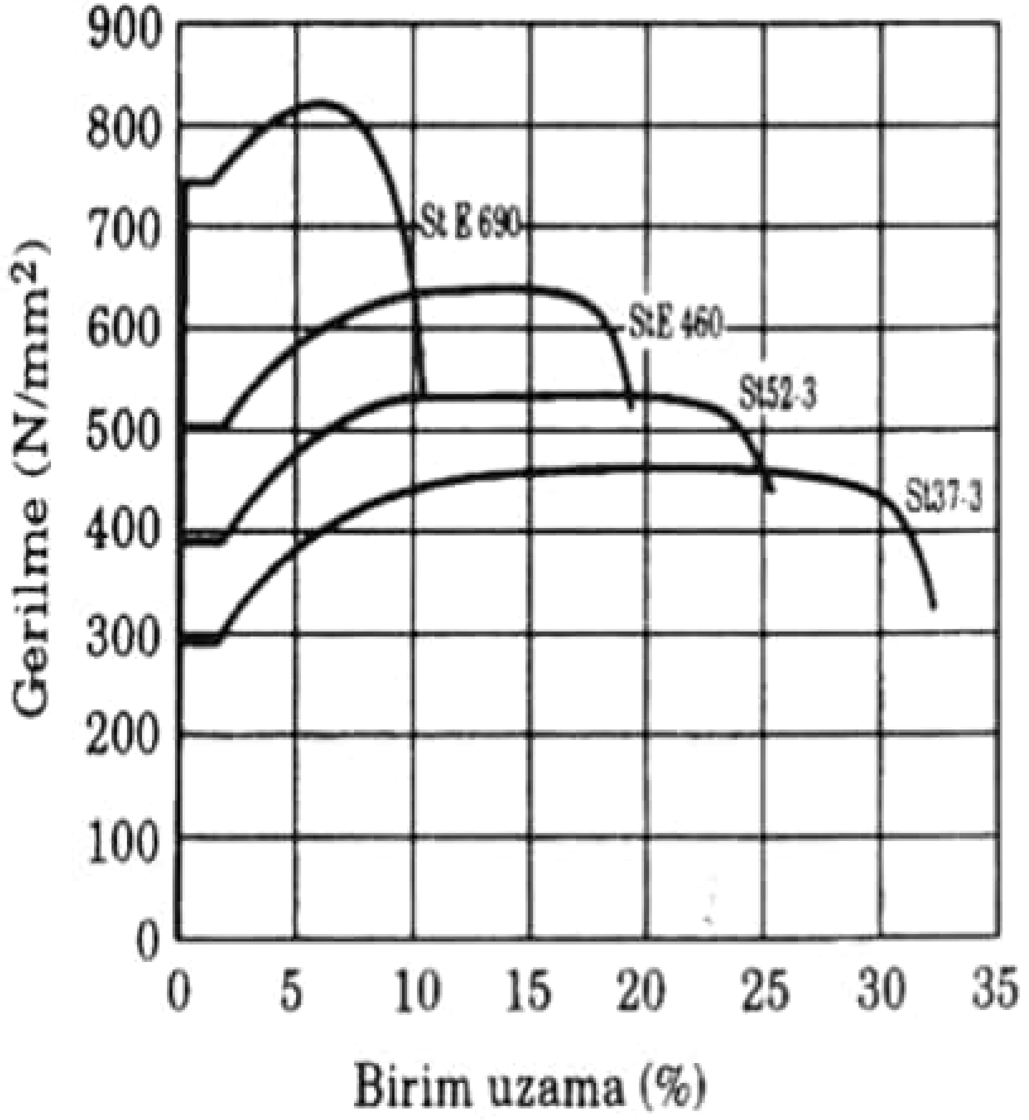
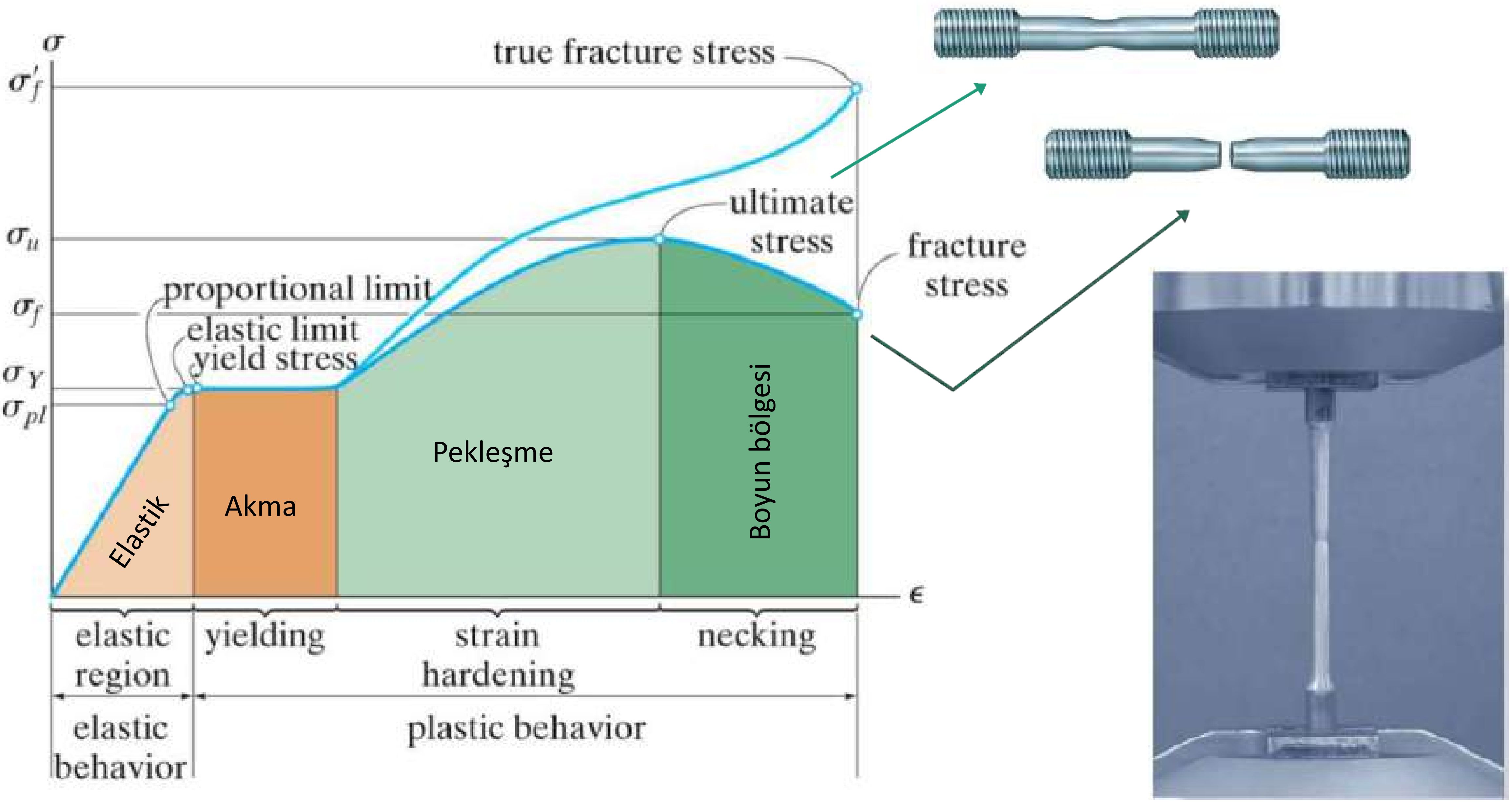
Sünek Çelik Bina Tasarımı

Depreme dayanıklı çelik bina tasarımına giriş

- Ön bilgiler :
  - Çelik Malzeme Davranışı
  - Plastikleşme
  - Plastik Mafsal

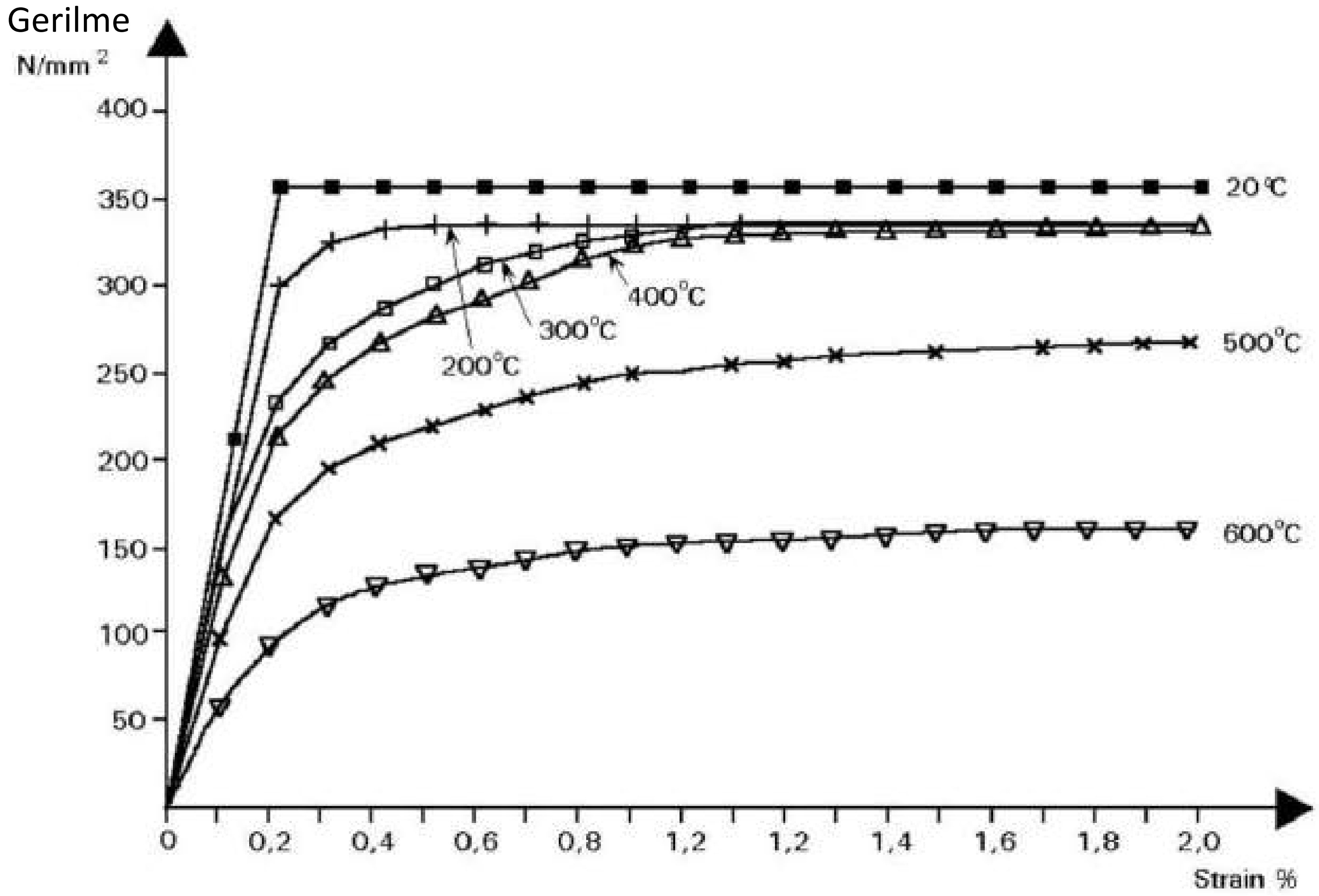


900
800
700
600
500
400
300
200
100
0
Gerilme (N/mm²)
St E 690
StE 460
St52-3
St37-3
0
5
10
15
20
25
30
35
Birim uzama (%)



Elastik davranış

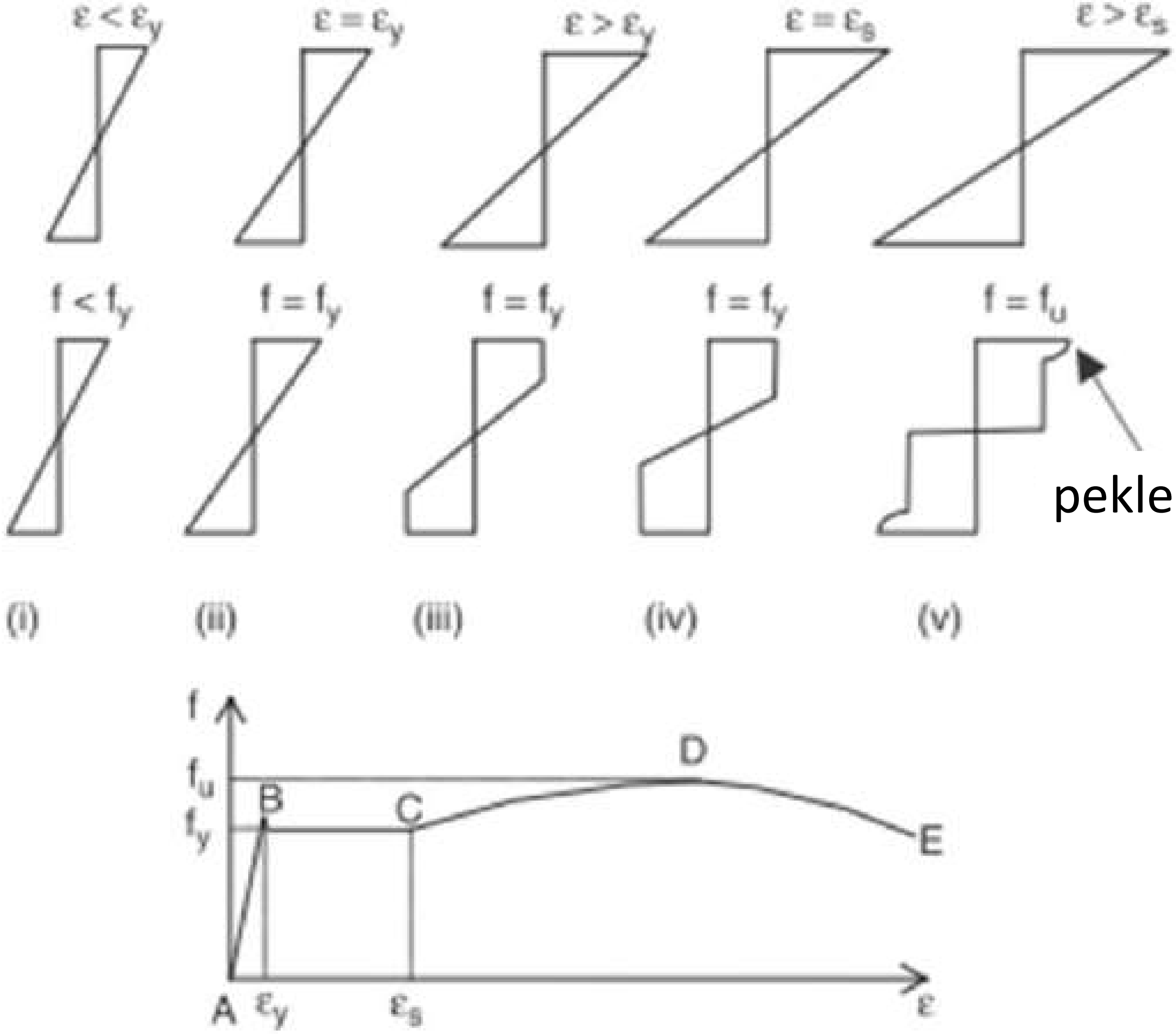
Plastik davranış



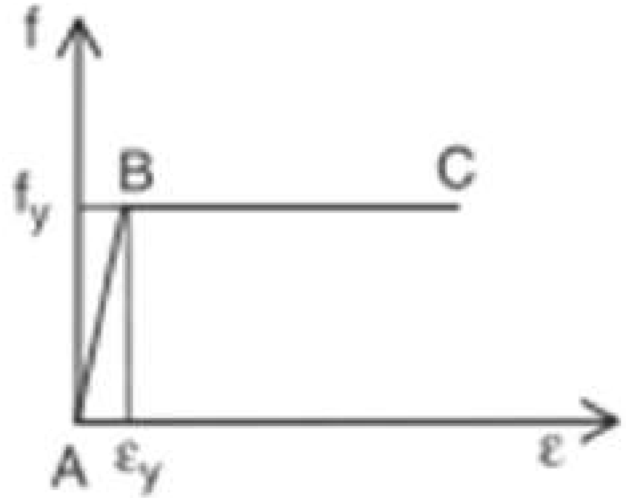
Isı etkisinin malzeme
Davranışına etkisi

strain

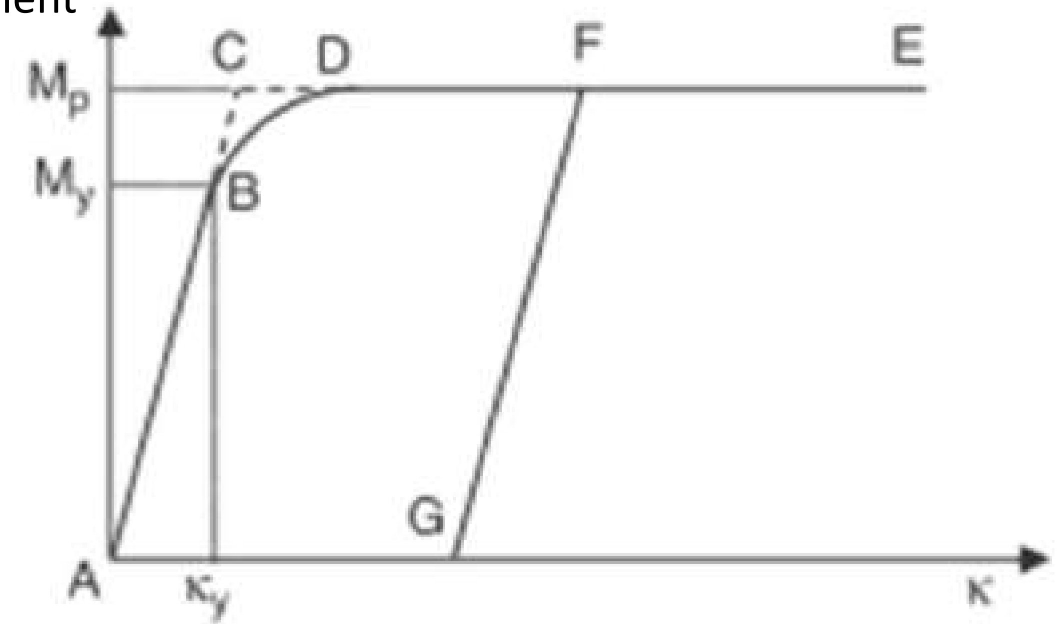
gerilme



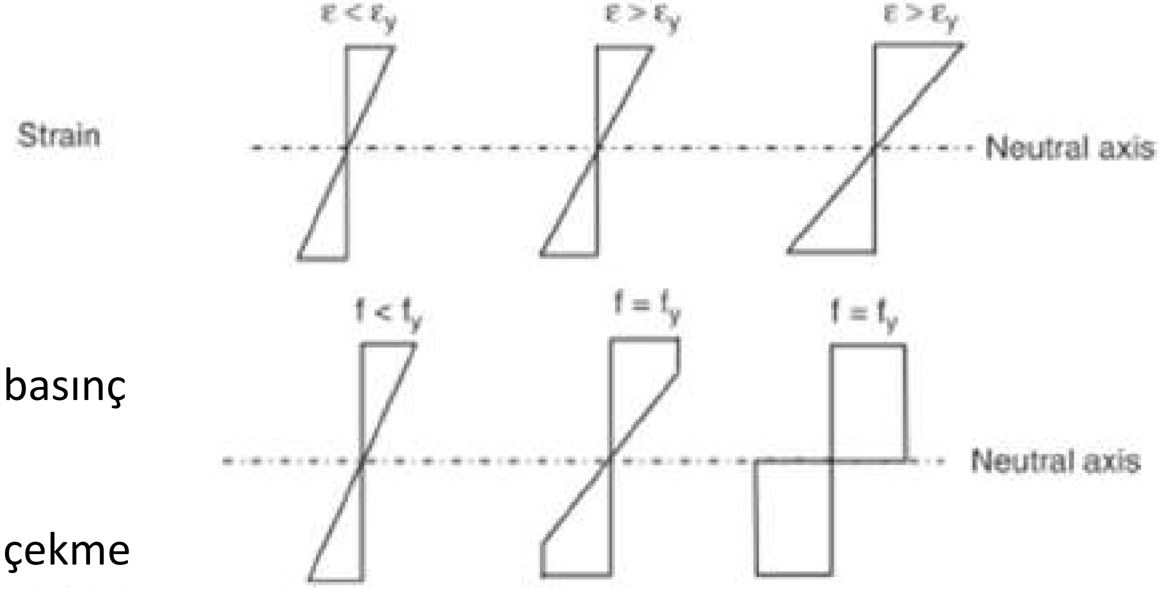
pekleşme



Moment



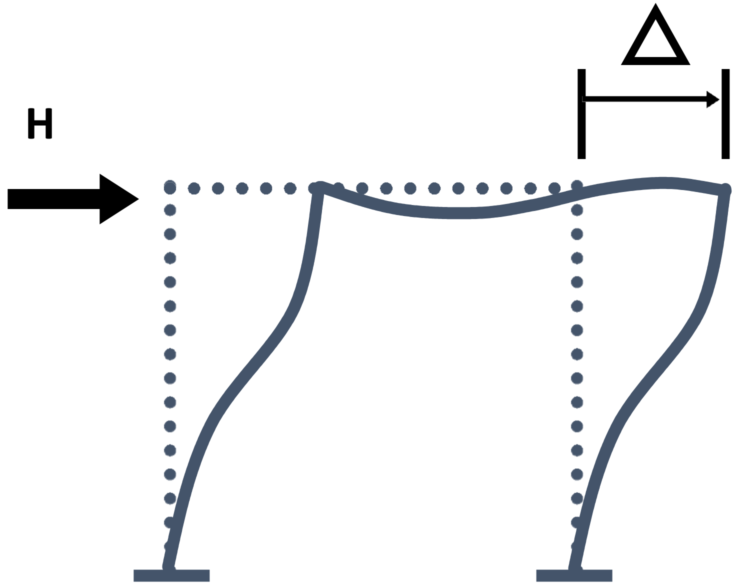
Dönme

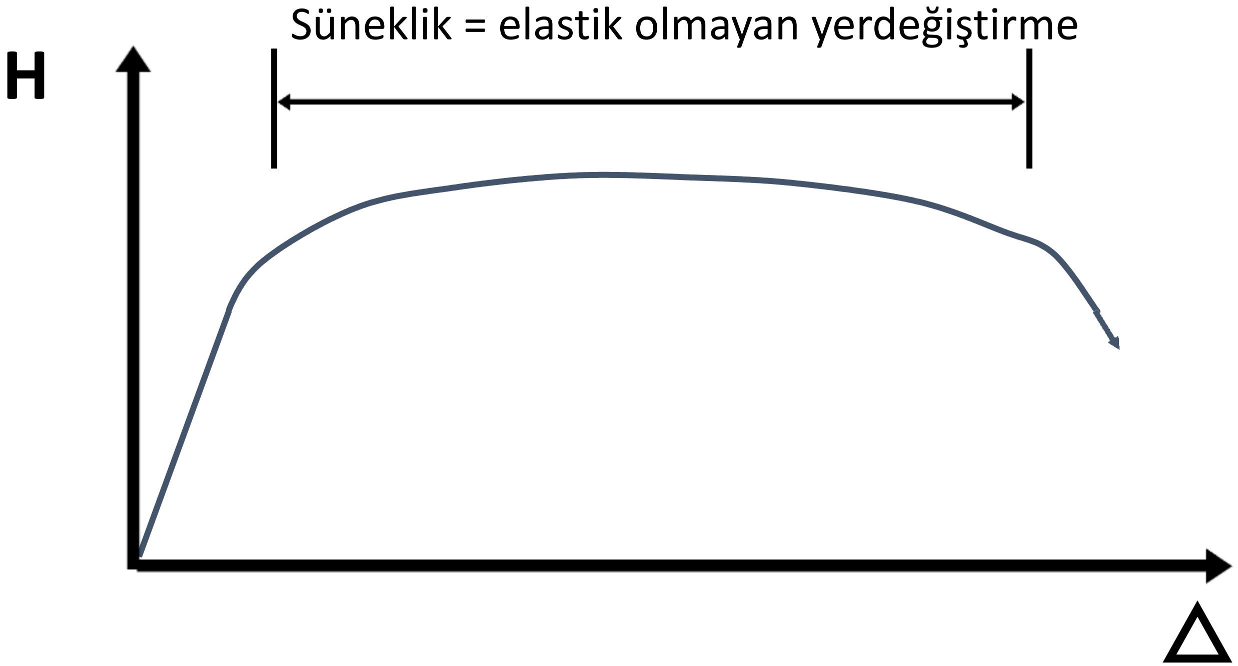


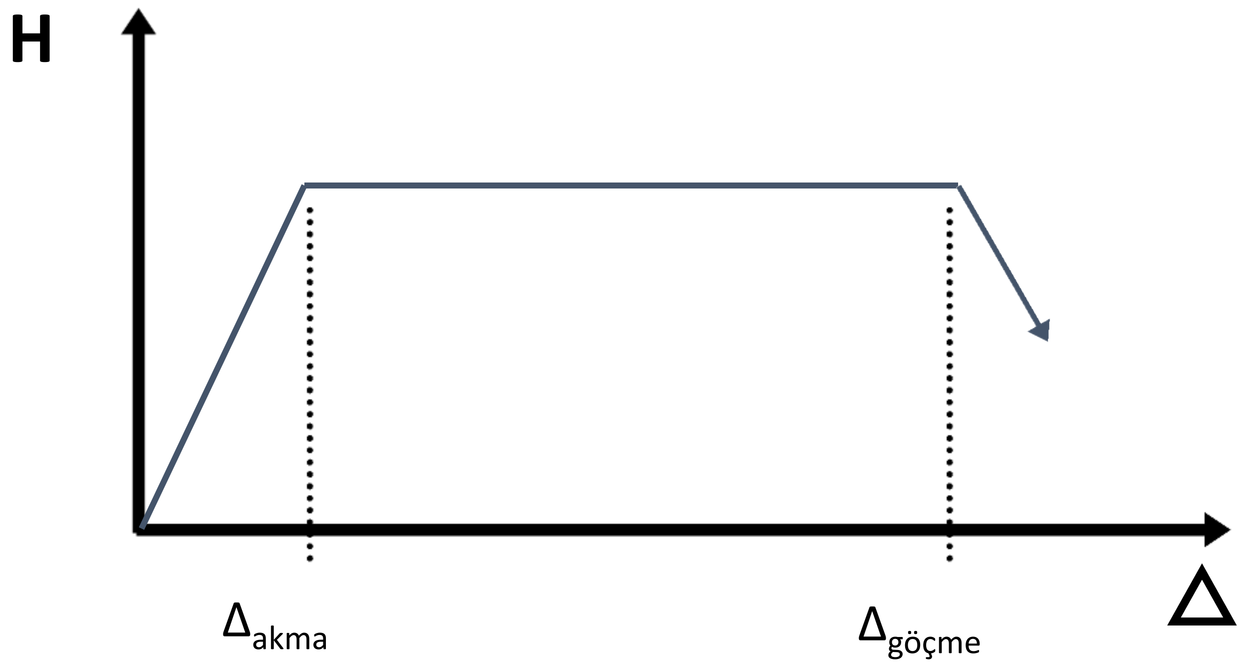
basınç

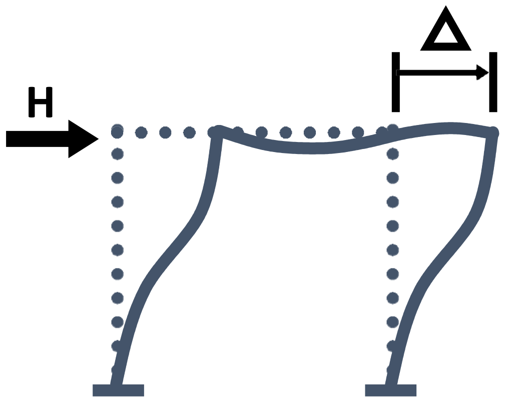
çekme

elastik Elastik-plastik plastik


H
Δ

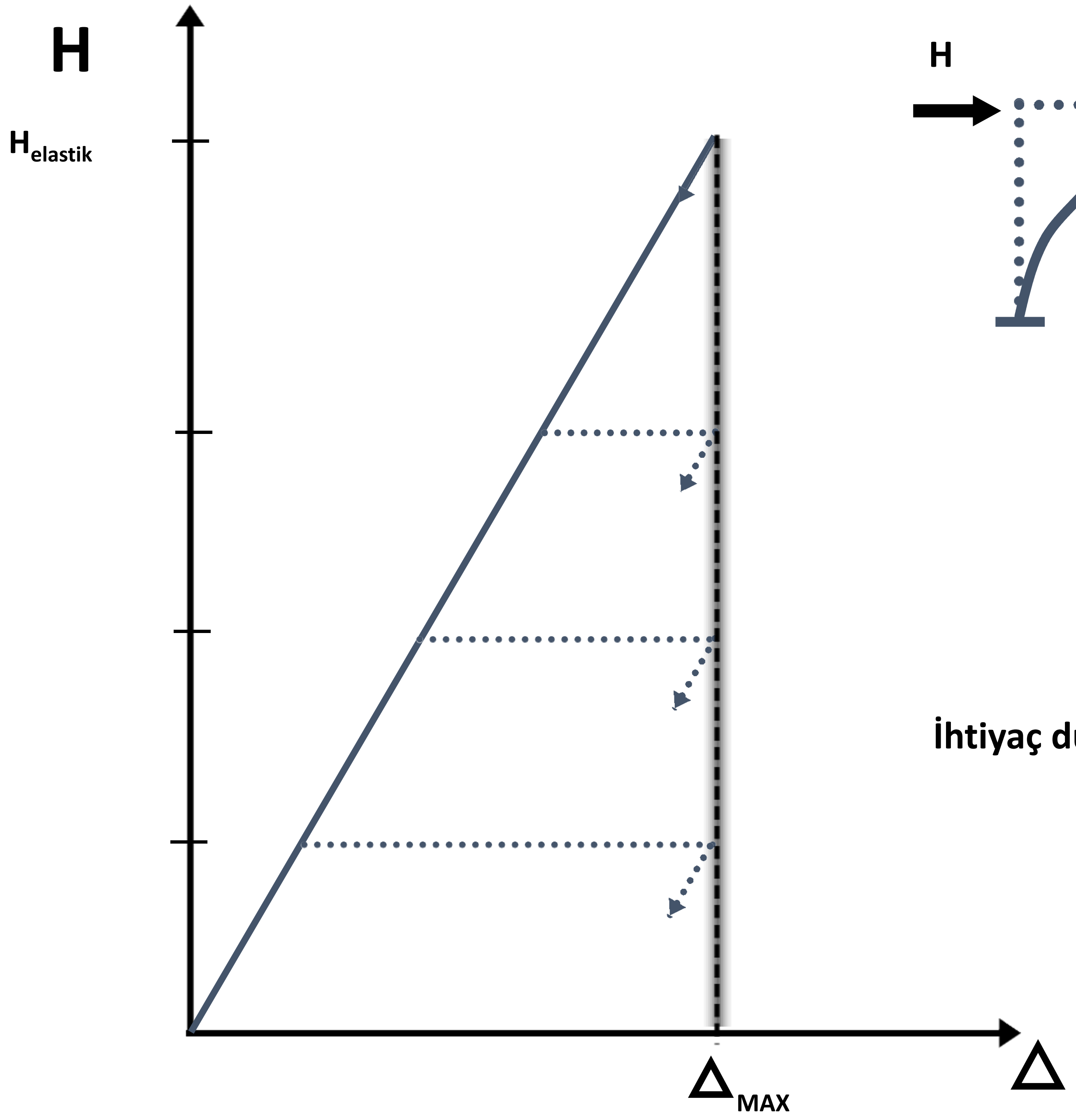

Süneklik = elastik olmayan yerdeğiştirme
H
Δ

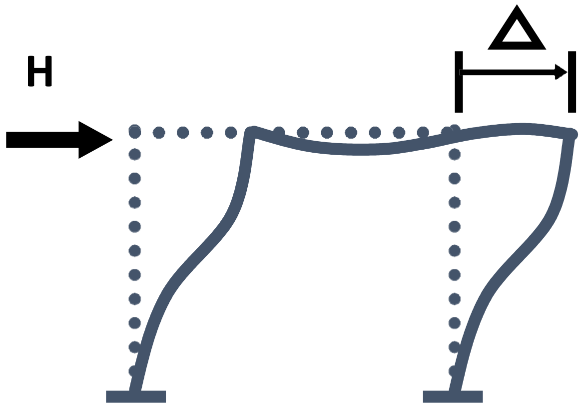




Süneklik faktörü

$$\textbf{Süneklik Faktörü} \quad \mu = \frac{\Delta_{göçme}}{\Delta_{akma}}$$



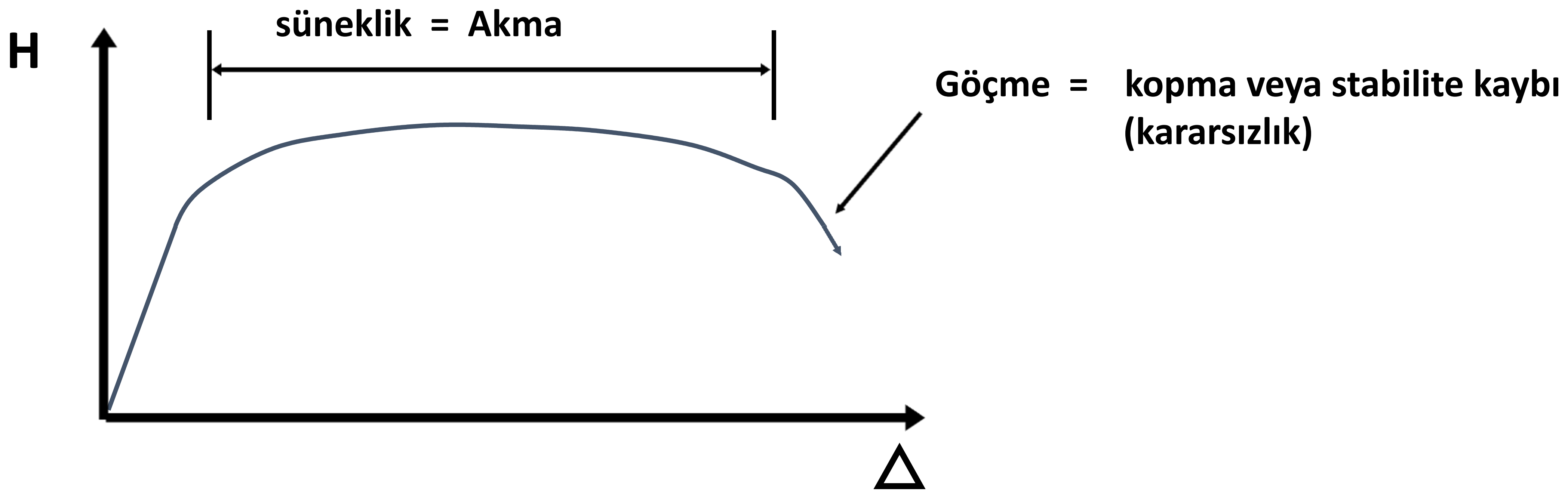


Dayanım

İhtiyaç duyulan süneklik

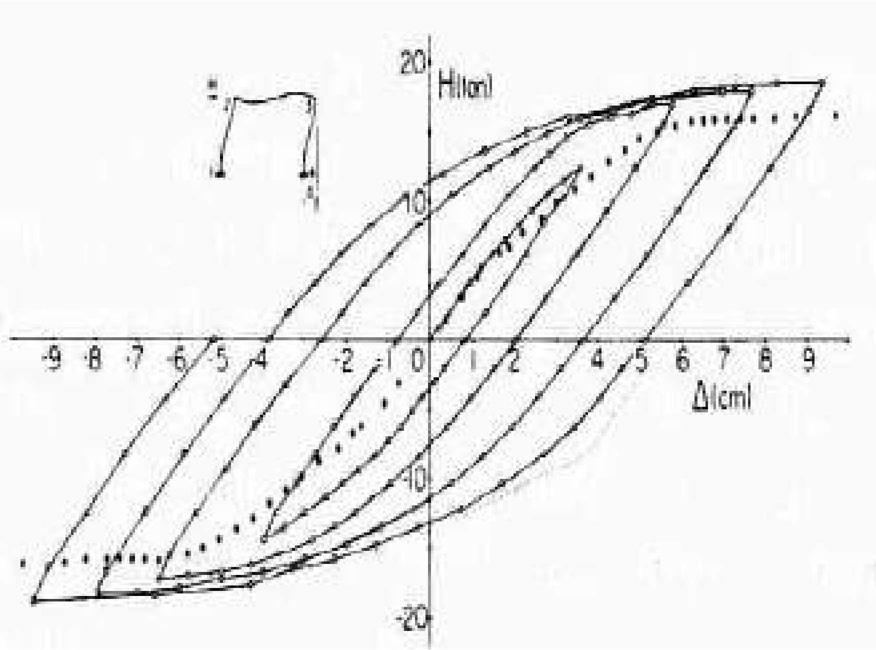
Çelik Yapıda süneklik : ***Akma***

Düktil olmayan göçme modu : ***kopma (yırtılma) veya kararsızlık***

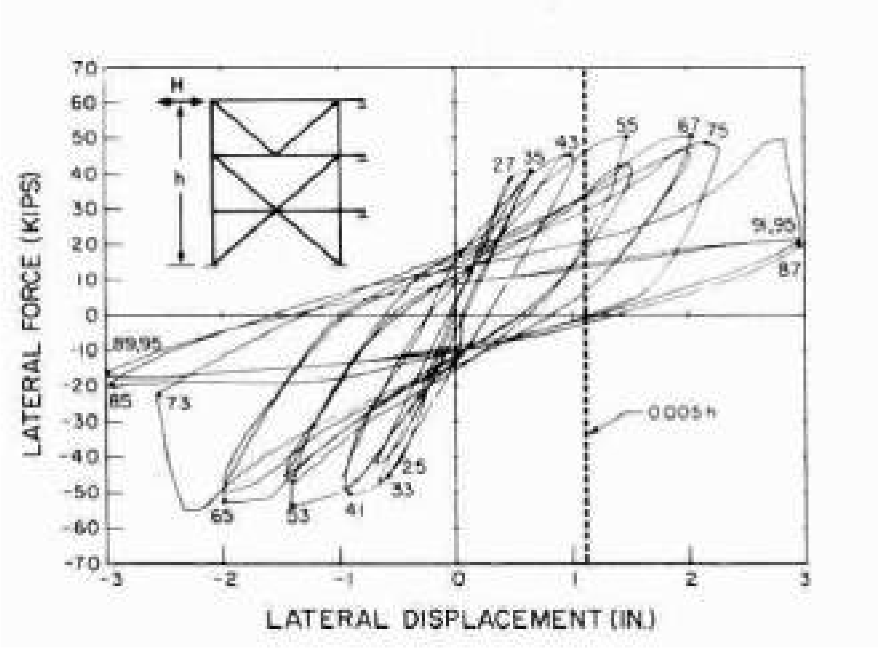


Sünek Davranış için:

- Deprem sırasında akmaya geçecek yapıda sigorta elemanlar seçin. Örneğin moment aktaran çerçevelerde kiriş, merkezi berkitmeli elemanlar (çapraz), dışmerkez berkitmeli sistemlerde link elmanı, vb.
- Seçilen bu sigorta elemanları sünek davranacak şekilde detaylandırın.
- Diğer bütün elemanları , sigorta elemanlarda plastikleşme ye olanak sağlıyacak şekilde daha kuvvetli olarak boyutlandırın.



(a)



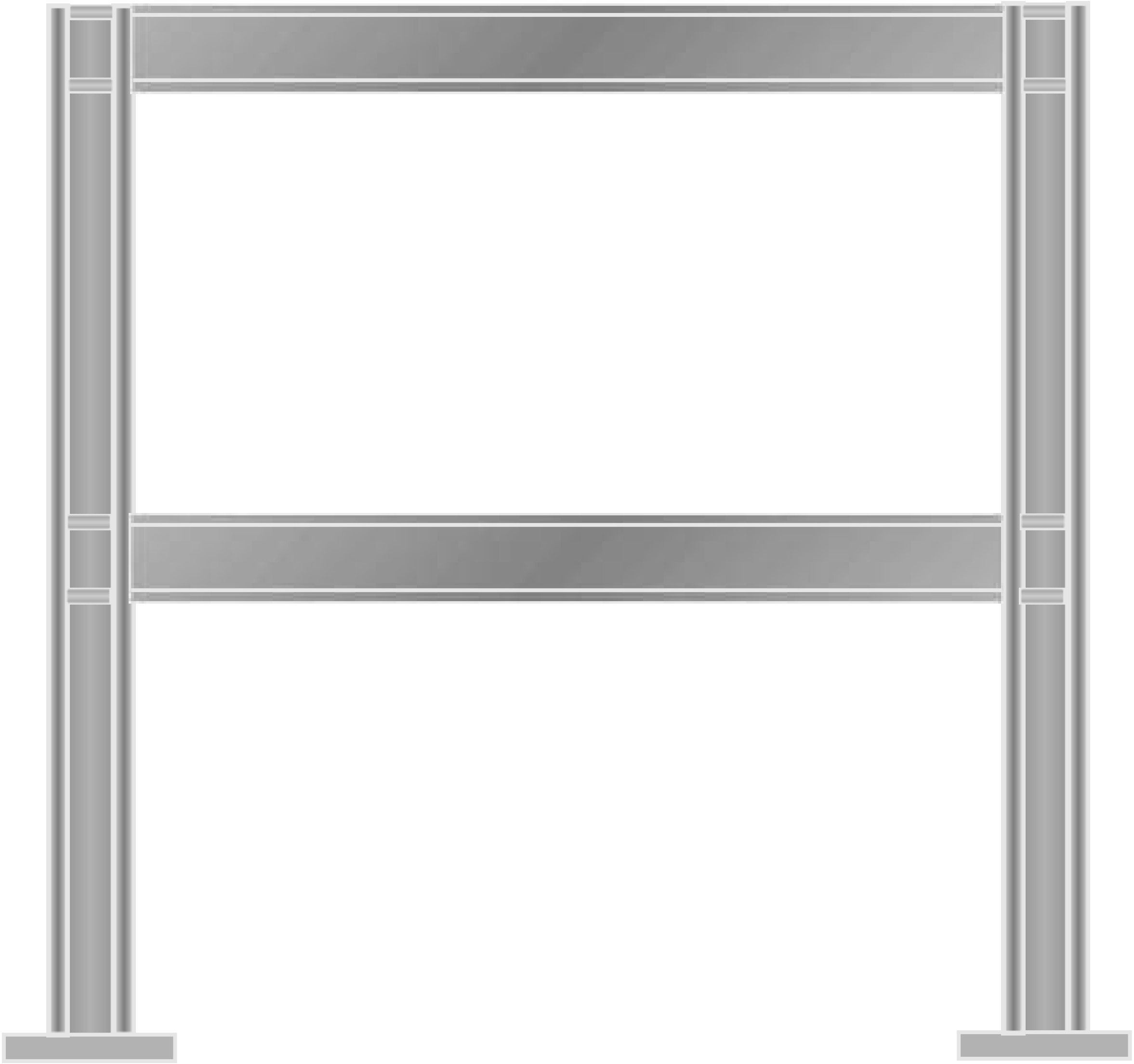
(b)

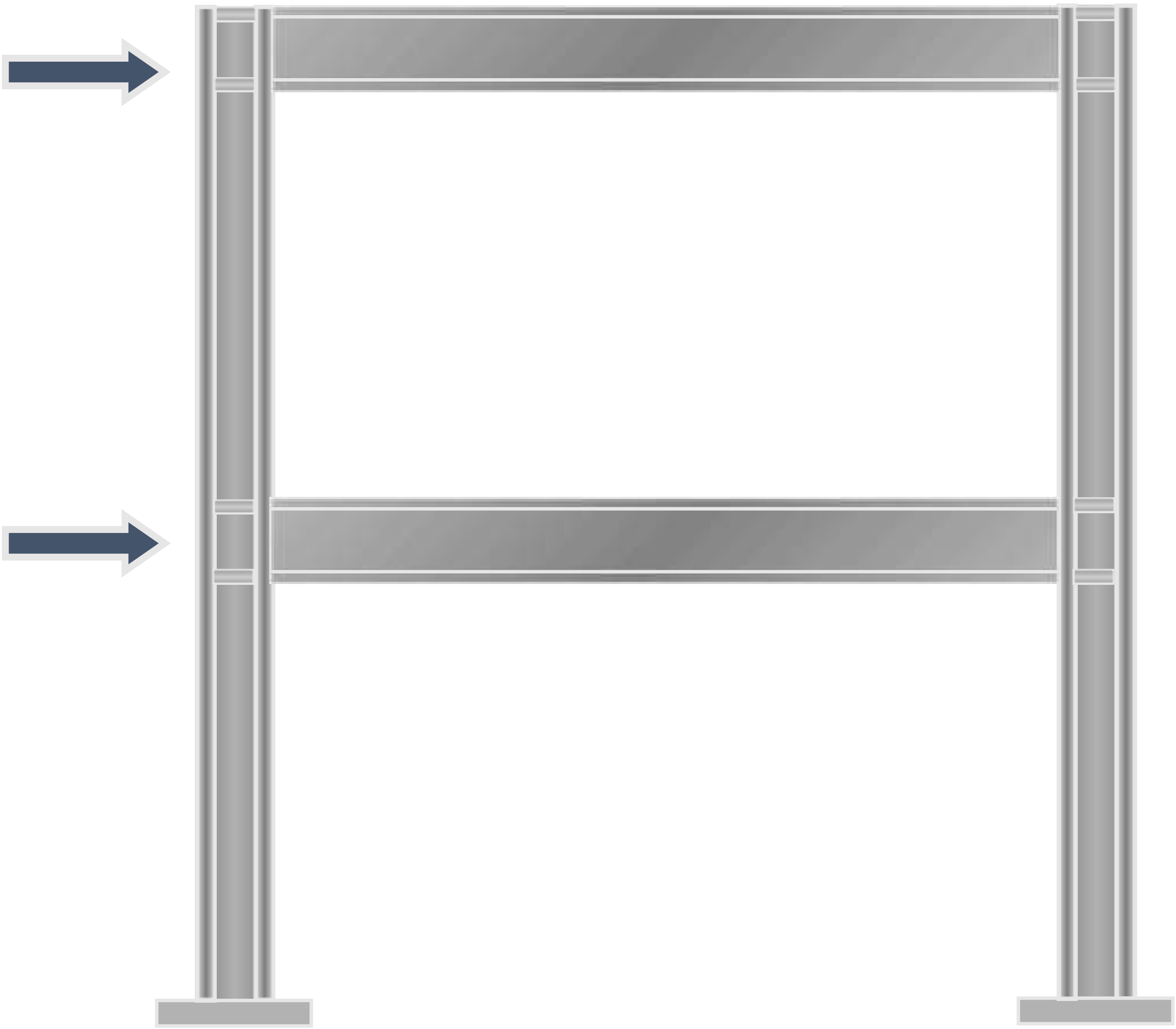
Örnek:

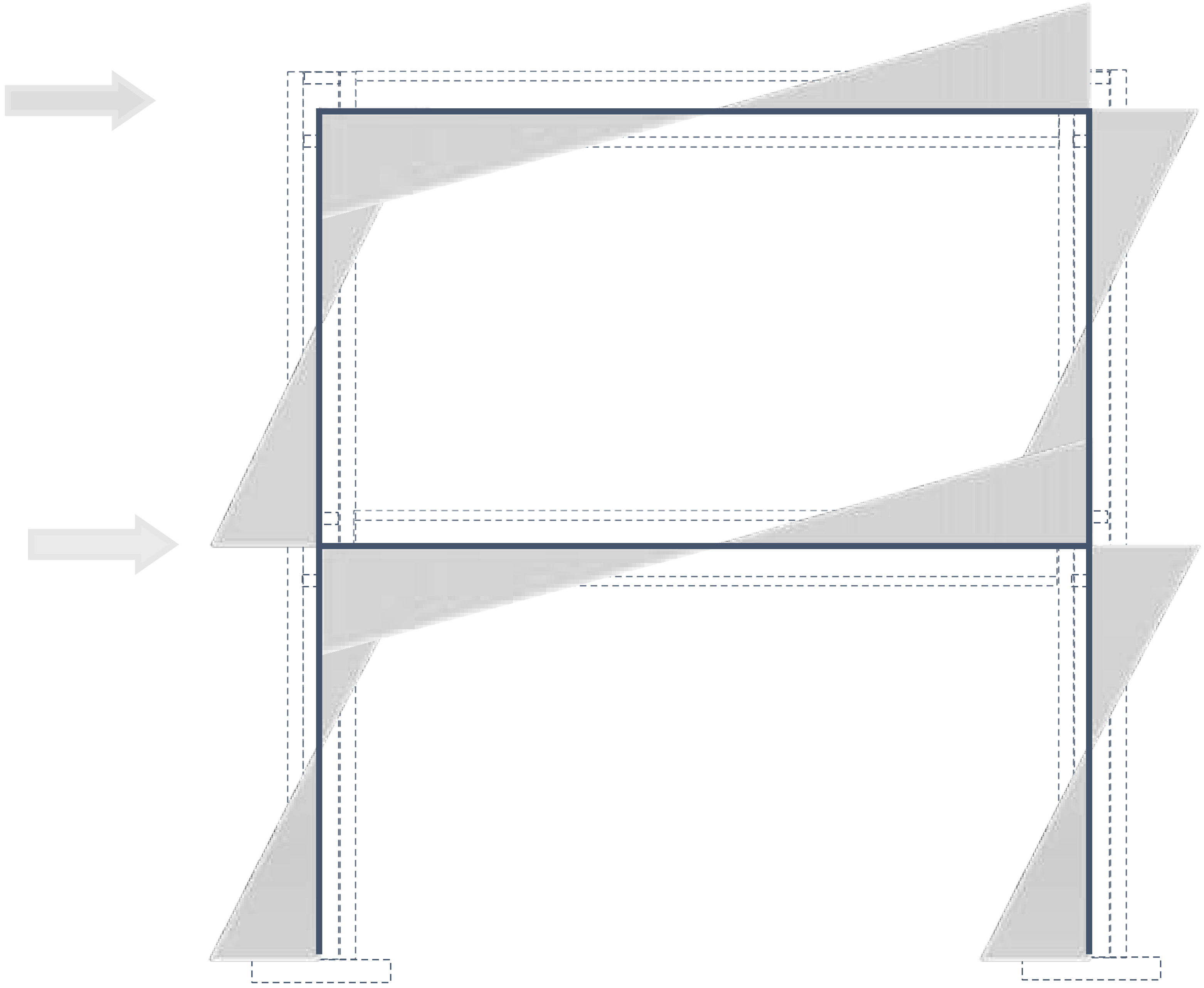
(a) Daha sünek davranış

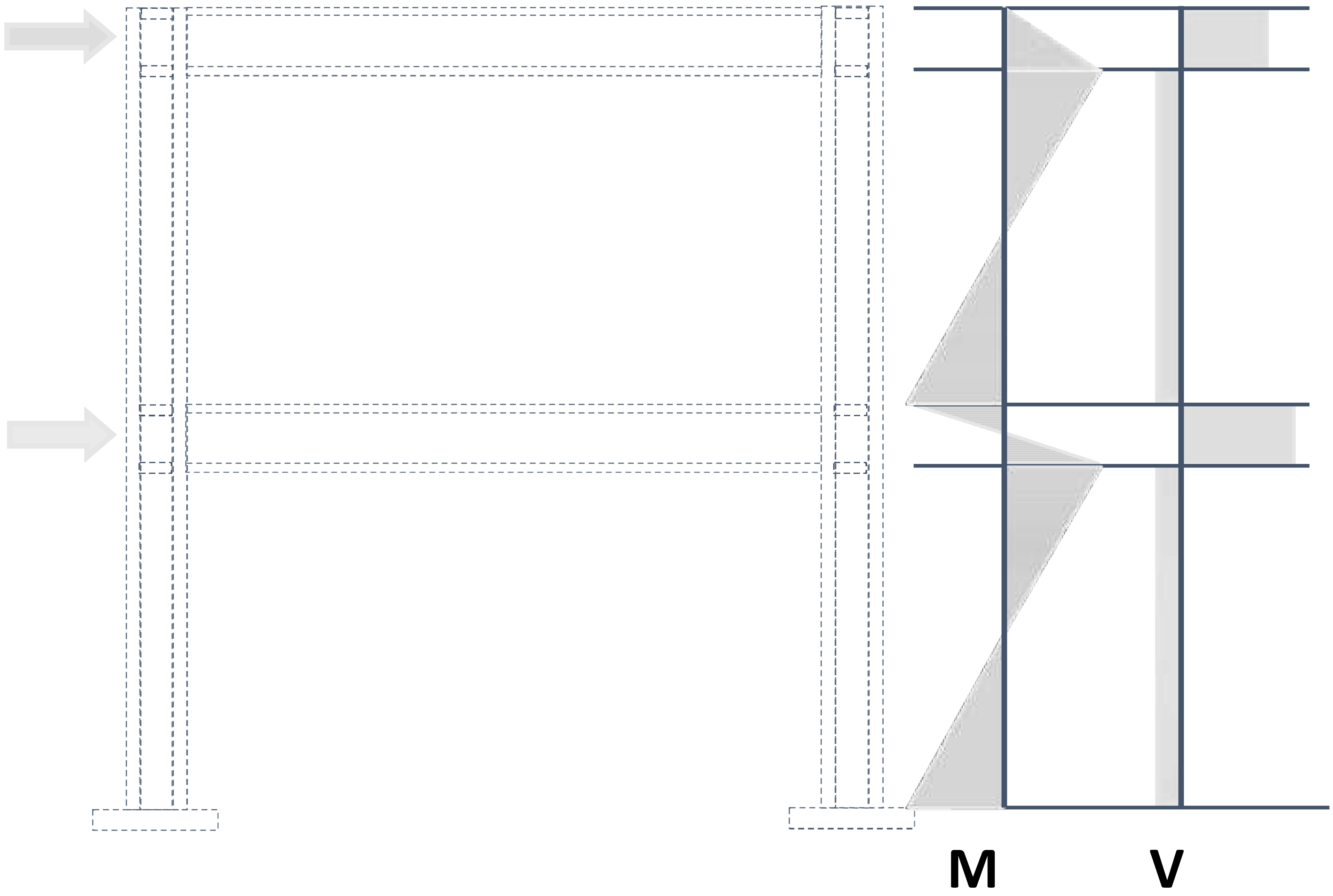
(b) Daha az sünek davranış

Sünek Yapı Çelik Bina Tasarımı : Çerçeve Sistemler

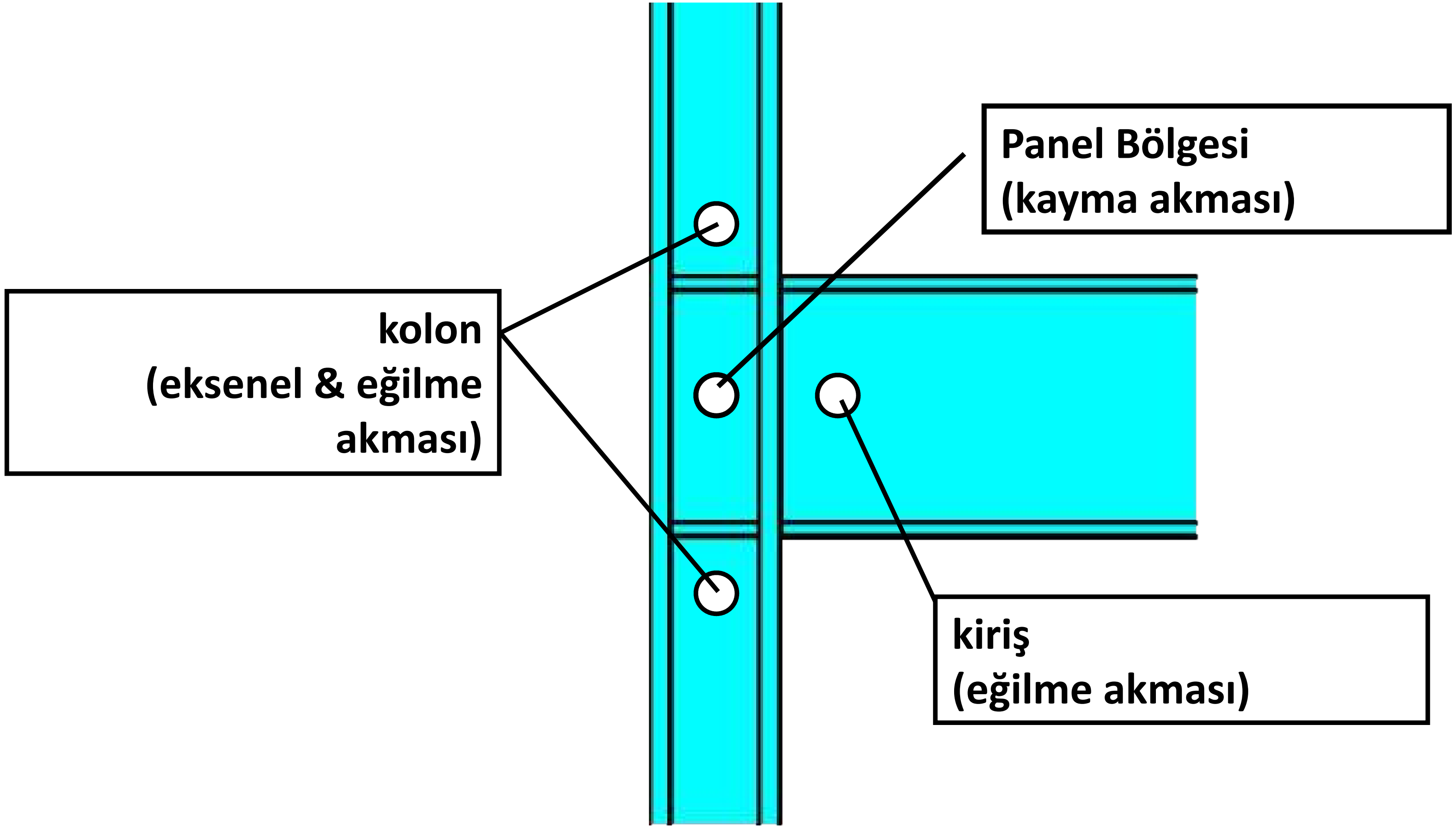




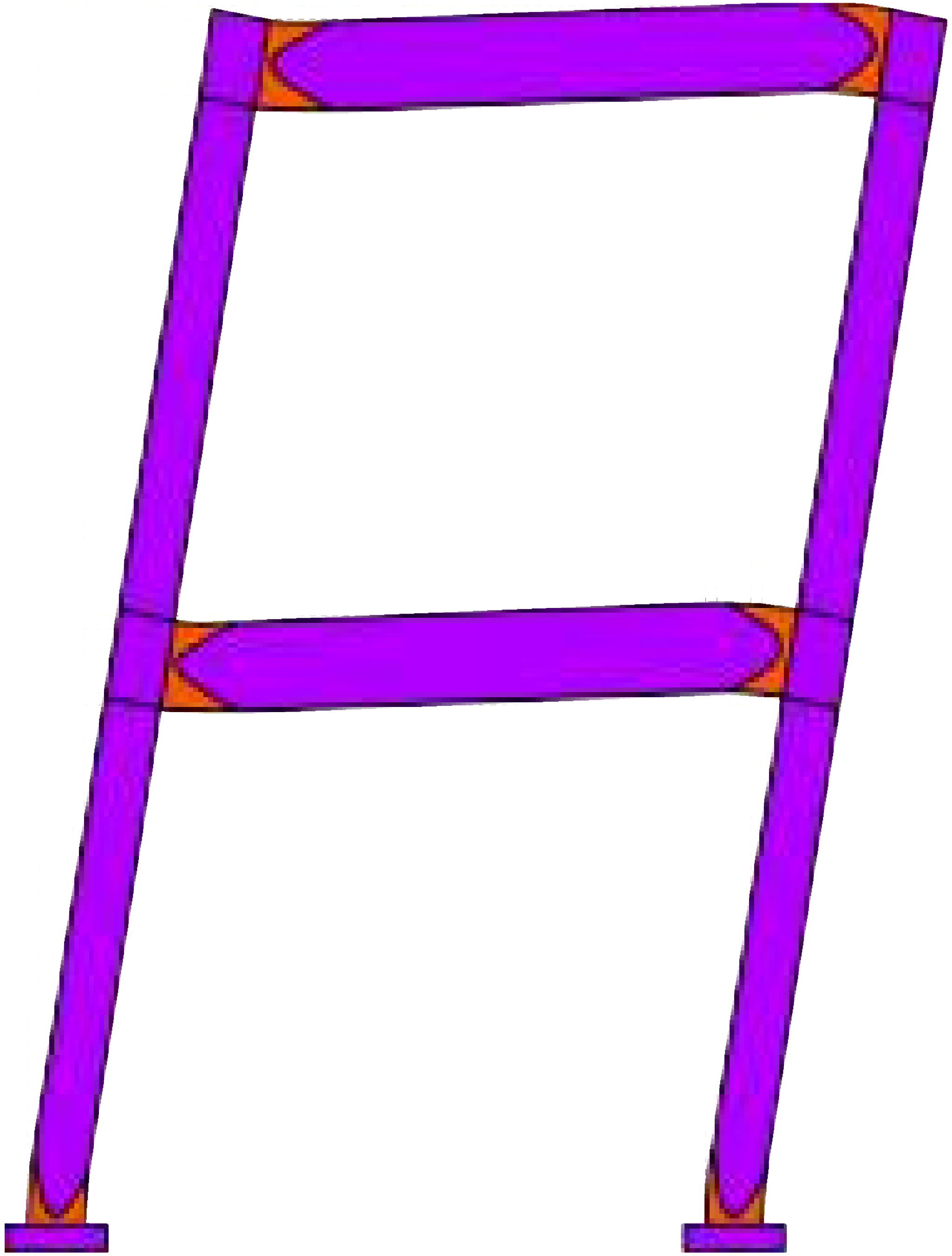



M
V

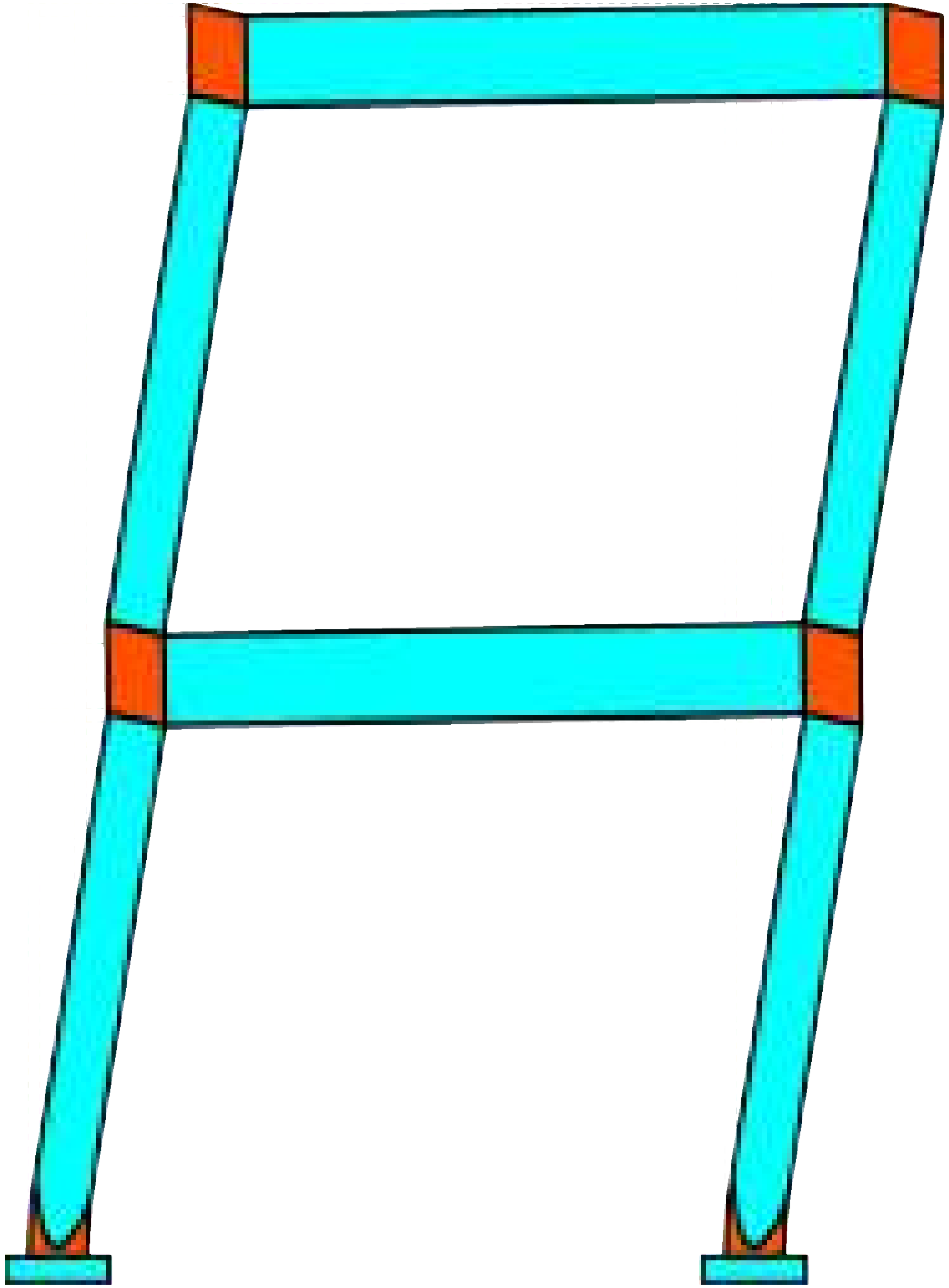
Muhtemel Plastik mafsal noktaları



Kirişlerdeki Plastik mafsallar

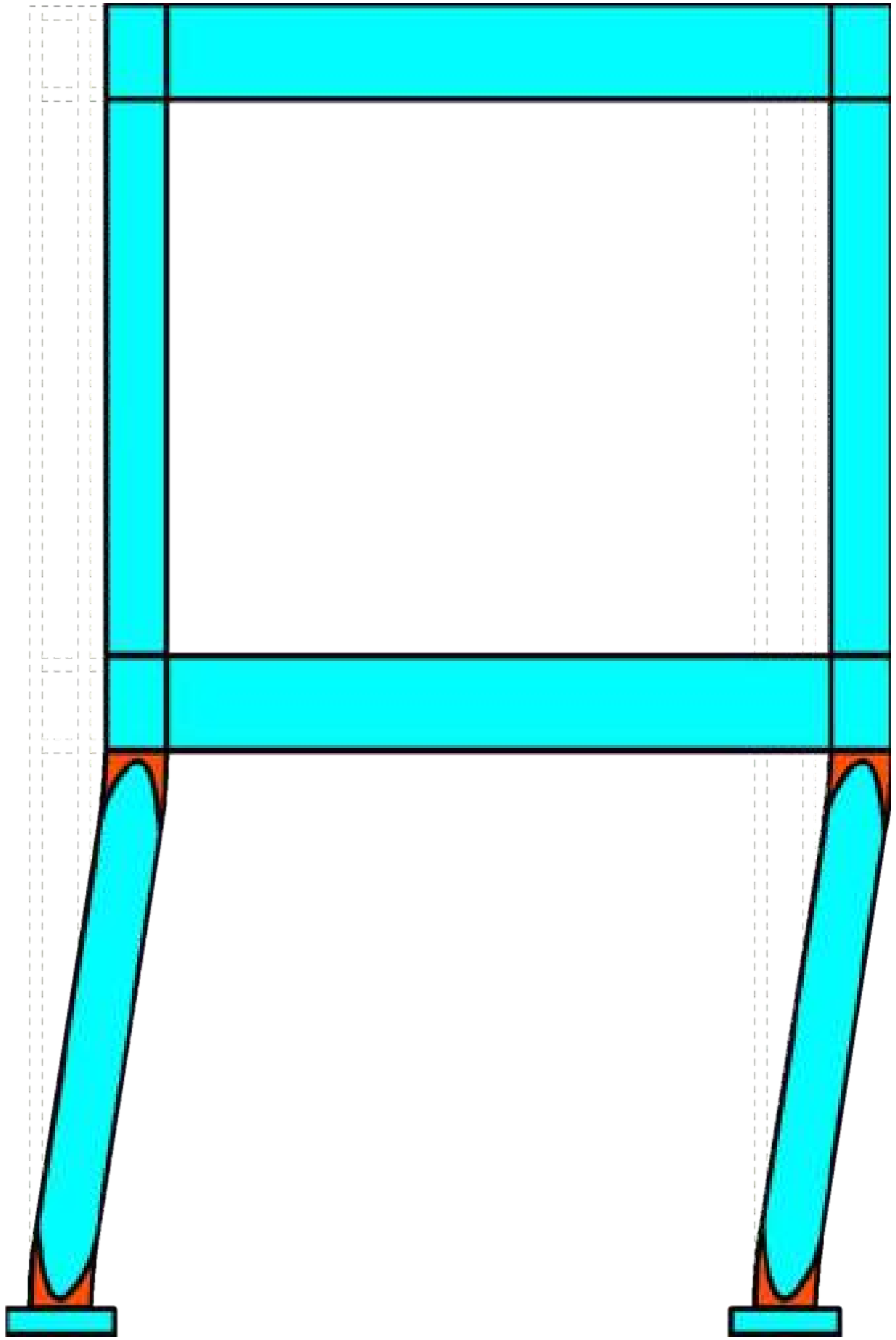


kolonda panel bölgesinde plastik mafsal oluşumu



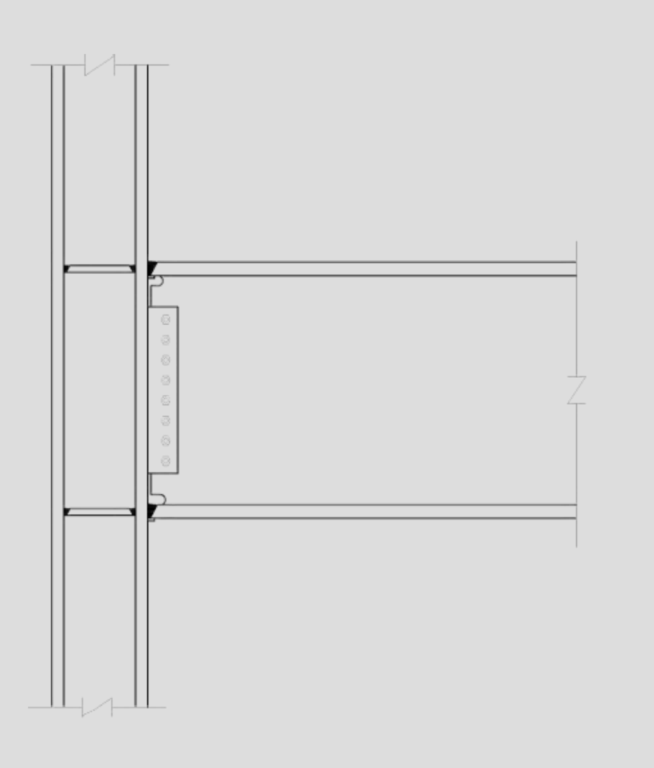
Kolonda plastik mafsal oluşumu

Yumuşak kat



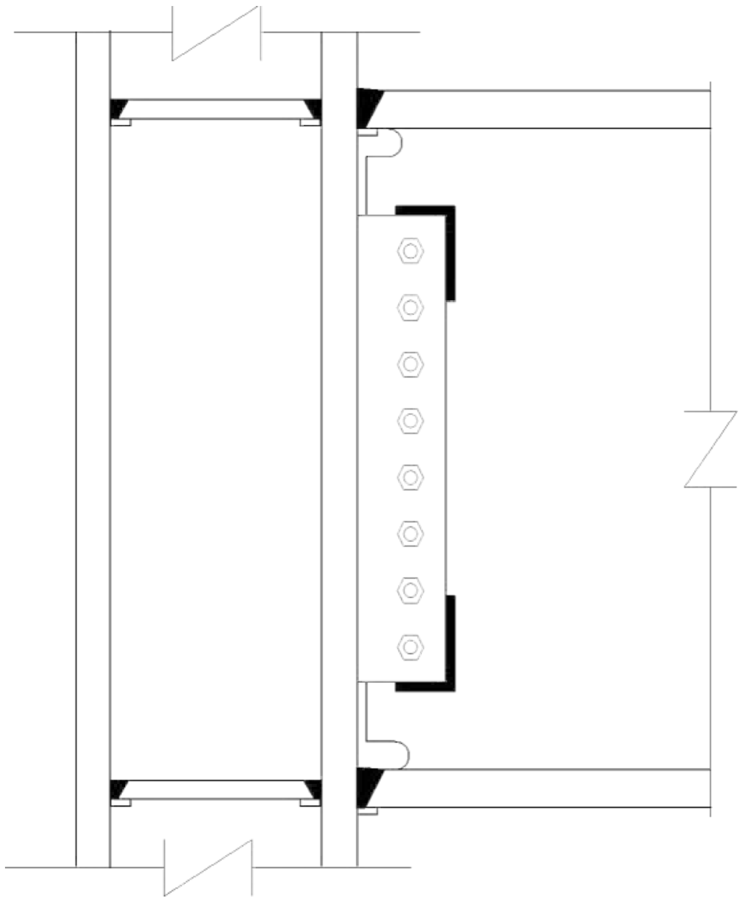
Moment çerçevesinde kritik bölge:

Kolon – kiriş birleşimi



Dikkat edilecek:

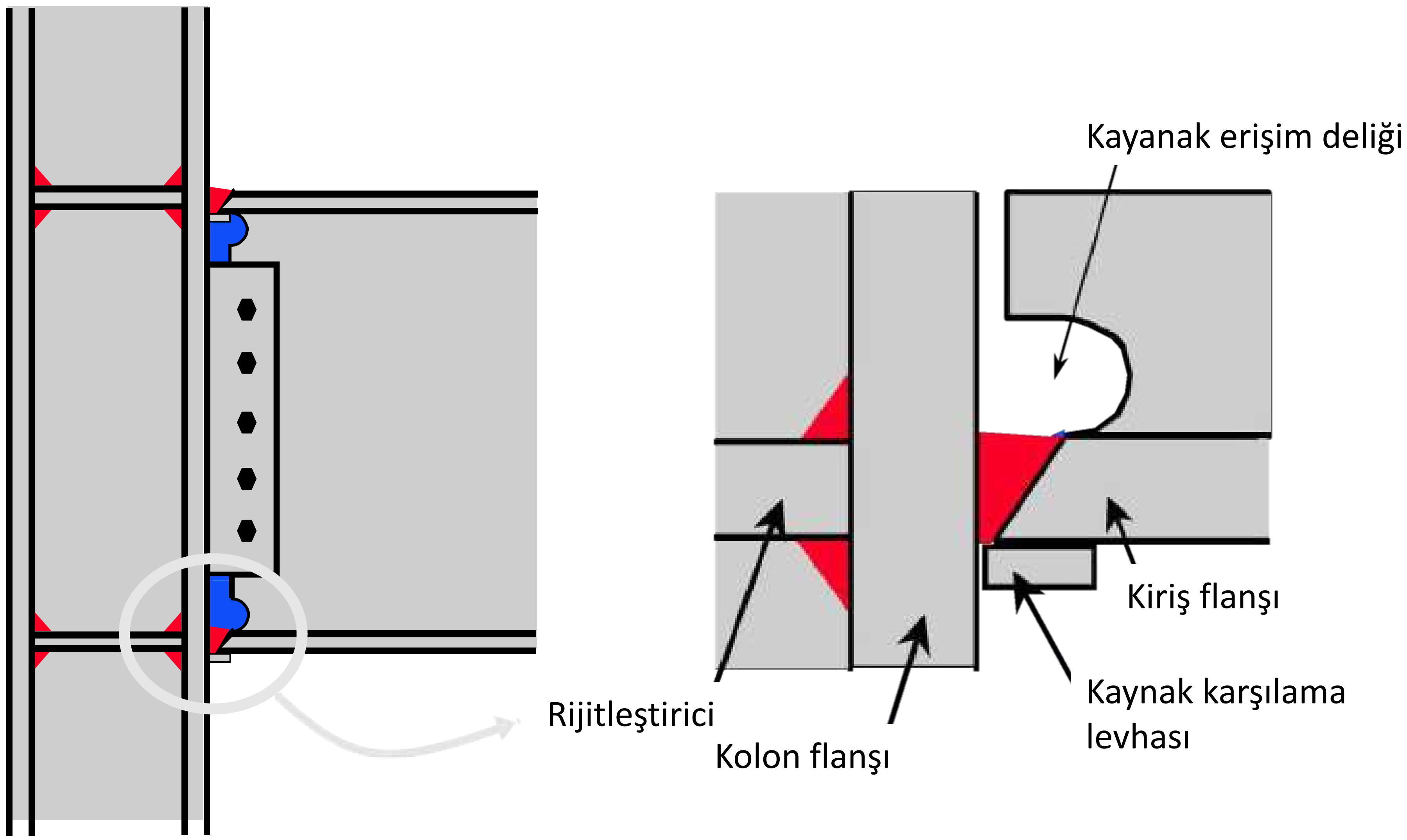
Çerçeve, kolon – kiriş birleşiminde göçme olmaksızın sünek davranış göstermeli



Northridge depremi öncesi kolon – kiriş birleşim detayı

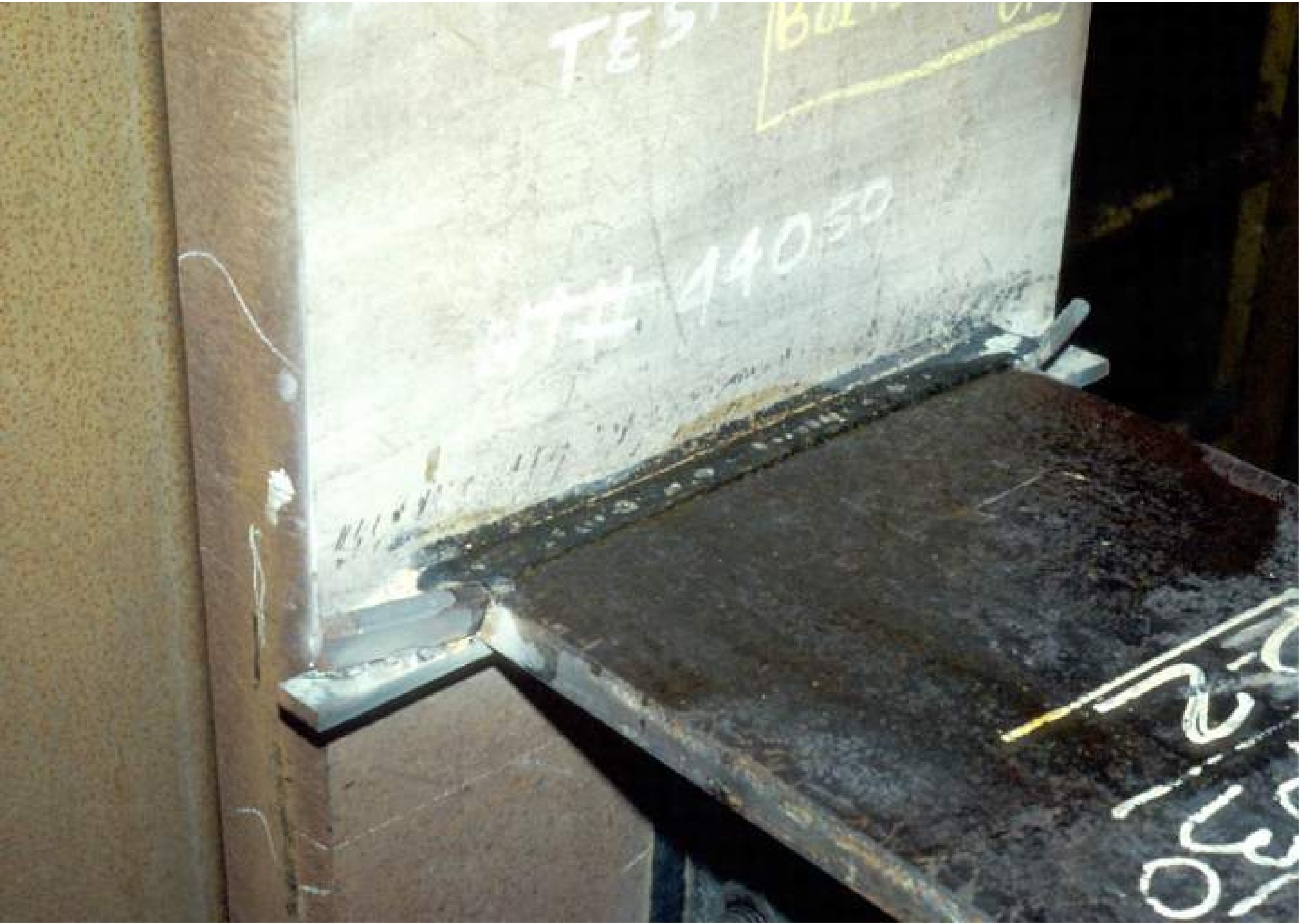
(1970-1994 yıllarında kullanılan)

Northridge öncesi
Flanşlar kaynaklı gövde bulonlu moment birleşimi



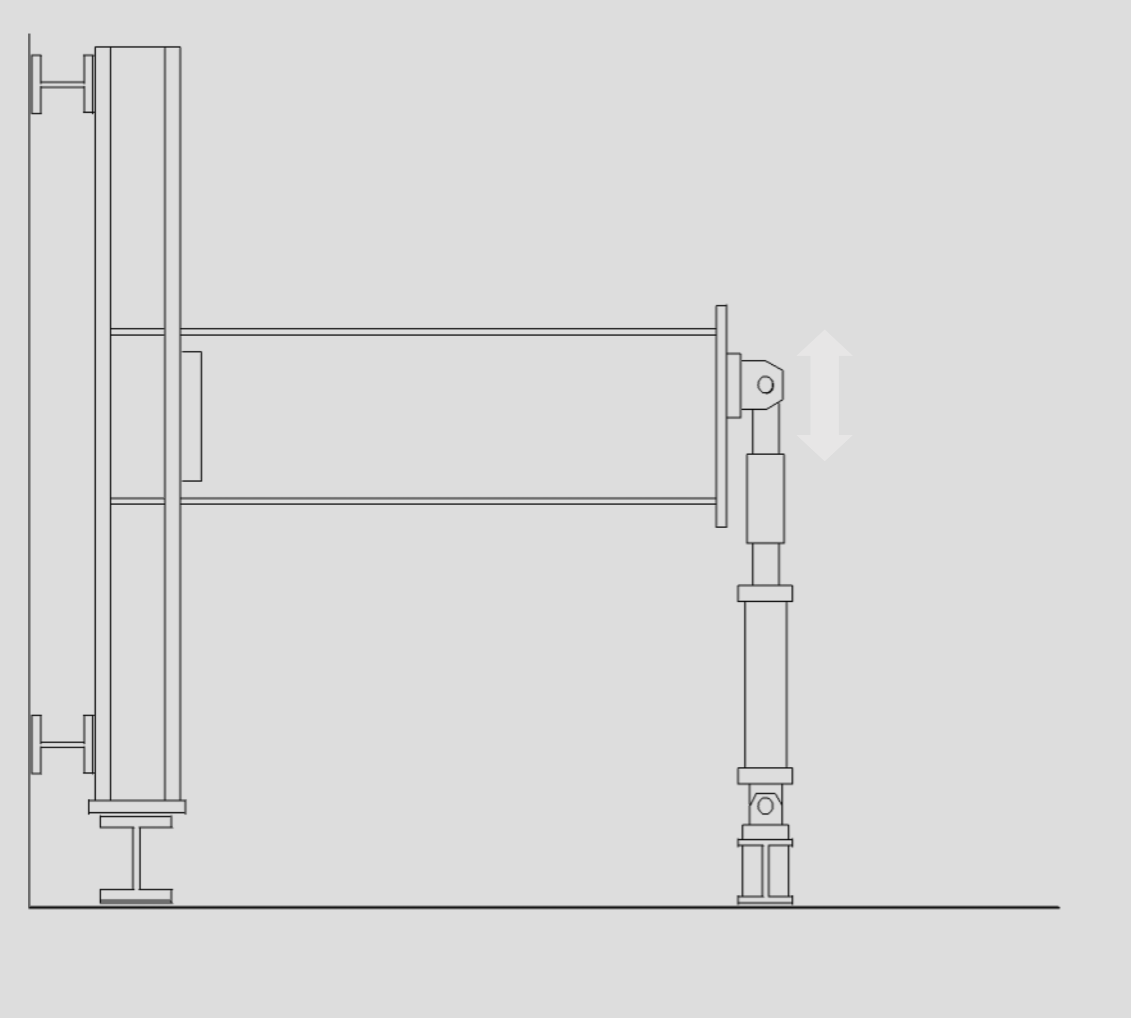

5


1050

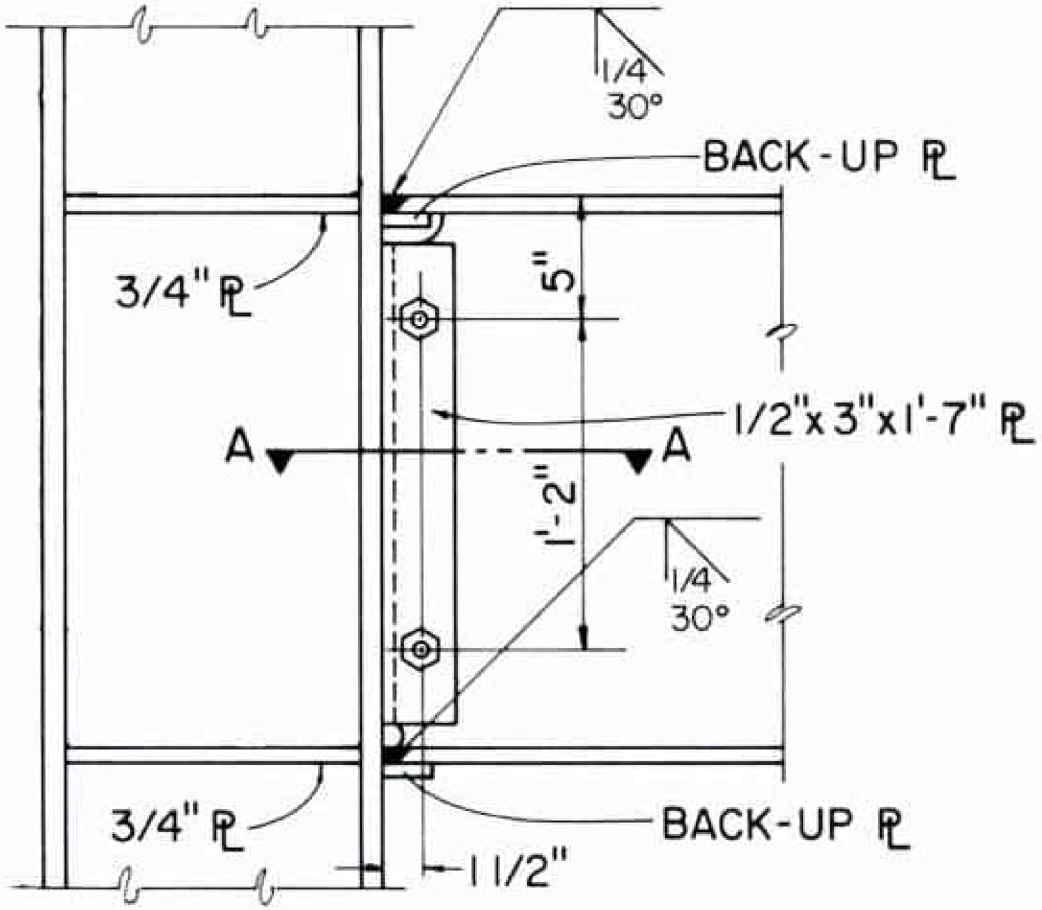

TEST


TEST C
AISC
TEST

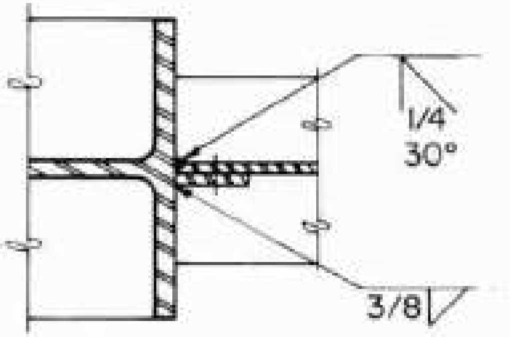
“Northridge Öncesi ” Moment Birleşim Test Düzeneği



