Primary Framing Systems

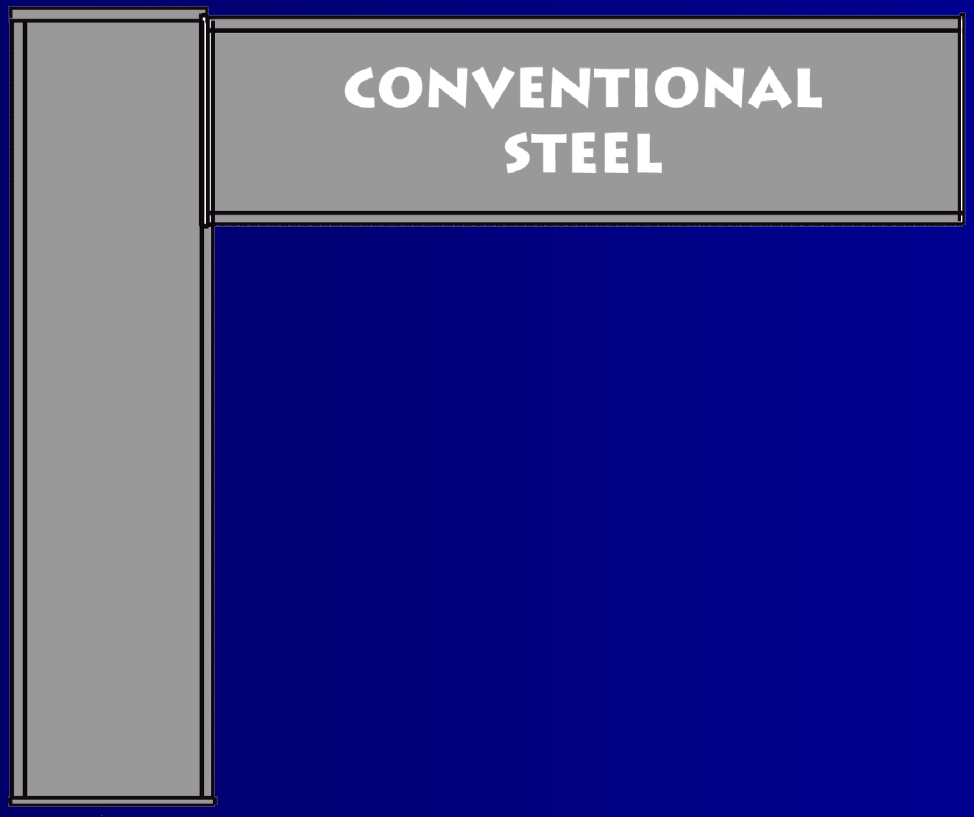
Plasma Arc

Webs

Conrac (welding)

Hand Weld

Structural Steel Beam Compared to Pre-engineered Beam of Equivalent Strength



Stress-Strain Curve

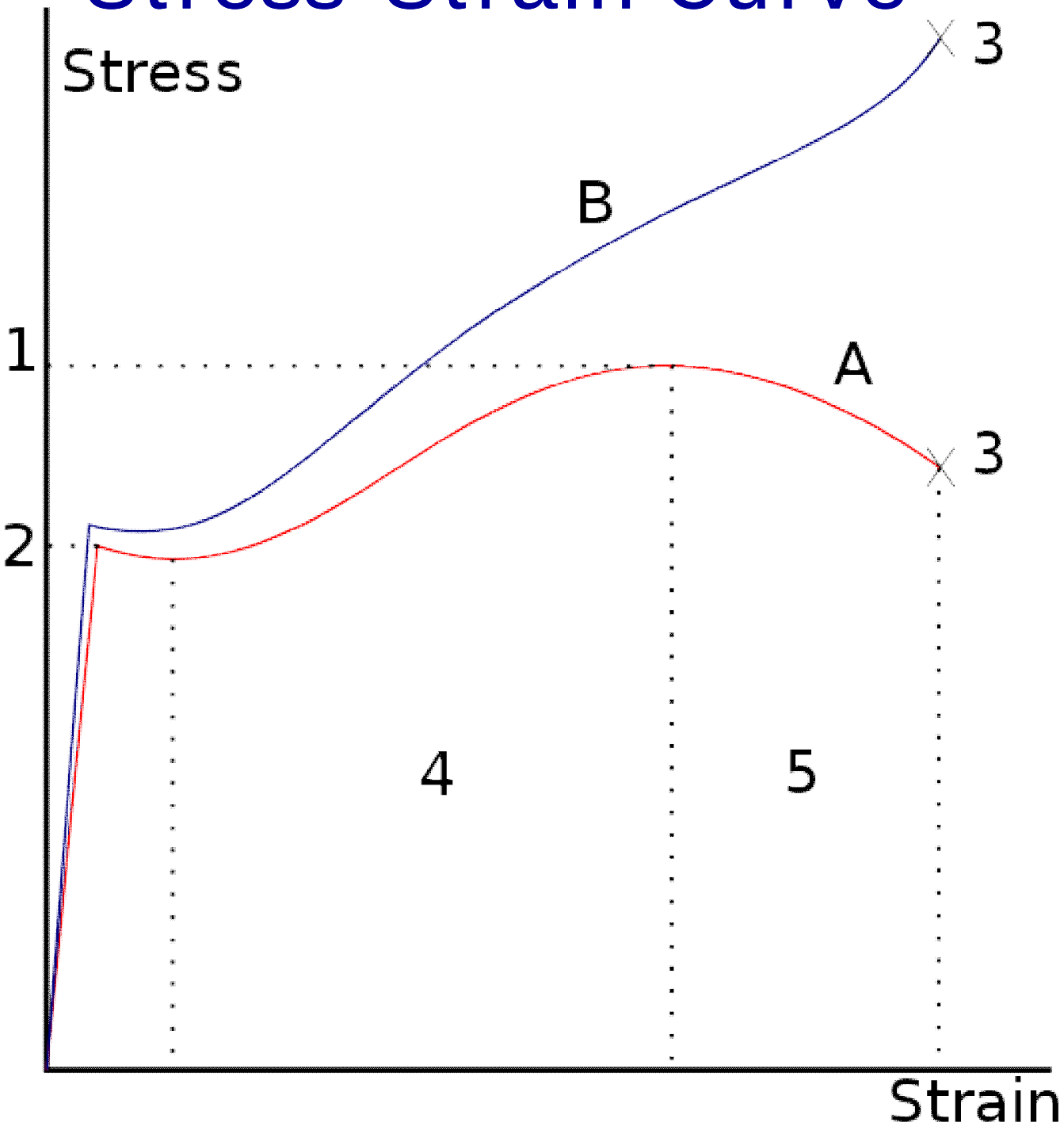
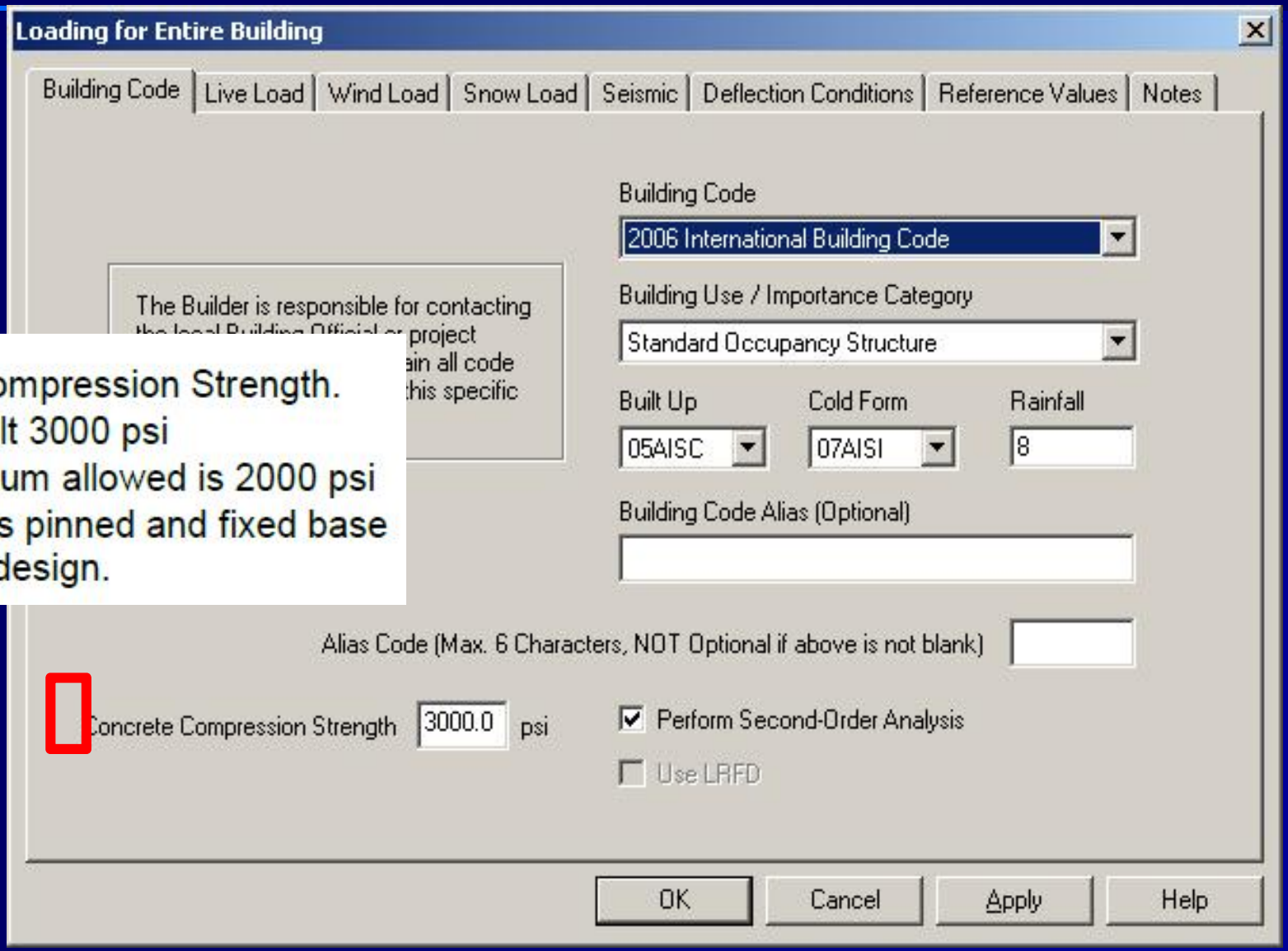


Fig 1. A stress–strain curve typical of structural steel
1. Ultimate Strength
2. Yield Strength
3. Rupture
4. Strain hardening region
5. Necking region.
A: Apparent stress (F/A_0)
B: Actual stress (F/A)

Concrete Compression Strength



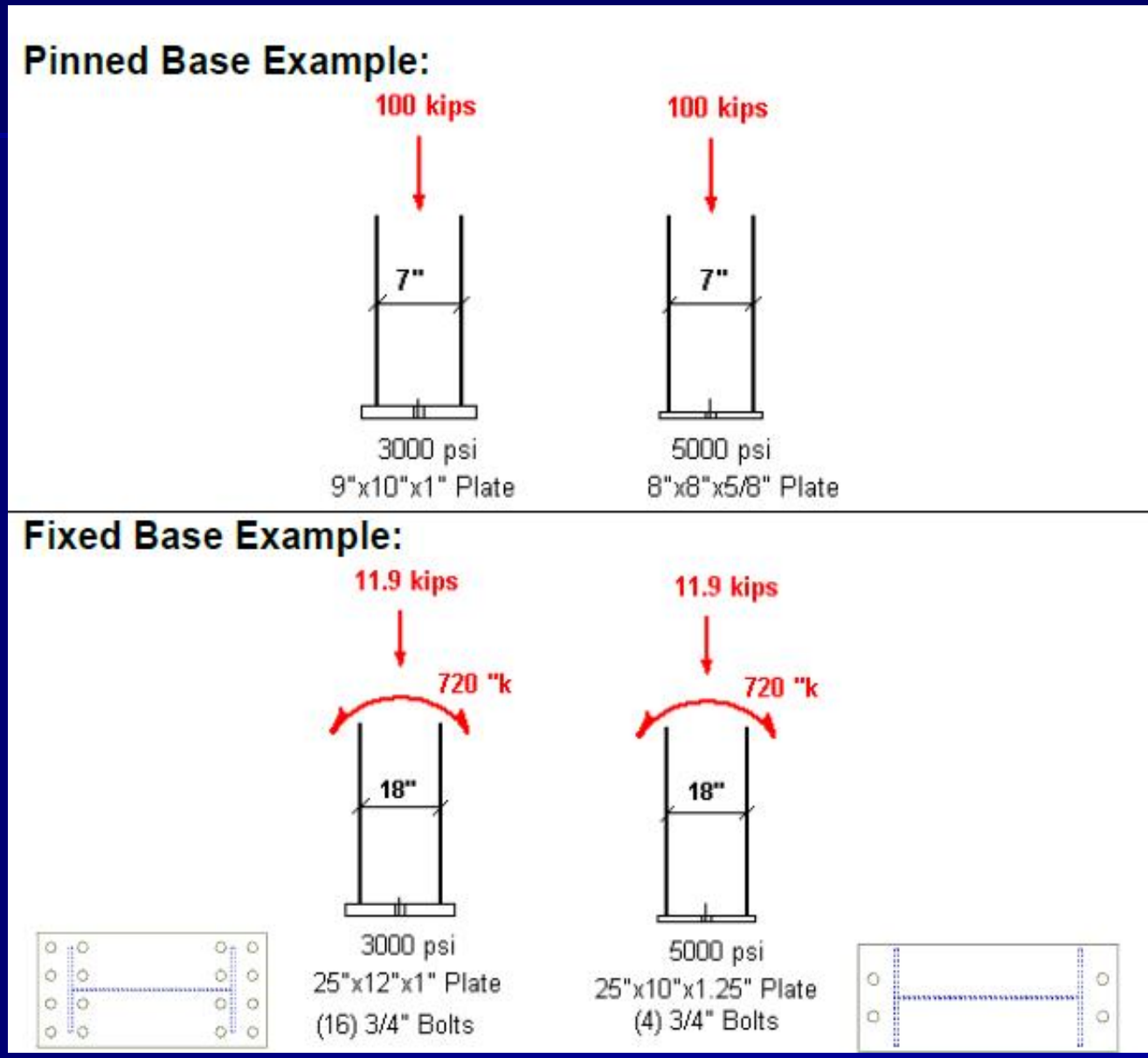
Concrete Compression Strength.

- Default 3000 psi
- Minimum allowed is 2000 psi
- Affects pinned and fixed base plate design.

Concrete Compression Strength

Don't lose the opportunity to take advantage of higher strength concrete when it's already specified on the project.

- The strength of the concrete used for the foundation design may have a noticeable impact on column base plates and anchor rods.
- For the examples shown, the base plate size and number of Anchor Rods were noticeably reduced when higher strength of concrete specified for the project is entered in VPCommand.



Pinned Base Sidewall Columns

B1.1 Sidewall Columns

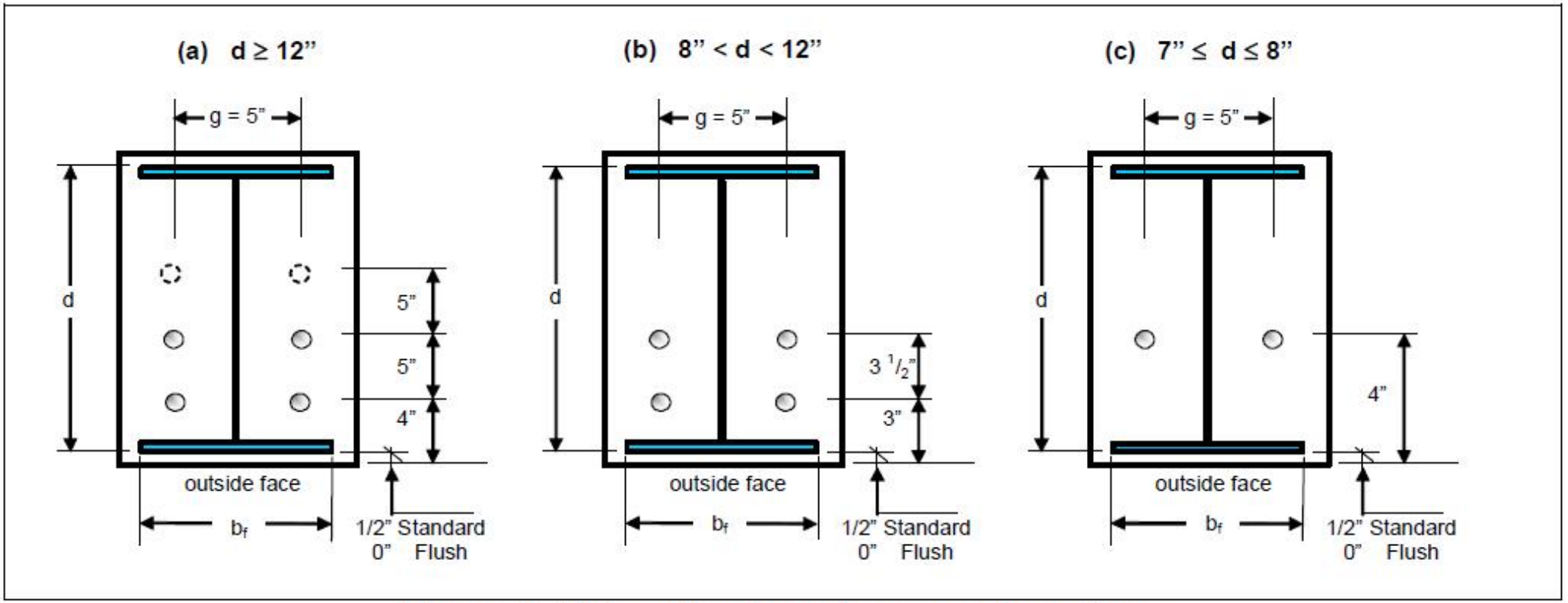


Figure 1 Sidewall column base configurations

The default minimum exterior column base depth is 12". For this condition, a minimum 4-anchor rod pattern is used as shown in Figure 1. A 5" anchor rod pitch and gage is standard for this condition.

Fixed Base

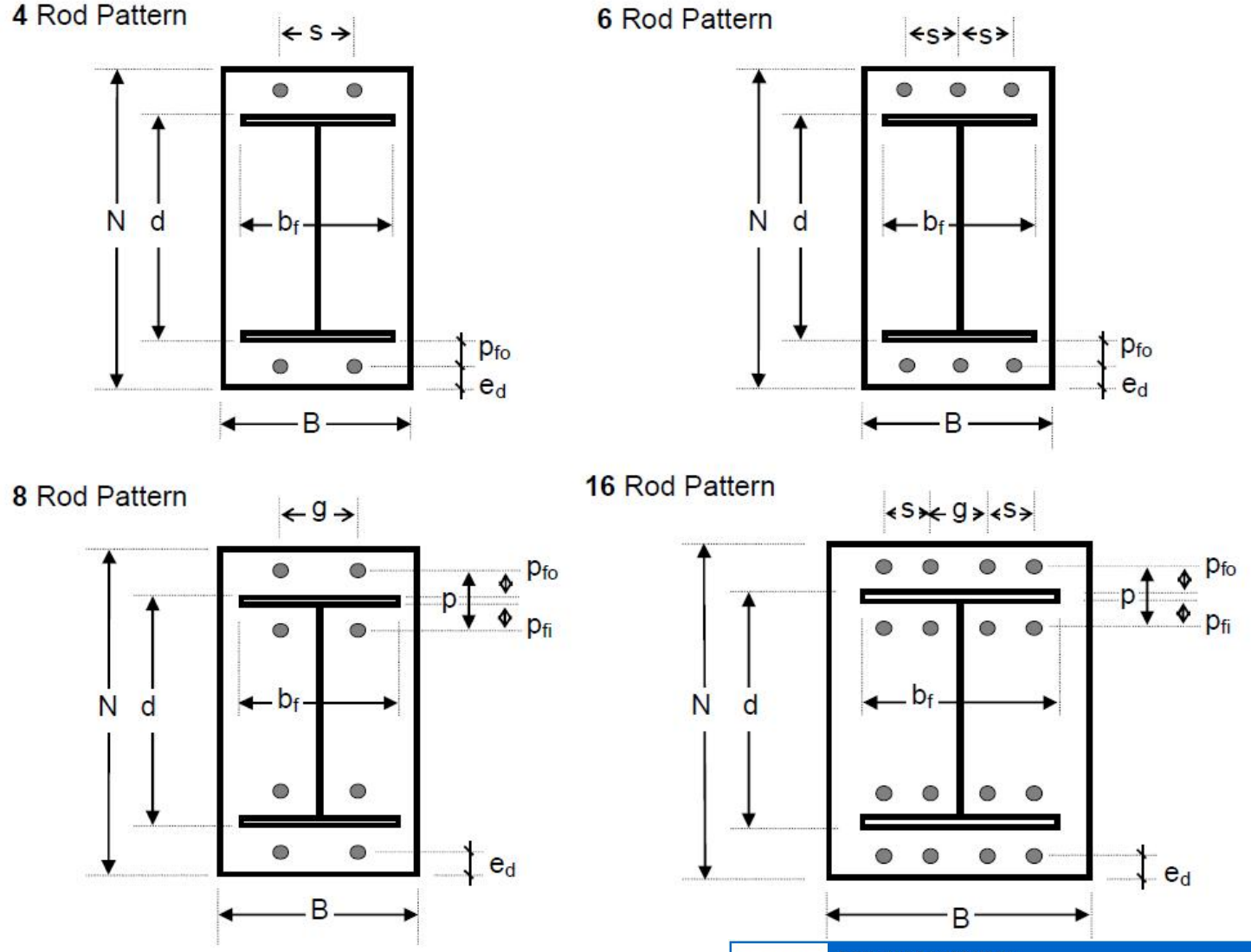
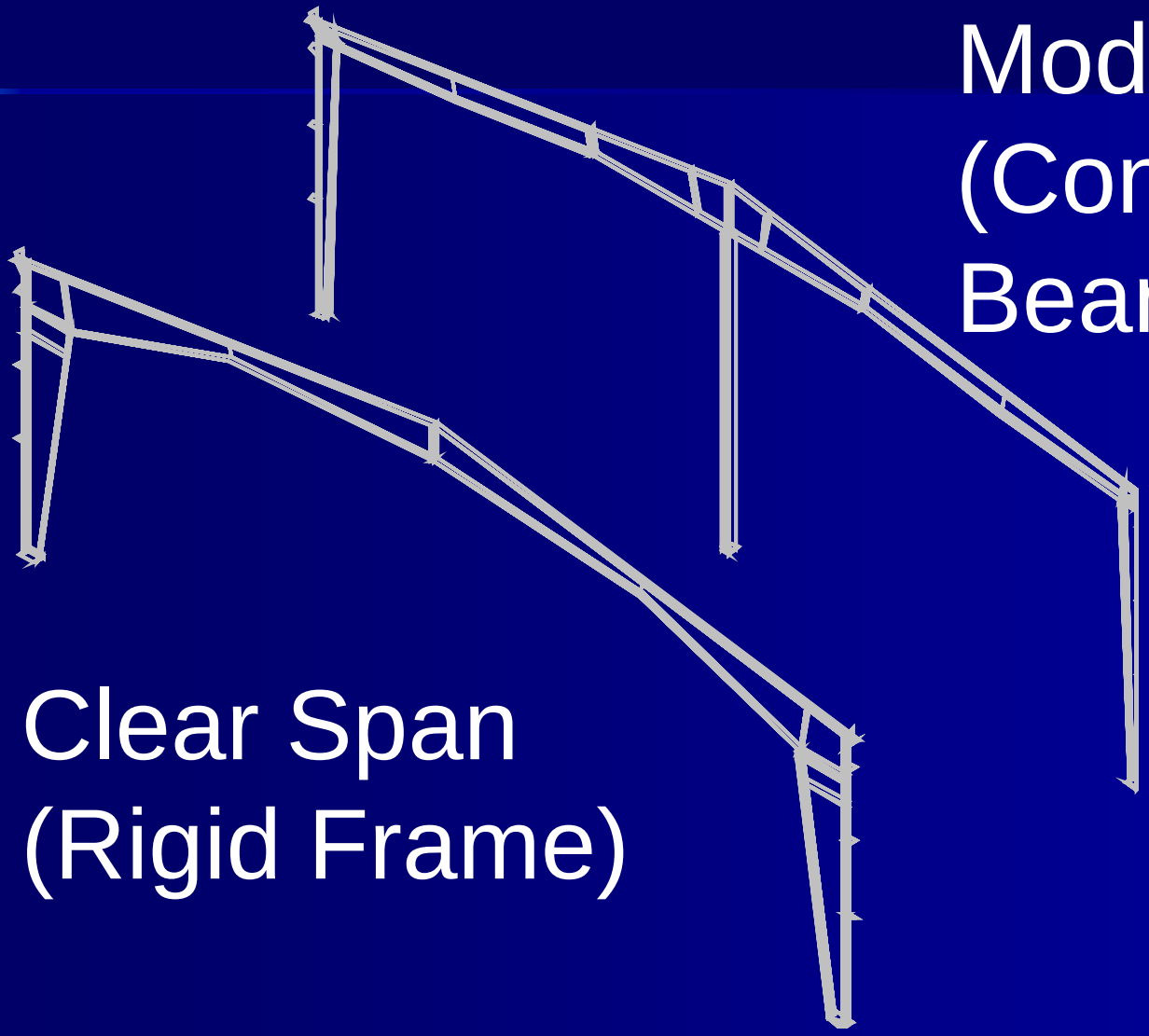


Figure 1 Standard fixed base plate configurations

[1] 2005 AISC Specification (ANSI/AISC 360-05) for Structural Steel Buildings, using either ASD or LRFD design methods, and CAN/CSA S16-01 for Canada which uses LSD method.

Primary Frames



Modular (Continuous Beam)

Clear Span (Rigid Frame)

Primary Frames

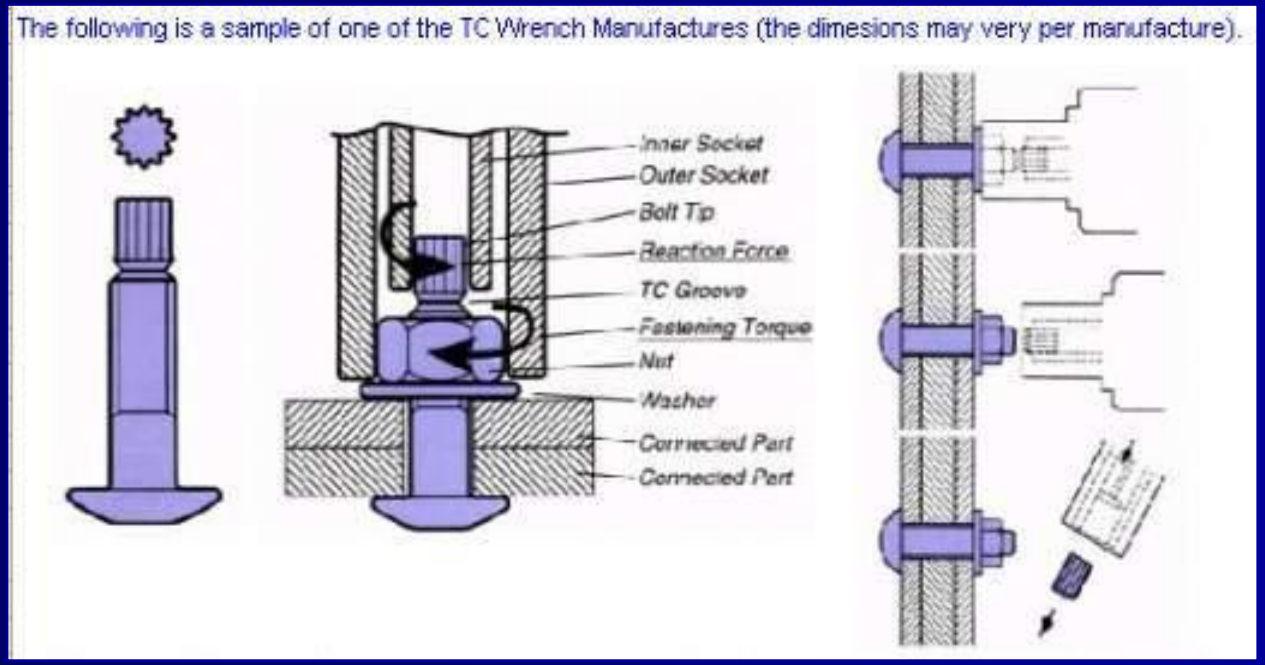
Primary Frames

- Carry loads to the foundation
- Shop Coat is 1 mil thick and gray* in color (bronze and red oxide also available at additional cost).
- Spans and Eave Heights in increments of 1/16”

* as of VPCommand v8.0 February 14, 2010

Bolts

- All Structural Connections use A325T (Full Thread) Bolts (optional A490)
- ASTM F1852 Tension Control Bolt Option still available.

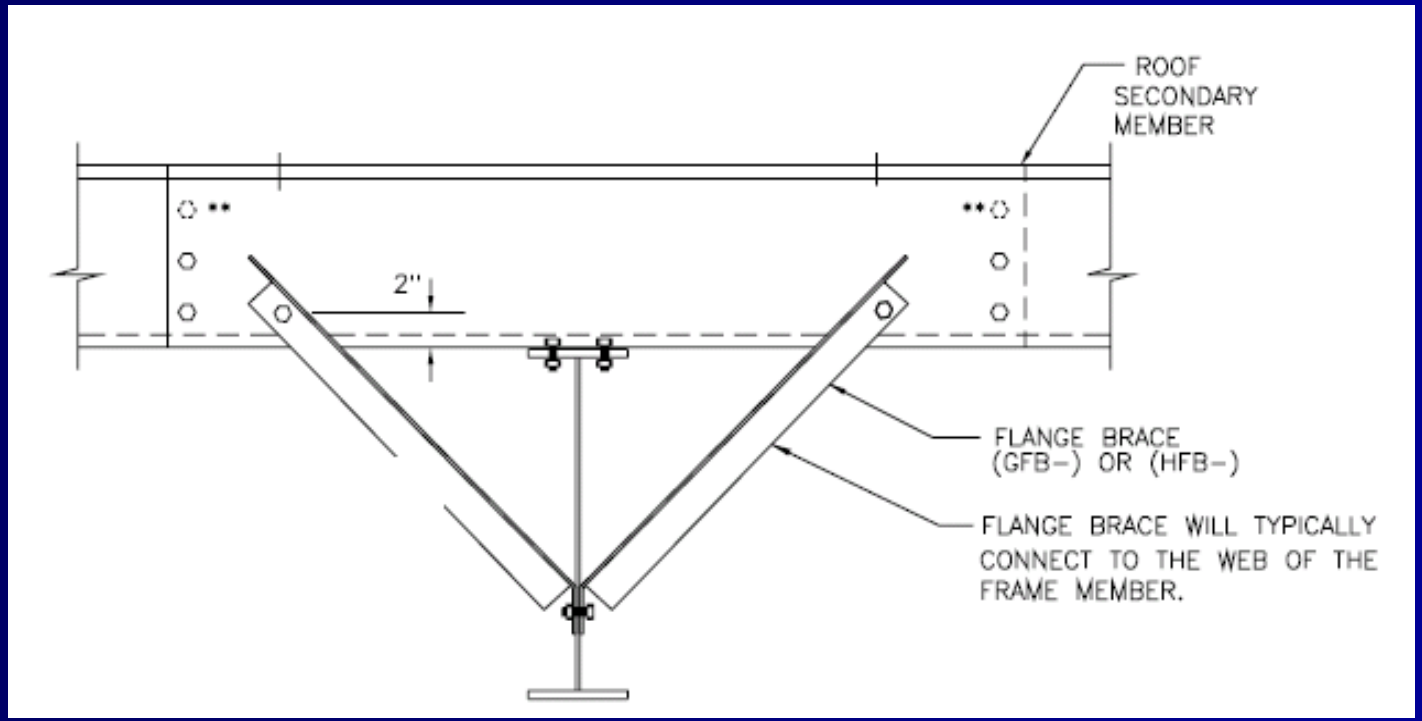


- All Secondary Connections (except girt to jambs) will be A325T (T = full-thread bolts) ½" x 1½" plated bolts.

