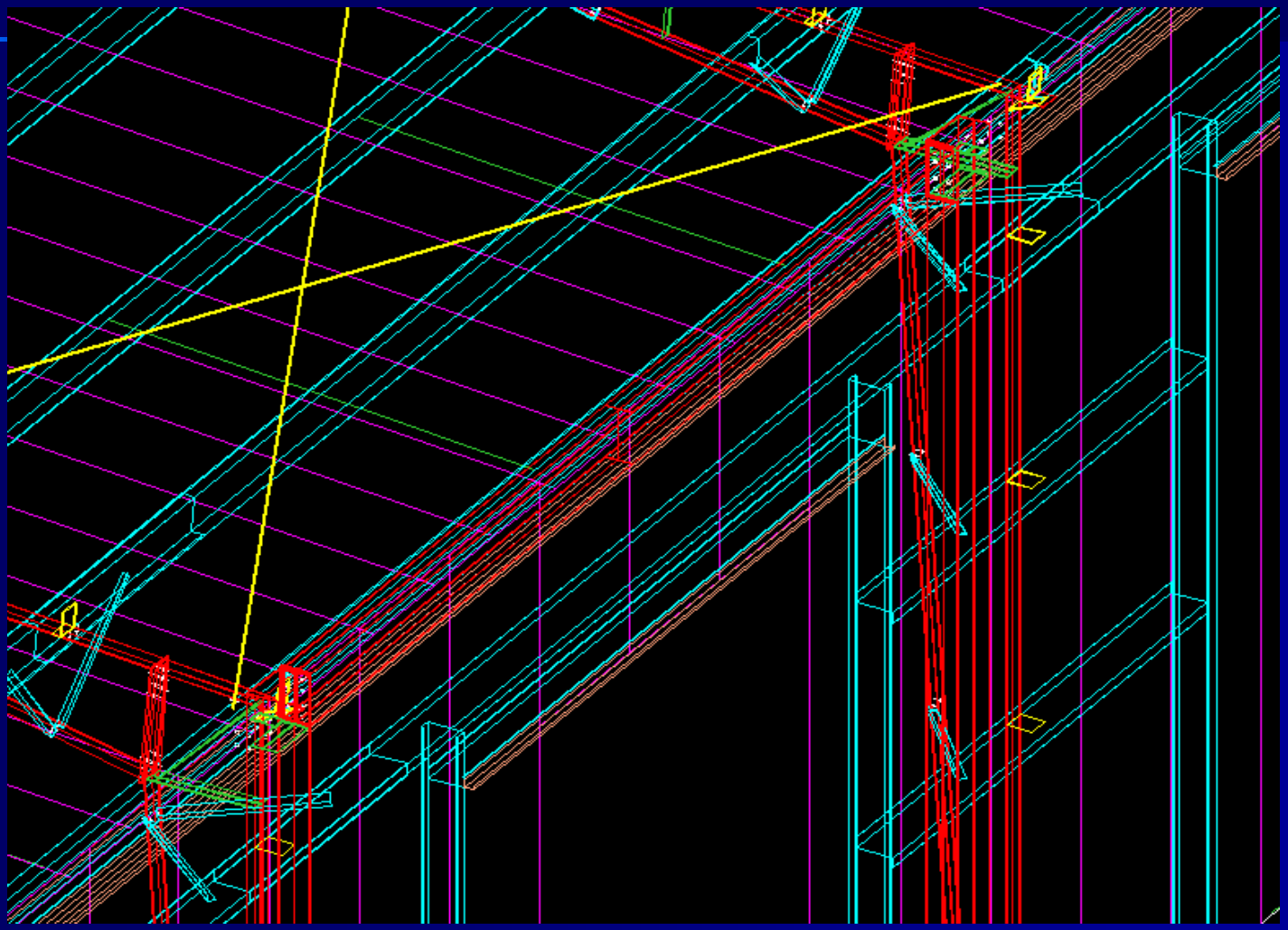
Alternative Bracing Methods

Notes About Portal Frames

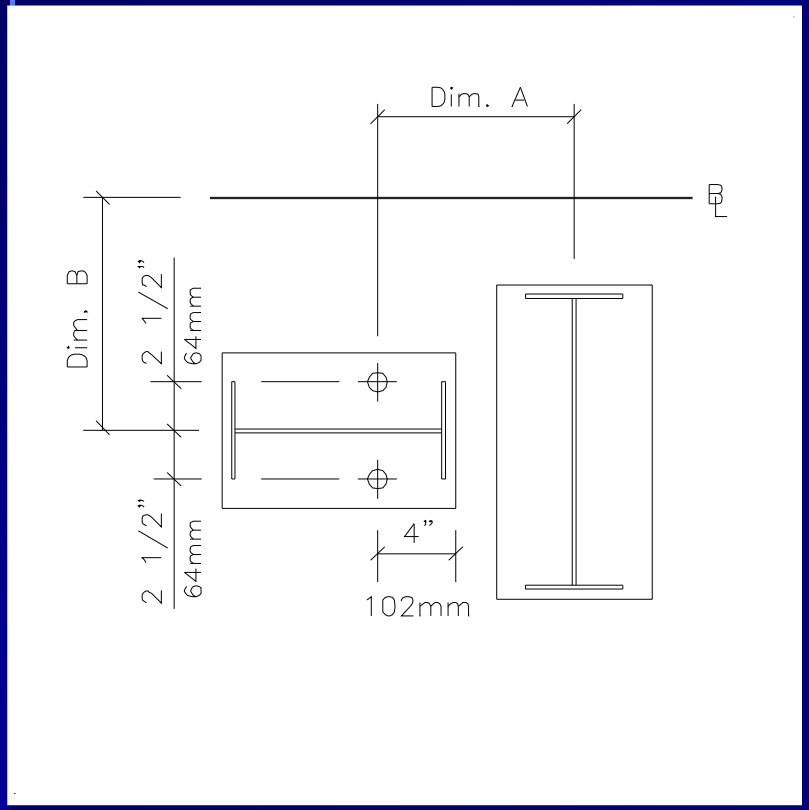
- More expensive than rods
