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Lateral Load Transfer From Diaphragms to Resisting Elements
Part 2: Horizontal Truss Diaphragms
September 2, 2021

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Course Description

Lateral Load Transfer From Diaphragms to Resisting Elements
Part 2 – Horizontal Truss Diaphragms
September 2, 2021

This two-part webinar will examine how loads flow through diaphragms and horizontal trusses to the vertical elements of the lateral force-resisting system. The second session in this two-part webinar will focus on horizontal truss diaphragms, with discussions on truss layout and connection considerations. The AISC 341 provisions pertaining to horizontal truss diaphragms will be reviewed and several case studies will be presented that demonstrate how to analyze the lateral load path.

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Learning Objectives

- List several reasons why horizontal truss diaphragms may be used on a building project.
- Identify the design requirements that permit diagonal members of horizontal trusses to be designed without consideration of overstrength.
- Describe the layout considerations that facilitate the constructability of horizontal truss diaphragm members.
- Demonstrate how to analyze the load path through a diaphragm using a simple statics approach.

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Lateral Load Transfer From Diaphragms to Resisting Elements

Part 2 – Horizontal Truss Diaphragms

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Principal
Magnusson Klemencic Associates
Seattle, Washington

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Overview

- Brief Recap from Session 1
- Horizontal Truss Systems
- Case Study – Idealizing a Load Path
- Case Study – Putting It All Together

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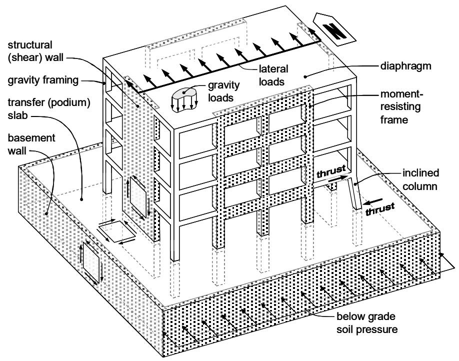
The Role of Diaphragms

- Gravity Forces
- Inertial Forces
- Wind Forces
- Transfer Forces
- Thrust from Inclined Columns
- Soil Pressures
- Column Bracing Forces



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Diaphragm Design Requirements

AISC 360, Section B3.5

Design of Diaphragms and Collectors

Diaphragms and collectors shall be designed for both forces that result from loads as stipulated in Section B2. They shall be designed in conformance with the provisions of Chapters C through K, as applicable.

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Diaphragm Design Requirements

ASCE 7, Section 12.10.1

Diaphragms shall be designed for both the shear and bending stresses resulting from design forces. At diaphragm discontinuities, such as reentrant corners, the design shall ensure that dissipation or transfer of edge (chord) forces combined with other forces in the diaphragm is within shear and tension capacity of the diaphragm.

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Diaphragm Design Requirements

Slab on Steel Deck Diaphragm Approaches

AISC 341, Section D1.5a

- Details shall be provided to transfer load between the diaphragm and boundary members, collector elements, and elements of the horizontal framing system.

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Diaphragm Design Requirements

Slab on Steel Deck Diaphragm Approaches

AISC 341, Section D1.5b

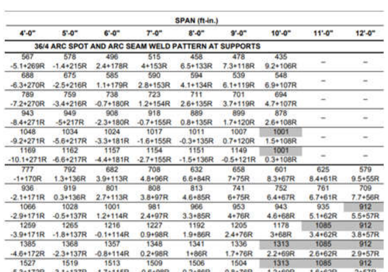
- Diaphragm is the topping slab above the flutes designed per ACI 318
- Diaphragm is the slab on deck assembly using in plane shear tests (such as ICC-ES or IAPMO-UES report values)

Horizontal Truss Diaphragms

- Common Instances
- Layout Considerations
- AISC 341 Design Requirements
- Connection Ideas

Horizontal Truss Diaphragms

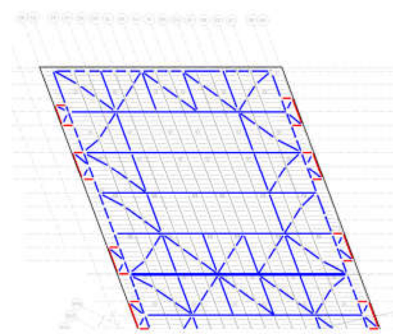
- **Additional Strength**
- Additional Stiffness
- Direct Load Transfer
- Discontinuities
- No Diaphragm Otherwise
- Redundancy



SPAN (ft-in.)								
4'-0"	5'-0"	6'-0"	7'-0"	8'-0"	9'-0"	10'-0"	11'-0"	12'-0"
36/4 ARC SPOT AND ARC SEAM WELD PATTERN AT SUPPORTS								
567 -5.1+269R	578 -1.4+215R	496 2.4+178R	515 4+153R	458 6.5+133R	478 7.3+118R	435 9.2+106R	–	–
688 -6.3+270R	675 -2.5+216R	585 1.1+179R	590 2.8+153R	594 4.1+134R	539 6.1+119R	548 6.9+107R	–	–
789 -7.2+270R	759 -3.4+216R	738 -0.7+180R	723 1.2+154R	711 2.6+135R	701 3.7+119R	694 4.7+107R	–	–
943 -8.4+271R	949 -5+217R	908 -2.3+180R	918 -0.7+155R	889 0.8+135R	899 1.7+120R	878 2.6+108R	–	–
1048 -9.2+271R	1034 -5.6+217R	1024 -3.3+181R	1017 -1.6+155R	1011 -0.3+135R	1007 0.7+120R	1001 1.5+108R	–	–
1169 -10.1+271R	1162 -6.6+217R	1157 -4.4+181R	1154 -2.7+155R	1151 -1.5+136R	1149 -0.5+121R	1001 0.3+108R	–	–
777 -1+170R	792 1.3+136R	682 3.9+113R	708 4.8+96R	632 6.6+84R	658 7+75R	601 8.3+67R	625 8.4+61R	579 9.5+55R
936 -2.1+171R	919 0.3+136R	801 2.7+113R	808 3.8+97R	813 4.6+85R	741 6+75R	752 6.4+67R	761 6.7+61R	709 7.7+56R
1066 -2.9+171R	1028 -0.5+137R	1001 1.2+114R	981 2.4+97R	966 3.3+85R	953 4+76R	943 4.6+68R	935 5.1+62R	912 5.5+57R
1259 -3.9+171R	1265 -1.8+137R	1216 -0.1+114R	1227 0.9+98R	1192 1.9+86R	1205 2.4+76R	1178 3+68R	1085 3.4+62R	912 3.8+57R
1385 -4.6+172R	1368 -2.3+137R	1357 -0.8+114R	1348 0.2+98R	1341 1+86R	1336 1.7+76R	1313 2.2+69R	1085 2.6+62R	912 2.9+57R
1527 -5.3+172R	1519 -3.1+137R	1513 -1.7+115R	1509 -0.6+98R	1506 0.2+86R	1504 0.8+76R	1313 1.2+69R	1085 1.6+62R	912 2+57R

Horizontal Truss Diaphragms

- Additional Strength
- **Additional Stiffness**
- Direct Load Transfer
- Discontinuities
- No Diaphragm Otherwise
- Redundancy