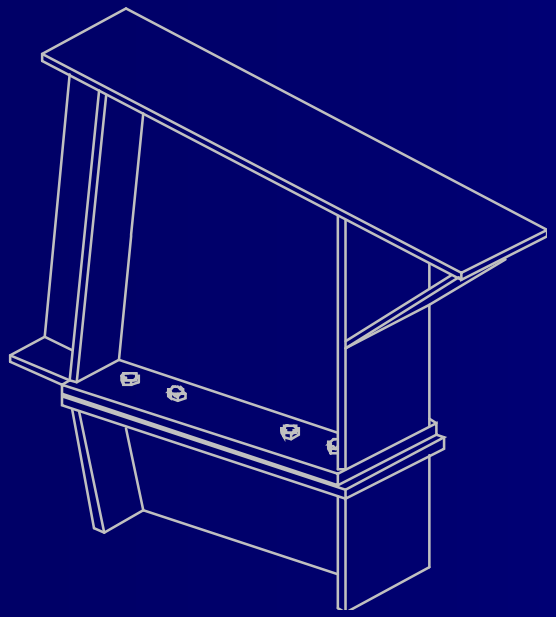
15

Pre-punched Holes

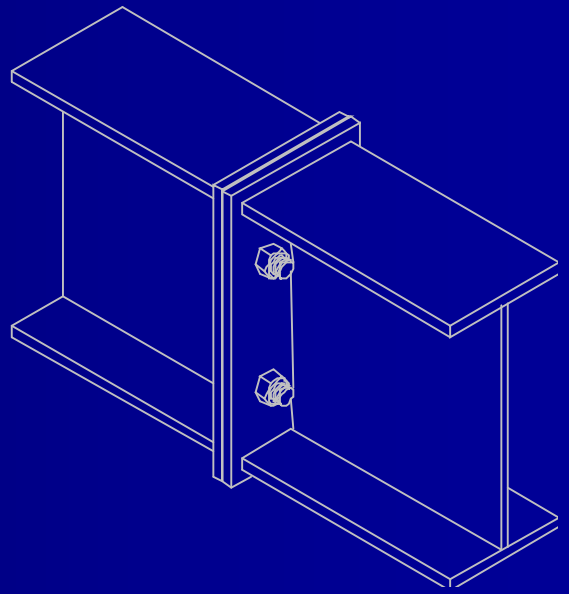
- VP primary frames have pre-punched holes for purlin connections



Typical Connections

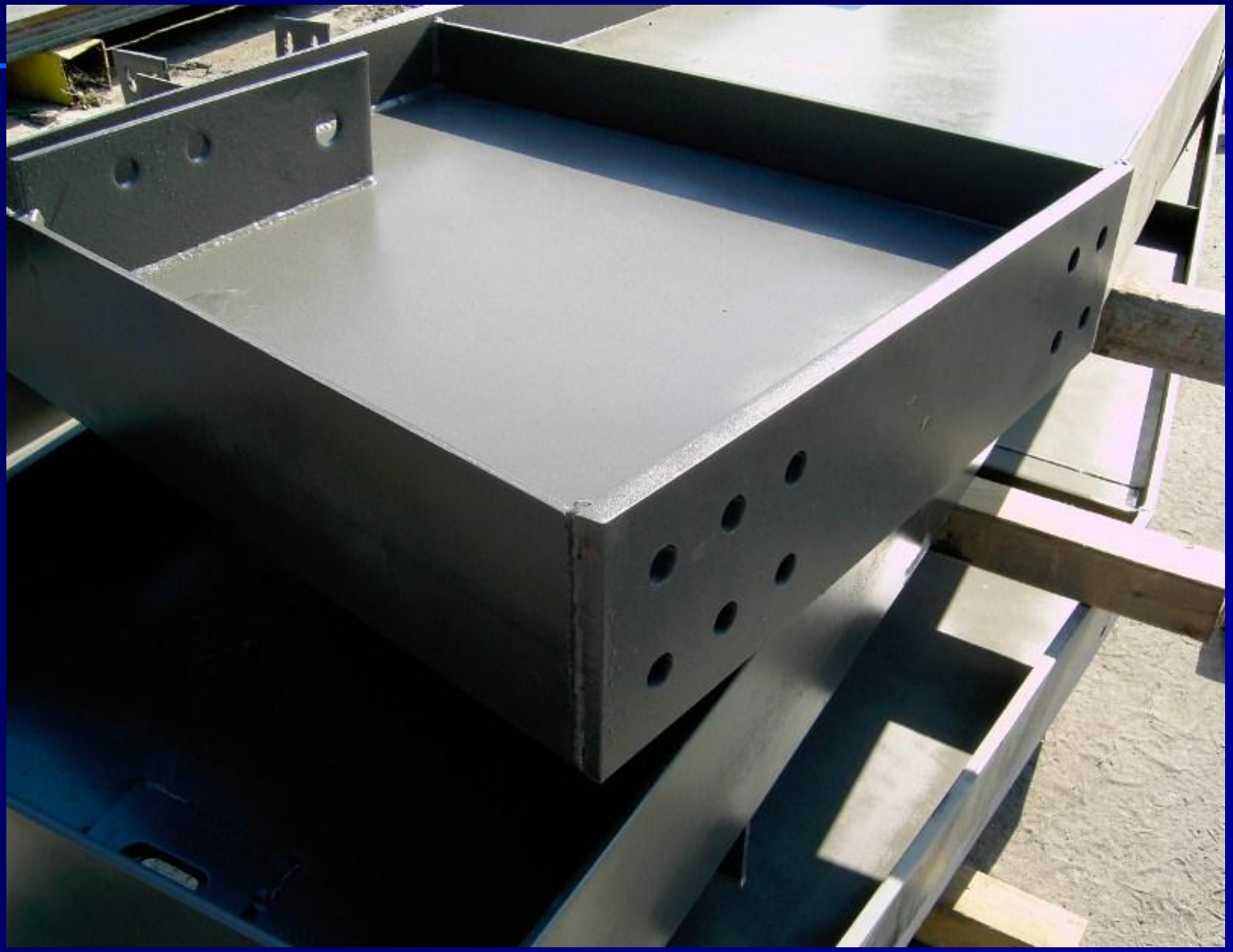


Rafter to Column at the Haunch



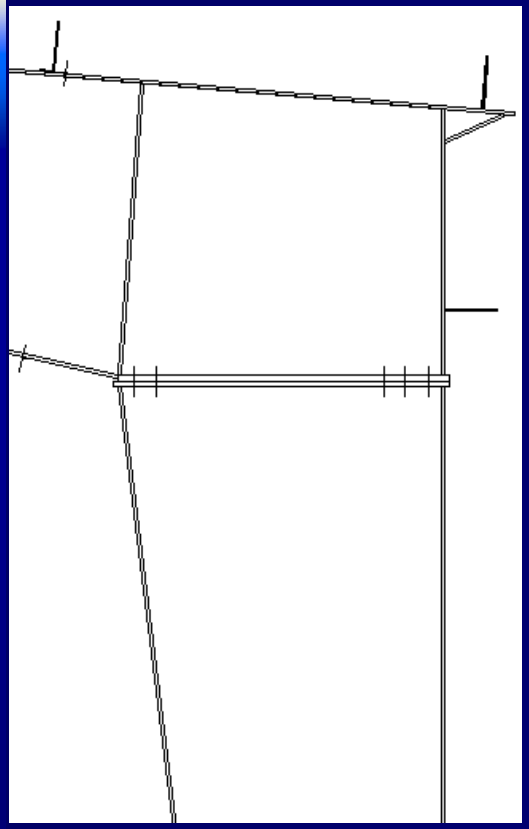
RAFTER BEAM SPLICE

Typical Connections ("A" splice plate)

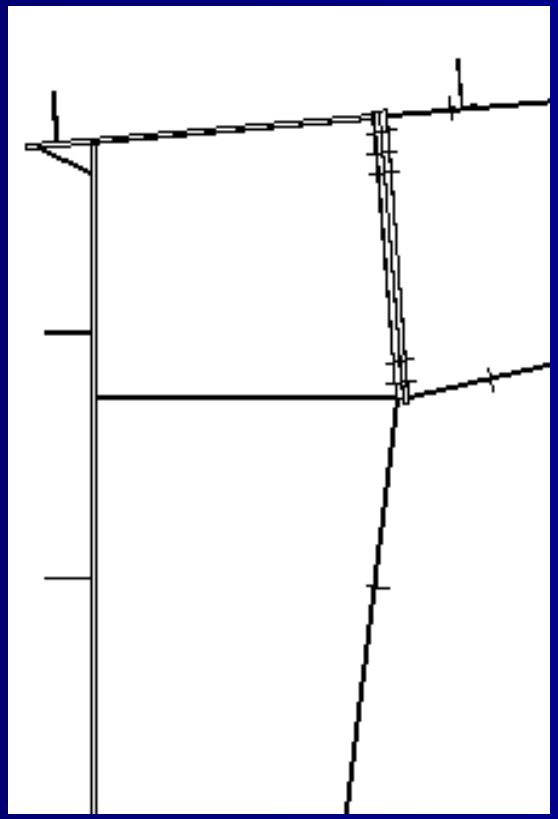


Typical Connections ("B" splice plate)

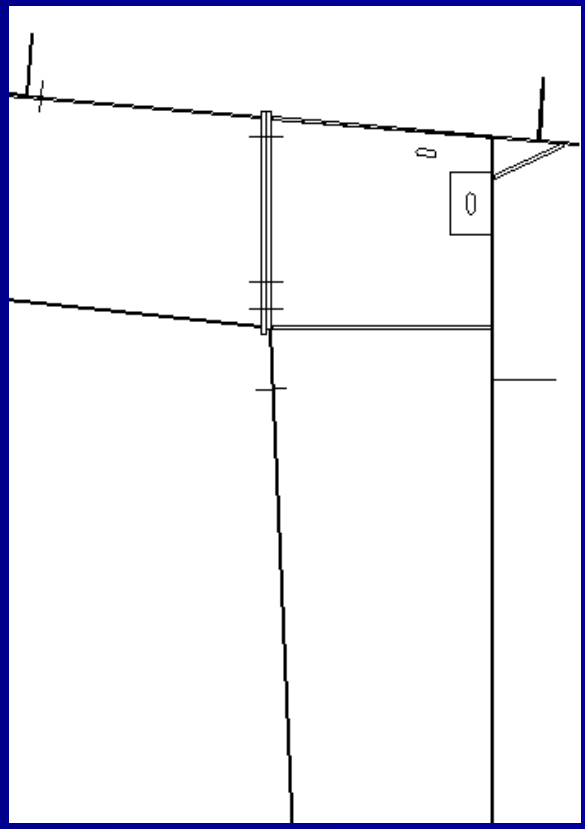
Typical Connections



Top Bolted

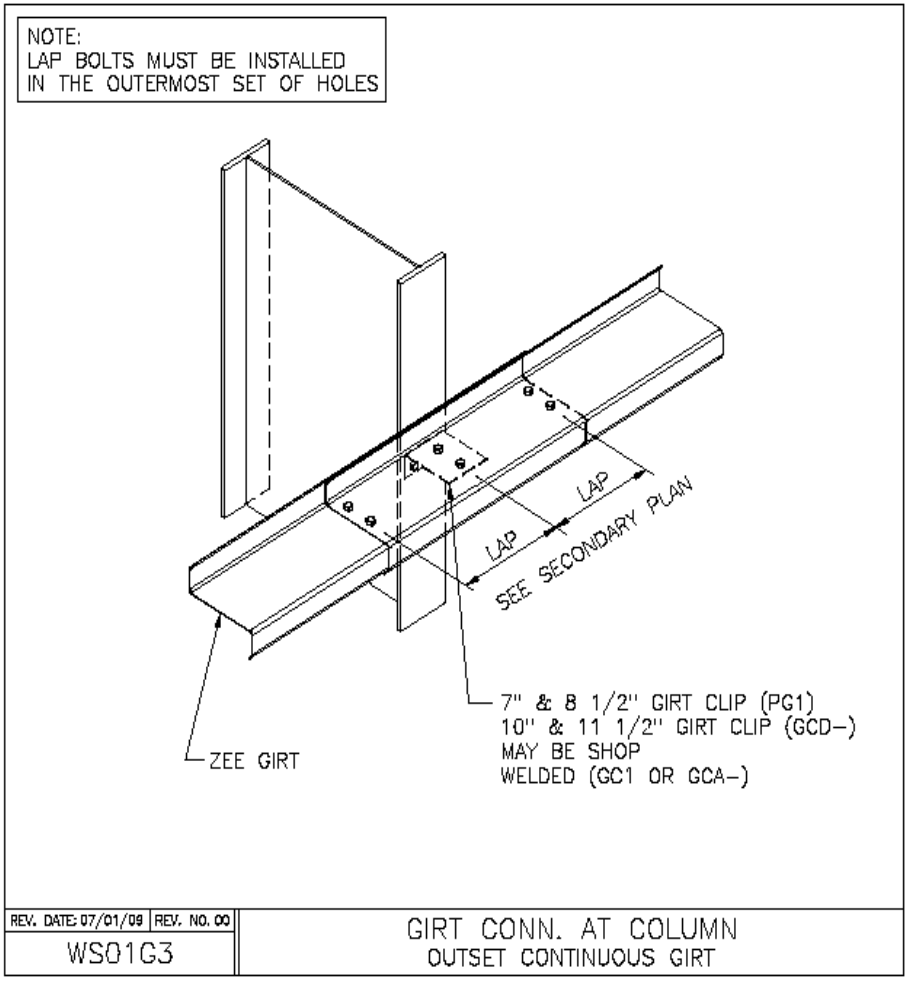


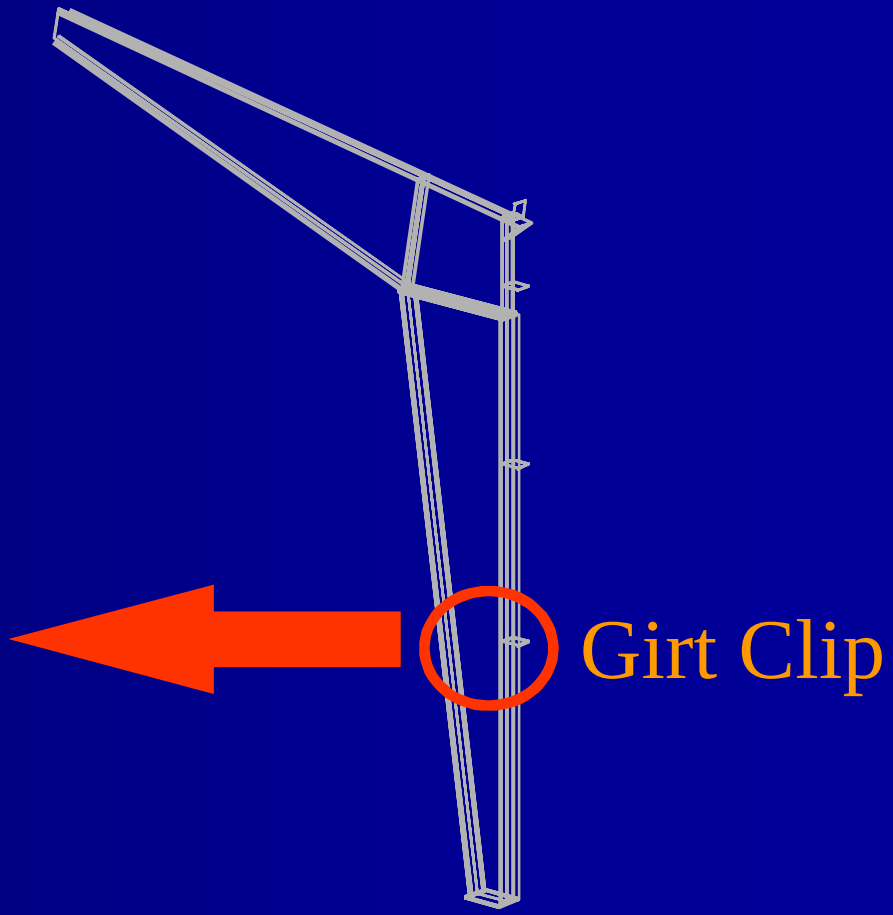
Face Bolted



Vertical Bolting Plate

Factory Welded Clips





Primary Frame

Solid Web

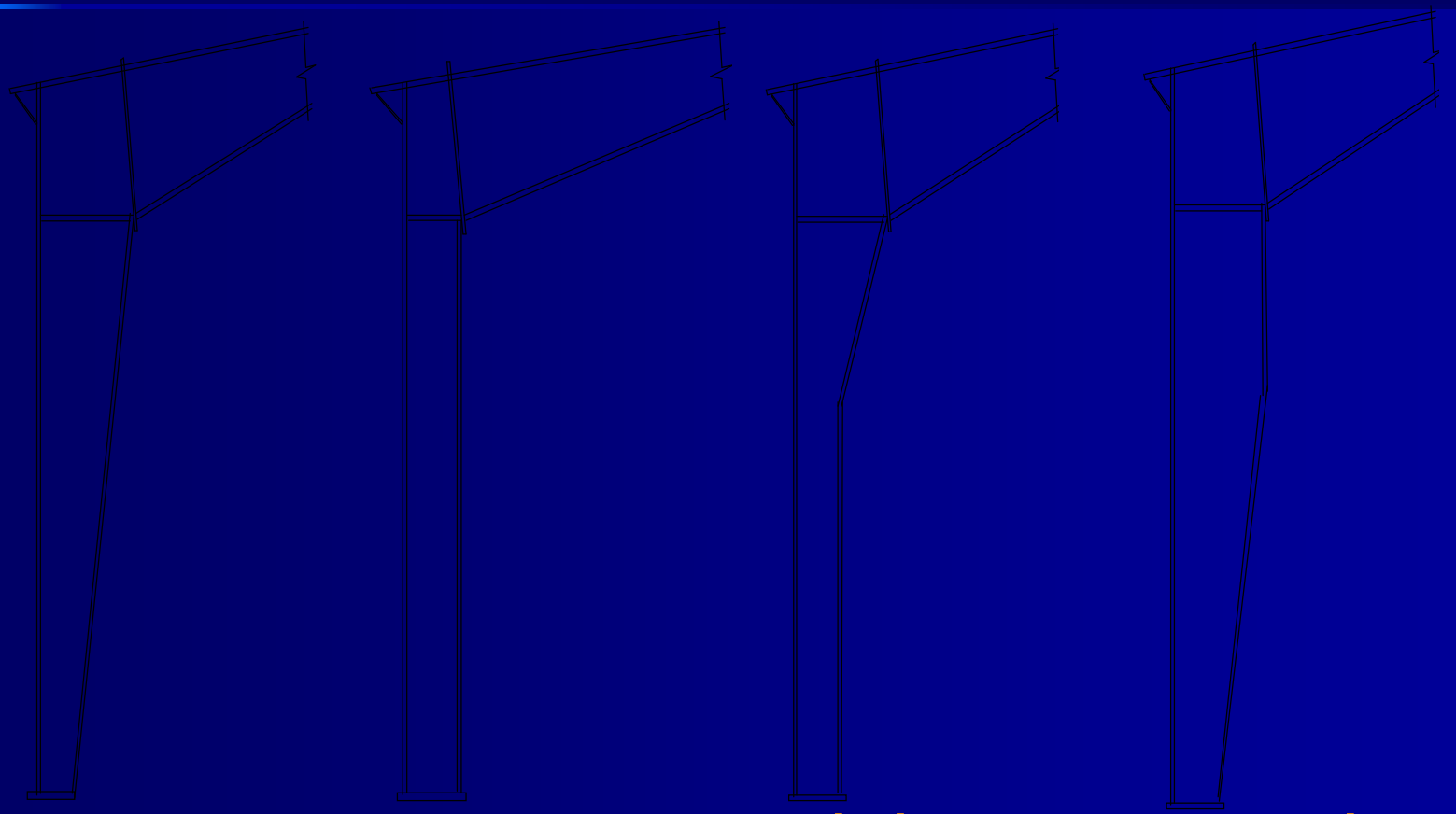
Open Web

Primary Frames Features & Benefits

- What roof pitches are available for Primary Frames?
  - Usually 1/4:12 to 4:12, steeper pitches available if needed
- What is the maximum eave height allowed?
  - As required by the end user

Two-piece bolted column

Exterior Column Variations



Tapered

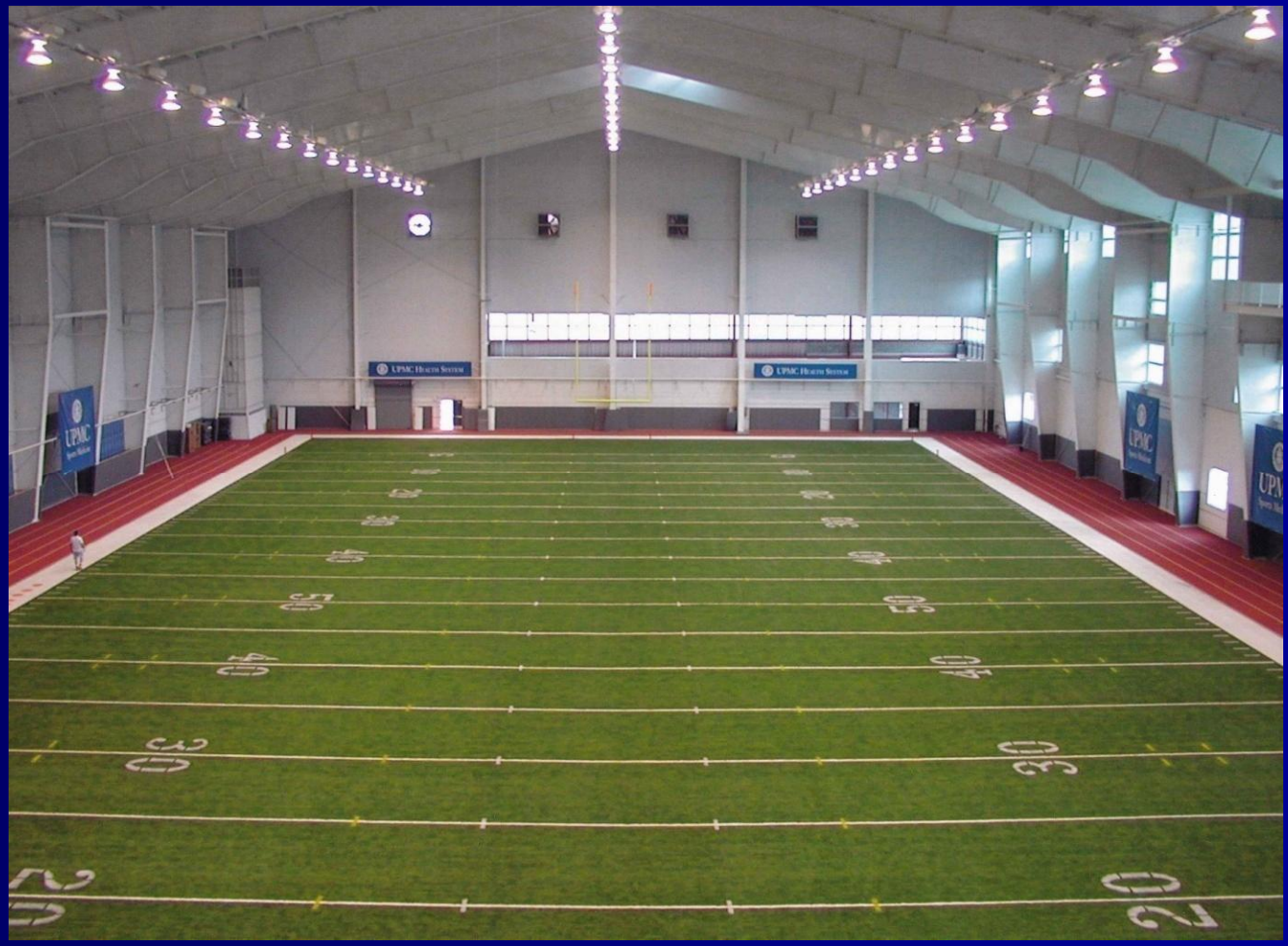
Straight

Straight
Tapered

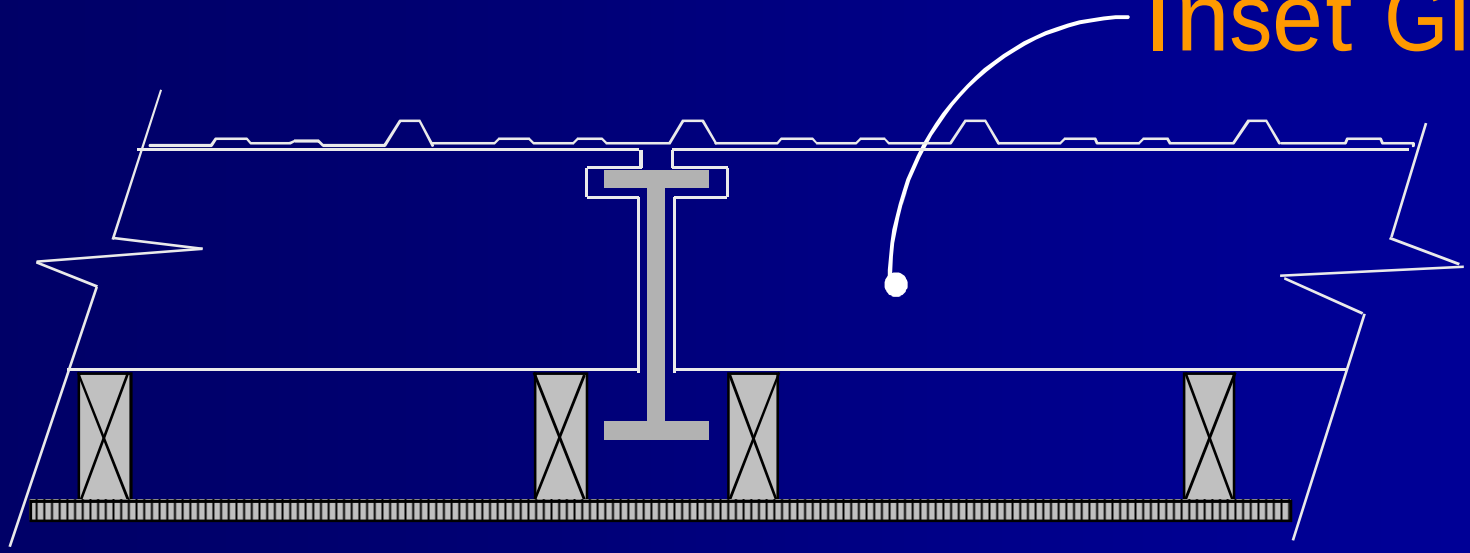
Tapered
Straight

Straight then Tapered

Column Tapered-Straight

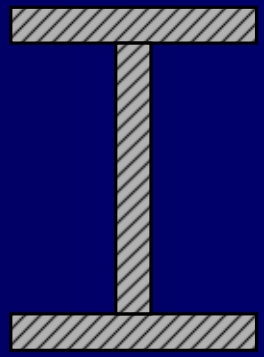


Straight Column Features & Benefits

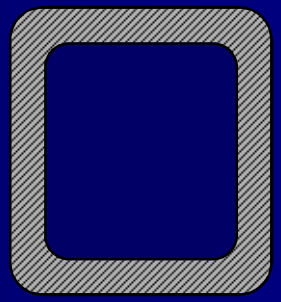


Columns can be hidden within a finished wall

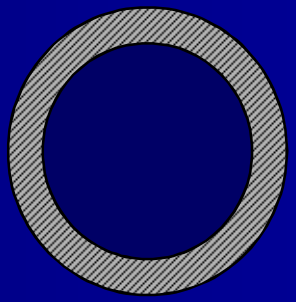
Interior Column Options



3-Plate Built-up



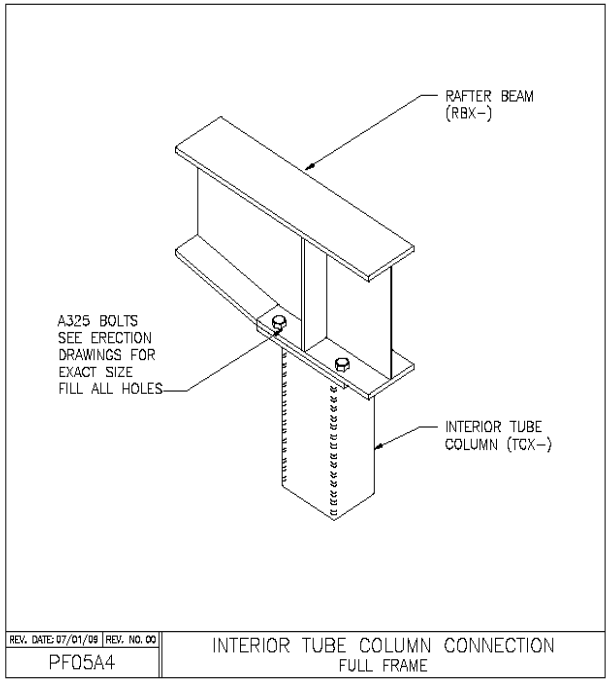
Tube (Square)