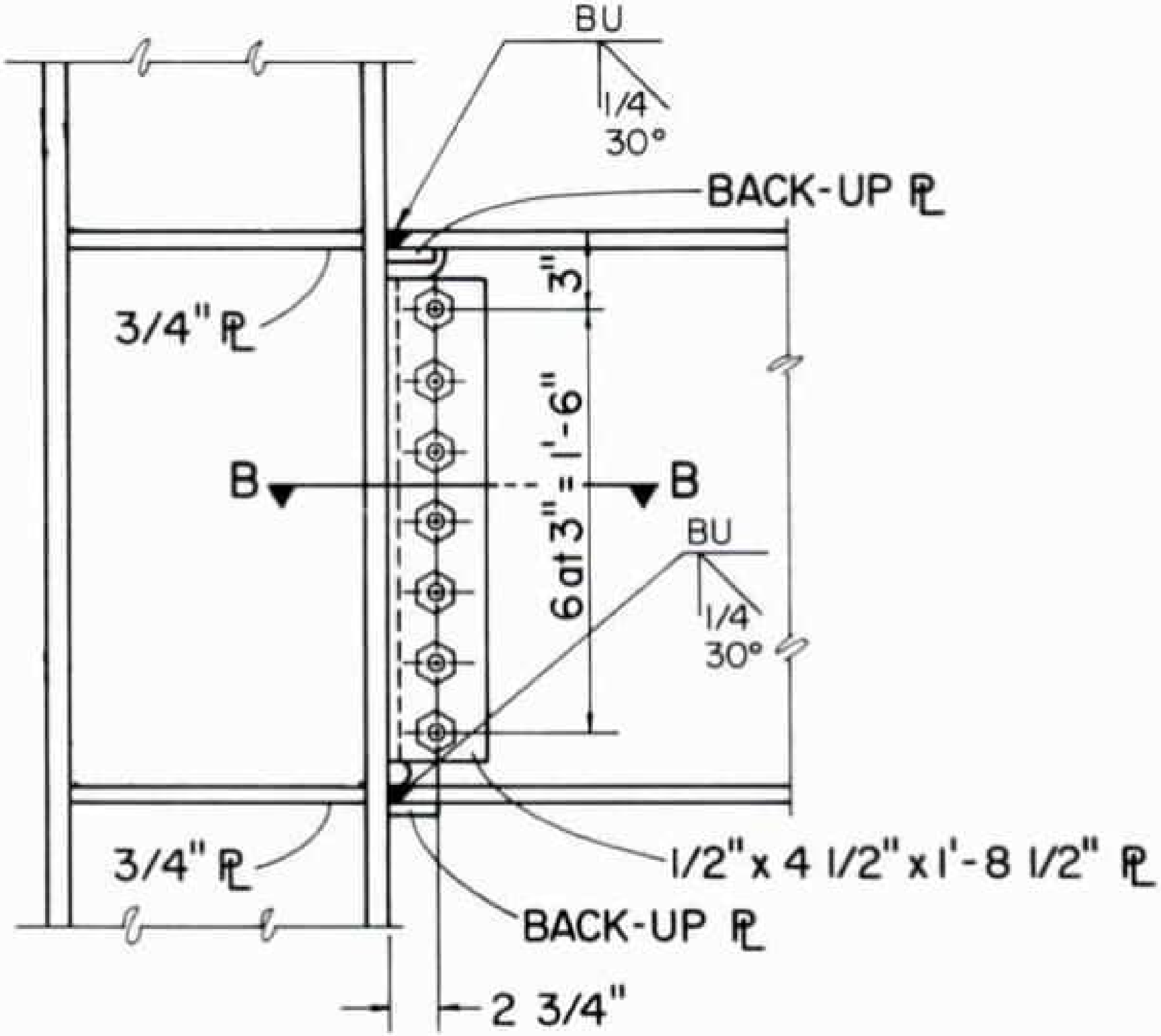

SPEC. 1A



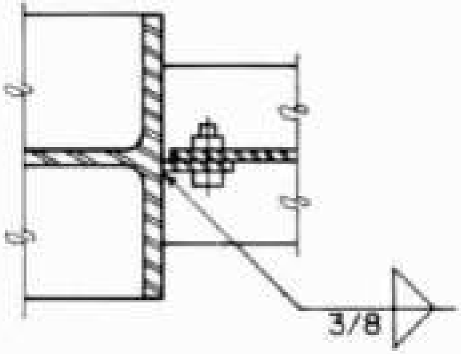
W24 x 76 WELDED
JOINT DETAIL



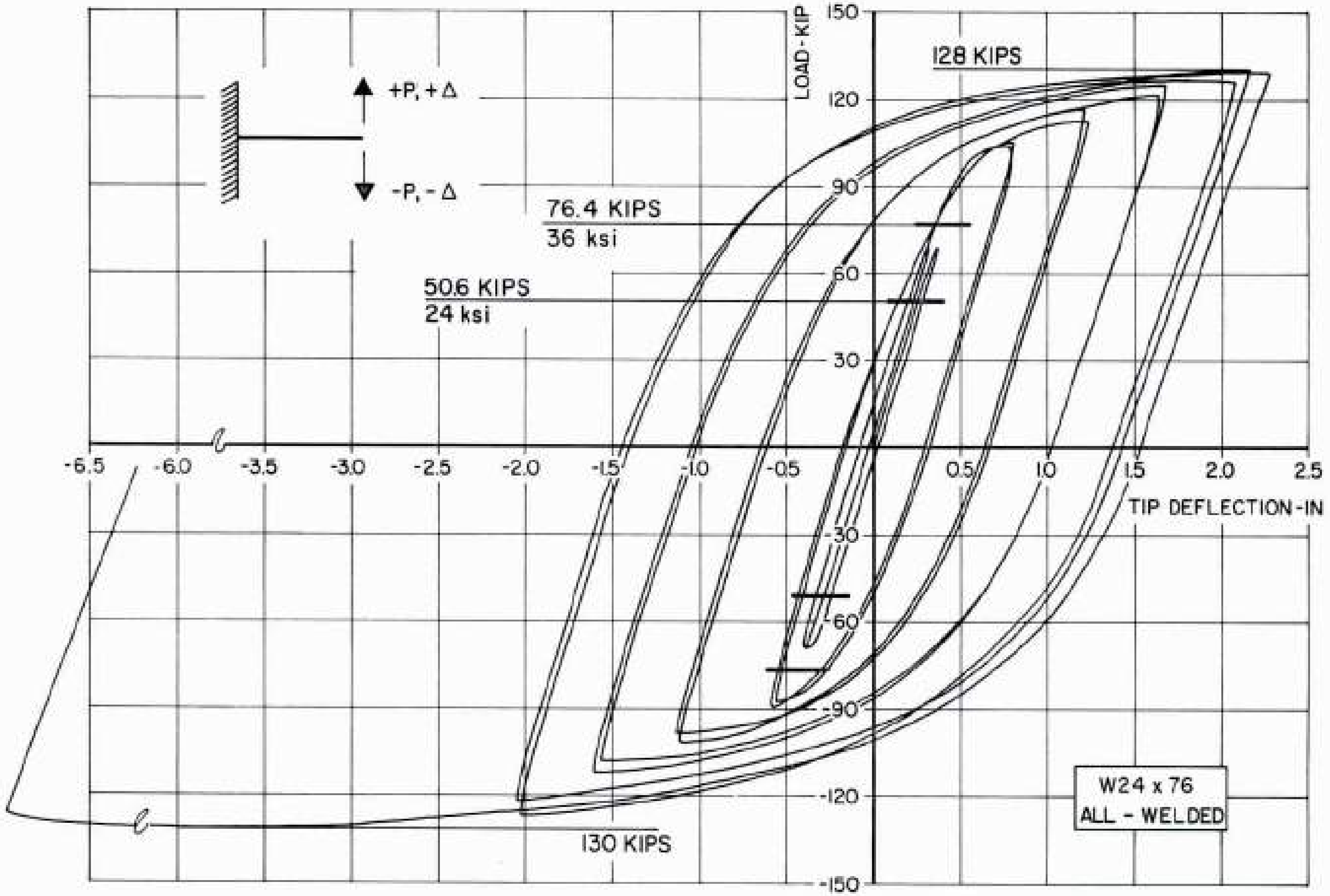
SECTION A-A



W24 x 76 BOLTED
JOINT DETAIL

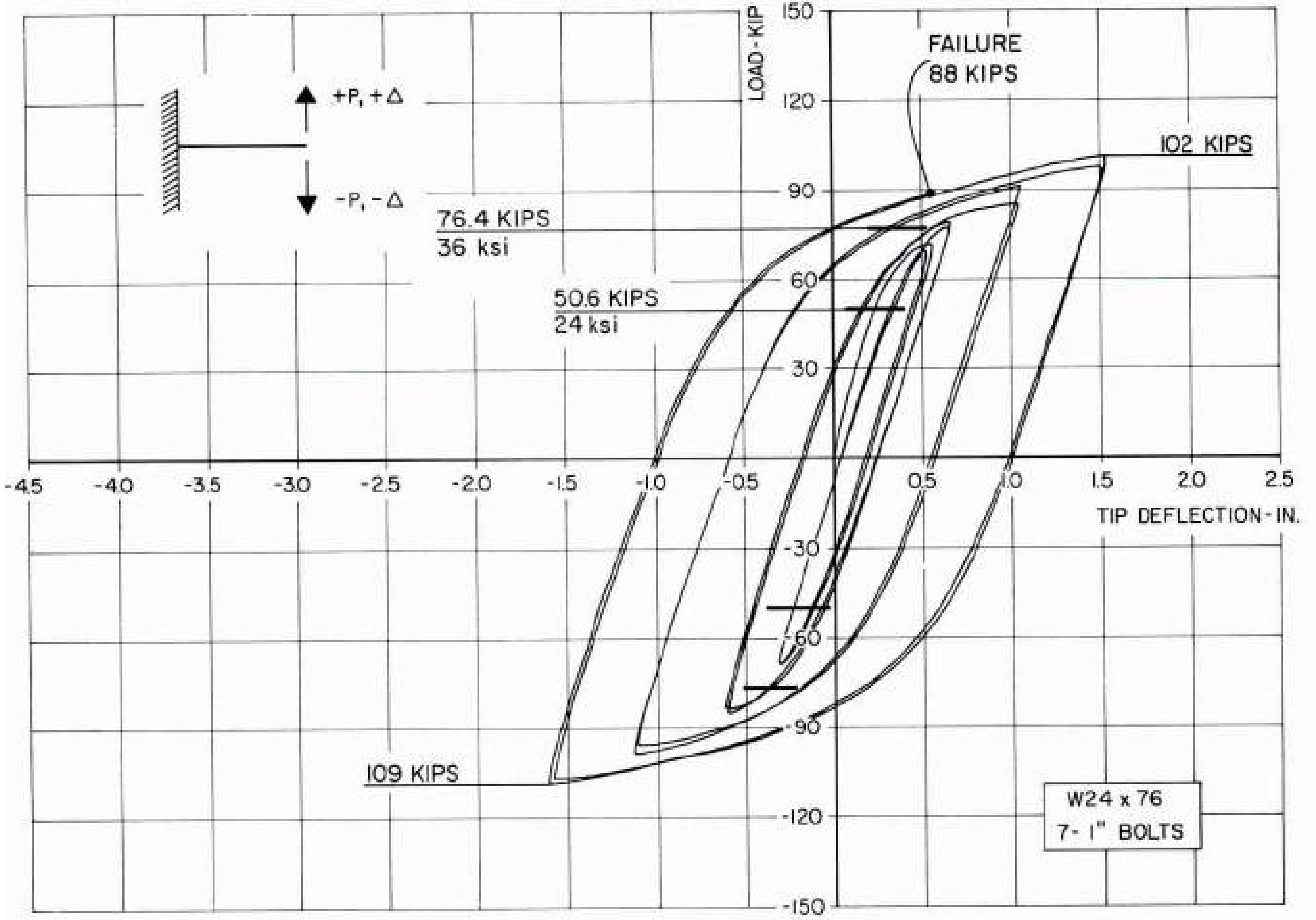


SECTION B-B

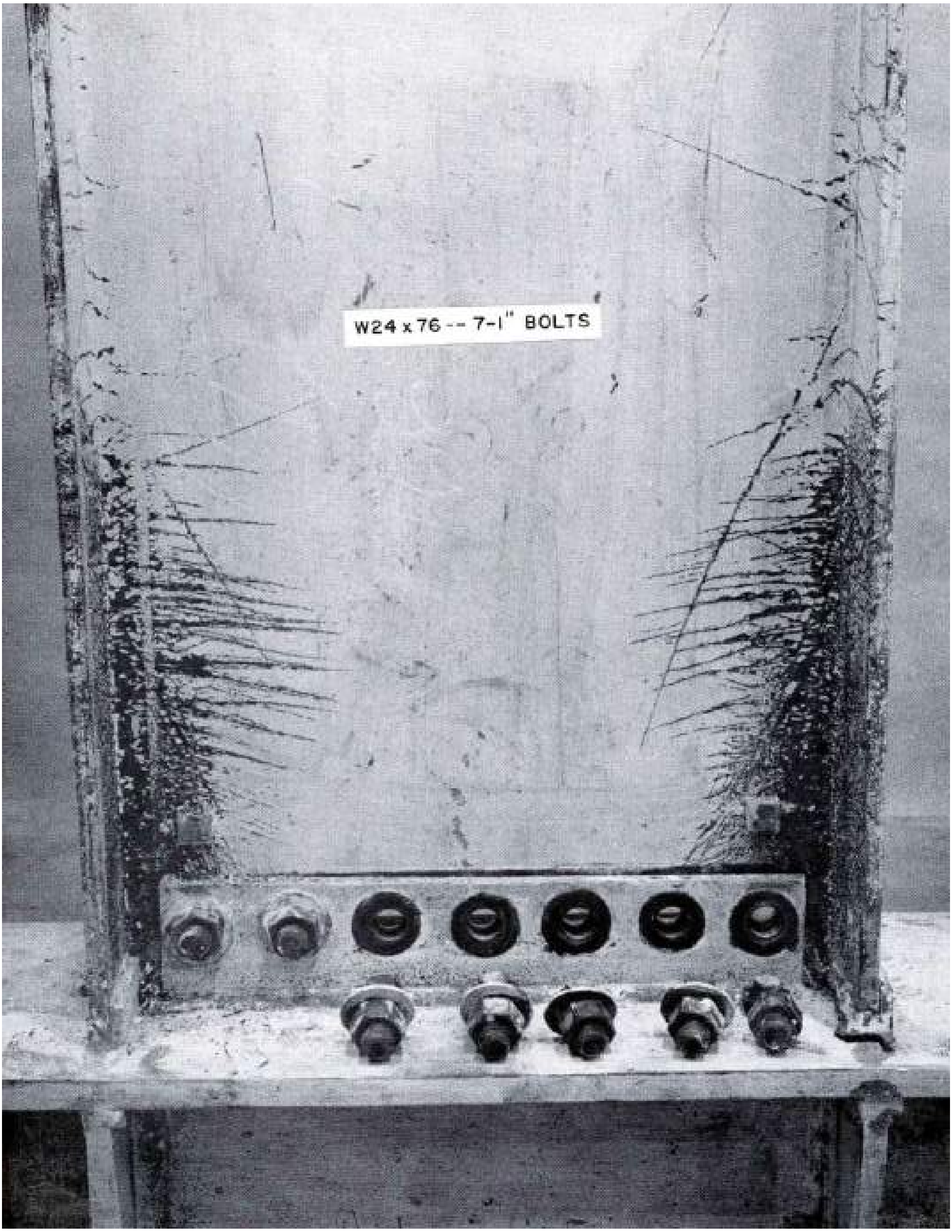


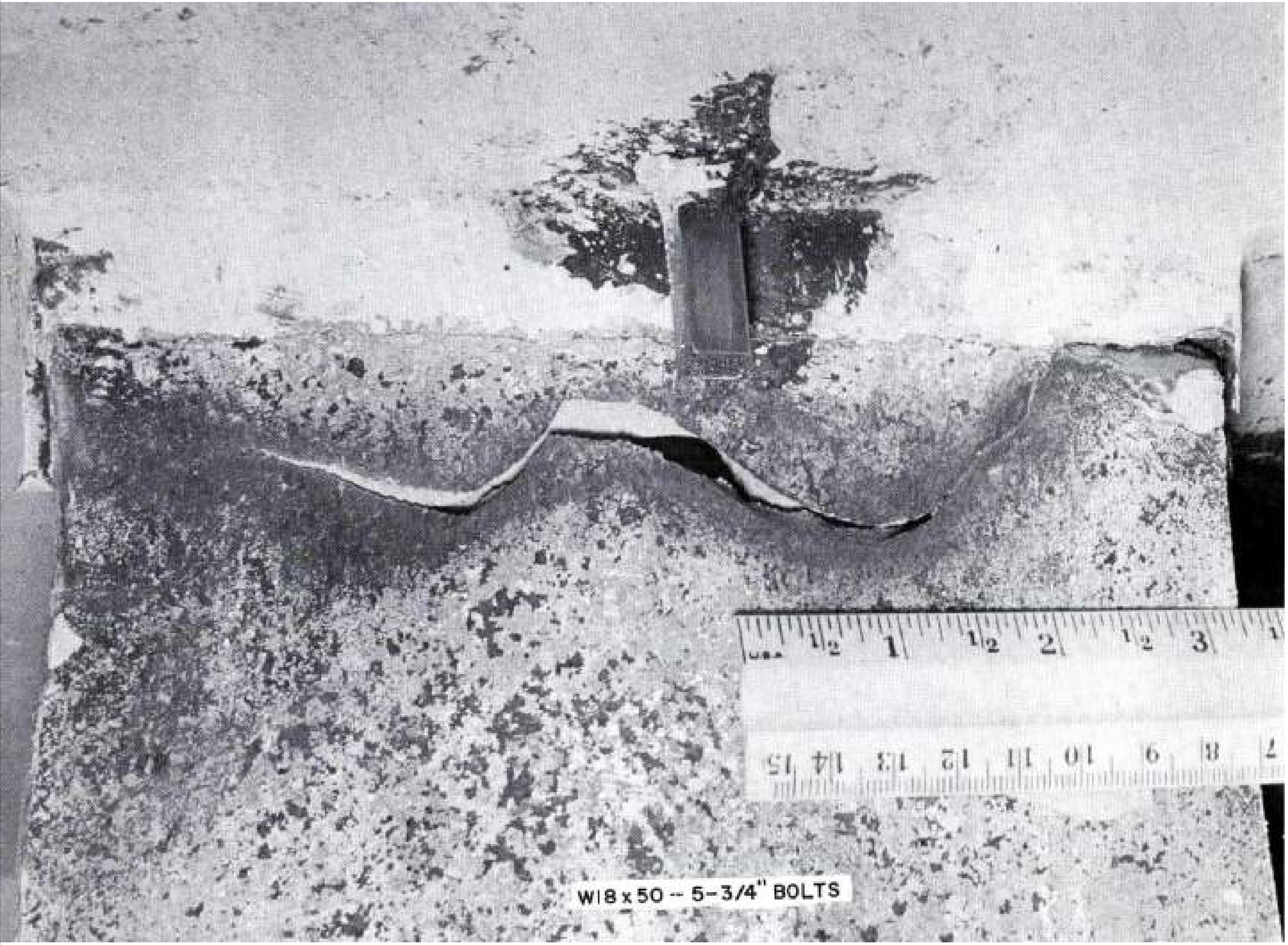
+P, +Δ
-P, -Δ
LOAD-KIP
150
120
90
60
30
-30
-60
-90
-120
-150
128 KIPS
76.4 KIPS
36 ksi
50.6 KIPS
24 ksi
-6.5
-6.0
-3.5
-3.0
-2.5
-2.0
-1.5
-1.0
-0.5
0.5
1.0
1.5
2.0
2.5
TIP DEFLECTION-IN
130 KIPS
W24 x 76
ALL - WELDED

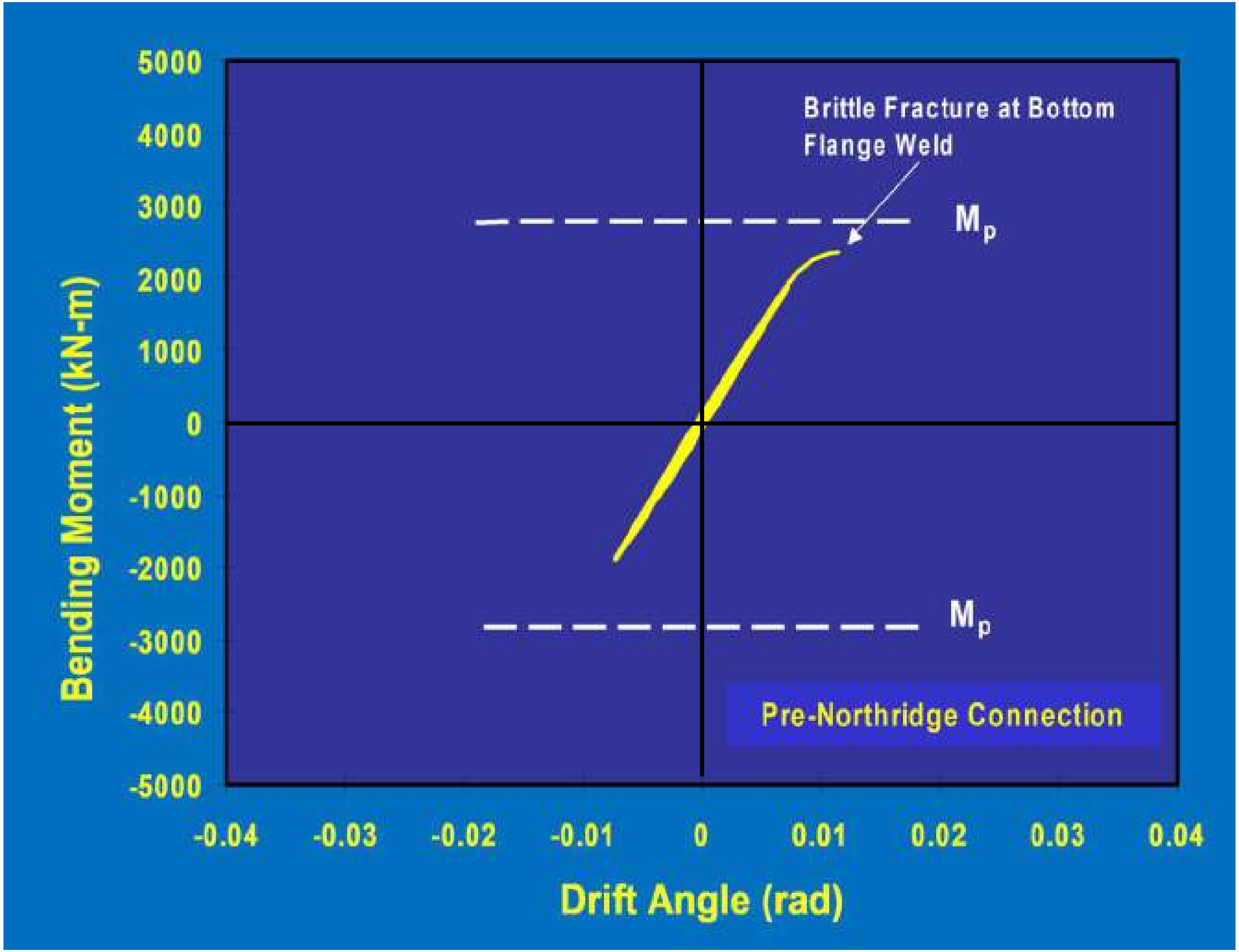

24 WF 76
ALL WELDED



LOAD-KIP
150
120
90
60
30
-30
-60
-90
-120
-150
+P, +Δ
-P, -Δ
FAILURE
88 KIPS
102 KIPS
76.4 KIPS
36 ksi
50.6 KIPS
24 ksi
109 KIPS
-4.5
-4.0
-3.5
-3.0
-2.5
-2.0
-1.5
-1.0
-0.5
0.5
1.0
1.5
2.0
2.5
TIP DEFLECTION-IN.
W24 x 76
7- 1" BOLTS


W24 x 76 -- 7-1" BOLTS


W18 x 50 -- 5-3/4" BOLTS


Brittle Fracture at Bottom Flange Weld
M_p
M_p
Pre-Northridge Connection
Bending Moment (kN-m)
5000
4000
3000
2000
1000
0
-1000
-2000
-3000
-4000
-5000
-0.04
-0.03
-0.02
-0.01
0
0.01
0.02
0.03
0.04
Drift Angle (rad)

1994 Northridge Depremi

Değişik göçme mekanizmalarıyla karşılaşılmıştır

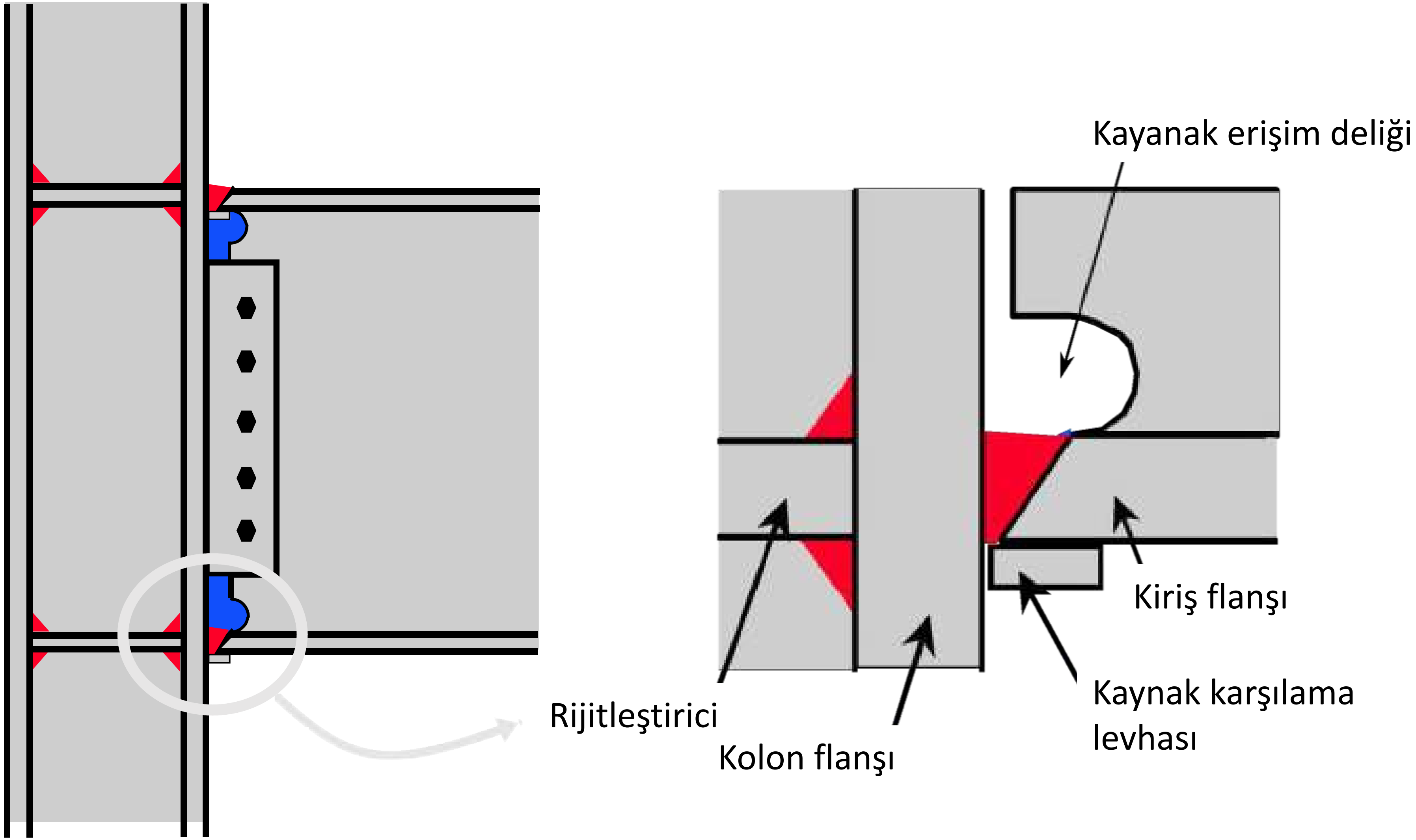
1994 Northridge Depremi

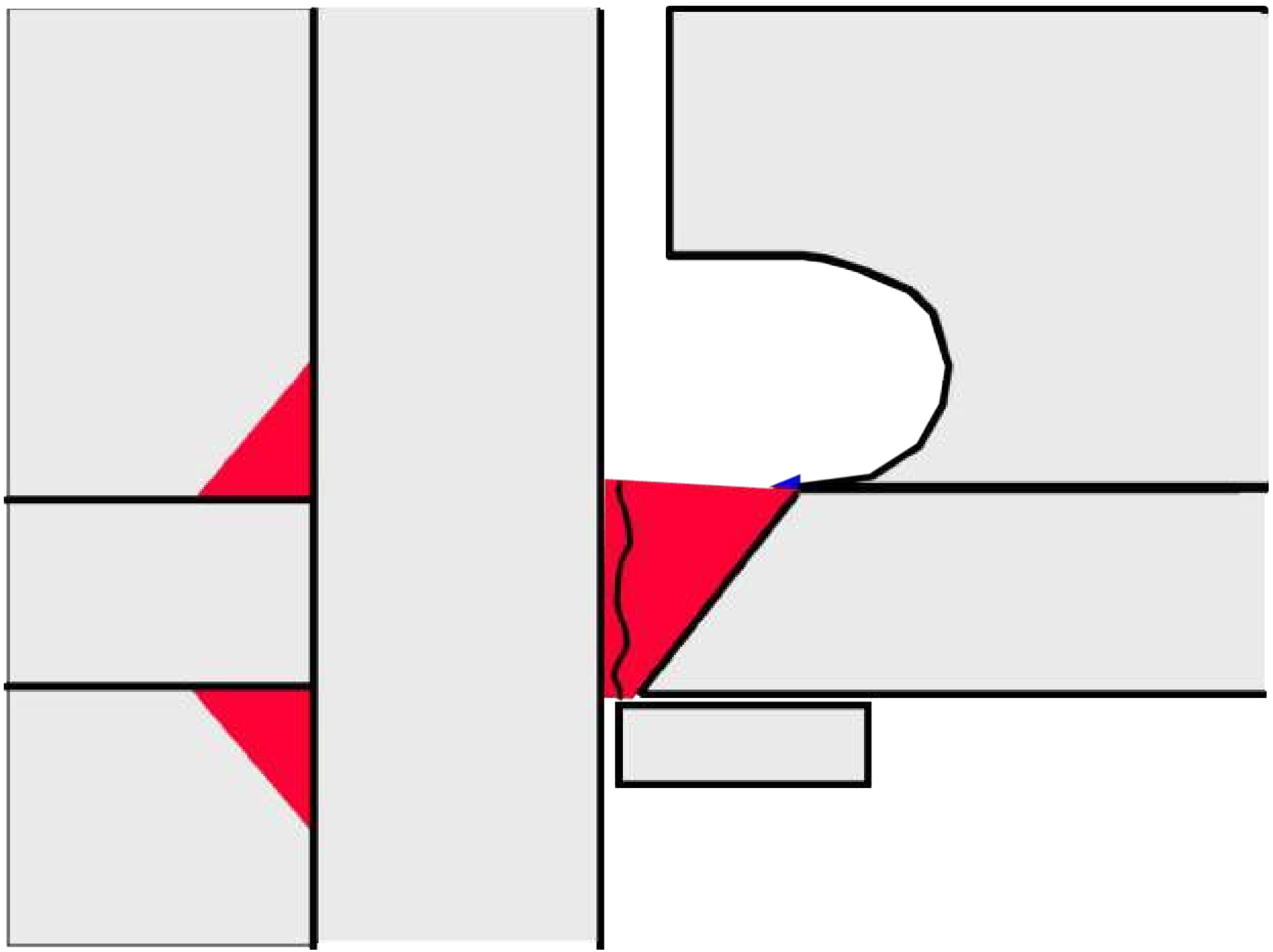
- Ocak 17, 1994
- Magnitude = 6.8
- Epicenter : Northridge - San Fernando Valley
  (Los Angeles area)
- Ölüm: 58
- Yaklaşık hasar maliyeti: 20 Milyar $

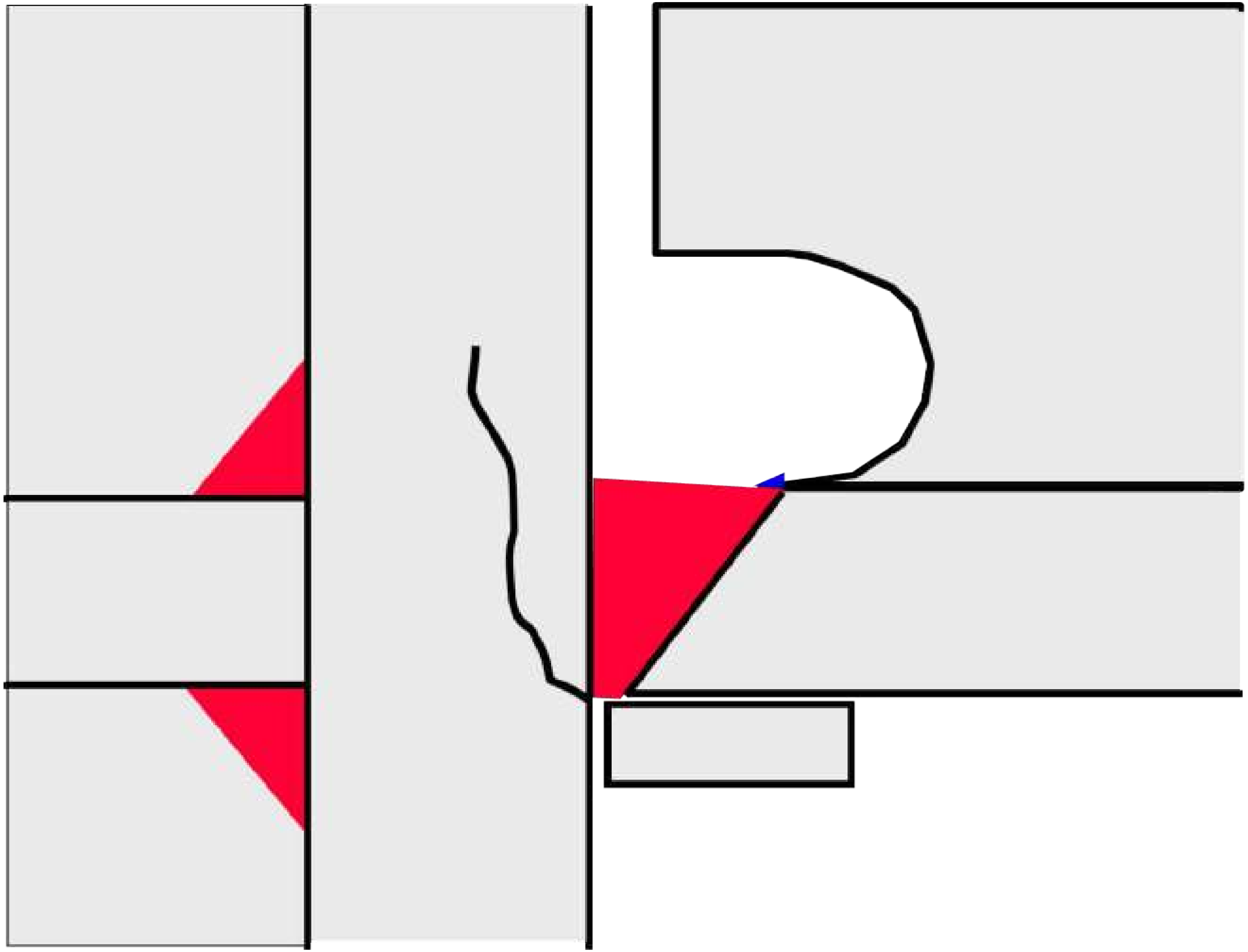
Northridge – yer ivmesi değerleri

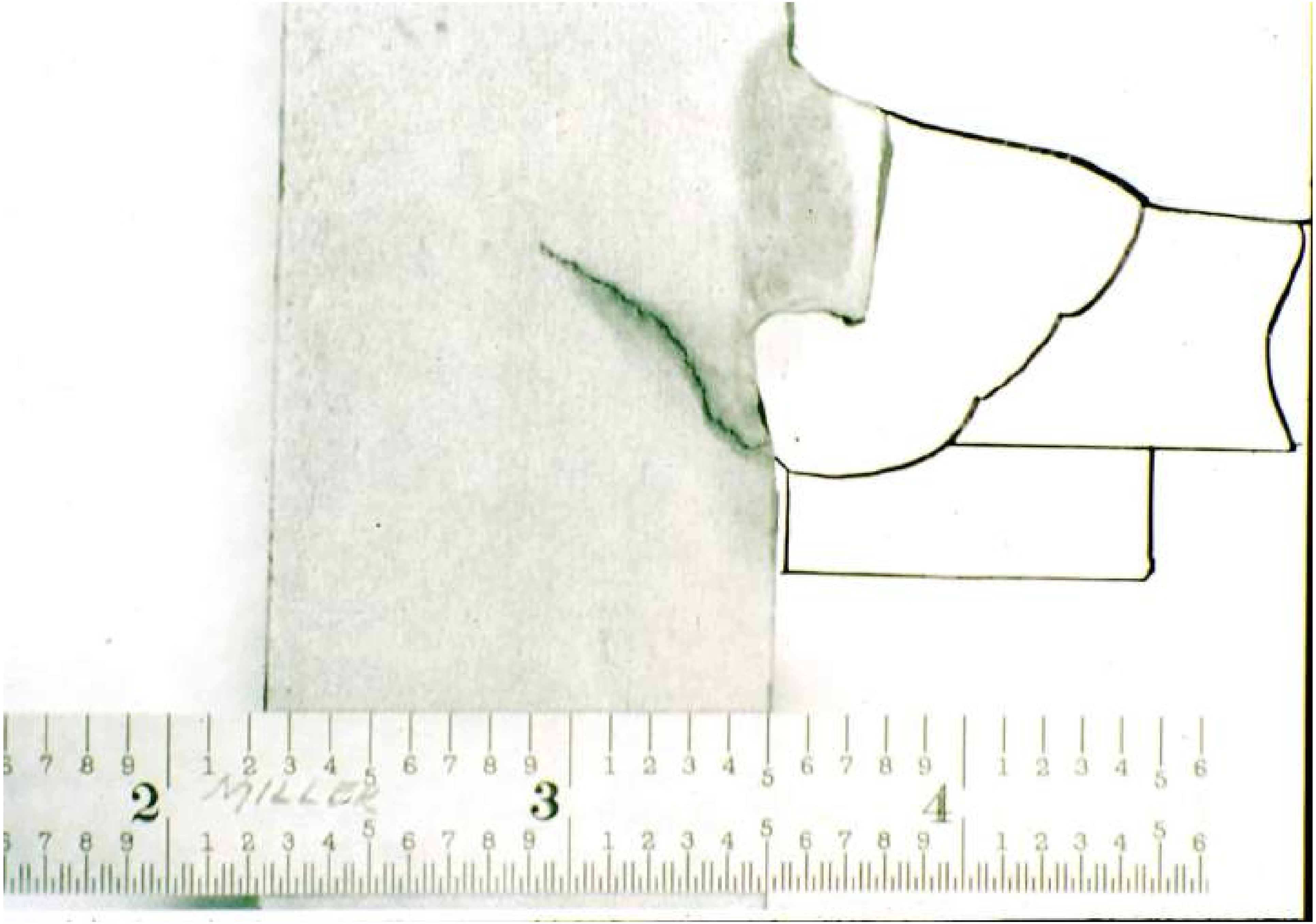
• Sylmar:	0.91g H	0.60g V
• Sherman Oaks:	0.46g H	0.18g V
• Granada Hills:	0.62g H	0.40g V
• Santa Monica:	0.93g H	0.25g V
• North Hollywood:	0.33g H	0.15g V