Horizontal Truss Diaphragms

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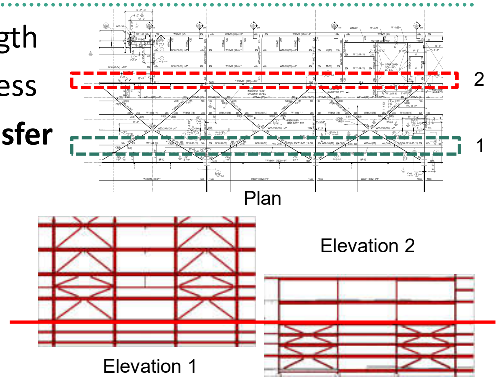

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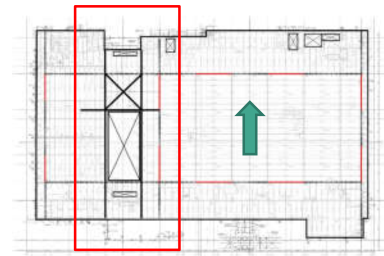
Horizontal Truss Diaphragms

- Additional Strength
- Additional Stiffness
- Direct Load Transfer
- **Discontinuities**
- No Diaphragm Otherwise
- Redundancy



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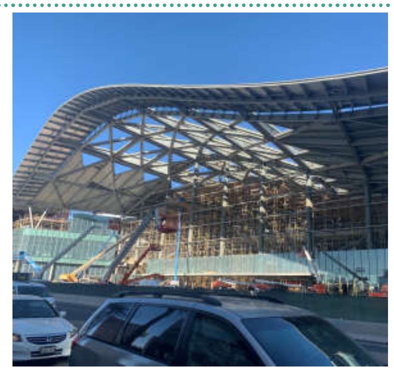
Horizontal Truss Diaphragms

- Additional Strength
- Additional Stiffness
- Direct Load Transfer
- Discontinuities
- **No Diaphragm Otherwise**
- Redundancy



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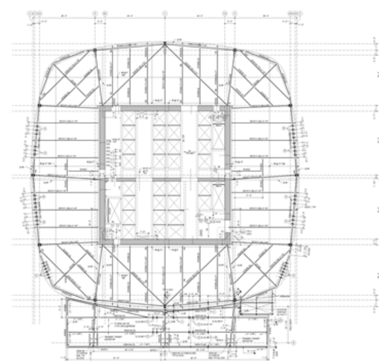
Horizontal Truss Diaphragms

- Additional Strength
- Additional Stiffness
- Direct Load Transfer
- Discontinuities
- No Diaphragm Otherwise
- **Redundancy**



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Horizontal Truss Diaphragms

- AISC 341-16, Section B5.2

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Horizontal Truss Diaphragms

- AISC 341-16, Section B5.2
  - Members and their connections shall be designed for load combinations with overstrength, $\boldsymbol{\Omega_0}$

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Horizontal Truss Diaphragms

- AISC 341-16, Section B5.2
  - Members and their connections shall be designed for load combinations with overstrength, $\boldsymbol{\Omega_0}$
  - Exceptions – **Diagonal members** of horizontal trusses that meet certain requirements of SCBF braces

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Horizontal Truss Diaphragms

Requirements to avoid Ω_0

- Diagonal member does not support gravity loads
- Diagonal member cannot be in a K- or V- configuration
- 30% -70% of diagonals in a given line oriented in tension
- Truss members must meet highly ductile proportioning limits
- $L_c/r \leq 200$
- Intermittent fastener requirements for built-up members
- Net sections must be reinforced
- Diagonal member connections designed for maximum probable brace capacity
- Gusset must accommodate brace buckling rotations

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Horizontal Truss Diaphragms

- AISC 341-16, Section B5.2
  - Members and their connections shall be designed for load combinations with overstrength, $\mathbf{\Omega_0}$
  - Exceptions – Seismic force-resisting system is OMF or OCBF and
    - No K-configurations in horizontal truss
    - Horizontal truss diagonal members meet slenderness and compactness requirements for OCBF braces
    - Horizontal truss diagonal connections meet requirements for OCBF brace connections

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Horizontal Truss Diaphragms

- AISC 341-16, Section B5.2
  - Members and their connections shall be designed for load combinations with overstrength, $\mathbf{\Omega_0}$
  - Exceptions – Apply only to the diagonal members
  - **Chords always designed for overstrength**
    - Chords shall meet the compactness and slenderness requirements for highly ductile members

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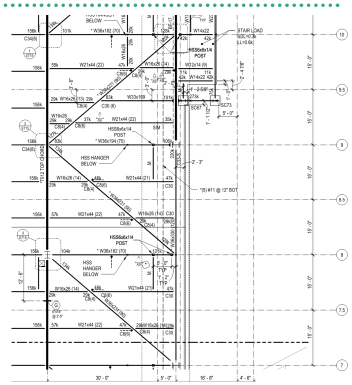
Horizontal Truss Diaphragms

- Layout Considerations – Diagonal Members
  - **Continuous**
  - Segmented



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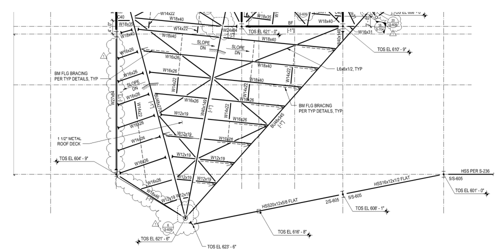
Horizontal Truss Diaphragms

- Layout Considerations – Diagonal Members
  - Continuous
  - **Segmented**



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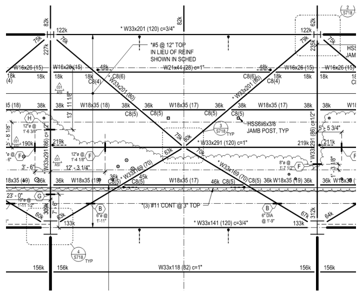
Horizontal Truss Diaphragms

- Layout Considerations – Diagonal Members
  - Continuous
  - Segmented



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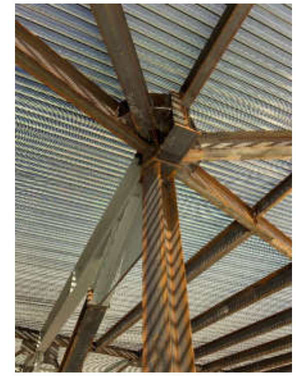
Horizontal Truss Diaphragms

- Layout Considerations – Diagonal Members
  - **Top of Steel Aligned**
  - Centerline (Centroid) Aligned



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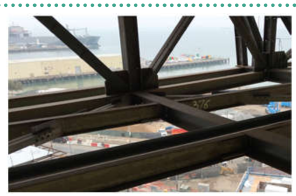
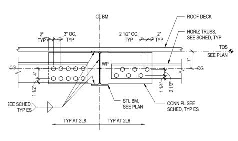
Horizontal Truss Diaphragms

- Layout Considerations – Diagonal Members
  - Top of Steel Aligned
  - **Centerline (Centroid) Aligned**





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Horizontal Truss Diaphragms

- Layout Considerations – Shapes
  - Wide Flange
  - Angles/Double Angles
  - HSS
  - WT

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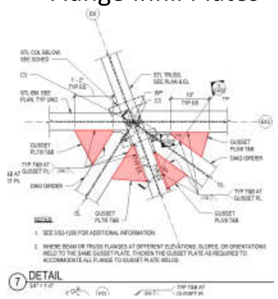
Horizontal Truss Diaphragms

