

نحوه ی تعریف دیوار برشی فولادی در Etabs

برای تعریف دیوار برشی فولادی ابتدا دویا سه ورق فولادی از منوی Define > frame section با طول حدود 50 الی 60 سانت ...

دیدگاه



آموزش تصویری مدلسازی دیوار برشی فولادی

فیلم ورکشاپ مدلسازی تحلیل و طراحی دیوار برشی فولادی به همراه تشریح عملکرد و بررسی برخی مقالات و موضوعات جدید مطرح ...

دیدگاه (۰) 

طراحی دیوار برشی فولادی در SAP2000

در آیین نامه 10-341 AISC نه قاب زیر پشتیبانی می شوند که از بین آنها تنها برخی در ETABS قابل طراحی هستند: OMF ...

دیدگاه (۵)

طراحی دیوار برشی فولادی در Etabs

...

دیدگاه

نحوه مدلسازی دیوار برشی فولادی در نرم افزار Etabs

در این فایل شما با دیوار برشی فولادی آشنا خواهید شد همچنین نحوه مدلسازی دیوار برشی فولادی در نرم افزار Etabs نیز تش...

دیدگاه (۵)

ضریب رفتار R دیوار برشی فولادی

ضریب رفتار R دیوار برشی فولادی برای مدلسازی در Etabs به صورت زیر در نظر گرفته می شود مدلسازی دیوار برشی فولادی به ر ...

دیدگاه (۵)

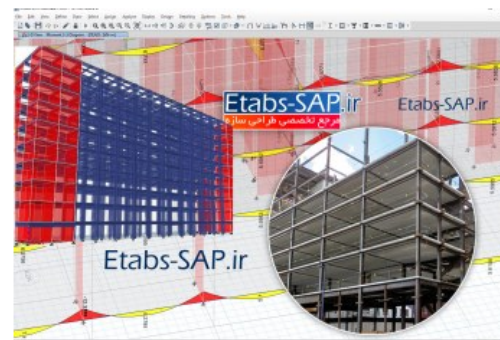
معرفی کتاب تحلیل و طراحی سازه های فولادی

فصل یکم این کتاب، به تشریح مبانی و خصوصیات فولاد اختصاص داده شده است. در این فصل مشخصات مکانیکی فولاد مورد اشاره قر ...

دیدگاه

دیوار پرشی بتنی در سازه فولادی

تنها مورد بحث اتصال ستون های فولادی توسط گل میخ به ...

دیدگاه (۰)  

آموزش طراحی دیوار برشی بتنی در سازه فولادی

CE591 Lecture 8: Shear Walls

- ❑ Introduction
 - History, examples
 - Benefits
 - Disadvantages
- ❑ Plate Girder Analogy
- ❑ Behavior of Special Plate Shear Walls (SPSW)
- ❑ Design of SPSW
 - Important considerations

Special Plate Shear Walls (SPSW)

□ Prior to 1980s

- Limit State considered to be **out-of-plane buckling**
- Result: heavily stiffened steel plates
 - Not competitive with reinforced concrete shear walls

Since then...

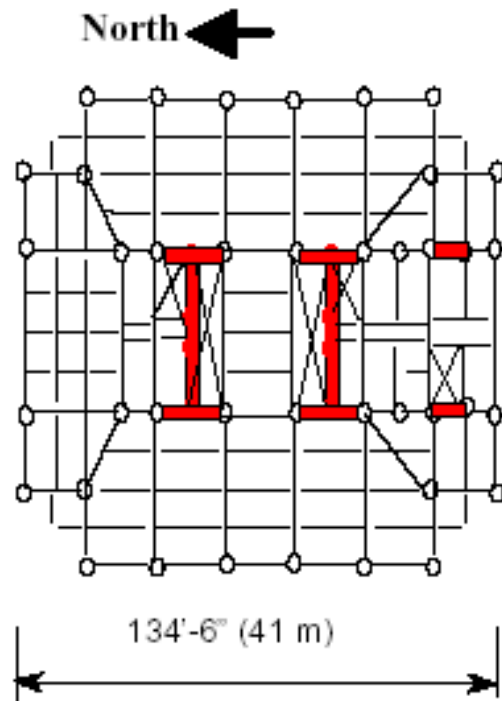
- Experimental studies have demonstrated **significant post-buckling strength, tension field action**
- Canadian Standards Association and AISC *Seismic Provisions for Structural Steel Buildings* 2005 implemented design standards for SPSW

Steel plate shear wall with horizontal and vertical stiffeners (Japan)

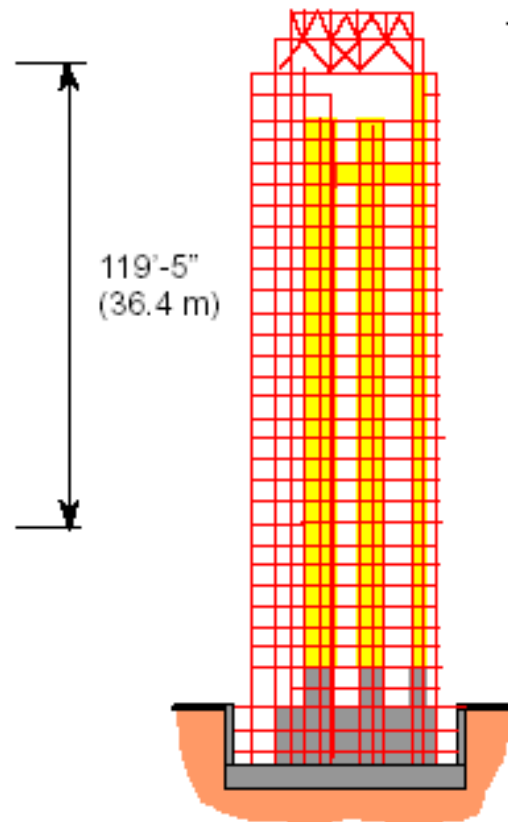




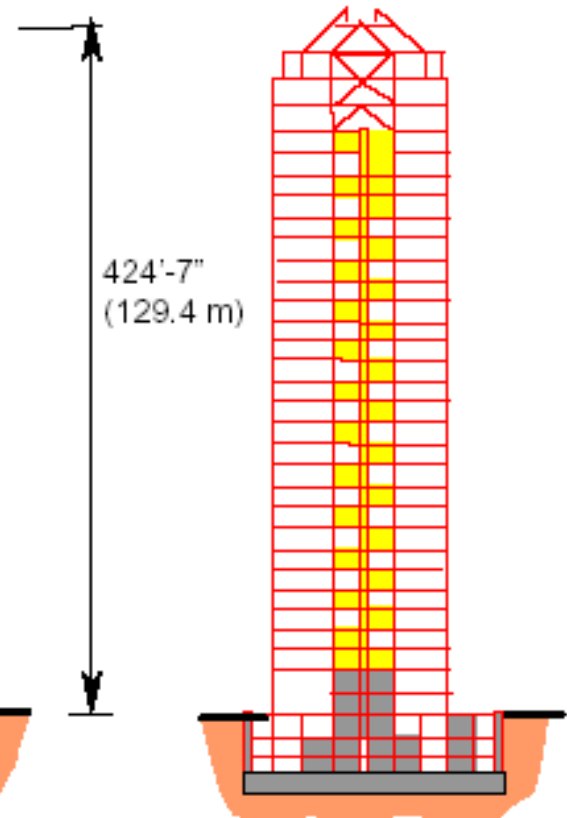
Kobe Office Building



Typical Floor Plan



N-S Frame

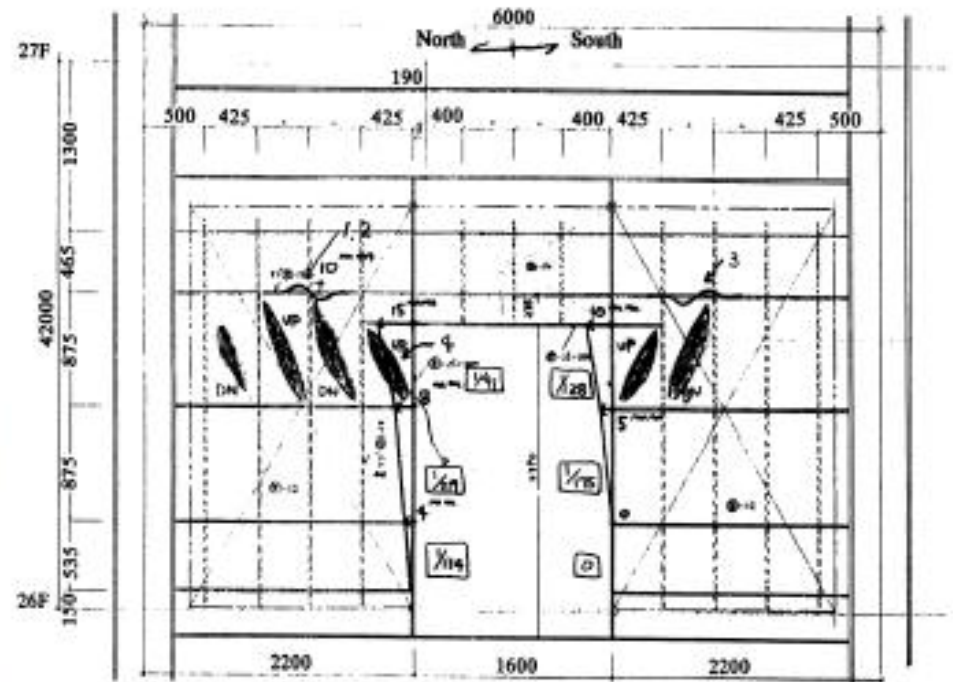


E-W Frame

Kobe Office Building

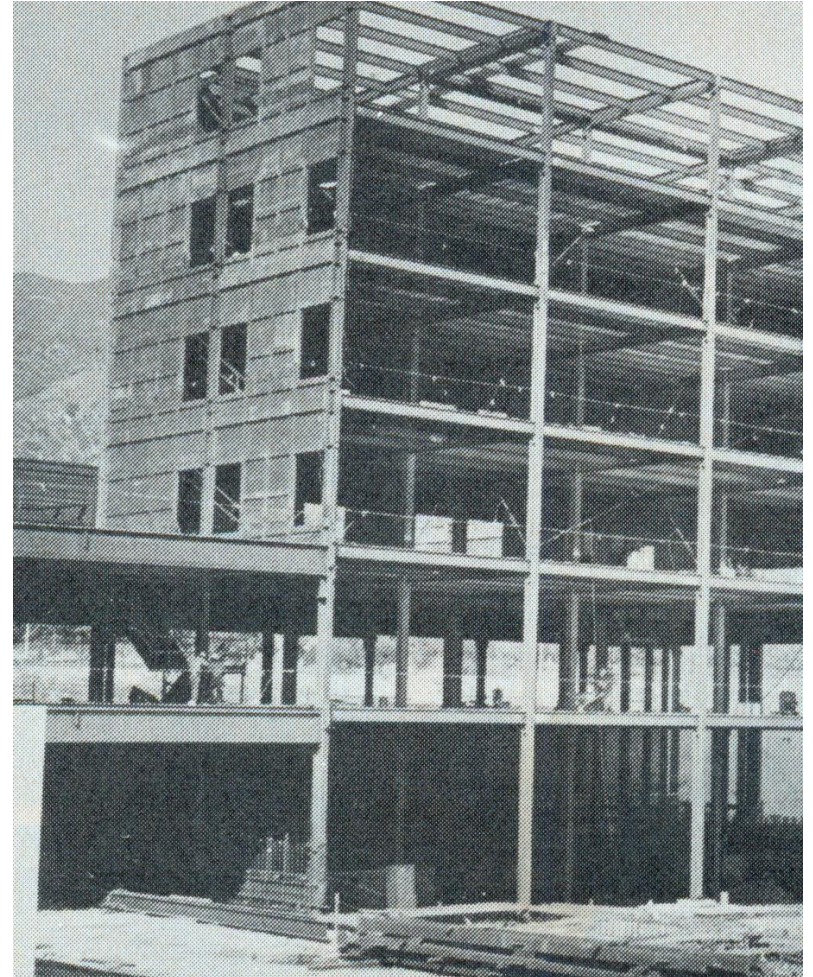
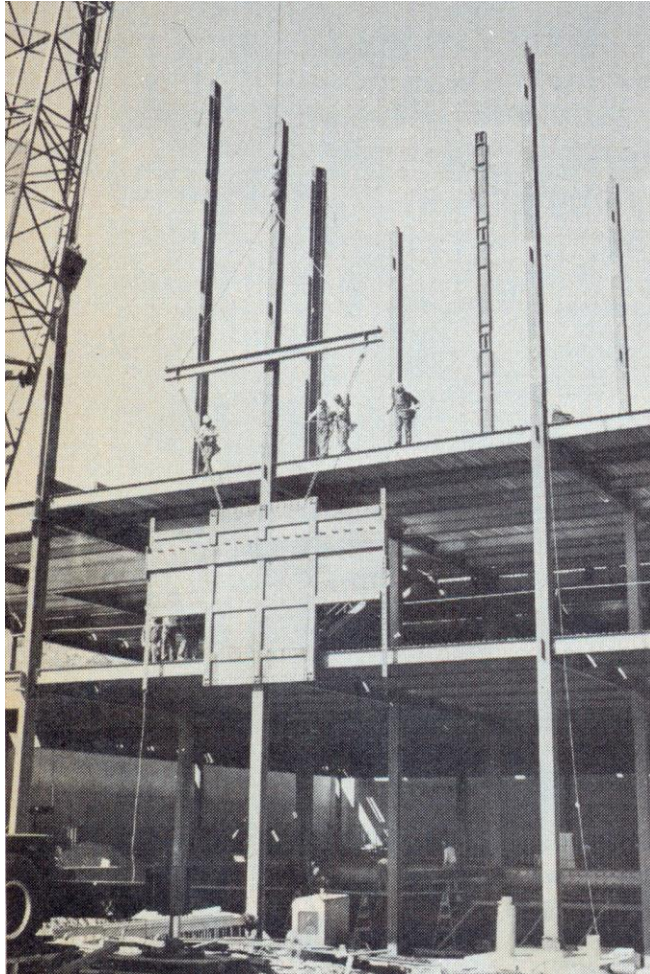


(Photo by M. Kanada, from Kanada and Astanceh-Asl, 1996),



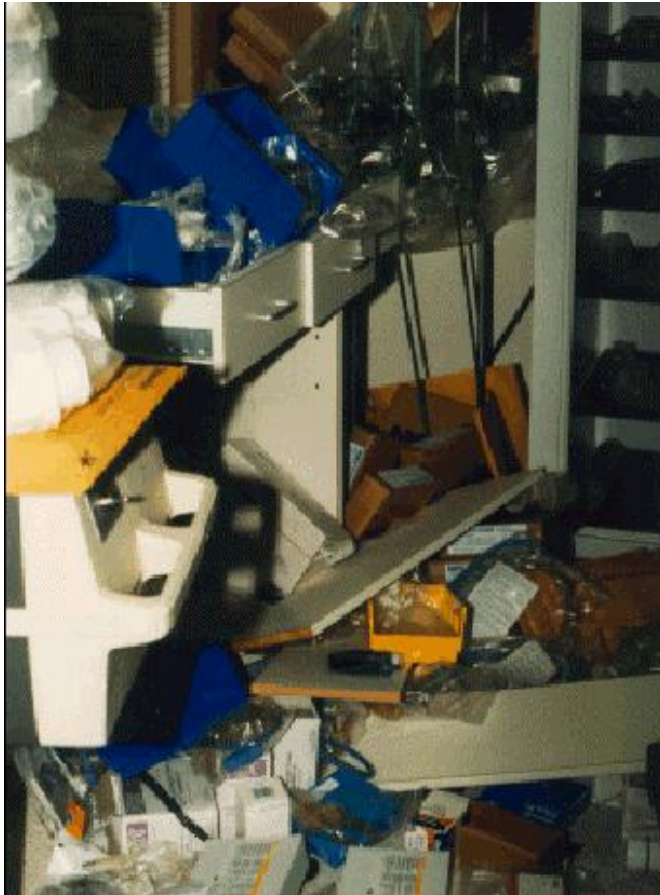
(From: Fujitani et al., 1996) and (AIJ, 1995)