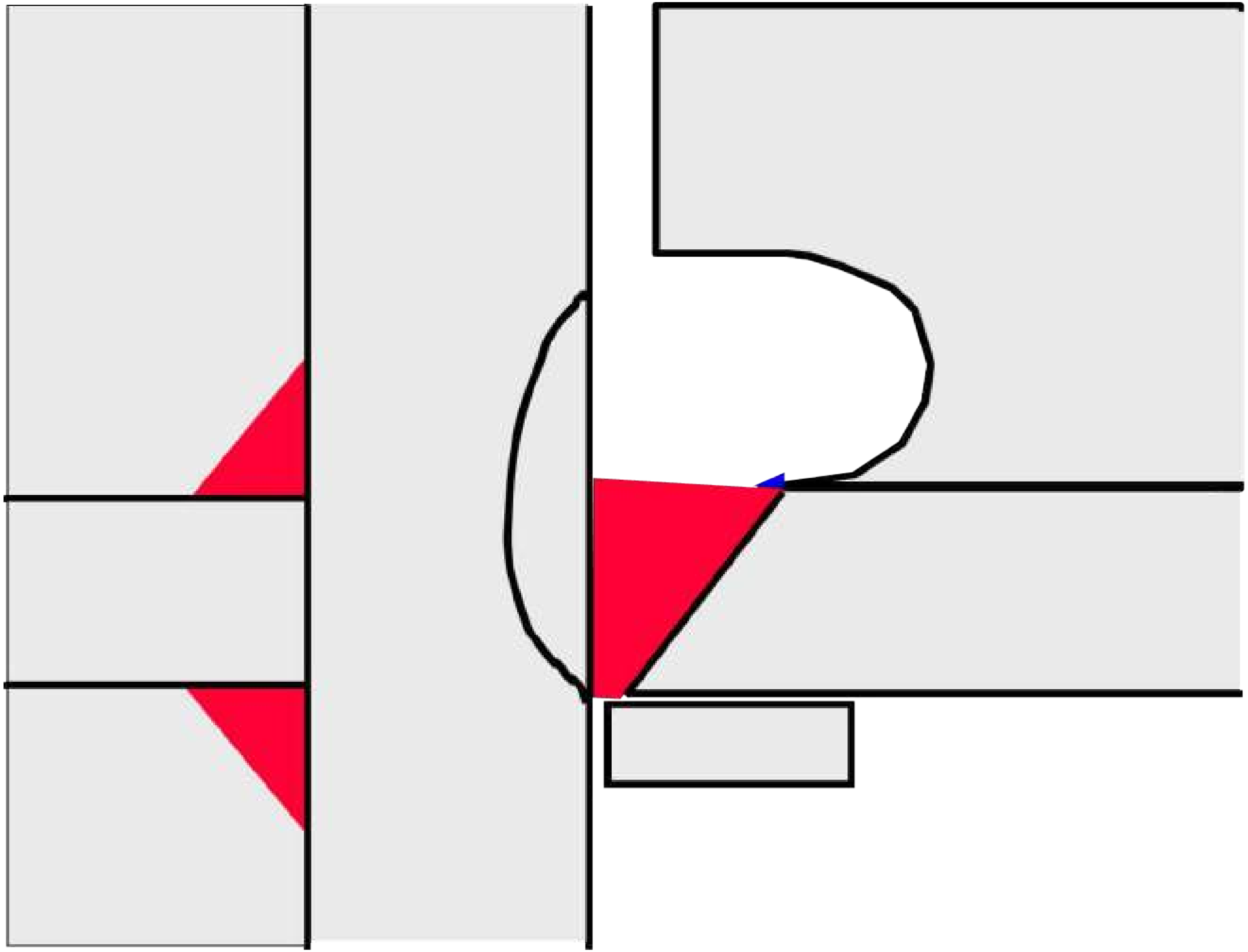

Northridge öncesi
Flanşlar kaynaklı gövde bulonlu moment birleşimi





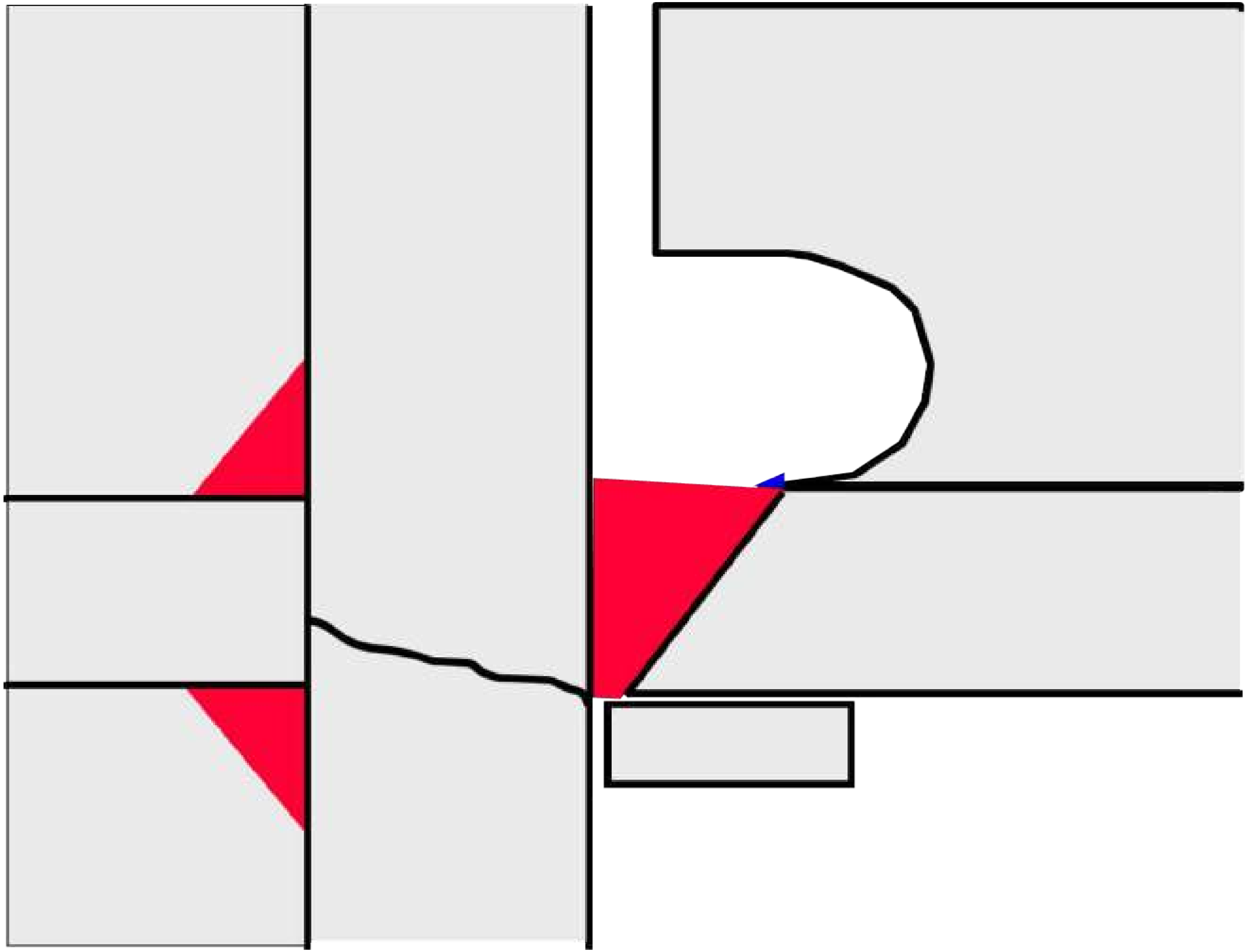


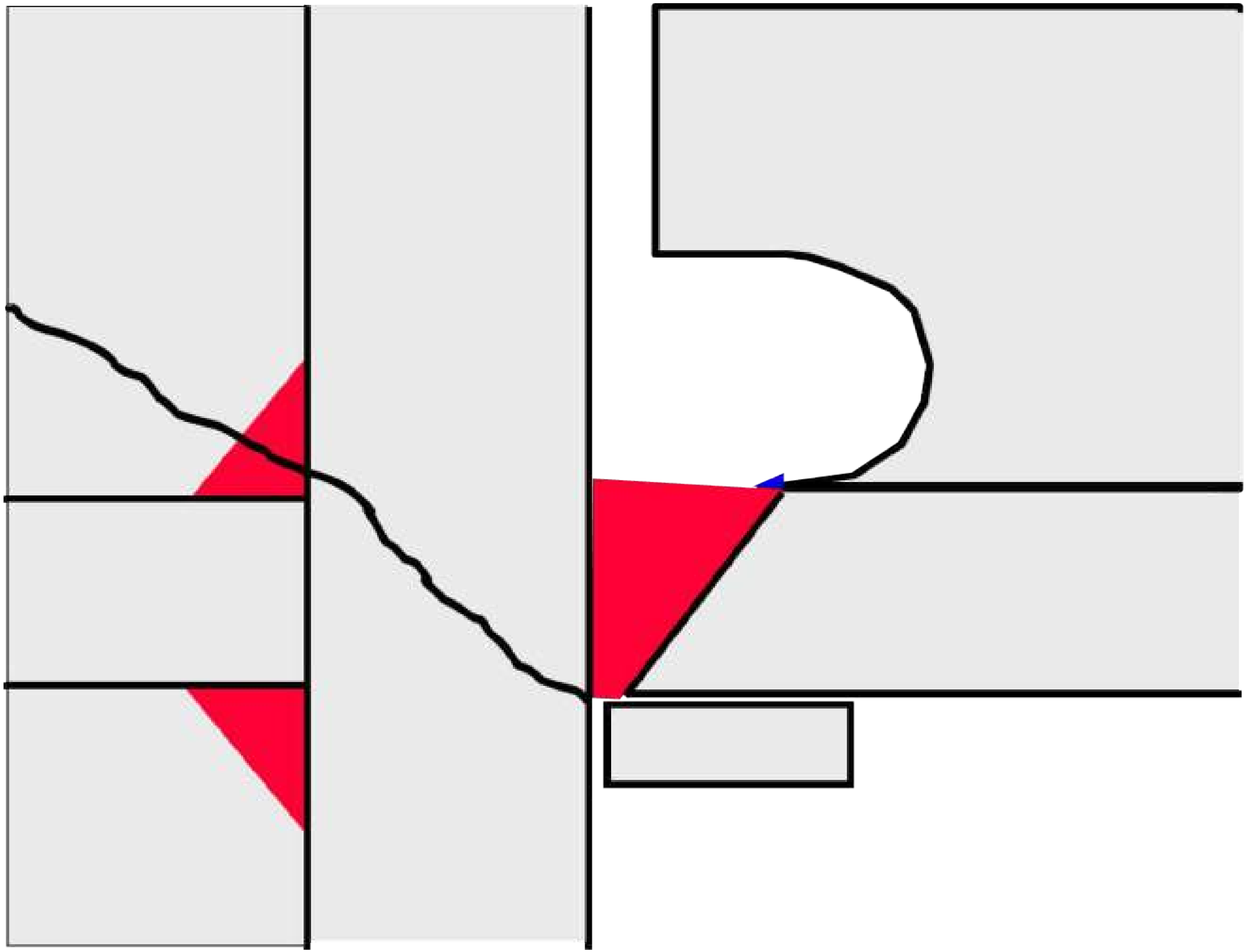

MILLER
2
3
4

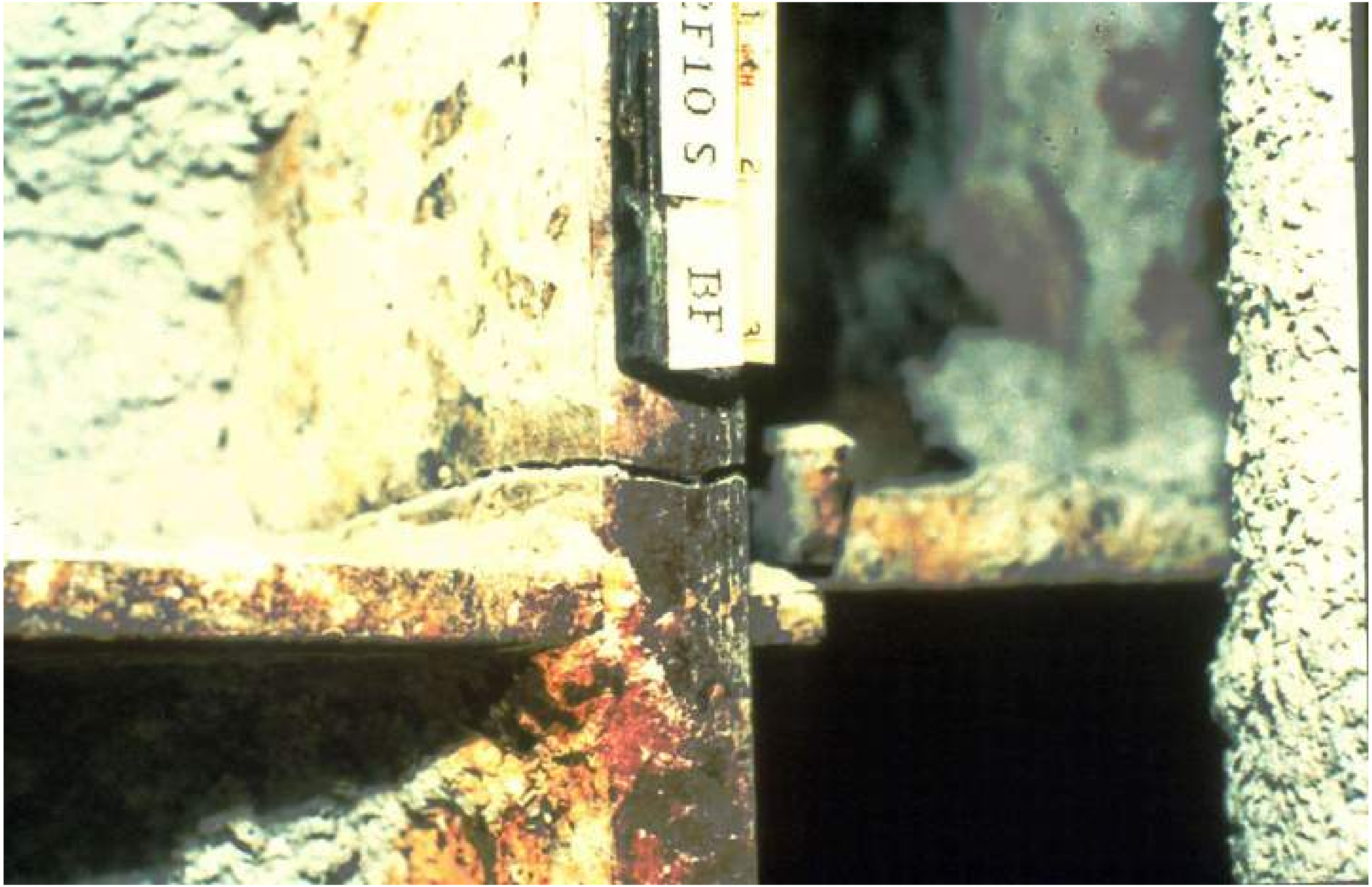



1M3 E BF


18

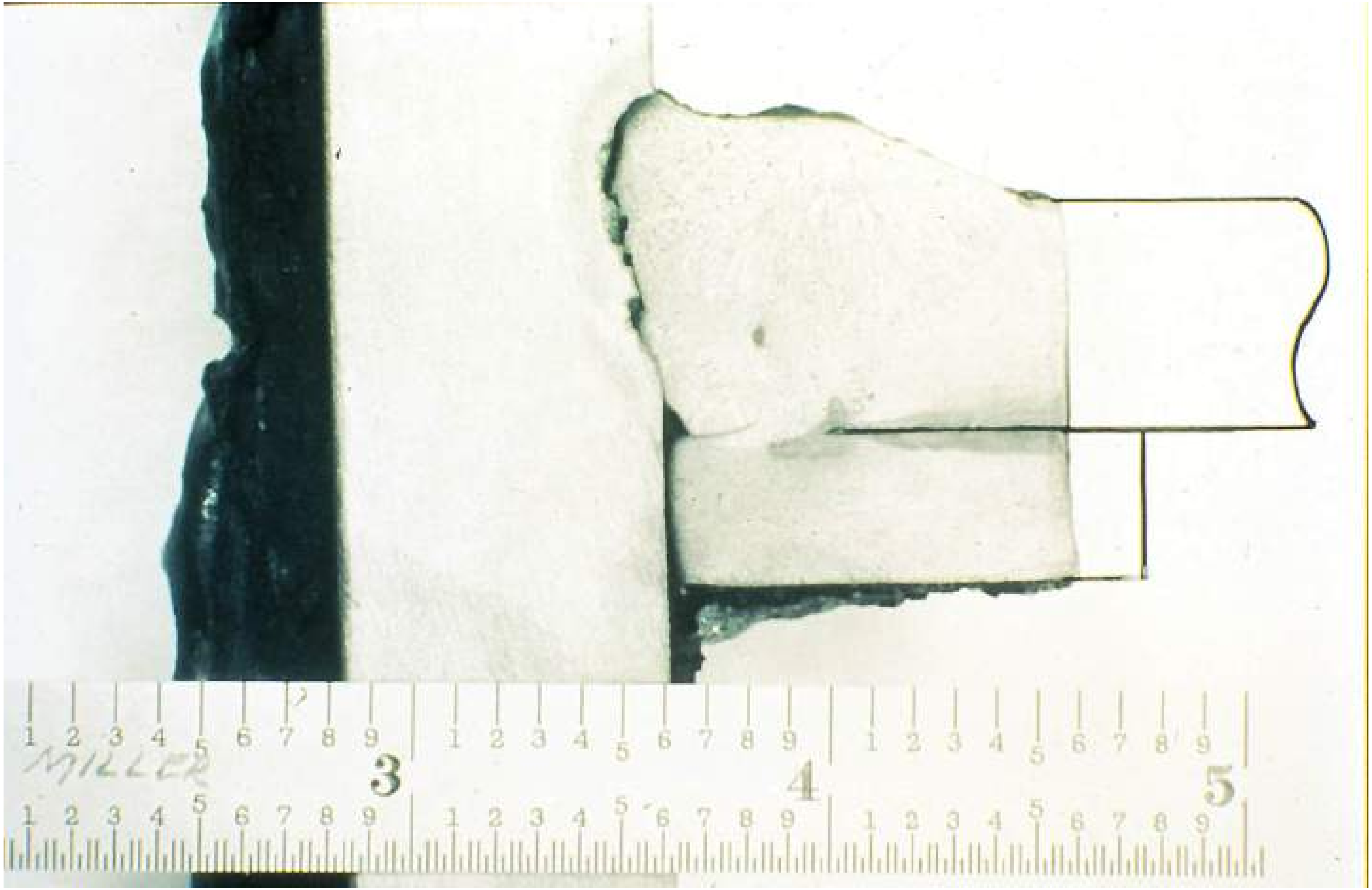




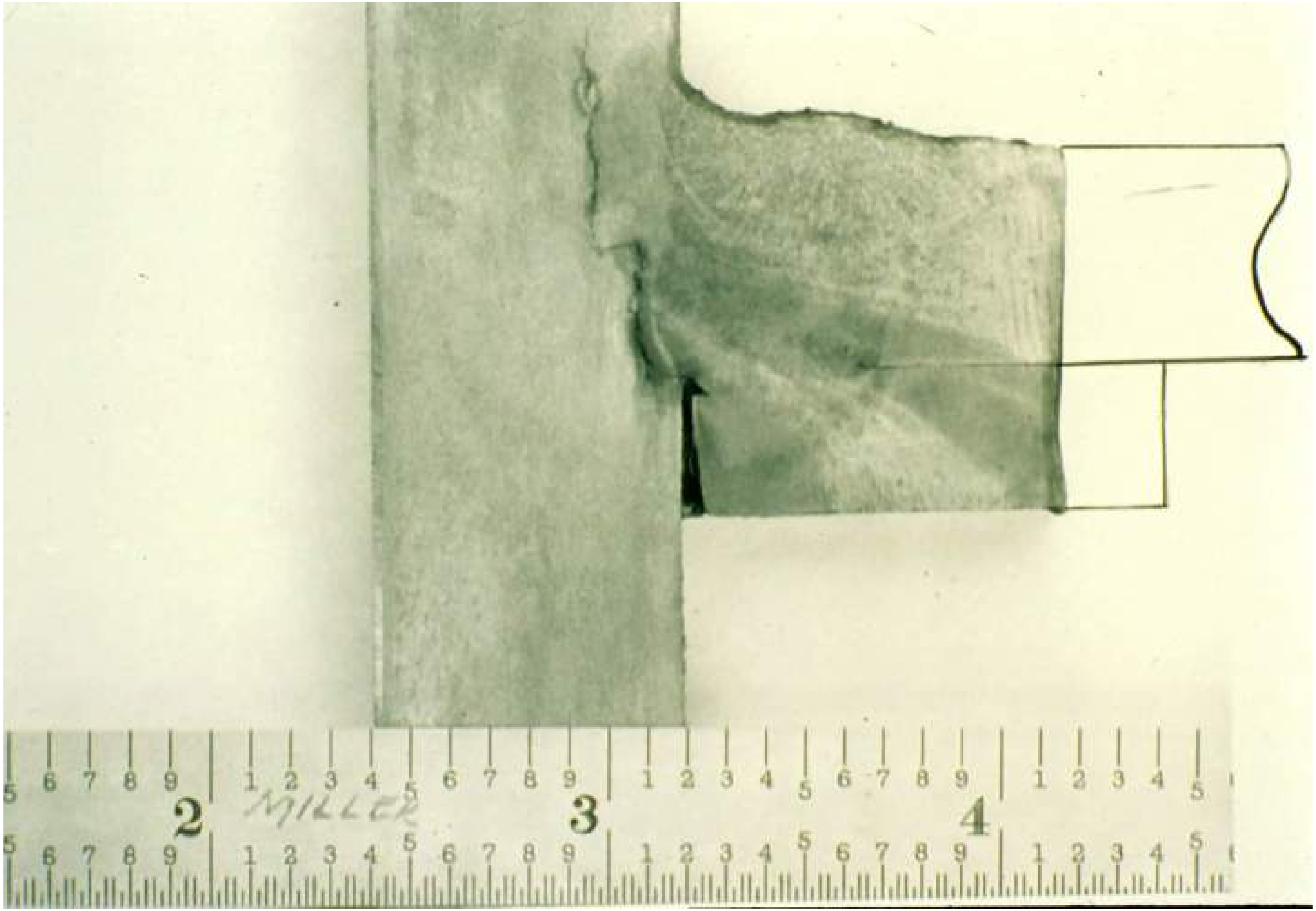

F10S
BF

Moment birleşimlerin deprem sırasında hasar görmesinin nedenleri

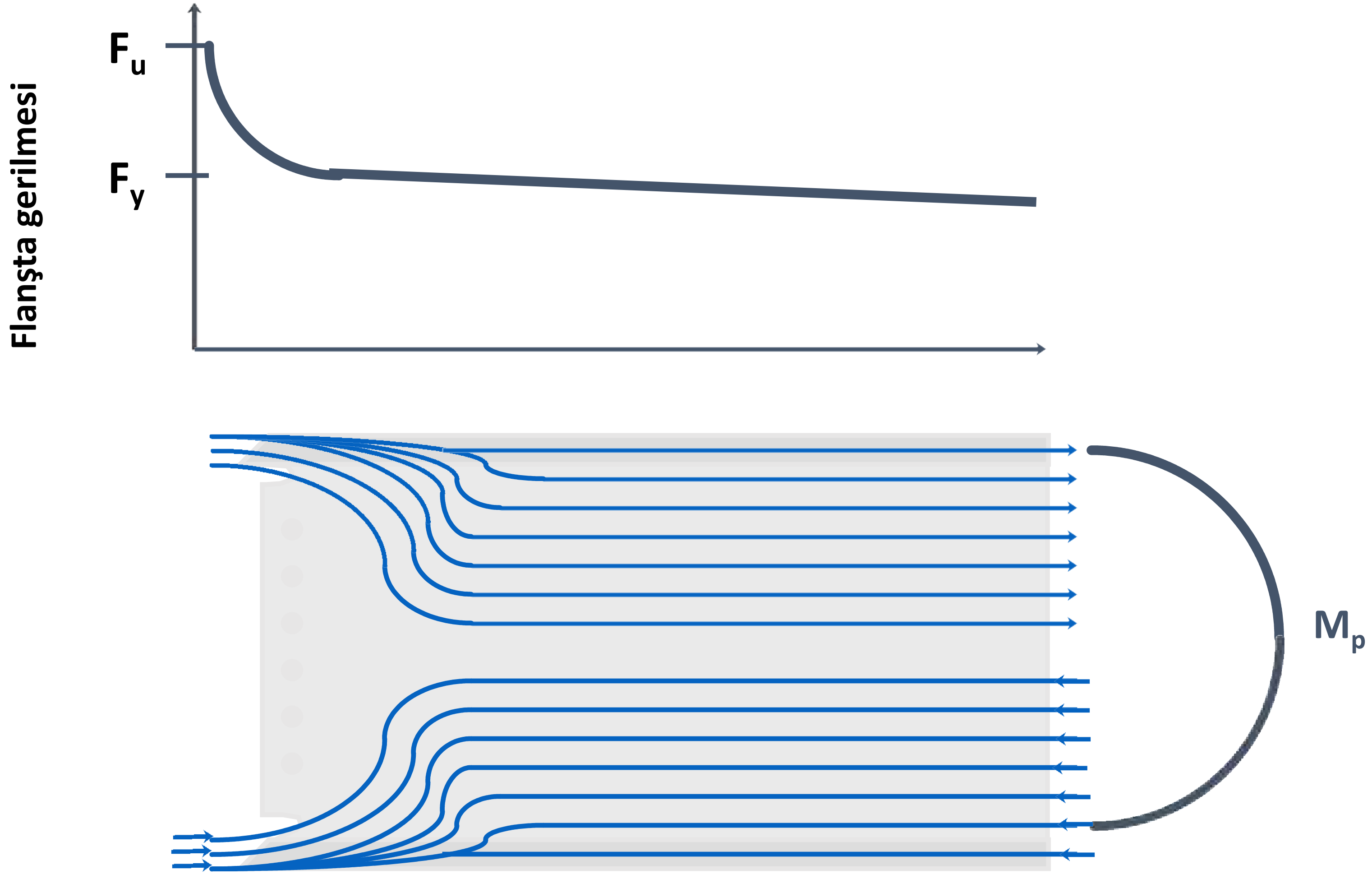
- kaynak
- Birleşimin boyutlandırılması
- malzeme



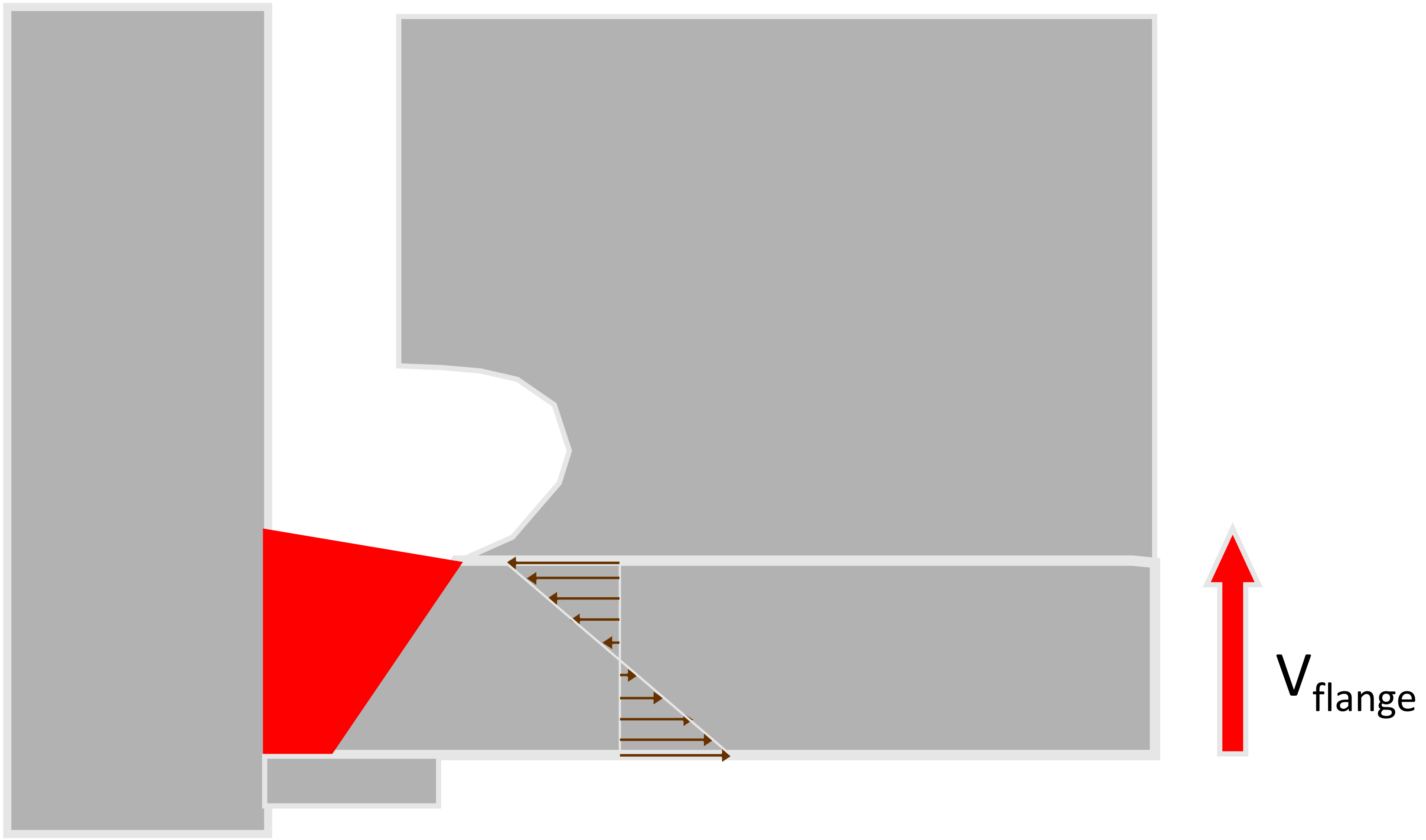
MILLER
3
4
5

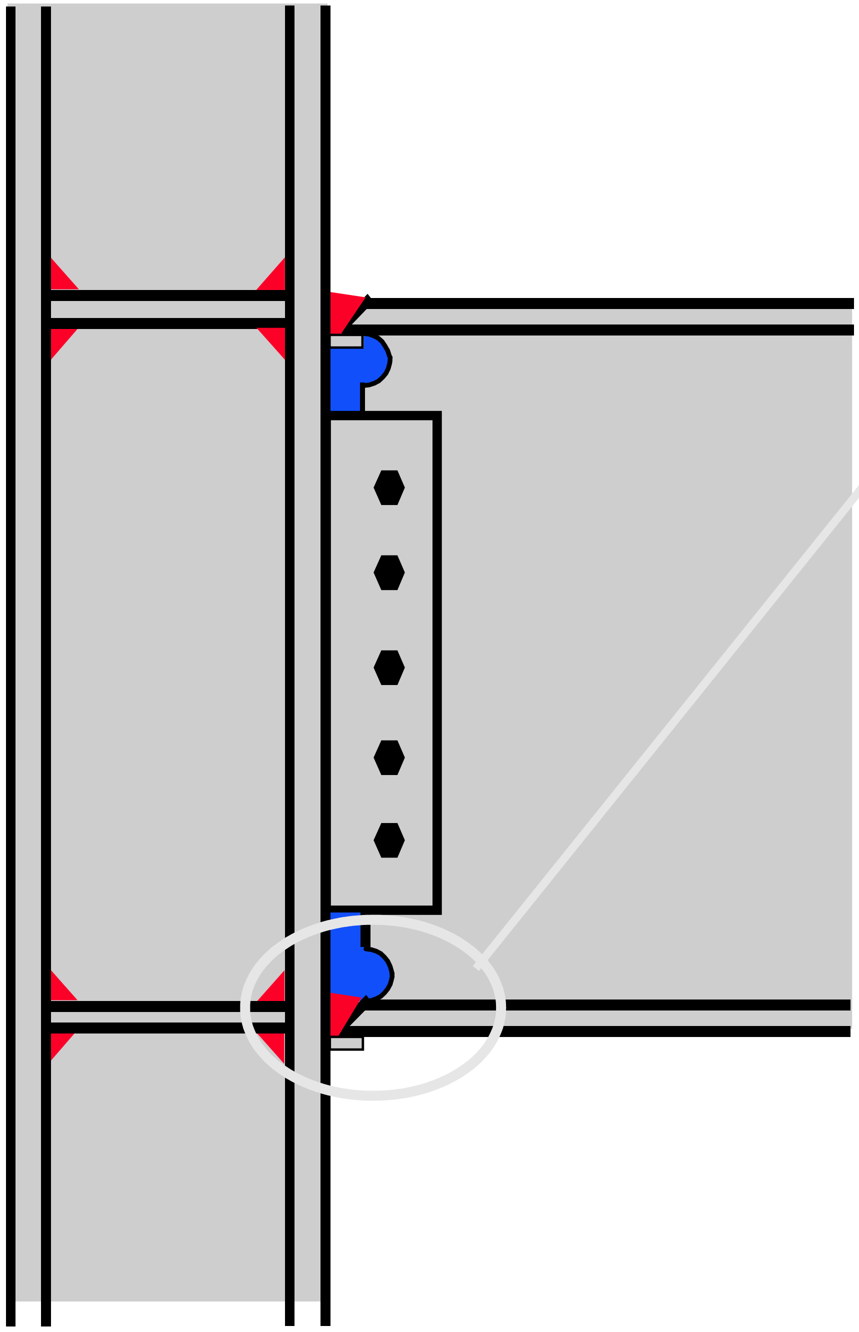

MILLER
2
3
4


12 3 '98



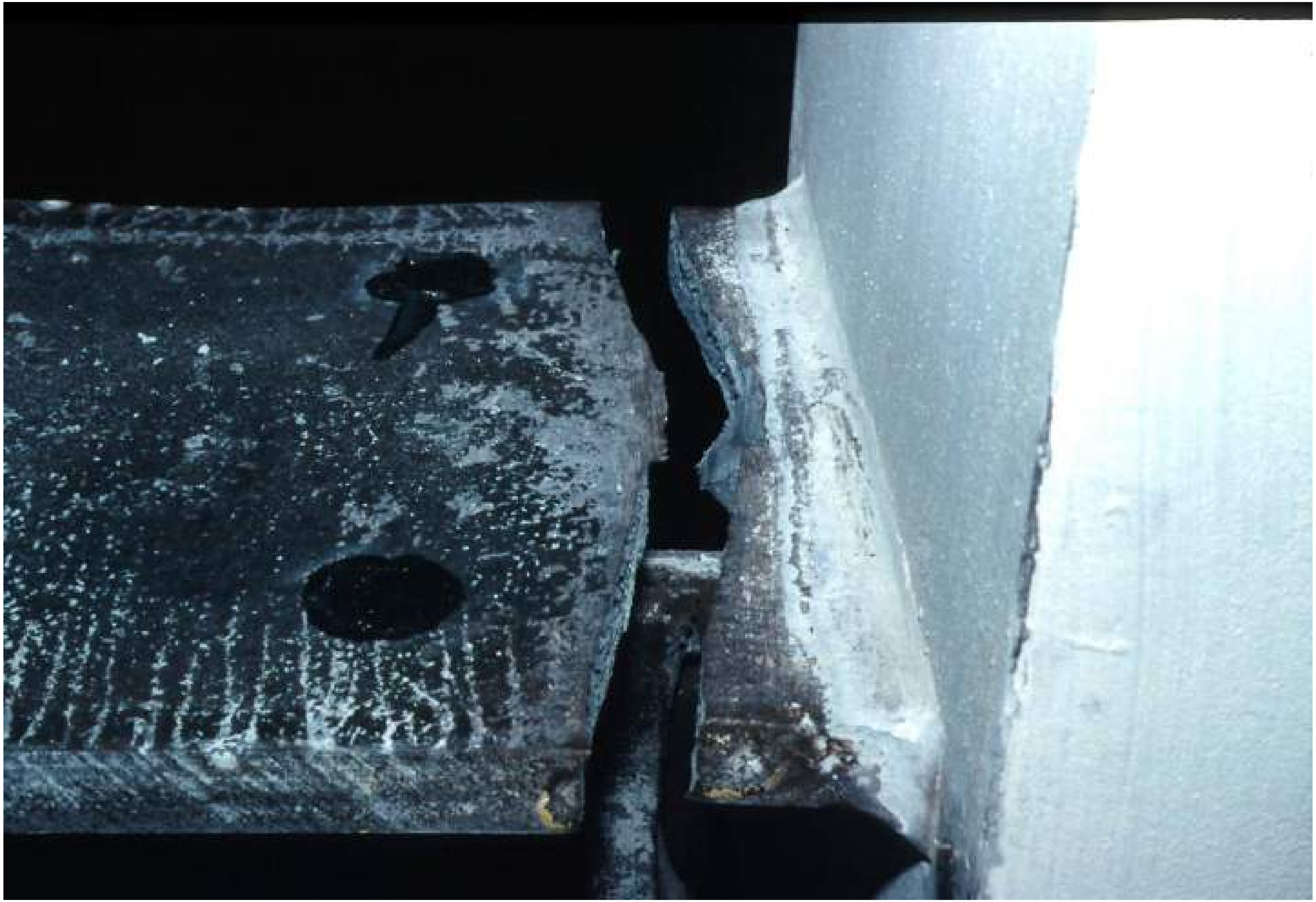
Flanşta gerilmenin artışı

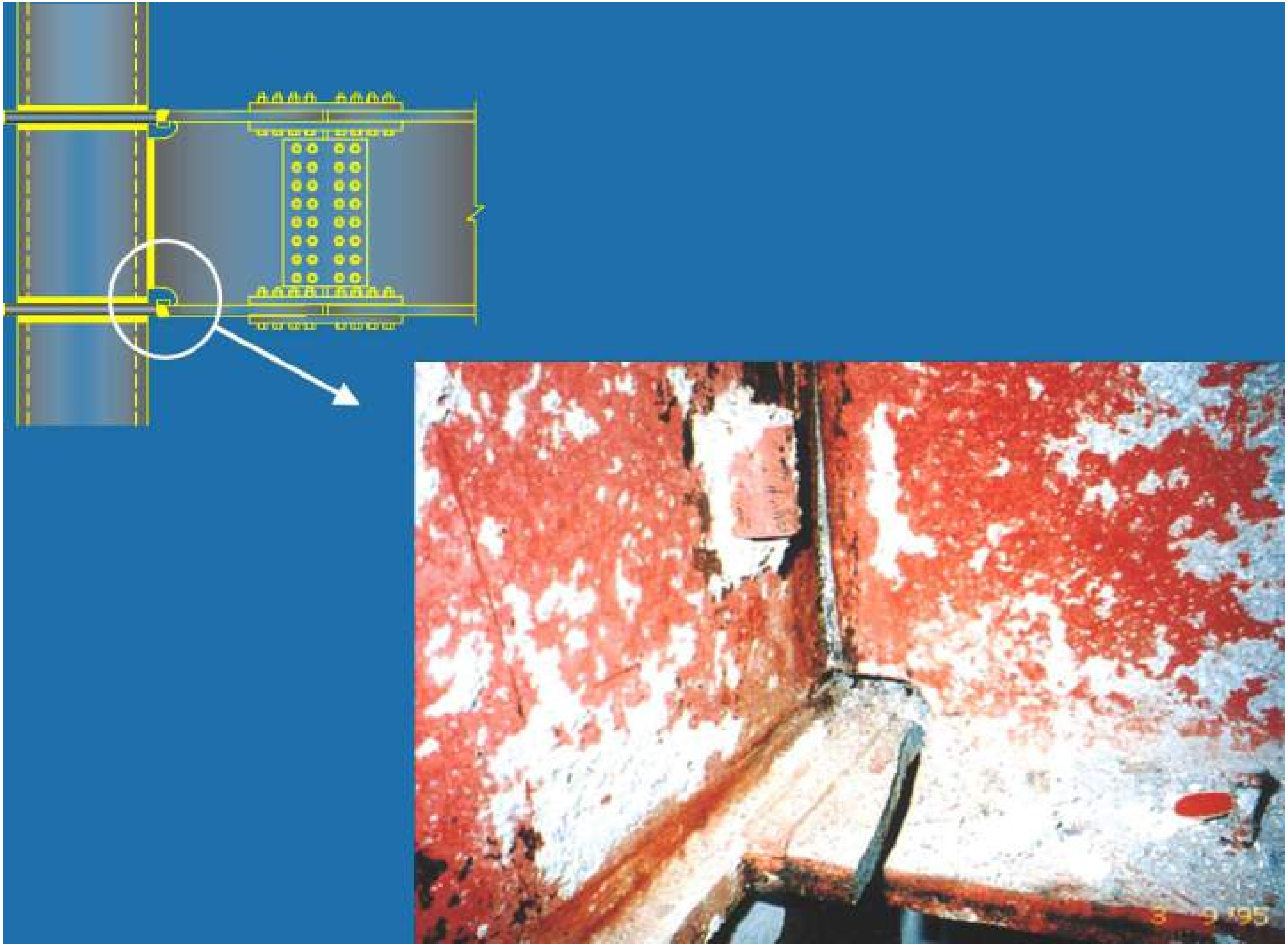

V_{flange}



Gerilme konsantrasyonu:

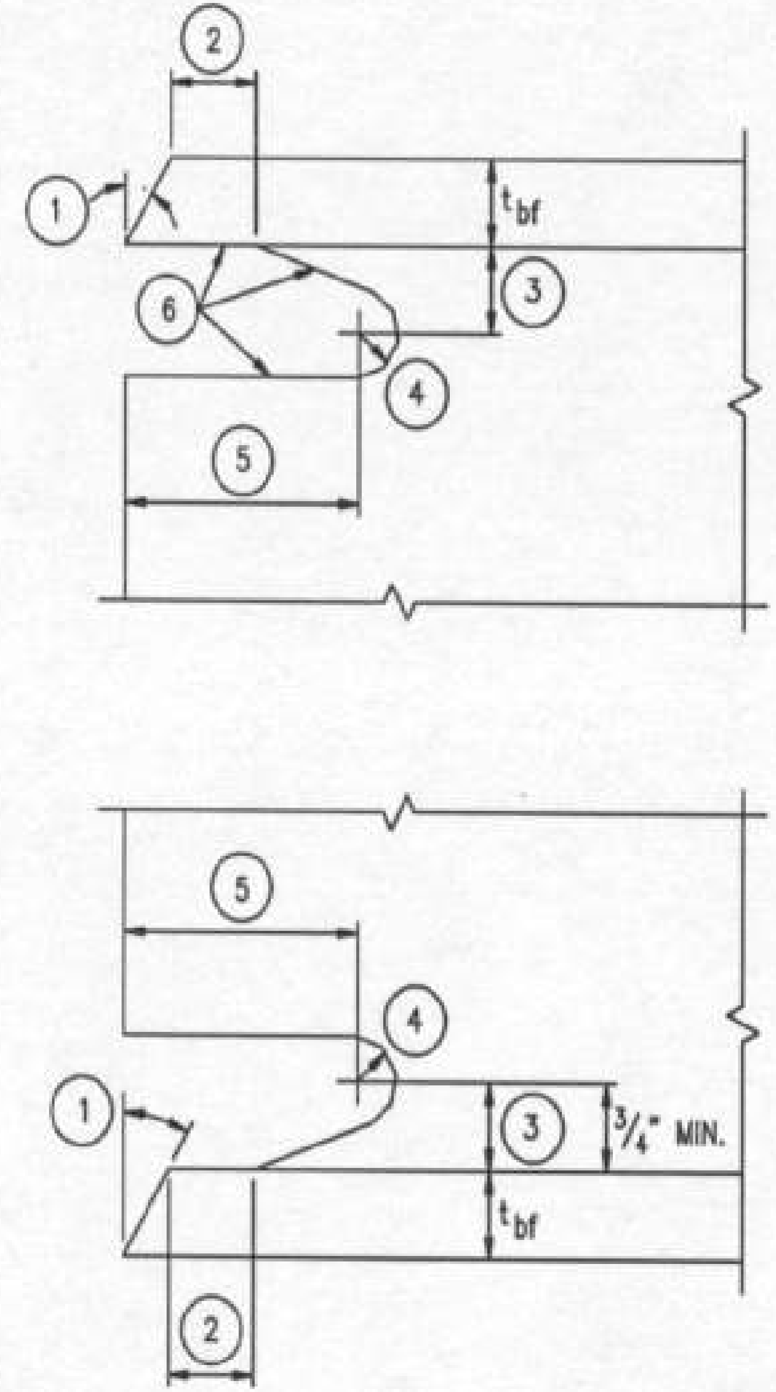
- **Kaynak erişim deliği**
- **Flanştaki kayma kuvveti**
- **Gövdenin eğilmeye momentinin taşınmasına katılımının az olması**

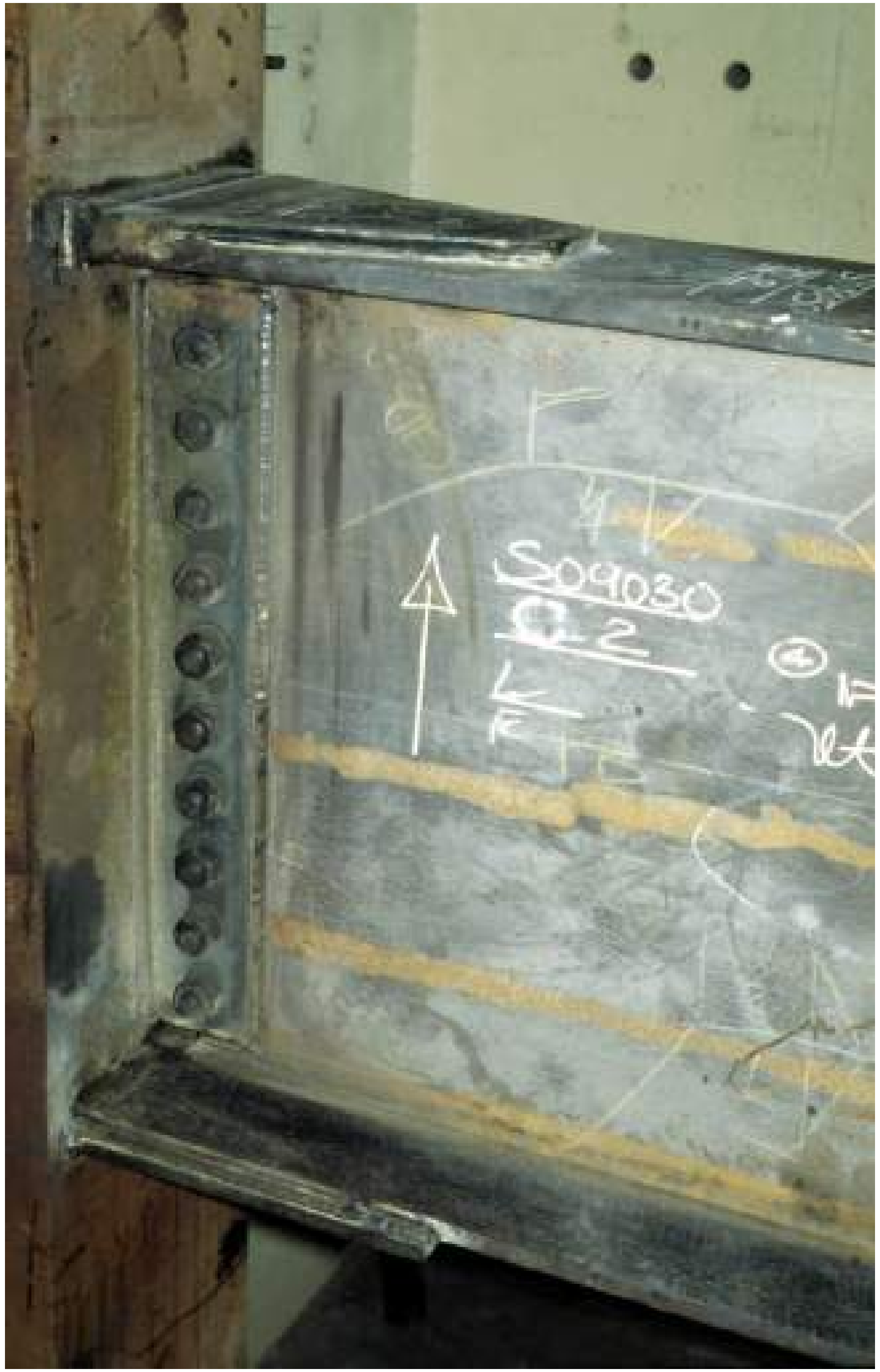


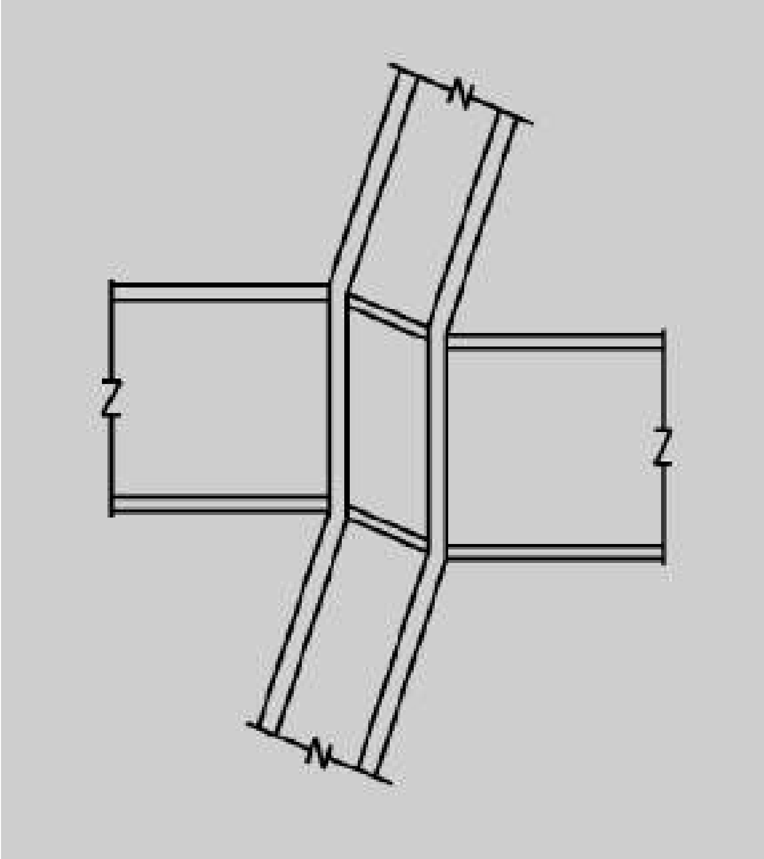


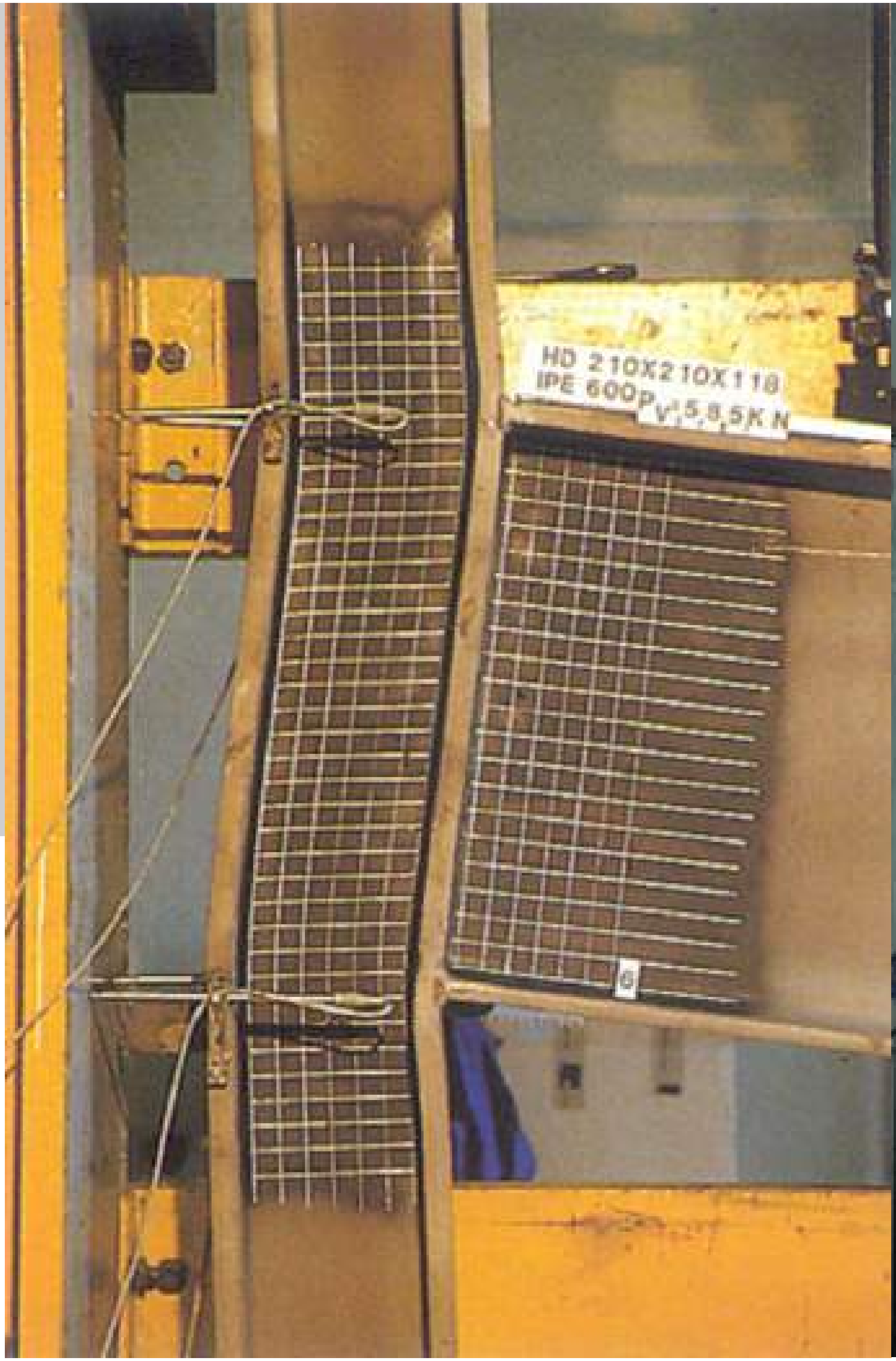
Moment birleşimlerin performansının arttırılması

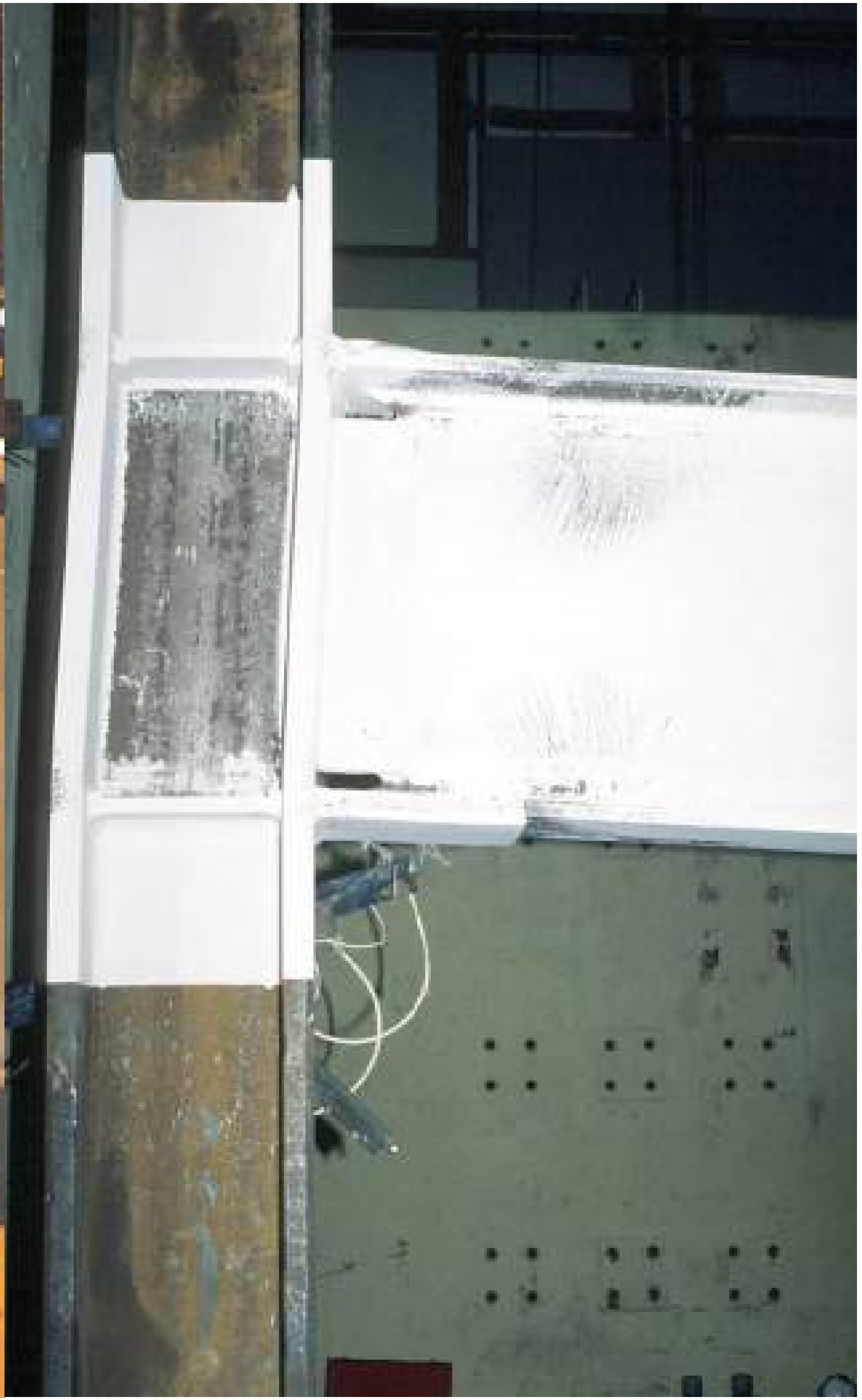
- Kaynak : değişik ısılarda CVN ve kaynakta iyileştirme
- Malzeme : CVN, kaynaklanabilirlik, muhtemel akma ve kapma gerilmelari
- Boyutlama ve detay: birleşimde kaynak erişim deliği iyileştirmesi