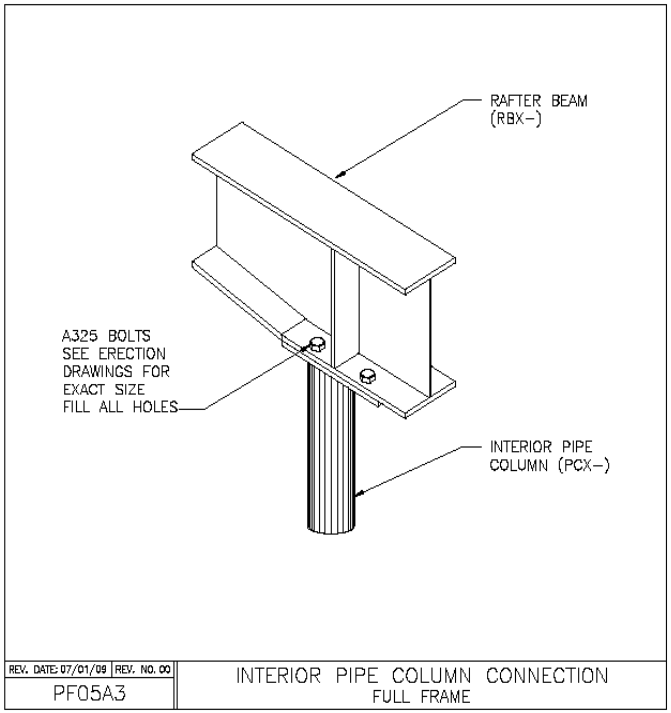
Pipe

Triangle Tube

Interior Columns



REV. DATE: 07/01/09	REV. NO. 00	INTERIOR TUBE COLUMN CONNECTION FULL FRAME
PF05A4		



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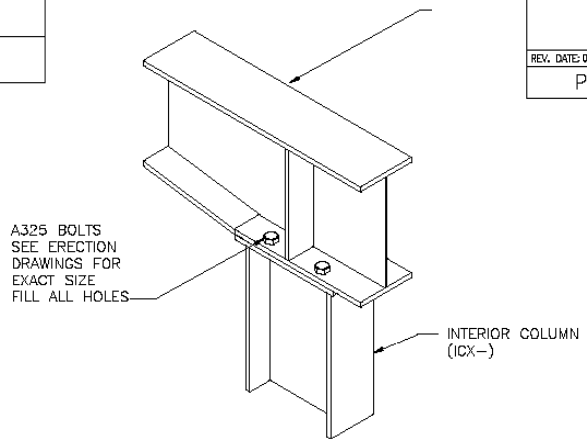
PF05A3		



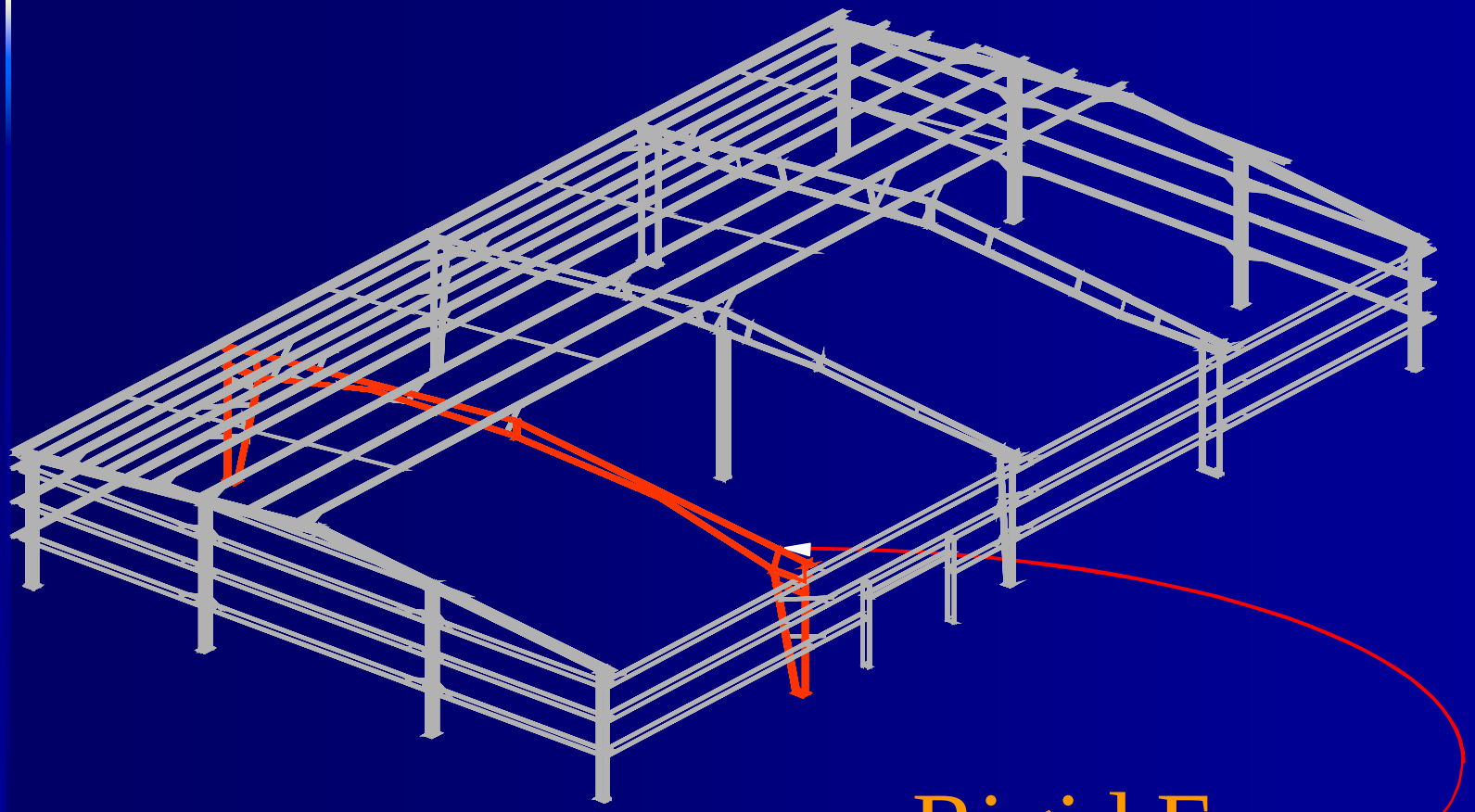
REV. DATE: 07/01/09	REV. NO. 00	INTERIOR COLUMN CONNECTION FULL FRAME
PF05A1		

Interior Column - Pipe

Primary Frames

Rigid Frame

Rigid Frames

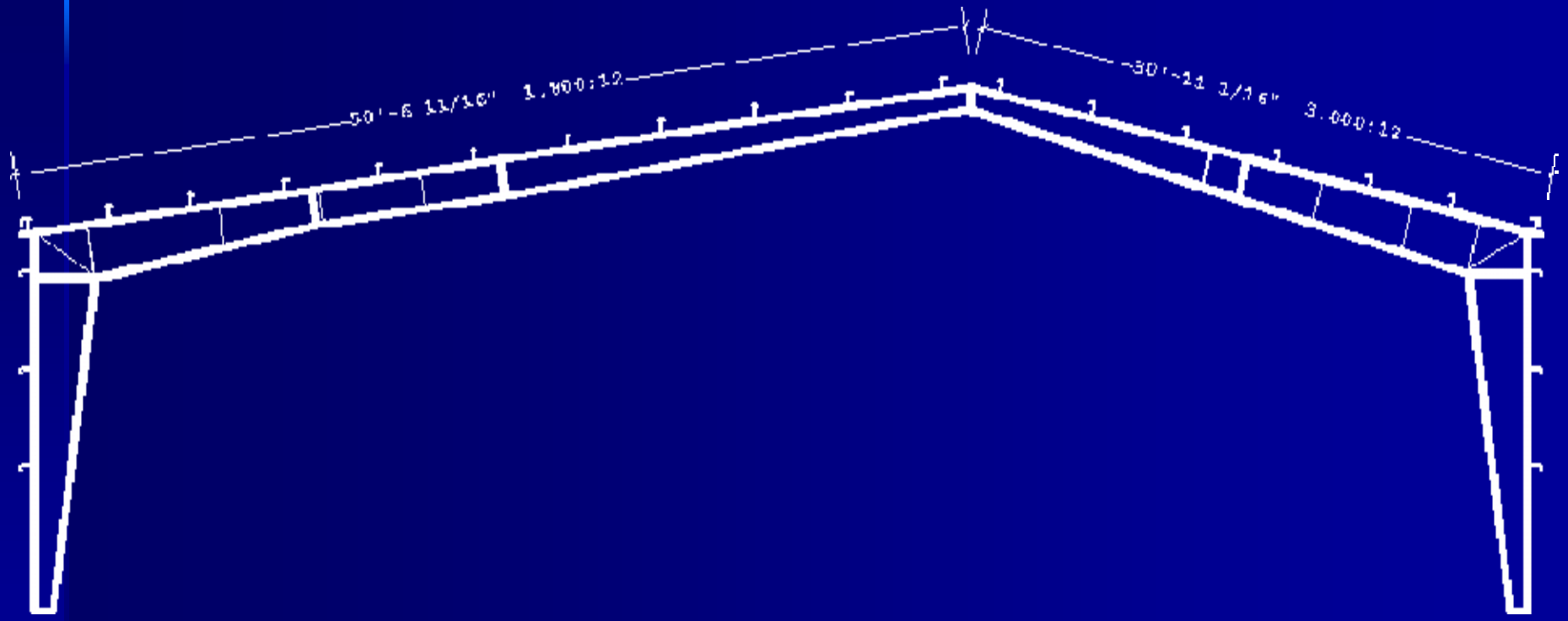


Rigid Frames (with crane brackets)

Rigid Frame Cross Section

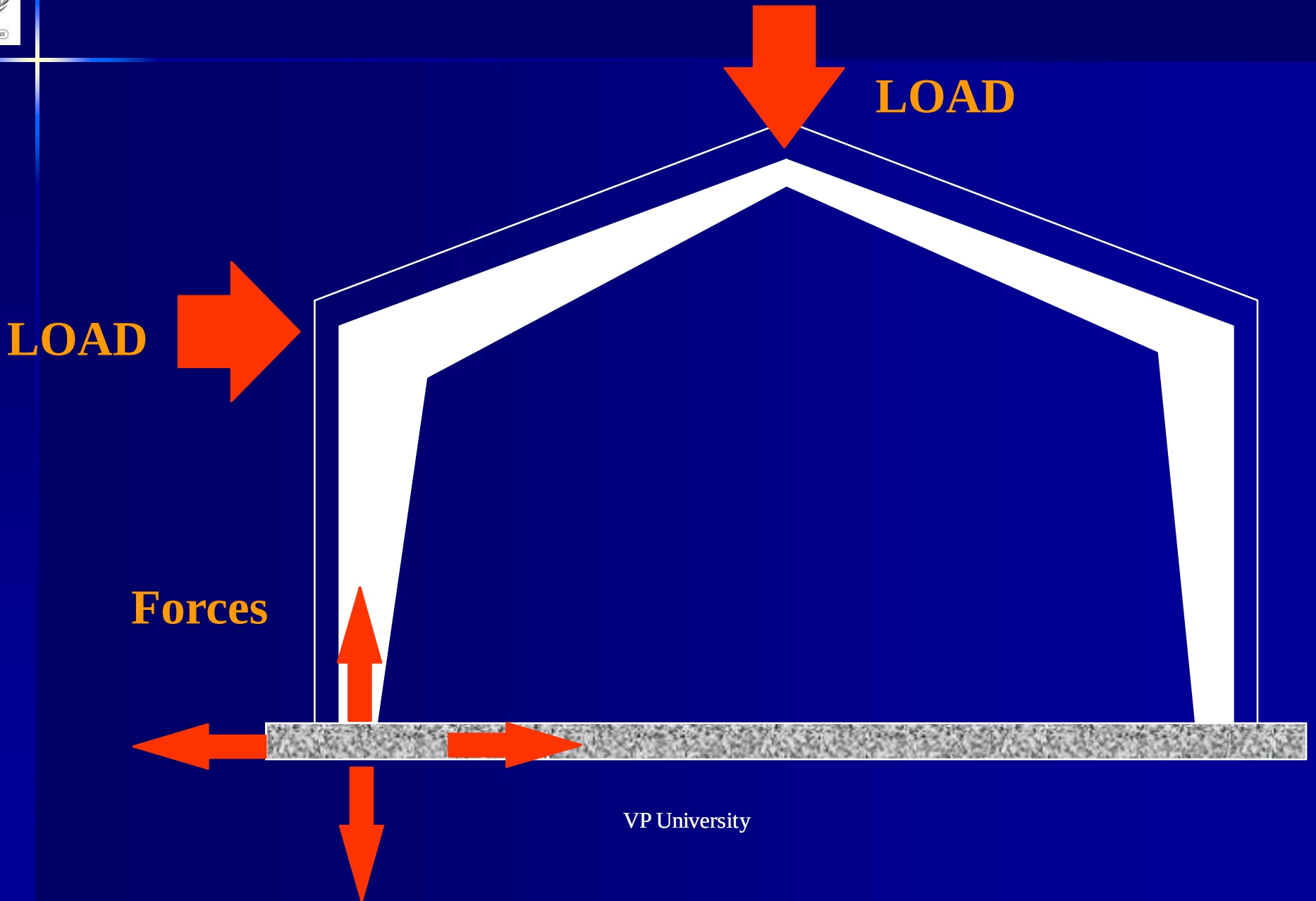
When a “CLEAR SPAN” is required

RF with an Offset Ridge



RF Single Slope

Loads to the Foundation

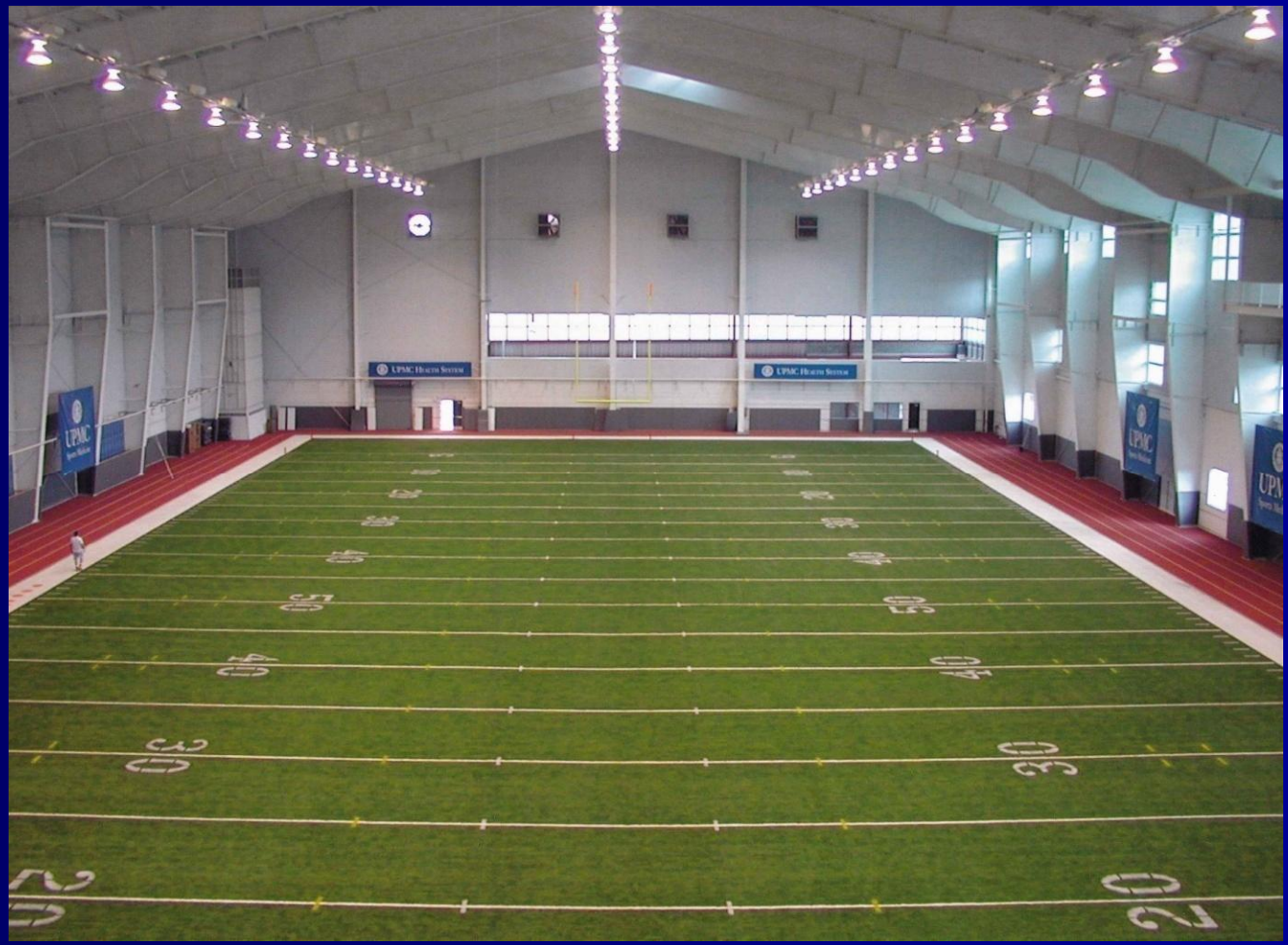


Anchor Bolts

Rigid Frames
Features & Benefits

- Why or when should this type of frame be used?
  - When CLEAR SPANS are required
- How wide can a Rigid Frame be?
  - VP has done them up to 300' wide

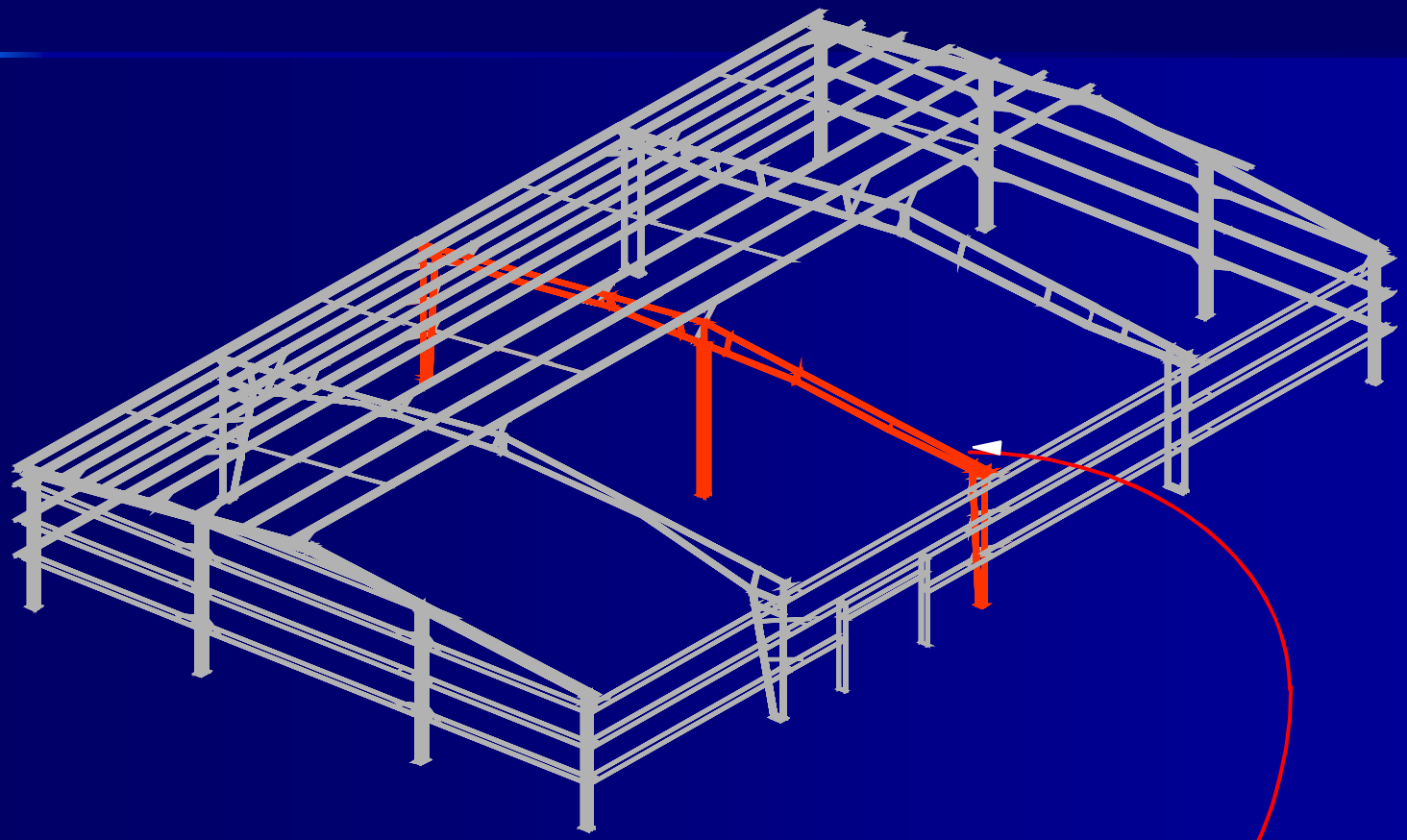
RF (Pitt Panthers)



Baumer Construction
Ft. Laramie, Ohio
Hickory Hill Concert Pavilion

Continuous Beam

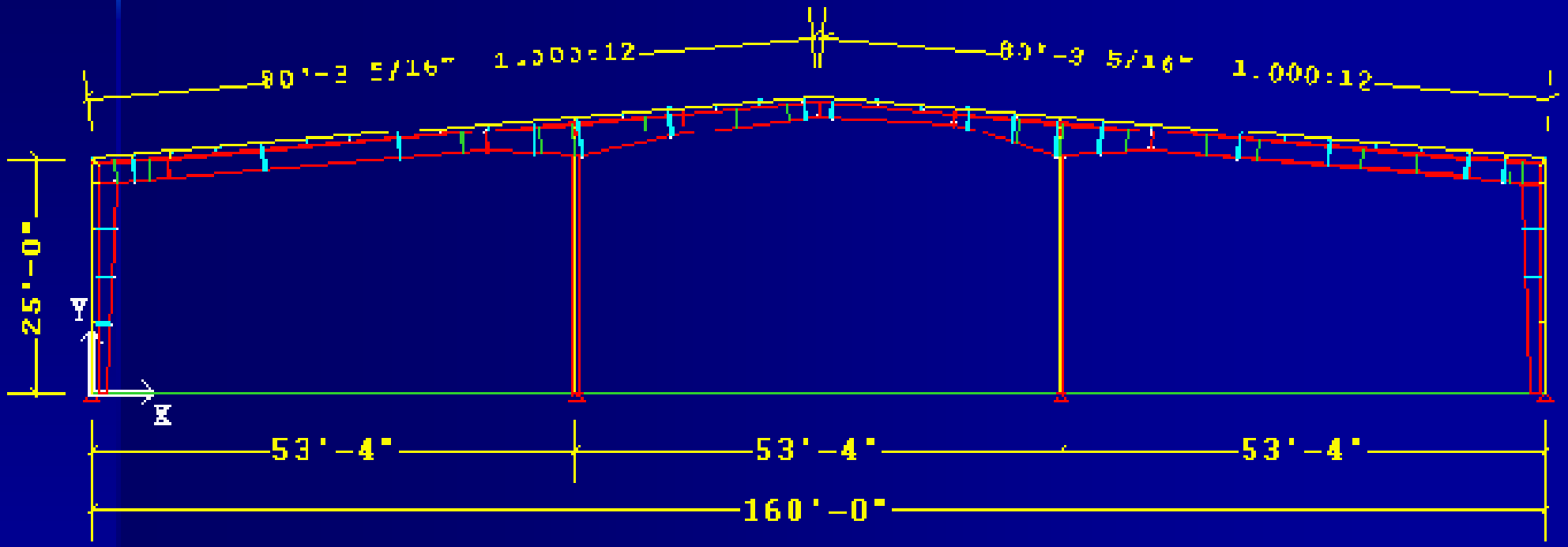
Continuous Beam Frames



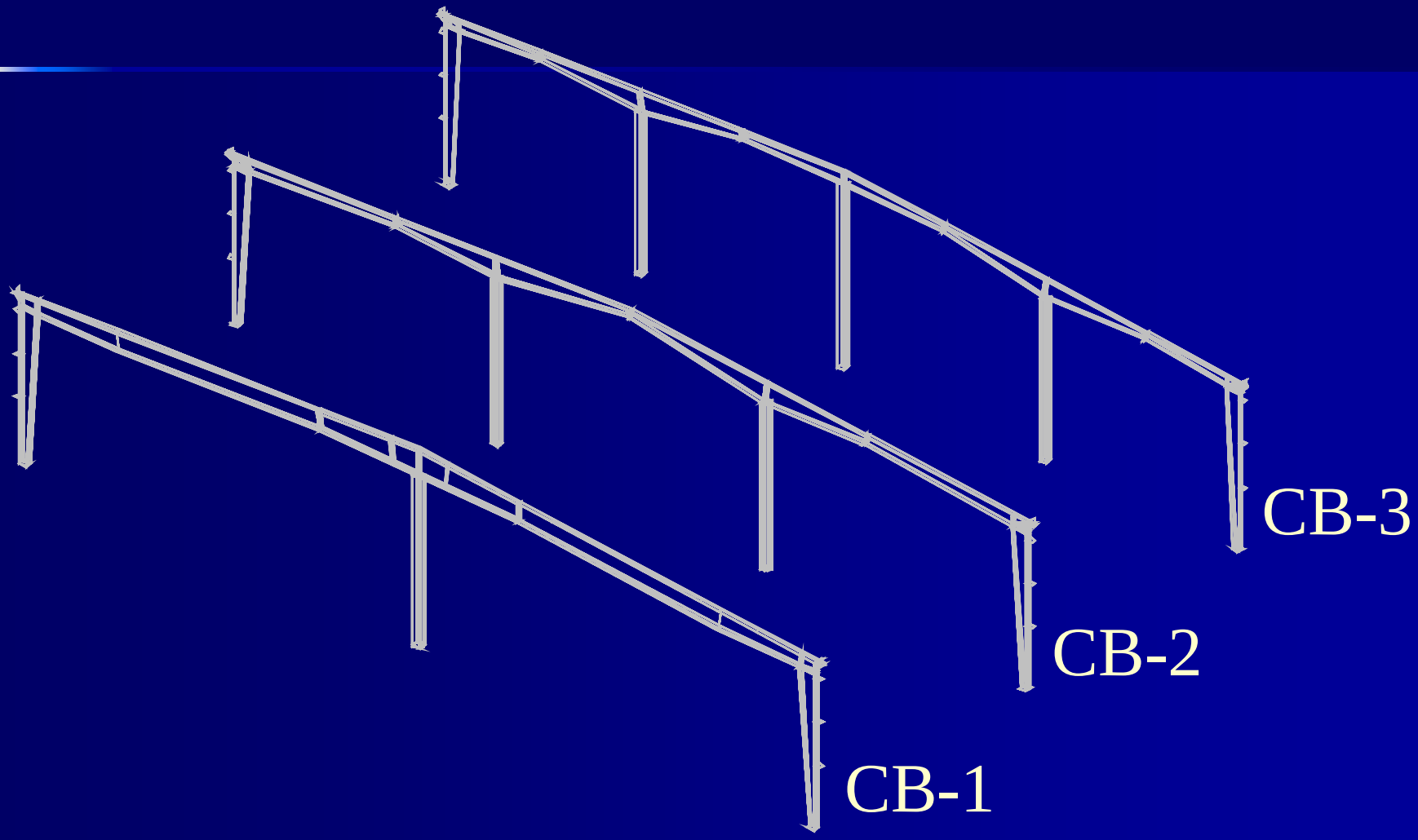
Continuous Beam Frame (CB-1)