Olive View Hospital



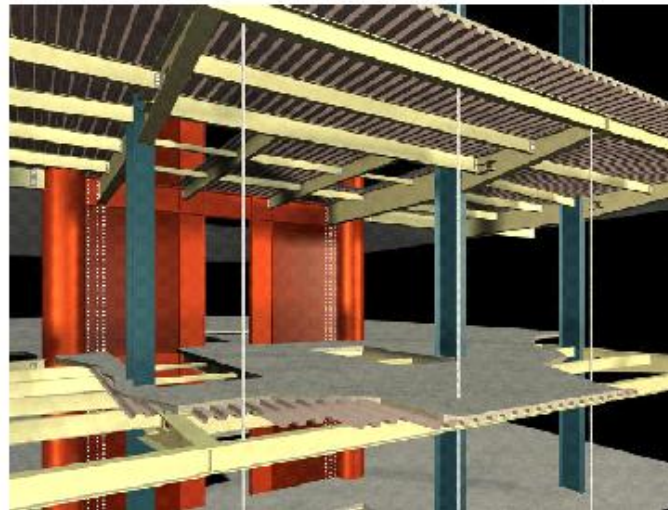
Courtesy of ENR

Olive View Hospital



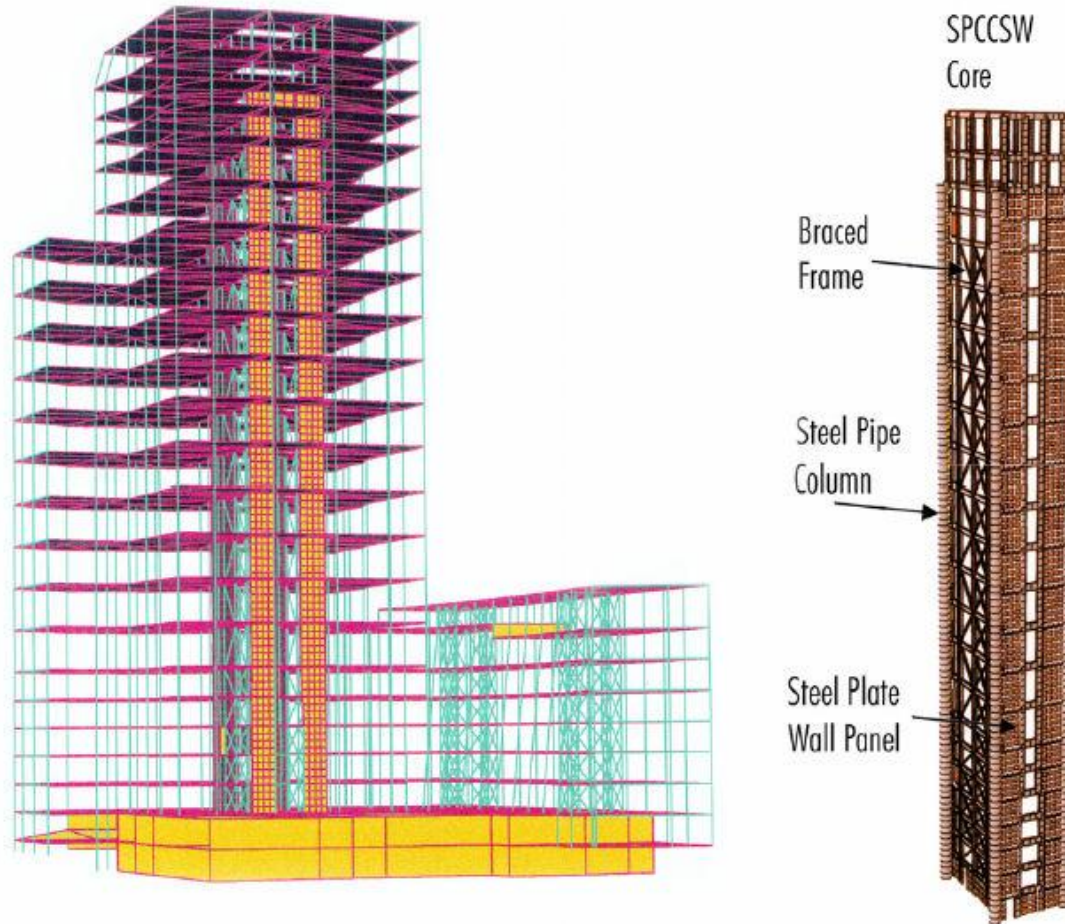
Courtesy of Naeim and Lobo

U.S. Federal Courthouse, Seattle



Courtesy of John Hooper, MKA Seattle

U.S. Federal Courthouse, Seattle



Courtesy of John Hooper, MKA Seattle

Steel plate shear walls in residential construction



Courtesy of Matt Eatherton, GFDS

Courtesy of Jon Brody Structural Engineers

Steel plate shear walls and details at base of SPW, ING building



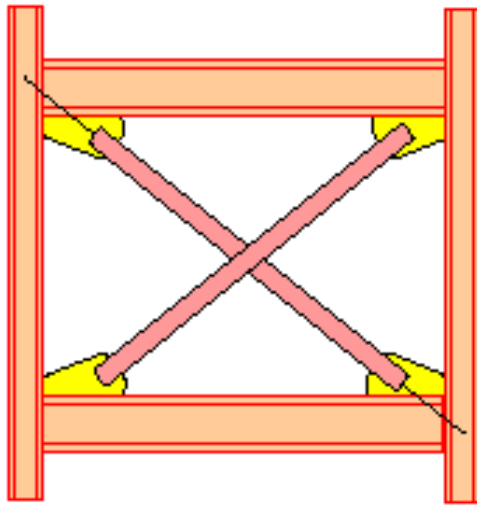
***Courtesy of Louis Crepeau and
Jean-Benoit Ducharme, Groupe
Teknika, Montreal, Canada***



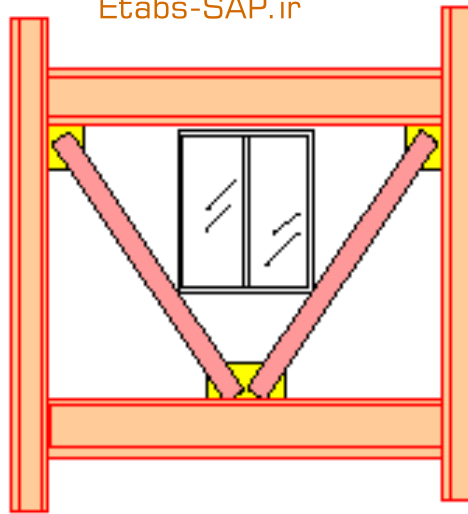
Advantages

- ❑ Ductility, energy dissipation
 - *if detailed properly, up to 4% drift without damage*
- ❑ Thinner walls
- *<18" with furring+finishes, savings in gross square footage*
- ❑ Light weight
 - *Lower total building weight; reduced foundation and overall building seismic loads*
- ❑ Fast construction time
 - *e.g. shop-welded, field-bolted; no curing time*
 - *"Easier than ... concentrically braced frames."*
- ❑ Easier retrofit

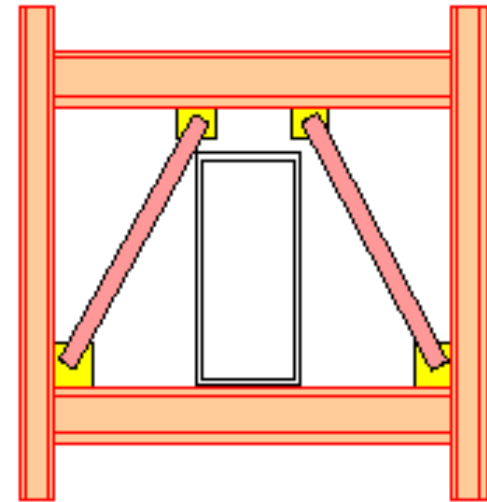
Seilie, I., and Hooper, J. (2005) "Steel Plate Shear Walls: Practical Design and Construction," Modern Steel Construction, April 2005.



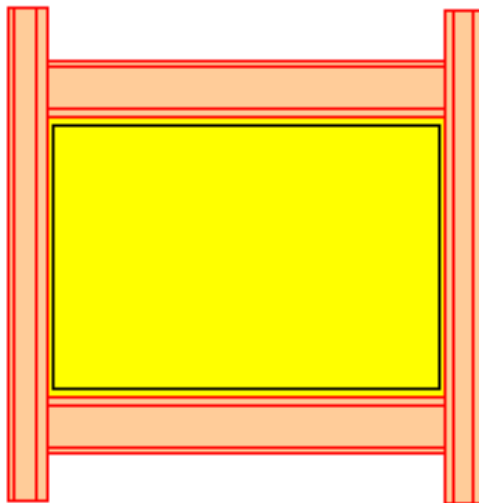
X-bracing



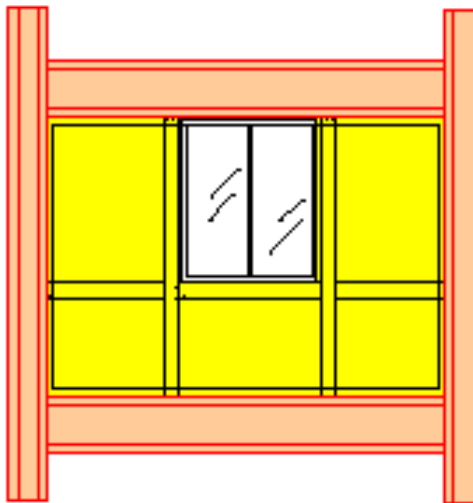
**V-bracing /
K-bracing**



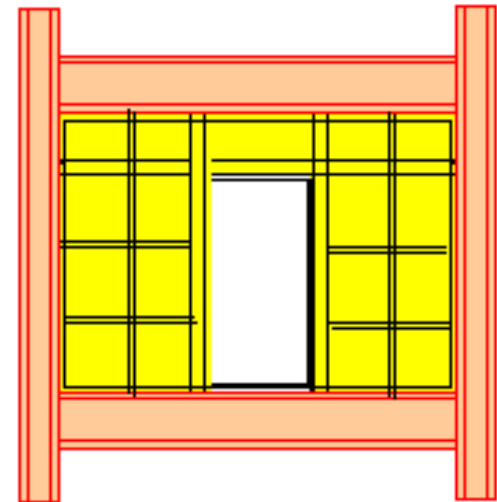
**Eccentric
Bracing**

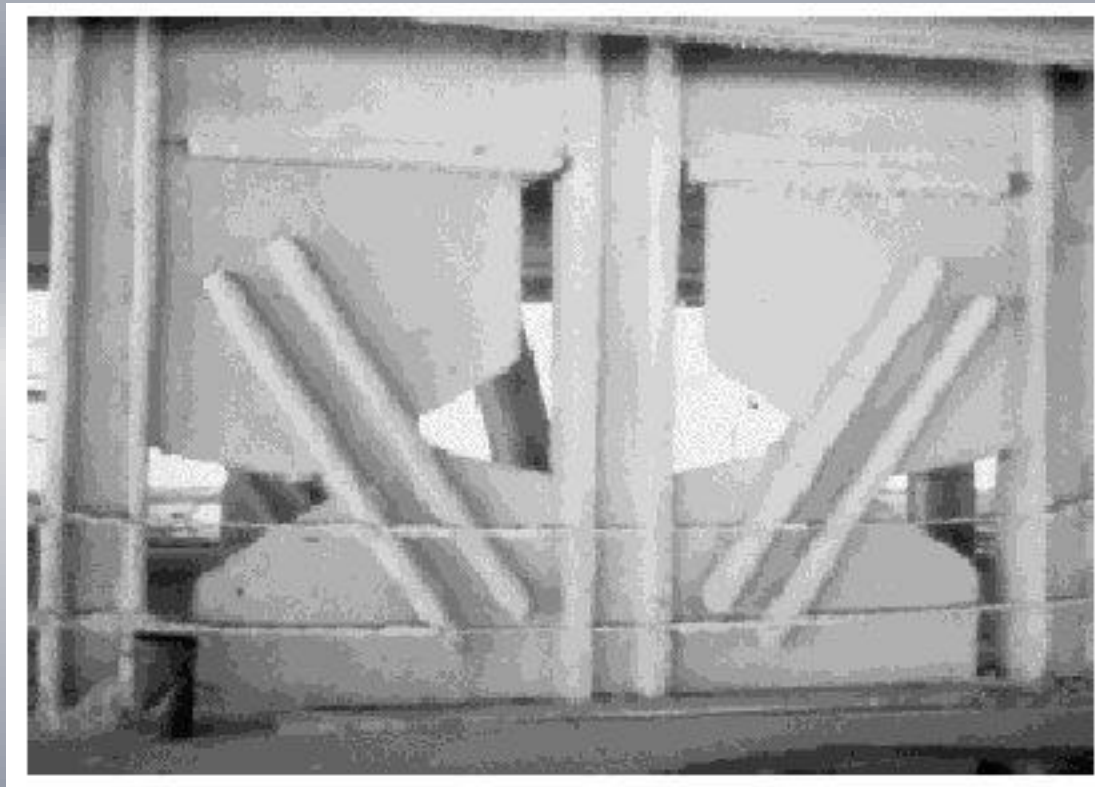


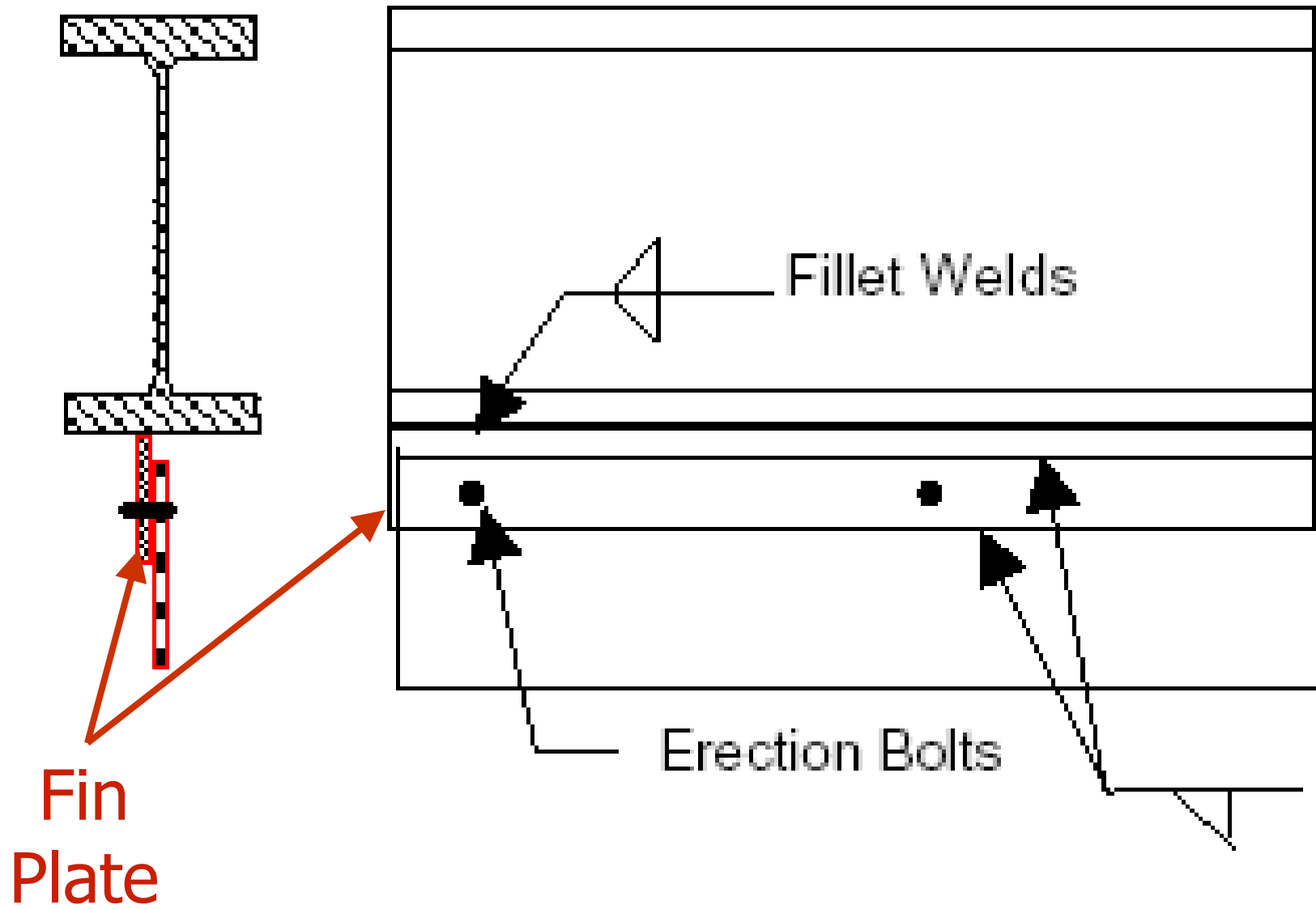
**Steel Plate Shear
Wall (Unstiffened)**