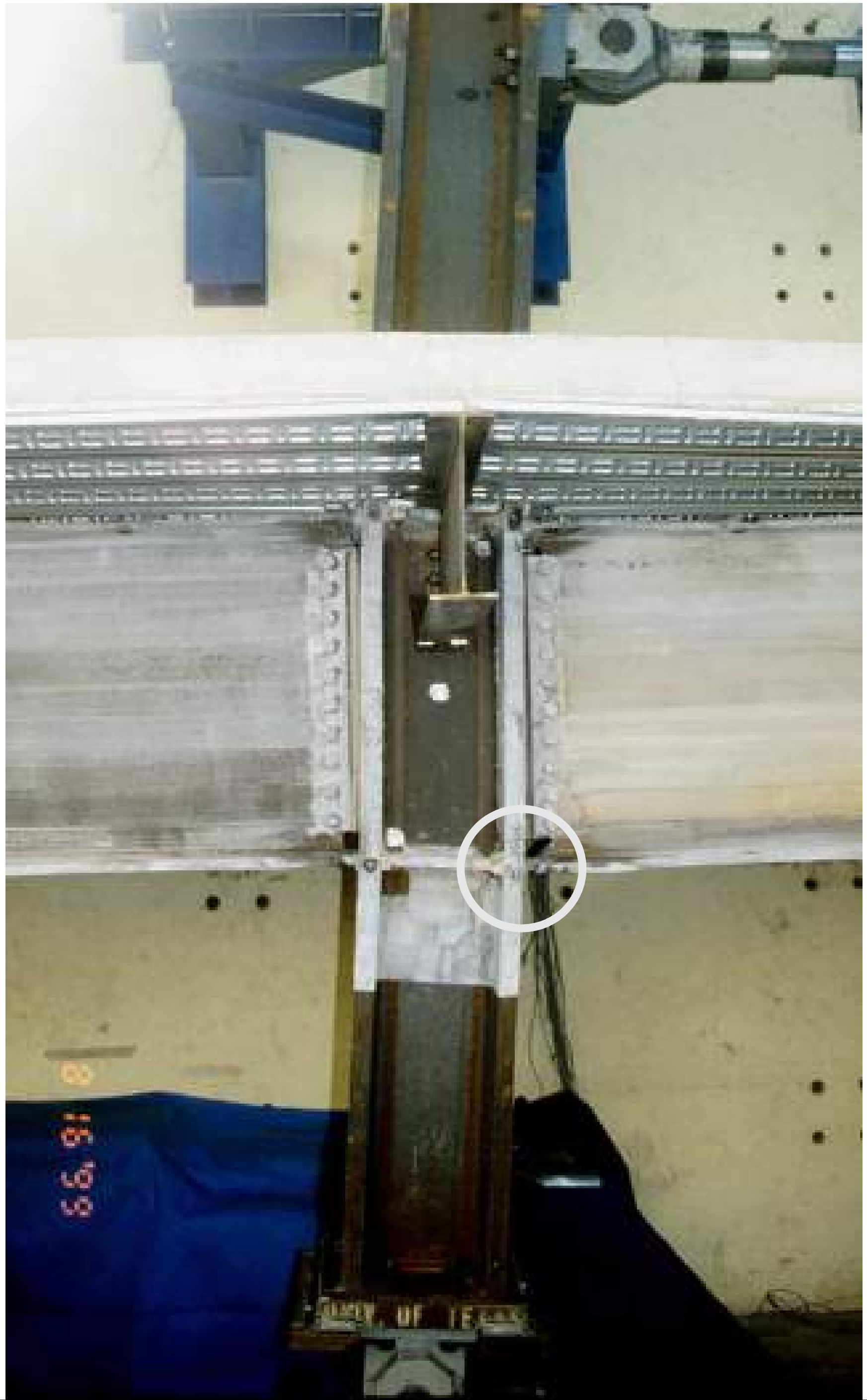

2
1
t_{bf}
6
3
4
5
5
4
1
3
3/4" MIN.
t_{bf}
2


S09030

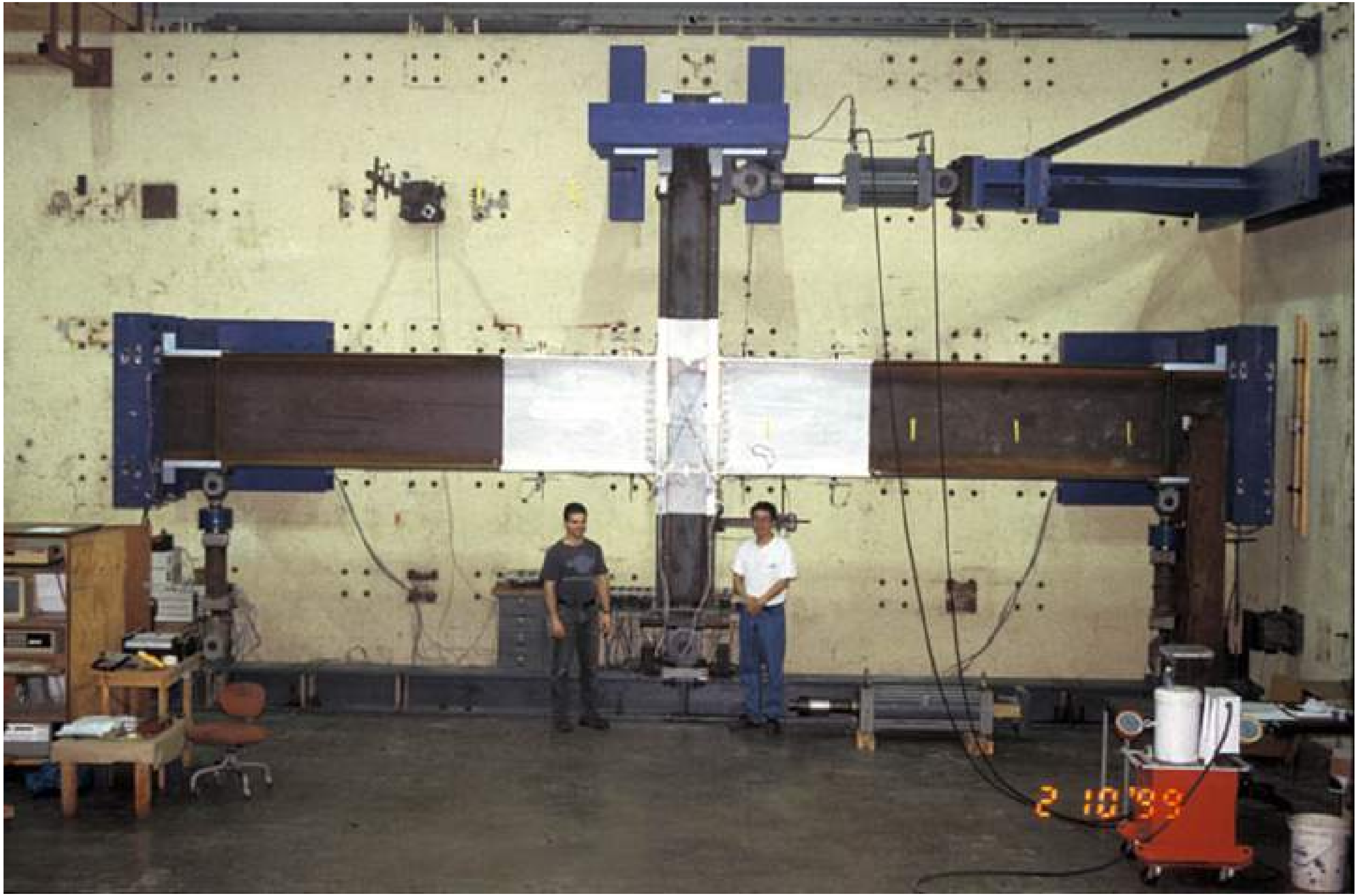


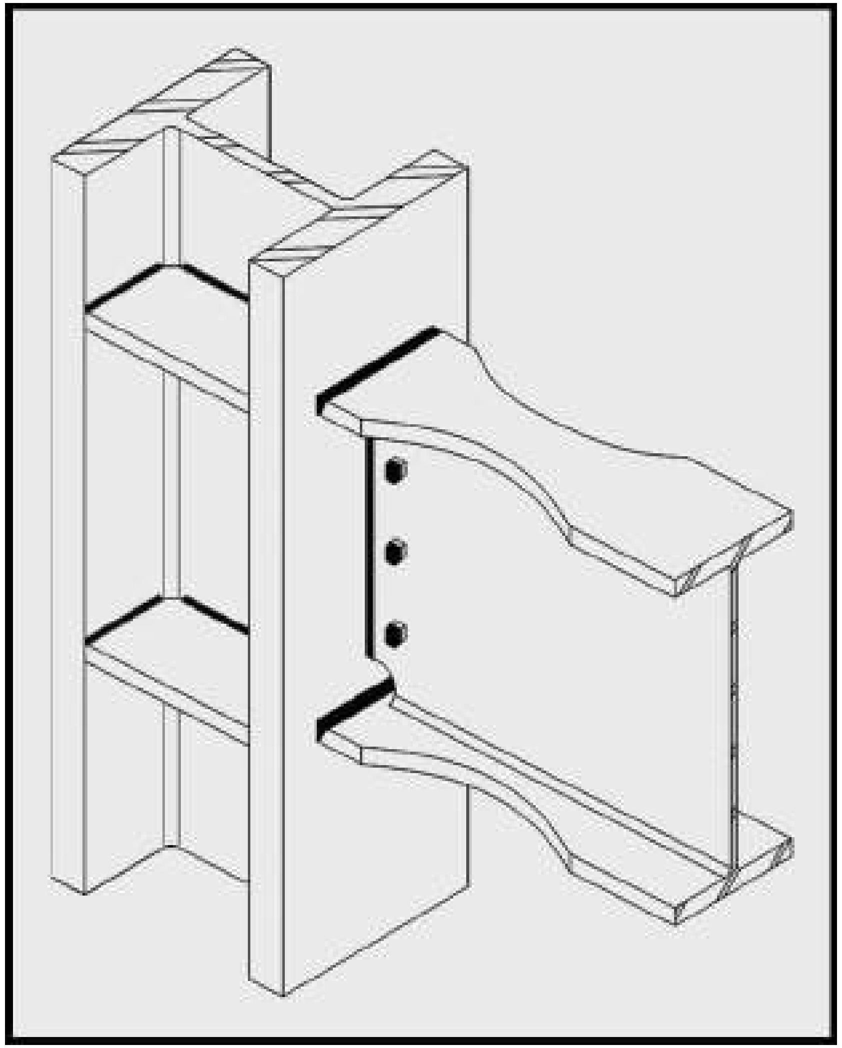

HD 210X210X118
IPE 600P

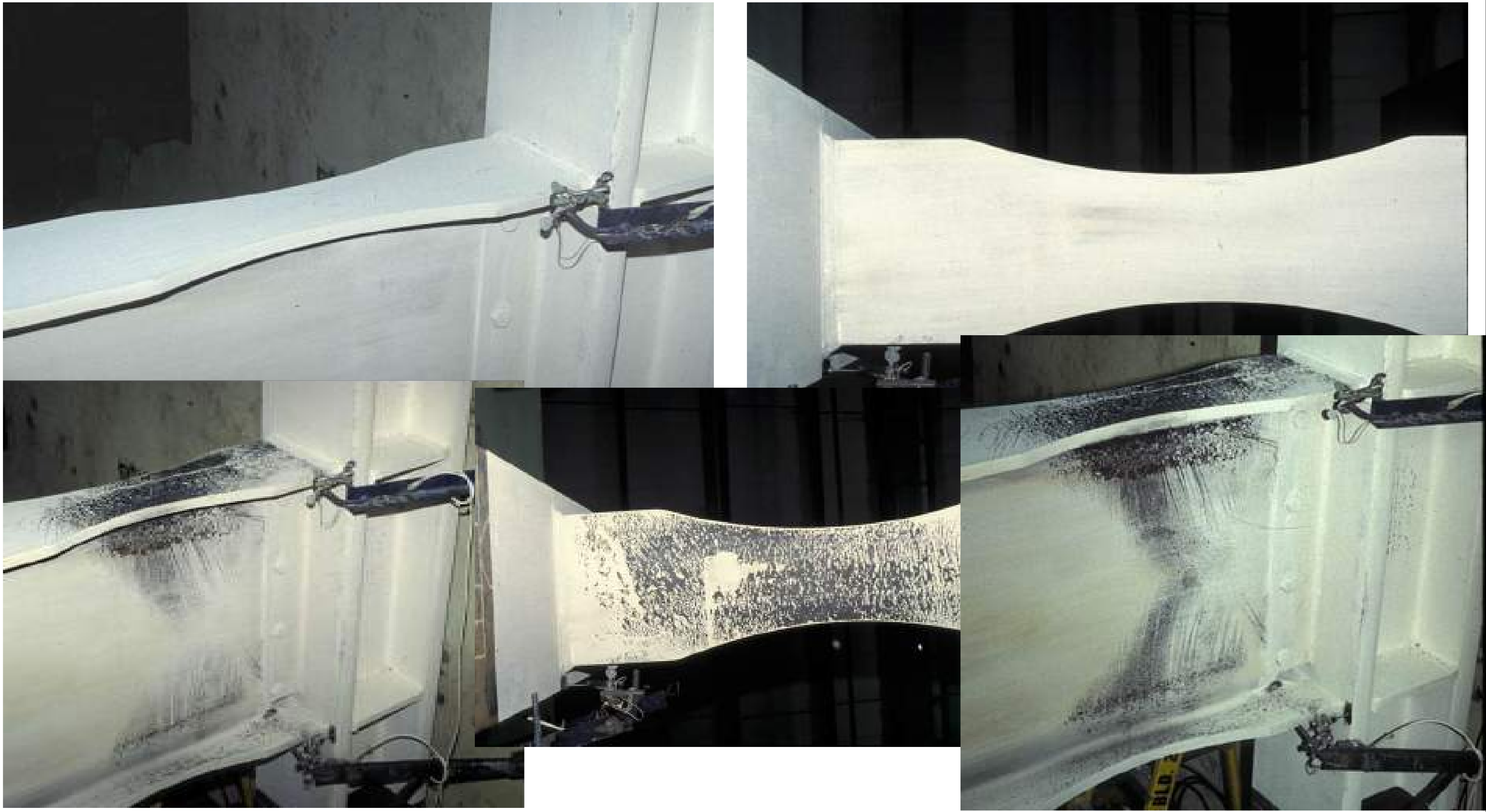


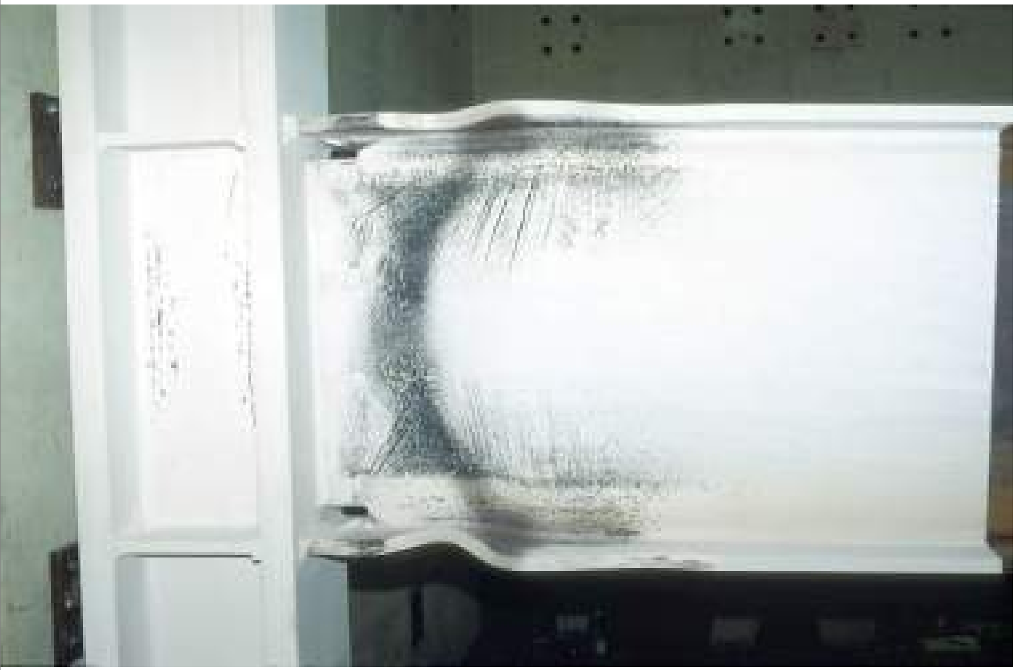


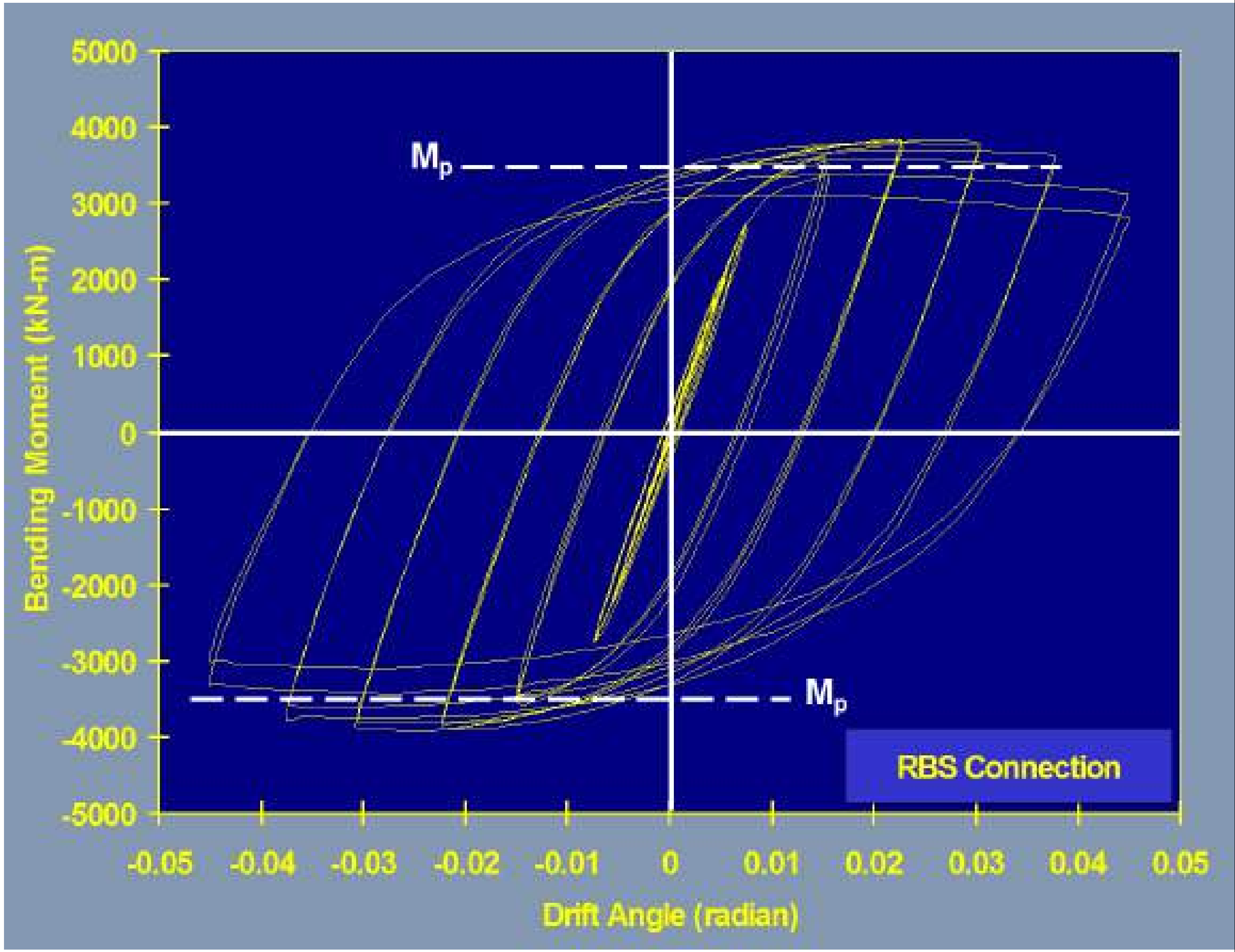

8 16 '99


2 10 '99





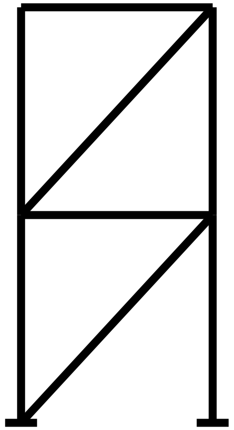


Bending Moment (kN-m)
5000
4000
3000
2000
1000
0
-1000
-2000
-3000
-4000
-5000
M_p
M_p
RBS Connection
-0.05
-0.04
-0.03
-0.02
-0.01
0
0.01
0.02
0.03
0.04
0.05
Drift Angle (radian)

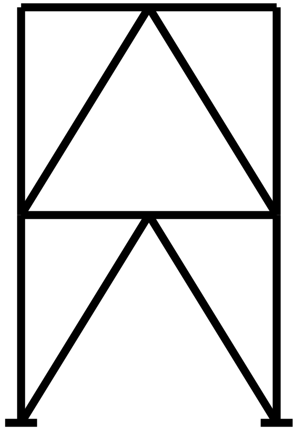

10 17 '97

Sünek Yapı Çelik Bina Tasarımı :
Merkezi Berkitilmiş sistemler

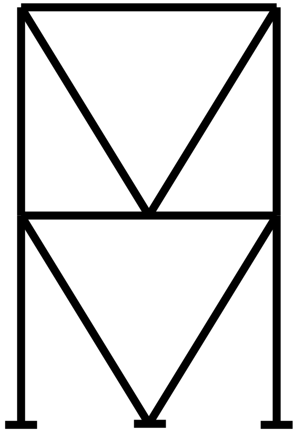
Merkezi berkitilmiş yapı tipleri



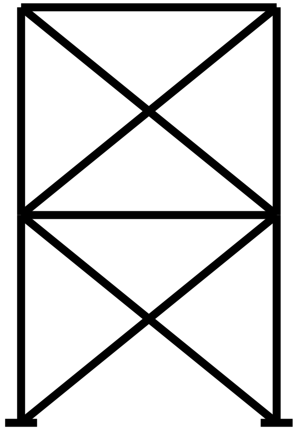
Tek diyagonal



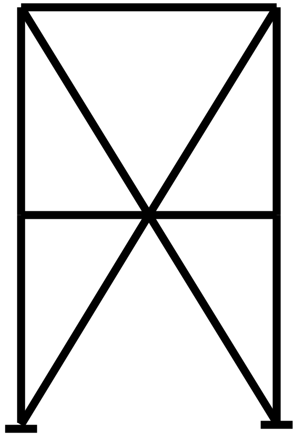
Ters V



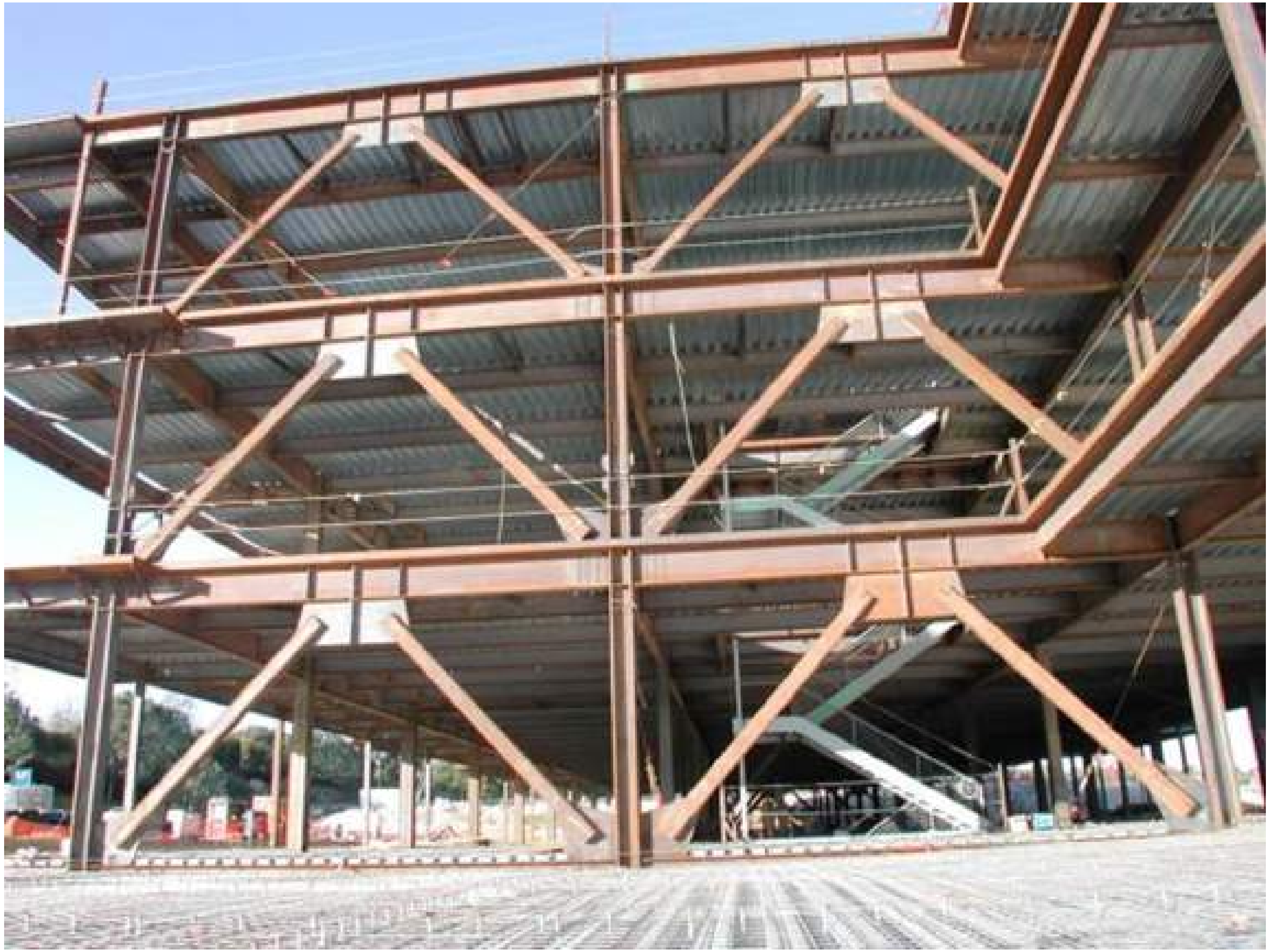
V berkitme



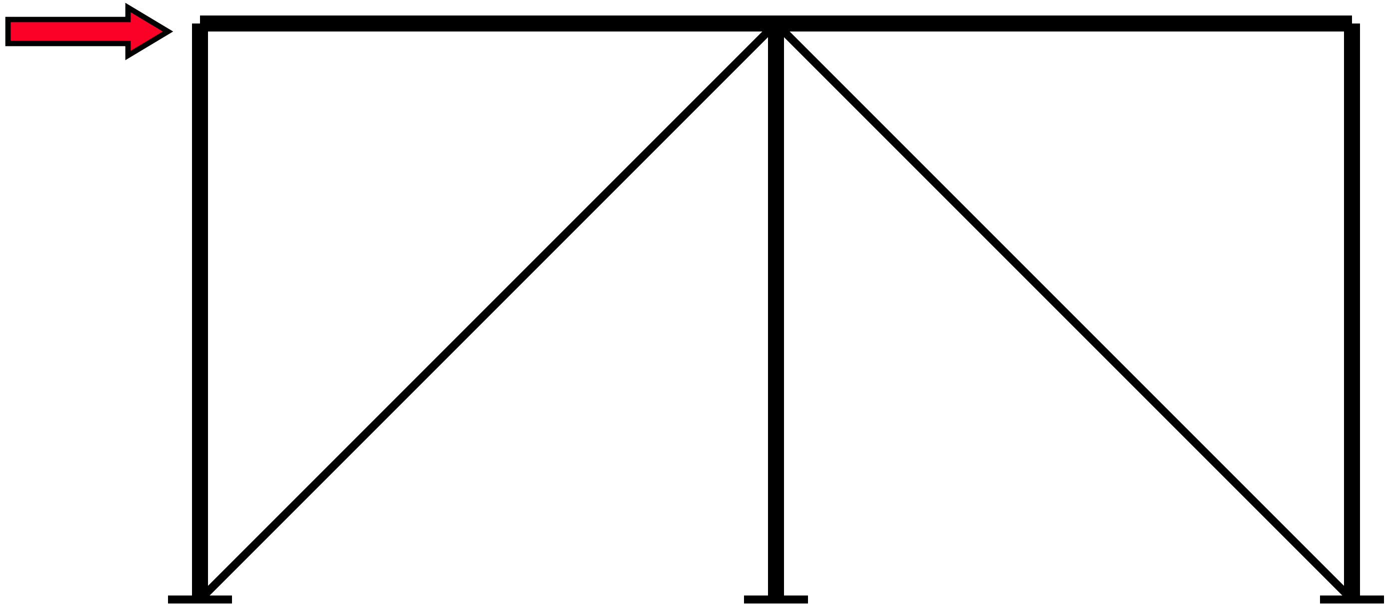
X- Berkitme

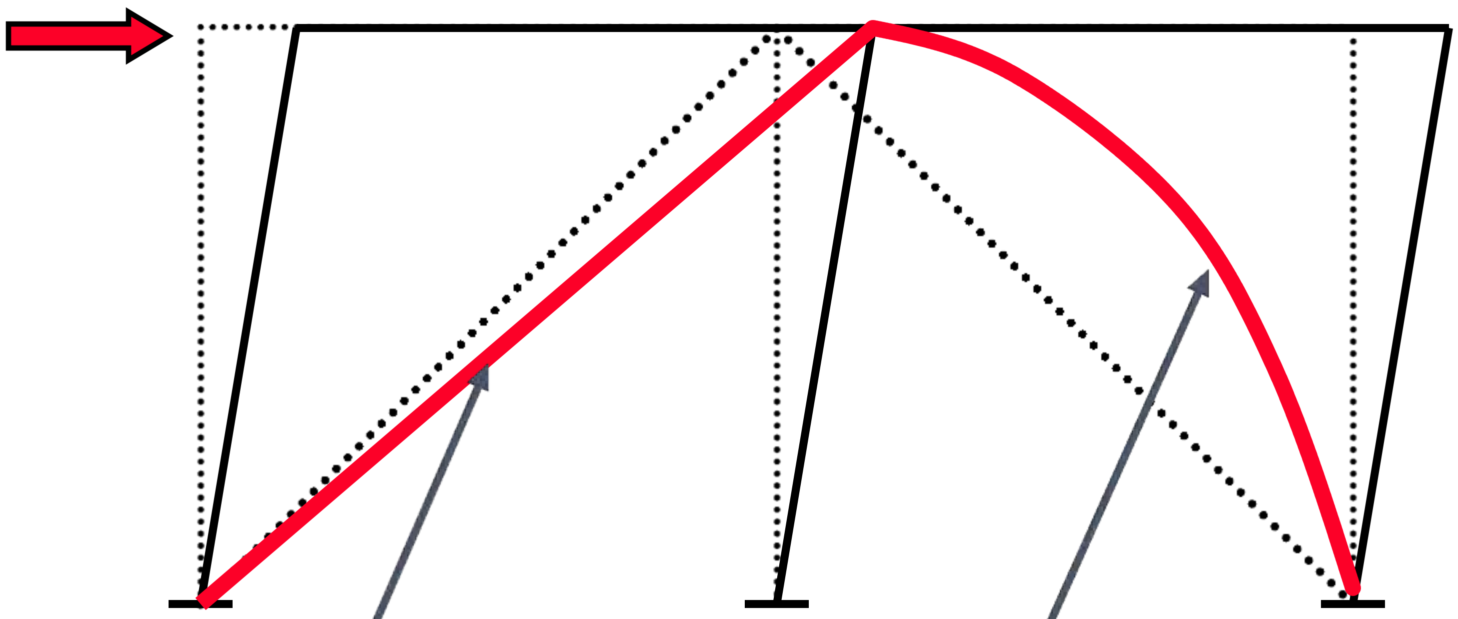


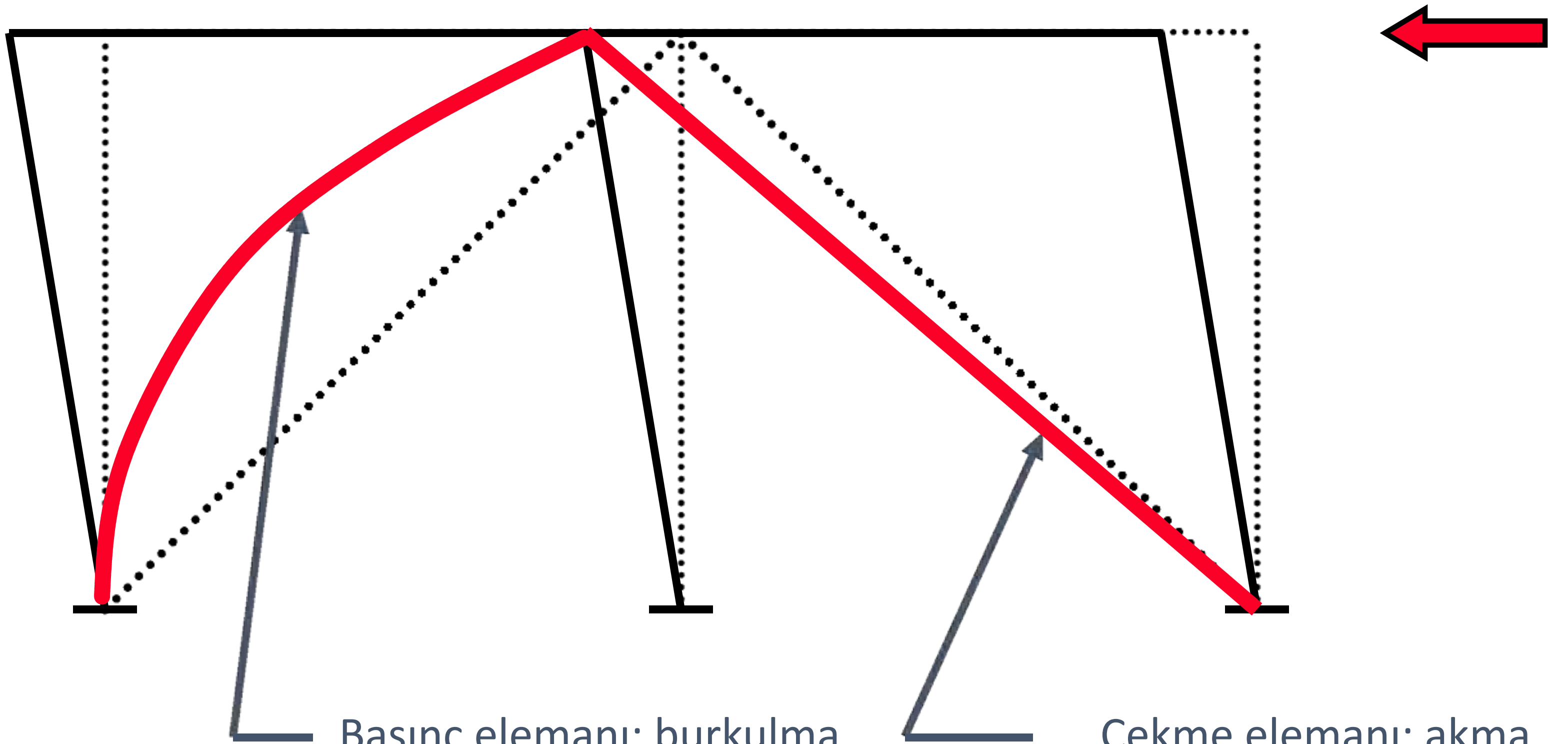
İki kat X- berkitme



Deprem sırasında merkezi berkitilmiş yapının elastik olmayan davranışı




Çekme elemanı: akma
Sünek davranış
Basınç elemanı: burkulma
Sünek olmayan davranışnductile
Kolon ve kirişler: elastik kalıyor

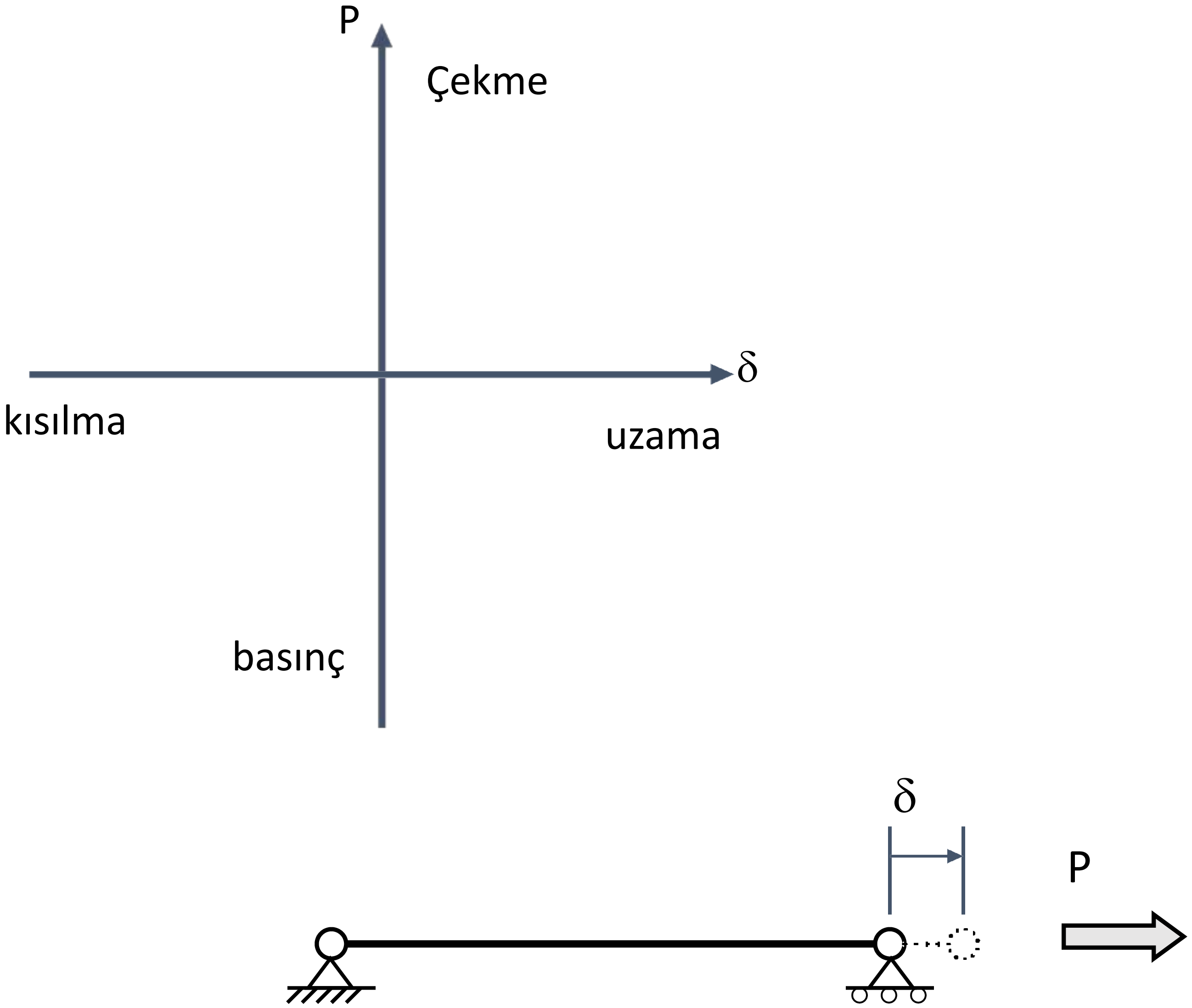


Basınç elemanı: burkulma
Sünek olmayan davranışnductile

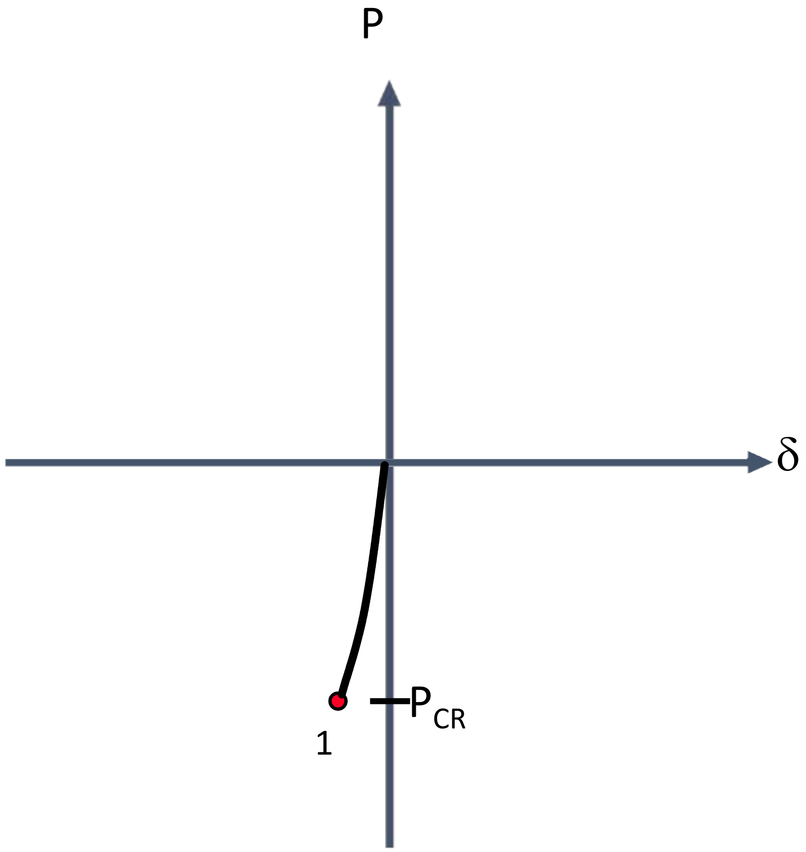
Çekme elemanı: akma
Sünek davranış

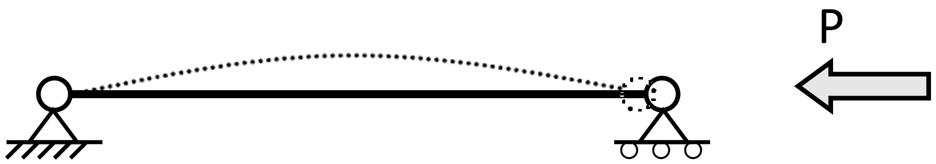
Kolon ve kirişler: elastik kalıyor

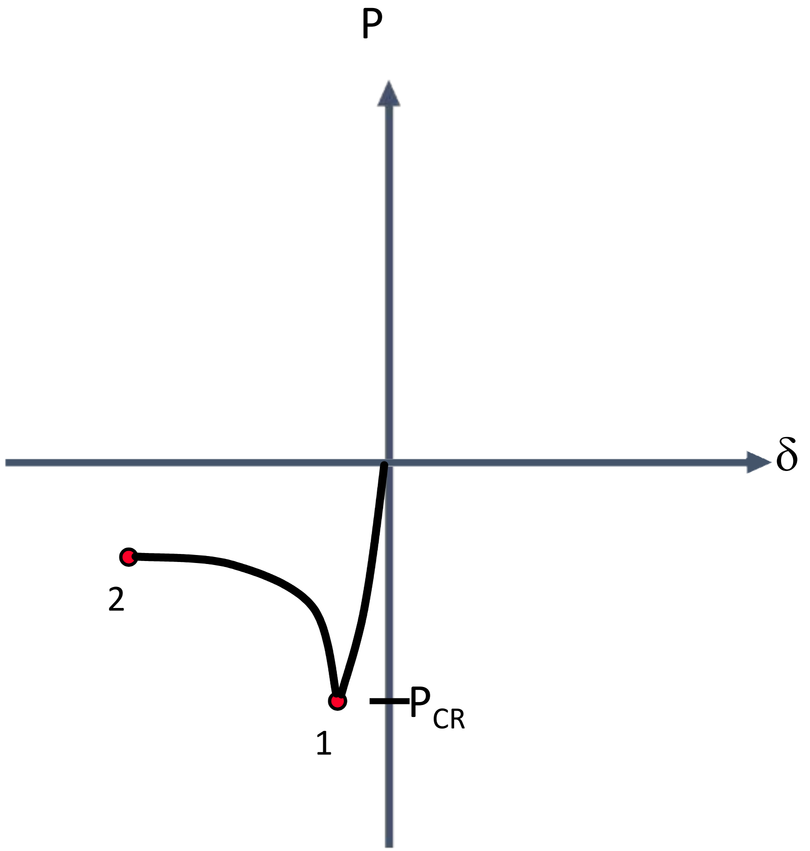
Tekrarlı eksenel yük altında berkitme elemanının davranışı



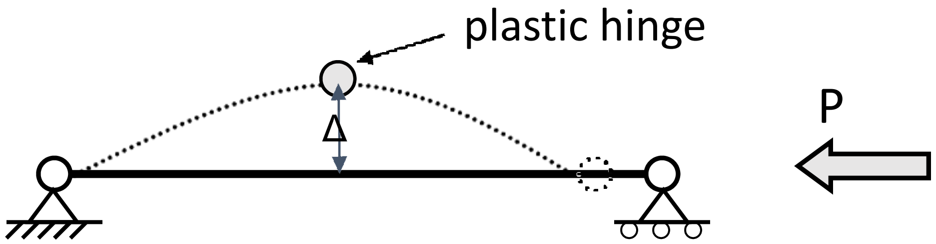
1. berkitme elemanı burkulma yüküne kadar yükleniyor

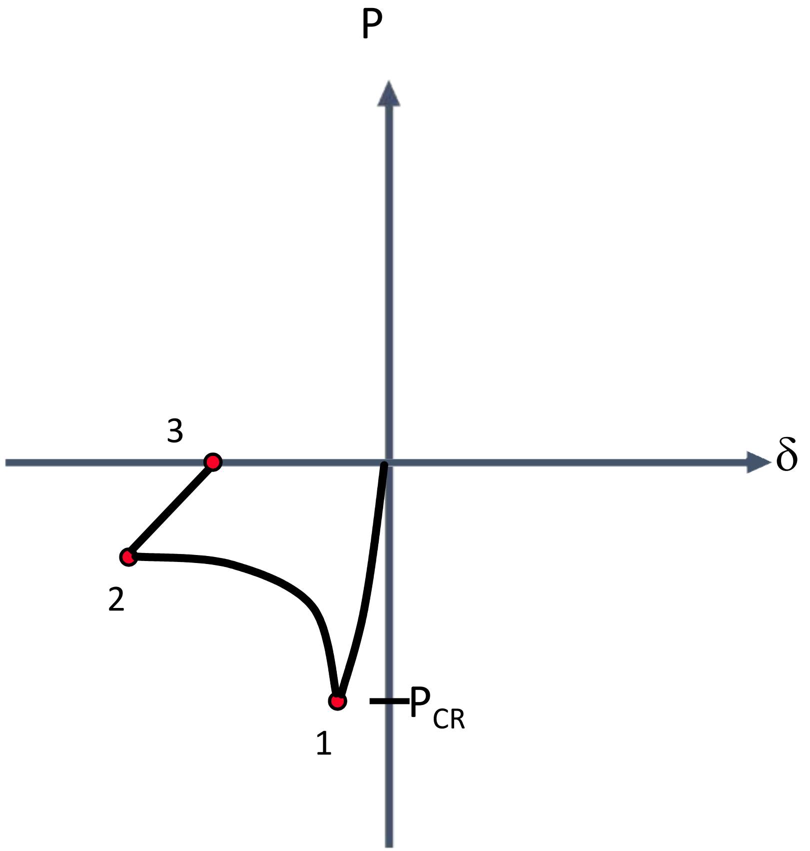




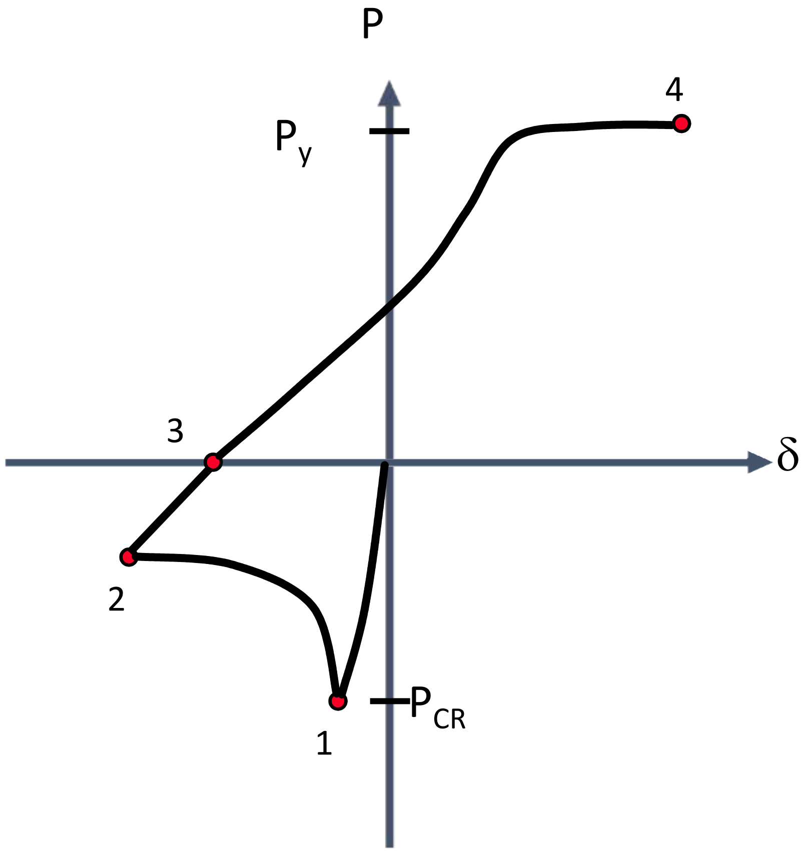


2. Basınç kuvveti uygulanmaya devam ediyor ancak basınç dayanımı aniden düşüyor. Berkitmenin orta noktasında eğilme plastikleşmesi oluşuyor (elemandaki P-Δ etkisi).

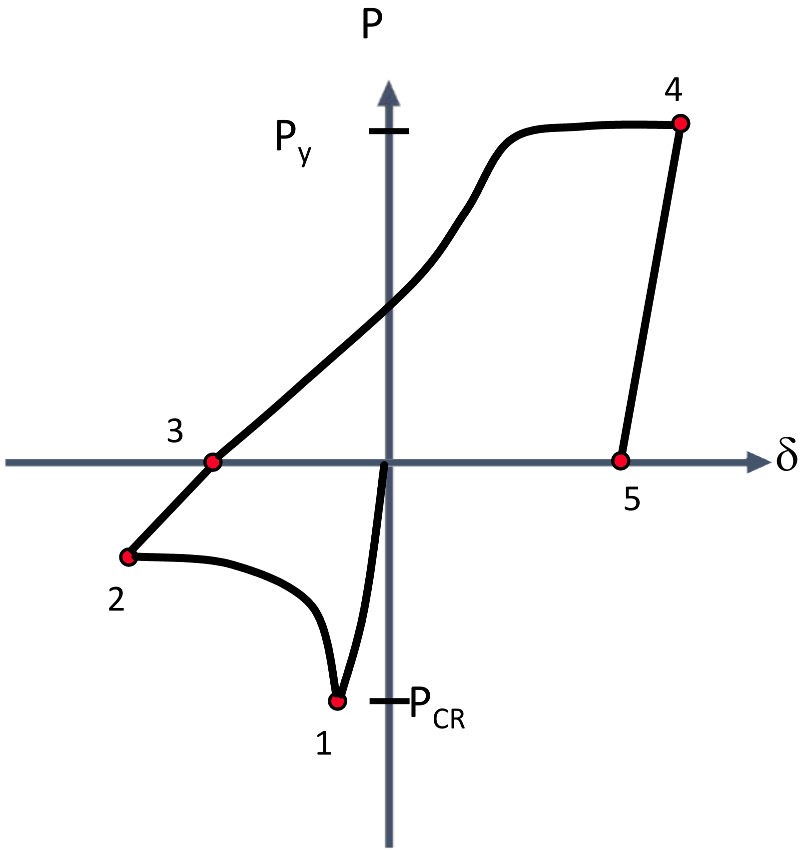




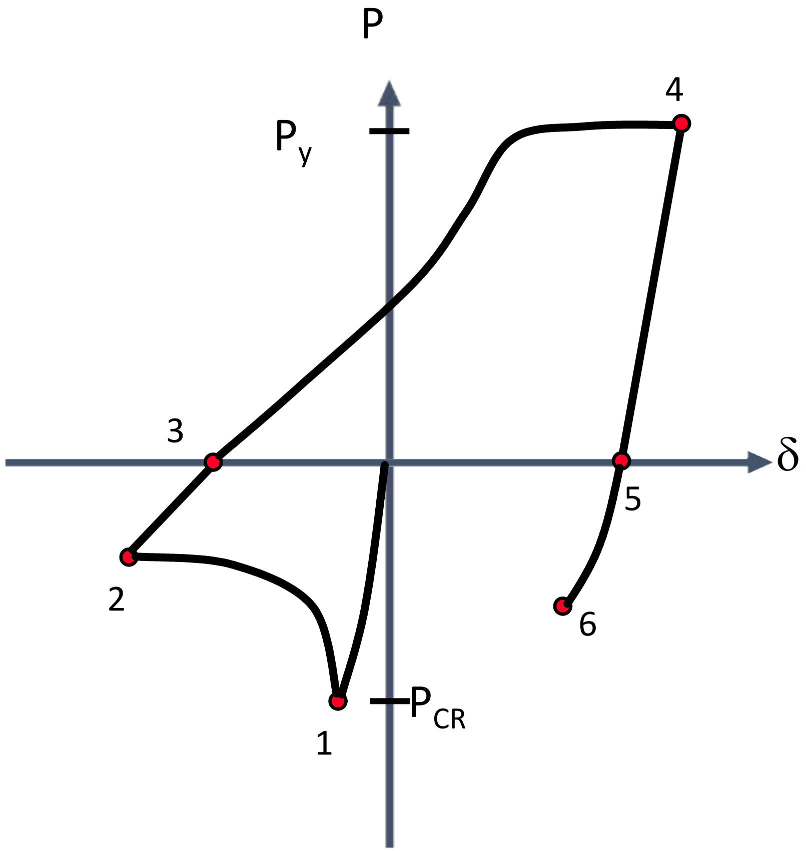
3. Yük sıfırlanıyor. (P=0). Eleman düzlem dışı deformasyona sahip..



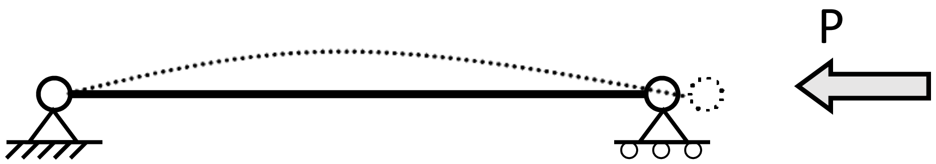
4. berkitme elemanına akmaya geçinceye kadar çkme kuvveti uygulanıyor..