- Relatively stiff (can hold drift on frame)
- Special clearances possible

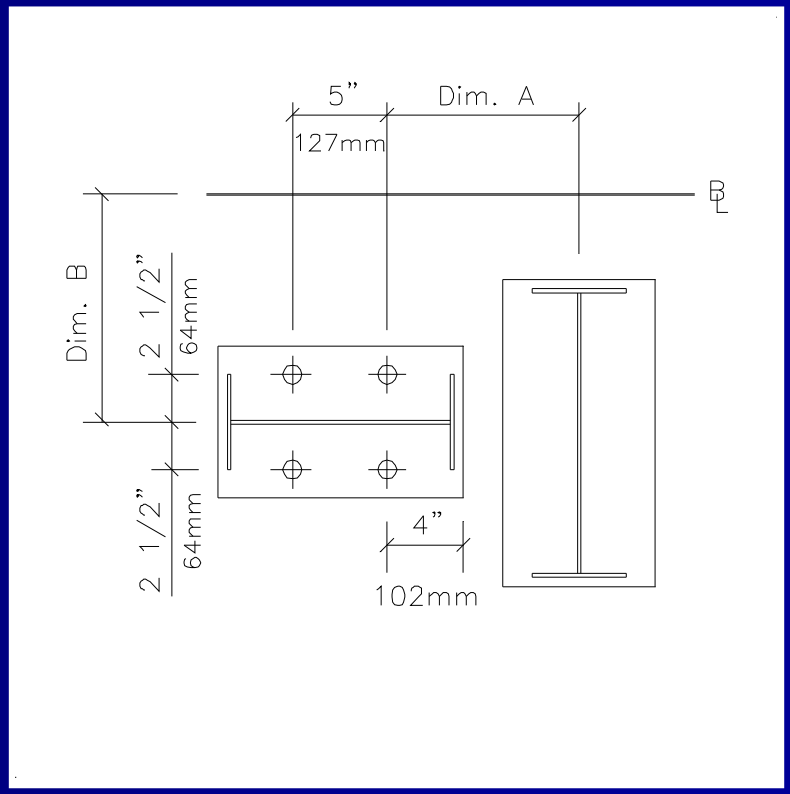
  (Hold column & rafter depths)