**Stiffened Shear Walls with
Openings**







Disadvantages

□ Stiffness

→ *Stiff, but more flexible than reinforced concrete shear walls*

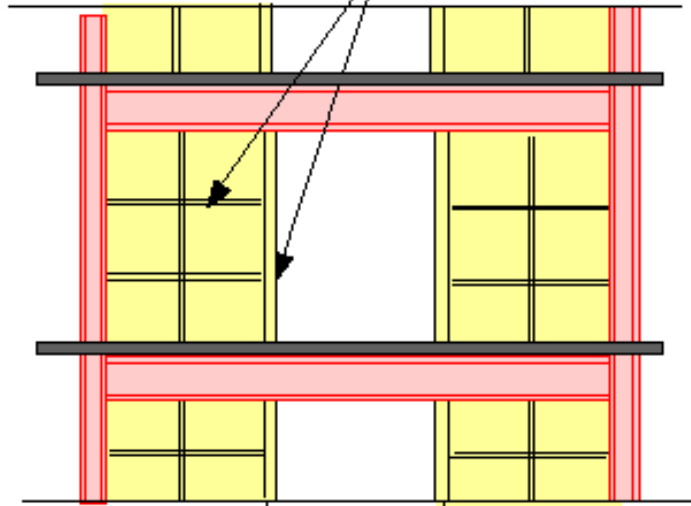
□ Construction Sequence

→ *Need to avoid pre-compression of SPSW due to dead loads ?*

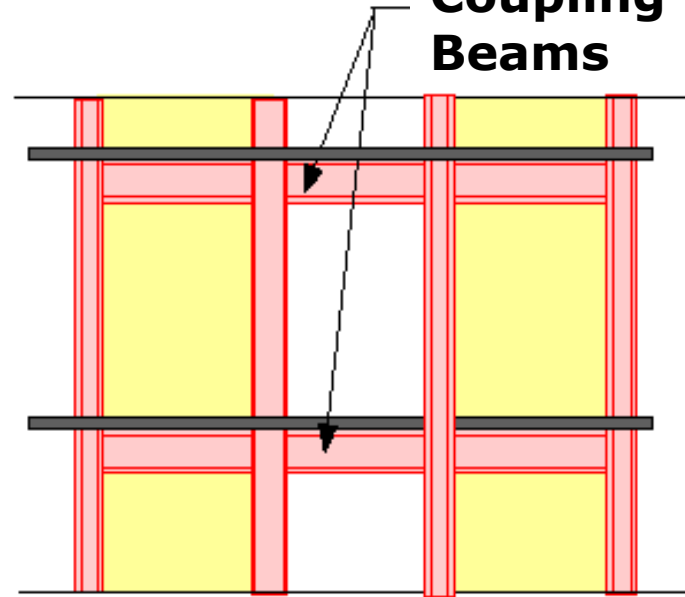
□ Unfamiliarity

→ *Currently, relative unfamiliarity with SPSW might result in higher costs for fabrication/erection (this is becoming less of an issue)*

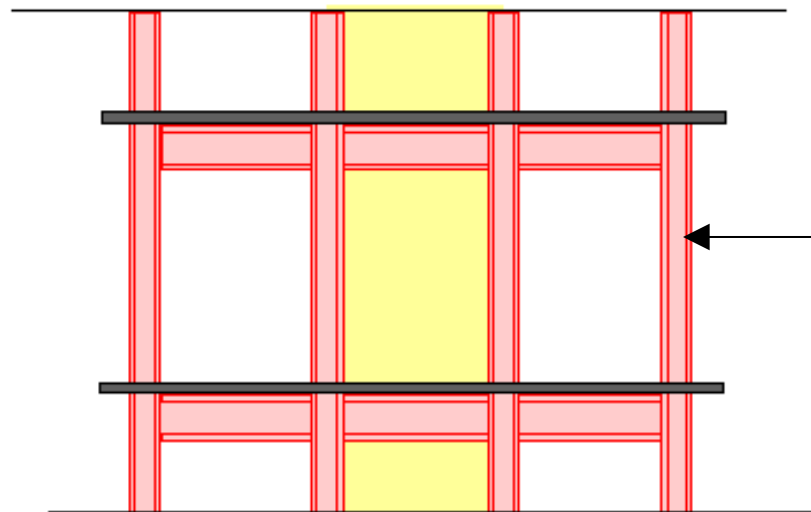
Stiffeners

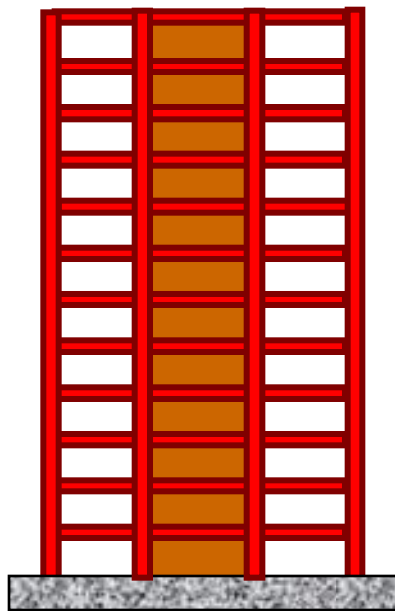


Coupling Beams

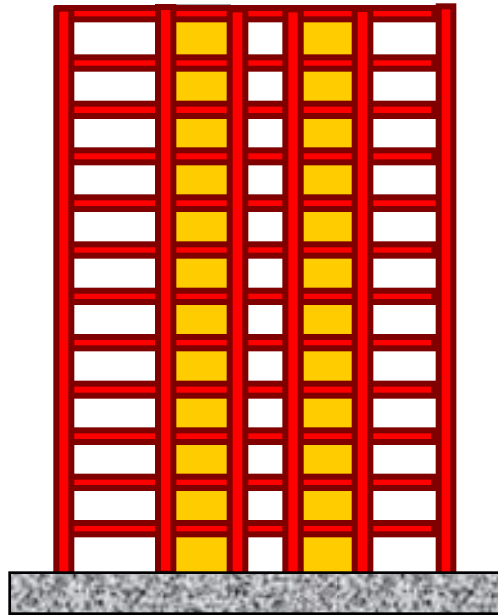


Outriggers

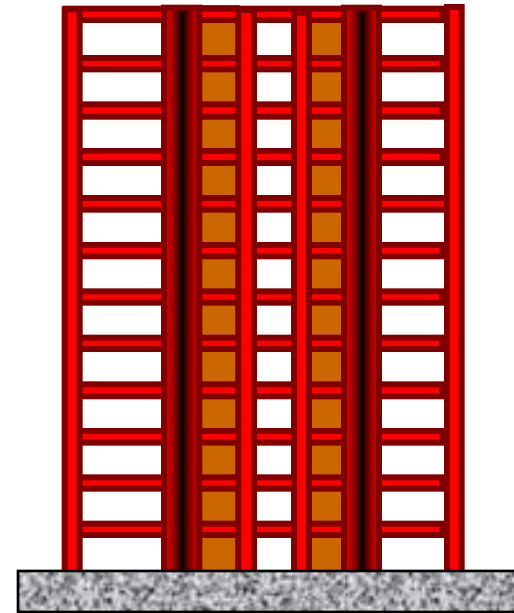




Single Bay



Coupled Bays



Coupled Bays & CFT Columns



L.A. Live

"Nabih Youssef Associates ...suggested replacing the heavy 30-in. concrete shear walls with light 1/4-in. to 3/8-in. steel-plate shear walls to free valuable real estate space; eliminate 35% of the weight of the structure; and reduce seismic design forces and foundation sizes.

...compressed the construction schedule and budget while allowing for more simplified and efficient construction."

SPSWs at 45th floor



Box column
fabricated in Japan




L.A. Live

Buckling-restrained
braces at 28th floor
(transition from
hotel to condo)



<http://blogdowntown.com/2008/10/3756-la-live-tower-structure-hailed-at-steel-industry>


<http://www.aisc.org/content.aspx?id=16012>



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L.A. LIVE

14th Edition Manual ON SALE NOW

FILE SHARING AND SOCIAL NETWORKING FOR
steelTOOLS.org

Have you **SEEN** what we do?
STEELDAY 9.28.2012

An interview with
Dr. John W. Fisher, P.E.
AISCPodcasts

L.A. Live Hotel & Residences
An Innovative Steel-Plate Shear Wall Solution


THE STORY

It was March, 2006 when Nabih Youssef Associates started the review of the conceptual design for L.A. Live Hotel & Residences and a new idea was born - an idea to replace heavy 30" concrete shear walls with light 1/4"-3/8" steel plate shear walls and free valuable real estate space, reduce seismic design forces and foundation sizes by eliminating 35% of the weight of the structure, compress the construction schedule and budget, and allow for simplified and more efficient construction. The concept was intriguing enough that Nabih Youssef Associates was hired by the developing group, AEG, to convert the 56-story concrete shear wall design to steel-plate shear wall solution. Both schemes were being developed in parallel for six months in order to validate them thoroughly. The decision was made and the FIRST steel-plate shear wall high-rise building in Los Angeles is on its way to the sky!

THE PROJECT

L.A. Live Hotel & Residences broke ground on November 2007 and the structural steel erection is expected to be completed by the end of 2008, 2 months ahead of schedule. Opening date is scheduled for early 2010.

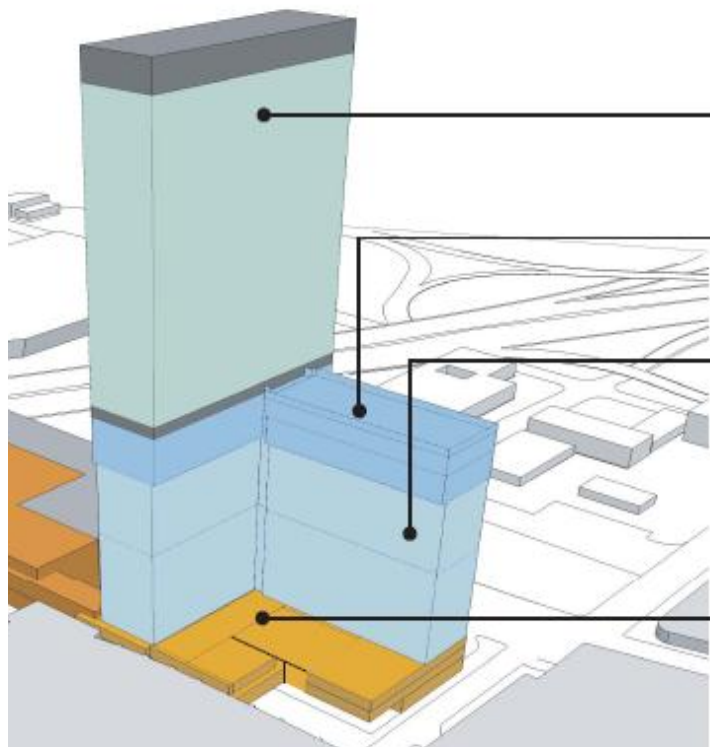
L.A. Live Hotel & Residences building is the centerpiece of L.A. LIVE development, a 4 million square foot / \$2.5 billion downtown Los Angeles sports, residential & entertainment district development adjacent to STAPLES Center and the Los Angeles Convention Center. The 56-story structure would house 1,001 hotel rooms and 224 luxury condominiums. Its total development cost is estimated at \$1.0 billion for the two million square feet of space.



Links to full presentation, videos of site tour (2008), etc.