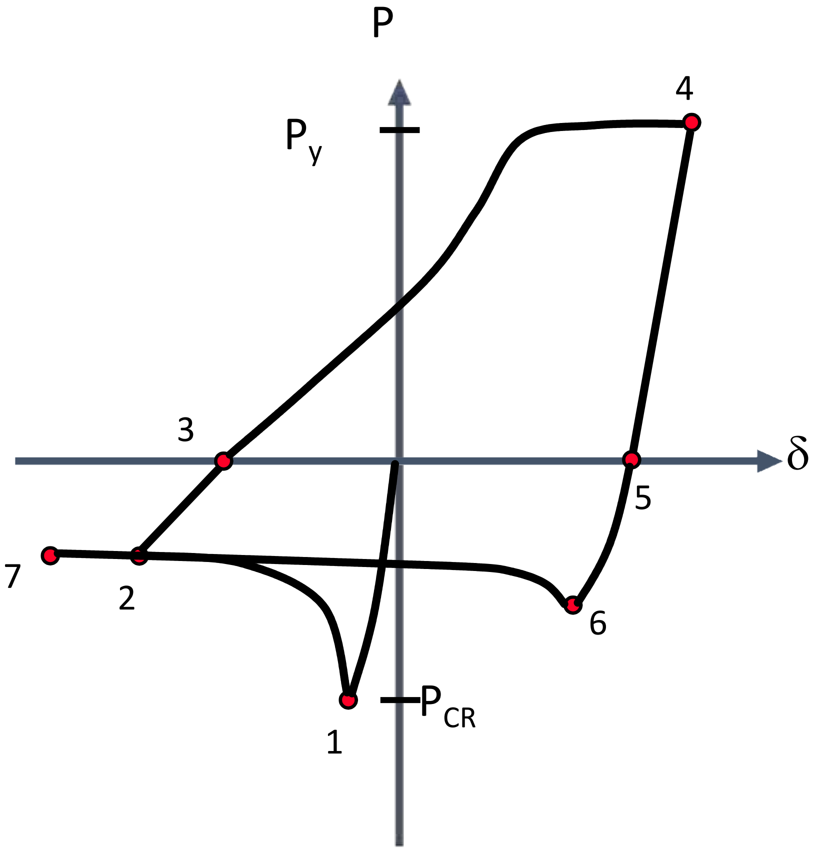


5. Yük kaldırılıyor(P=0).
Eleman üzerinde hala kalıcı düzlem dışı deformasyon var..

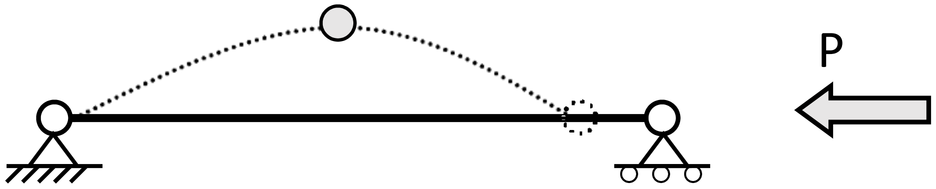


6. Burkuluncaya kadar yükleme yapılıyor. İlk burkulma yükünden daha küçük bir yükte burkulma gözleniyor..

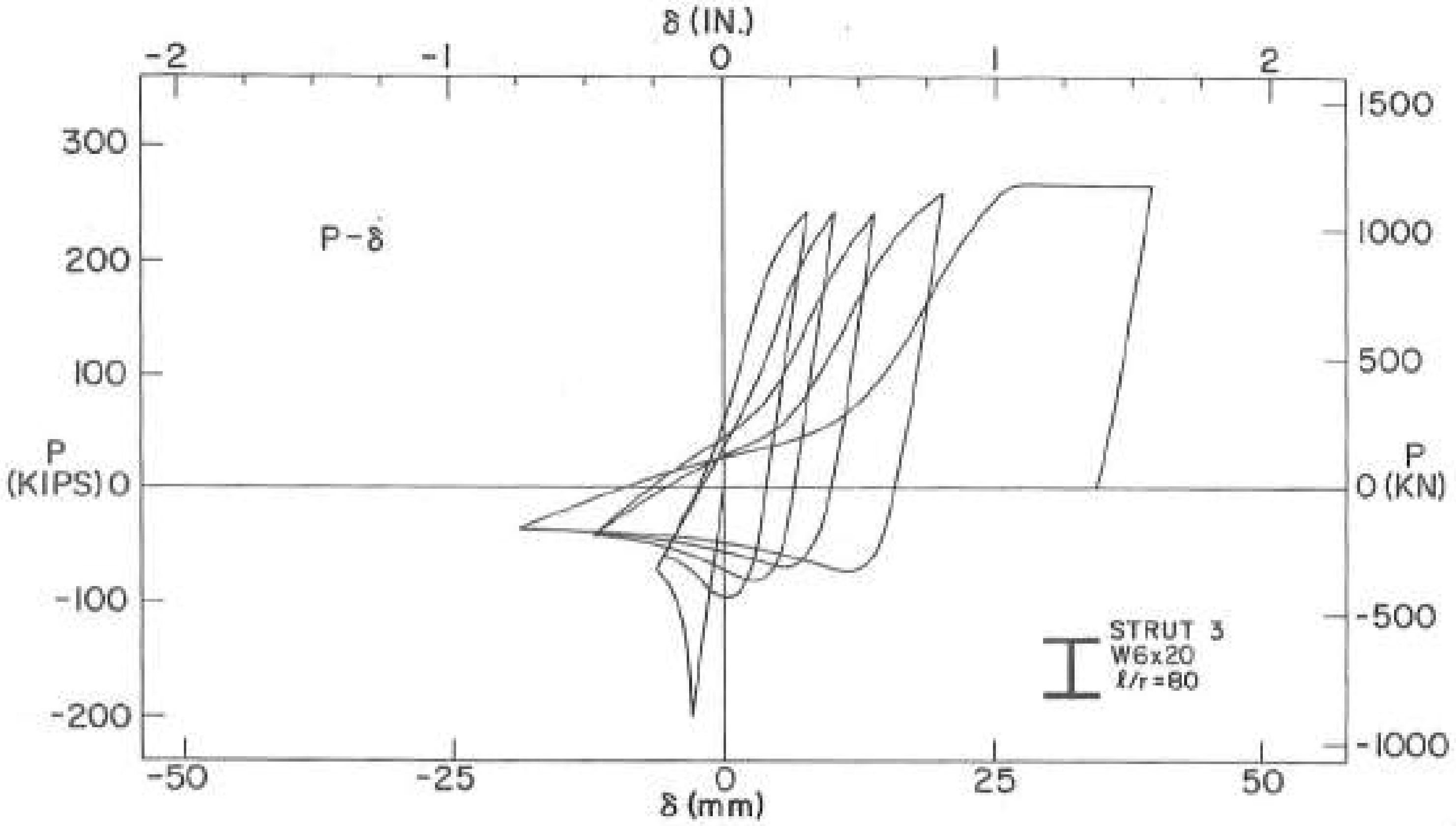


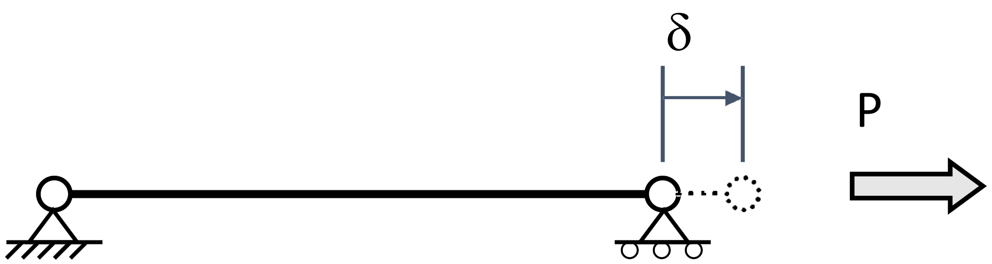


7. Basınç bölgesinde yük tatbik edilmeye devam ediyor. Eğilme plastik mafsalı elemanın orta noktasında oluşuyor. . (P-Δ etkisi).

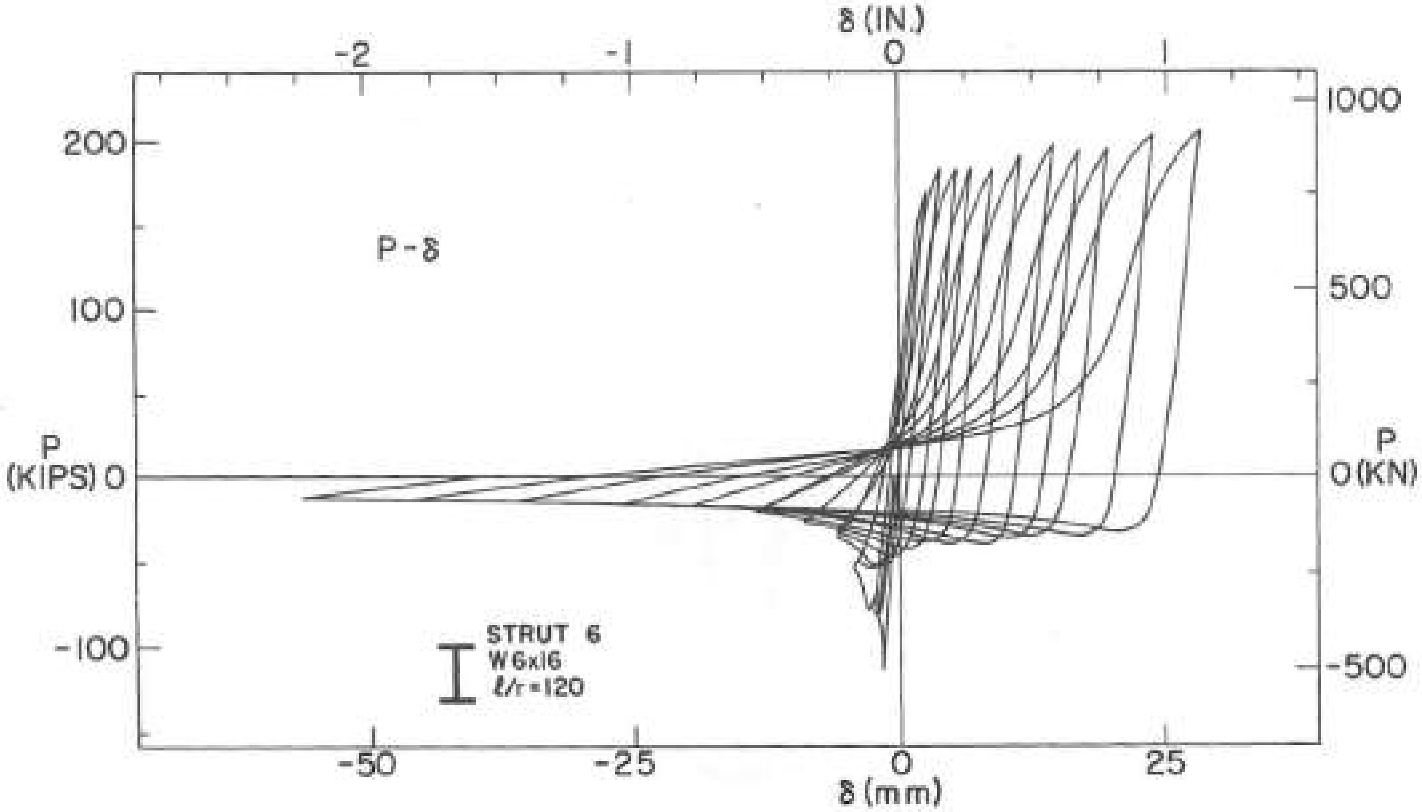


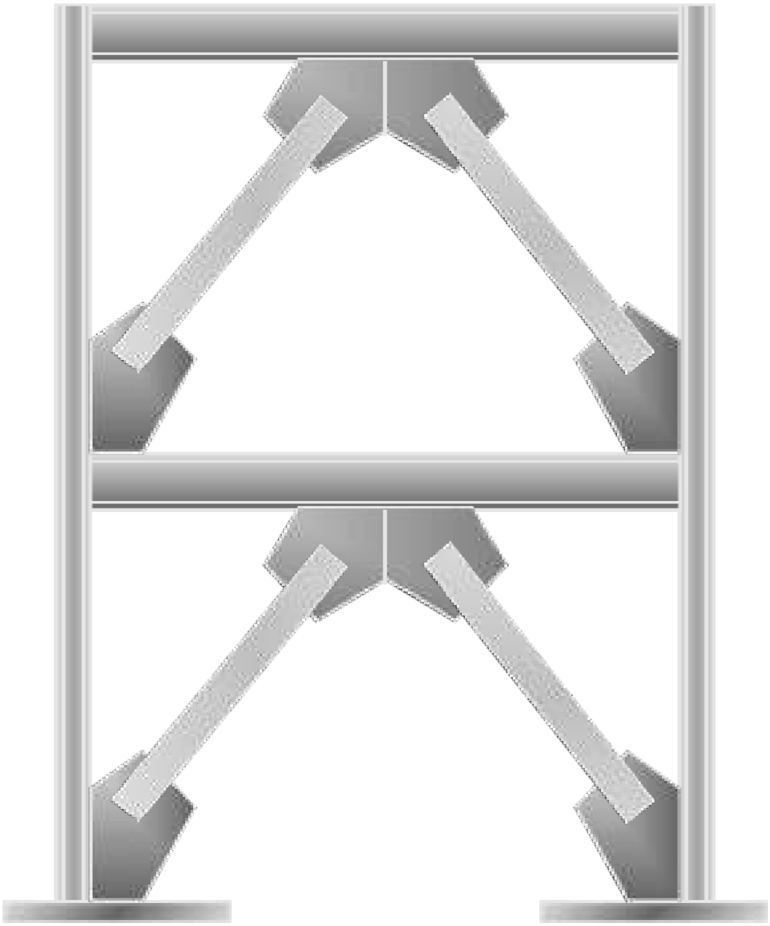
W6x20 Kl/r = 80


δ (IN.)
-2
-1
0
1
2
300
200
100
P
(KIPS) 0
-100
-200
1500
1000
500
P
0 (KN)
-500
-1000
P - δ
STRUT 3
W6x20
ℓ/r = 80
-50
-25
0
25
50
δ (mm)

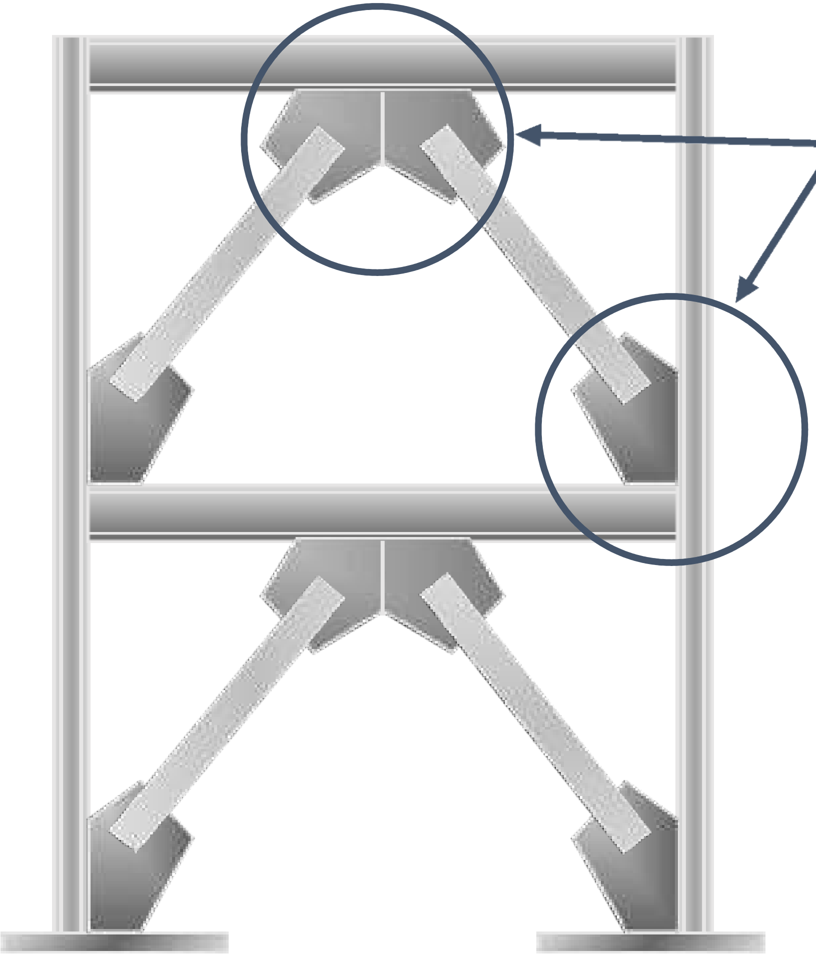

δ
P

W6x16   Kl/r = 120

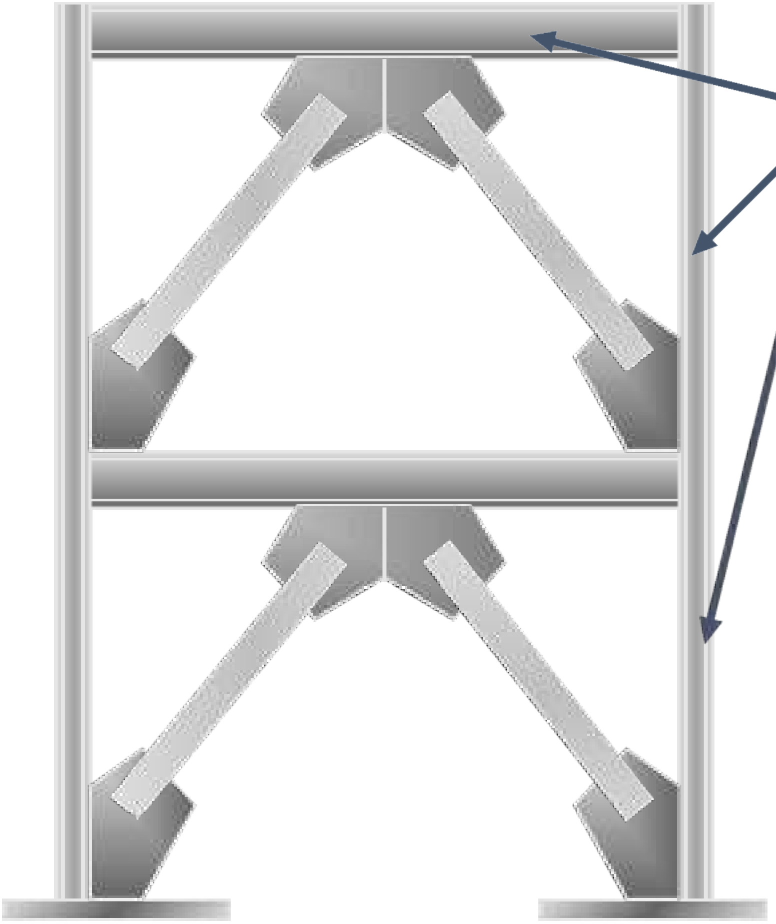




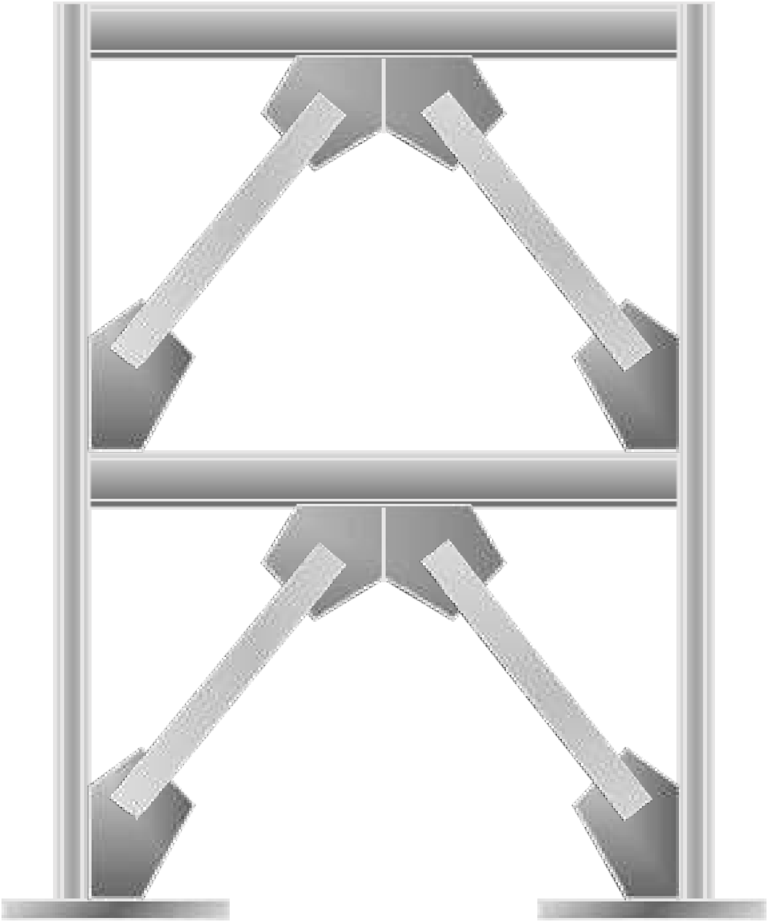
Yapının sigortası berkitme elemanları



Birleşimler çok önemli



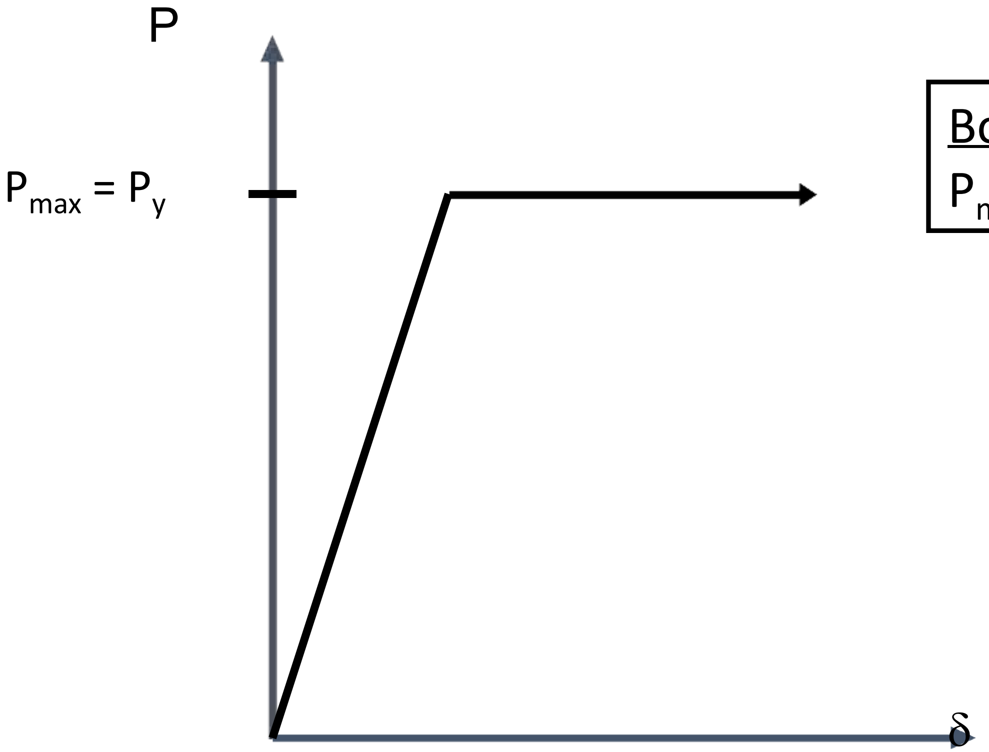
Berkitme elemanlarının plastikleşmesi için gerekli dayanıma göre kolon ve kirişler boyutlandırılmalı



Berkitme elemanlarını yönetmeliklere göre boyutlandırınız

Diğer elemanları bu berkitme elemanlarının doğuracağı maksimum yüke göre bo

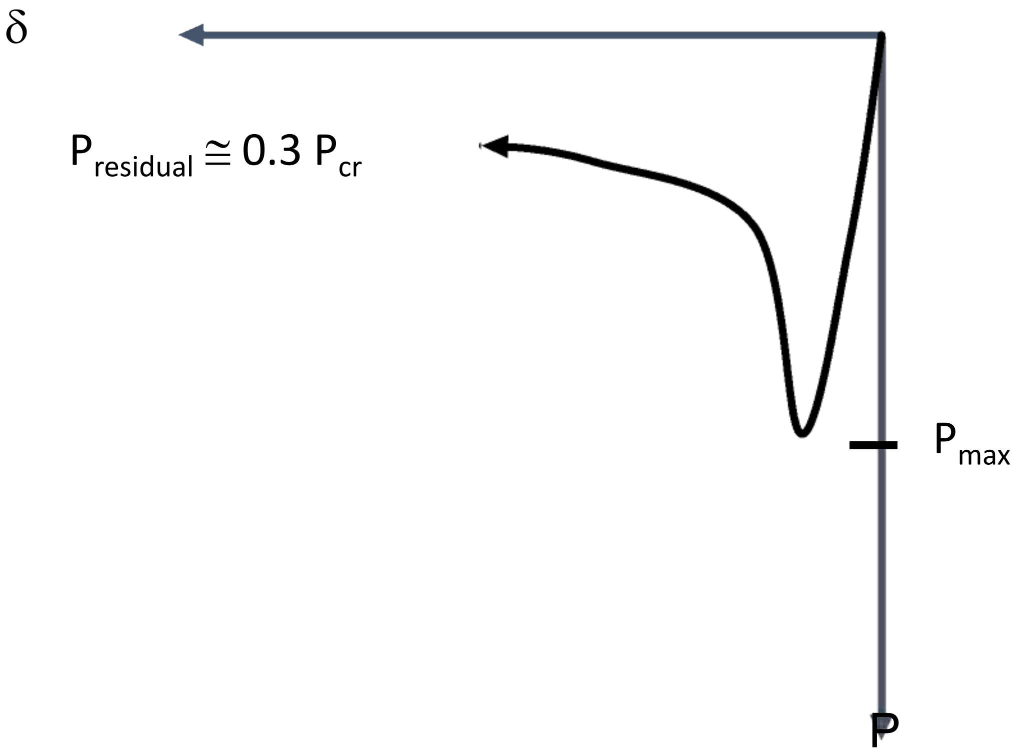
Berkitmelerde çekme kuvveti :



Boyutlandırma için:

$P_{max} = R_y F_y A_g$

Berkitmede basınç kuvveti



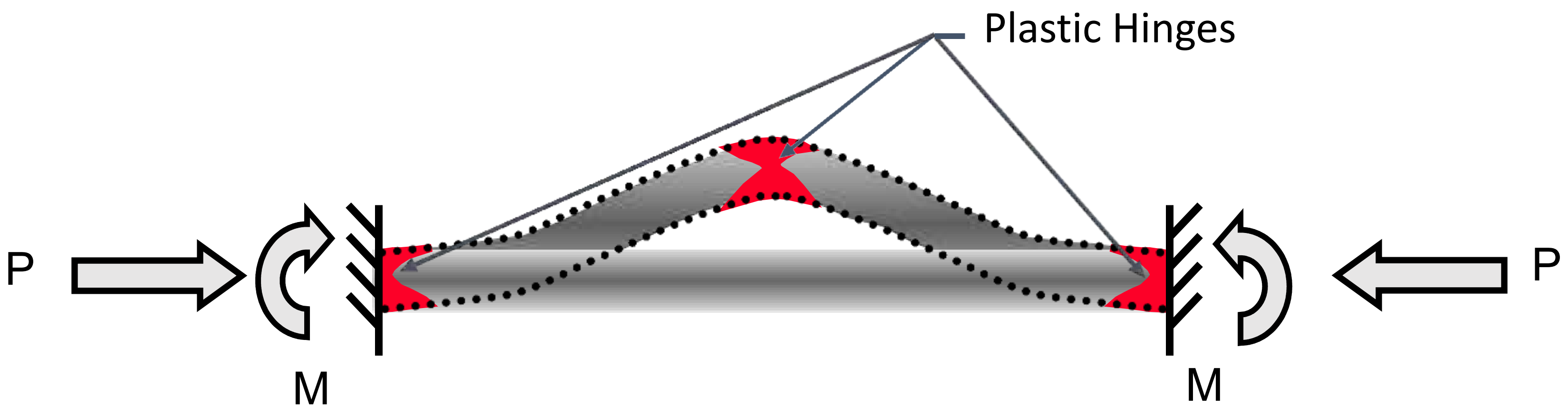
<u>Boyutlandırma için:</u>

$P_{max} = 1.1\ R_y\ P_n$

$(\ P_n = A_g\ F_{cr}\ )$

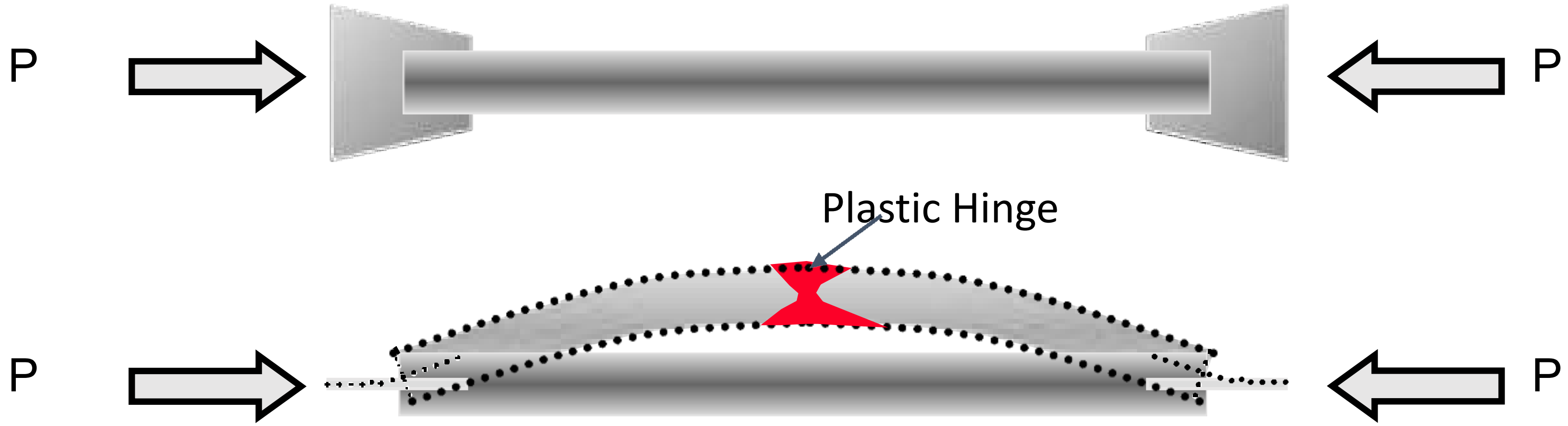
$P_{residual} = 0.3\ P_n$

Berkitme elemanında basınç:



Düğüm noktaları rijit bağlanmış.

<u>Bayutlandırma için:</u>
$M_{max} = 1.1\, R_y\, F_y\, Z_{brace}$



Düğüm noktaları mafsallı bağlanmış

Kolon ve kirişlerde oluşacak kuvvetlerin hesaplanışı ::

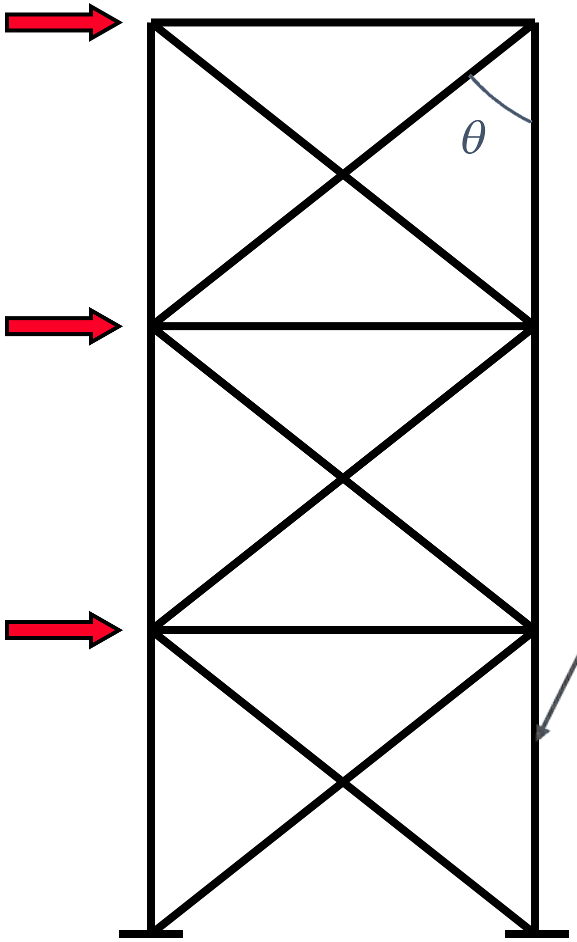
Berkitmede çekme kuvveti var:

$$P = R_y F_y A_g$$

Berkitmede basınç kuvveti var:

$$P = 1.1 R_y P_n \qquad P = 0.3 P_n$$

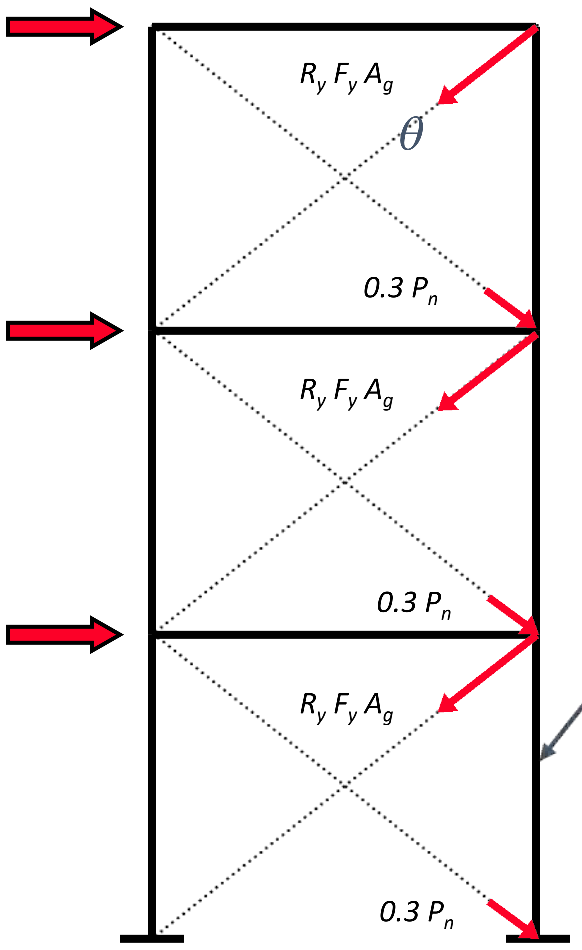
Hangisi daha kritik durum oluşturuyorsa.



Kolonda Maksimum eksenel basınç kuvveti

Berkitmede çekme:
Take $P = R_y F_y A_g$

Berkitmede basınç:
Take $P = 0.3 P_n$

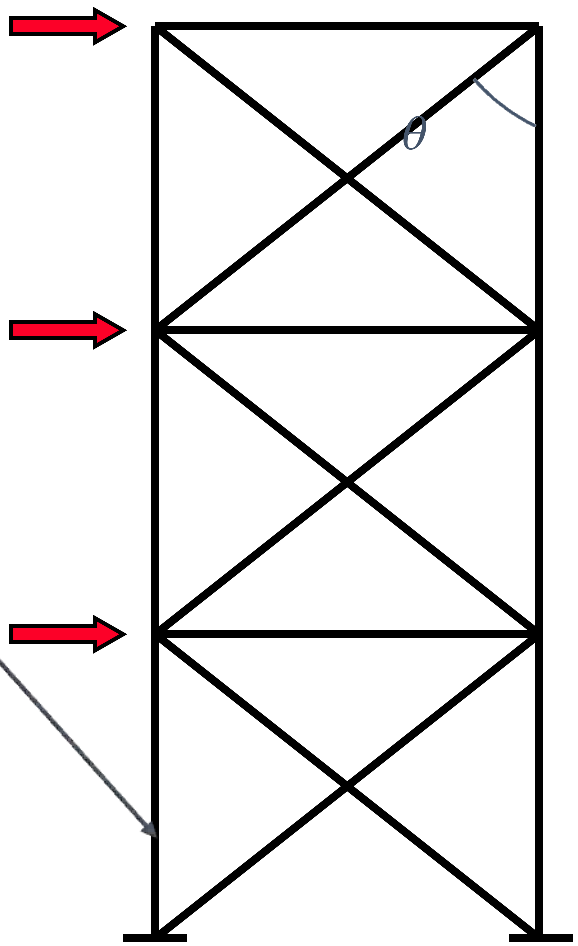


Kolondaki eksenel yük=

$[\ \Sigma\ (R_y\ F_y\ A_g\ )\cos\theta + \Sigma\ (0.3\ P_n)\cos\theta\ ] + P_{gravity}$

(her kattaki düşey yüklerin toplamı)

Kolonda maksimum
çekme kuvveti.

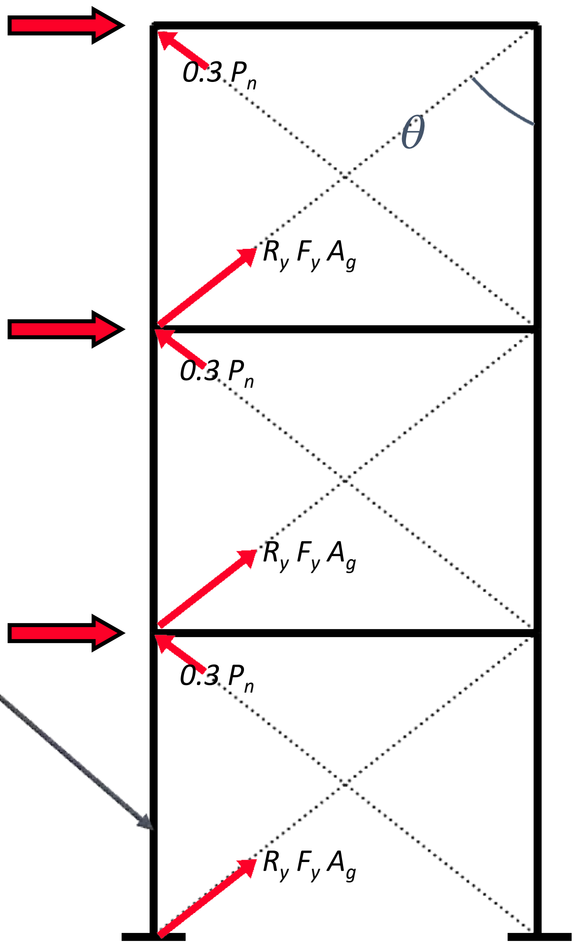


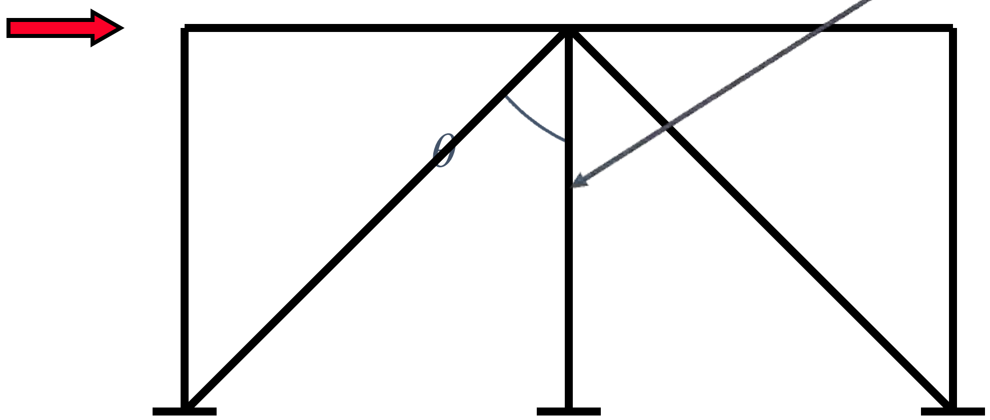
Çekme :
$P = R_y F_y A_g$

basınç:
$P = 0.3\ P_n$

Kolonda çekme kuvveti=

$$[\ \Sigma\ (R_y\ F_y\ A_g\ )\ \cos\theta + \Sigma\ (0.3\ P_n)\ \cos\theta\ ] - P_{gravity}$$

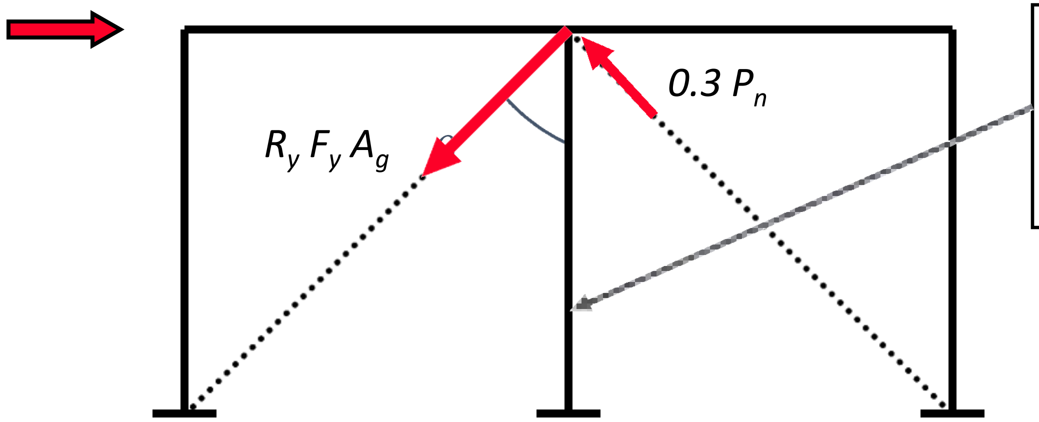




En büyük Eksenel basınç kuvveti.

Çekme (berkitmede):
$P = R_y F_y A_g$

Basınç :
$P = 0.3 P_n$



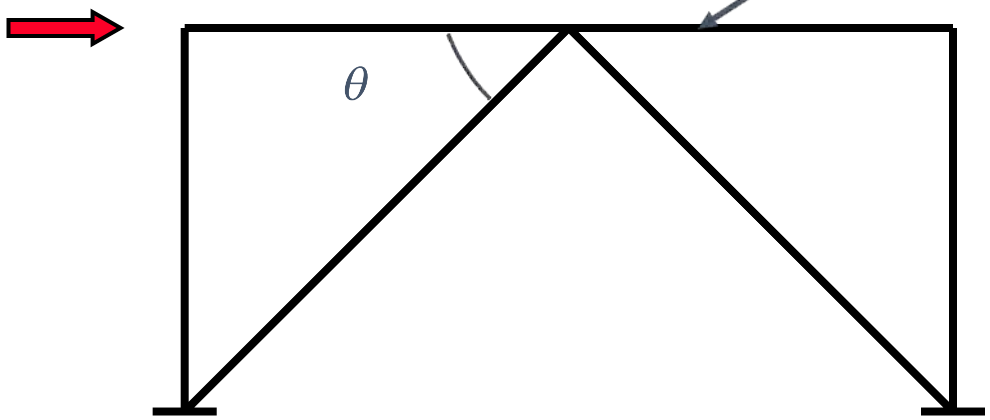
Eksenel basınç=

$(R_y \, F_y \, A_g) \cos\theta + (0.3 \, P_n) \cos\theta + P_{gravity}$

<u>Note</u>

Elastik analiz sonucu düşey yüklerden dolayı hesaplanmış yük :

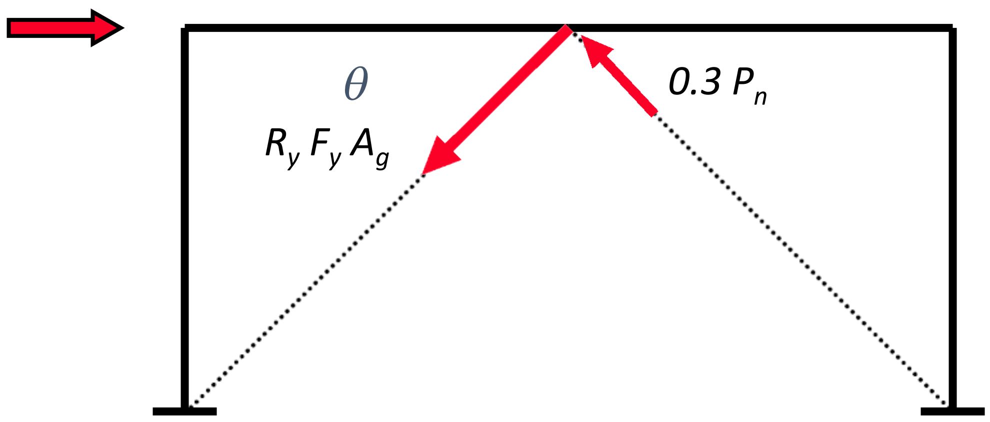
$= P_{gravity}$



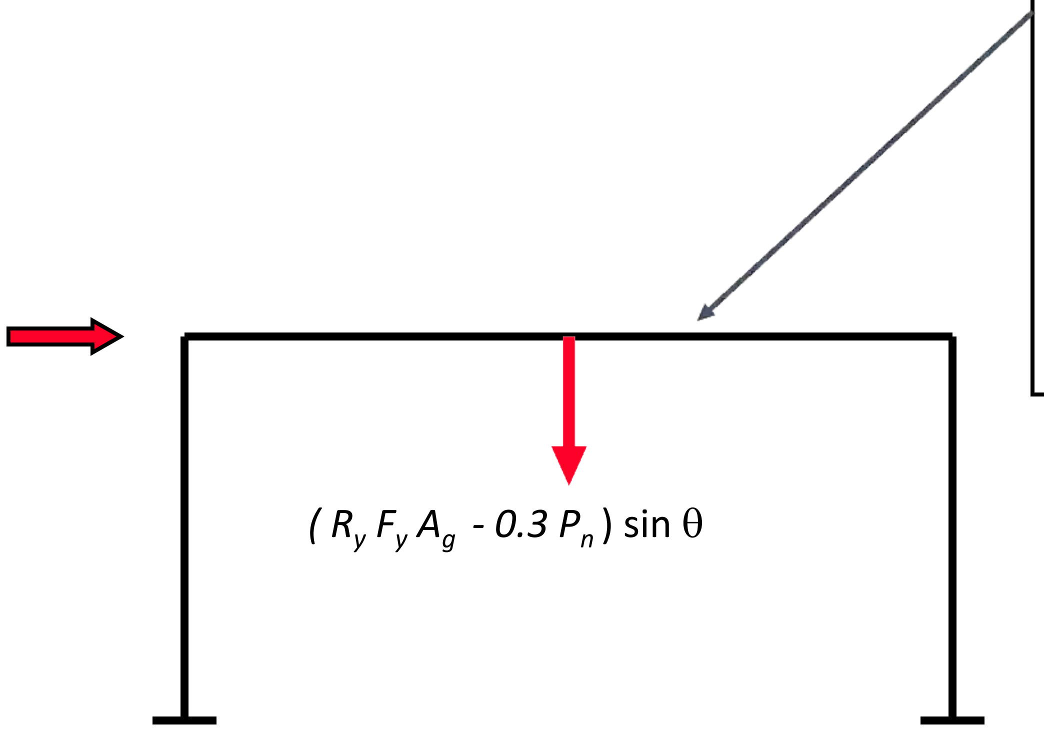
Kirişte oluşan en büyük eğilme.