- Connections
  - Flange Infill Plates – welded



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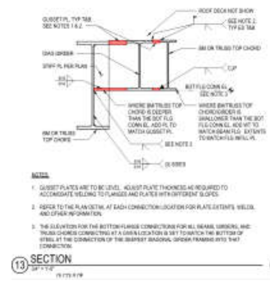
Horizontal Truss Diaphragms

- Connections
  - Flange Infill Plates – welded



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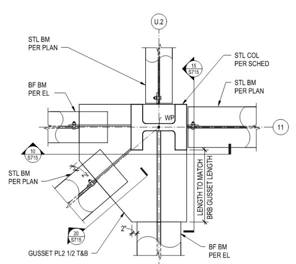
Horizontal Truss Diaphragms

- Connections
  - Gusset Plates – Flange Welded

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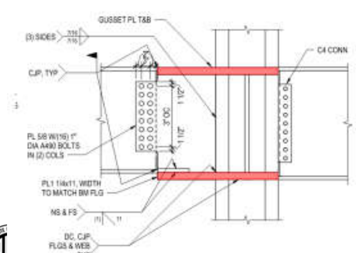
Horizontal Truss Diaphragms

- Connections
  - Gusset Plates – Flange Welded



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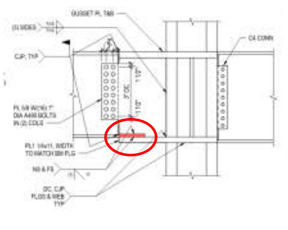
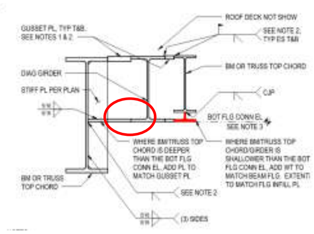
Horizontal Truss Diaphragms

- Connections
  - Pay attention to member depths





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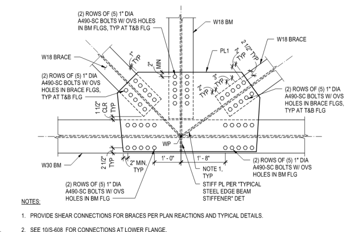
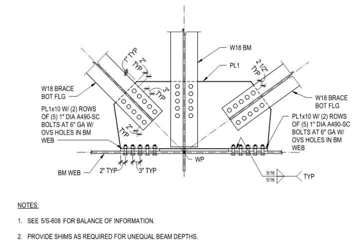
Horizontal Truss Diaphragms

- Connections
  - Gusset Plates – Flange Bolted





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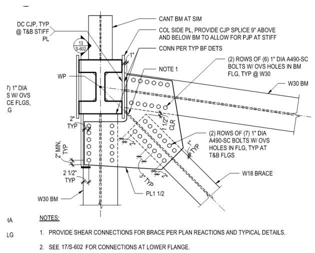
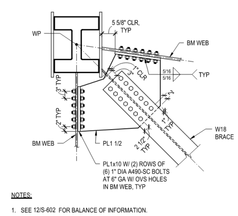
Horizontal Truss Diaphragms

- Connections
  - Gusset Plates – Flange Bolted





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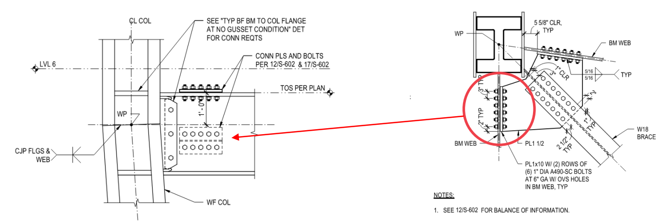
Horizontal Truss Diaphragms

- Connections
  - Gusset Plates – Flange Bolted



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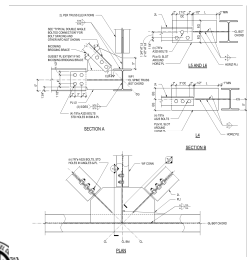
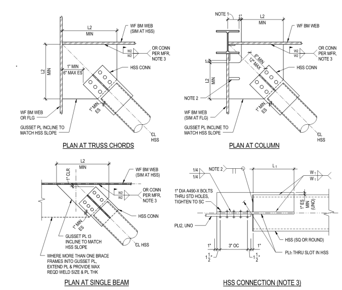
Horizontal Truss Diaphragms

- Connections
  - Horizontal Gusset Plates with Bolted Double Angles



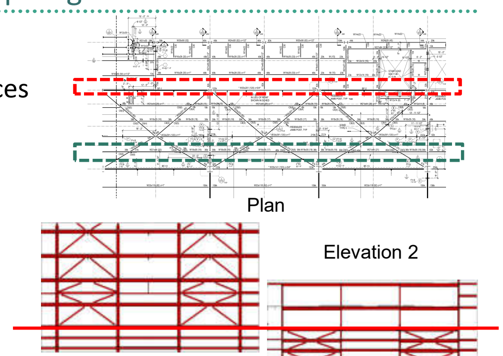
Horizontal Truss Diaphragms

- Connections
  - Horizontal Gusset Plates with Bolted HSS



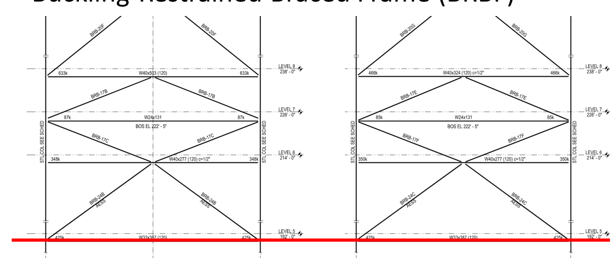
Horizontal Truss Diaphragms

- Design Example
  - Transfer Forces



Horizontal Truss Diaphragms

- Design Example
  - Buckling-Restrained Braced Frame (BRBF)



Partial Elevation - 1

Horizontal Truss Diaphragms

- Design Example
  - Transfer Forces – AISC 341, F4-3
    Capacity-Limited Horizontal Seismic Load Effect, E_{cl}

3. Analysis

The required strength of columns, beams, struts and connections in BRBF shall be determined using the capacity-limited seismic load effect. The capacity-limited horizontal seismic load effect, E_{cl}, shall be taken as the forces developed in the member assuming the forces in all braces correspond to their adjusted strength in compression or in tension.