Continuous Beam Frames

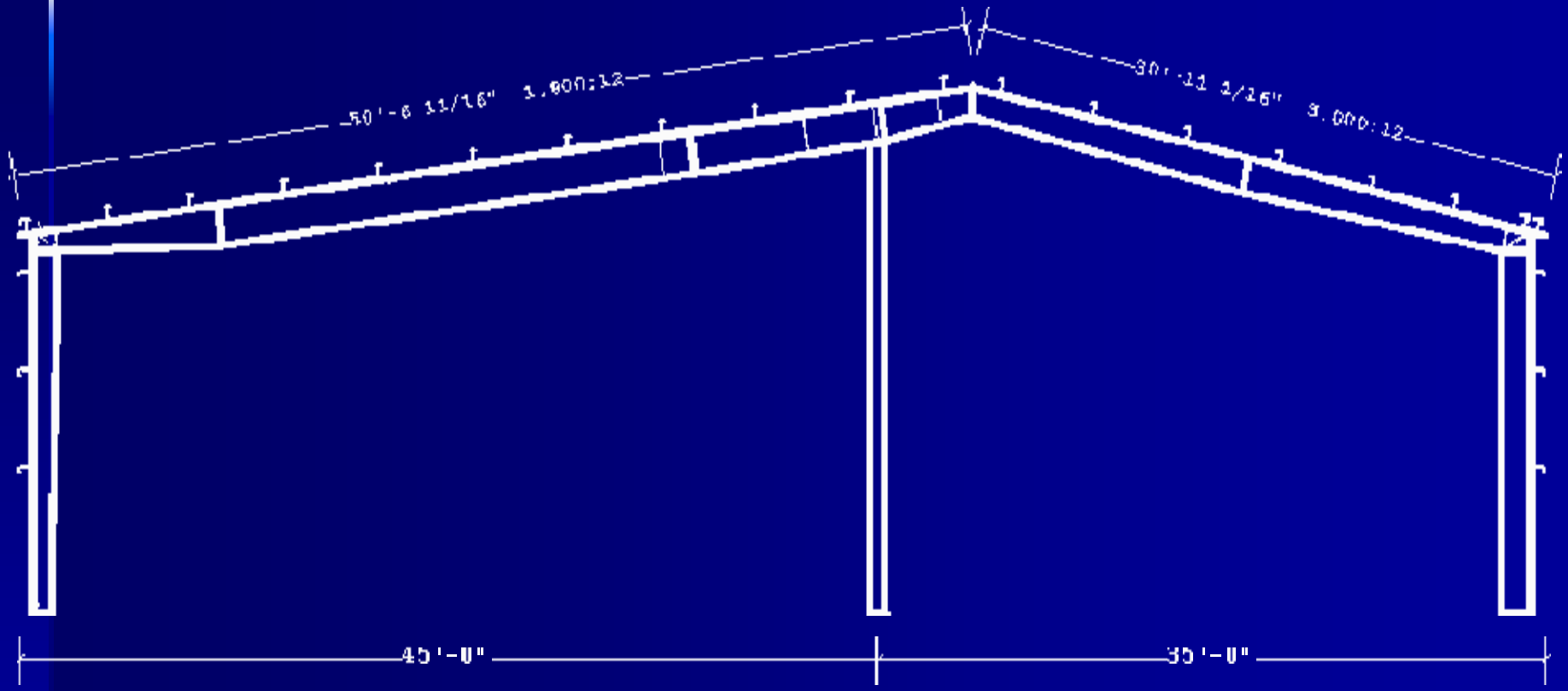
Continuous Beam Frame



Continuous Beam Frames

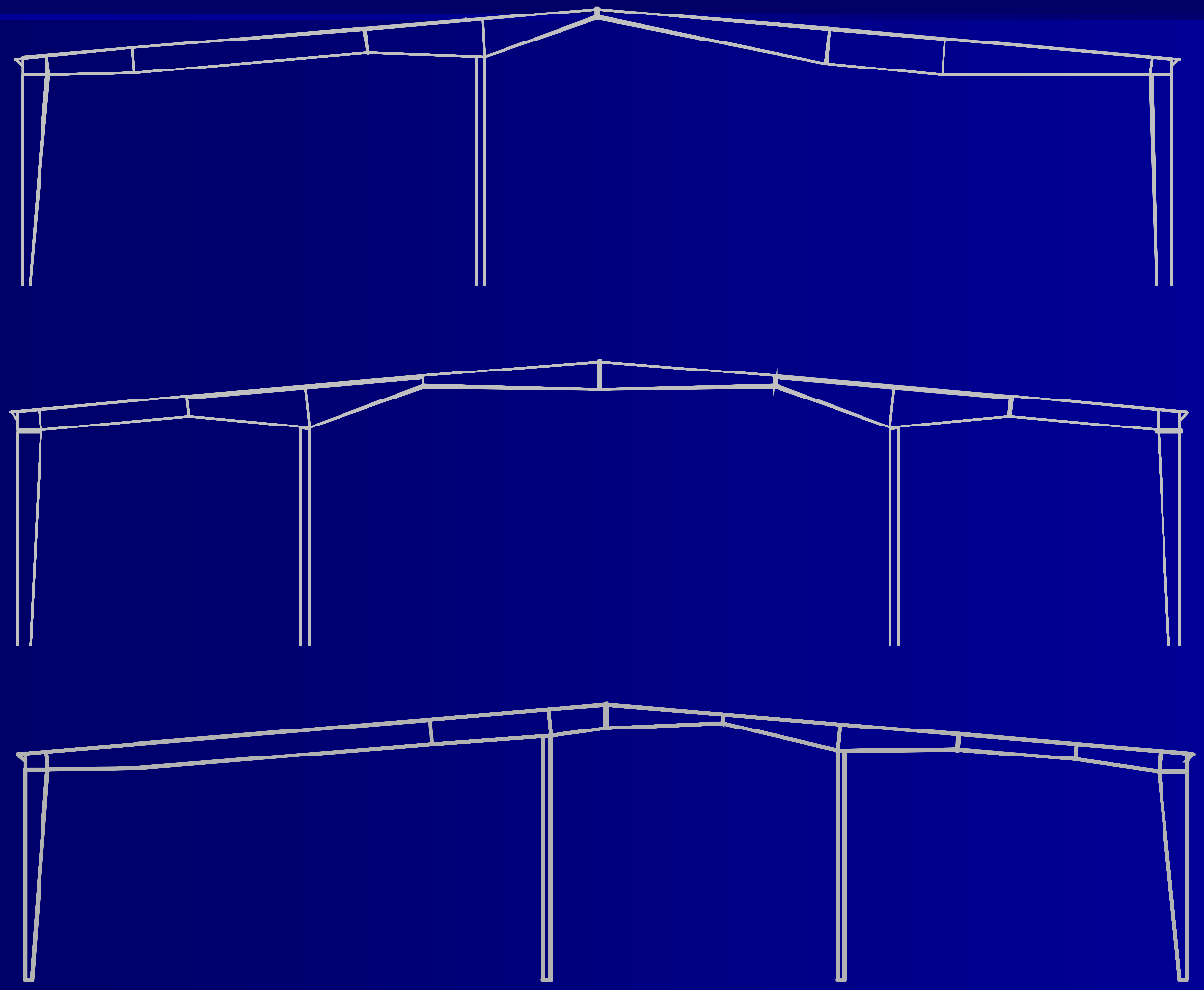


CB Frame w/ Offset Ridge

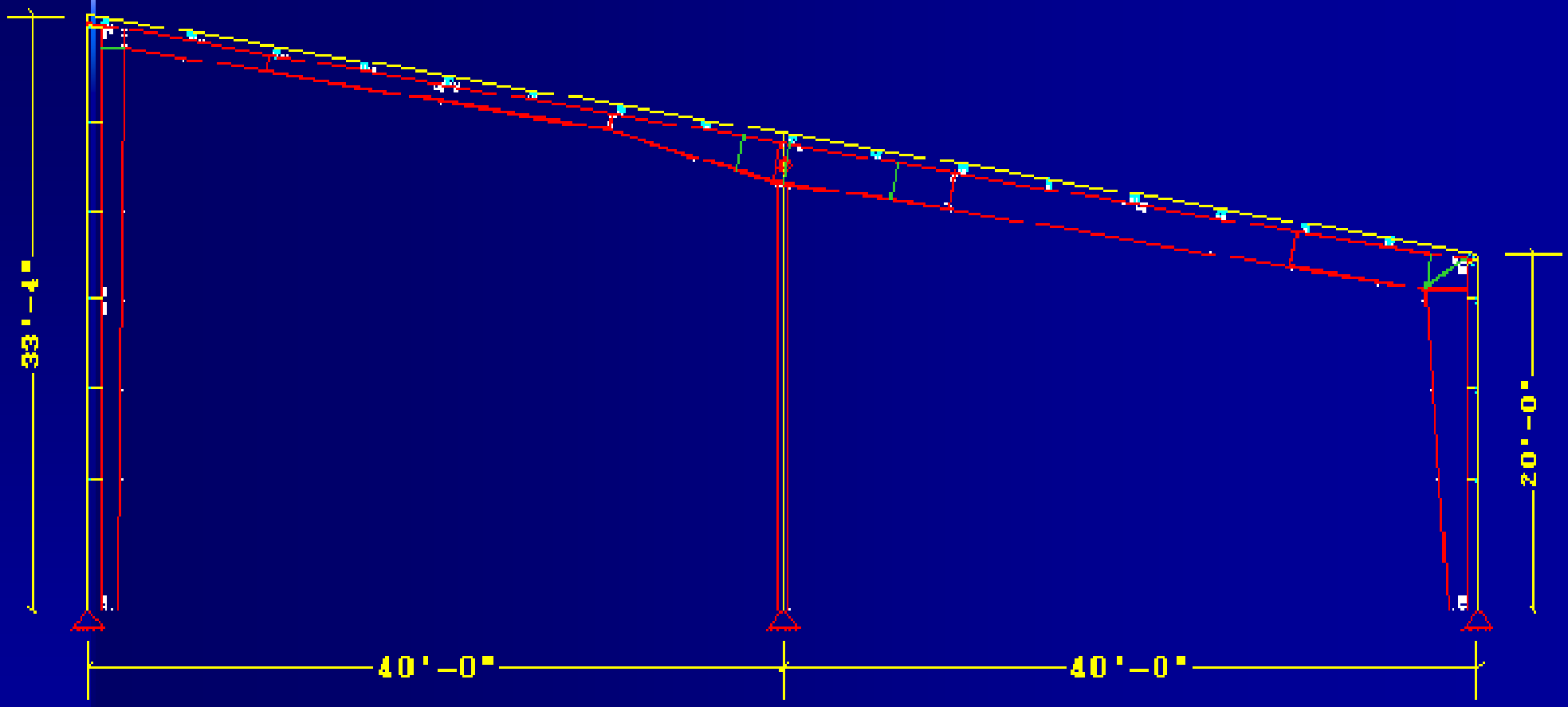


Interior Column at CB

CB Frame with Unequal Modules



CB Frame Options - Single Slope



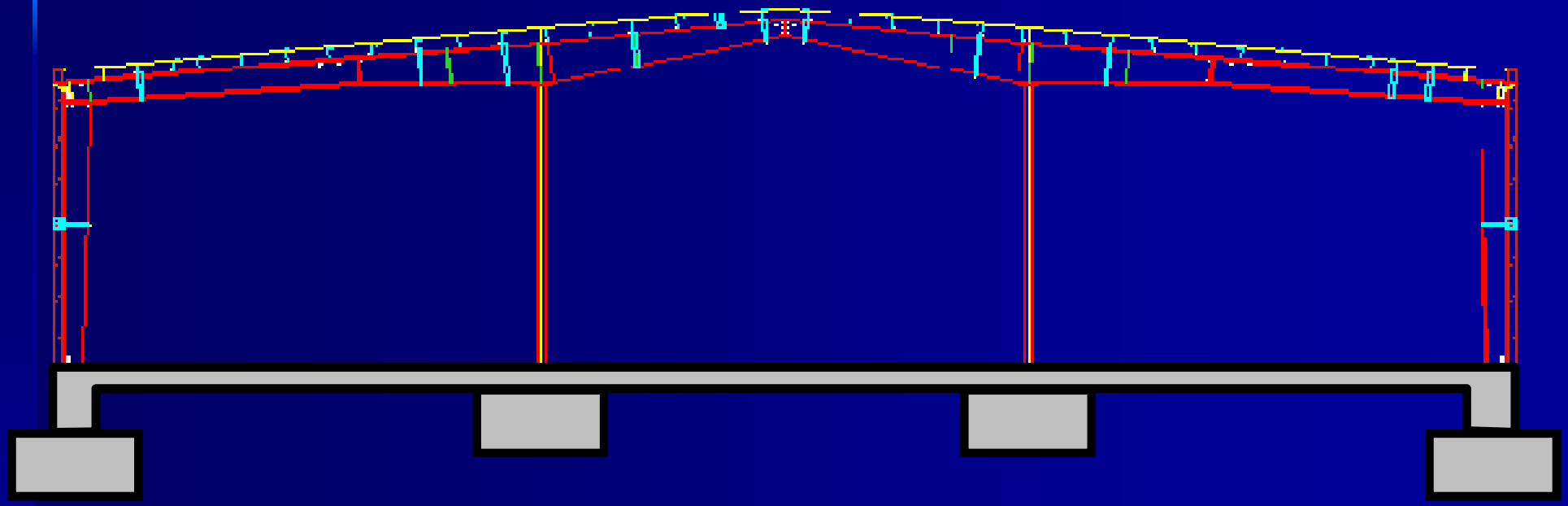
Continuous Beam Frames Features & Benefits

- When should this type of frame be used?
  - Wide Span Buildings
- What does adding interior columns do to the rafter?
  - Makes it lighter

Continuous Beam Frames Features & Benefits

- How does this affect the price of the rafter?
  - The price decreases
- How wide can a CB frame be?
  - VP has done them over 800' wide

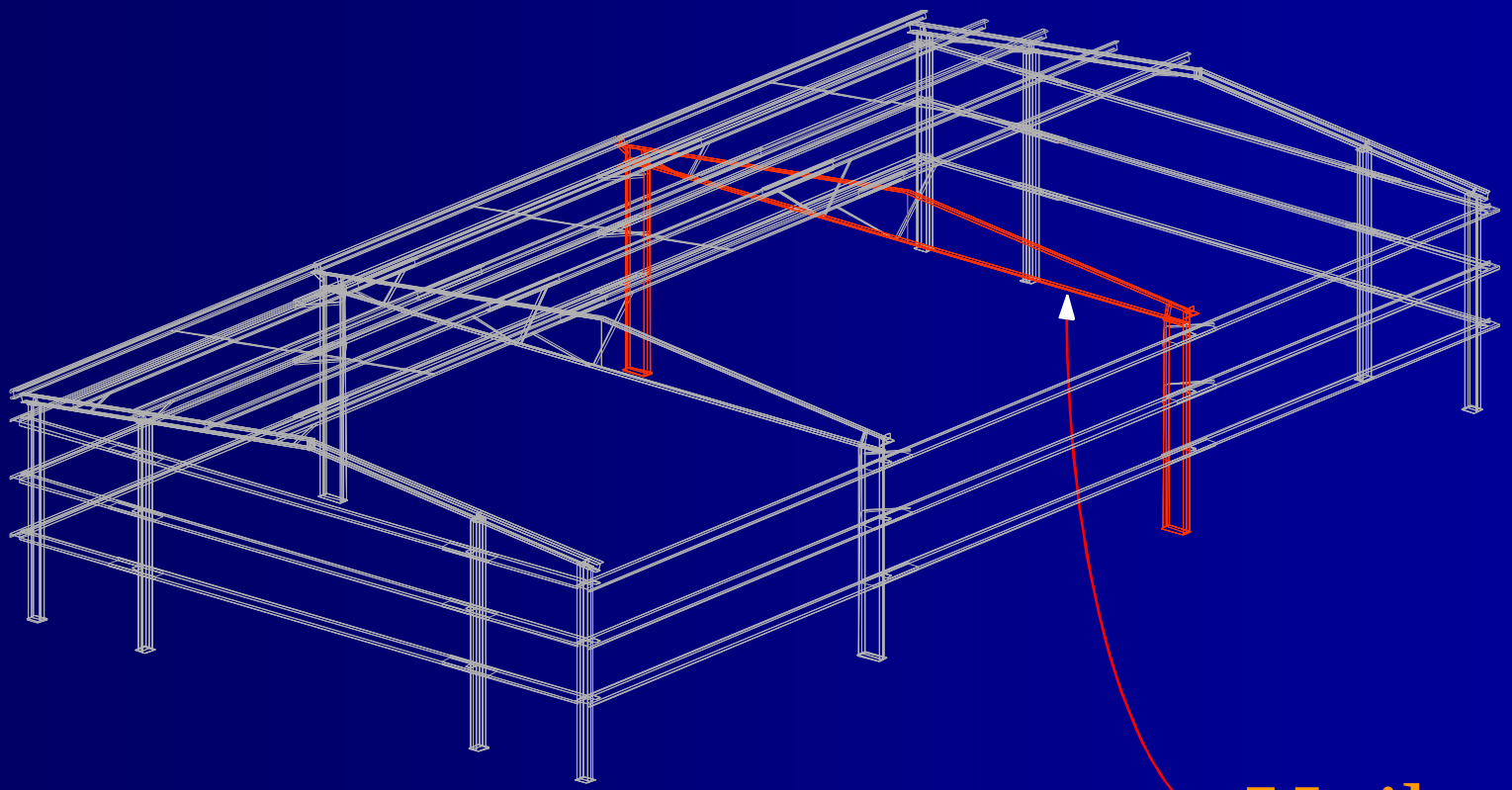
In-place Cost Considerations



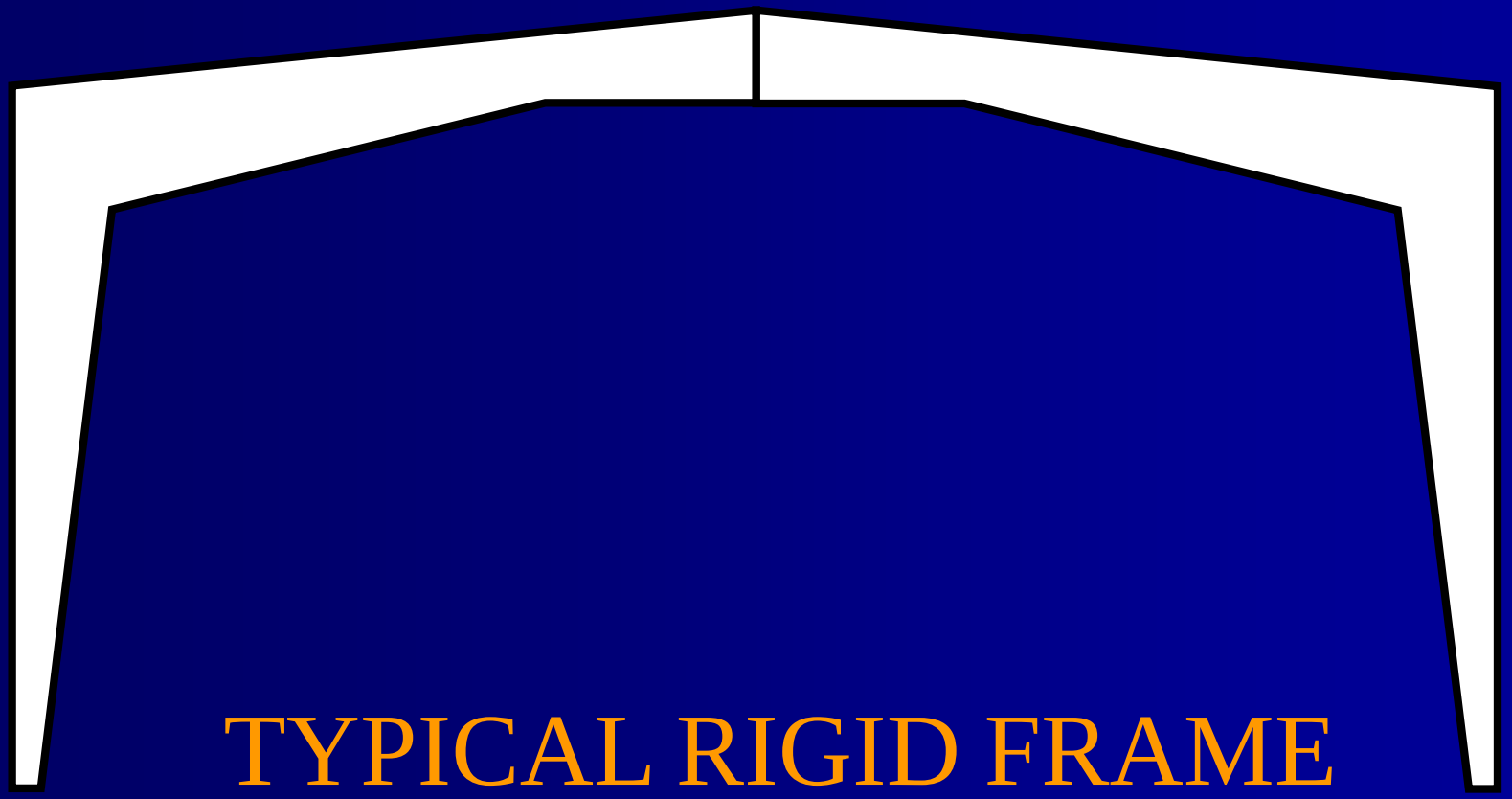
Primary Frames

Unibeam Frames

Unibeam Frames

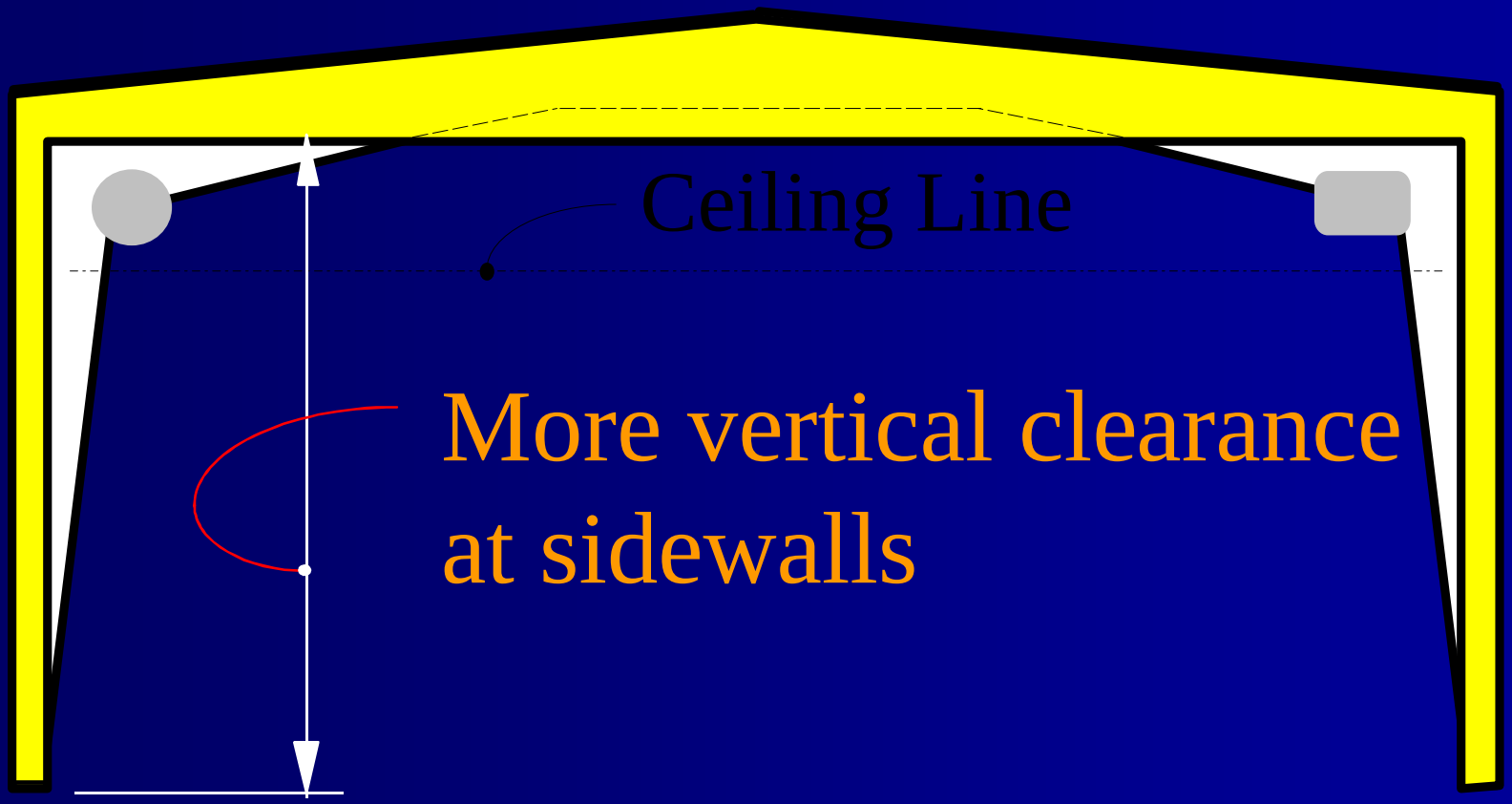


Unibeam Features & Benefits

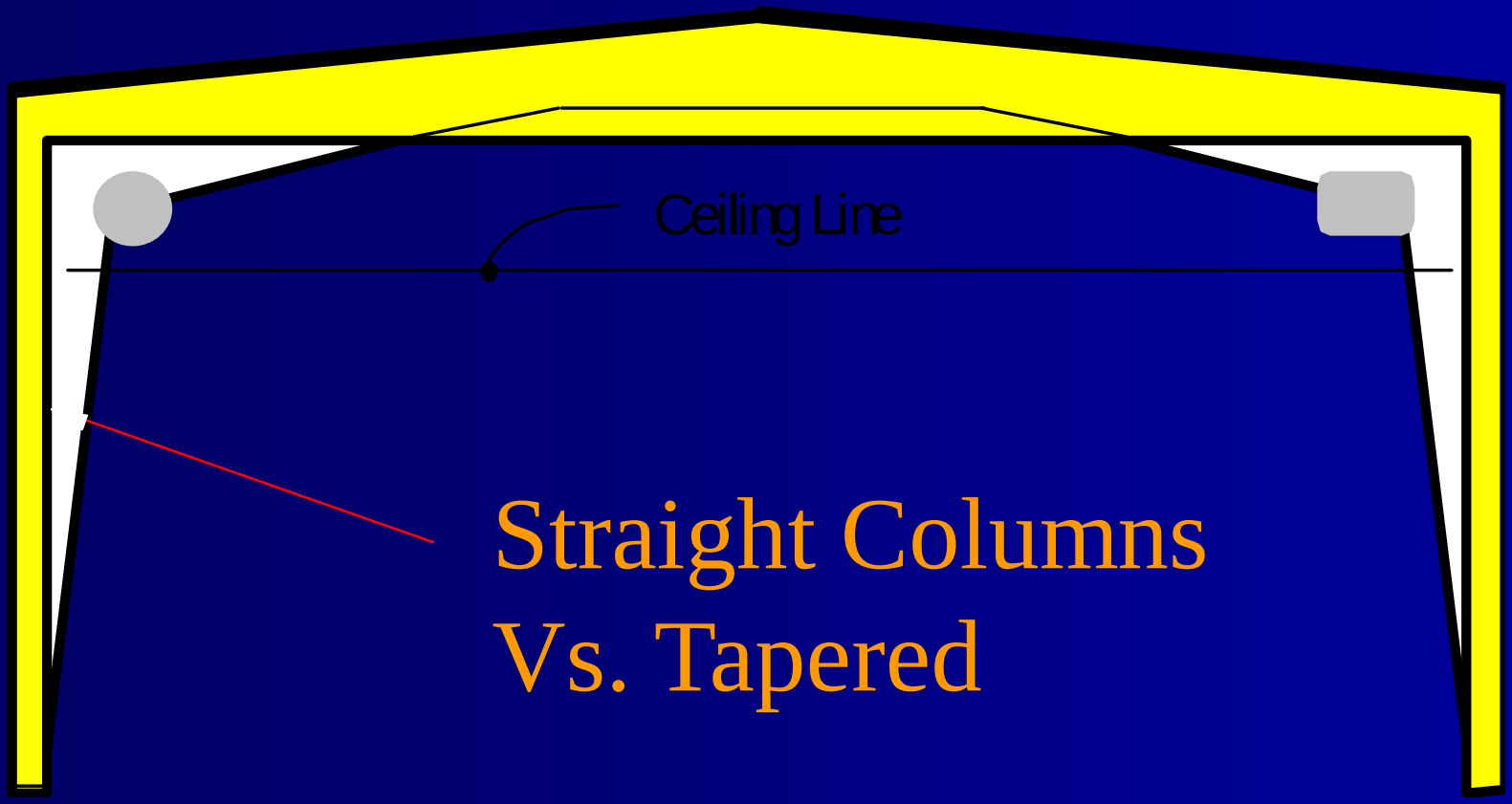


TYPICAL RIGID FRAME

Unibeam Features & Benefits



Unibeam Features & Benefits



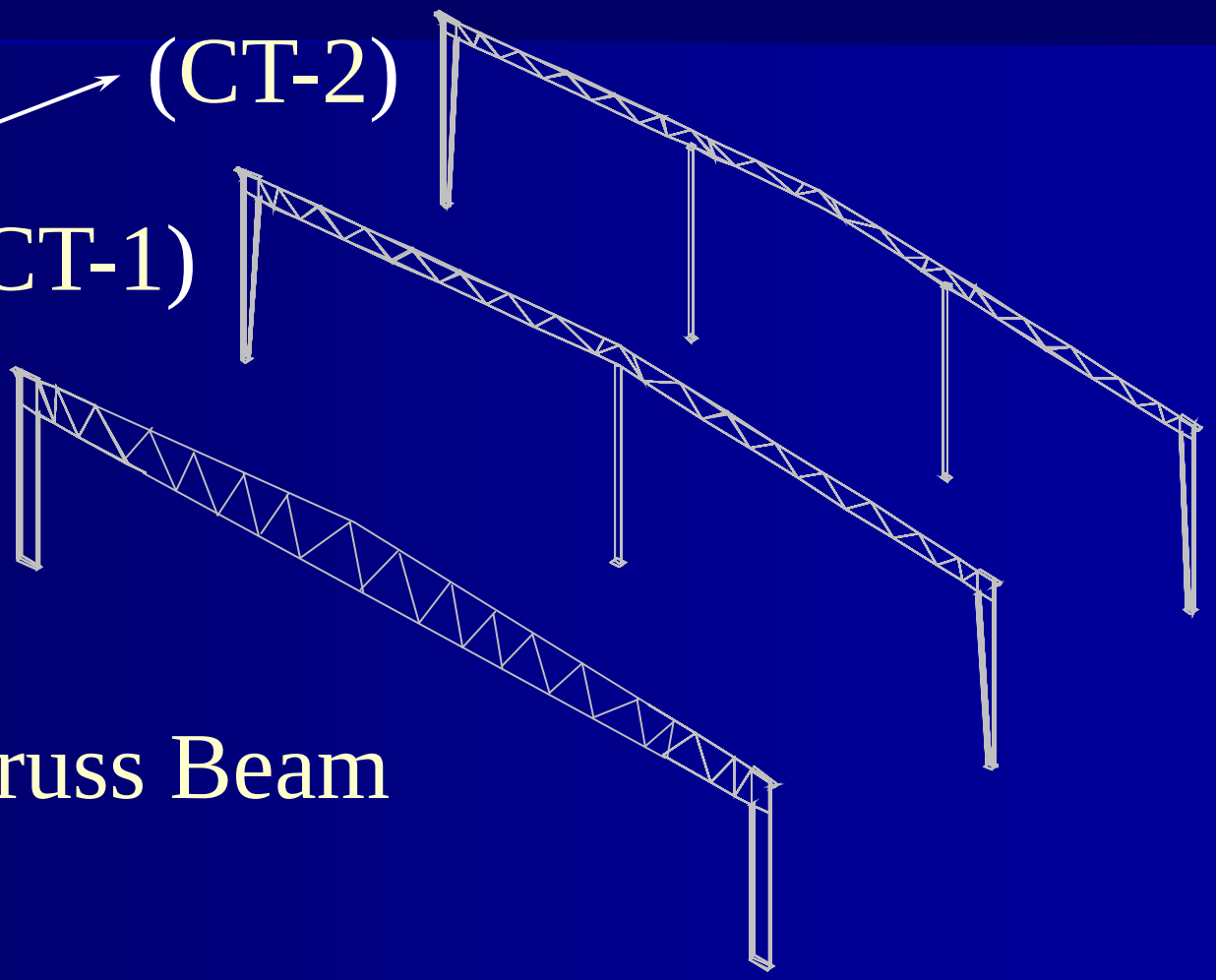
Straight Columns
Vs. Tapered

Truss Frames

Continuous Trusses

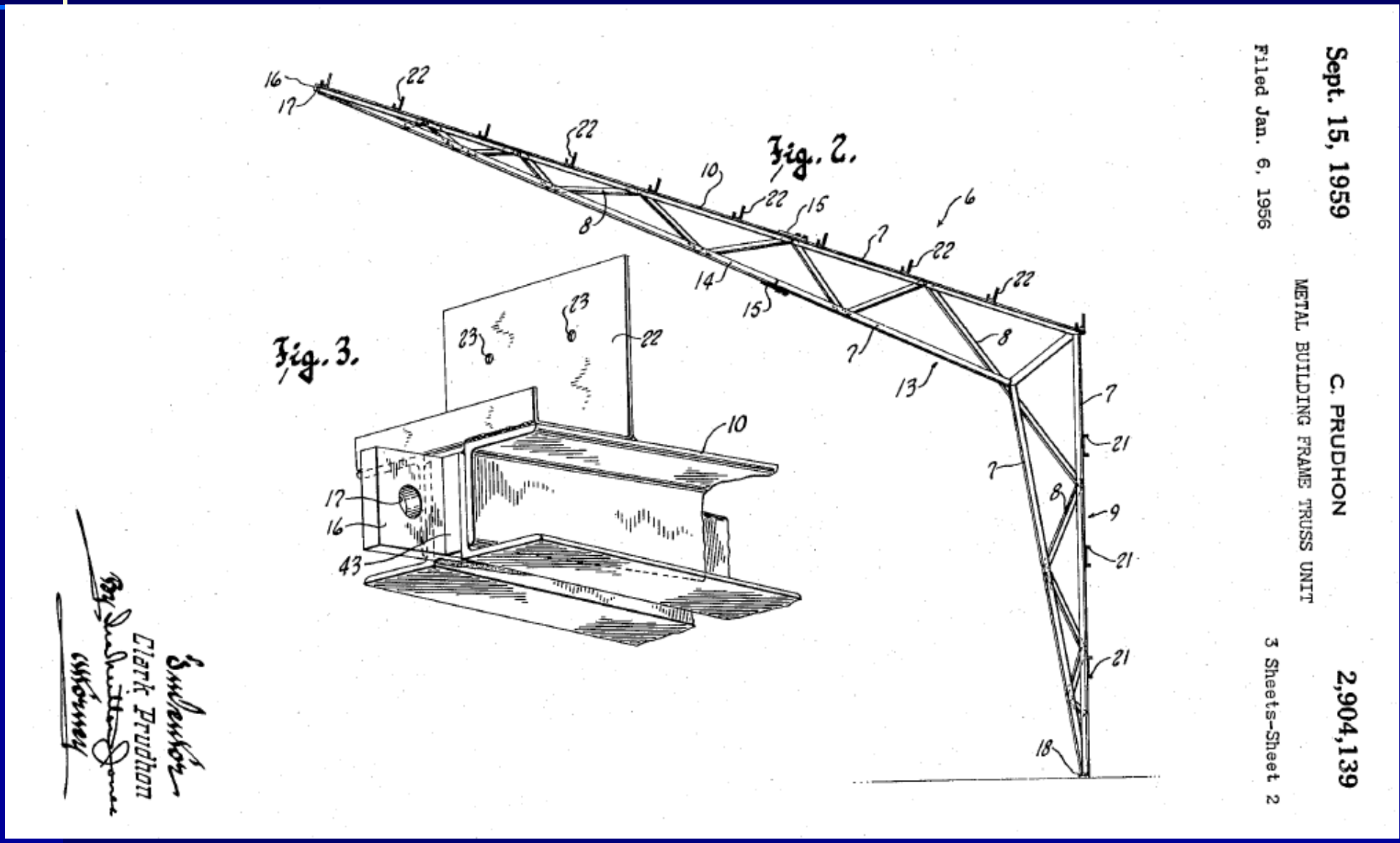
(CT-2)