çekme:
Take $P = R_y F_y A_g$

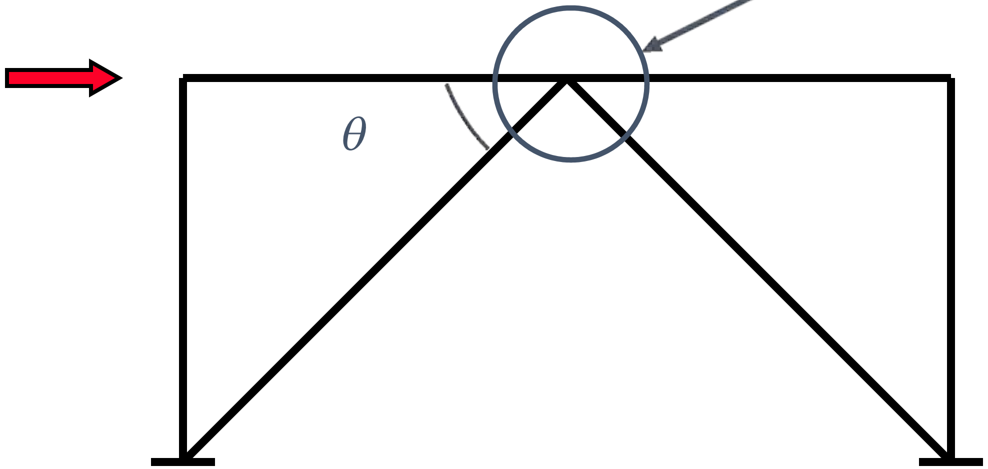
basınç:
Take $P = 0.3 P_n$



θ
$R_y\ F_y\ A_g$
$0.3\ P_n$



Bileşke kuvvet($R_y F_y A_g$ + $0.3\ P_n$) sin θ
Ve düşey yüklerden oluşan moment



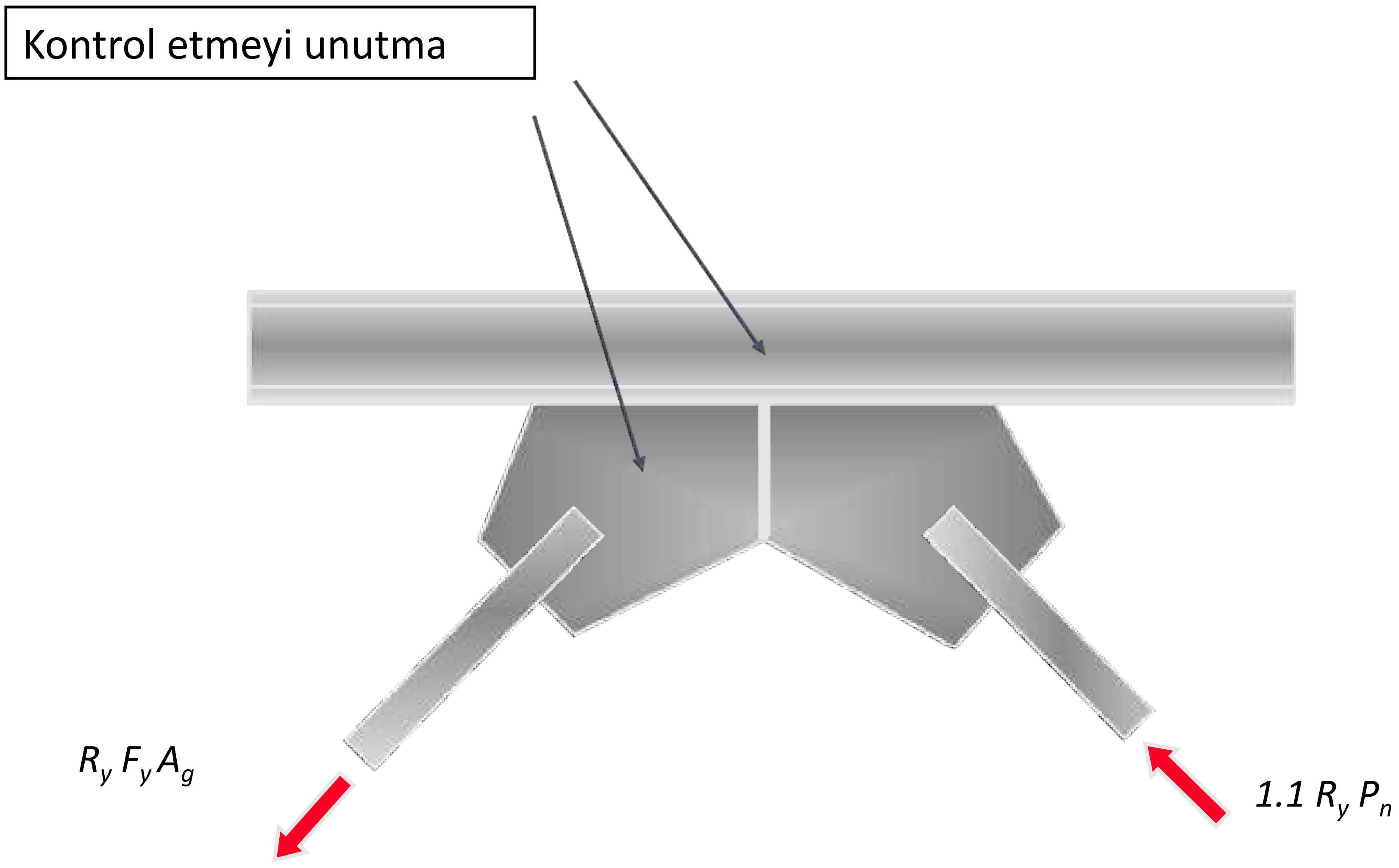
Kirişte maksimum eksenel yük

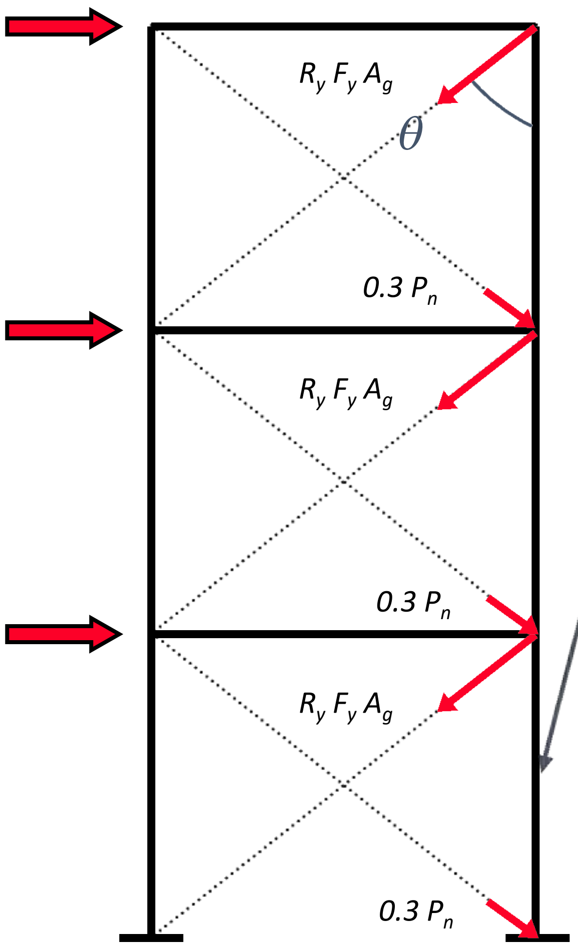
çekme:

$P = R_y F_y A_g$

basınç:

$P = 1.1 R_y P_n$


Kontrol etmeyi unutma
$R_y\,F_y\,A_g$
$1.1\,R_y\,P_n$



Bütün berkitme elemanlarında narinlik: $\frac{KL}{r} \le 4\sqrt{\frac{E}{F_y}}$

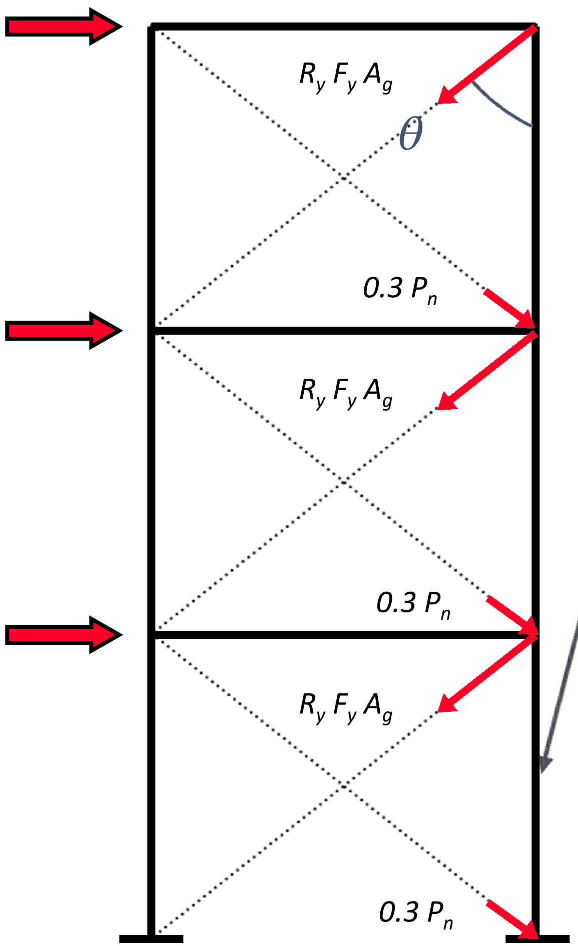
Gerekli kolon basınç dayanımıstrength =

$$[\ \Sigma\ (R_y\ F_y\ A_g\ )\cos\theta + \Sigma\ (0.3\ P_n)\cos\theta\ ]$$
$$+$$
$$\Sigma\ [(1.2 + 0.2S_{DS})\ D + 0.5L]$$

OR

$$\Omega_0\ Q_E$$
$$+$$
$$\Sigma\ [(1.2 + 0.2S_{DS})\ D + 0.5L]$$

Berkitme elemanları narinliği: $4\sqrt{\dfrac{E}{F_y}} \le \dfrac{KL}{r} \le 200$



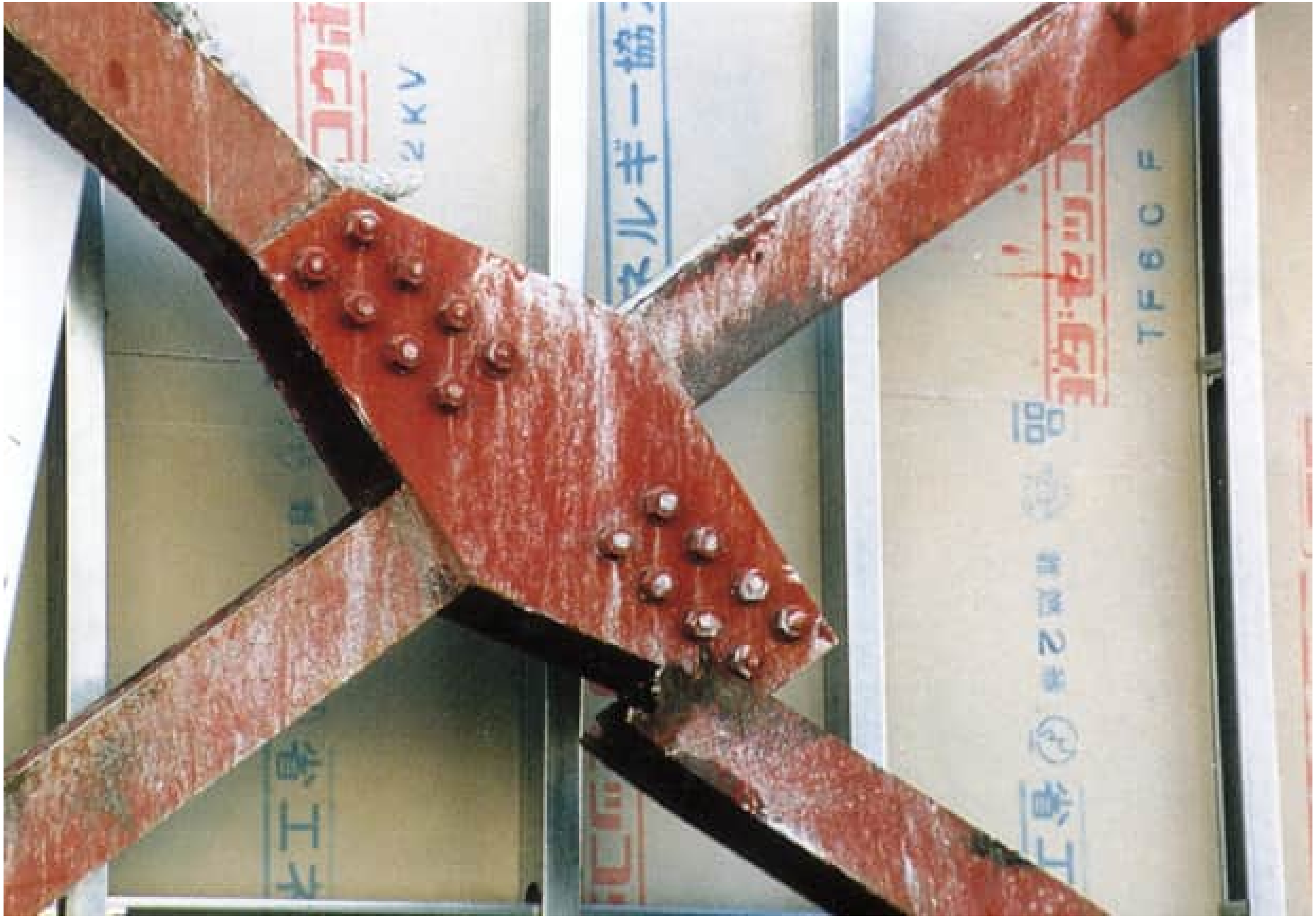
Gerekli kolon basınç dayanımı=

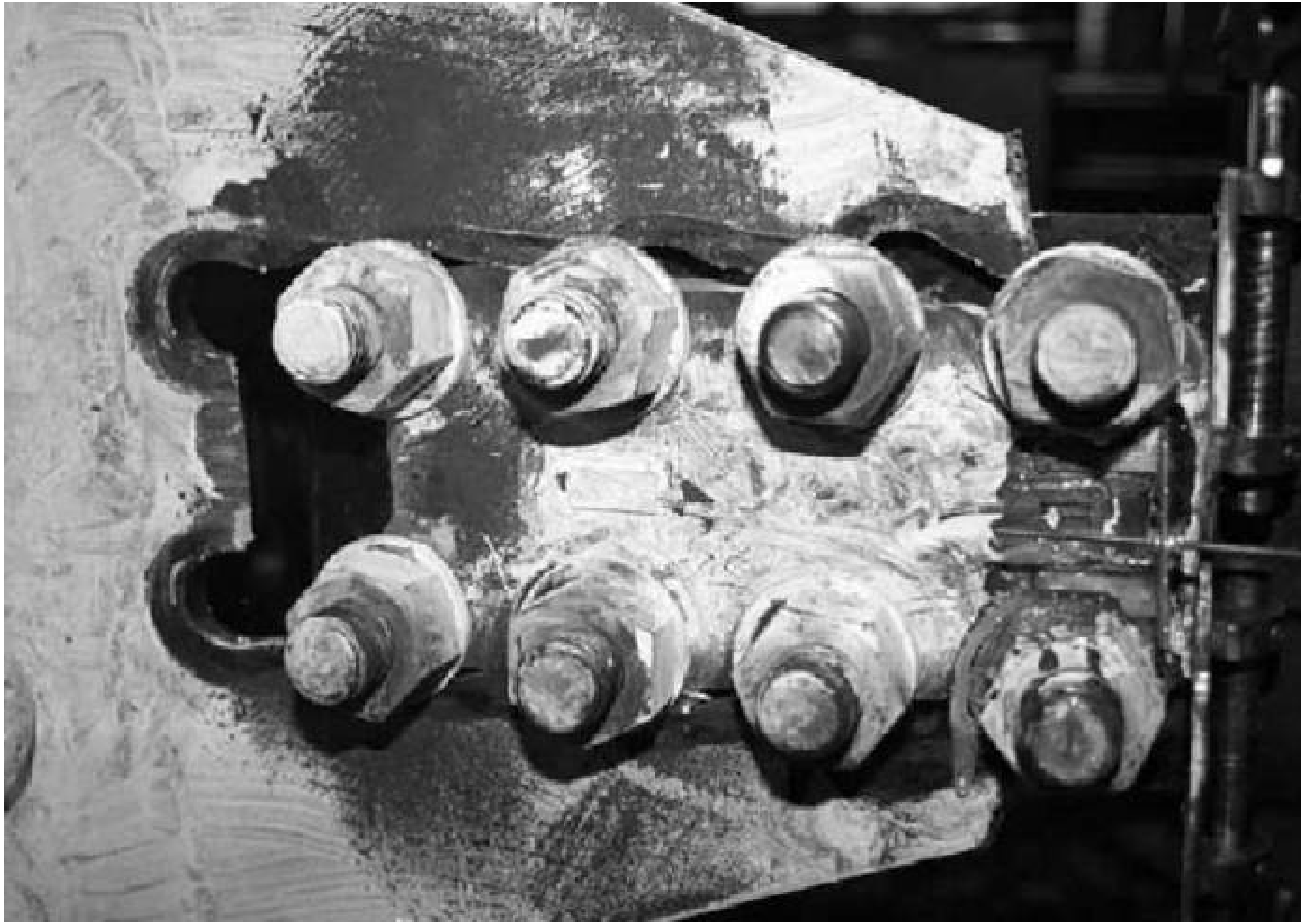
$$[\,\Sigma\,(R_y\,F_y\,A_g\,)\cos\theta - \Sigma\,(0.3\,P_n)\cos\theta\,]$$
$$+$$
$$\Sigma\,[(1.2 + 0.2S_{DS})\,D + 0.5L]$$

$$\cancel{\Omega_0\,Q_E + \Sigma\,[(1.2 + 0.2S_{DS})\,D + 0.5L]}$$

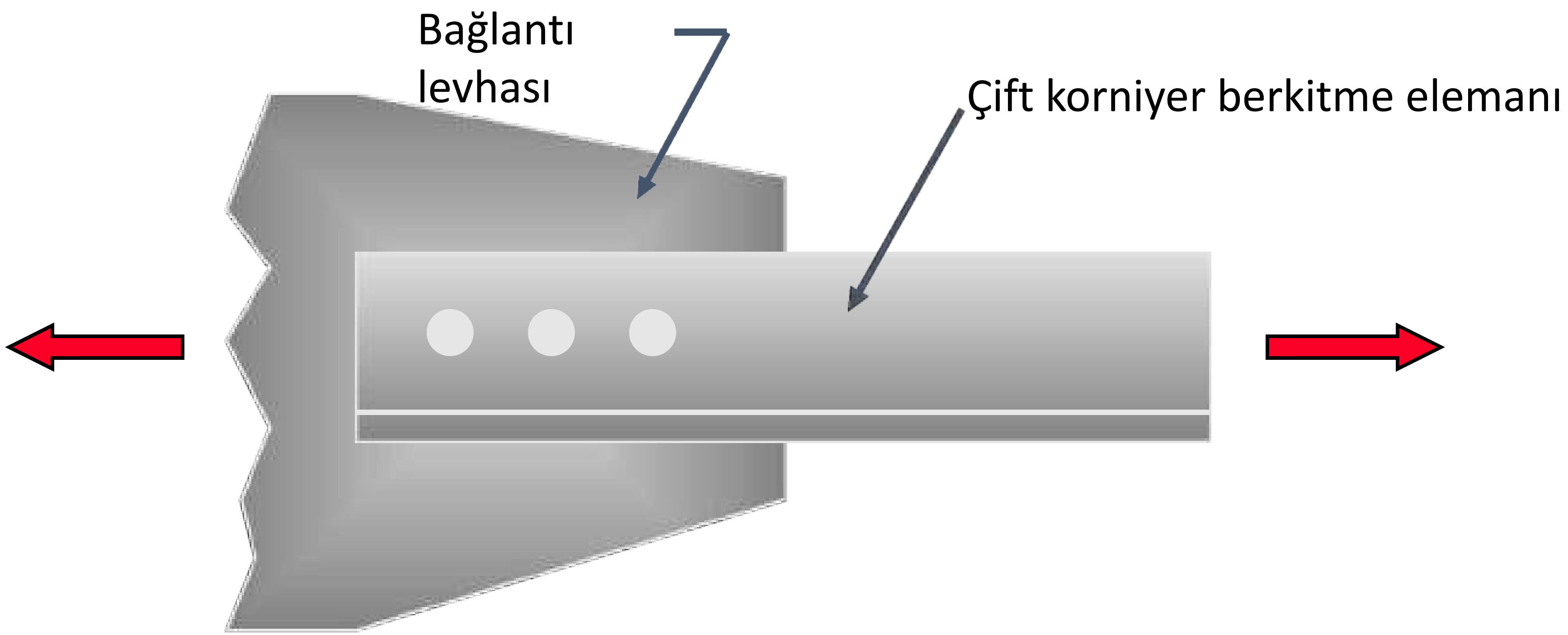
İzin verilmiyor

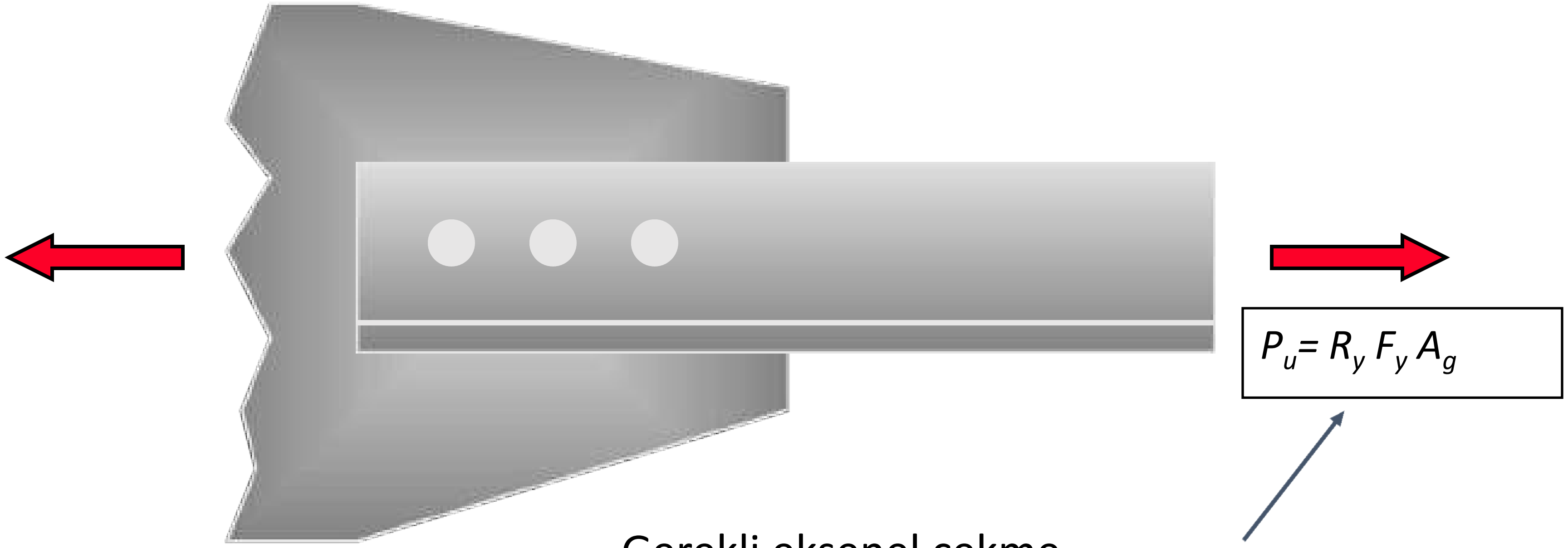

'95 2 17


TF6C F

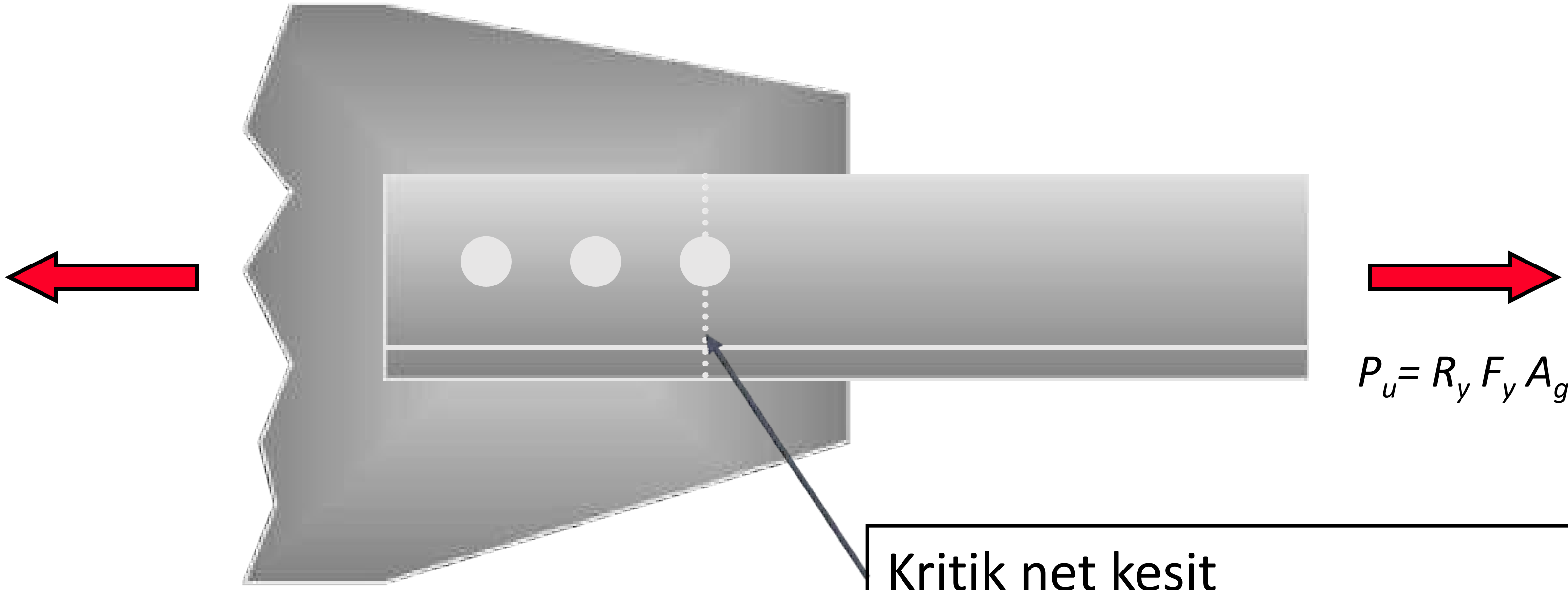


örnek





Gerekli eksenel çekme
dayanımı



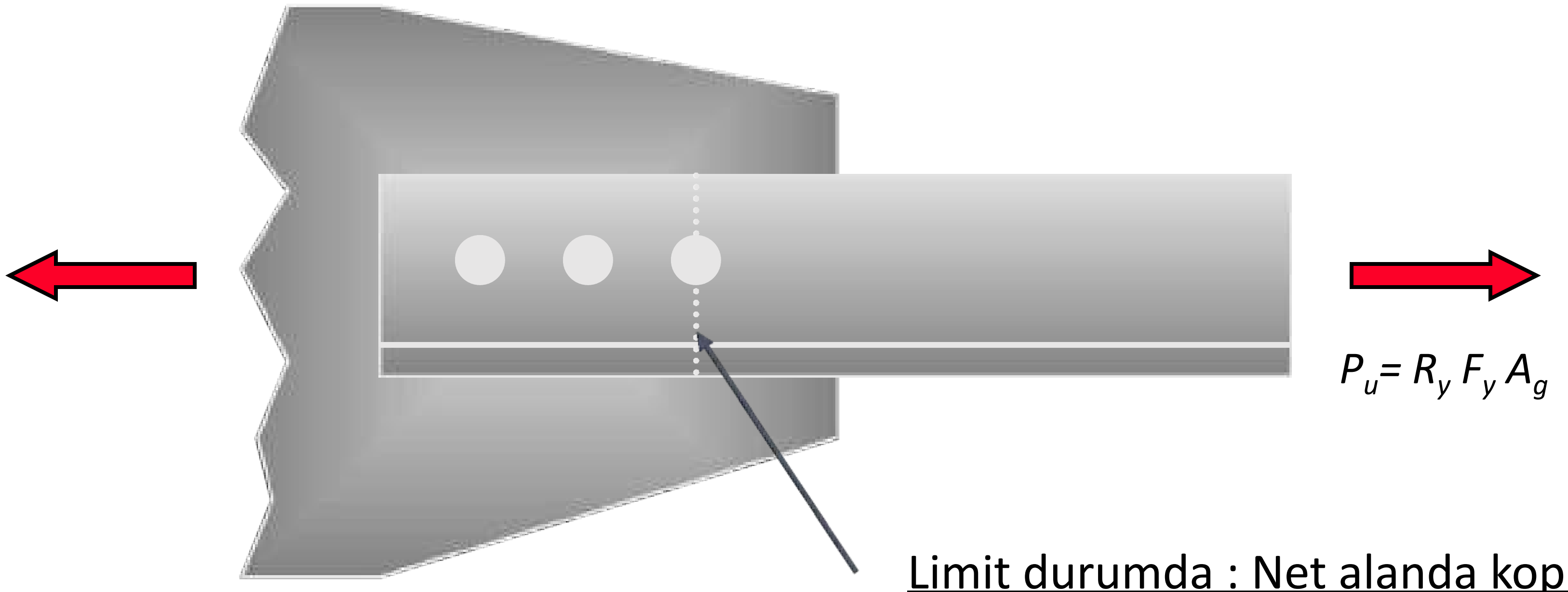
Kritik net kesit

$A_e = U A_n$

$A_e < A_g$:

bulon deliğinin olduğu noktada ($A_n < A_g$), ve

kayma gecikmesi nedeniyle etkili net alan($U < 1$)



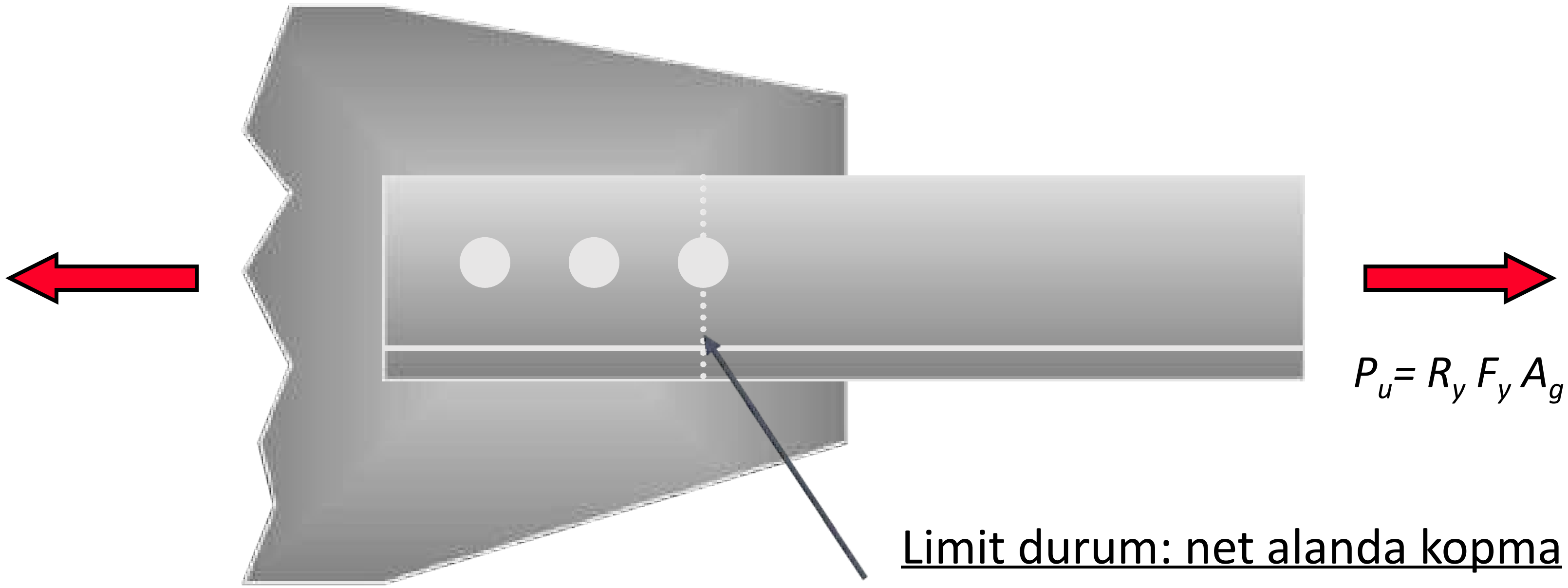
$P_u = R_y\ F_y\ A_g$

Limit durumda : Net alanda kopma

$(0.75)\ A_e\ (R_t\ F_u) \geq R_y\ F_y\ A_g$

OR:

$$\frac{A_e}{A_g} \geq \frac{R_y F_y}{(0.75) R_t F_u}$$



$P_u = R_y F_y A_g$

Limit durum: net alanda kopma

$$\frac{A_e}{A_g} \geq \frac{R_y F_y}{(0.75) R_t F_u}$$

A36 Angles:

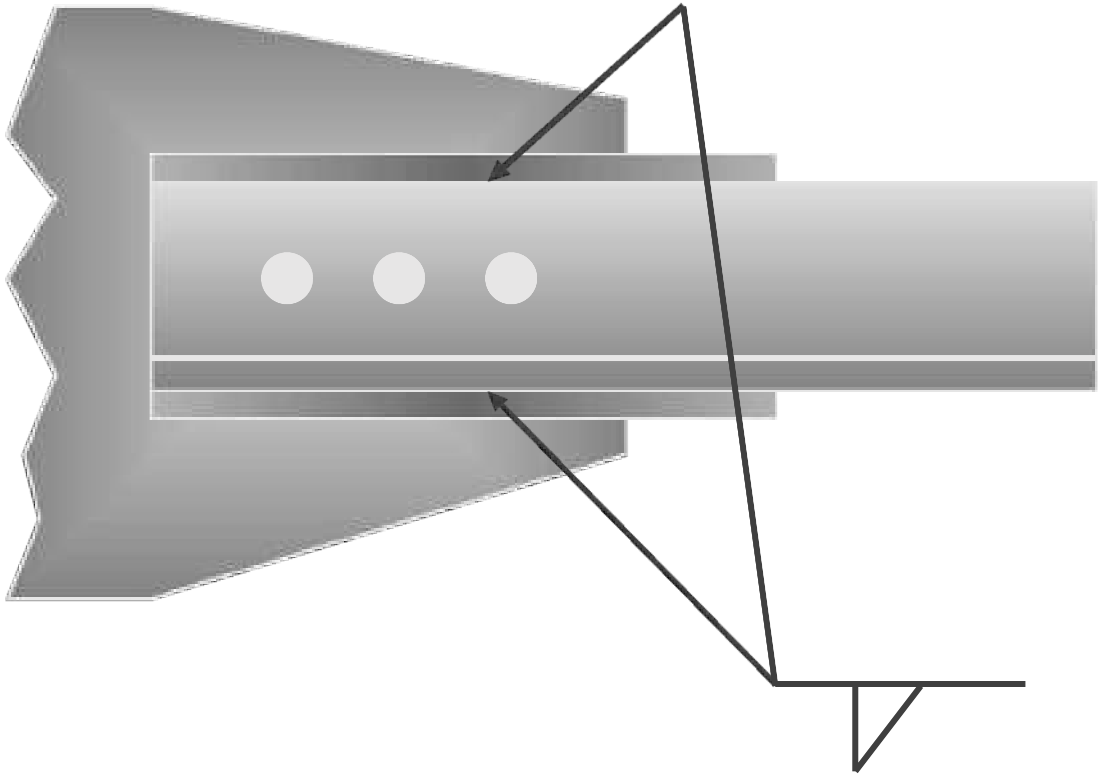
$$\frac{A_e}{A_g} \geq \frac{1.5 \times 36ksi}{(0.75) 1.2 \times 58ksi} = 1.03$$

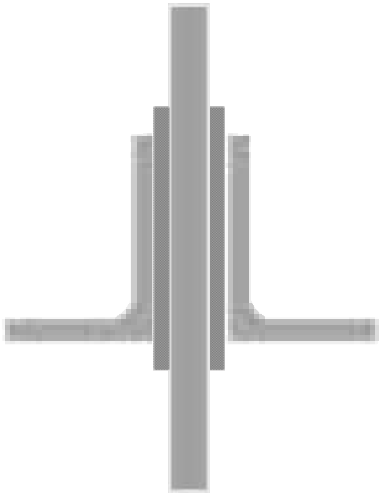
A572 Gr. 50 Angles:

$$\frac{A_e}{A_g} \geq \frac{1.1 \times 50ksi}{(0.75) 1.1 \times 65ksi} = 1.03$$

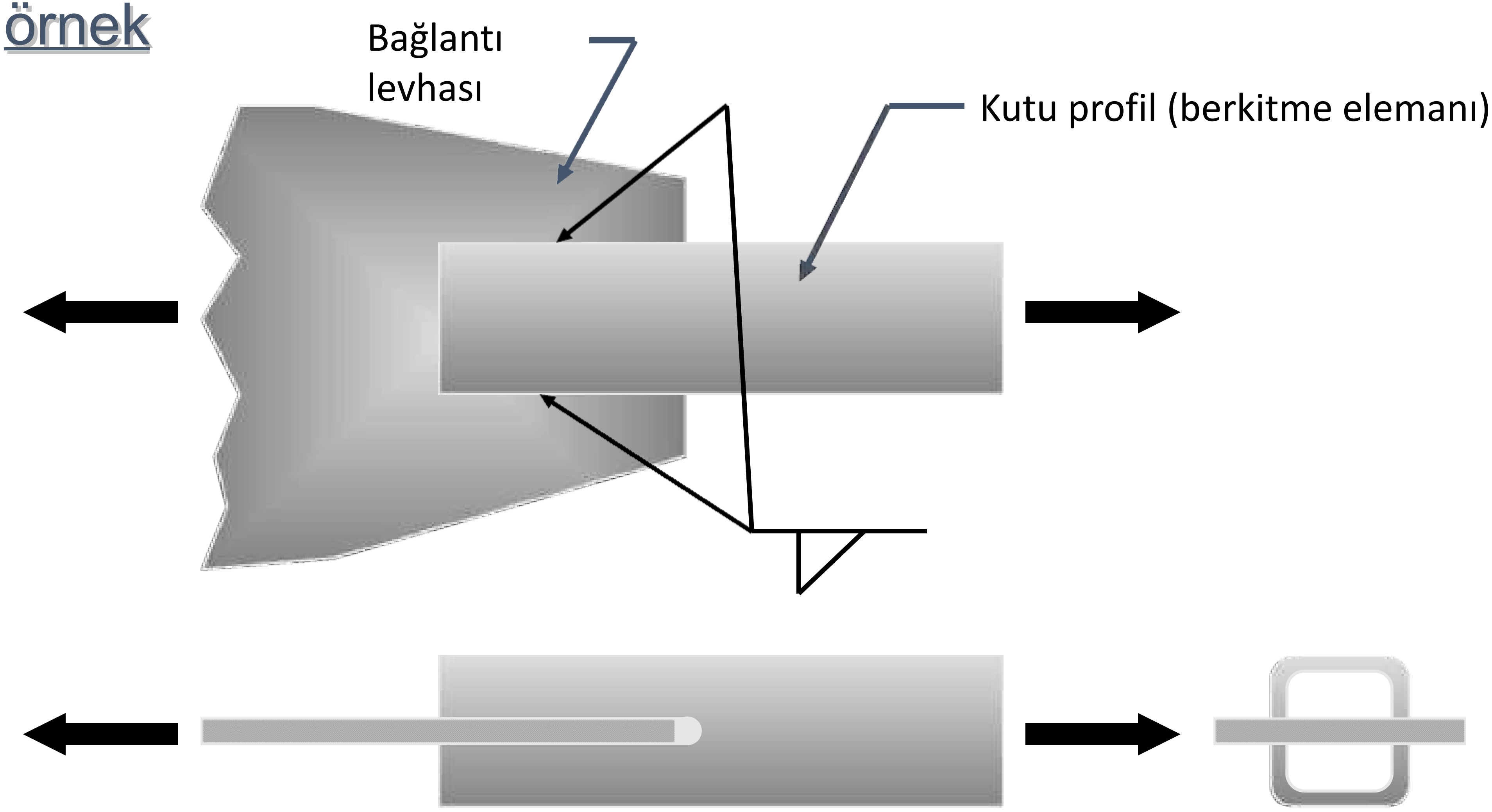
Net kesit takviye edilmeli

Net alanda takviye



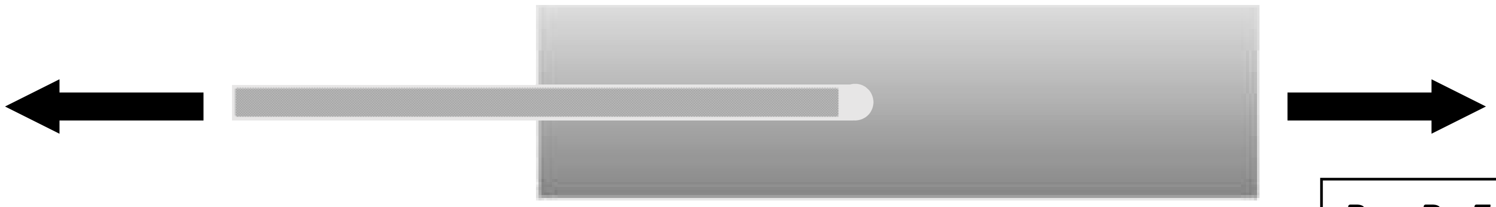


örnek



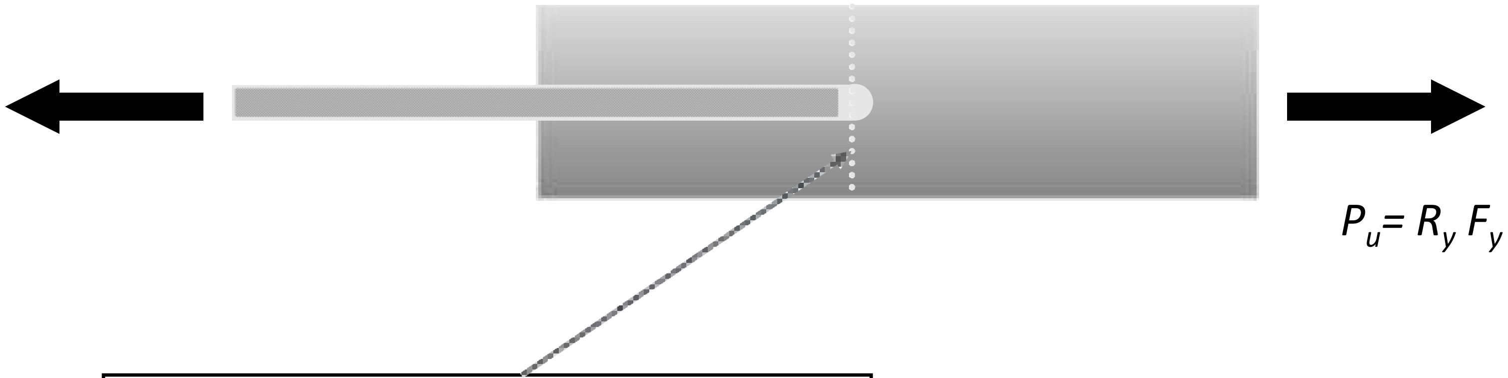
Net alanda kontrol etmeyi unutma!


13A



$P_u = R_y F_y A_g$

Net alanda limit durumda
gerekli dayanım



$P_u = R_y F_y A_g$

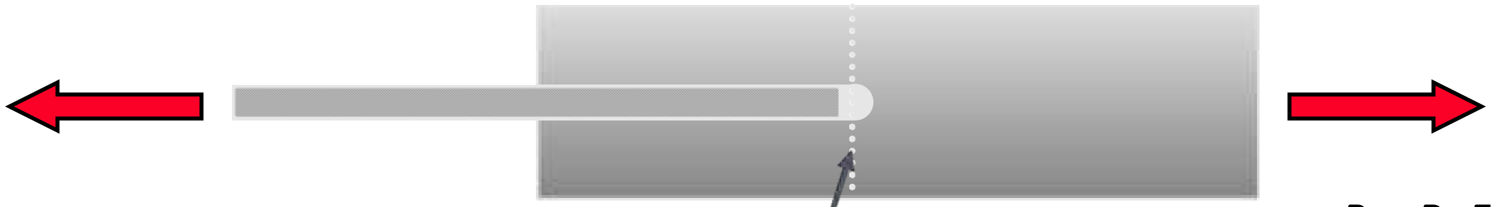
<u>Kritik net kesitte</u>

$A_e = U A_n$

$A_e < A_g$:

slot ($A_n < A_g$), ve

kayma gecikmesi ($U < 1$)



$P_u = R_y\, F_y\, A_g$

<u>Limit durumda net kesitte kopma</u>

$(0.75)\, A_e\, (R_t\, F_u) \geq R_y\, F_y\, A_g$

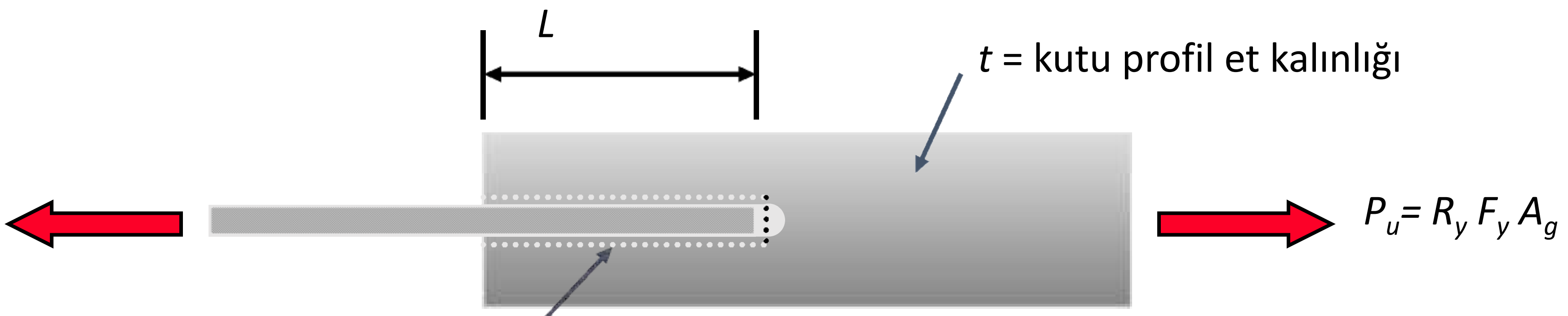
$$\frac{A_e}{A_g} \geq \frac{R_y F_y}{(0.75)\, R_t F_u}$$

<u>A500 Gr B dikdörtgen kutu kesit:</u>

$$\frac{A_e}{A_g} \geq \frac{1.4 \times 46 ksi}{(0.75)\, 1.3 \times 58 ksi} = 1.14$$

<u>Net kesit bölgesi takviye edilmeli</u>

Ayrıca blok kesme kontrol edilmeli

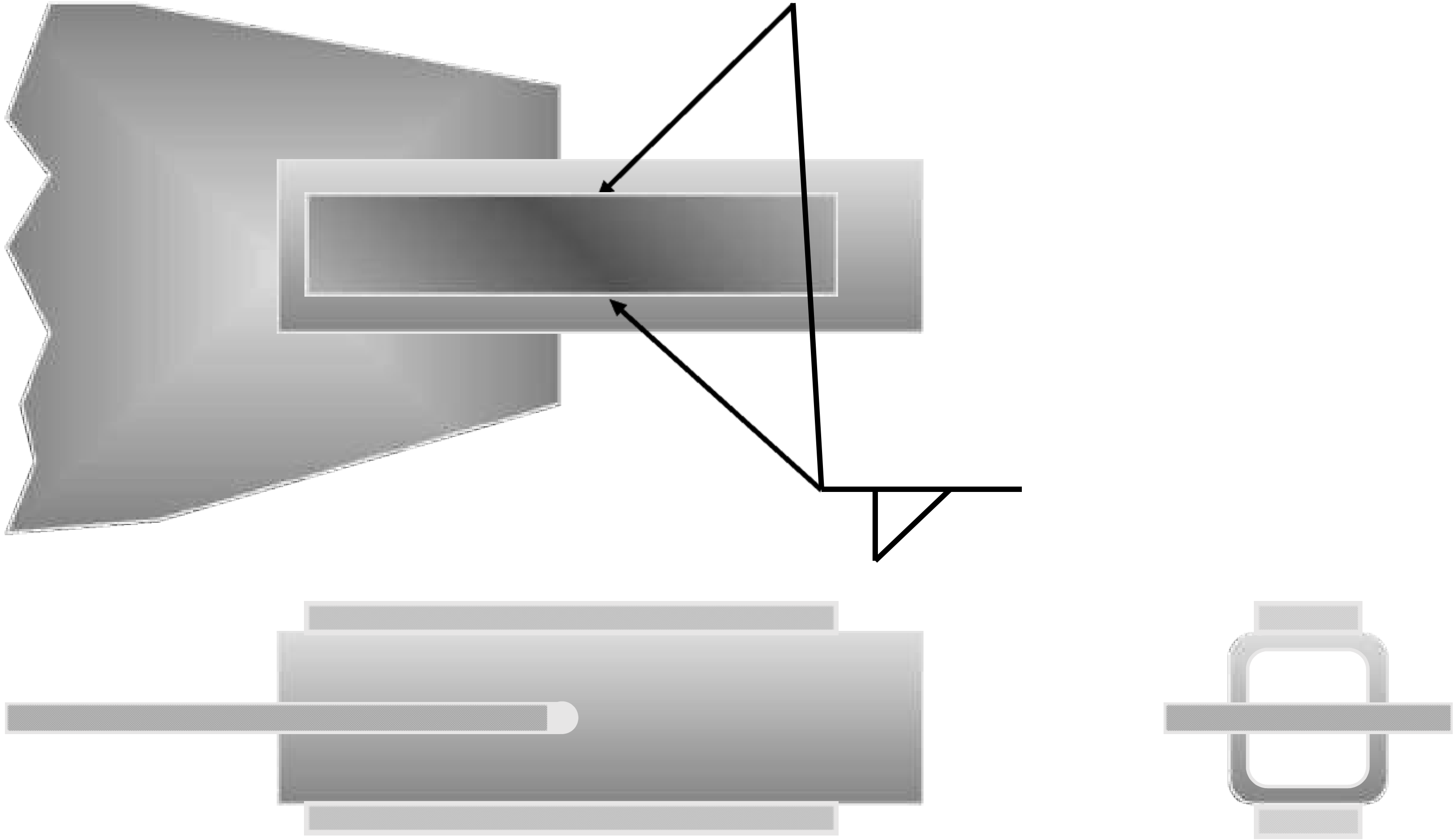


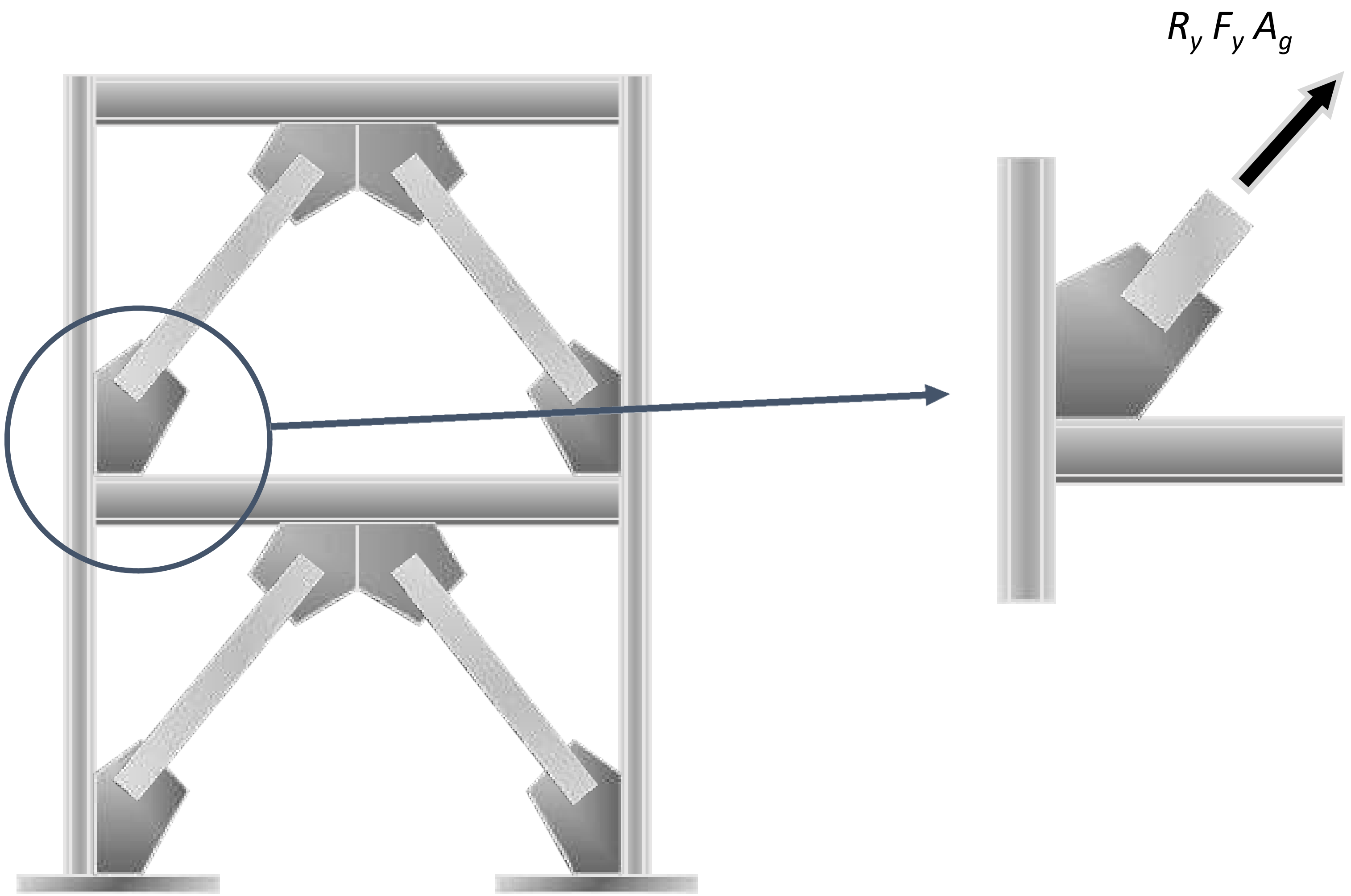
$$\phi P_n = (0.75)\left[U_{bs} A_{nt} R_t F_u + \textit{lesser of} \begin{Bmatrix} 0.6\, A_{nv}\, R_t\, F_u \\ 0.6\, A_{gv}\, R_y\, F_y \end{Bmatrix} \right]$$