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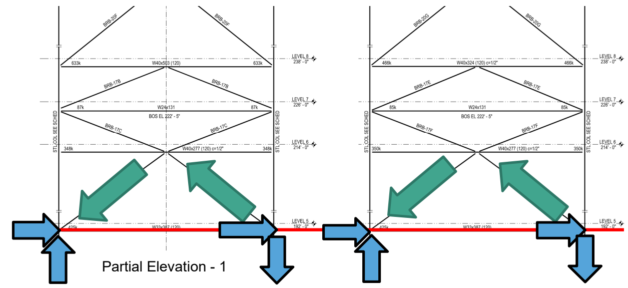
Horizontal Truss Diaphragms

- Design Example
  - Buckling-Restrained Braced Frame (BRBF)



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Horizontal Truss Diaphragms

- Design Example
  - BRB Properties
    A_{sc} = 24.0 in^2
    F_y = 42 $\pm$ 2 ksi (Coupon Test Validation)
    ω = 1.26
    β = 1.16

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Horizontal Truss Diaphragms

- Design Example
  - BRB Adjusted Brace Strength
  - Tension
    $T = \omega F_y A_{sc} = 1.26(44)(24.0) = 1331\ k$
  - Compression
    $P = \omega \beta F_y A_{sc} = 1.26(1.16)(44)(24.0) = 1543\ k$

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Horizontal Truss Diaphragms

- Design Example
  - Capacity-Limited Horizontal Seismic Load Effect, E_{cl}
  - Brace Angle = 37^0

Tension Brace

$$(1331)\cos 37 = 1063\ k$$

Compression Brace

$$(1543)\cos 37 = 1232\ k$$

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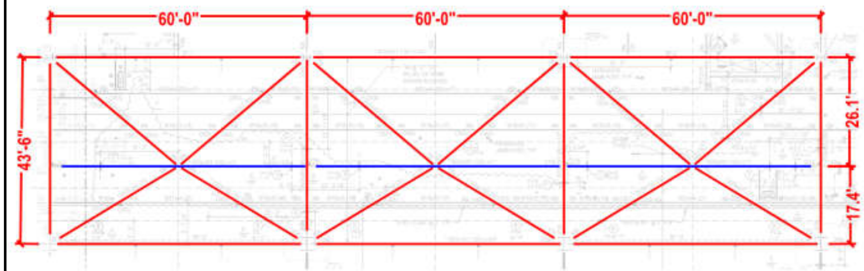
Horizontal Truss Diaphragms

- Design Example



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Horizontal Truss Diaphragms

- Design Example
- Simplifying Assumptions

Each support (braced frame) resists the same load

Each truss diagonal resists the same load

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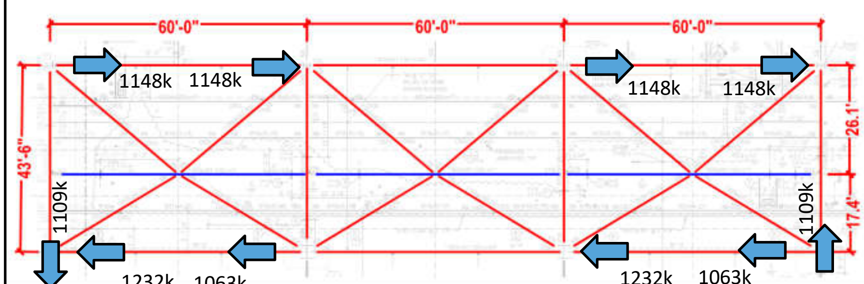
Horizontal Truss Diaphragms

- Design Example – Free Body Diagram



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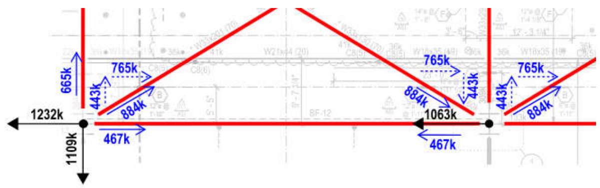
Horizontal Truss Diaphragms

- Design Example – Nodal Equilibrium



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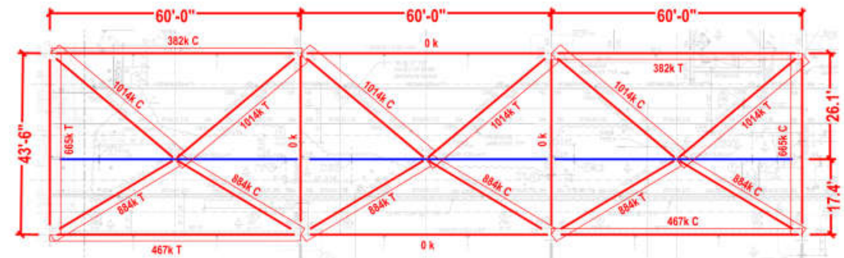
Horizontal Truss Diaphragms

- Design Example – Member Axial Forces



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Idealizing Load Paths in a Diaphragm

- Case Study
  - Transfer Force at Core Setback

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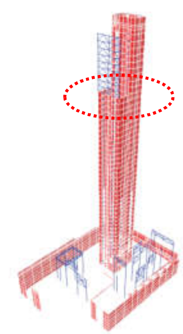
Idealizing Load Paths in a Diaphragm

- Case Study
  - Transfer Force at Core Setback



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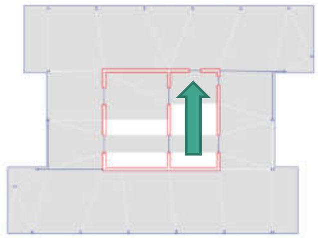
Idealizing Load Paths in a Diaphragm

- Case Study
  - Transfer Force at Core Setback



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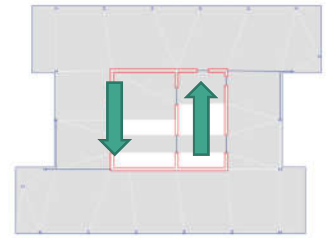
Idealizing Load Paths in a Diaphragm

- Case Study
  - Transfer Force at Core Setback



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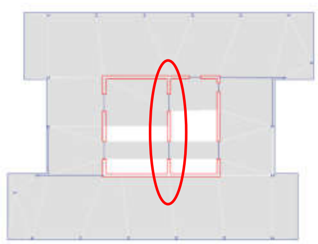
Idealizing Load Paths in a Diaphragm

- Case Study
  - Transfer Force at Core Setback
  - **2,284 k!**



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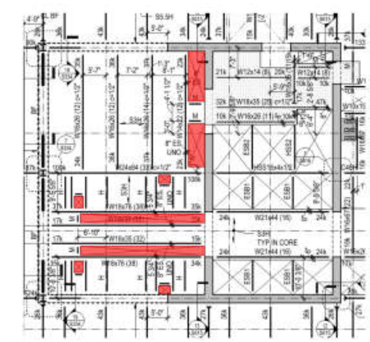
Idealizing Load Paths in a Diaphragm

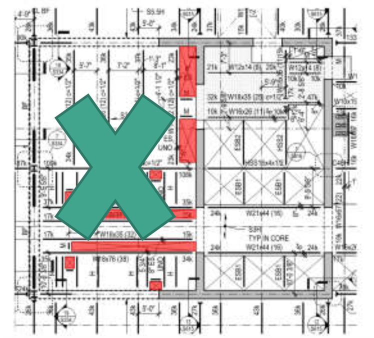
- Case Study
  - Transfer Force at Core Setback
  - **2,284 k!**



60

Idealizing Load Paths in a Diaphragm

- Case Study
  - Transfer Force at Core Setback
  - **No direct load path available**



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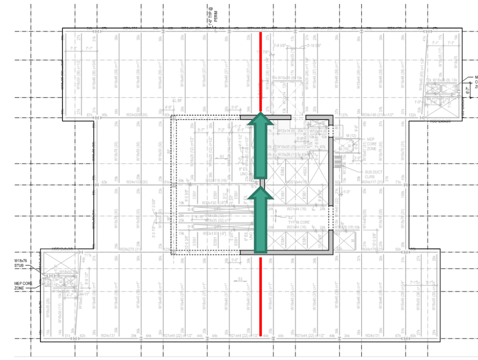
Idealizing Load Paths in a Diaphragm