(CT-1)



Truss Beam

Patent for Clark Prudhon's Truss Frame - 1959



Sept. 15, 1959 C. PRUDHON 2,904,139

METAL BUILDING FRAME TRUSS UNIT

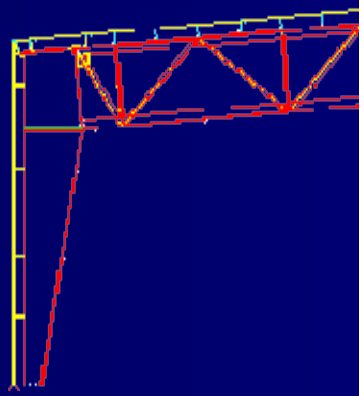
Filed Jan. 6, 1956 3 Sheets-Sheet 2

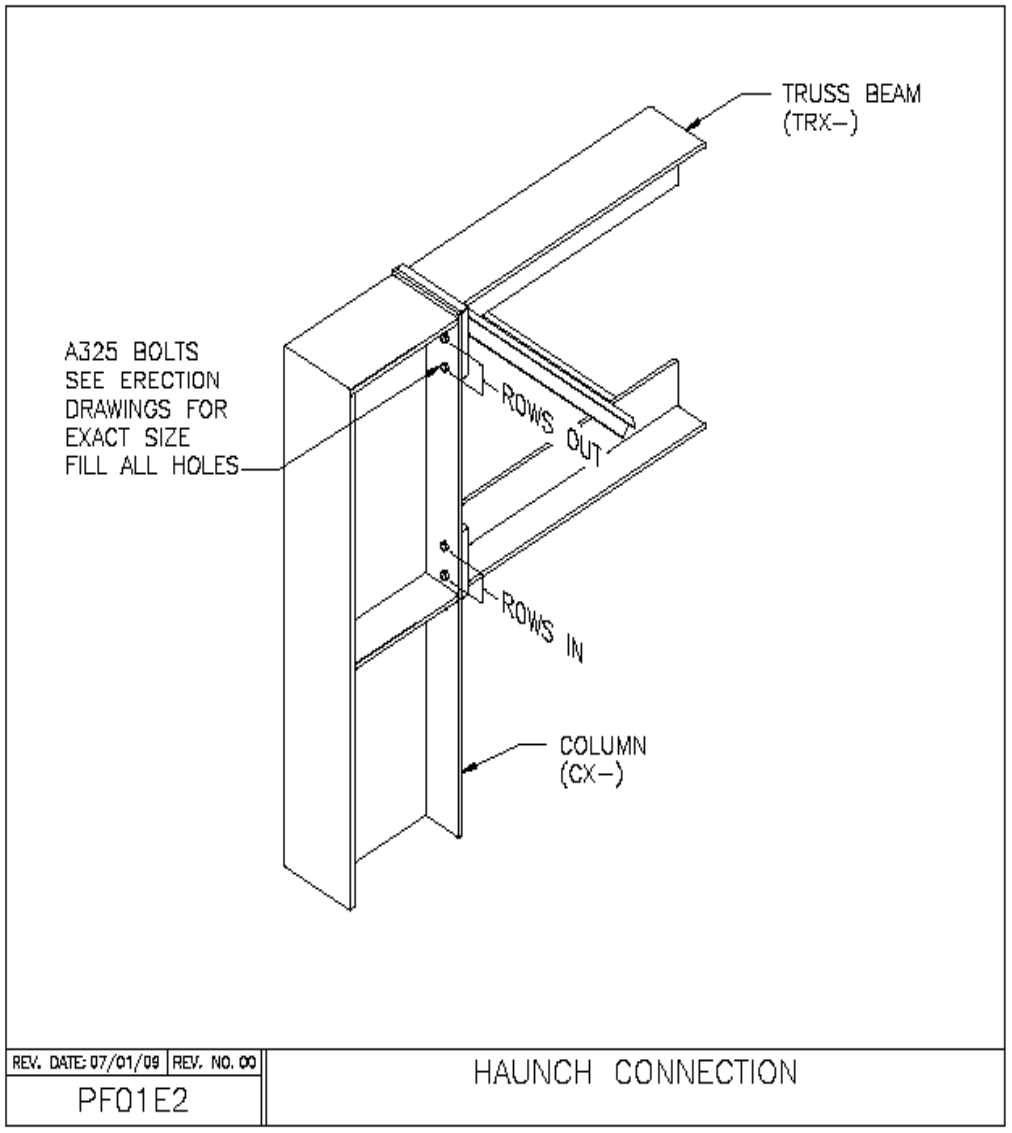
Fig. 2.

Fig. 3.

Inventor
Clark Prudhon
By Pushman Jones
Attorney

Rigid Frame Truss






JLG
03/24/2003 12:3

Open Web To Column

Open Web Rafter

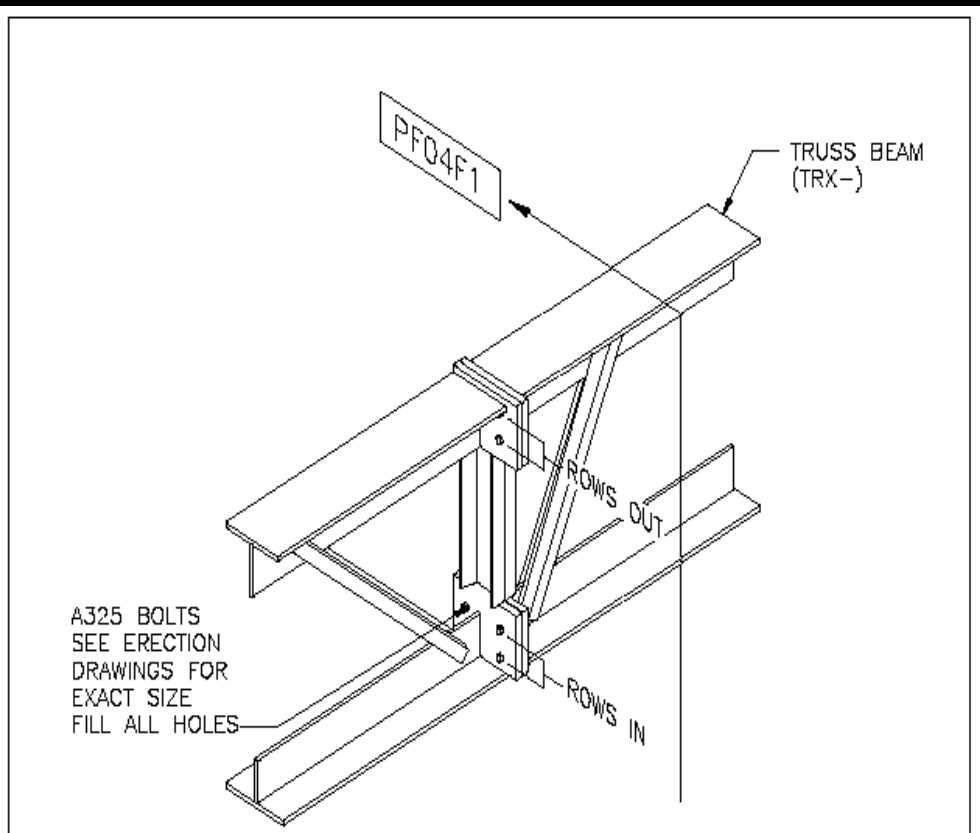
Open Web Rafter

Rigid Frame Truss

Truss Beam

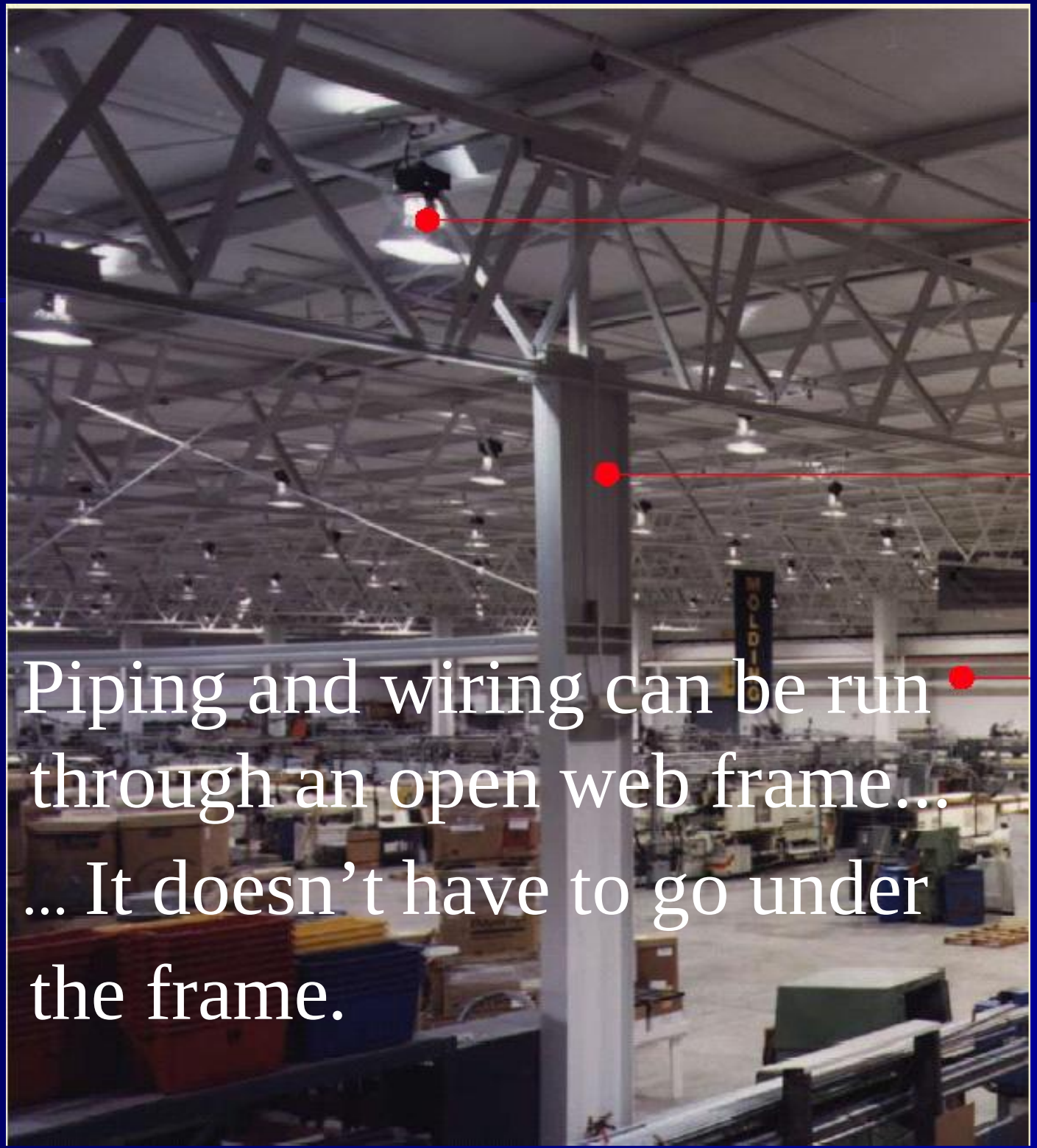
- Straight Columns
- Flat Bottom

Continuous Truss



Continuous Truss

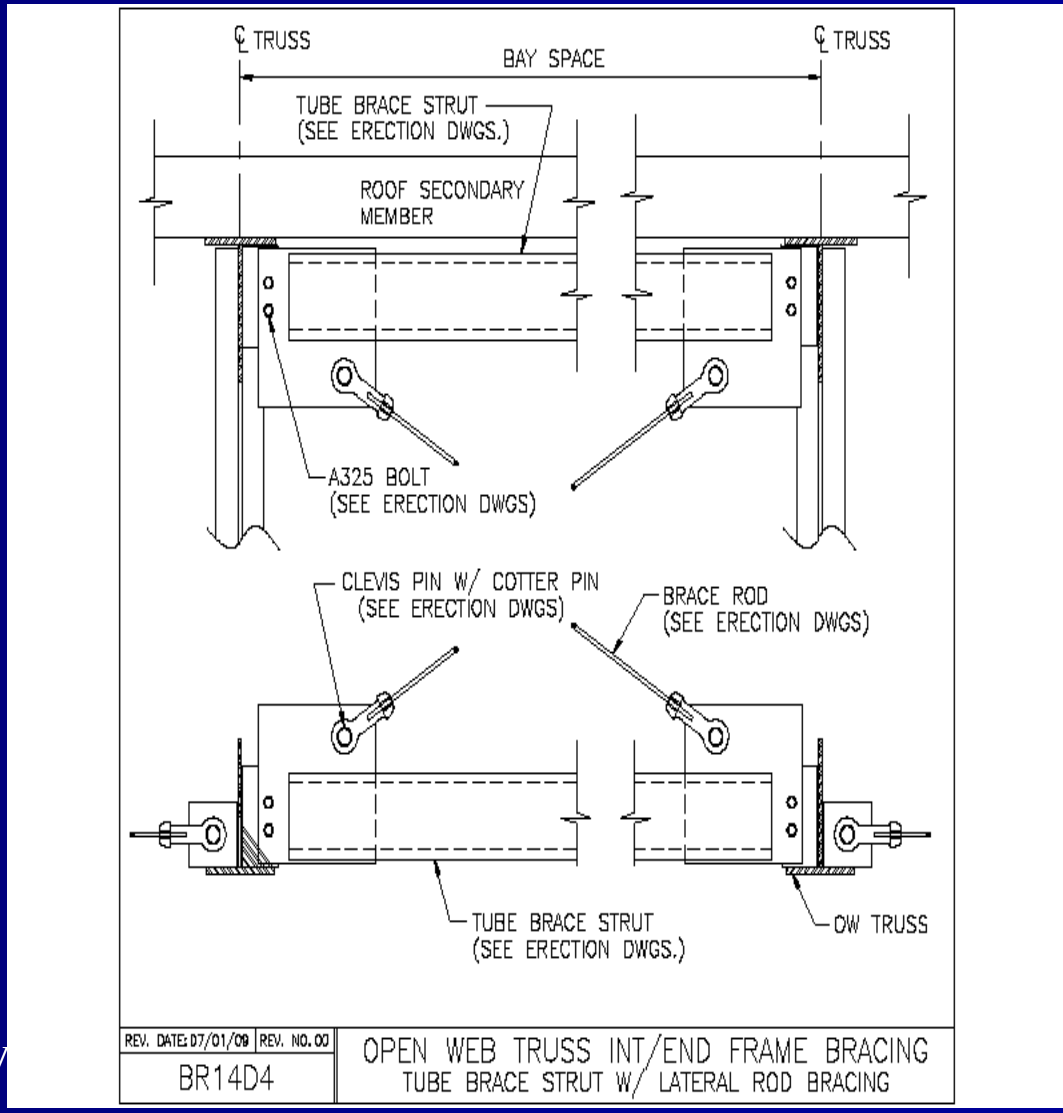
The Open Web Advantage



Gambrel-Open Web

Open Web Considerations

- Manufacturing availability varies by Service Center
  - Alabama and Wisconsin
- Lateral Bracing to bottom cord
- Economical for large span and large interior grids



Crane – VP / Hybrid


N717DX

Sample Project

180 x 350 x 20

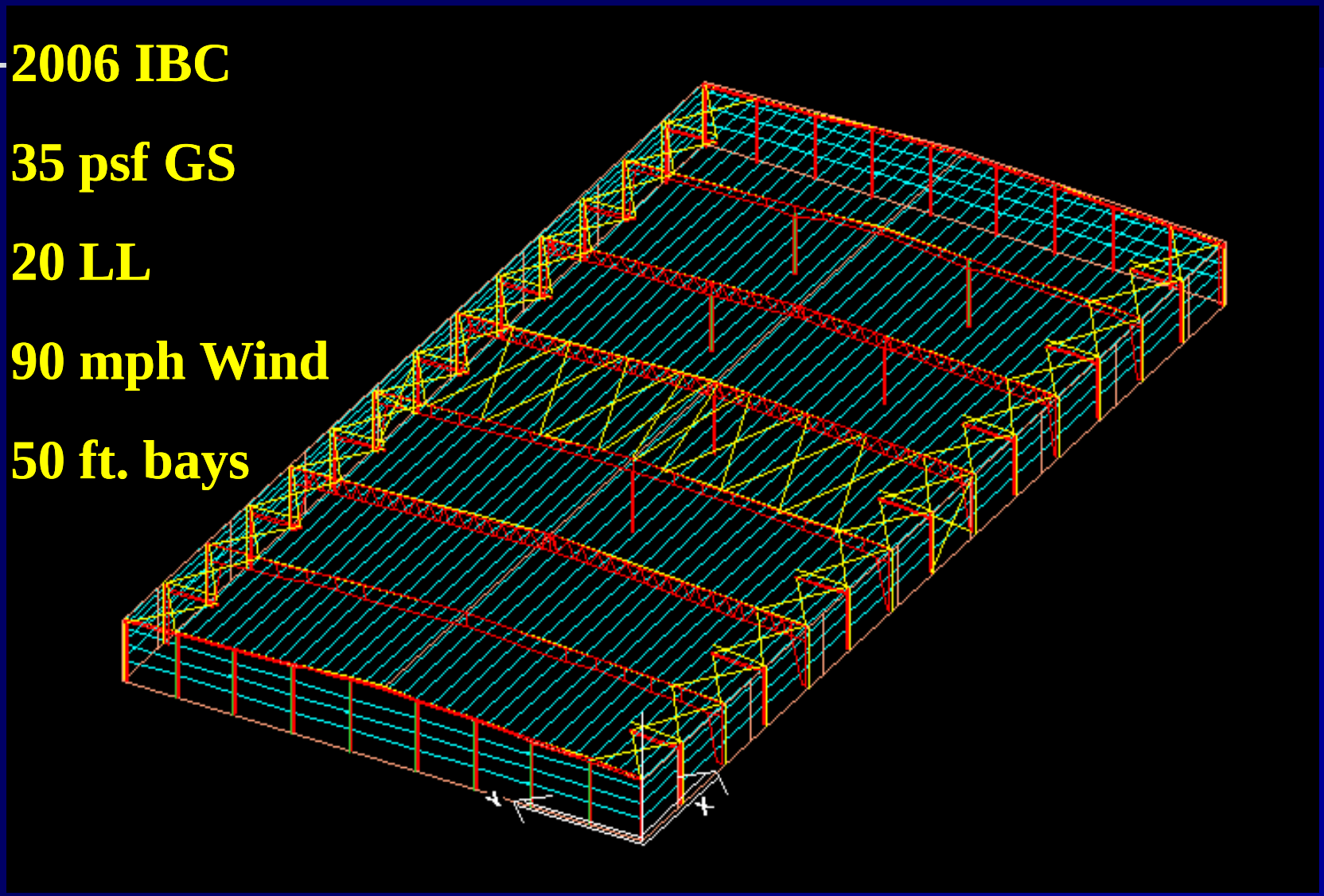
2006 IBC

35 psf GS

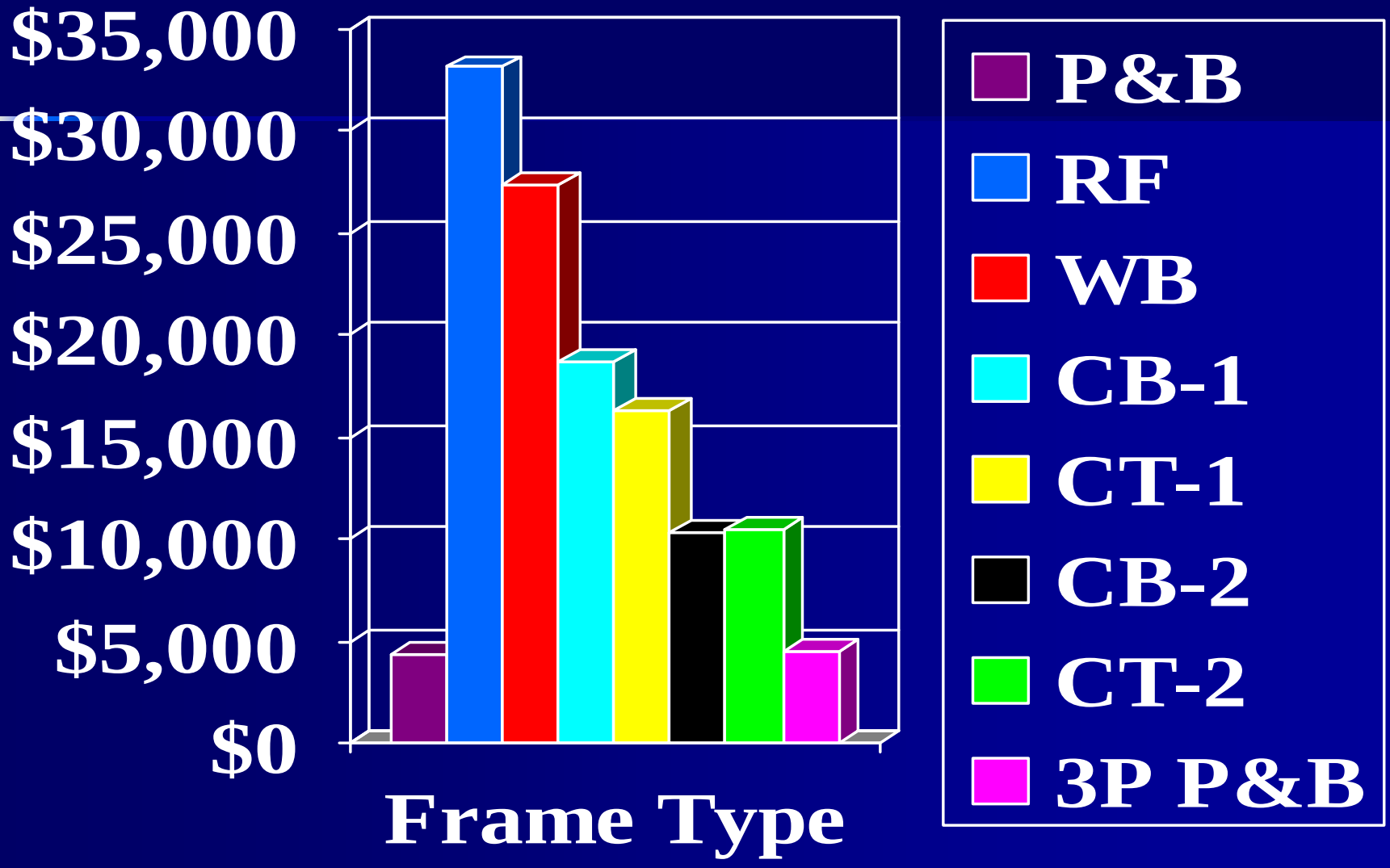
20 LL

90 mph Wind

50 ft. bays



Frame Comparisons

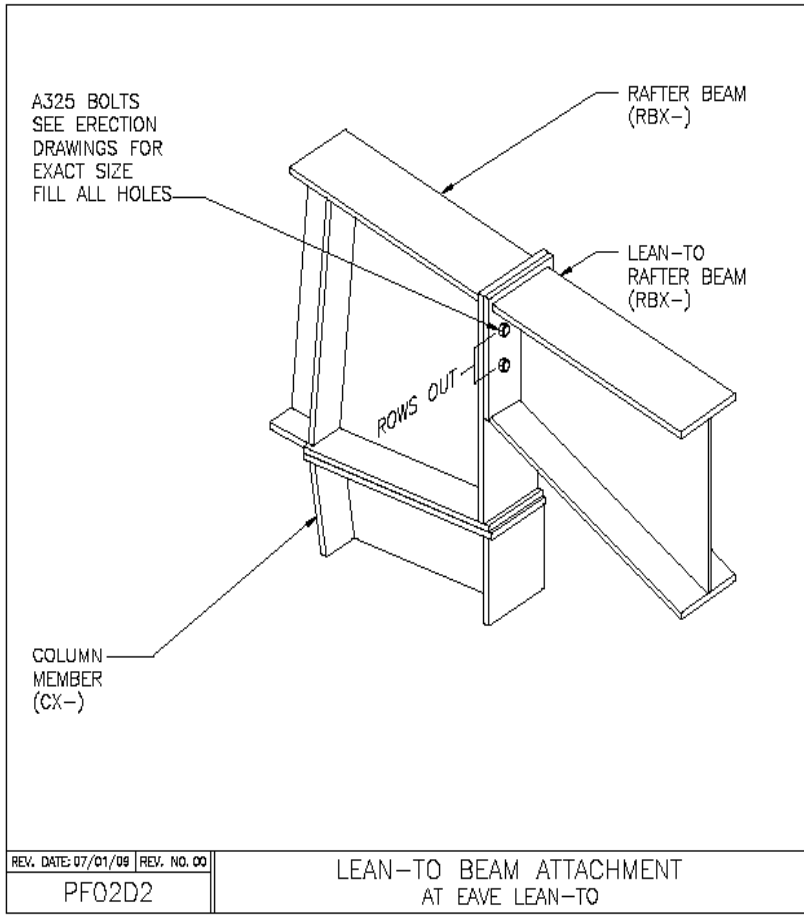


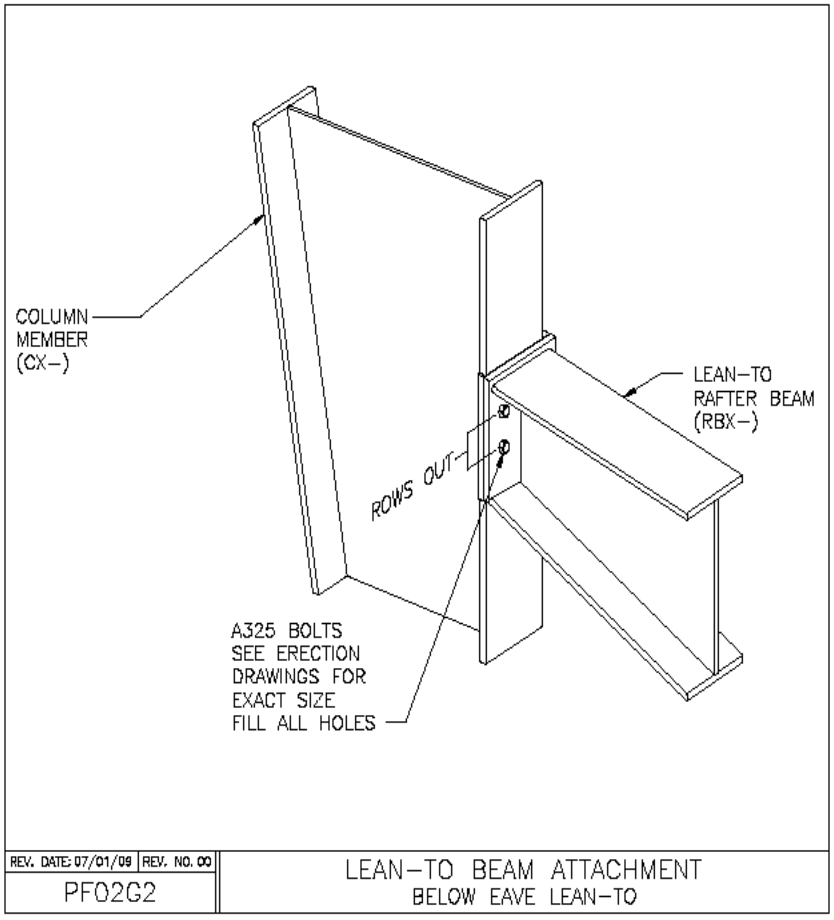
(Non-discounted prices shown)