Project Description

Architectural



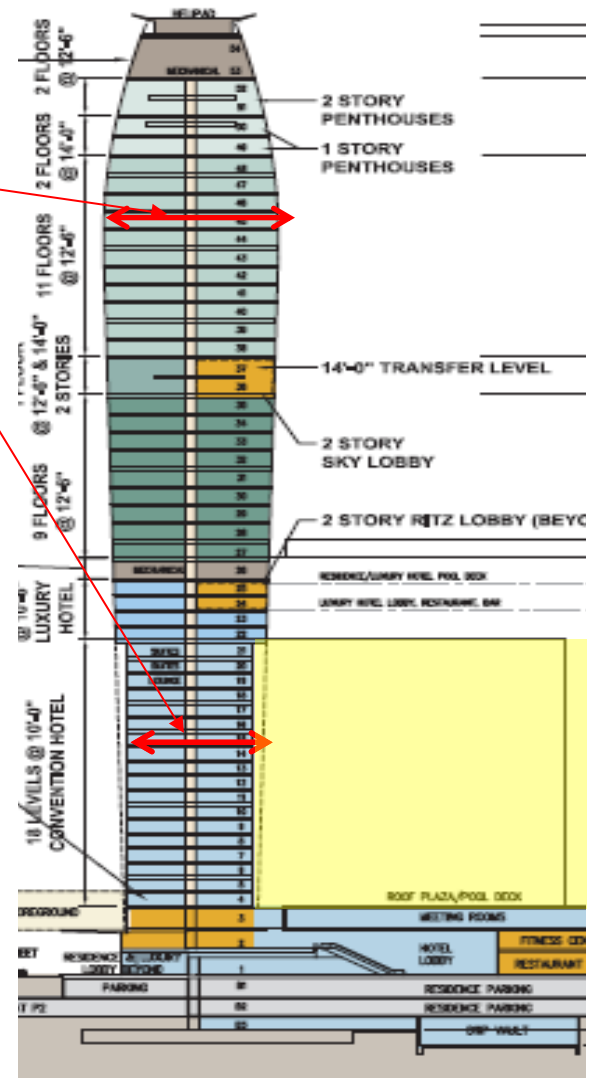
Variable Floor

Upper Tower

Pool Deck

Lower Tower

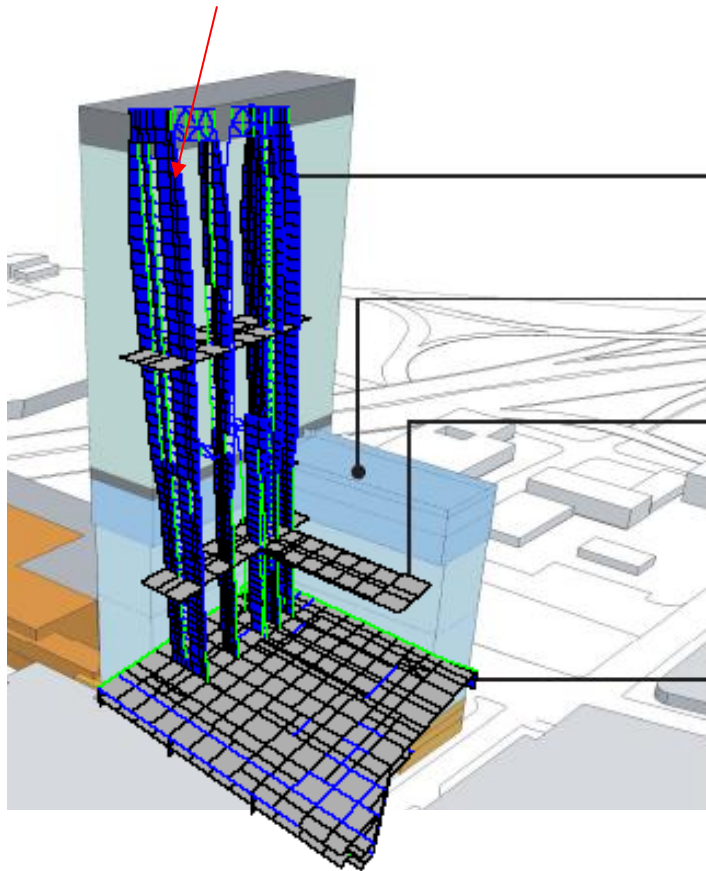
Podium



Project Description

Structural

Thin Steel Plates



BRB Outrigger

Variable Floor

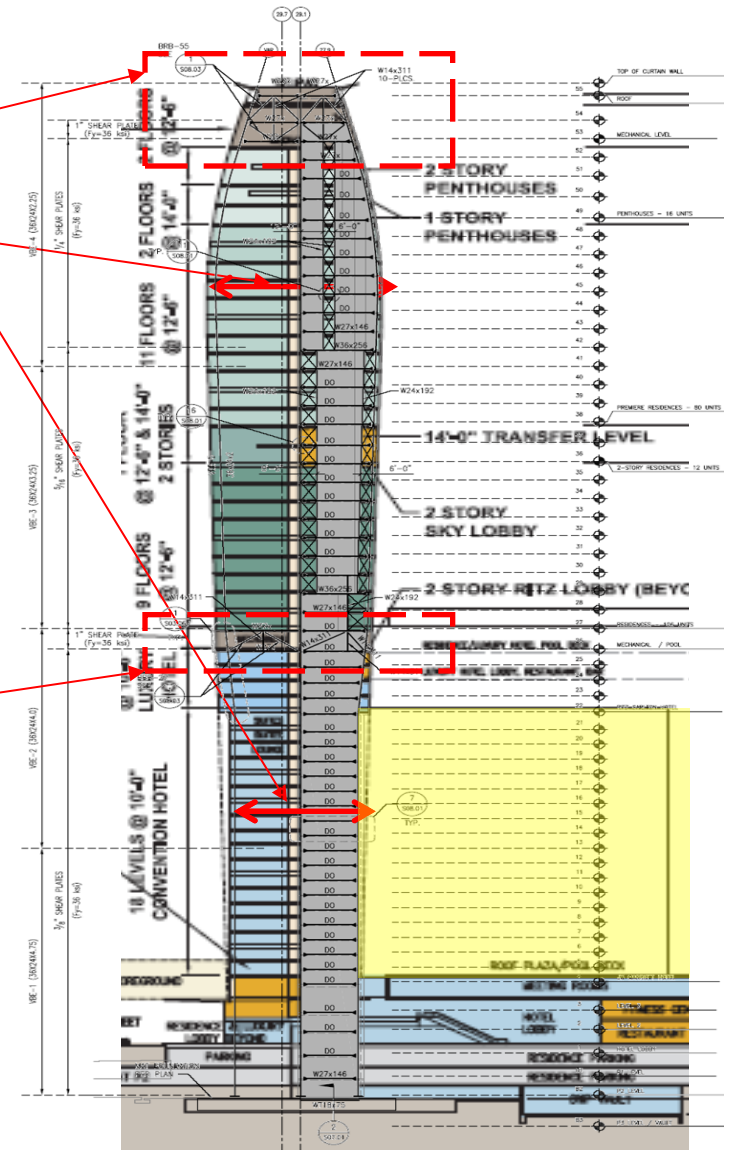
Upper Tower

Pool Deck

Lower Tower

BRB Outrigger

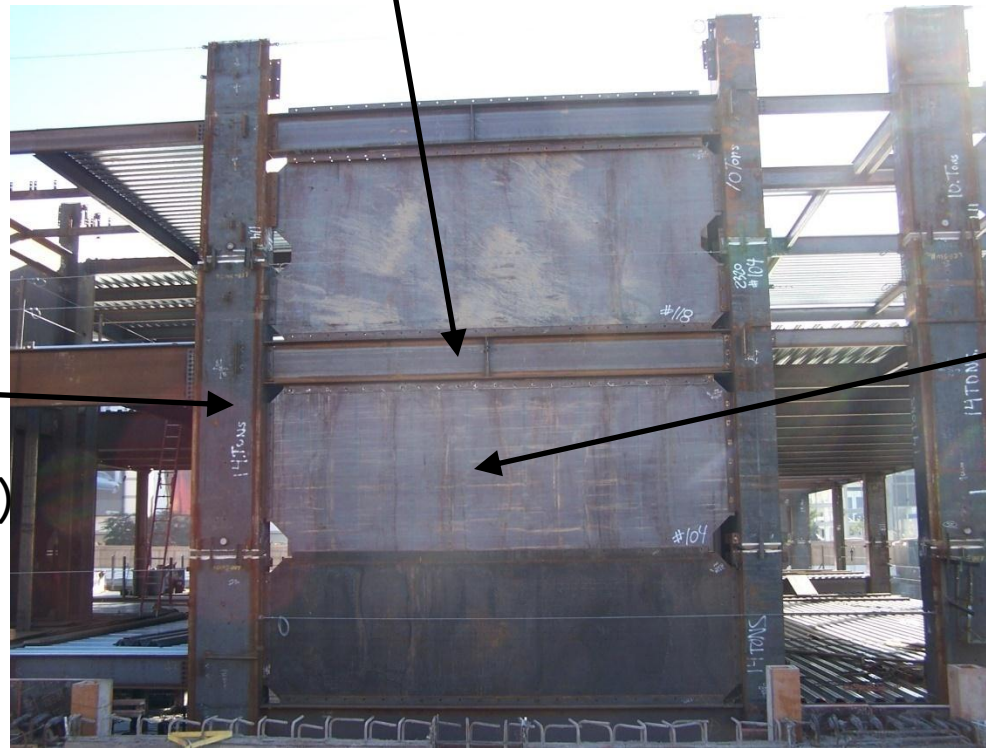
Podium



Horizontal Boundary Element (HBE)

Vertical
Boundary
Element (VBE)

1/4" to 3/8"
Plate



STEEL PLATE SHEAR WALL

Boundary elements (HBE and VBE) are designed to allow the web plates to develop significant **diagonal tension** and reach their expected yield stress across the entire panel to **dissipate the seismic energy**

L.A. Live – SPSW at Foundation





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813



Etabs-SAP.ir



Project Goals/Achievements

- ❑ Enhanced & Confirmed Performance
- ❑ Uncompromised Architectural Vision
 - No Deep Spandrel at Perimeter
- ❑ More Sellable Floor Area for Ownership
- ❑ Lighter Building Weight
 - 30% lighter without Concrete Walls
 - Reduced Foundation Pressures
- ❑ Early Completion of Structural Frame
 - Erected 3 Floors Per Week



Plate Girder Analogy

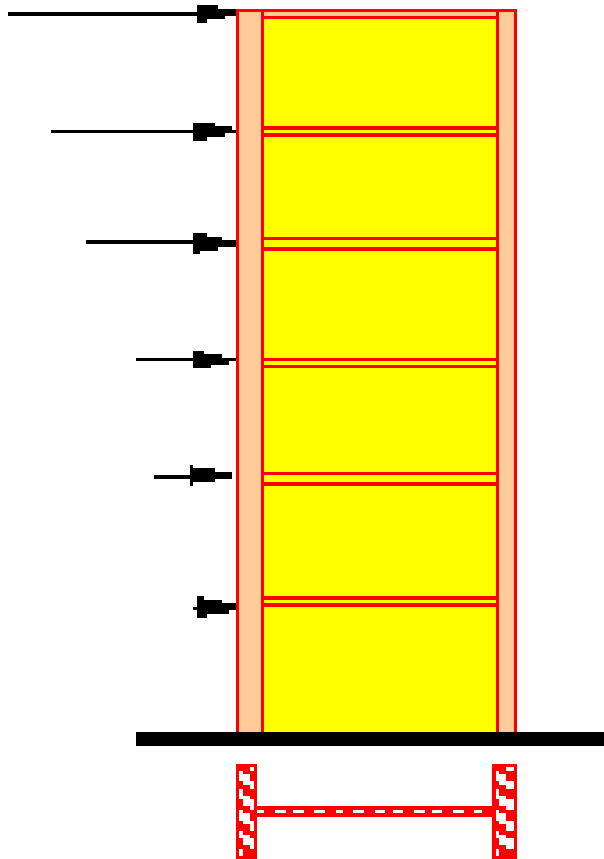
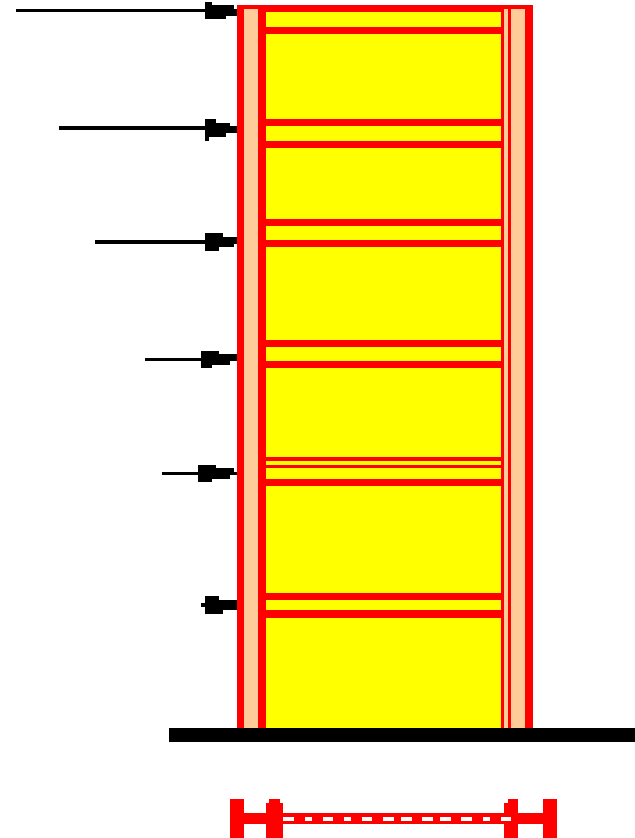


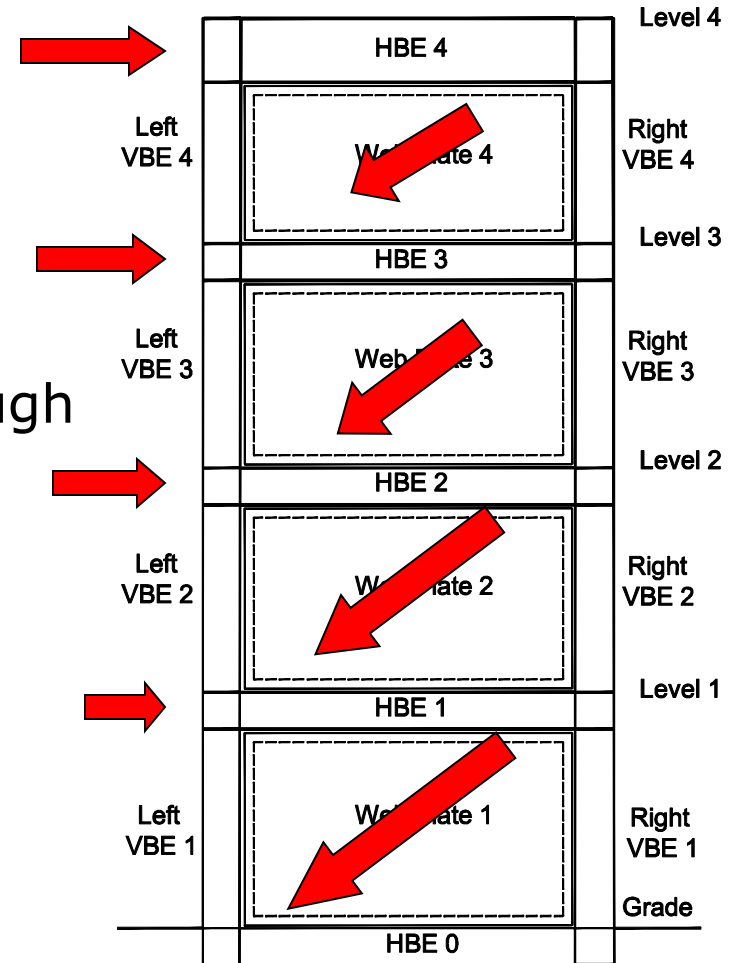
Plate Girder



Shear Wall

Behavior

- Behavior *similar* to that of a vertical plate girder
 - Boundary columns act as flanges
 - Story beams act as stiffeners
 - Infill plate acts as web
- Infill plate allowed to buckle in shear
- Then diagonal tension field forms and the infill plate dissipates energy through yielding in tension

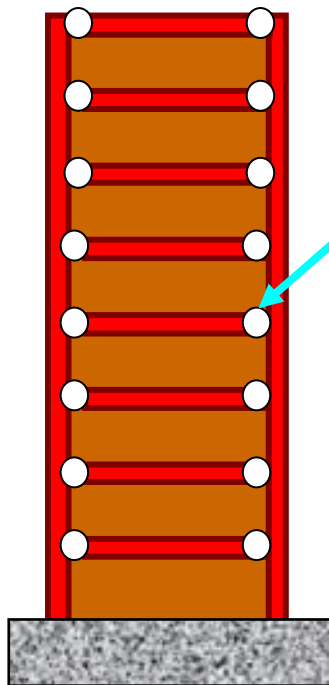


Courtesy of Jeff Berman, UW

Shear wall vs. Plate girder

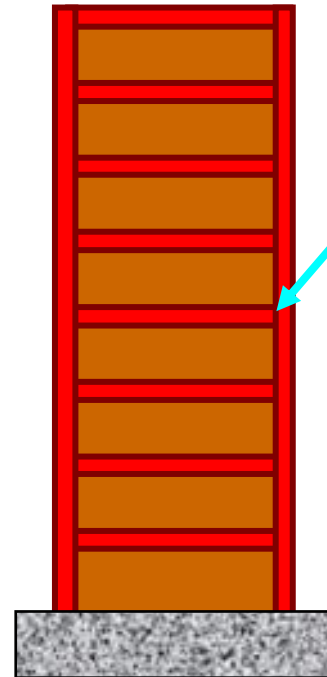
- ❑ Axial load
 - Taken by boundary columns*
 - $P-\Delta$ effects must be considered*
- ❑ Flanges
 - Boundary columns = flanges*
 - Affect inclination of tension field*
- ❑ Stiffeners
 - Floor beams provide very good anchors for tension field*
 - Also affect angle of tension field!!!
- ❑ Loading
 - Shear walls expected to see large inelastic cyclic loading*