Portal Frame

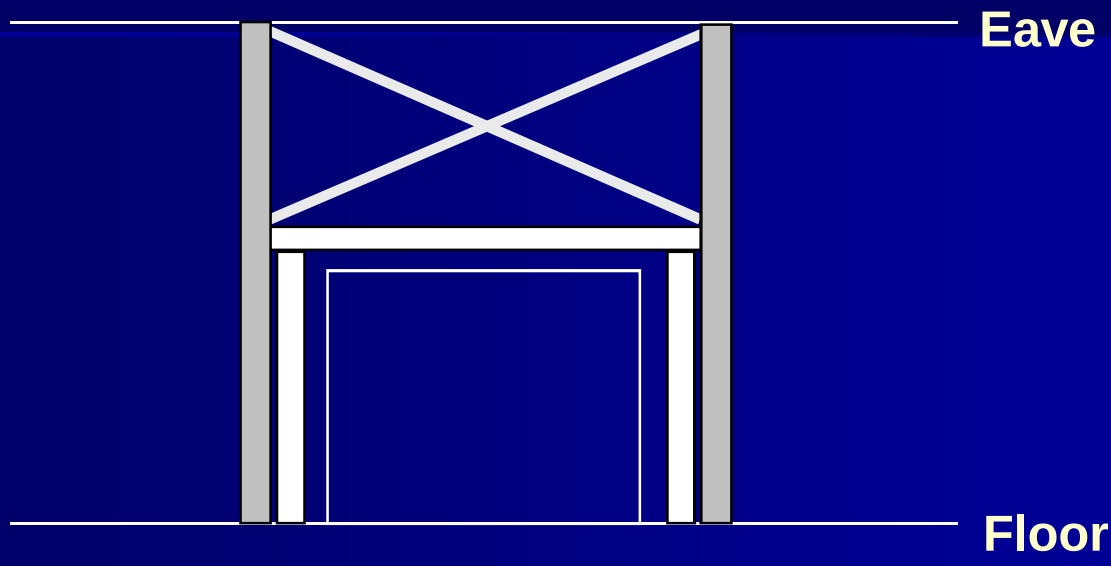


Portal Frame
(typical Anchor Rod Detail)