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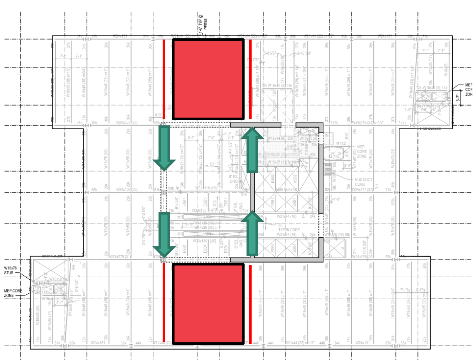
Idealizing Load Paths in a Diaphragm



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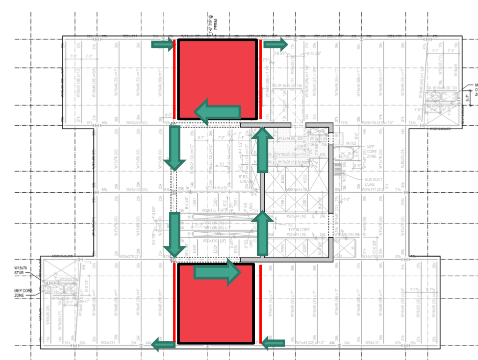
Idealizing Load Paths in a Diaphragm



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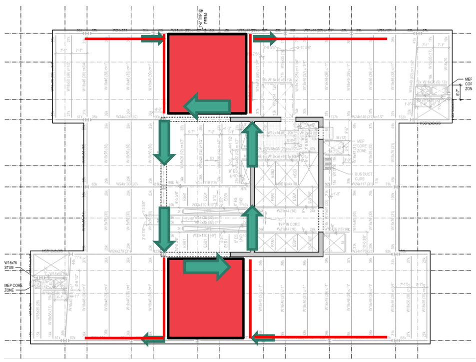
Idealizing Load Paths in a Diaphragm



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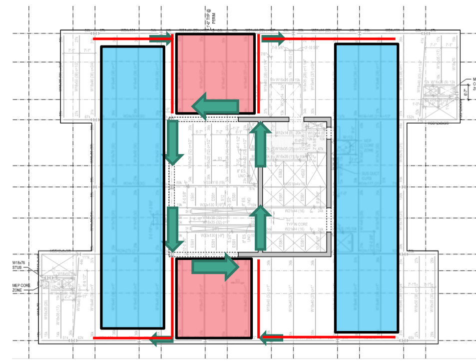
Idealizing Load Paths in a Diaphragm



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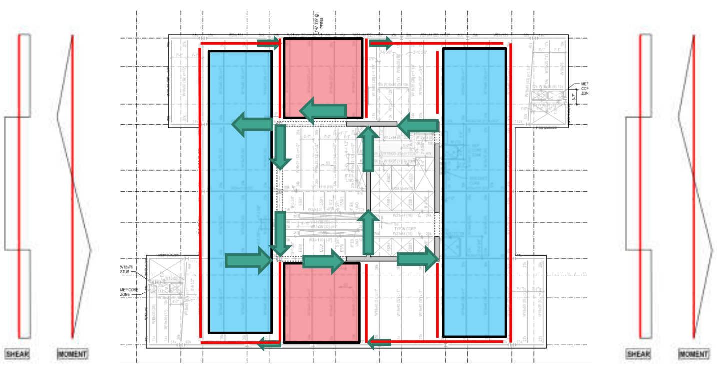
Idealizing Load Paths in a Diaphragm



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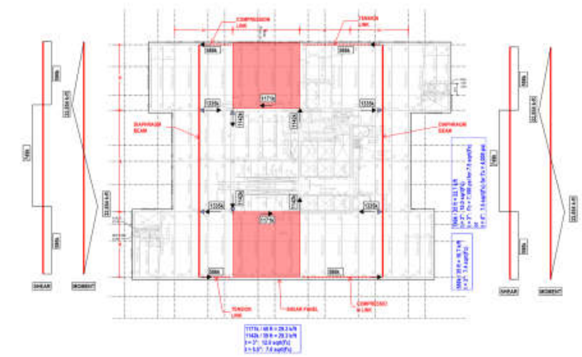
Idealizing Load Paths in a Diaphragm



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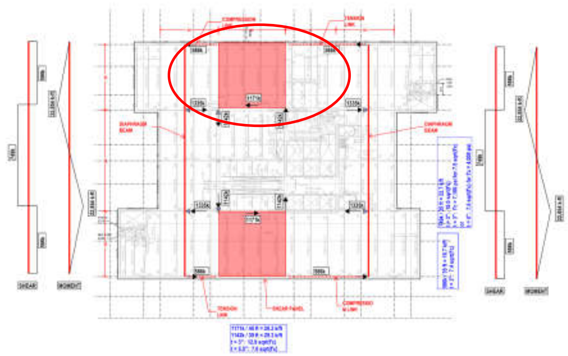
Idealizing Load Paths in a Diaphragm



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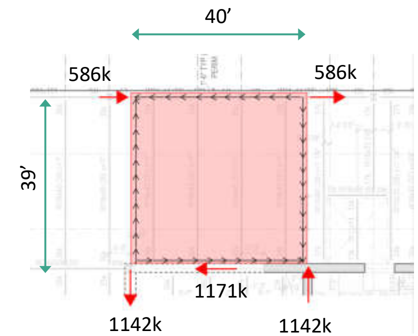
Idealizing Load Paths in a Diaphragm

Uniform Shear Stress

$$\frac{1142k \ x\ 40'}{39'} = 1171k$$

$$\frac{1142k}{39'} = \frac{1171k}{40'} = 29.3\ k/ft$$



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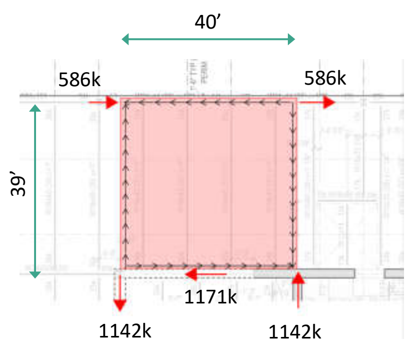
Idealizing Load Paths in a Diaphragm

Diaphragm Shear Design

- 5-1/2” normal-weight concrete on 3” deck
- f'_c = 6,000 psi
- F_y = 60 ksi



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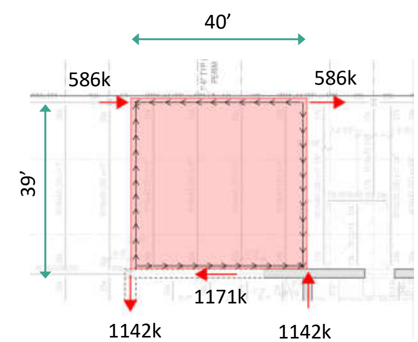
Idealizing Load Paths in a Diaphragm

Diaphragm Shear Design

$$V_u = 29.3\frac{k}{ft}$$

$$\emptyset V_n = \emptyset A_{cv}\left(2\sqrt{f'_c} + \rho f_y\right)$$



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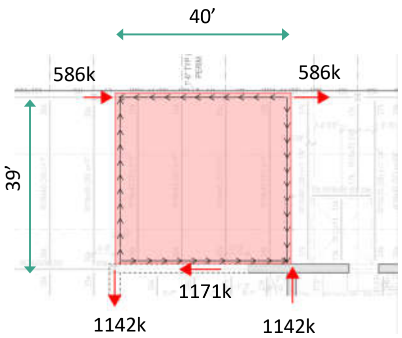
Idealizing Load Paths in a Diaphragm