Behavior of Shear Walls



**Simple
Connections**

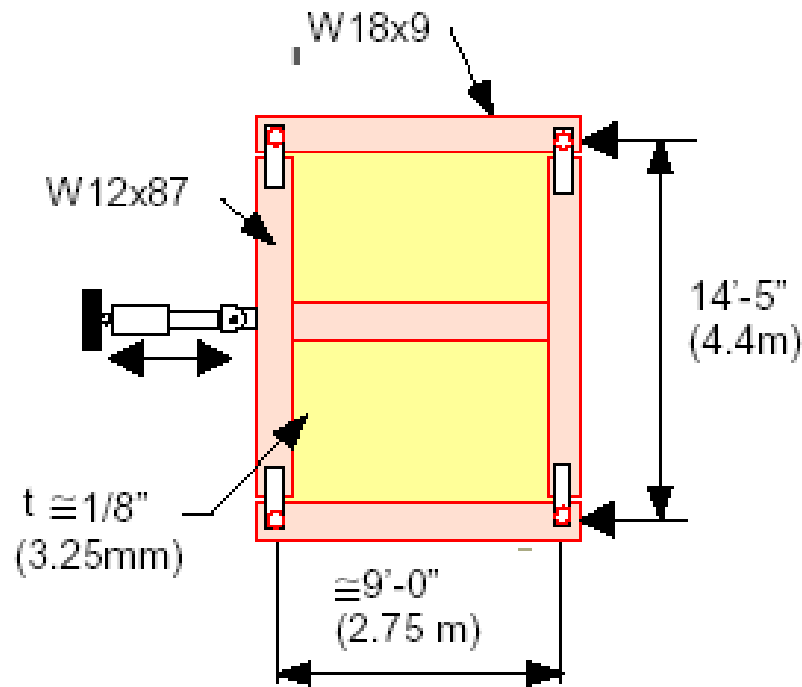
Shear Wall Within a Simple Frame



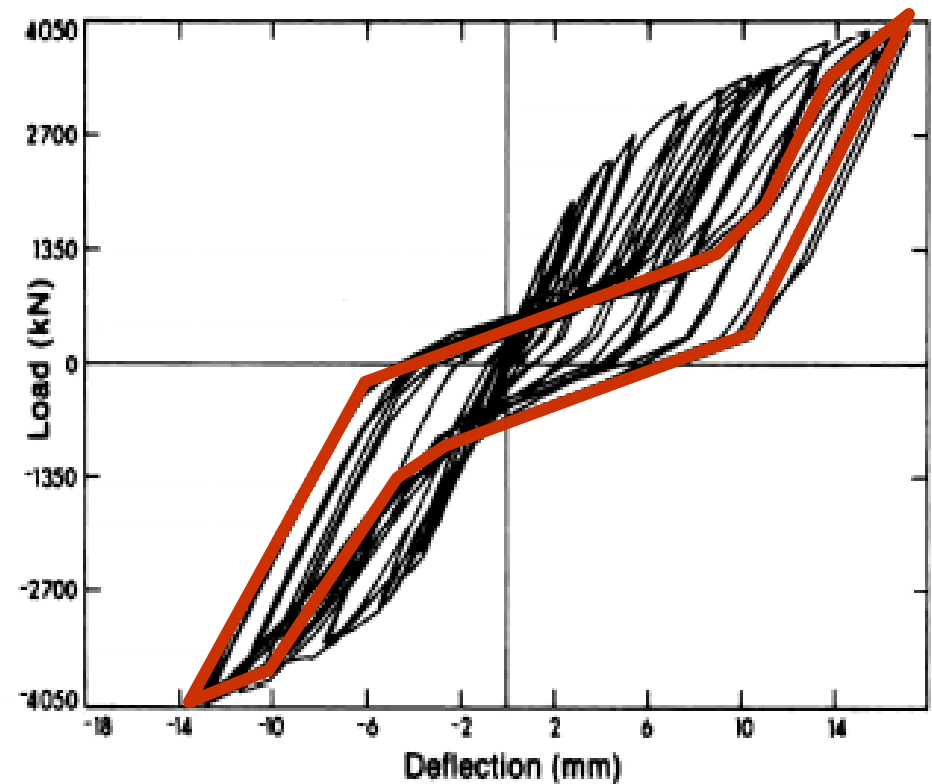
**Moment
Connections**

**Shear Wall Within a Moment Frame
(Dual System)**

Tests of Steel Plate Shear Walls



Test Specimen

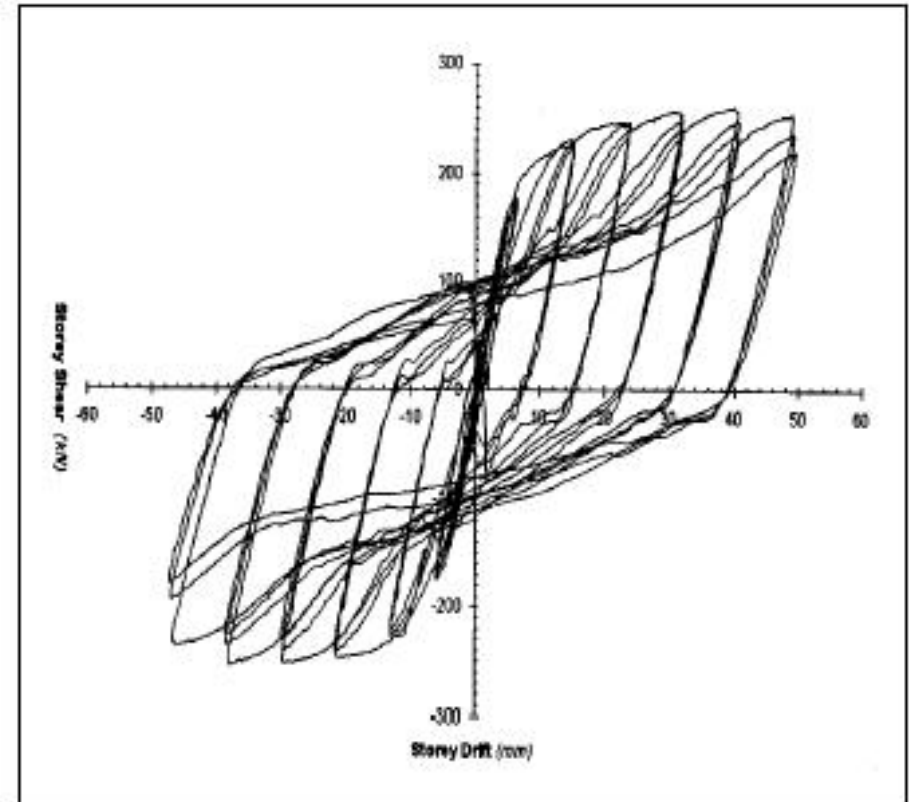


Load vs. Displacement
(Curves from: Timler and Kulak, 1983)

Tests of Steel Plate Shear Walls

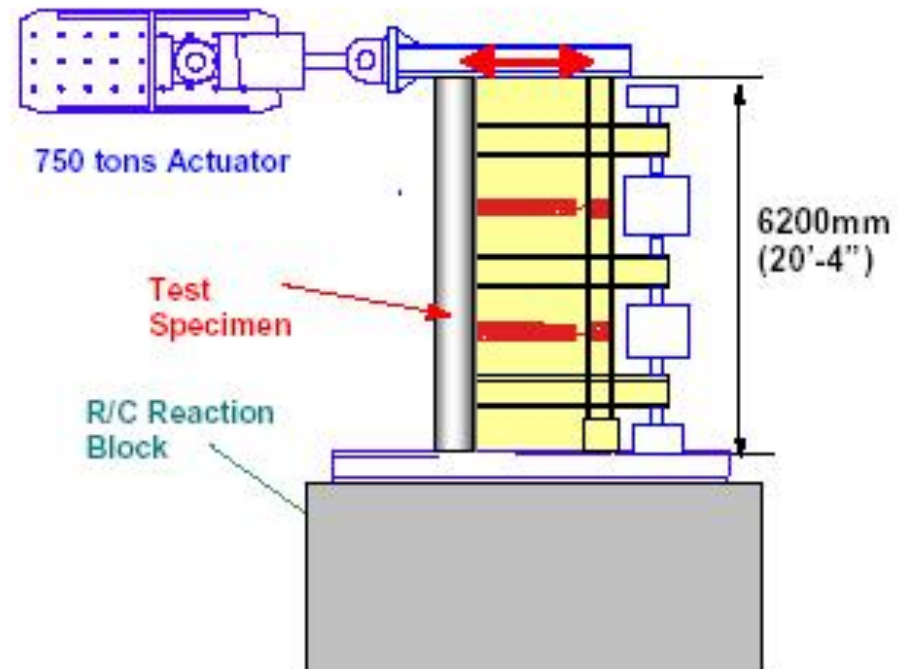
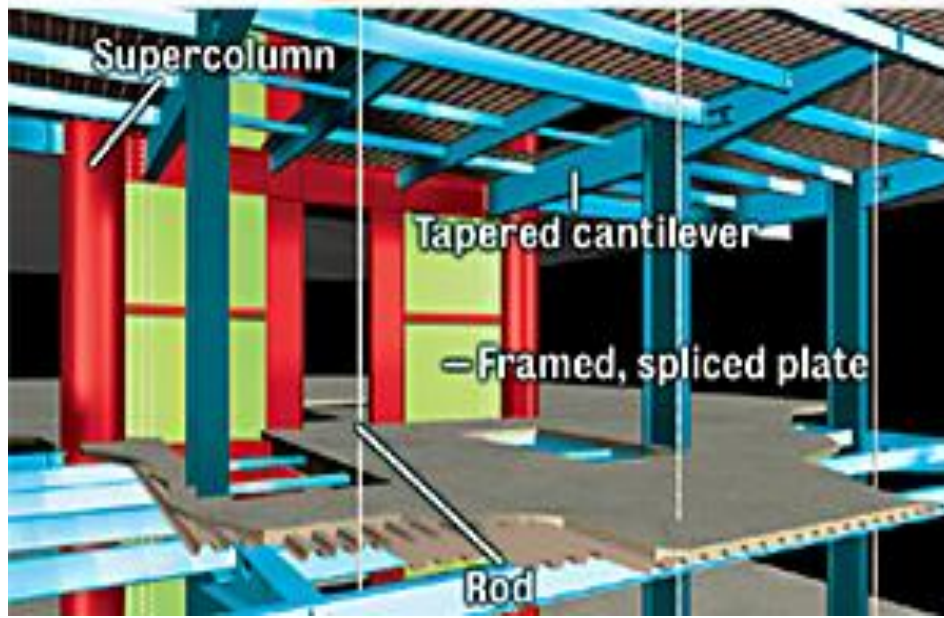


(Photo: Curtsey of C. Ventura))

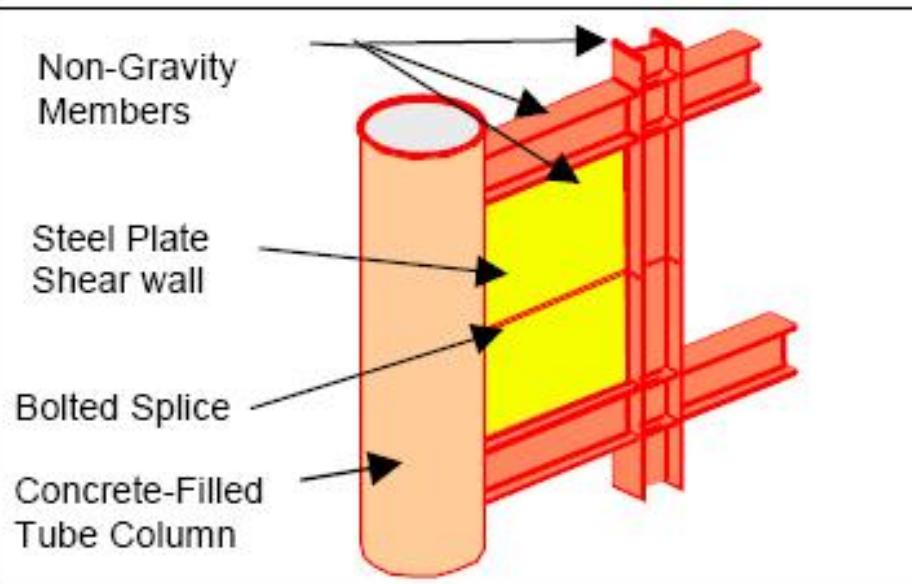


(Curves from: Lubell, 1997)

Testing for US Federal Courthouse (Seattle)

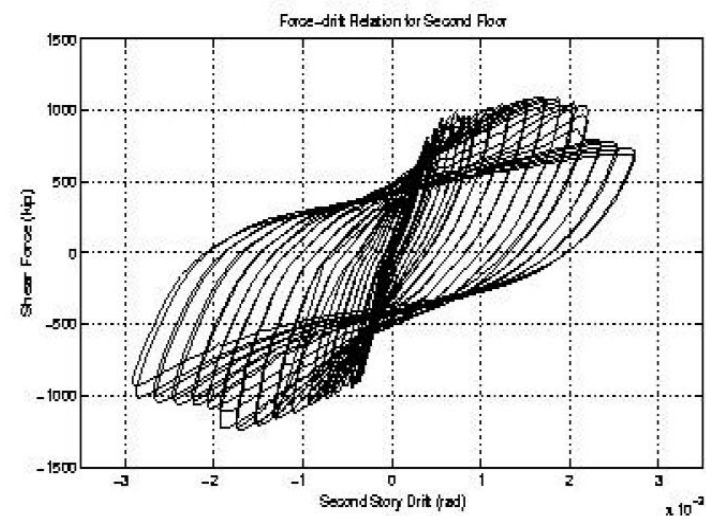
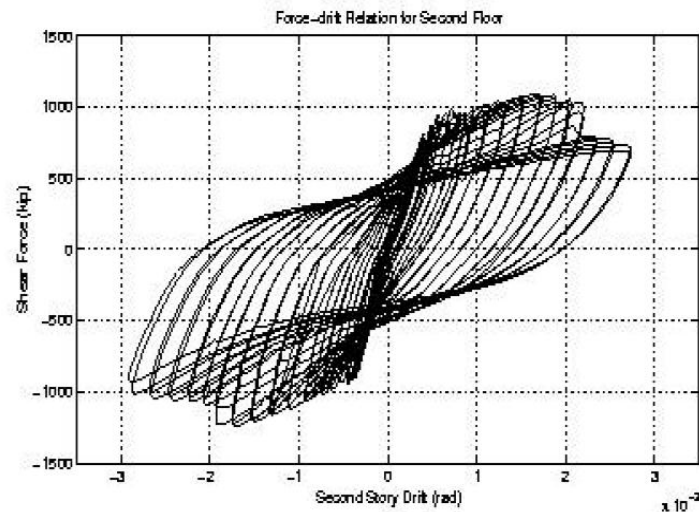
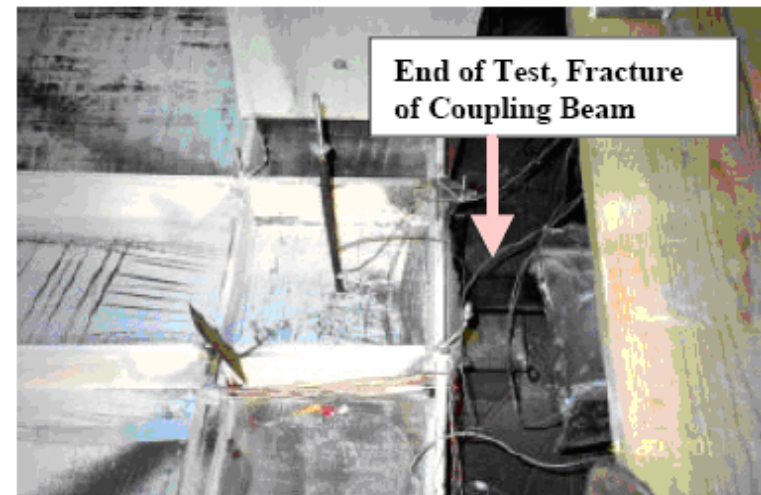
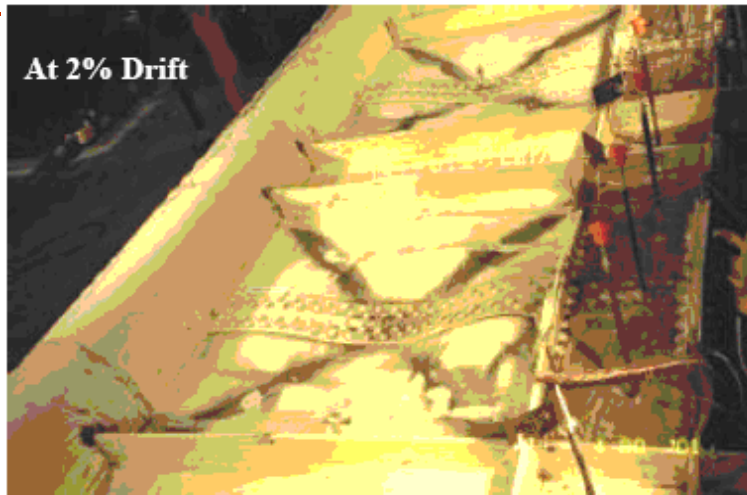


SPSW Test for US Federal Courthouse



Courtesy of Astaneh-Asl and Zhao

SPSW Test for US Federal Courthouse



Courtesy of Astaneh-Asl and Zhao



Plate Buckling, multi-story SPSW



Courtesy of Robert Driver, University of Alberta, Edmonton, Canada

Local buckling and fracture of column

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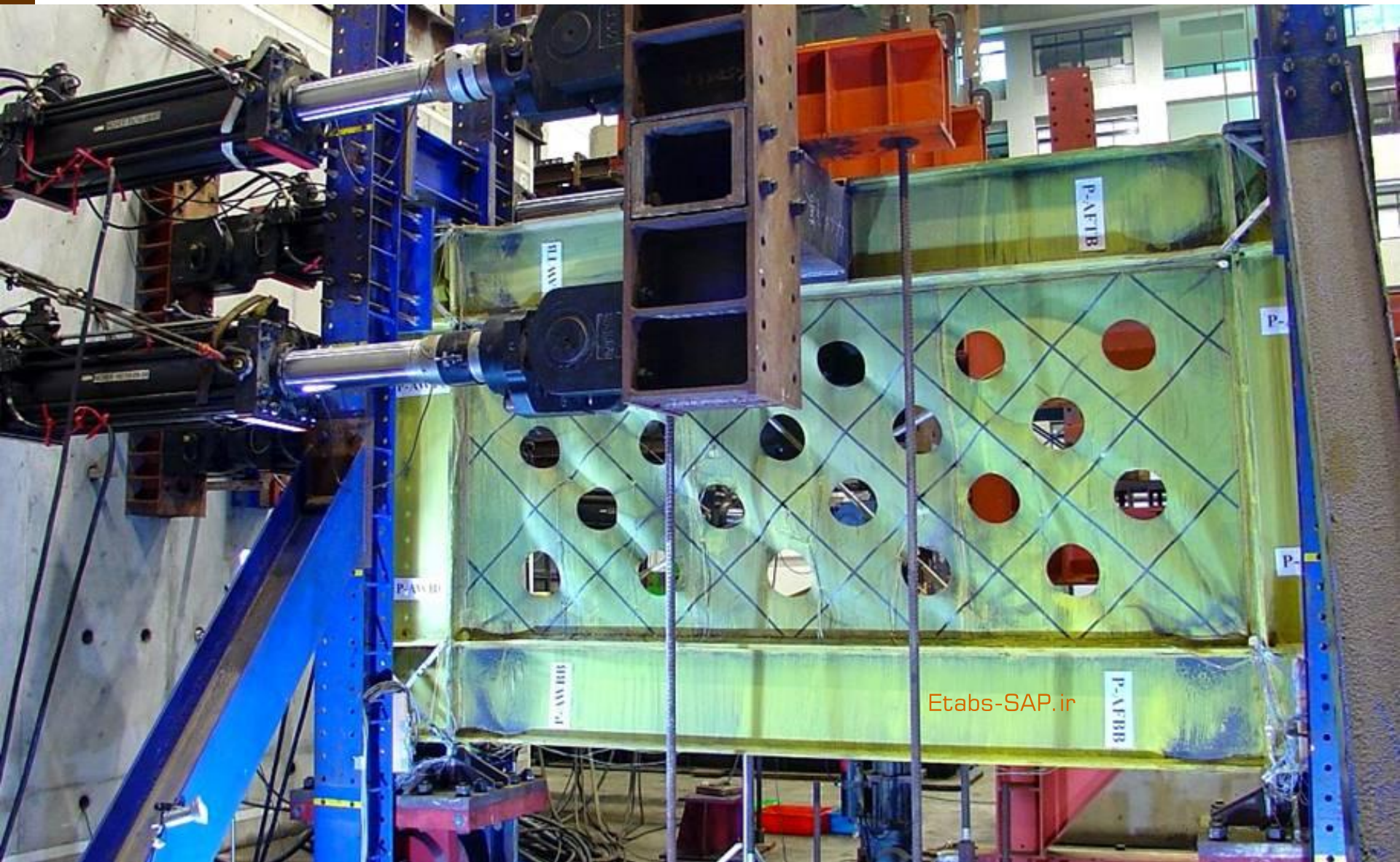
Courtesy of Robert Driver, University of Alberta, Edmonton, Canada