Primary Frames

Lean-to Frames

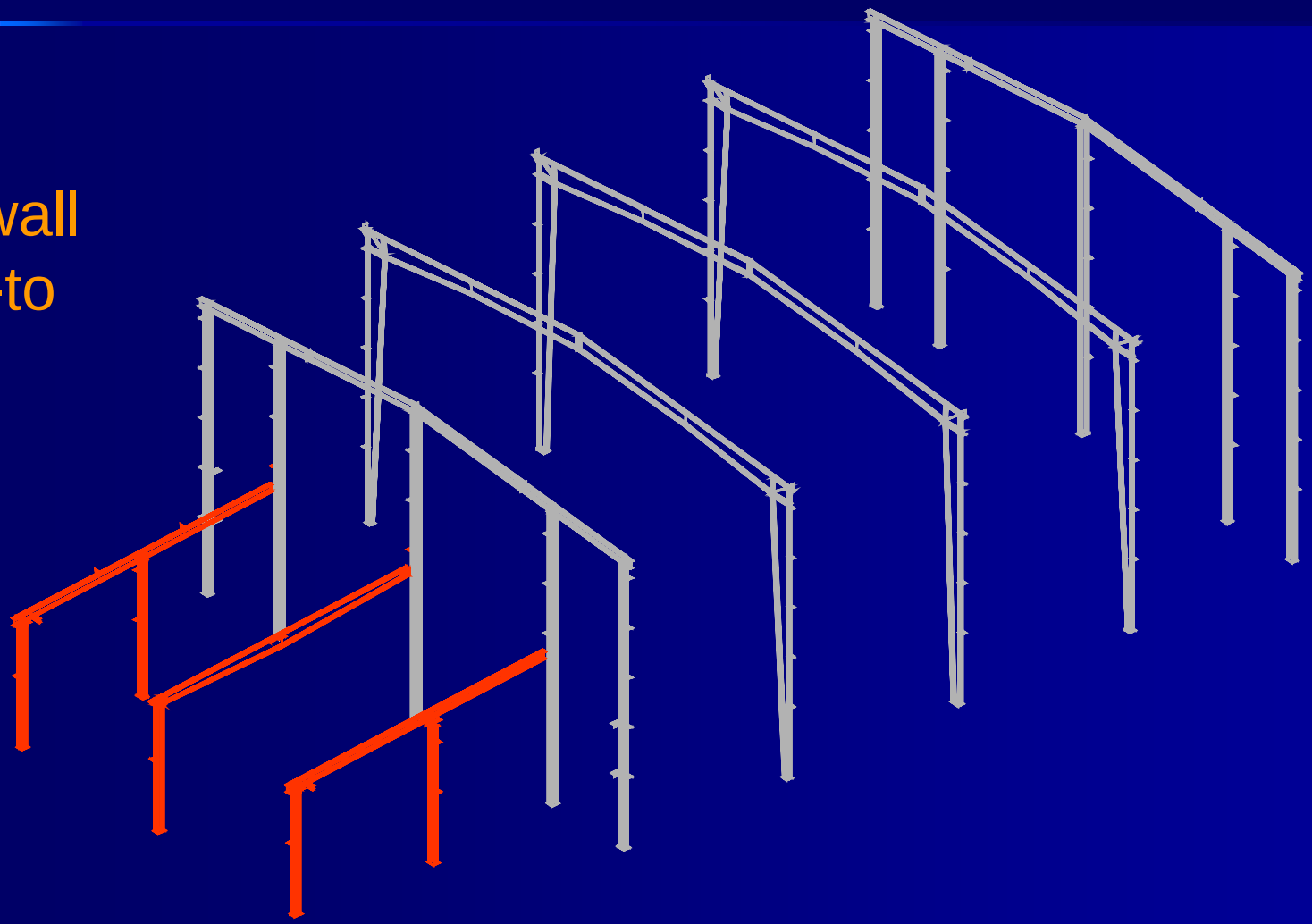
Lean-To Frames



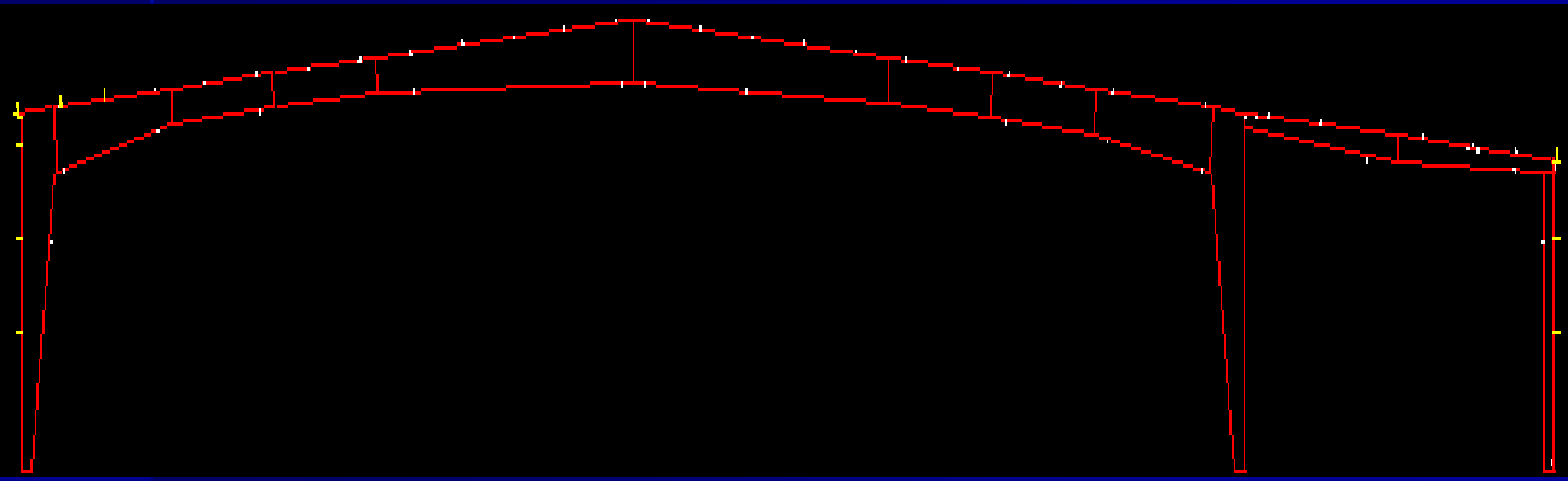


Endwall Lean-To

End wall
Lean-to



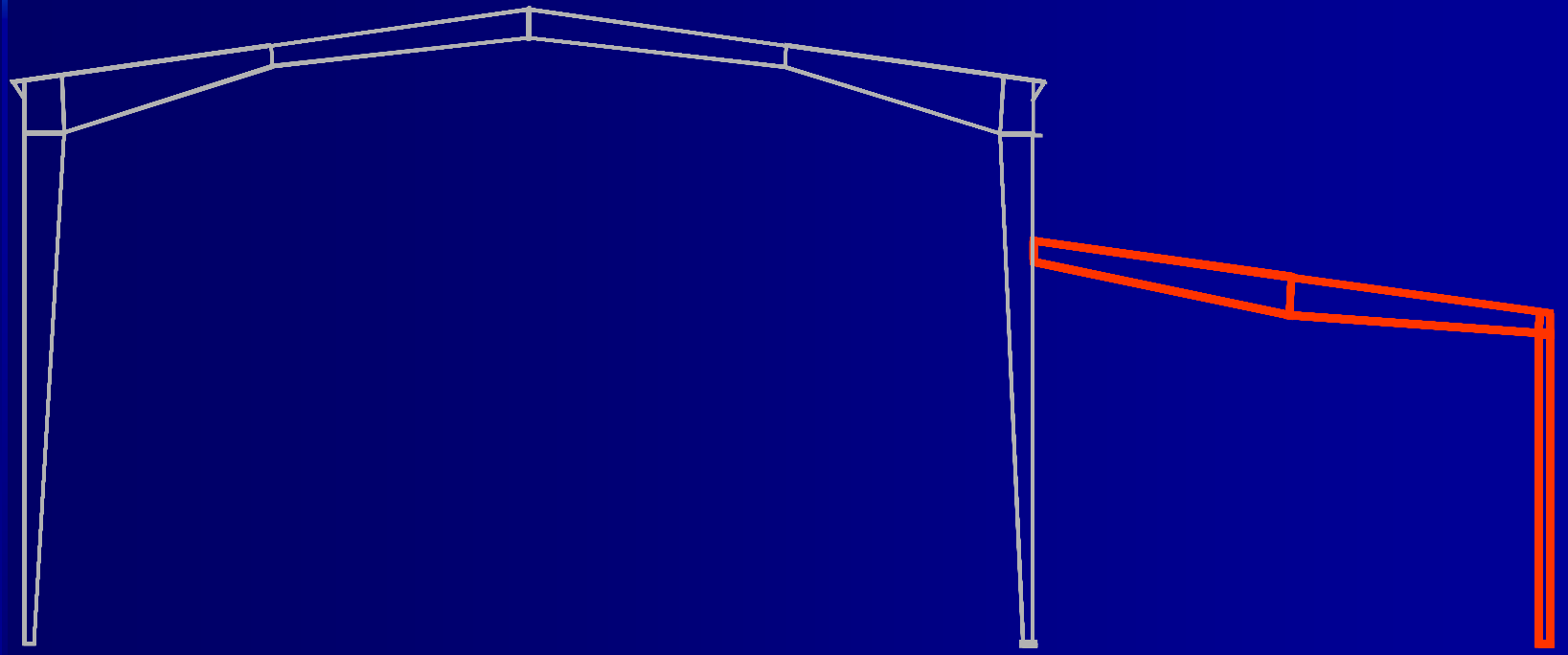
At Eave Height Lean-To



At Eave Lean-to connection

Below Eave Height Lean-To

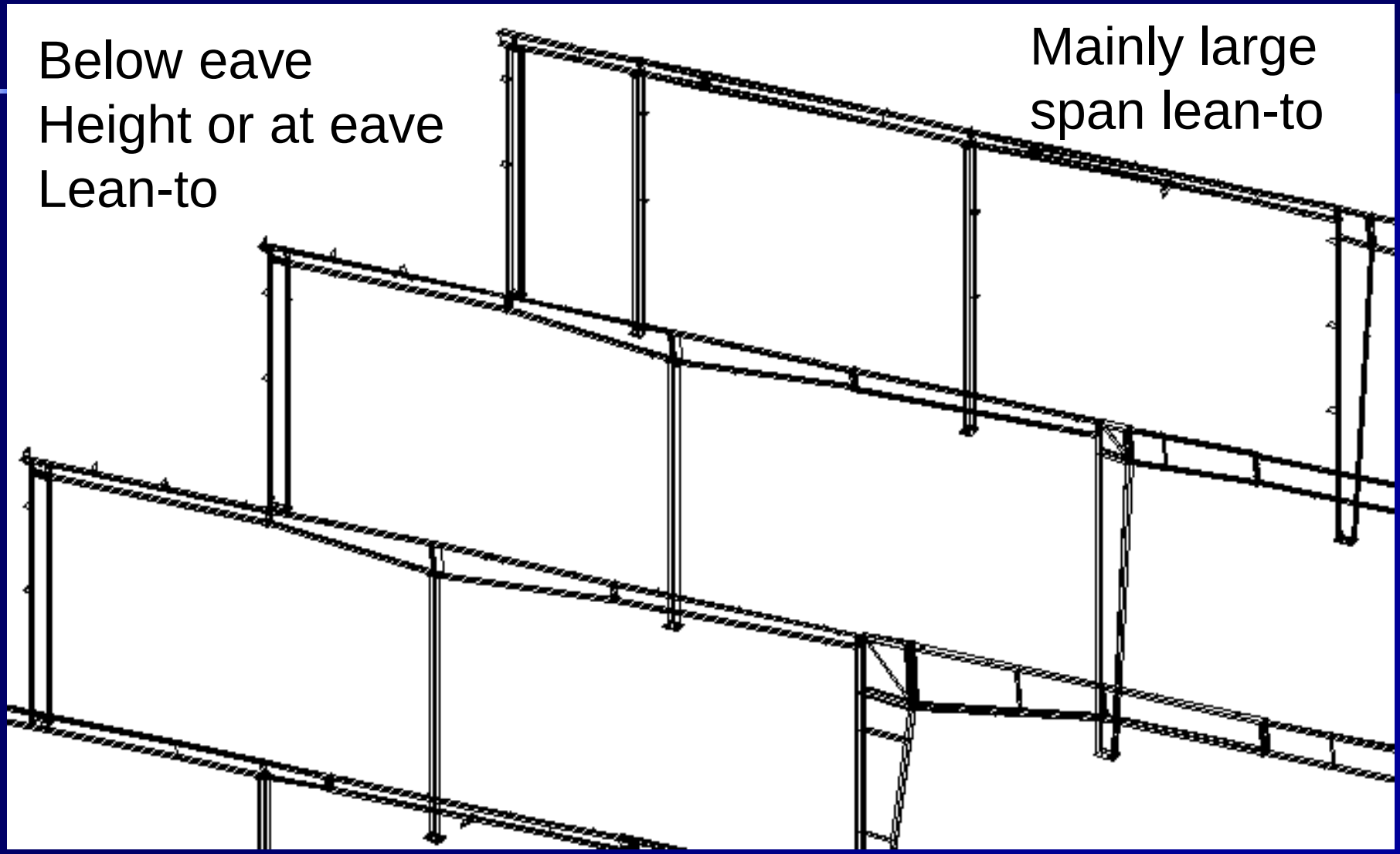
- Can add interior columns if needed.