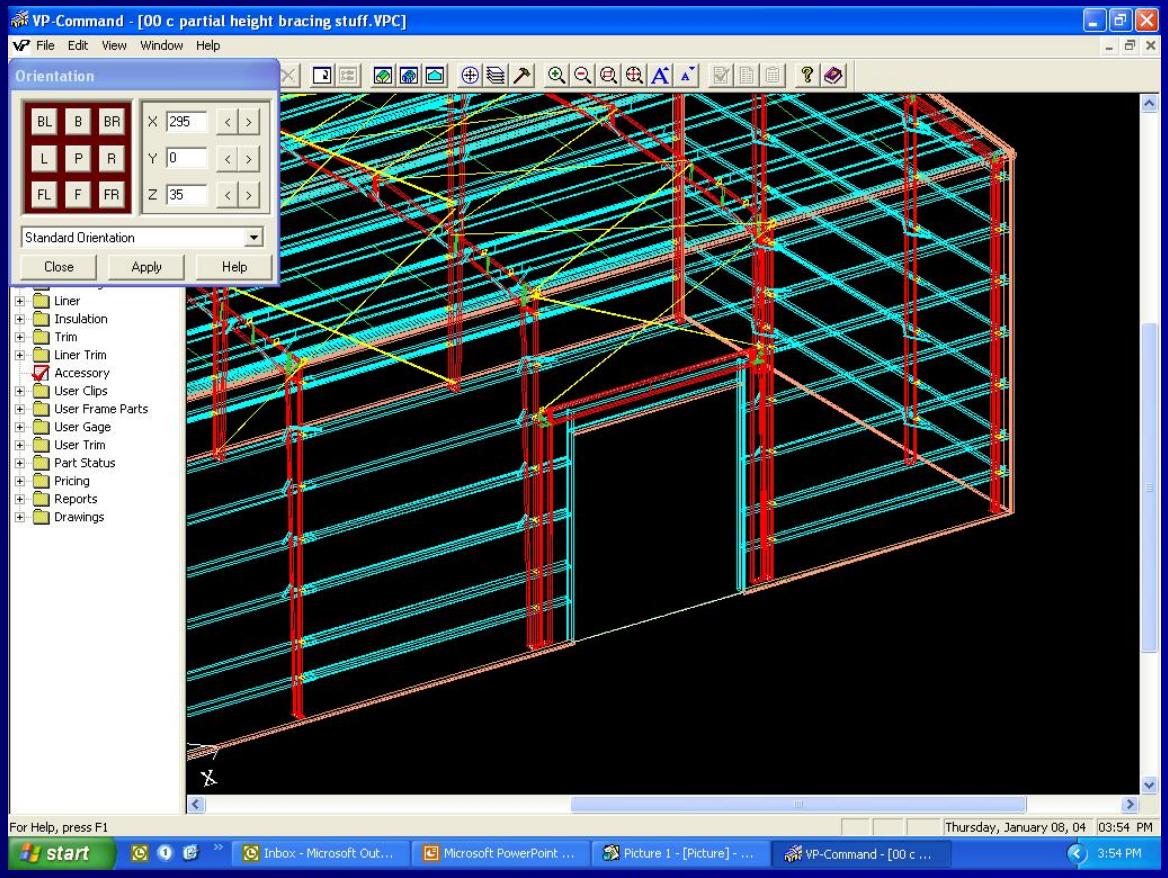
Alternative Bracing Methods



Combination of Rods and Portal Frame

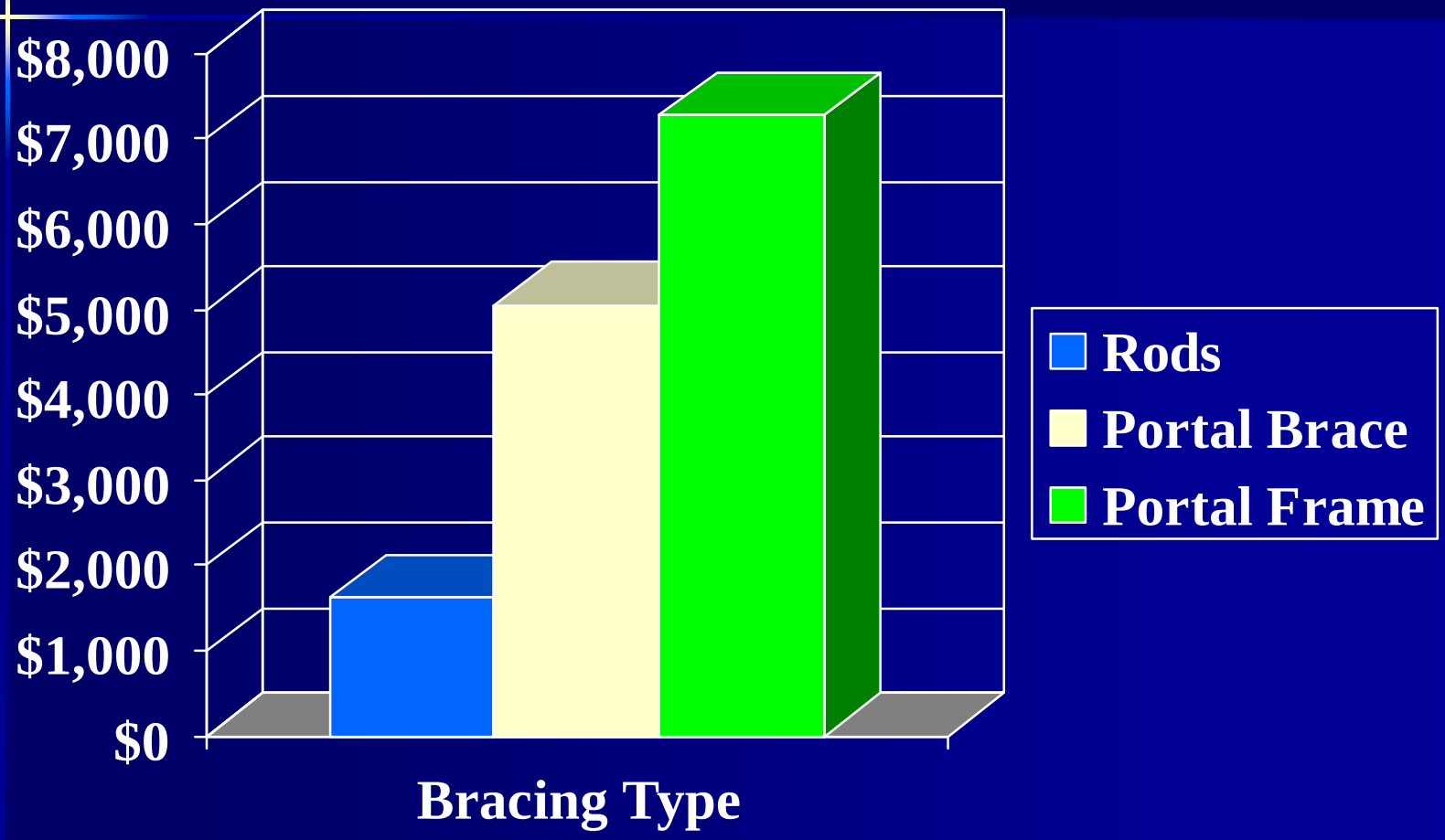
- May be more for building heights above 20’ tall.