Fracture of steel plate shear wall web plate corner at 3.07% Drift



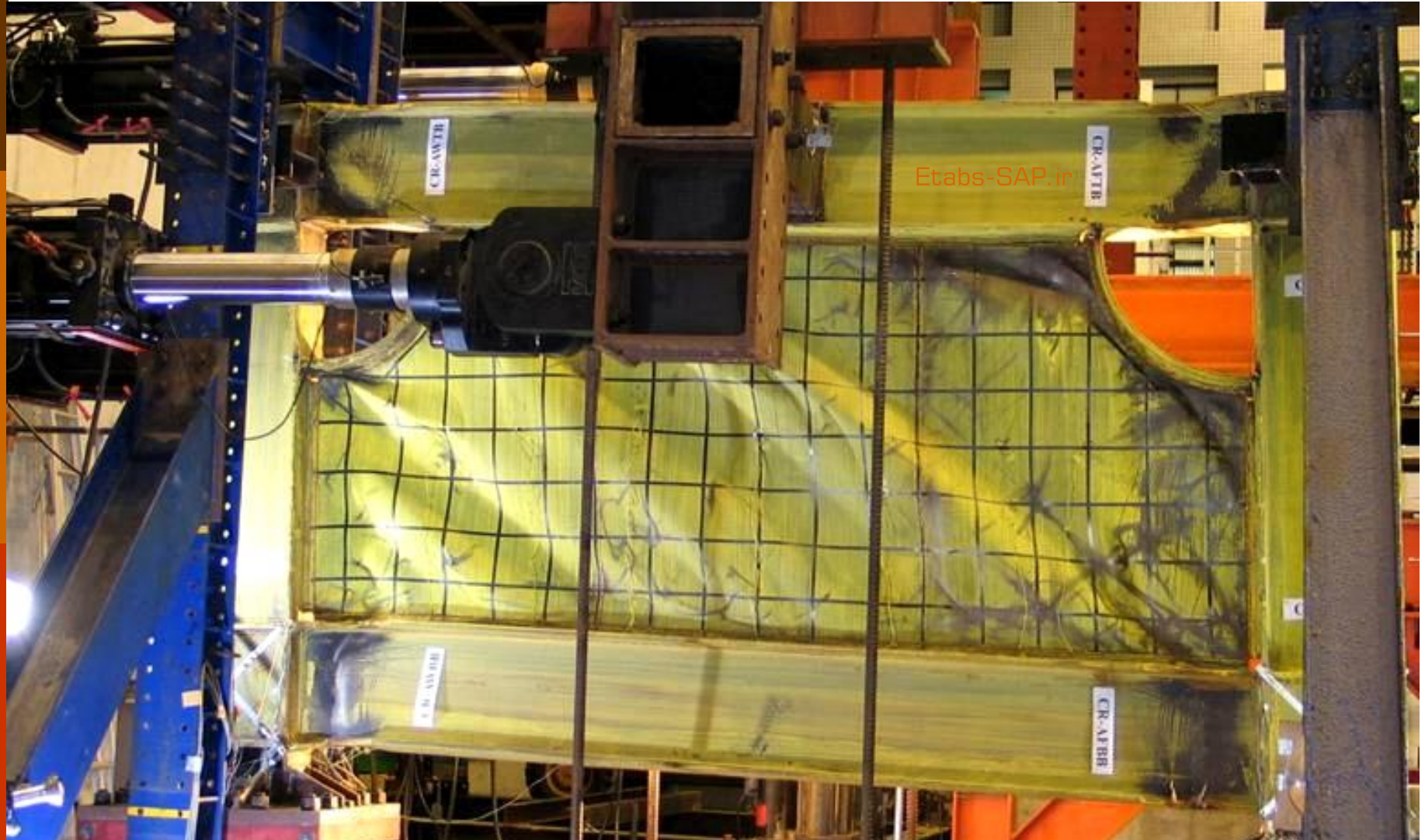
Courtesy of Berman and Bruneau

Perforated steel plate shear wall



Courtesy of Vian and Bruneau

SPSW with corner openings



Courtesy of Vian and Bruneau

Shear wall vs. Plate girder

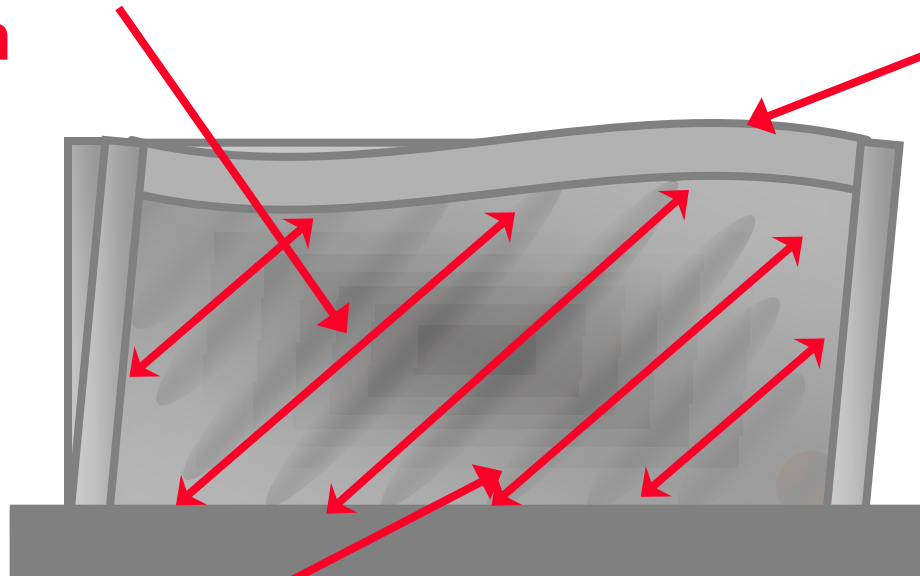
□ Implications for design

- AISC specifications for plate girders will underestimate capacity
- Different considerations for design of boundary elements
- Web slenderness limit (related to vertical flange buckling of plate girders) does not apply to SPSW

Expected Yield Mode

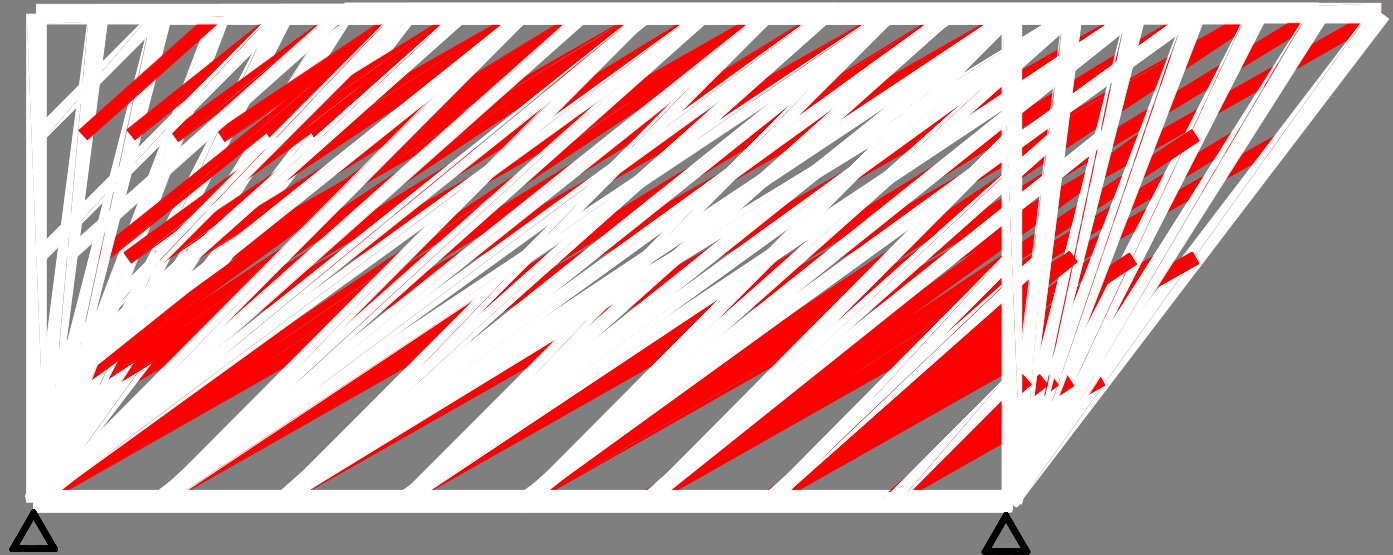
**Development
of tension
diagonals**

**Frame
flexure**



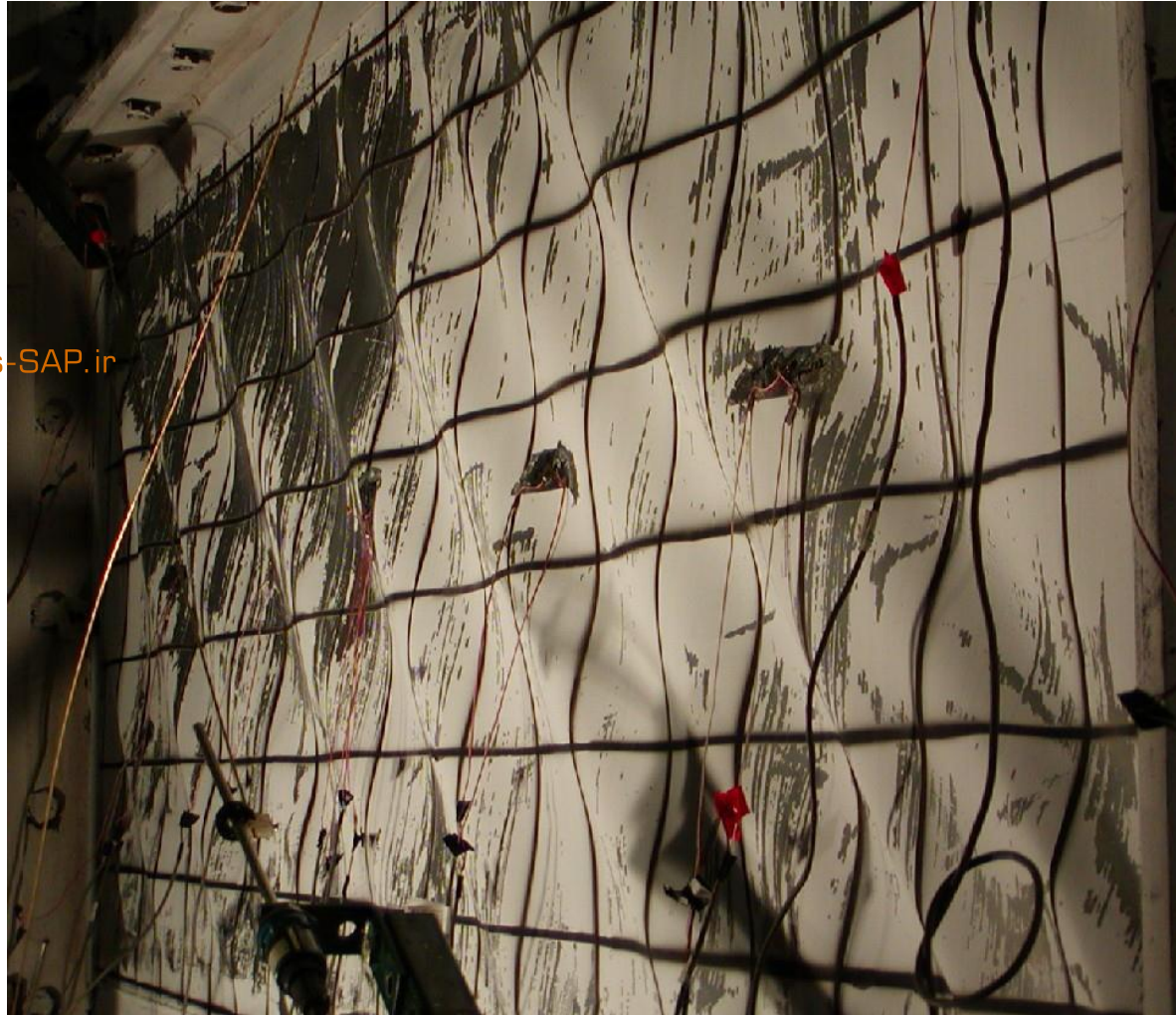
Shear buckling

Progression of yielding across strips



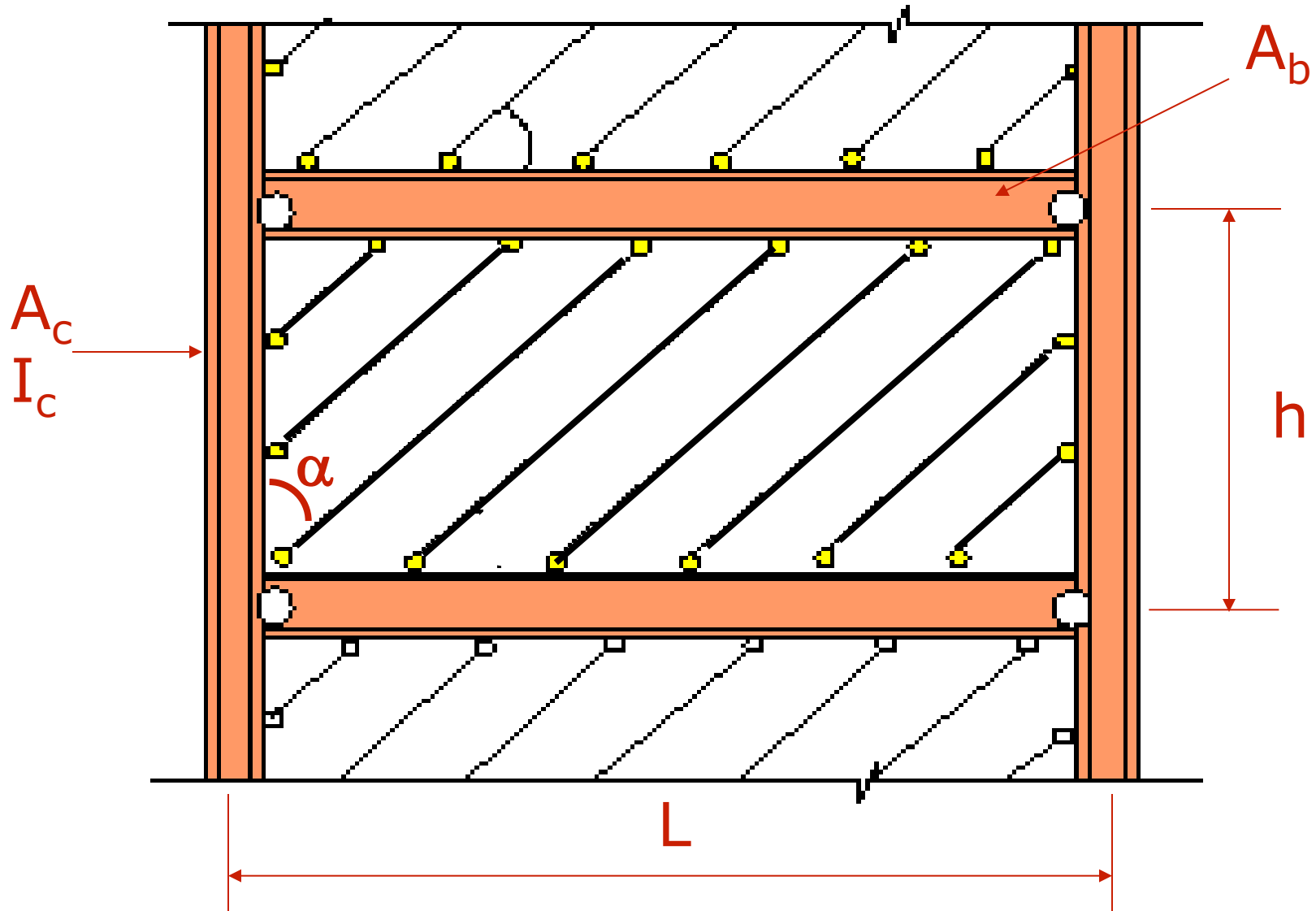
Buckling of steel plate shear wall web plate at 1.82% Drift