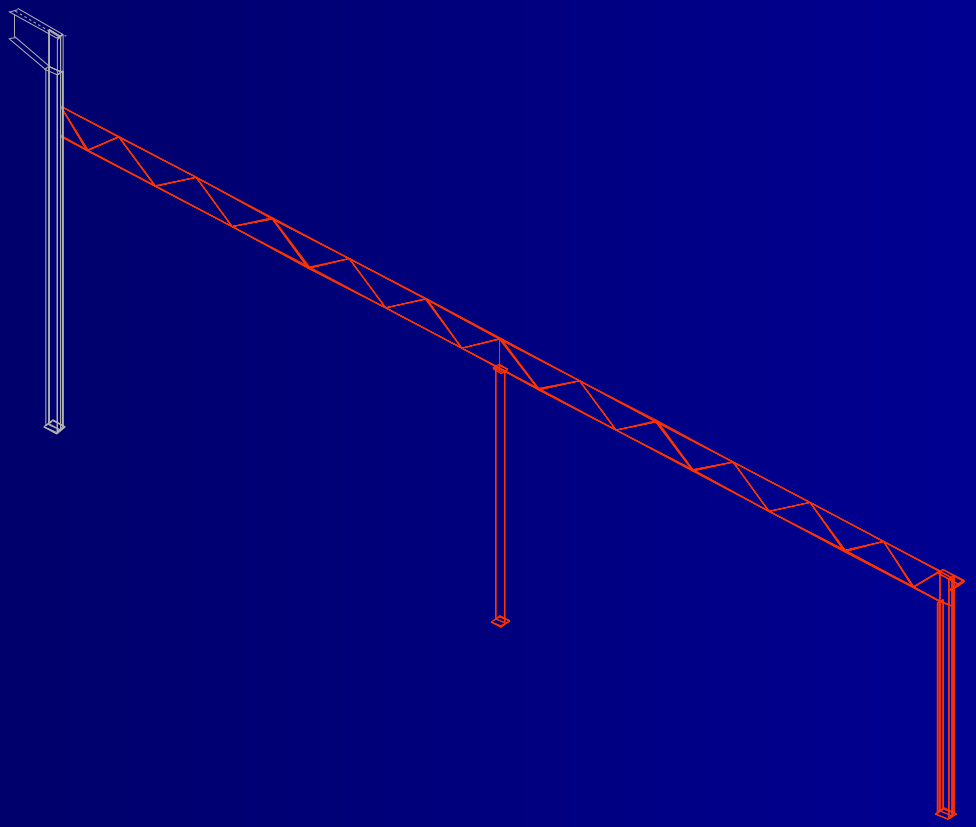
CB Lean-to

Below eave Height or at eave Lean-to

Mainly large span lean-to



CT Lean-to

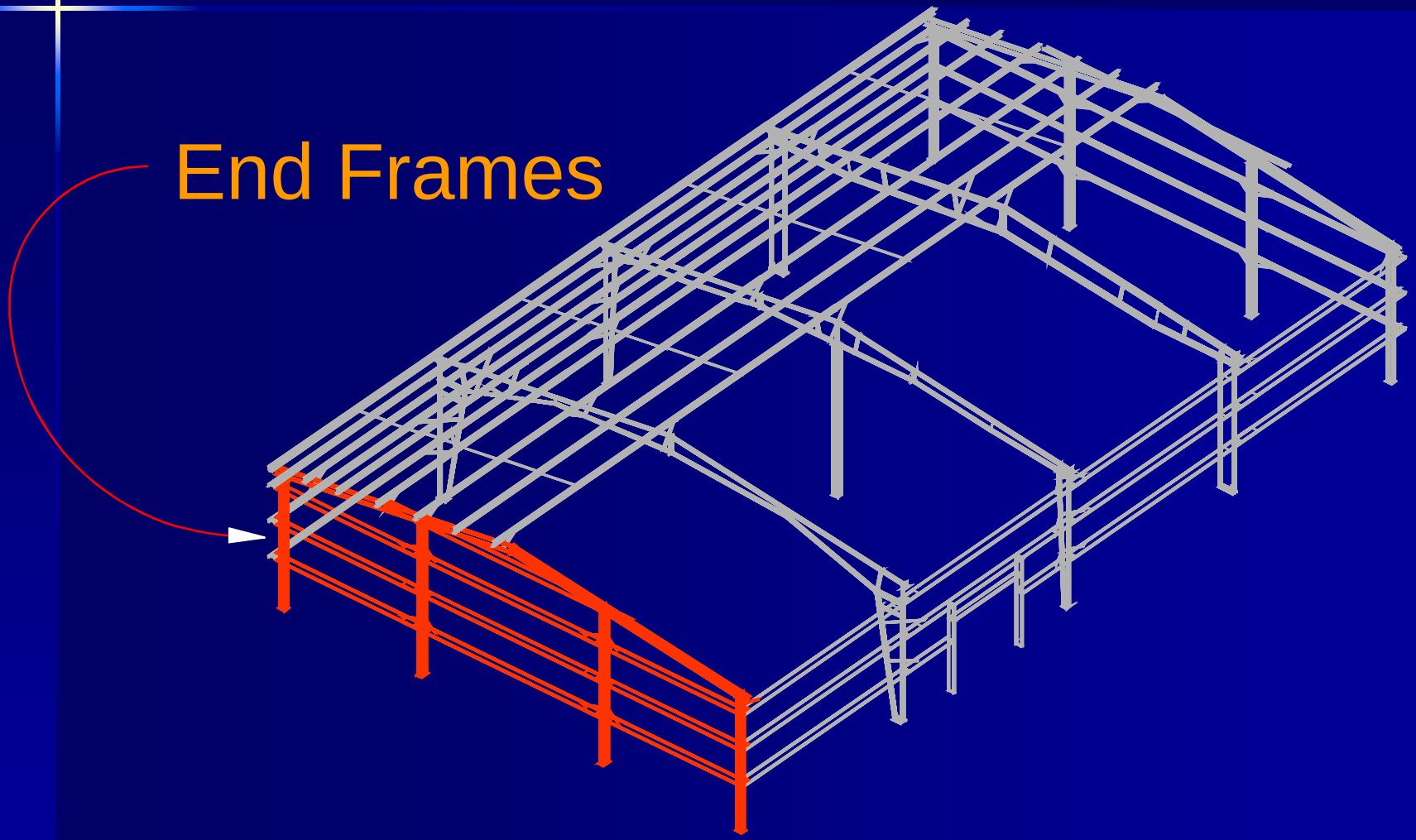


Lean-To

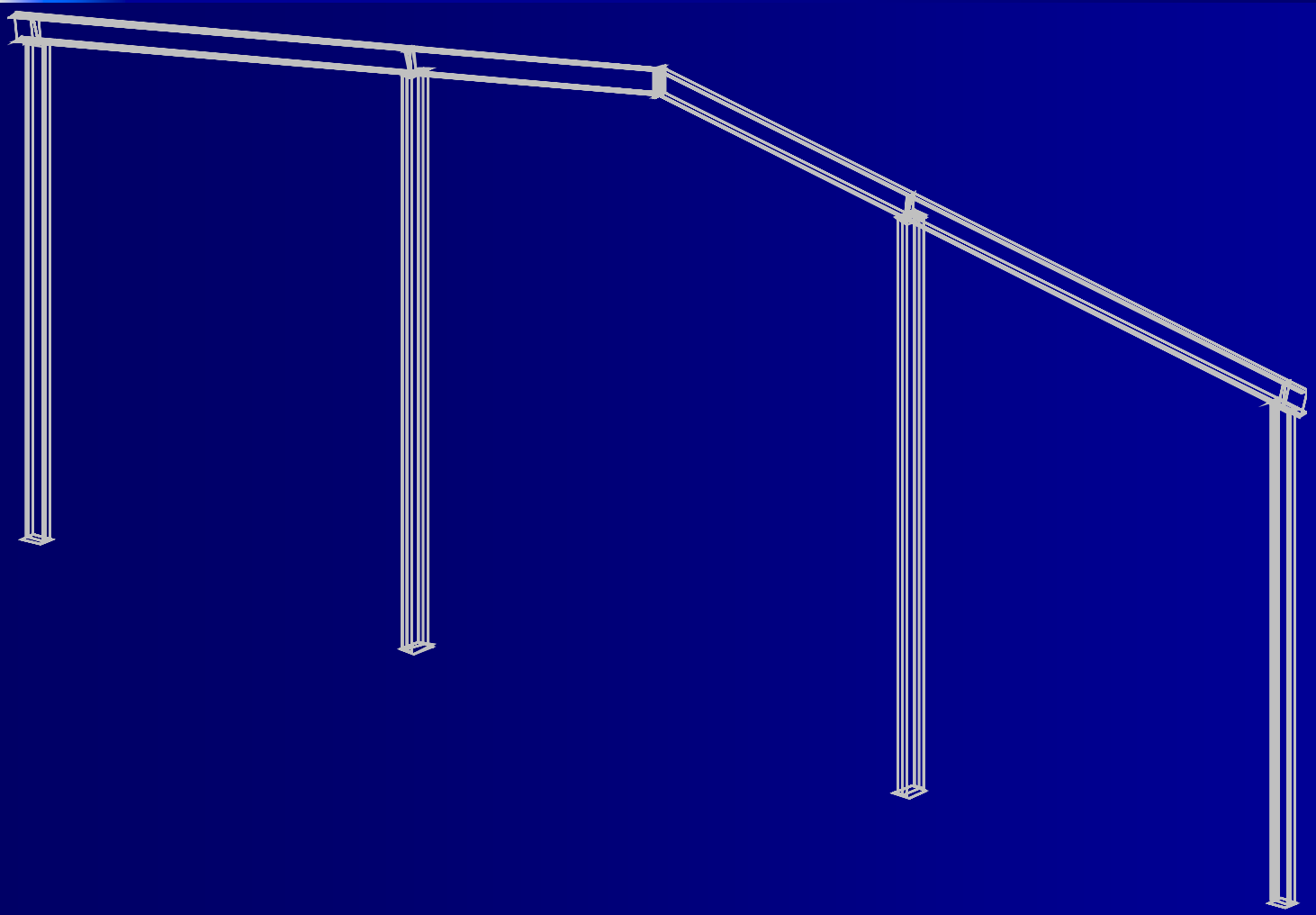
Primary Frames

Endwall Framing

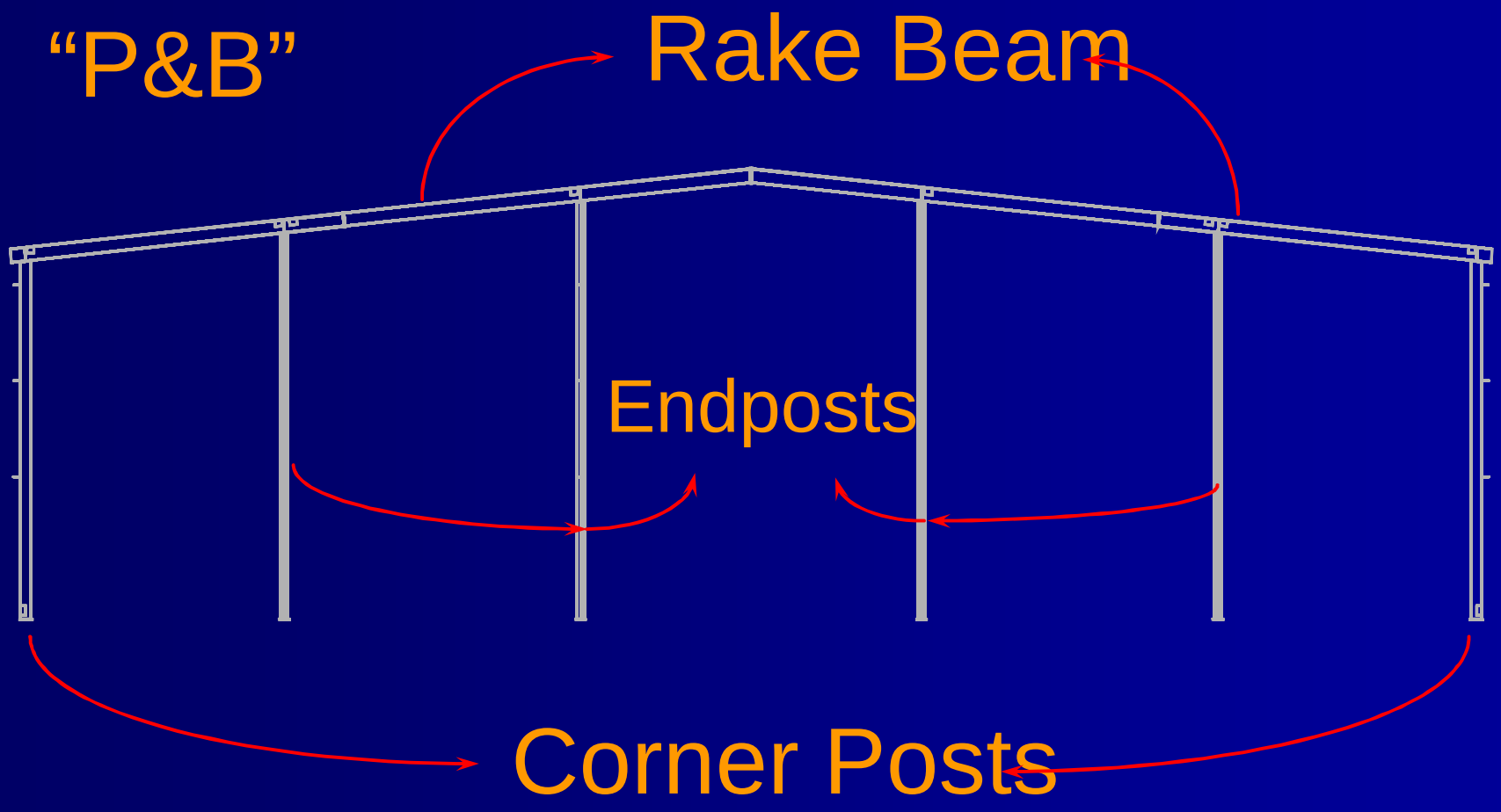
End Frames



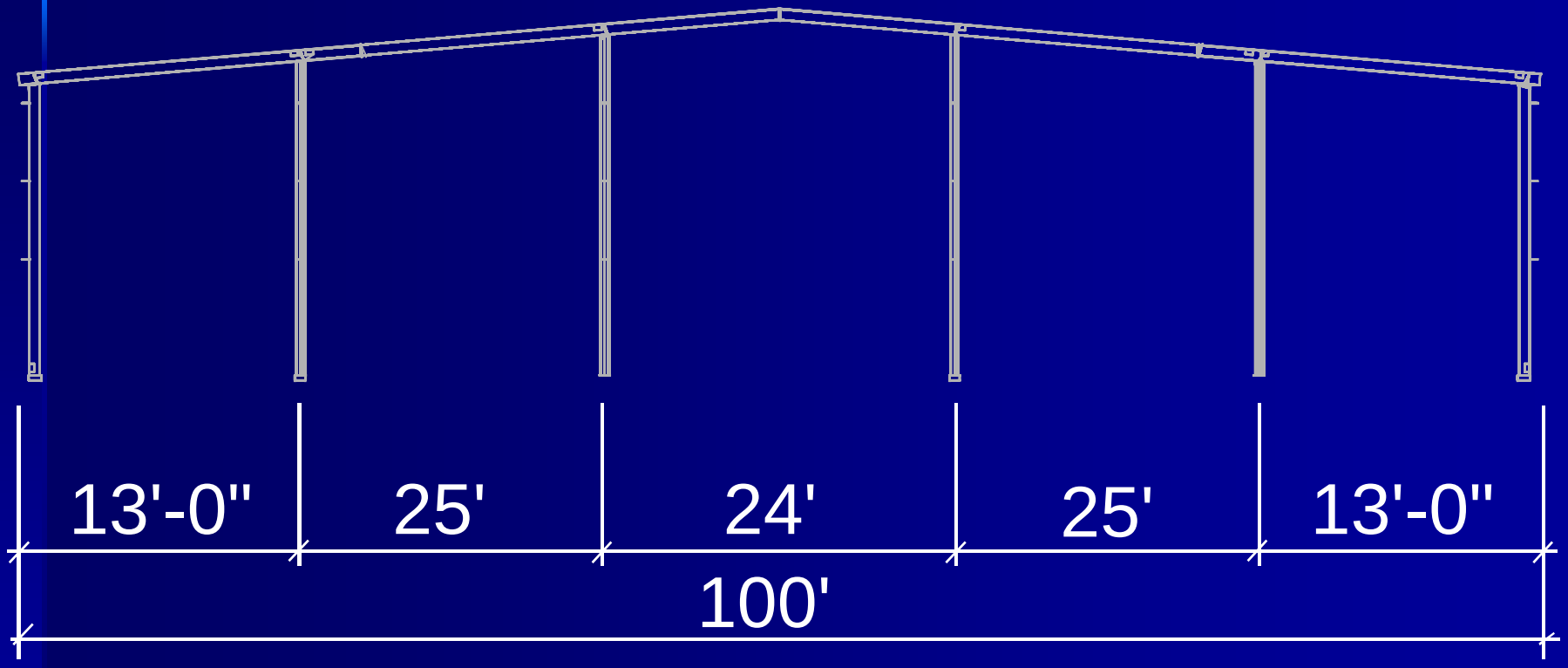
Post & Beam End Frames



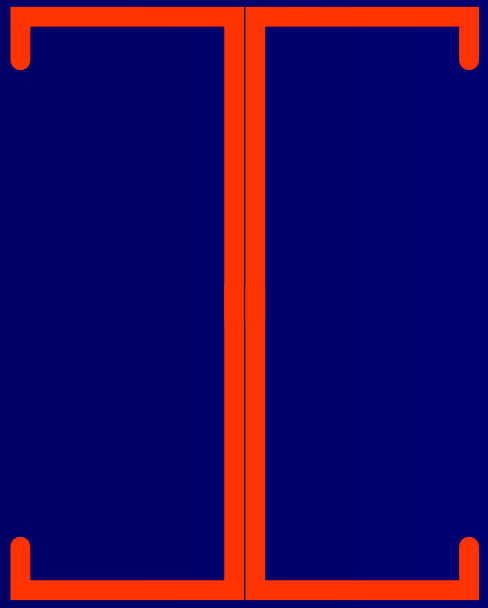
Components



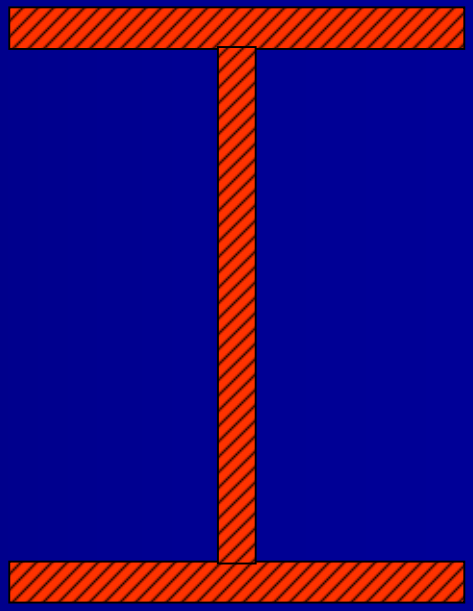
Typical Endpost Spacing



Materials



Back-to-Back Cees

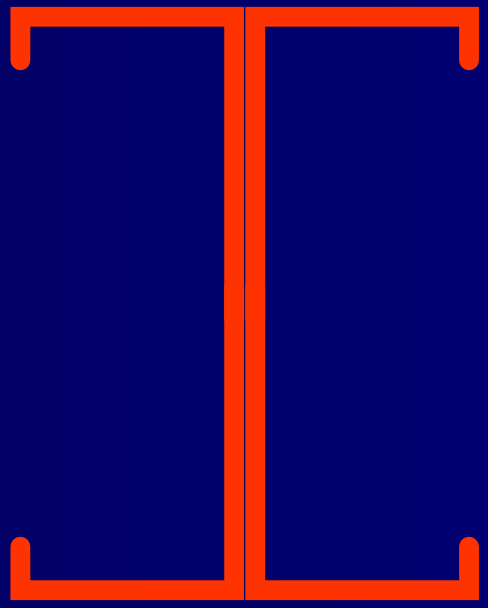


3-Plate Built-Up

Cornerpost and Endpost

G30 Acrylic; Rafter is 3-plate

Materials

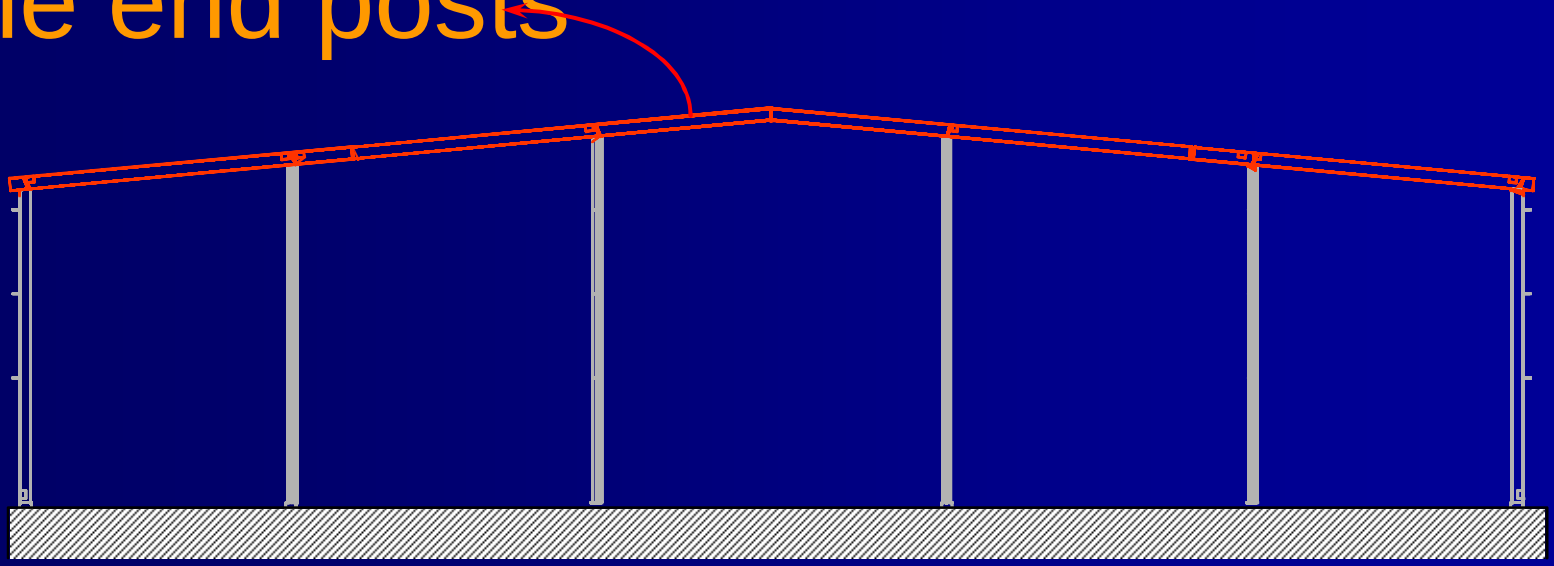


Cornerpost and Endpost G30 Acrylic; Rafter is 3-plate

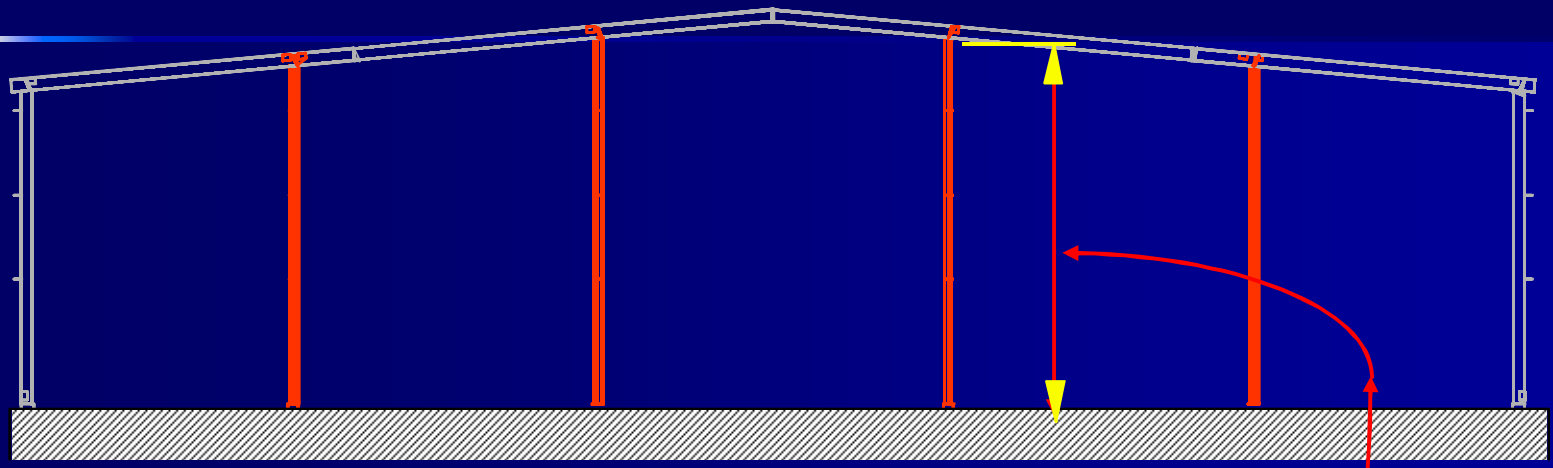
- Endposts are:
  - G30 acrylic coated cold formed CEEs
  - riveted back-to-back CEEs
  - Single CEE (inset girts only)
  - 3-plate welded solution as needed
  - Tube and Hot Roll endwall posts are an option.

How a Post & Beam Frame Works

The Rake Beam is designed as a CONTINUOUS BEAM spanning across the end posts

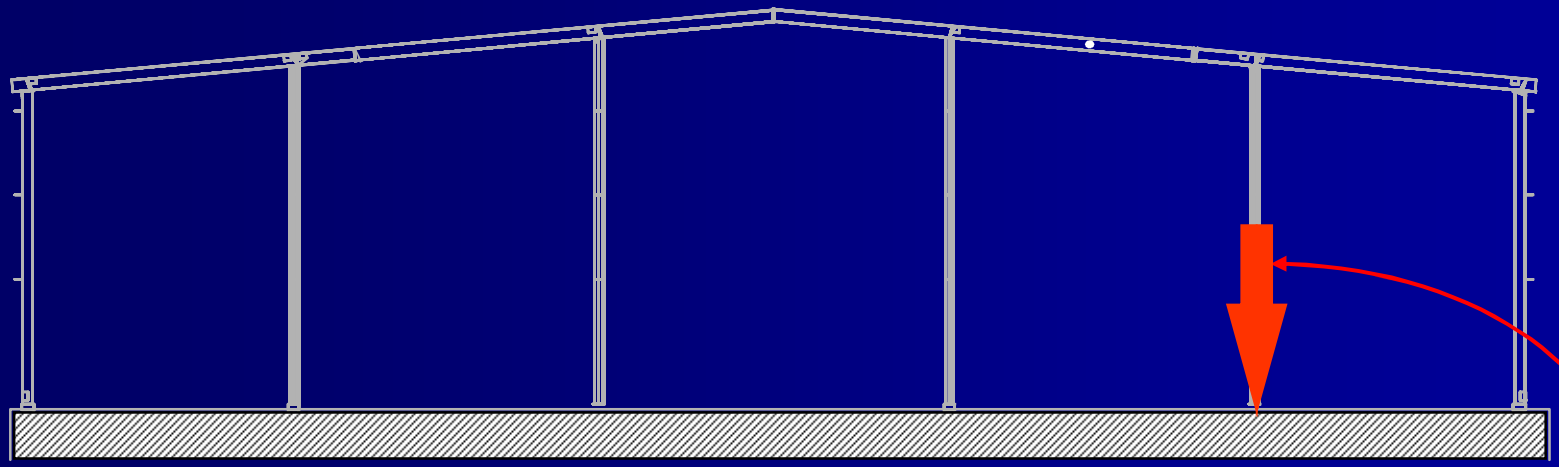


How a Post & Beam Frame Works



End posts span from the floor to the rake to support wind loads

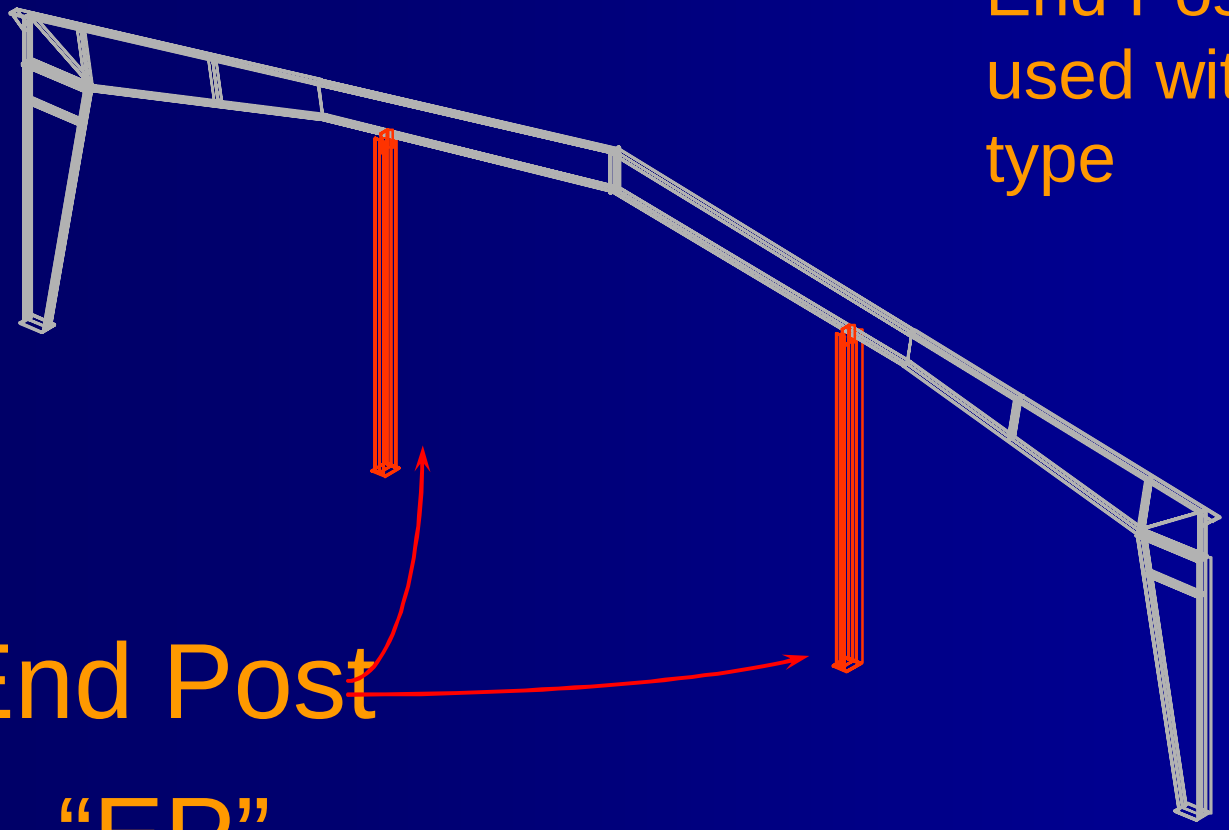
How a Post & Beam Frame Works



End posts also support the gravity loads vertically, carrying them from the Rake Beam to the foundation

Rake Beam to Endpost

Rigid Frame with End Posts



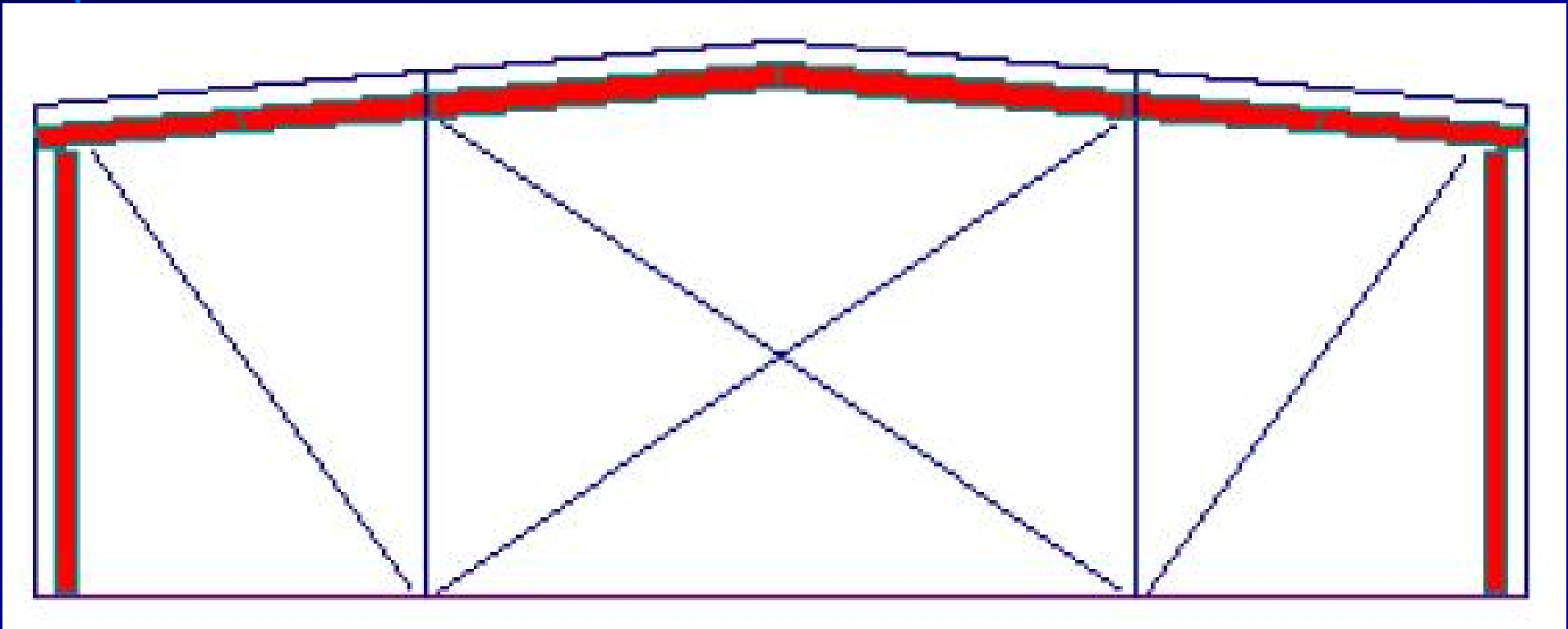
End Posts can be used with any frame type

End Post "EP"

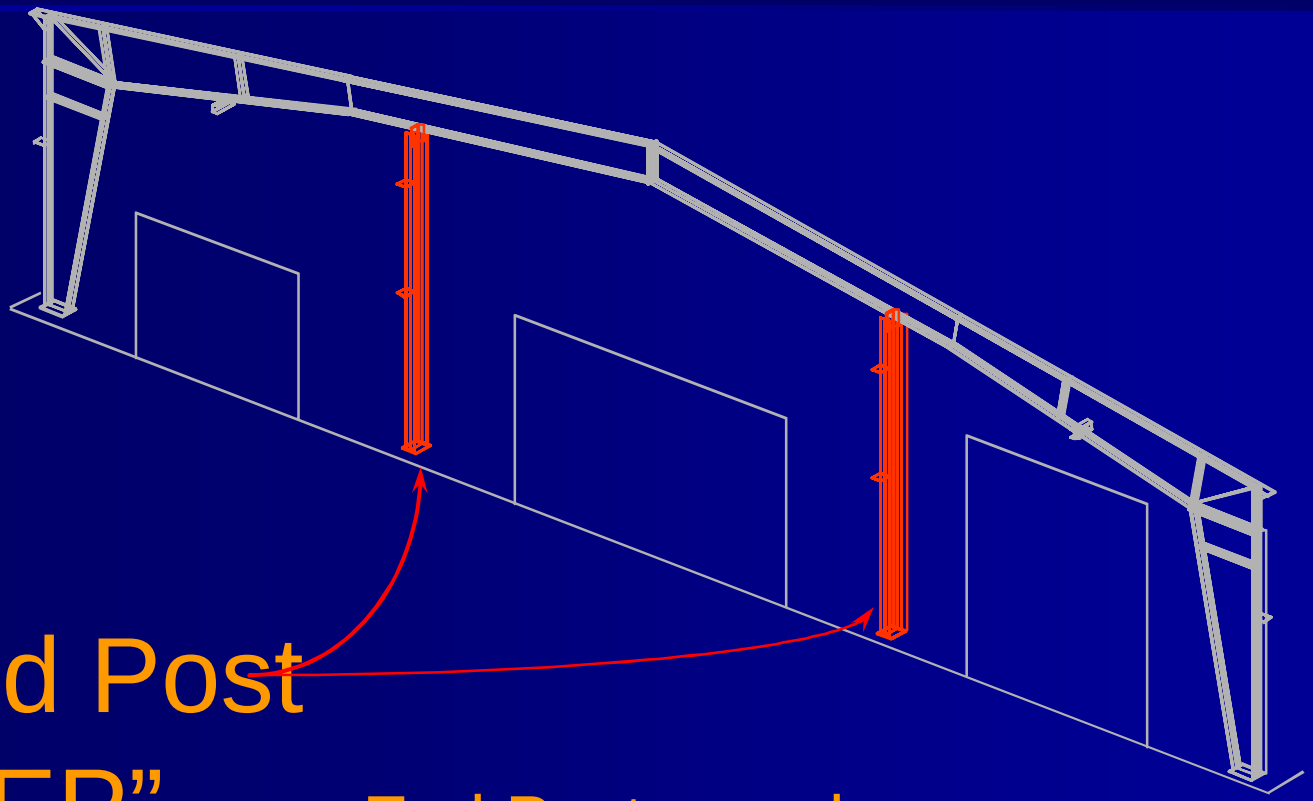
Post and Beam Stability

- Automated diaphragm check;
- If fails, Rods may automatically be designed...
- ...Initially at interior bay...
- ...Then at endbay(s)

Post and Beam Stability



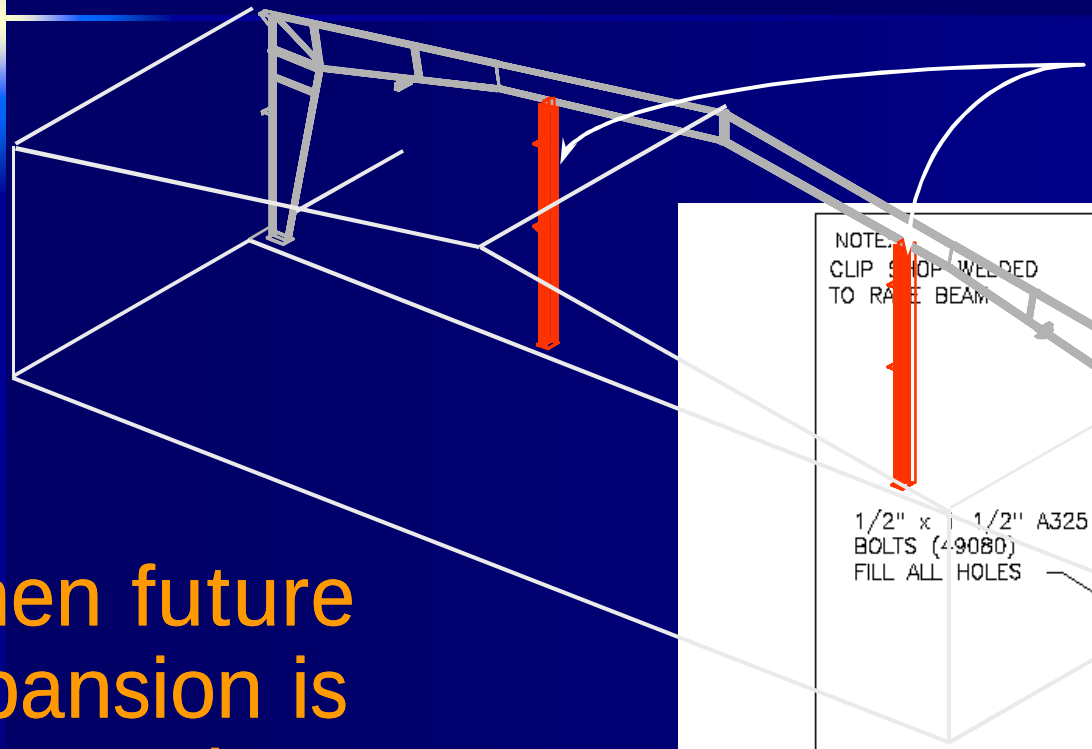
Half-Load Frames with End Posts



End Post "EP"

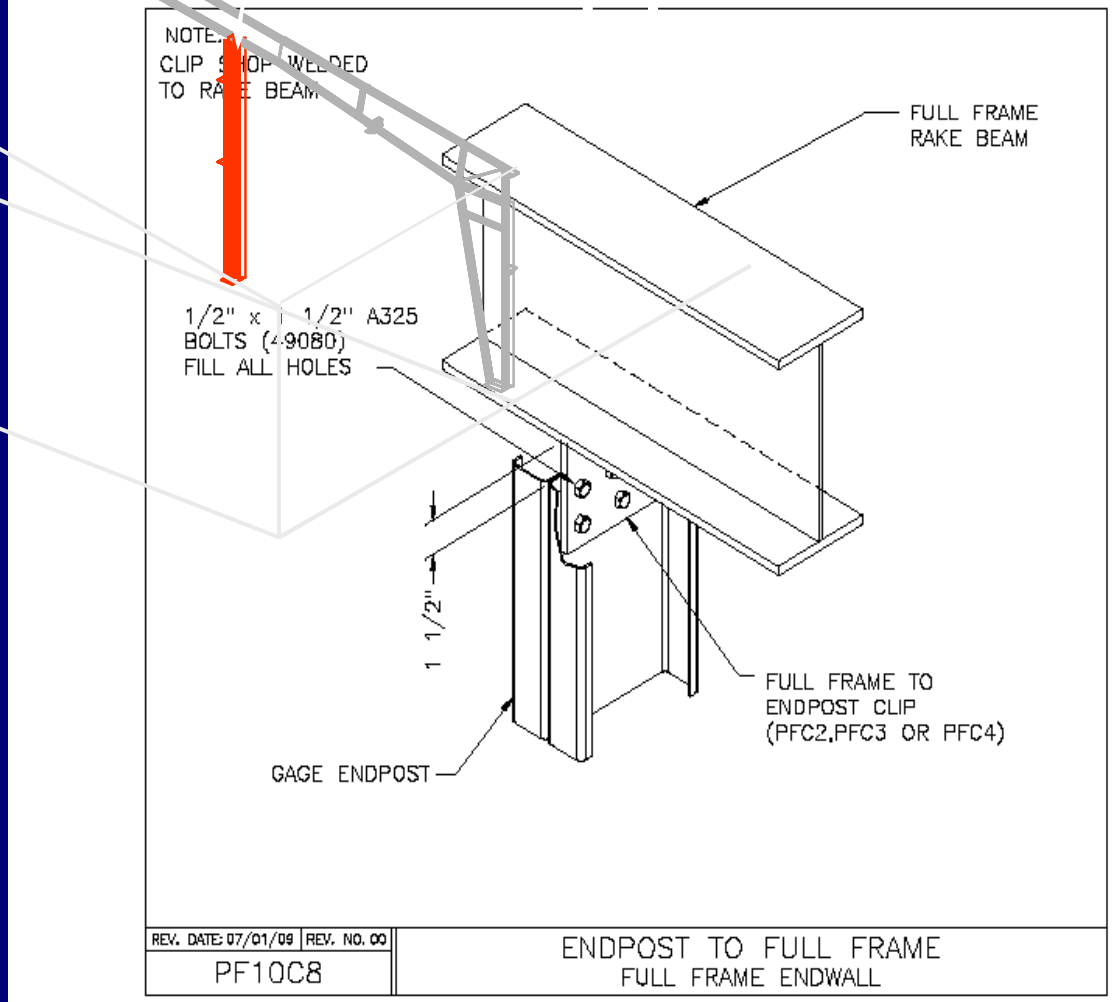
End Posts can be used with any frame type

Full-Load Frames with End Posts

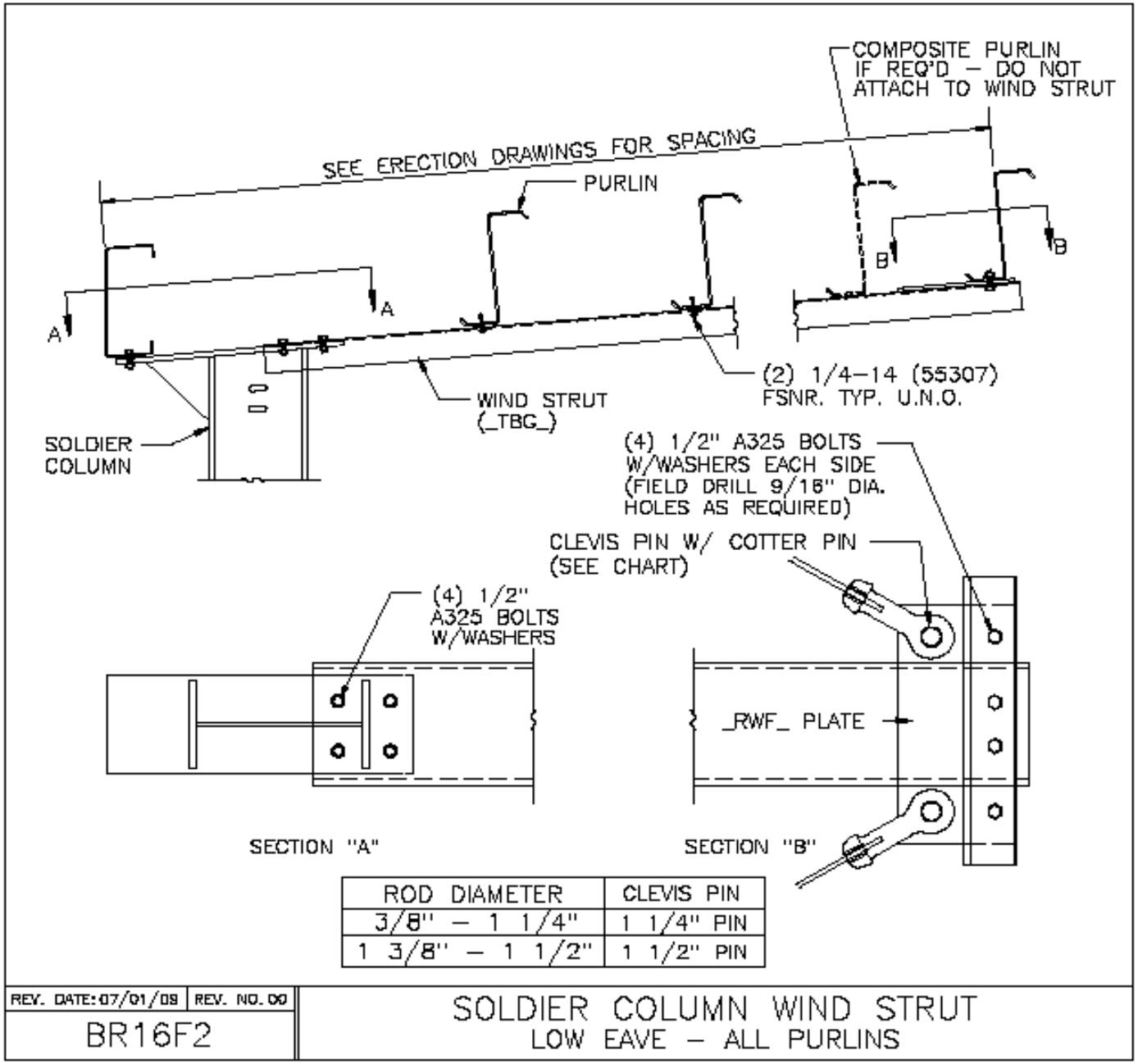


End Post "EP"