Diaphragm Shear Design,

Solve for ρ (ACI 318-14, Eq 12.5.3.3)

$$\emptyset V_n = \emptyset A_{cv}\left(2\sqrt{f'_c} + \rho f_y\right)$$

$$\rho = \frac{\frac{V_u}{\emptyset A_{cv}} - 2\sqrt{f'_c}}{f_y}$$



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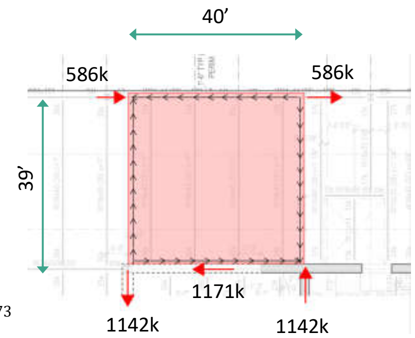
Idealizing Load Paths in a Diaphragm

Diaphragm Shear Design,

Solve for ρ (ACI 318-14, Eq 12.5.3.3)

$$\emptyset V_n = \emptyset A_{cv}\left(2\sqrt{f'_c} + \rho f_y\right)$$

$$\rho = \frac{\frac{29.3}{(0.75)(12)(5.5)} - 2\sqrt{6{,}000}/1000}{60} = .0073$$



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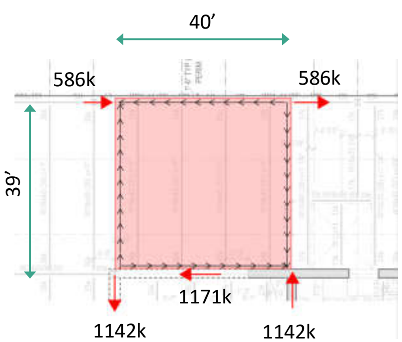
Idealizing Load Paths in a Diaphragm

Diaphragm Shear Design,

Determine A_s

$$A_s = \rho A_{cv} = .0073(12)(5.5) = 0.48\ in^2/ft$$

#5 @ 7-1/2" both directions above flutes



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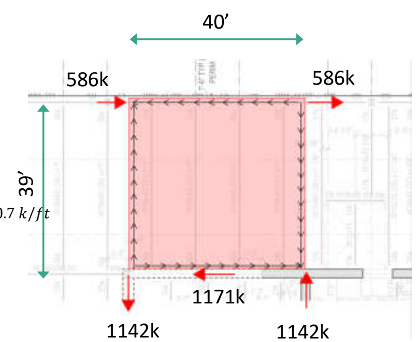
Idealizing Load Paths in a Diaphragm

Diaphragm Shear Design,

Check Upper Limit

$$V_u \le \emptyset 8 A_{cv}\sqrt{f'_c} = .75(8)(12)(5.5)\sqrt{6000}/1000 = 30.7\ k/ft$$



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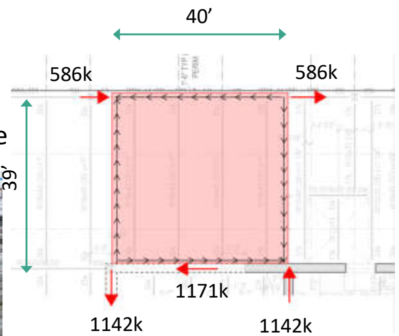
Idealizing Load Paths in a Diaphragm

Shear friction connection to core



Idealizing Load Paths in a Diaphragm

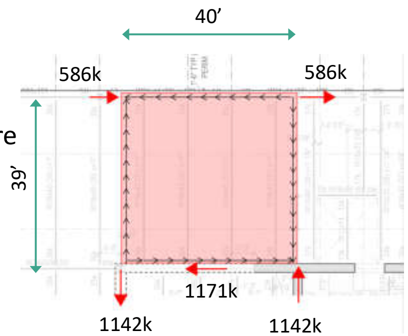
Shear friction connection to core

- ACI 318-14, Section 22.9

$$\emptyset V_n = \emptyset \mu \lambda A_{vf} f_y$$

Solve for A_{vf}

$$A_{vf} = \frac{V_u}{\phi \mu \lambda f_y}$$



Idealizing Load Paths in a Diaphragm

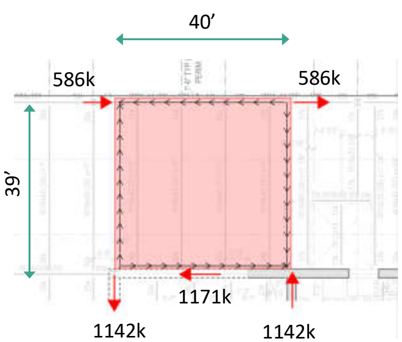
Shear friction connection to core

- Normal-weight concrete
- Intentionally roughened surface

$$A_{vf} = \frac{29.3}{0.75(1.0)(1.0)(60)}$$

$$A_{vf} = 0.65\ in^2/ft$$

#6 @ 8”



Idealizing Load Paths in a Diaphragm

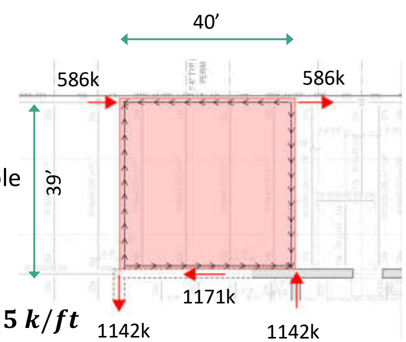
Shear friction connection to core

Check upper limit (ACI 318-14, Table 22.9.4.4)

$\emptyset V_n = \emptyset 0.2 f'_c A_c = 59.4$ k/ft

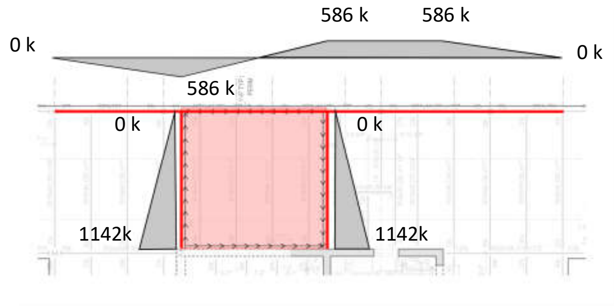
$\boldsymbol{\emptyset V_n = \emptyset(480 + .08 f'_c) A_c = 47.5\ k/ft}$

$\emptyset V_n = \emptyset 1600 A_c = 79.2$ k/ft



Idealizing Load Paths in a Diaphragm

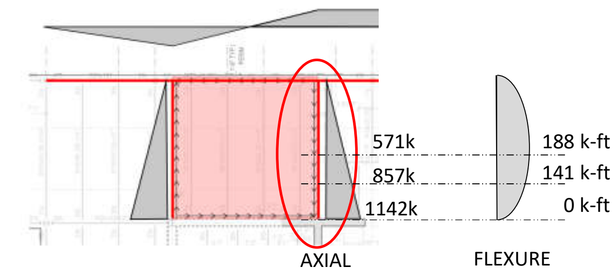
Collector/Chord Axial Force Distribution