Etabs-SAP.ir

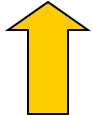


Courtesy of Berman and Bruneau

Design

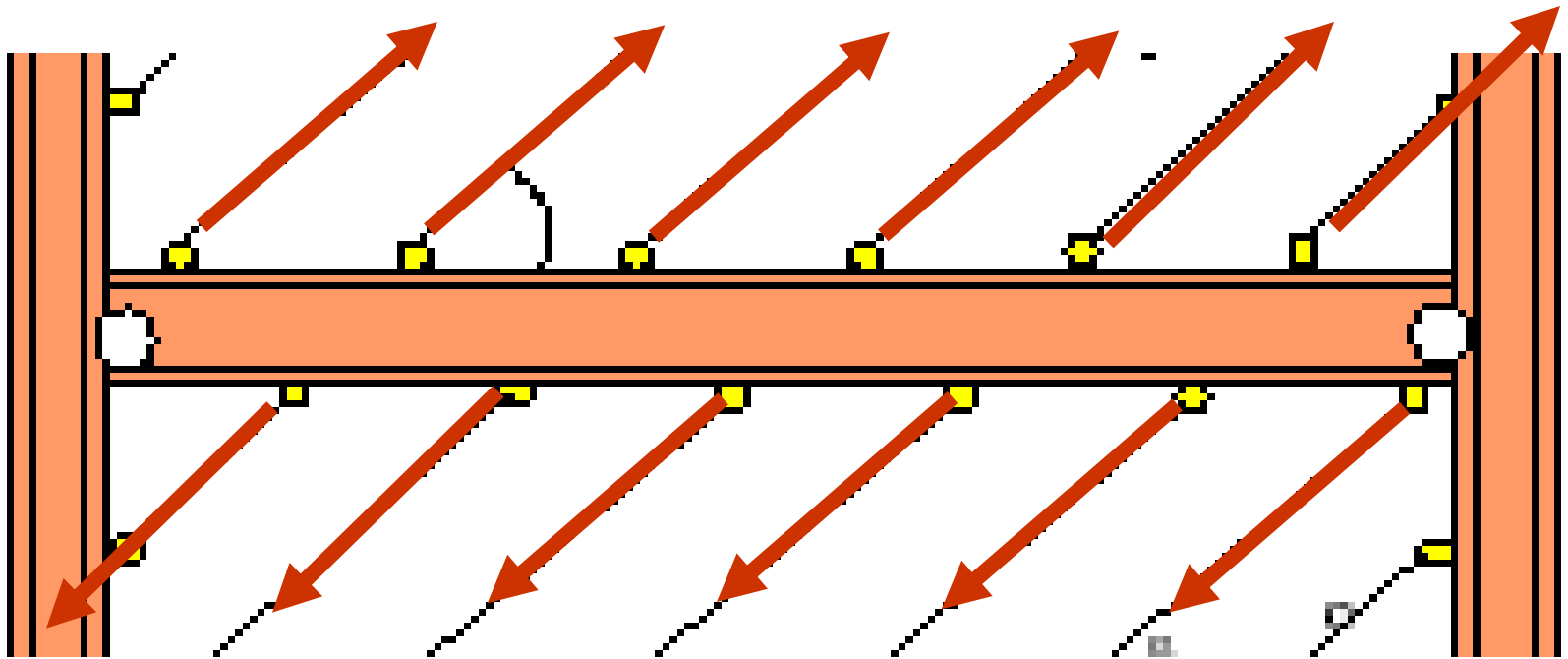


Design

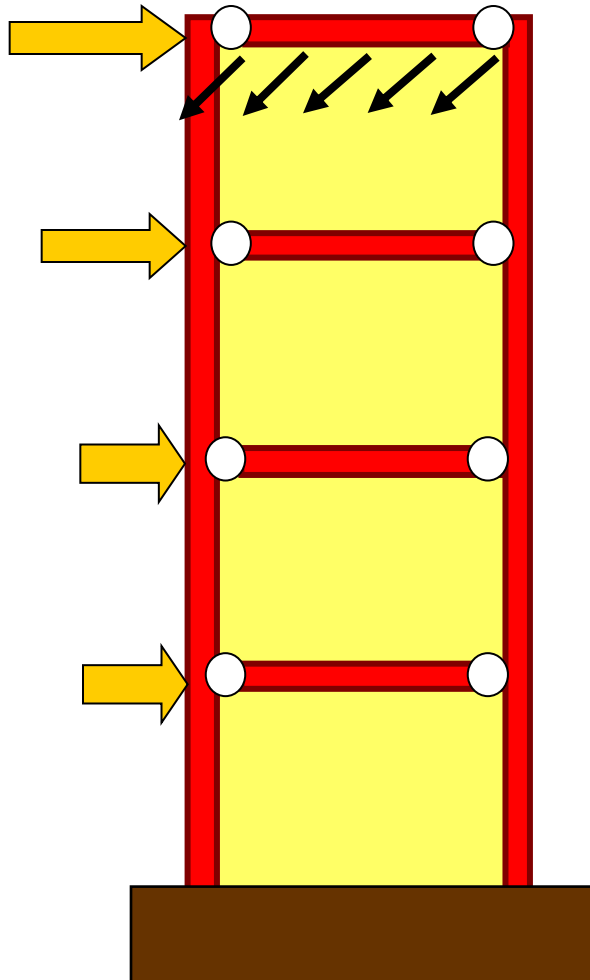
$$\tan^4 \alpha = \frac{1 + \frac{t_w L}{2 A_c}}{1 + t_w h \left[\frac{1}{A_b} + \frac{h^3}{360 \textcircled{I_c} L} \right]}$$


AISC Seismic Provisions 2010 Eq. F5-2

Design

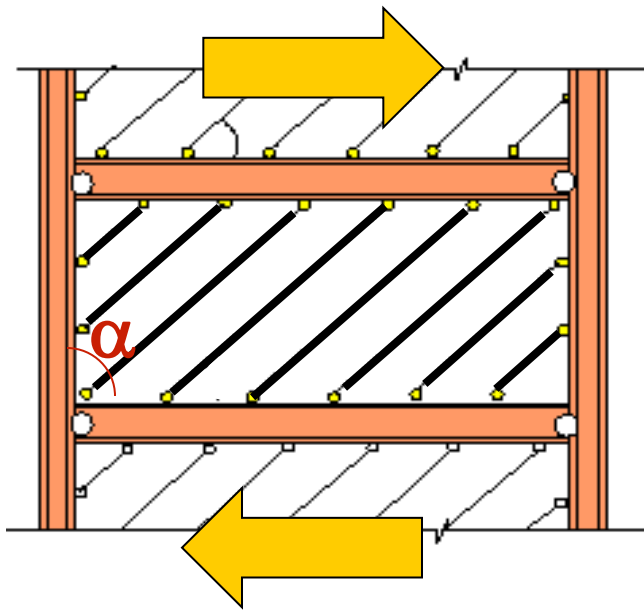


Design



- Top and Bottom of SPSW?
 - Need stiff horizontal boundary elements (HBE) to anchor the tension field!

Design



$$V = \frac{1}{2} t L F_y \sin 2\alpha$$

Same basic equation
for TFA only for Plate
Girders

Equivalent to γ for
Plate Girders, but
much different value

- Note: buckling strength negligible for SPSW

Design

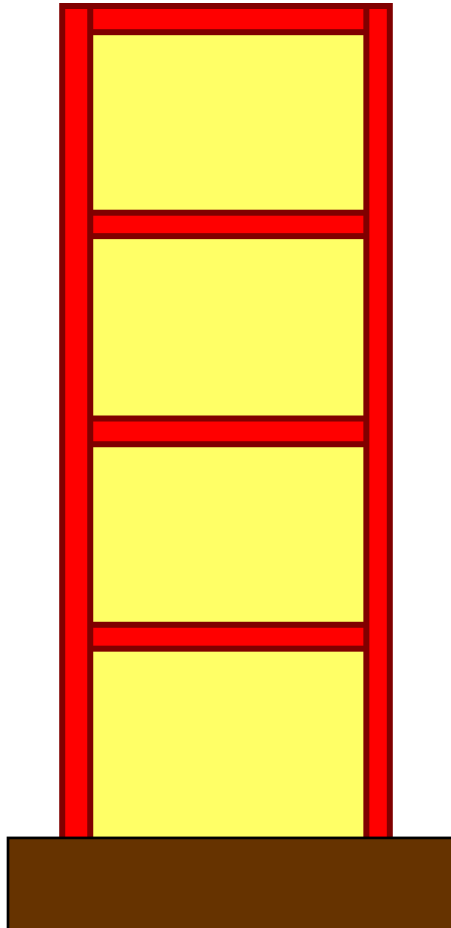
▣ AISC Seismic 2010 – PANEL Design Shear Strength

$$\phi V_n = (0.9) \underline{0.42} t_w F_y \underline{L_{cf}} \sin 2\alpha$$

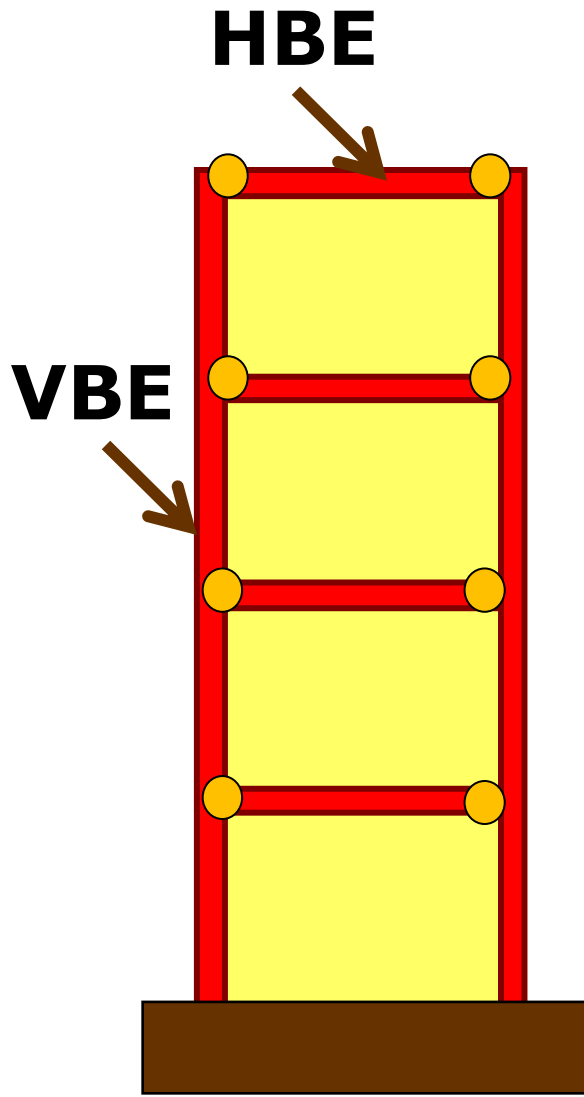
Clear distance
between column
flanges

0.5 divided by system
overstrength, defined by
FEMA, 1.2 for SPSW (Berman and
Bruneau, 2003)

Design

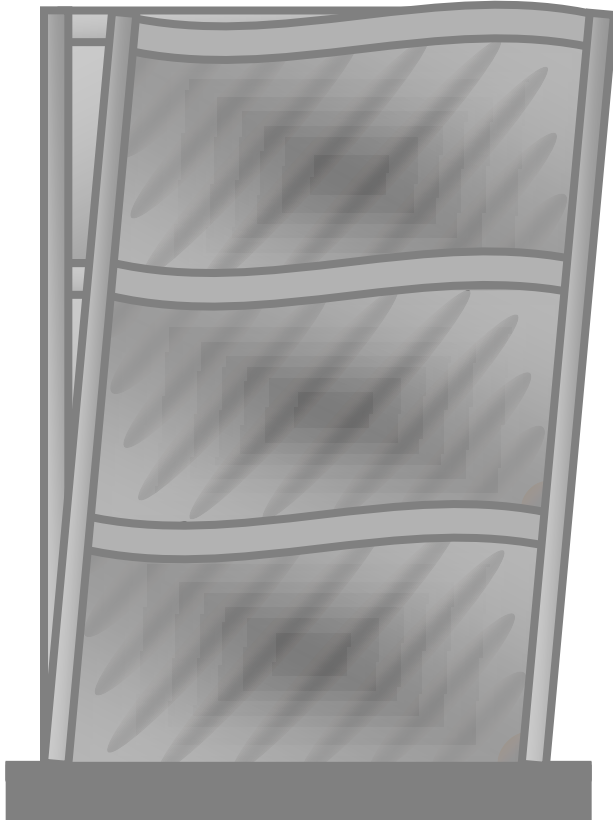


- Boundary elements designed for expected capacity of plate
- Vertical Boundary Elements (VBE) have minimum stiffness requirement to prevent excessive deformations under tension field action

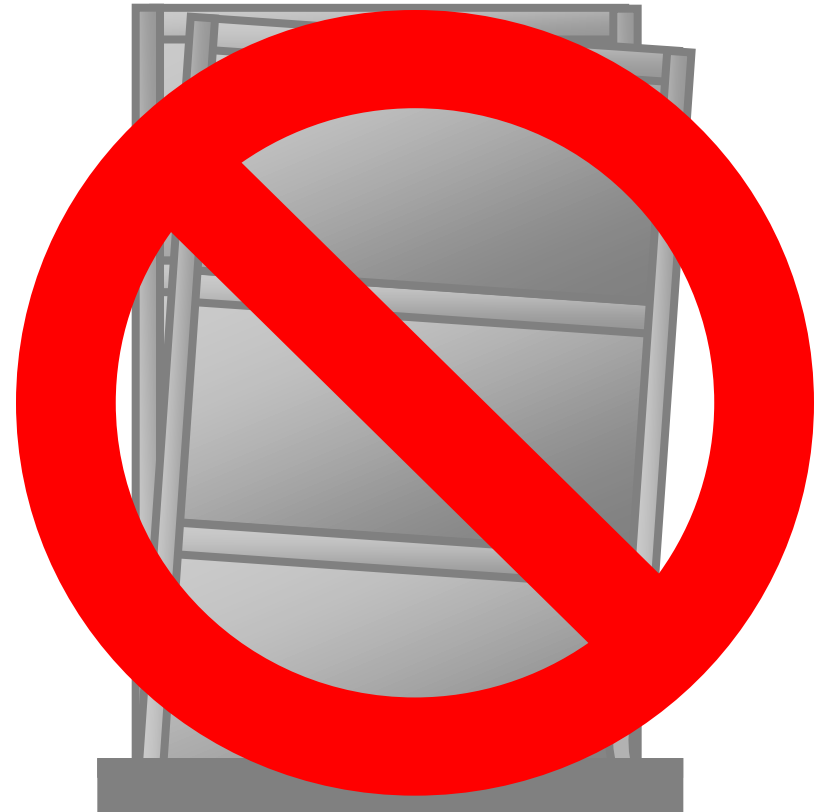


- **AISC 2010 requires HBE and VBE remain elastic (*except plastic hinging expected **at ends of HBE***)**
- **Additional requirements for HBE and VBE including width-thickness limits**