- When future expansion is expected
- End Posts can be used with any frame type



Soldier Columns



Soldier Columns

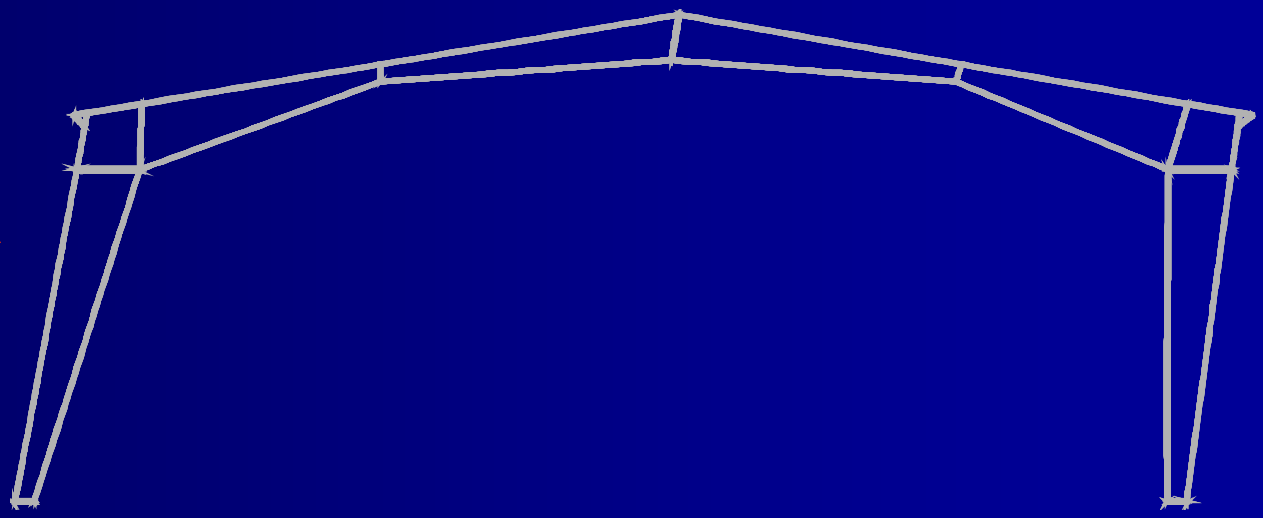
Primary Framing

Applied Design Concepts and Considerations

Primary Frames

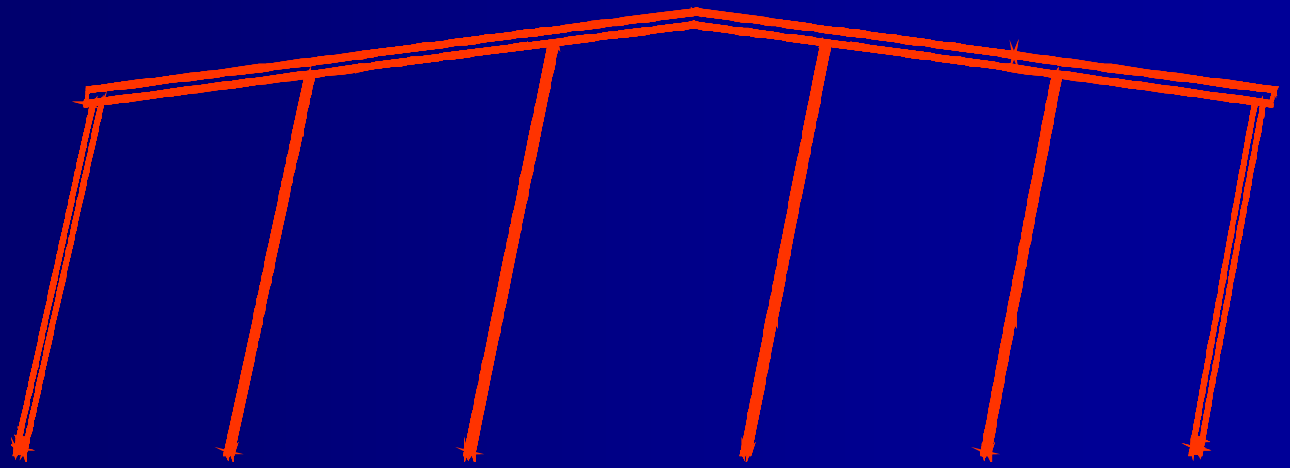
Moment Resisting Frames

Load



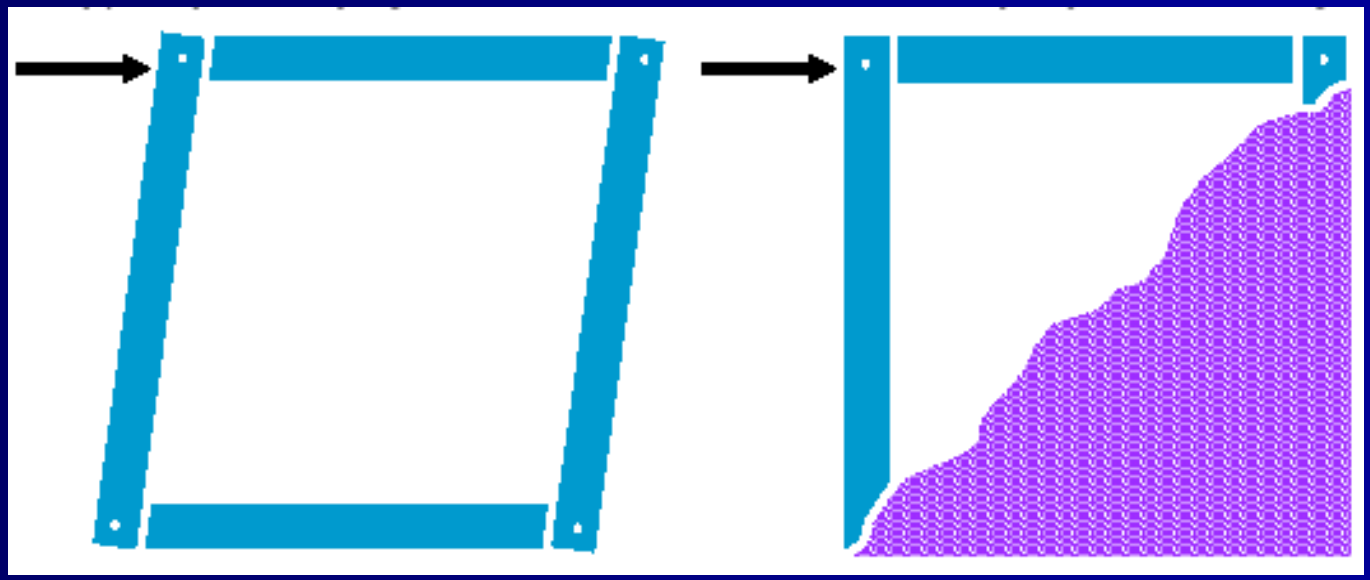
P & B's Are NOT Moment Resisting

Load

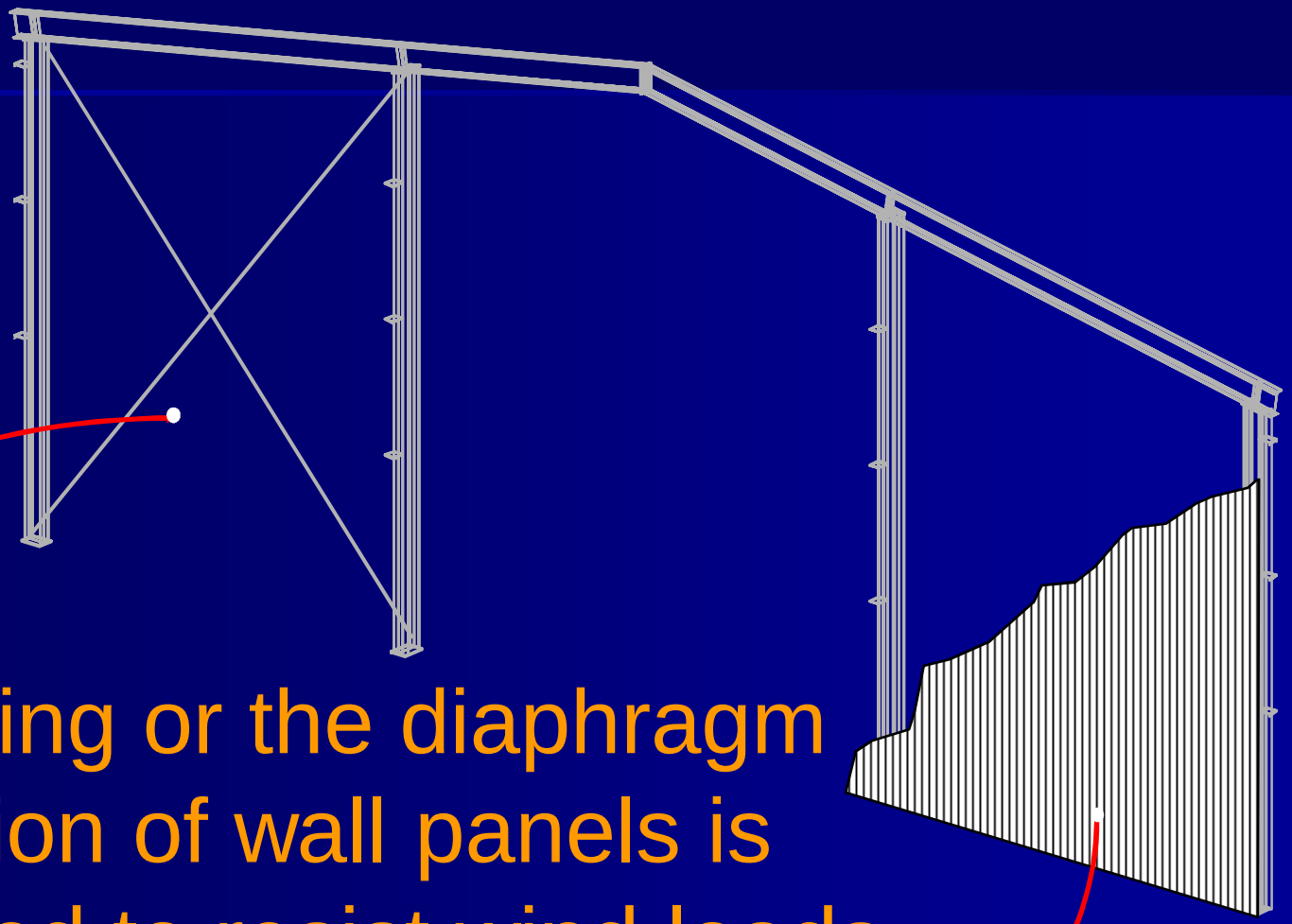


How a Post & Beam Frame Works

Diaphragm is the metal panel's ability to resist loads within its surface.



Post & Beam Frames

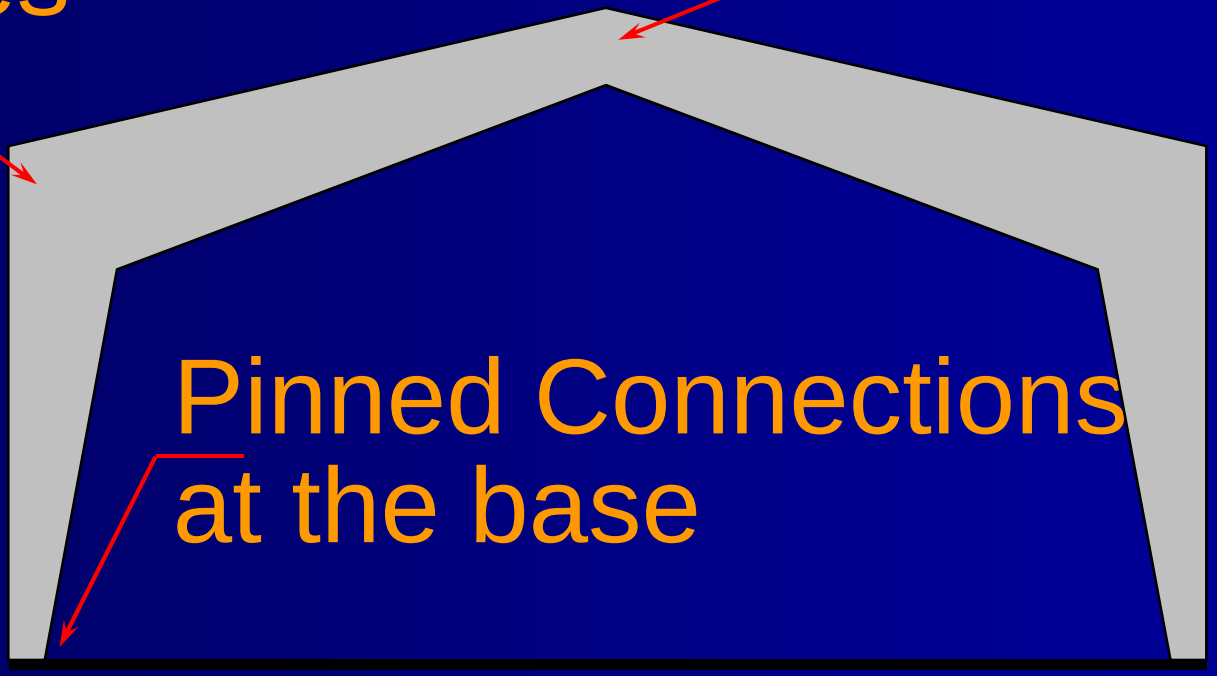


Bracing or the diaphragm action of wall panels is required to resist wind loads from the side of the building

Ledger Angle at End Frame Location

Pinned and Rigid Connection Types

Rigid Connections at the haunches and rafter splices



Standard Fixed Base

BLUESCOPE BUILDINGS	DESIGN PROCEDURES	Section: DP 3.2.2
	CONNECTIONS	Page 1 of 20
	Fixed Base Plates	Revision & Date 1 (06/10)

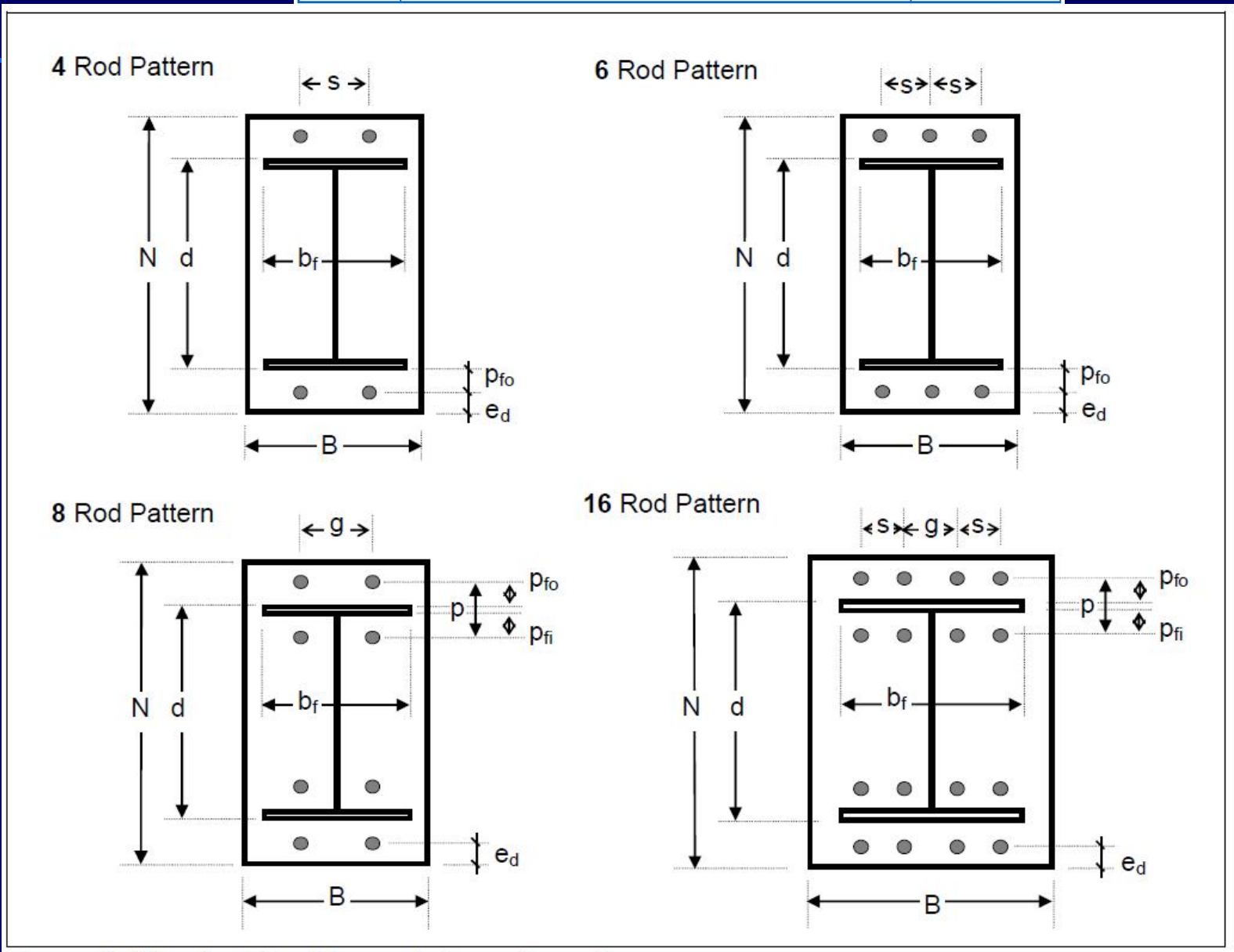
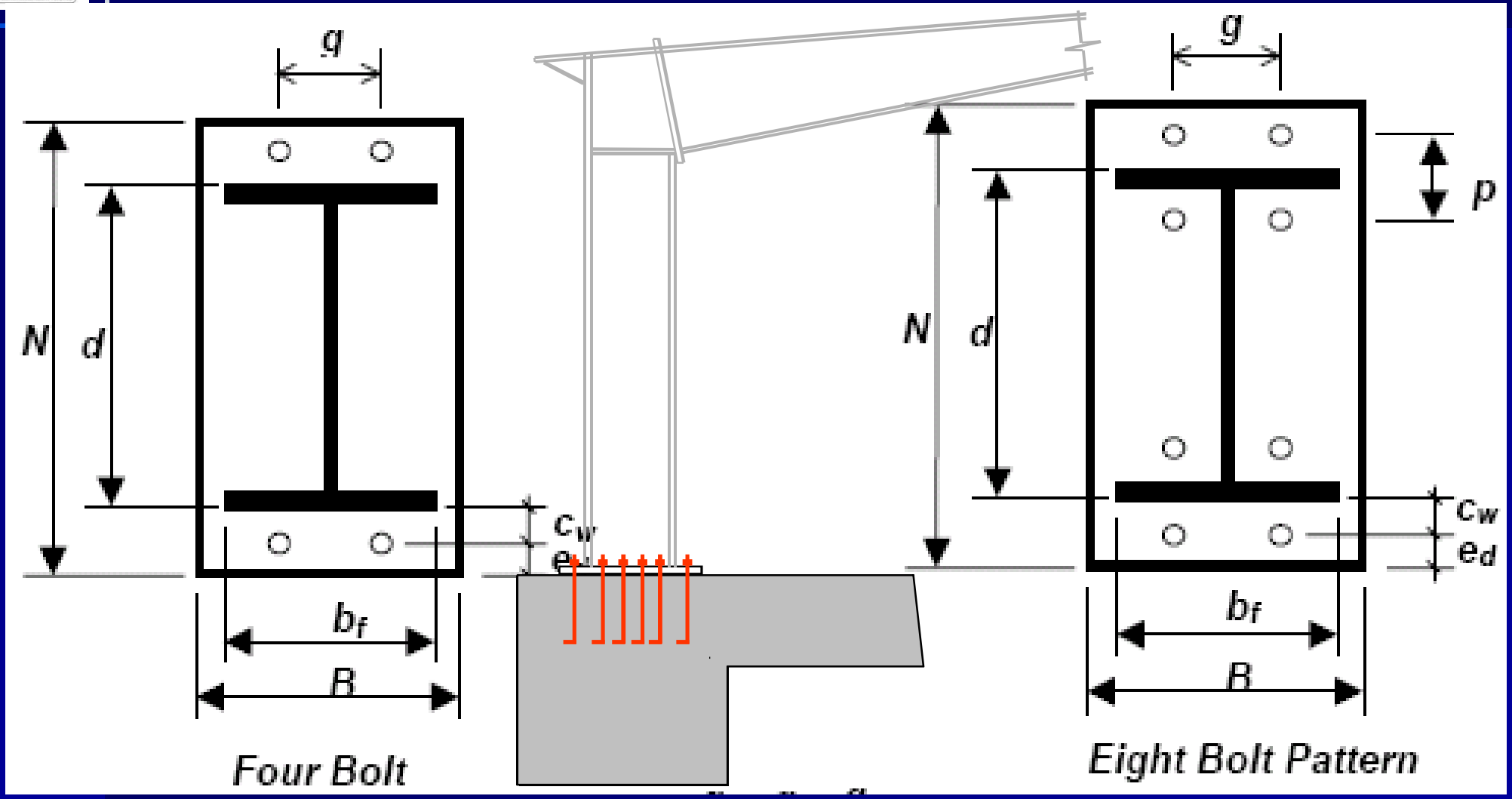


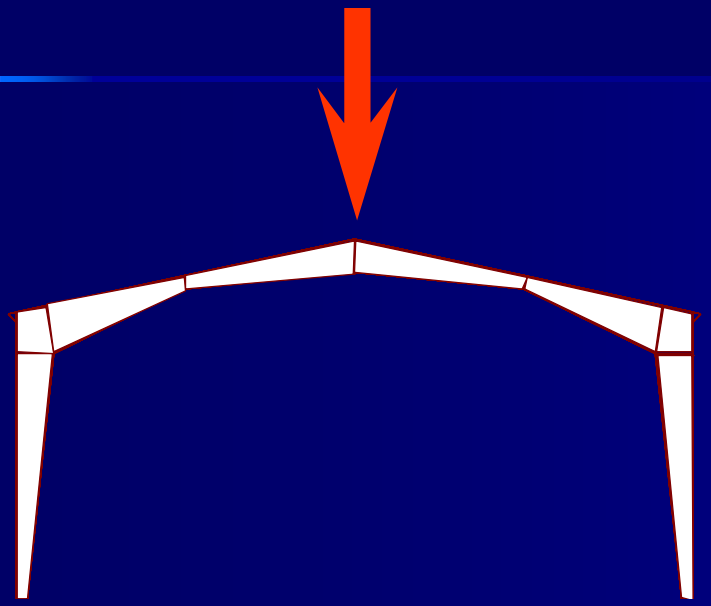
Figure 1 Standard fixed base plate configurations

Fixed Base Column



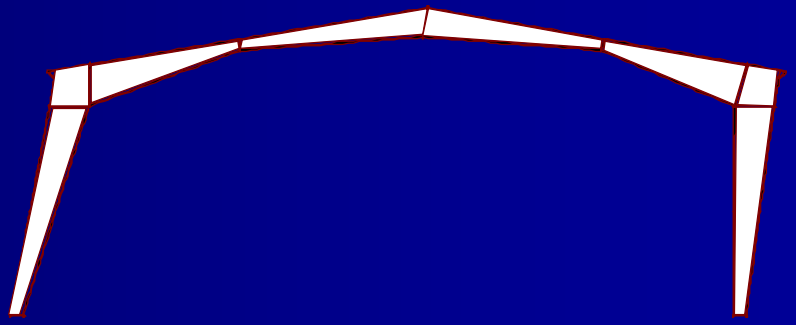
Fixed Base Column

Frame Deflection Considerations

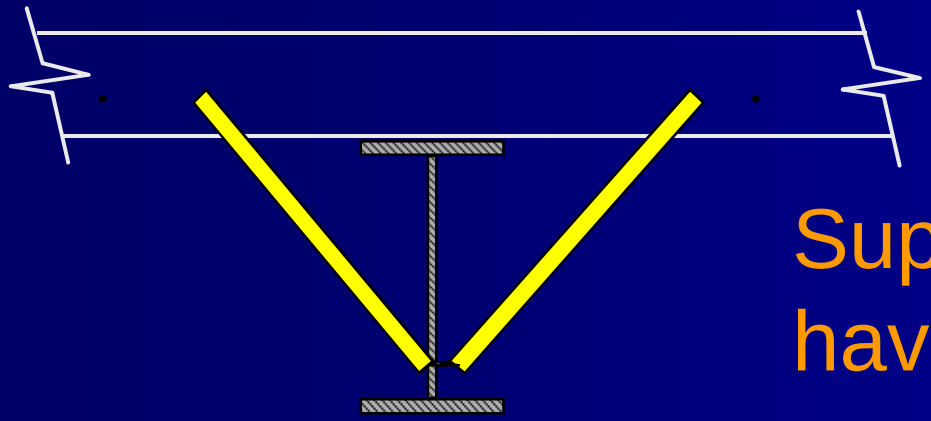


Vertical Deflection

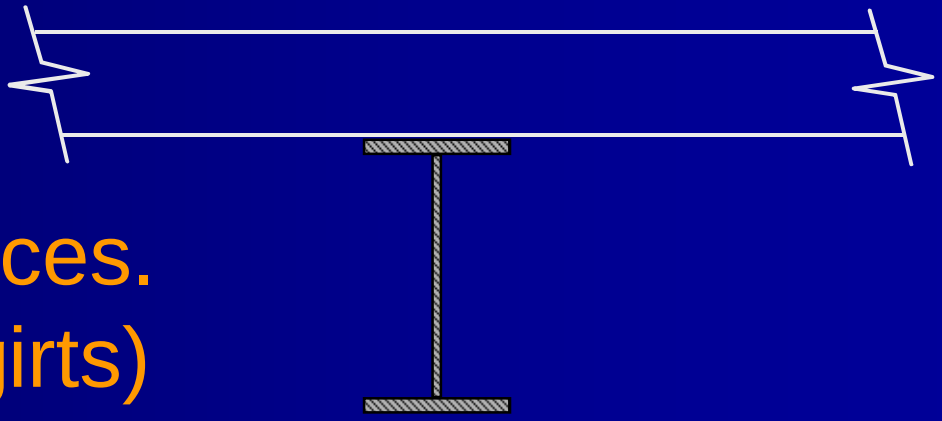
Horizontal Deflection



Unsupported Columns and Rafters



Supported Members have Flange Braces



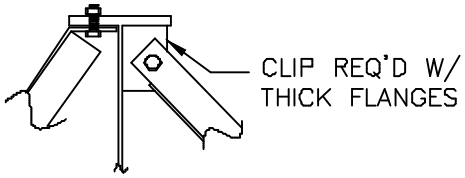
Unsupported Members do not have Flange Braces. (may or may not have girts)

Unsupported Columns and Rafters

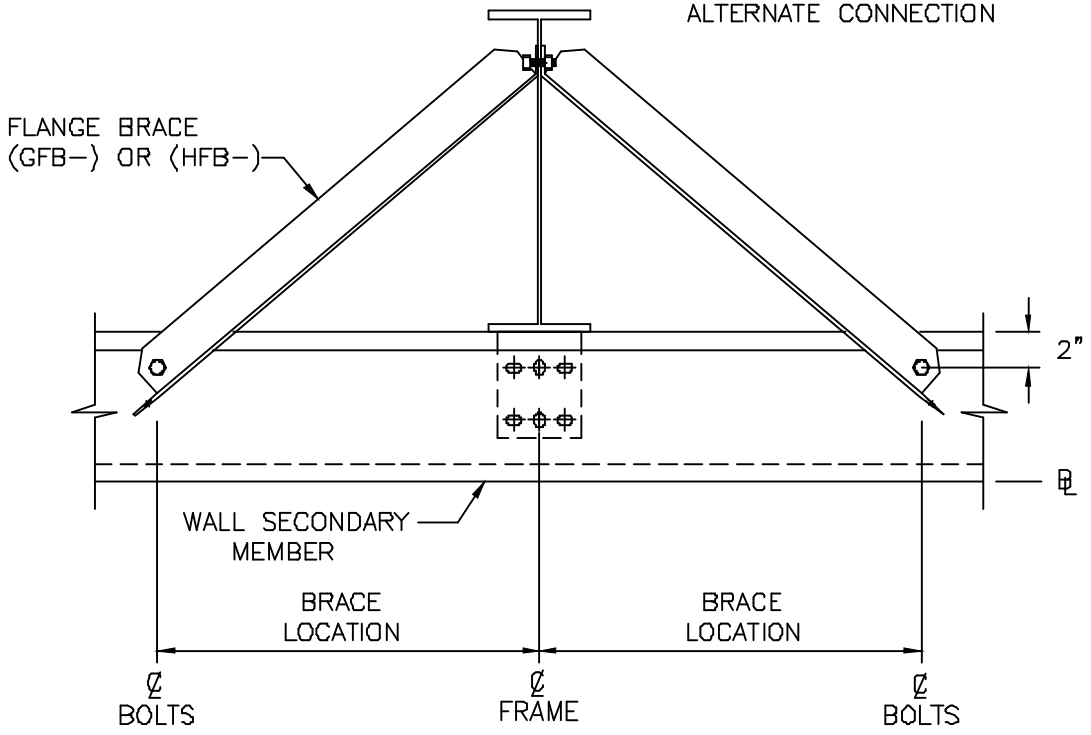
- A column or rafter is considered unsupported when it does not have Lateral support.
- This condition occurs when there are no flange braces attached to the compression (Inside) flange.
- Unsupported columns are typically more expensive than Supported.

Flange Bracing

COLUMN DEPTH	BR LOC (CONTIN)
0" THRU 28"	1'-10 1/2"
28"+ THRU 42"	2'-10 1/2"
42"+ THRU 60"	3'-10 1/2"



ALTERNATE CONNECTION

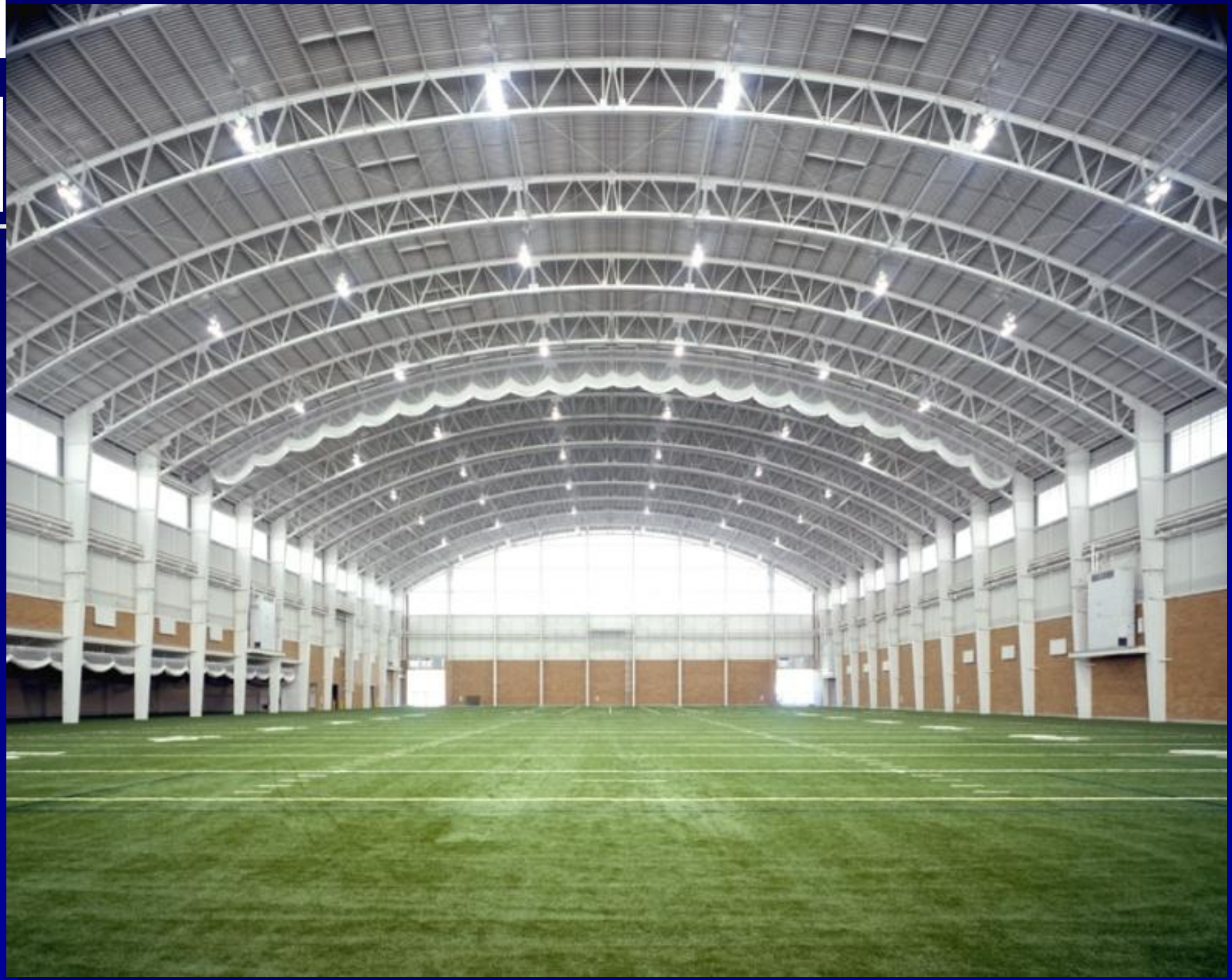


REV DATE: 07/01/09	REV NO 00
BR07J1	WALL FLANGE BRACING OUTSET SIDEWALL COL (CONTINUOUS & SIMPLE)

Special Curved Framing

Special Curved Framing

Special Curved Framing




09/16/2007


KANSAS CITY CHIEFS

Primary Framing Tips

- The more you *reduce the span* of a member the more you reduce the cost (to a certain point)...
- *Tapered* members most economical
- Span *frames shortest* distance in building

Primary Framing Tips

- *Gage Post and Beam* most economical endwall frame
- Reduce endbay span if possible
- Reduce Int. Col. Span near sidewalls
- Do Not specify deflection higher than necessary
- Open Web frames economical with large spans and heavy loads

VP University