Partial Height Portal Frame

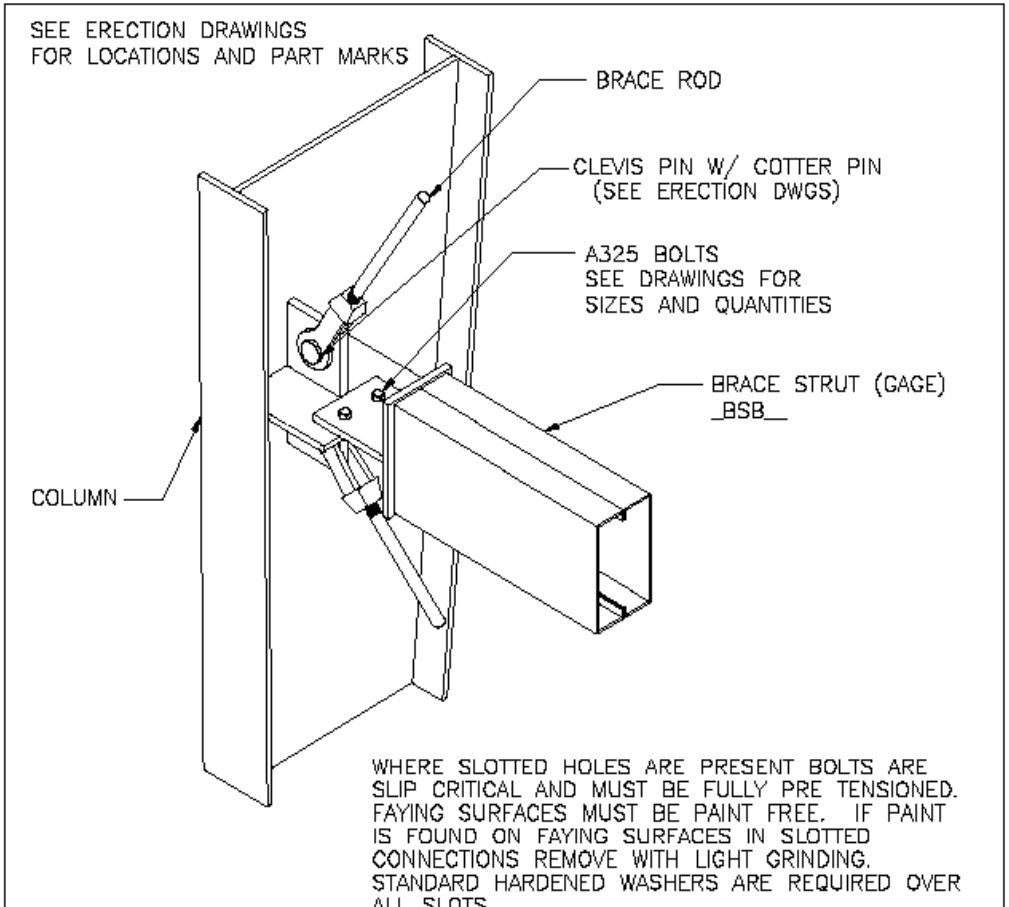


Bracing Comparisons

(Building Size = 200 x 300 x 19, IBC, 85 MPH Wind - Book Price Shown)