Expected Yield Mode

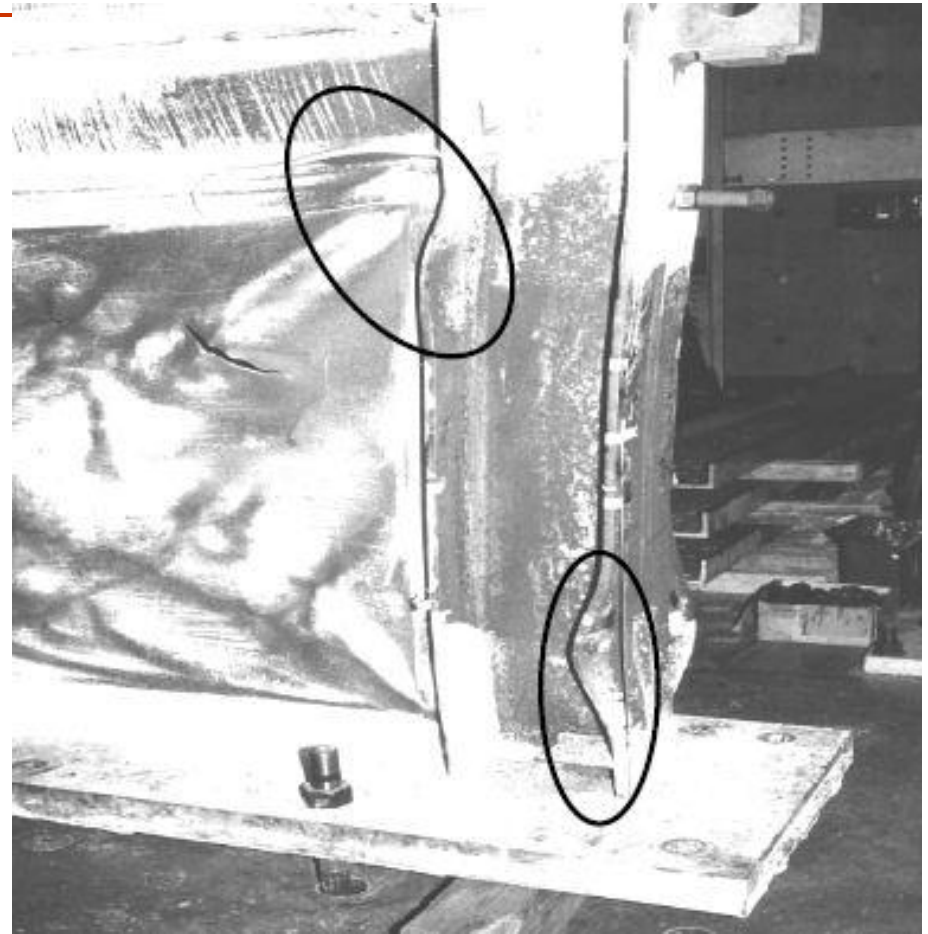
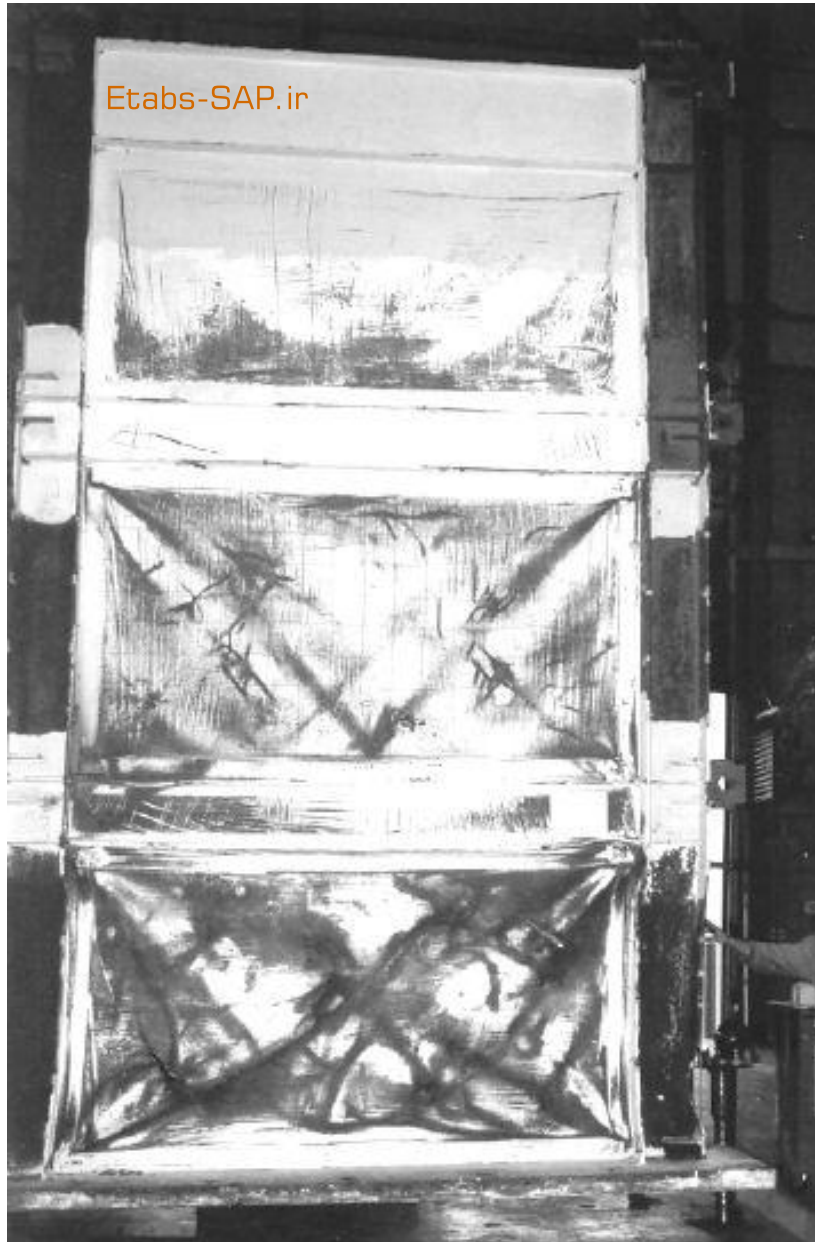


Multi-story shear mode



**Hinging at
base**

Multi-story steel plate shear wall

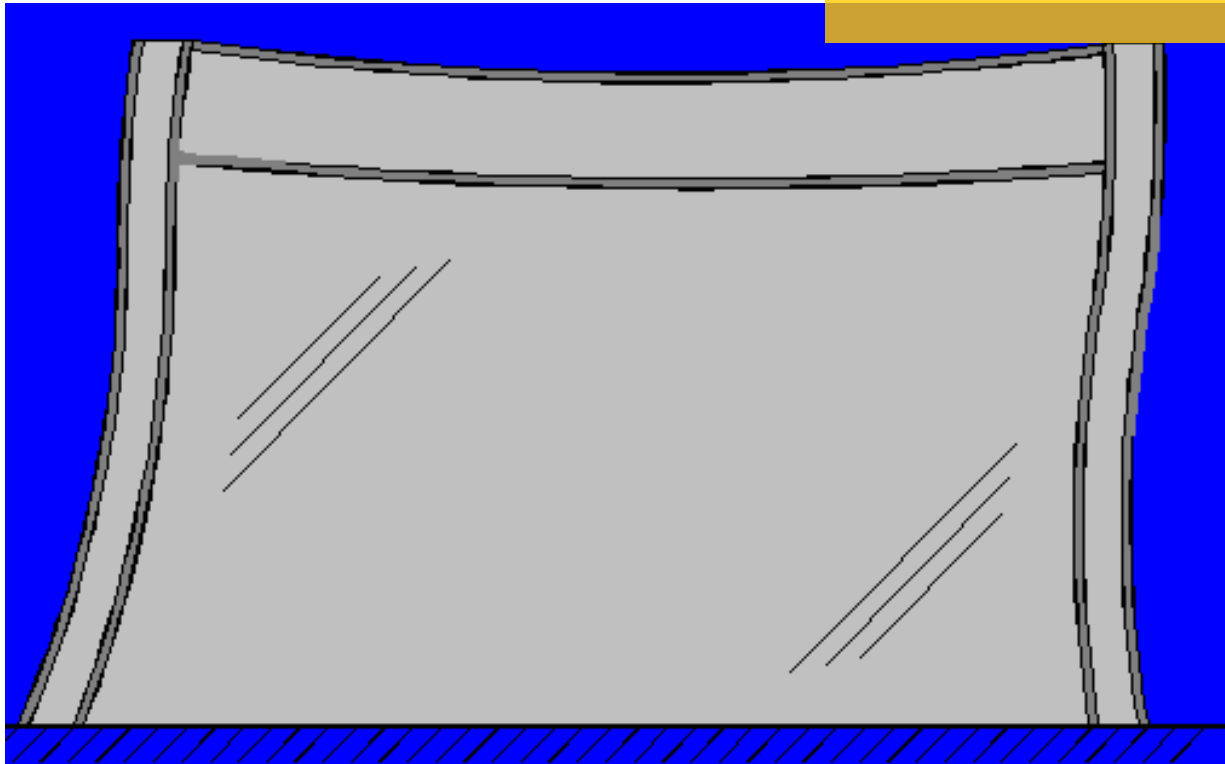


Courtesy of Behbahanifard

Inward Flexure of Boundary Elements

Required stiffness for VBE

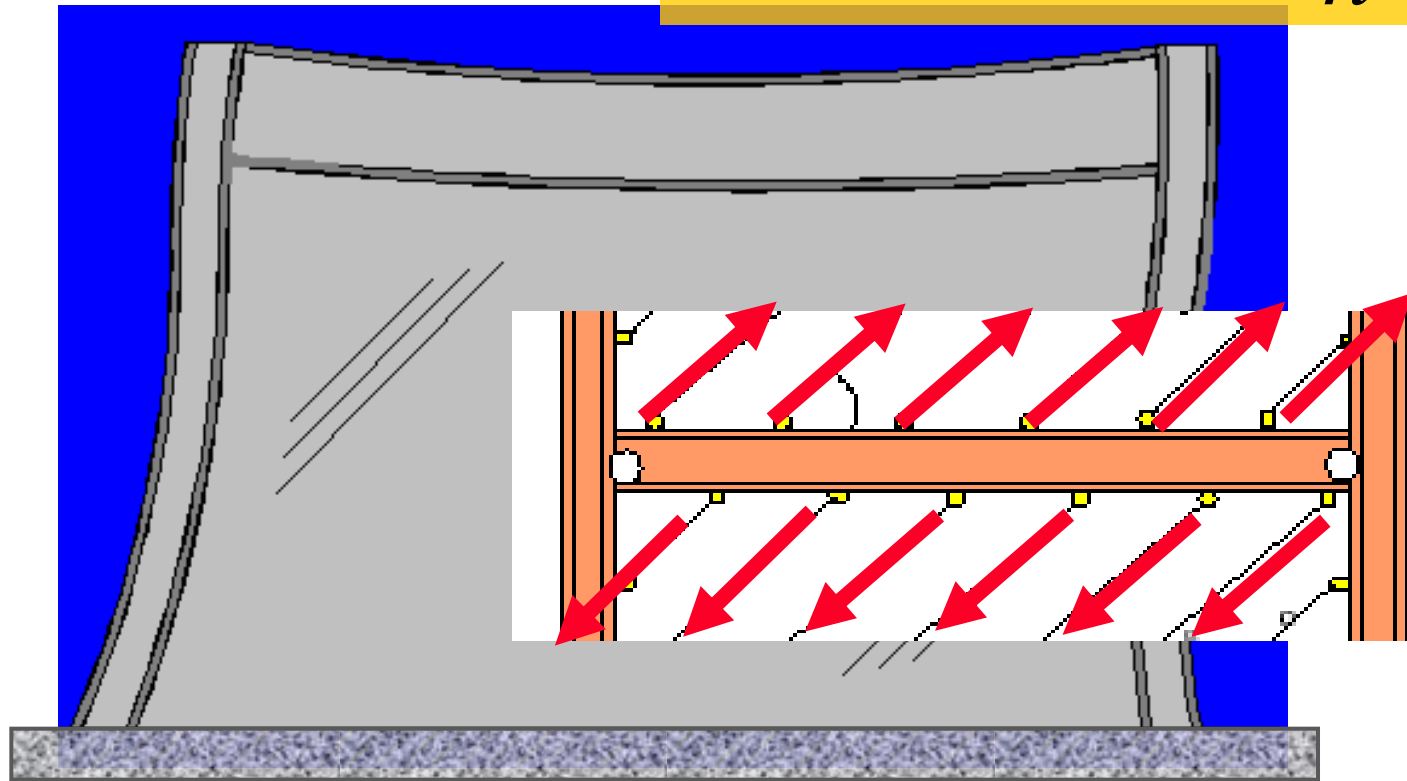
$$I_c \geq 0.0031 \frac{t_w h^4}{L}$$



Inward Flexure of Boundary Elements

**Required stiffness
for HBE**

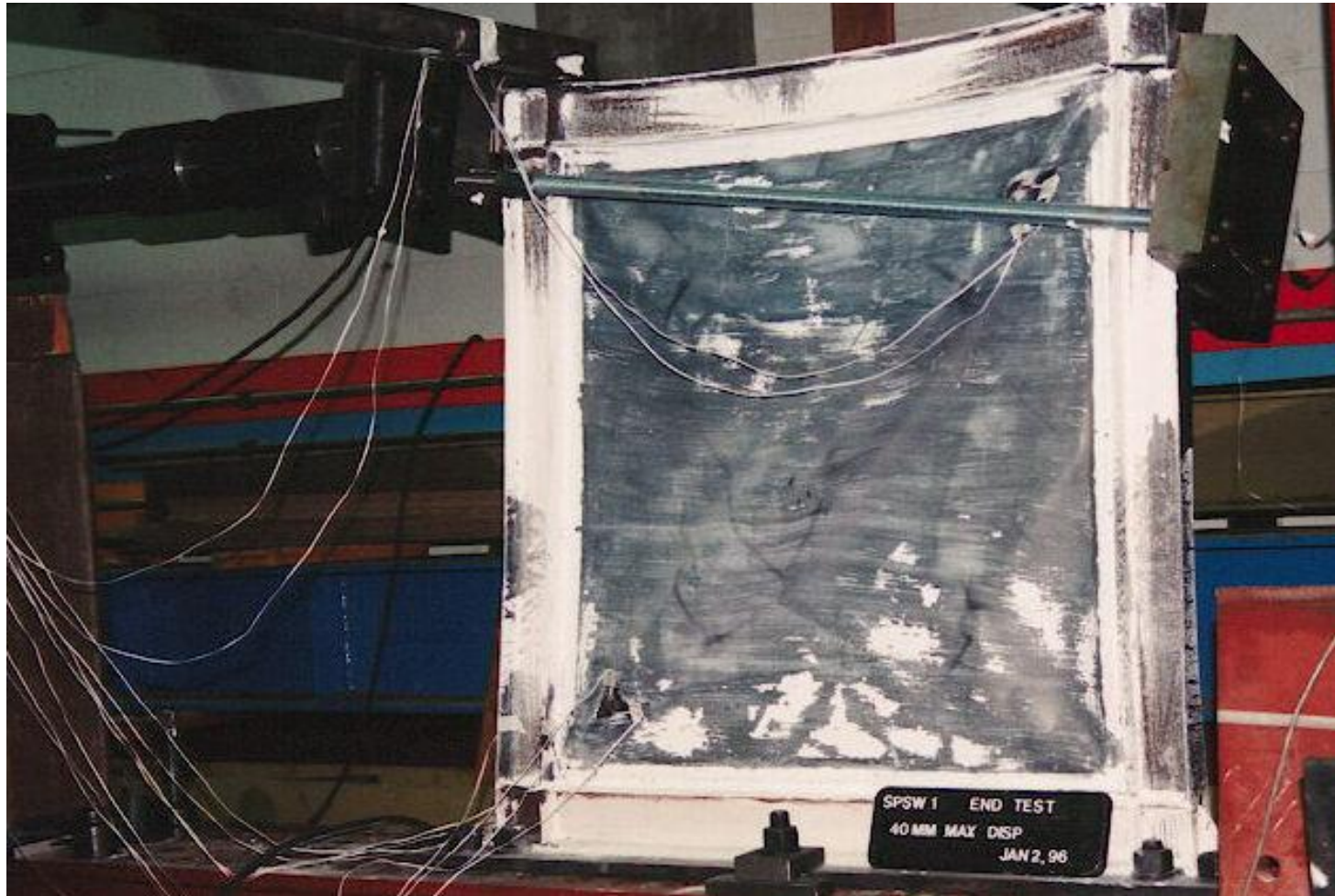
$$I_b \geq 0.0031 \frac{(t_i - t_{i+1})L^4}{h}$$



Distributed load on HBE

$$w_u = R_y F_y (t_i - t_{i+1}) \cos^2(\alpha)$$

Inward Flexure of Boundary Elements



***Courtesy of Carlos Ventura, University of British Columbia,
Vancouver, Canada***