Idealizing Load Paths in a Diaphragm

Collector/Chord Axial Force Distribution

- Member design forces



Idealizing Load Paths in a Diaphragm

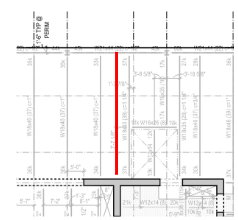
Collector/Chord Axial Force Distribution

- Seismic Load Combinations
  - $(\mathbf{1.2+0.2S_{ds}})D+\mathbf{f_1}L = 1.41D+0.5L$
    - $S_{ds} = 1.06$
    - $f_1 = 0.5$
  - M_D=114 k-ft, M_L=53 k-ft
  - M_u= 188 k-ft
  - $1.2M_D+1.6M_L$ = 222 k-ft

Idealizing Load Paths in a Diaphragm

Collector/Chord Axial Force Distribution

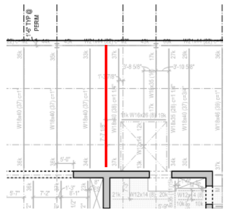
- Member Unbraced Lengths
- Seismic Design Manual, Table 8-1
  - Major Axis Flexural Buckling – Full Length
  - Minor Axis Flexural Buckling – Not Applicable
  - Constrained Axis Torsional Buckling – Full Length
  - Torsional Buckling – Not Applicable



Idealizing Load Paths in a Diaphragm

Collector/Chord Axial Force Distribution

- Constrained Axis Torsional Buckling
- Seismic Design Manual, Eq 8-2



$$F_e = 0.9[\frac{\pi^2 E I_y (h_0^2 + d^2)}{4L_{cz}^2} + GJ]\frac{1}{I_x + I_y + 0.25Ad^2}$$

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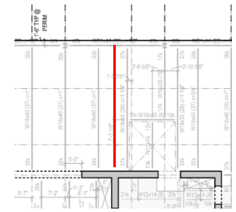
Idealizing Load Paths in a Diaphragm

Collector/Chord Axial Force Distribution

- Constrained Axis Torsional Buckling
- W14x193, $L_{cz} = 39' = 468\ in$



$$F_e = 0.9[\frac{\pi^2(29000)(931)(14.1^2 + 15.5^2)}{(4)(468^2)} + (11200)(34.8)]\frac{1}{2400 + 931 + 0.25(56.8)(15.5)^2}$$

$$F_e = 0.9[133542 + 389760]\frac{1}{6742.55}$$

$$F_e = 69.9\ ksi$$

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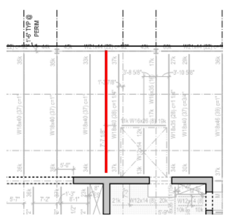
Idealizing Load Paths in a Diaphragm

Collector/Chord Axial Force Distribution

- Constrained Axis Torsional Buckling
- W14x193, $L_{cz} = 39' = 468\ in$



$$F_e = 69.9\ ksi$$

$$\frac{F_y}{F_e} = 0.72 < 2.25$$

$$F_{cr} = 0.658^{.72}x50 = 37.1\ ksi$$

$$\emptyset P_n = 0.9(37.1)(56.8) = 1896\ k$$

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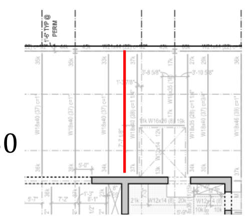
Idealizing Load Paths in a Diaphragm

Collector/Chord Axial Force Distribution

- Strong-axis Flexural Buckling
- W14x193, $L_x = 39' = 468\ in, r_x = 6.50$



$$\frac{L_x}{r_x} = 72.0$$

$$\emptyset F_{cr} = 30.8\ ksi$$

$$\emptyset P_n = (30.8)(56.8) = 1749\ k$$

Controls

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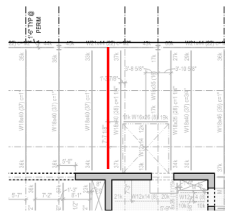
Idealizing Load Paths in a Diaphragm

Collector/Chord Axial Force Distribution

- Flexure (no LTB)
- W14x193

$$\emptyset M_n = 1330\ k - ft$$



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Idealizing Load Paths in a Diaphragm

Collector/Chord Axial Force Distribution

- Interaction
- $\emptyset P_n = 1749$ k
- $\emptyset M_n = 1330$ k-ft

Location	Pu (k)	B_1xMu (k-ft)	DCR
End	1142	0	.65
¼ Point	867	195	.63
Mid-Span	571	230	.48

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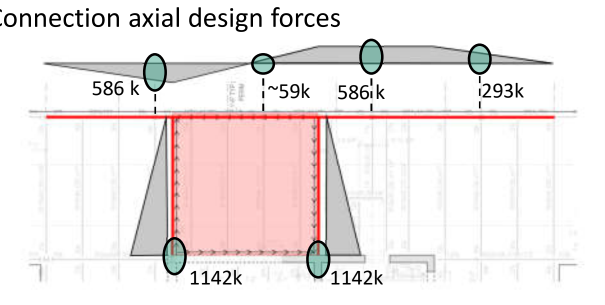
Idealizing Load Paths in a Diaphragm

Collector/Chord Axial Force Distribution

- Connection axial design forces



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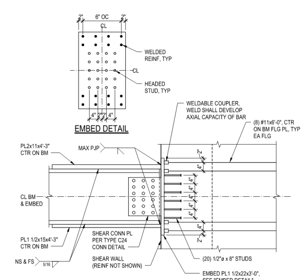
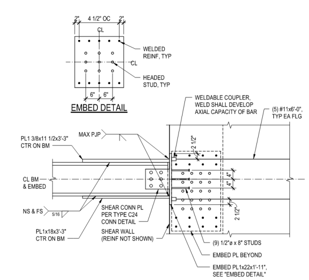
Idealizing Load Paths in a Diaphragm

Collector/Chord Connection at Core





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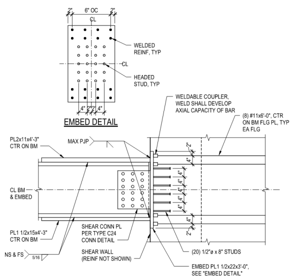
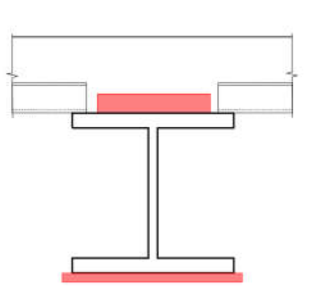
Idealizing Load Paths in a Diaphragm

Collector/Chord Connection at Core





SECTION

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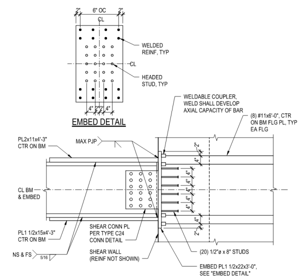
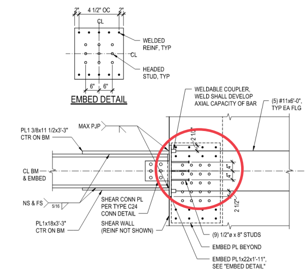
Idealizing Load Paths in a Diaphragm

Collector/Chord Connection at Core





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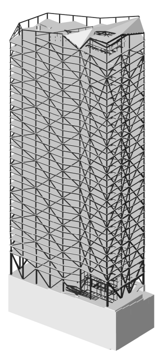
Putting It All Together