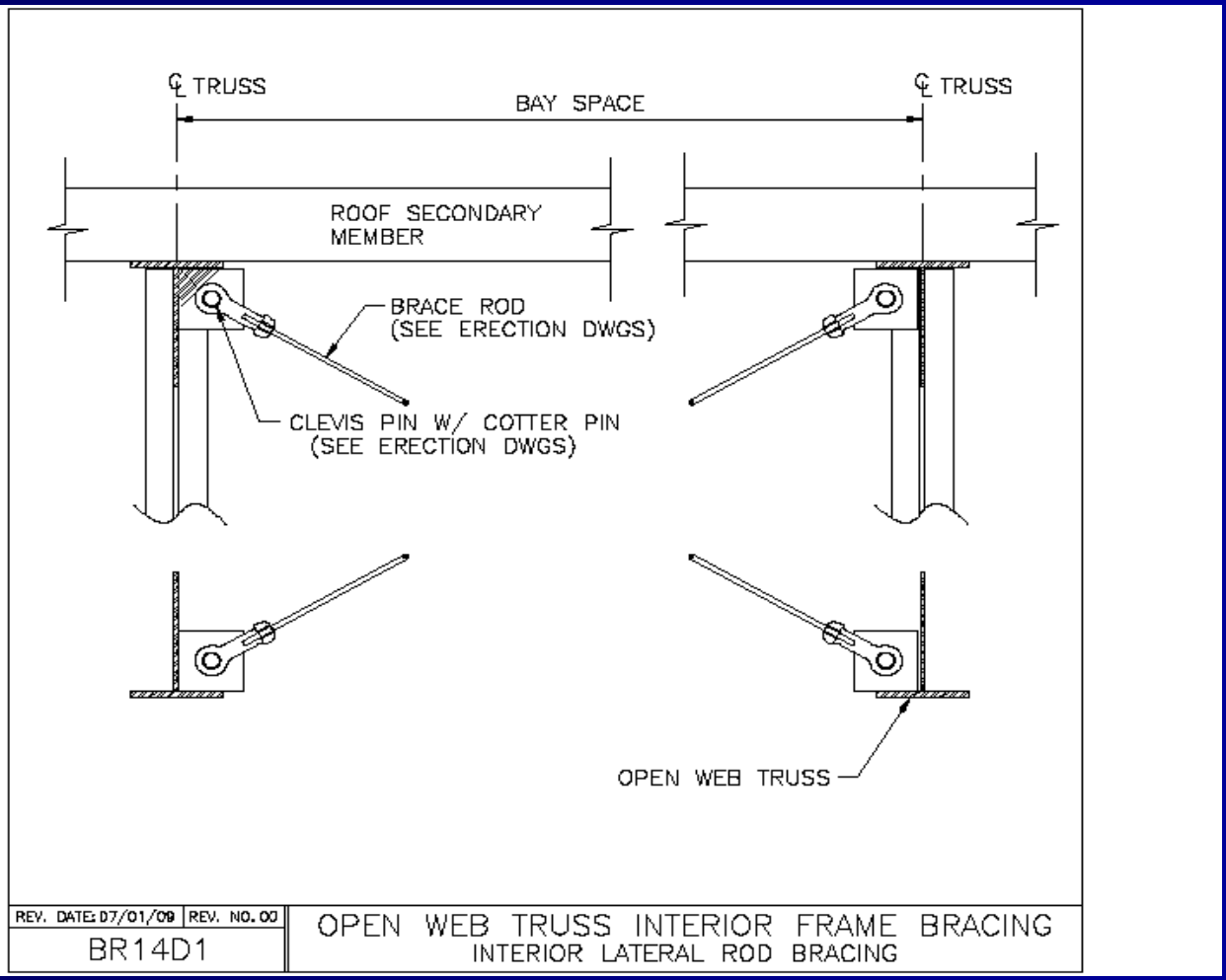


Strut Bracing at Wall



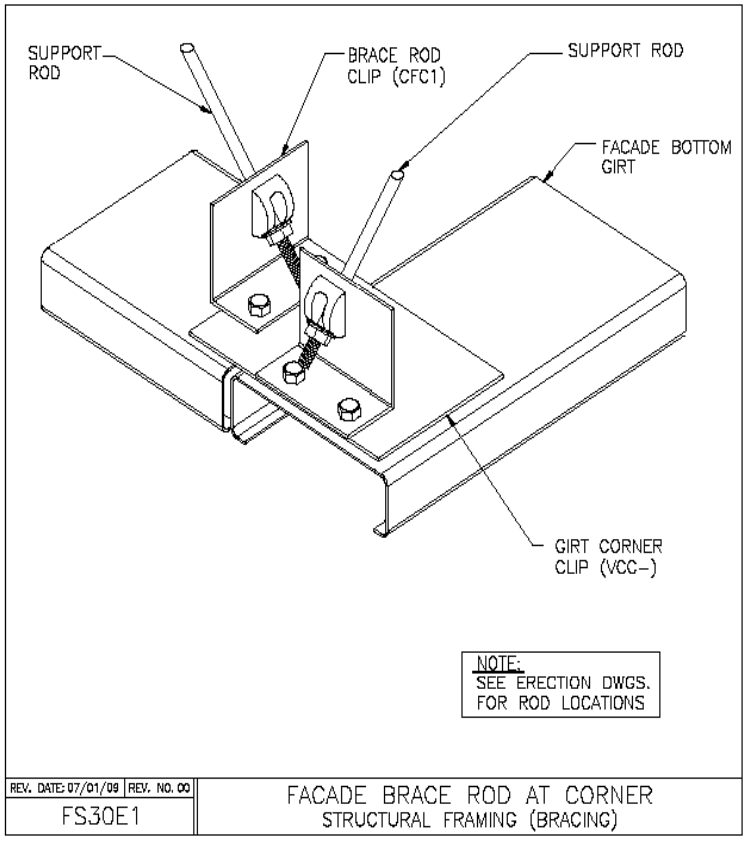
Tube Strut

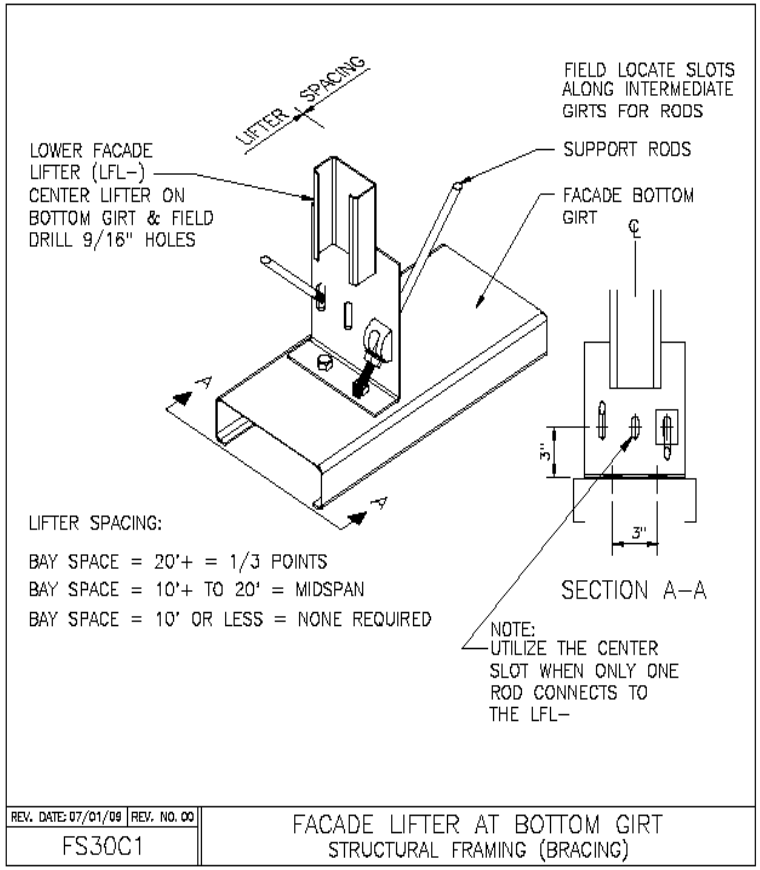
Rod Bracing at Truss Frame



Rod Bracing at Truss Frame

Rod Bracing at Facade





No Bracing?!?!?!

- **As erection proceeds all Brace Rods, Flange Braces, Struts, Purlin/Girt Laps should be installed before proceeding.**
- **All buildings will require some temporary bracing until all erection is complete ! <u>Do NOT take any chances !</u>**

What Wind Can Do!

Bracing Tips

- Bracing most effective at *45 degree* angle
- *Diagonal bracing* always most economical
- Consider *Interior Column Bracing* at wide buildings
- Consider "*shear walls*" with masonry, etc.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