Case Study

- Combining Multiple Effects



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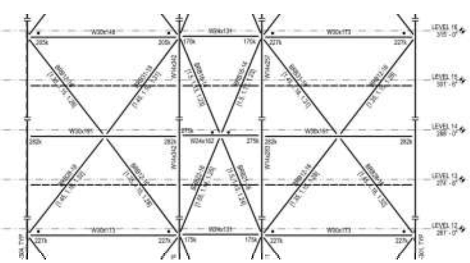
Putting It All Together

Case Study

- Two-story braces



PARTIAL ELEVATION

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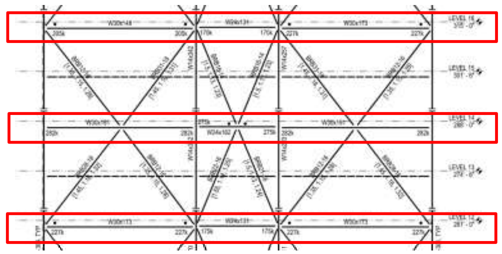
Putting It All Together

Nodal Floor

- Braces connect



PARTIAL ELEVATION

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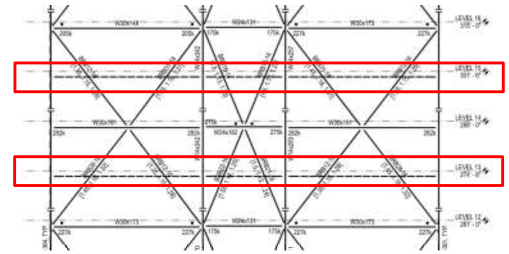
Putting It All Together

Internodal Floor

- Braces bypass



PARTIAL ELEVATION

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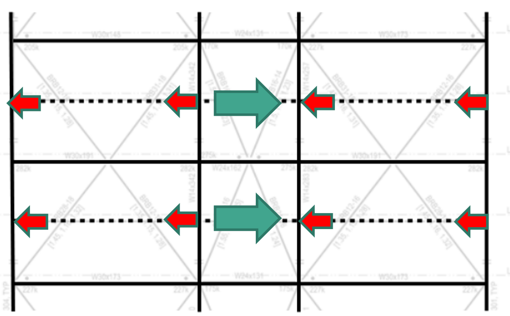
Putting It All Together

Internodal Floor

- Relies on column bending



PARTIAL ELEVATION

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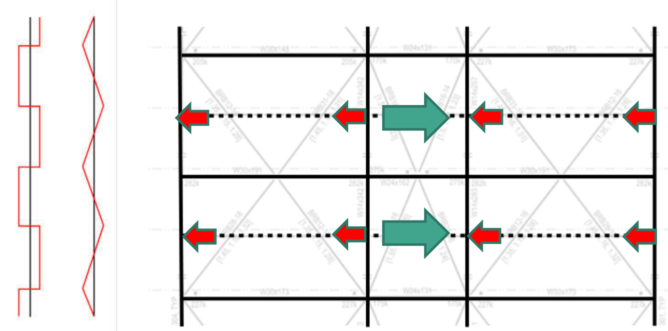
Putting It All Together



PARTIAL ELEVATION

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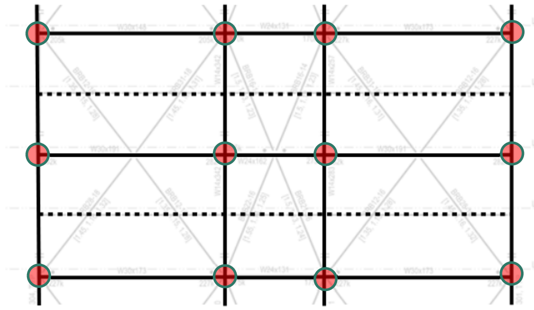
Putting It All Together

Internodal Floor

- Does not brace columns



PARTIAL ELEVATION

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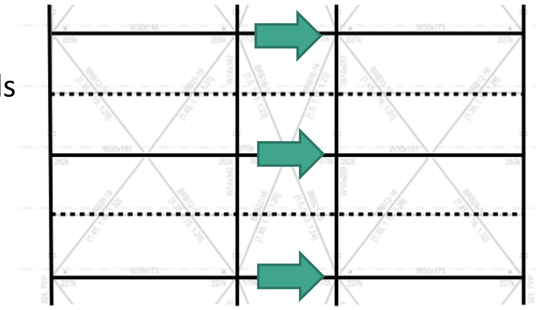
Putting It All Together

Nodal Floor Loads

- Inertial loads



PARTIAL ELEVATION

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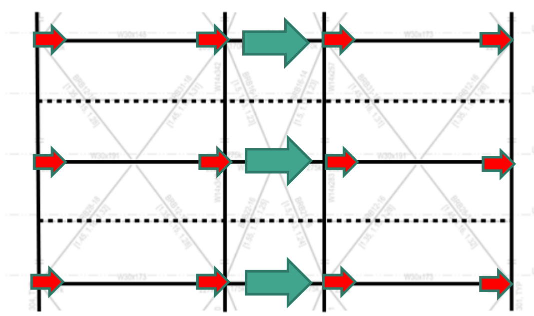
Putting It All Together

Nodal Floor Loads

- Transfer Loads from Internodal floors



PARTIAL ELEVATION

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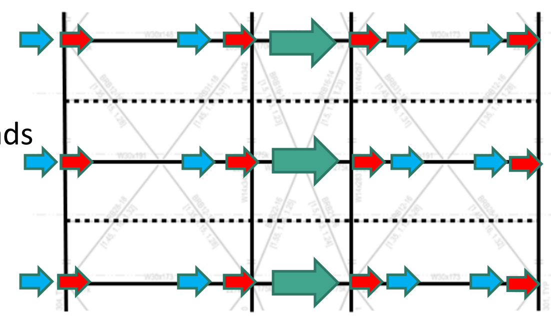
Putting It All Together

Nodal Floor Loads

- Column bracing loads



PARTIAL ELEVATION

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Putting It All Together

Nodal Floor Design Considerations

- Combining Inertial Forces generated at multiple levels
  - Inertial Forces, F_{px} ? (ASCE 7, Chapter 12)
  - Transfer Forces, F_x? (From analysis)

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Putting It All Together

Nodal Floor Design Considerations

- Combining Inertial Forces generated at multiple levels with Column Stability Forces
  - Consider random directionality?
  - AISC 360-16, Appendix 6 Commentary

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Putting It All Together

Nodal Floor Design Considerations

- Complete Load Path!
  - Provide a complete path for forces generated on internodal floor all the way to the lateral system

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AISC | Questions?

Smarter.
Stronger.
Steel.

CEU / PDH Certificates

For those participating at their own connection…

- Reporting attendance is not necessary.
- Certificates will be issued based on AISC's attendance record.
- You will be receiving certificates via email from registration@aisc.org.

Smarter. Stronger. Steel.

CEU / PDH Certificates

For those participating at one connection with a group…

- Main registrant will report attendance via an online form. (The link will be provided in an email from registration@aisc.org.)
  - Username: Same as AISC website username.
  - Password: Same as AISC website password.
- Once attendance has been reported, each group member will be receiving certificates via email from registration@aisc.org.

Smarter. Stronger. Steel.

AISC | Thank you

Smarter. Stronger. Steel.