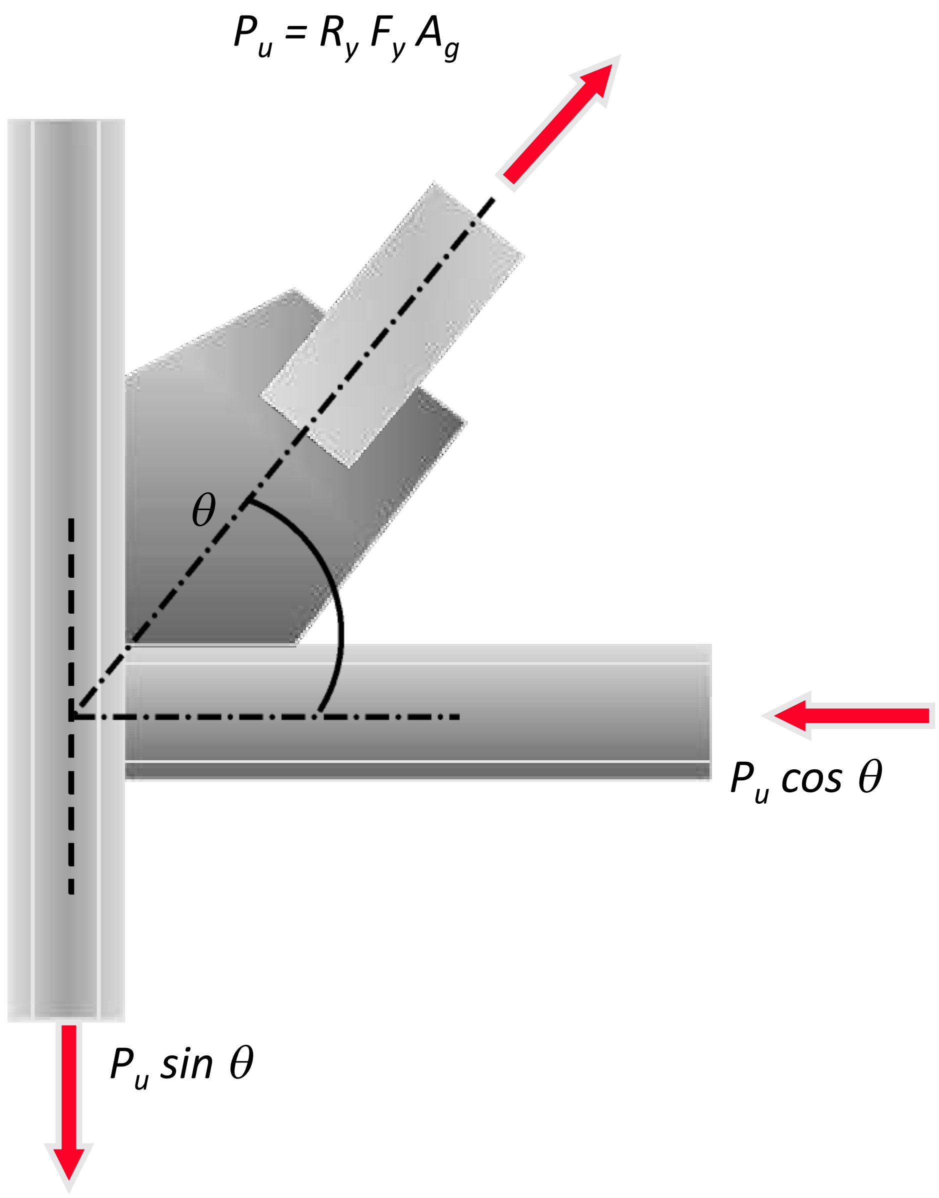
$A_{nt} \cong 0$

$A_{nt} = A_{gv} = 4\, L\, t$

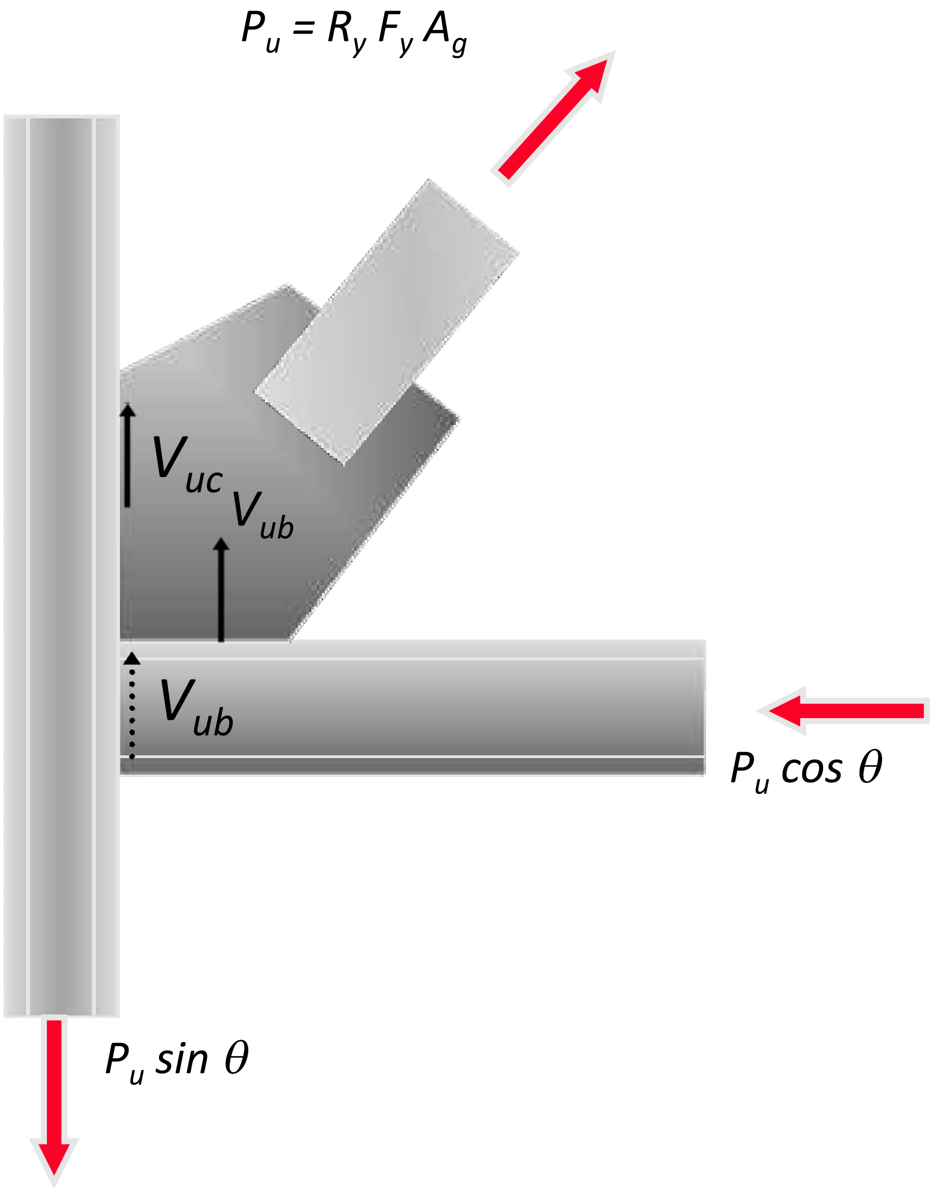
Net kesit bölgesinde takviye edilmeli....

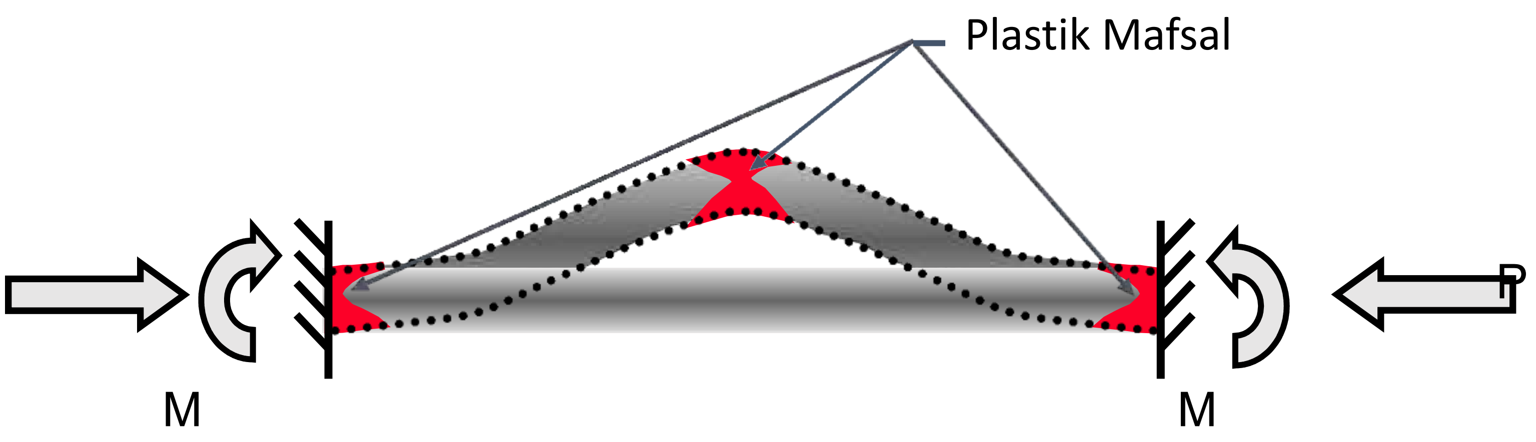




$R_y F_y A_g$



$P_u = R_y F_y A_g$
θ
$P_u \cos \theta$
$P_u \sin \theta$

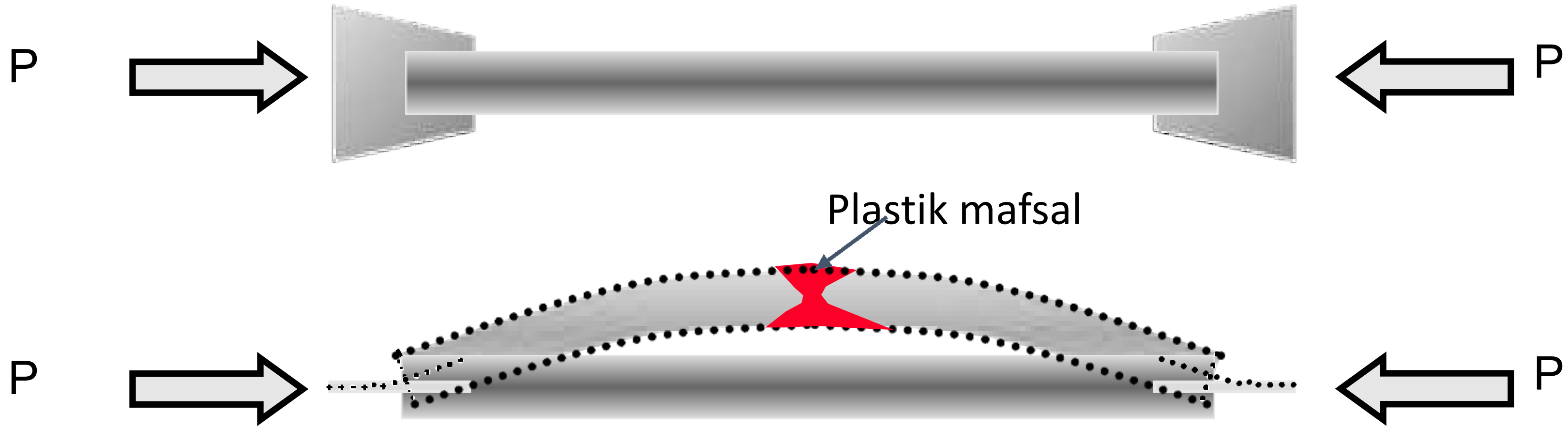

$P_u = R_y F_y A_g$
V_{uc}
V_{ub}
V_{ub}
$P_u \cos\theta$
$P_u \sin\theta$



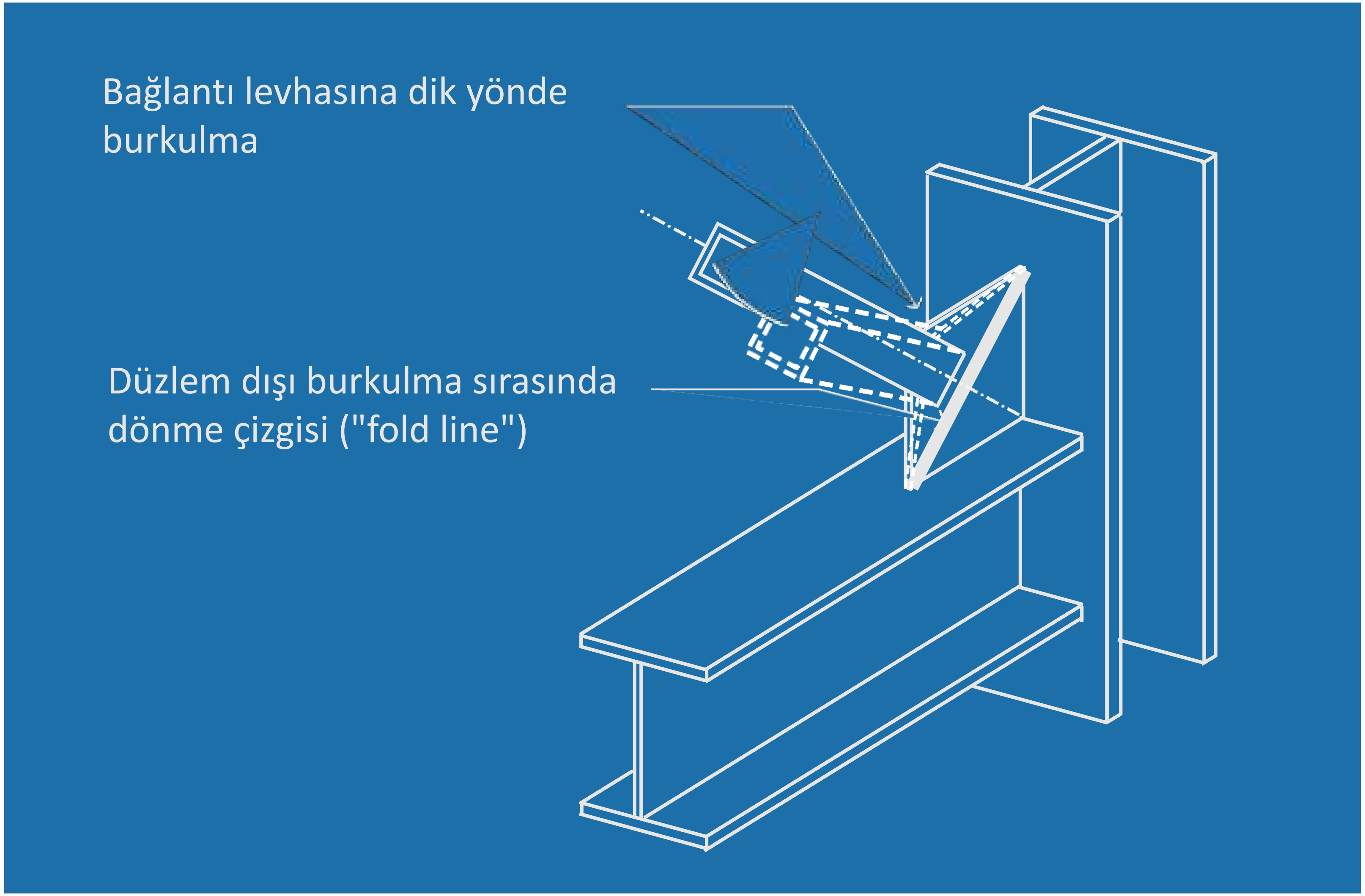
Rijit bağlantıl berkitme elemanı

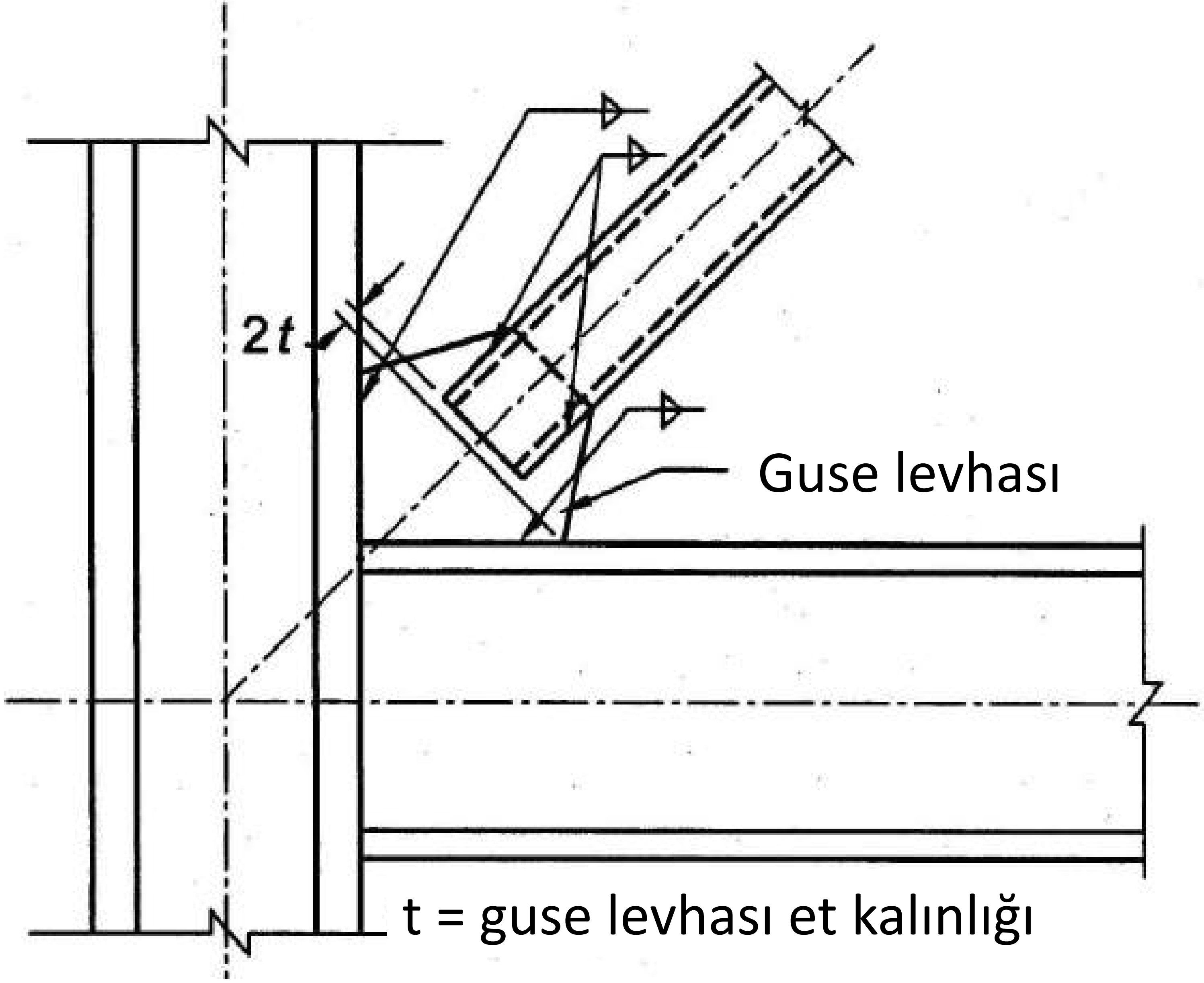
$M_u = 1.1\ R_y\ M_p\ = 1.1\ R_y\ F_y\ Z_{brace}$
(kritik burkulma yönünde)

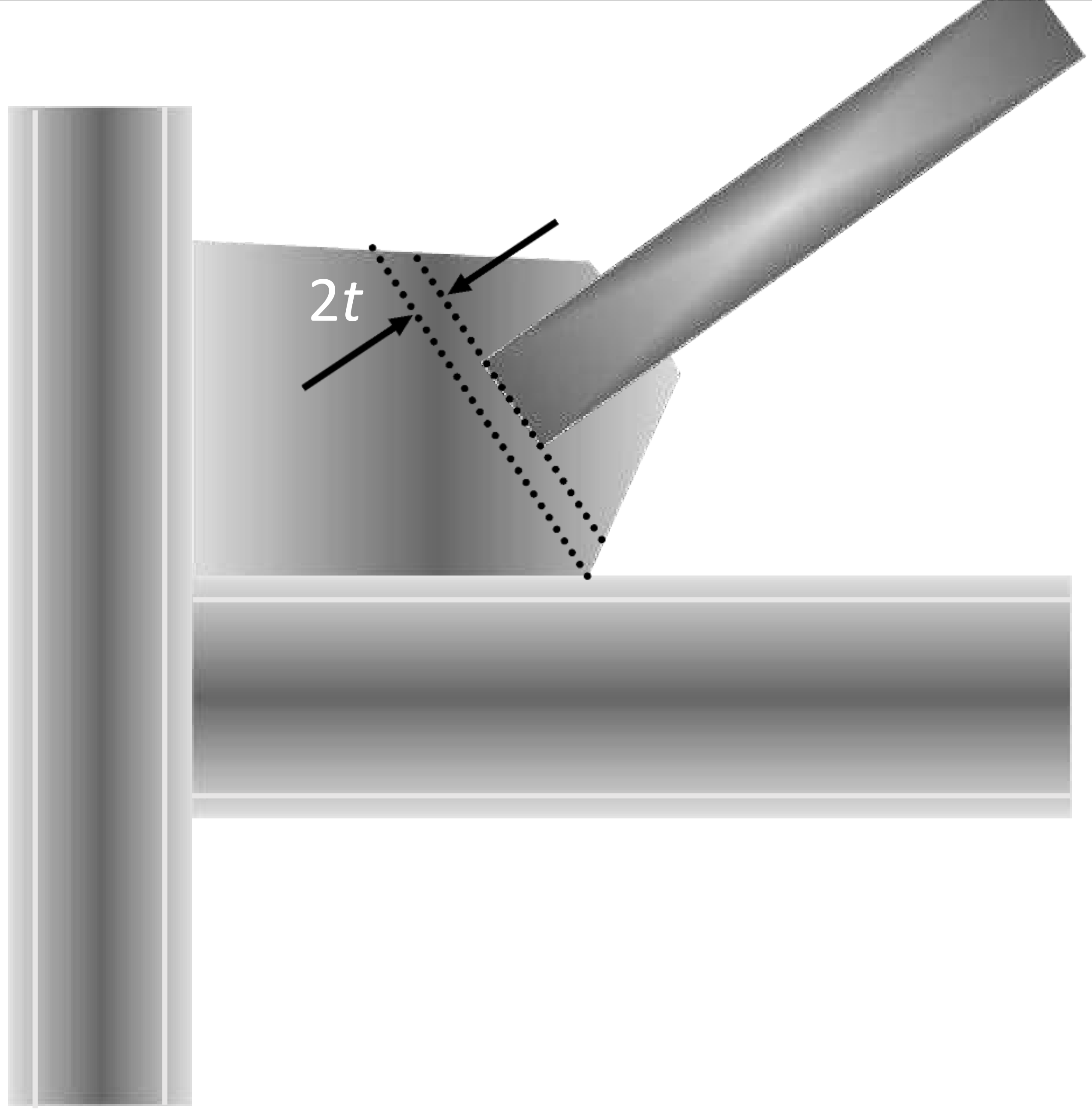

1.1 R_y M_p-brace

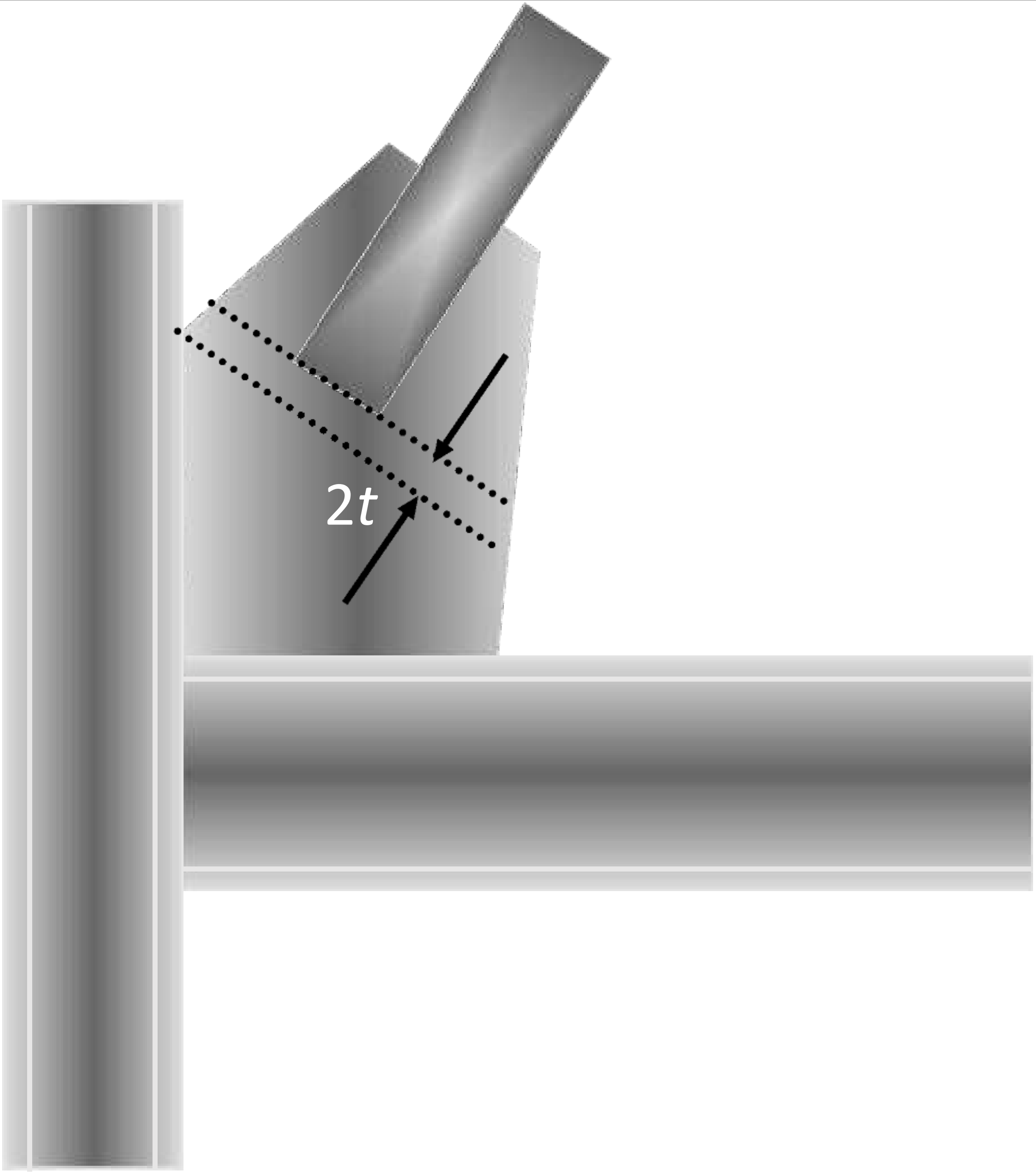


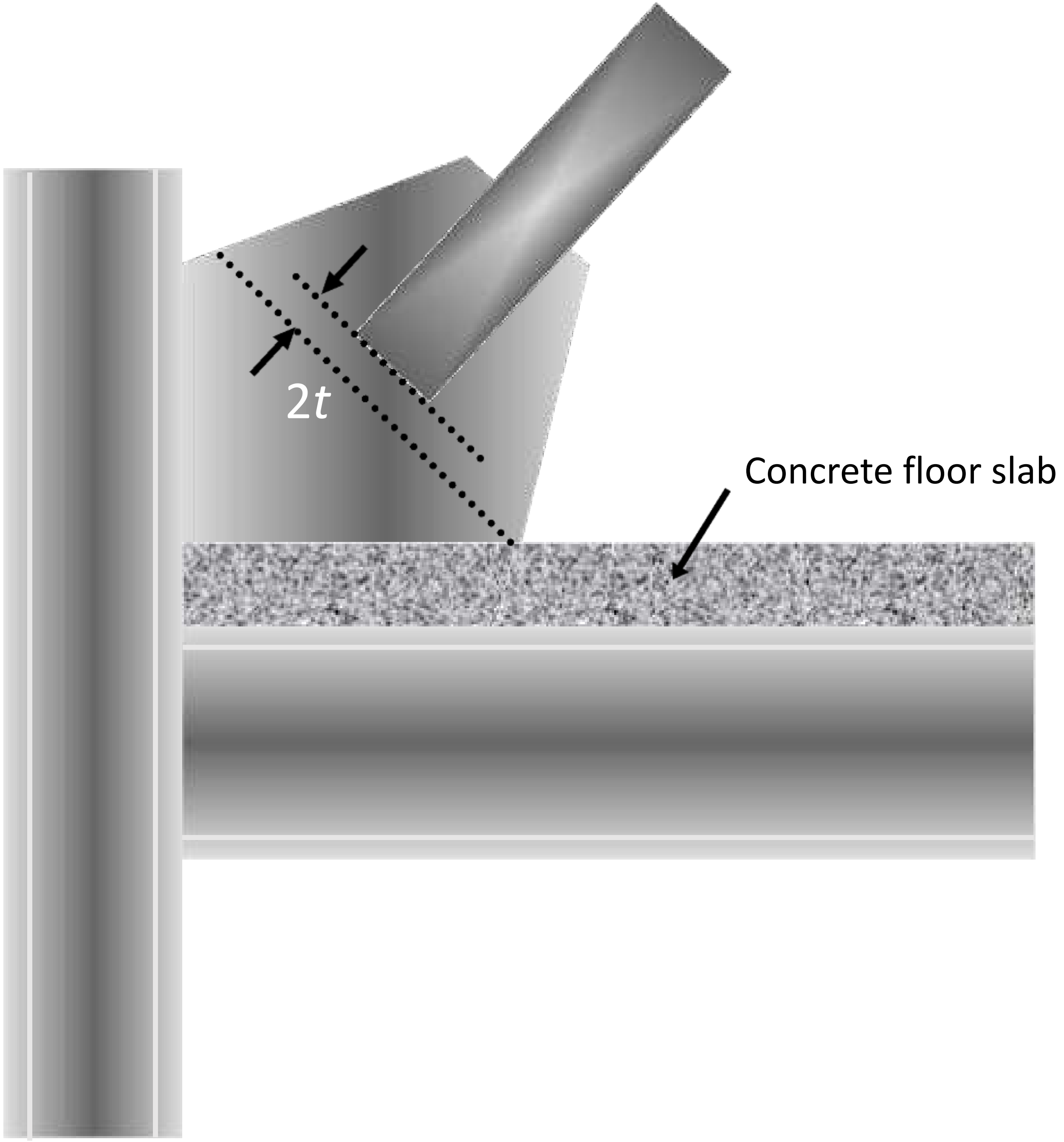
Mafsallı bağlantı durumunda

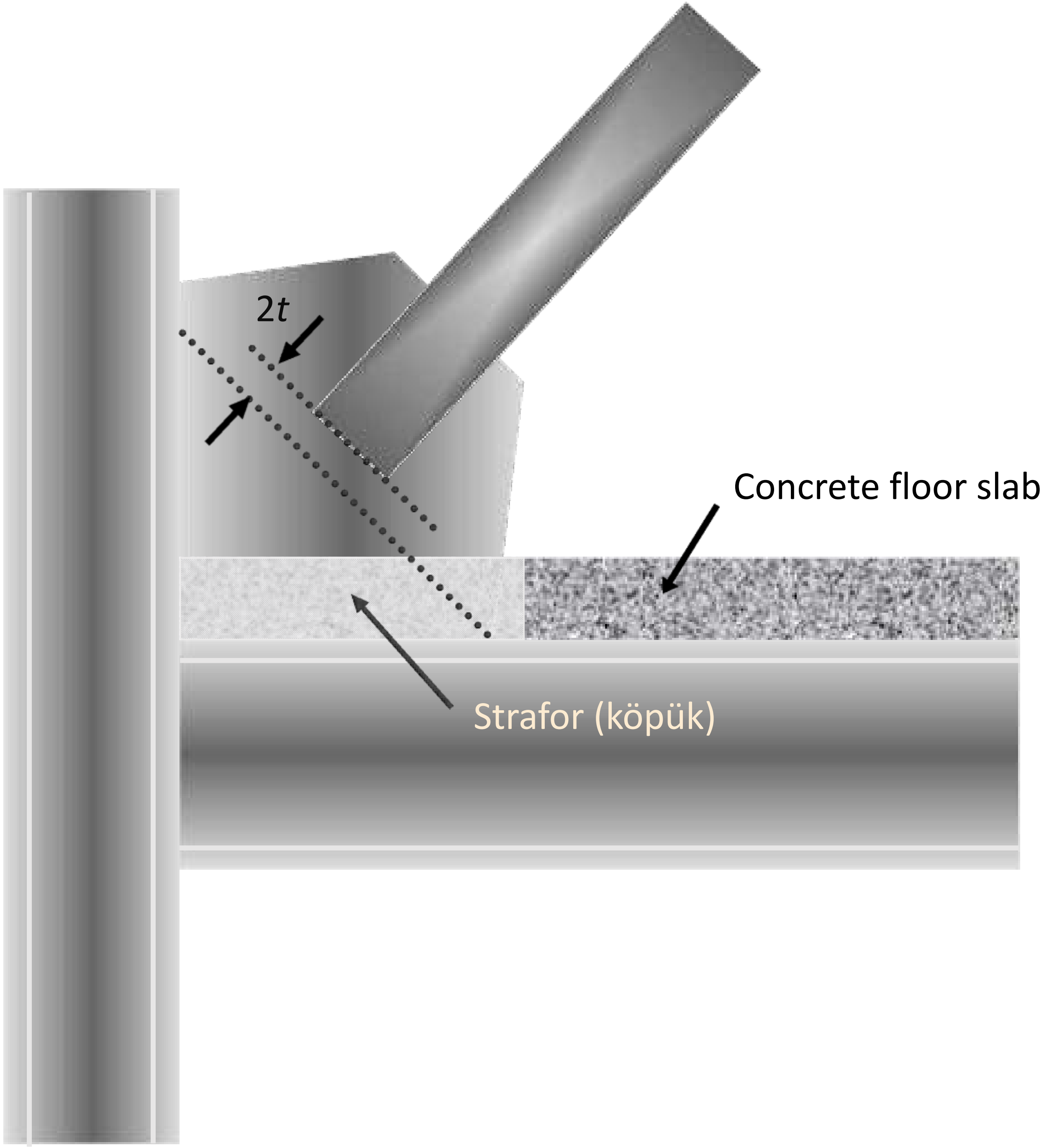

Bağlantı levhasına dik yönde
burkulma
Düzlem dışı burkulma sırasında
dönme çizgisi ("fold line")


2t
Guse levhası
t = guse levhası et kalınlığı

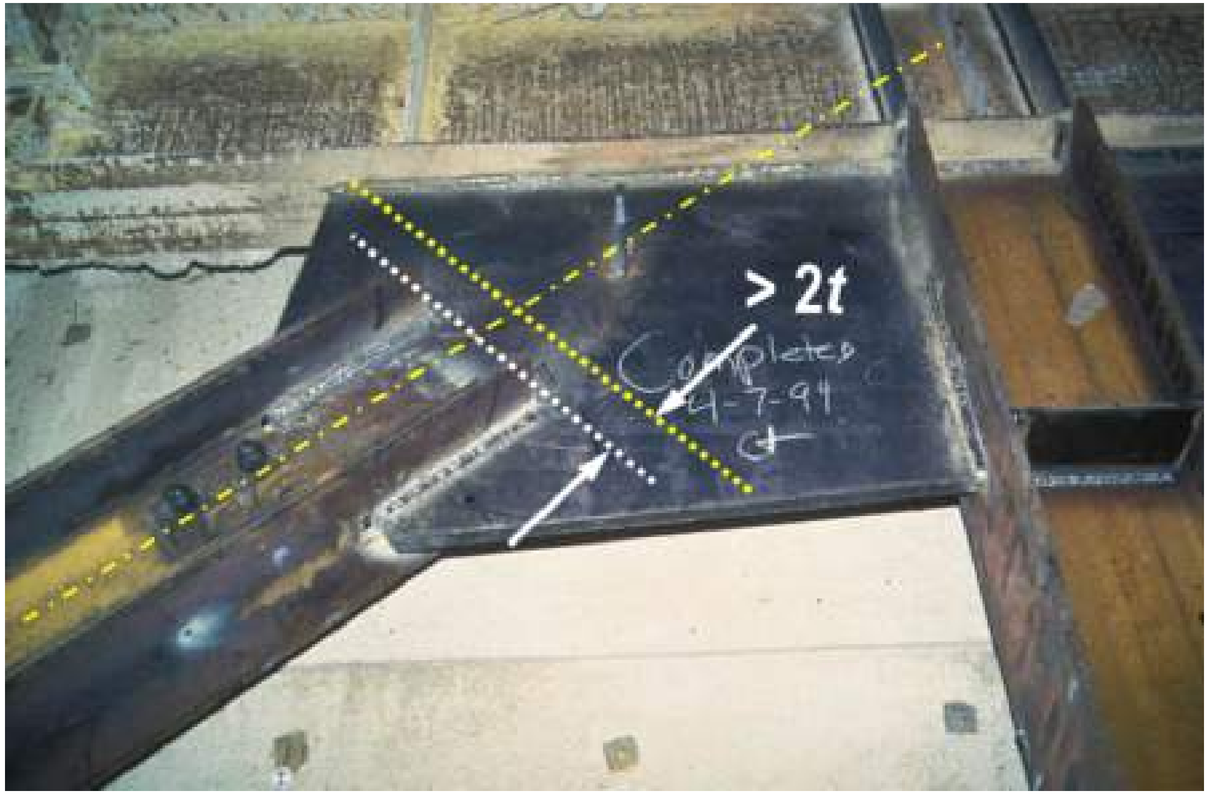

2t


2t

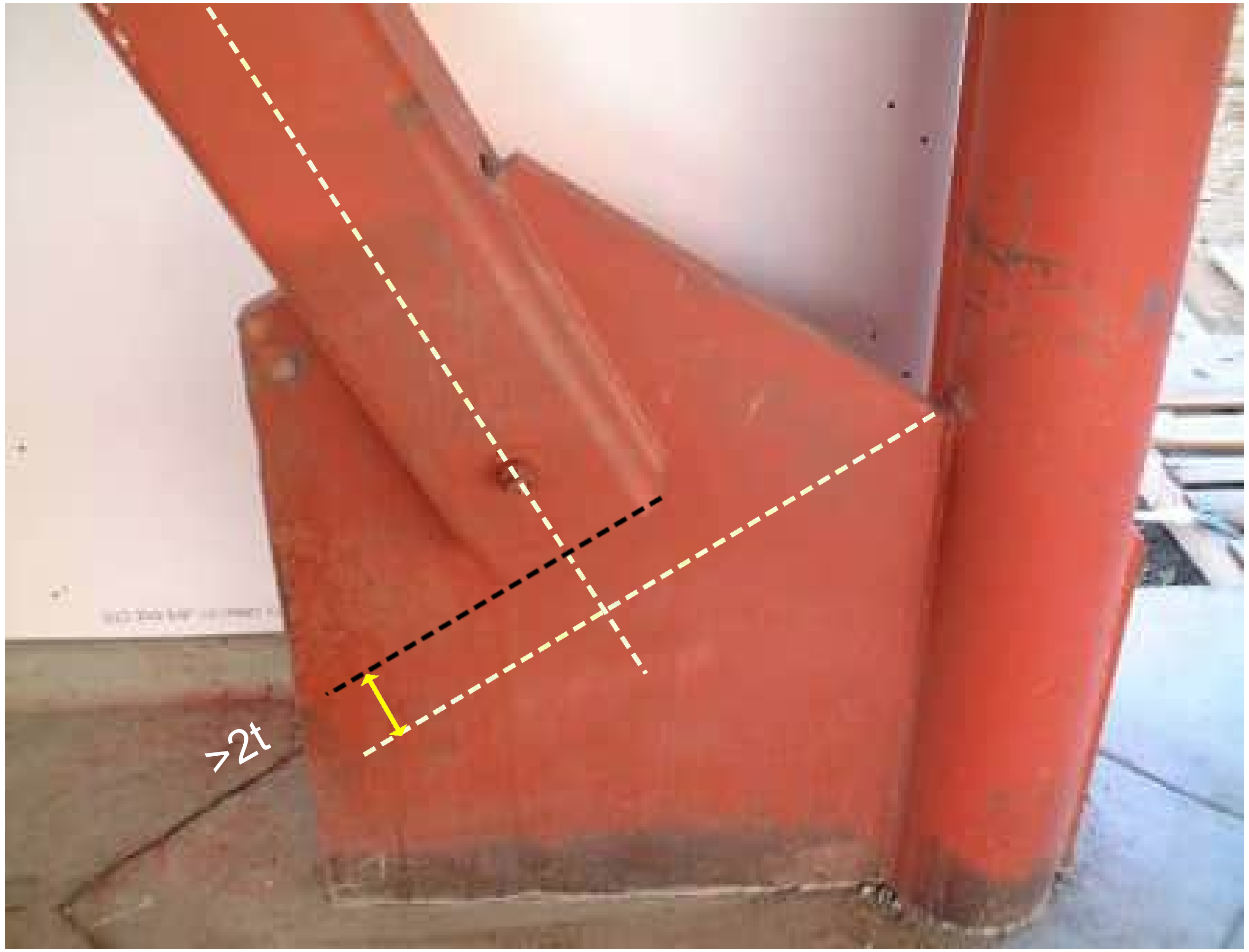

2t
Concrete floor slab


2t
Concrete floor slab
Strafor (köpük)





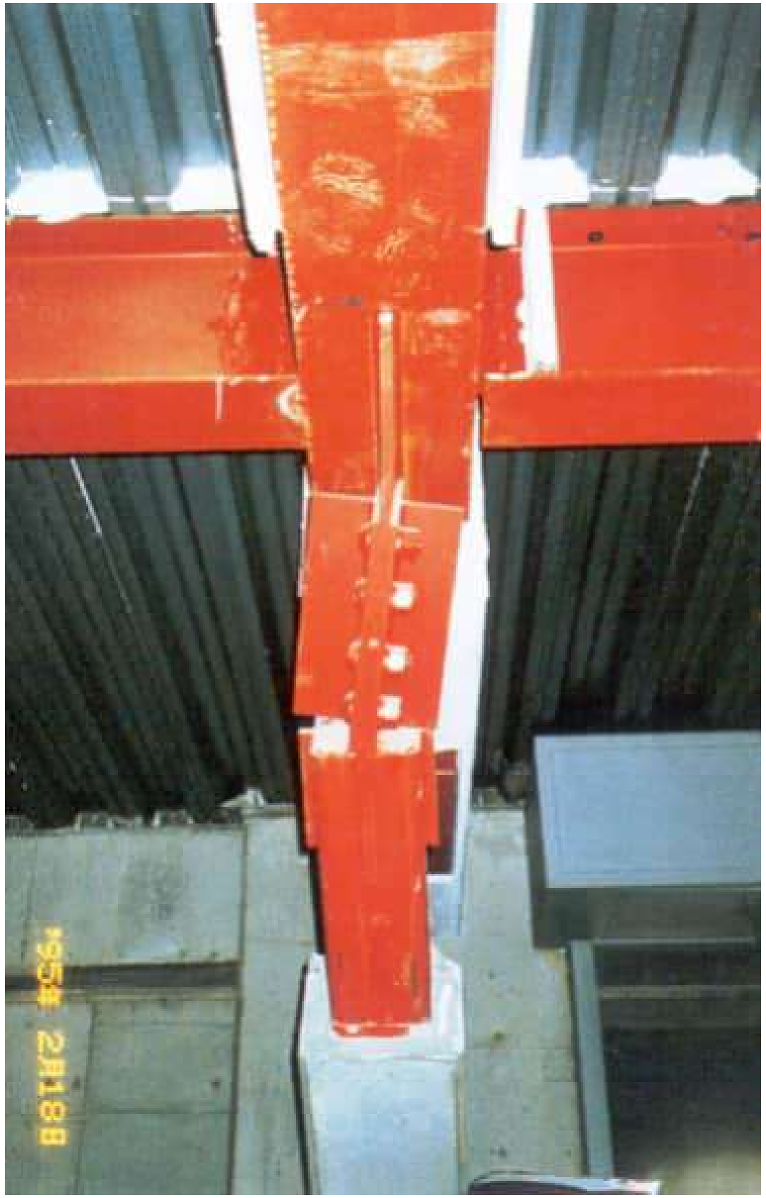
> 2t
Completed
4-7-94



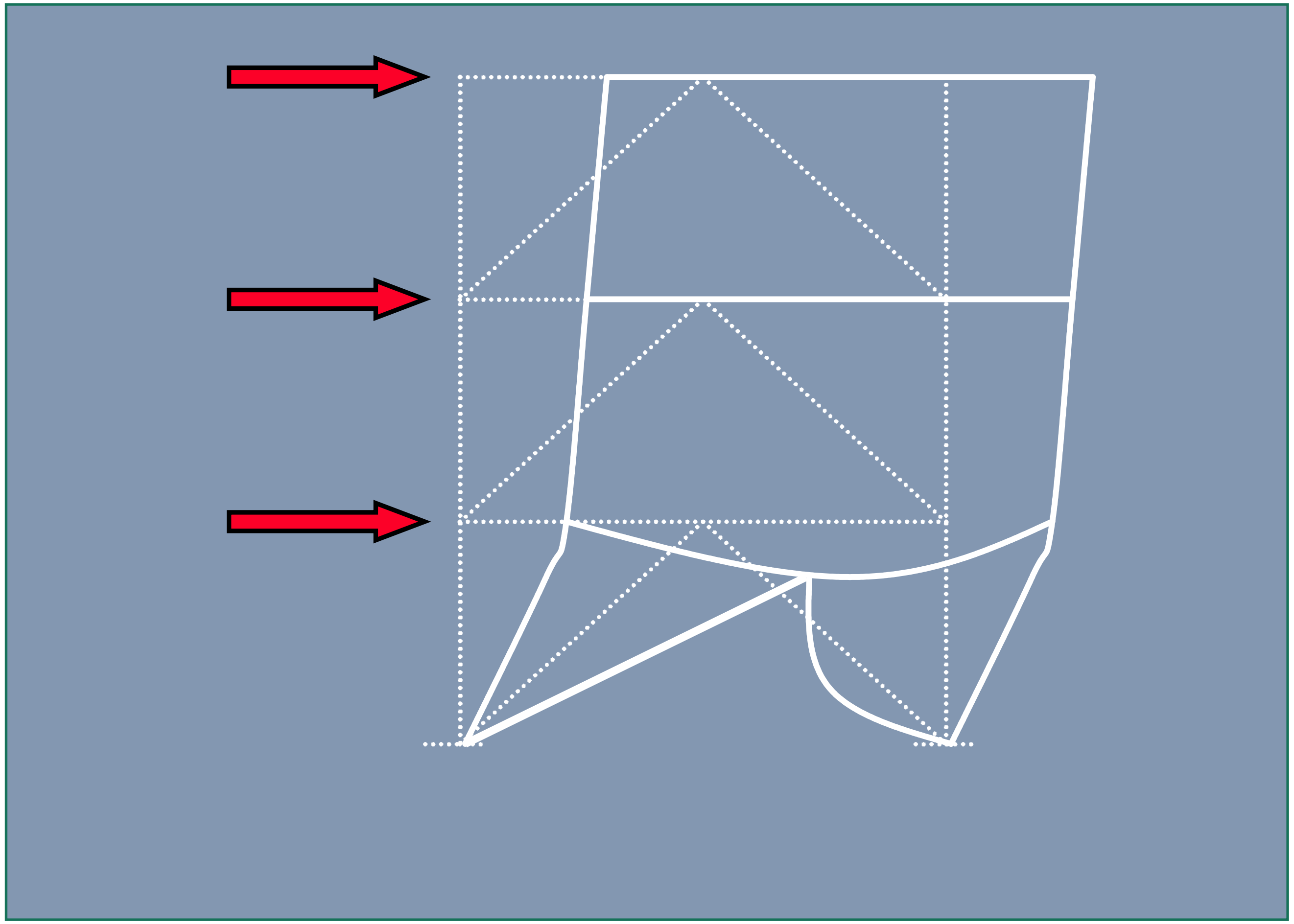
>2t

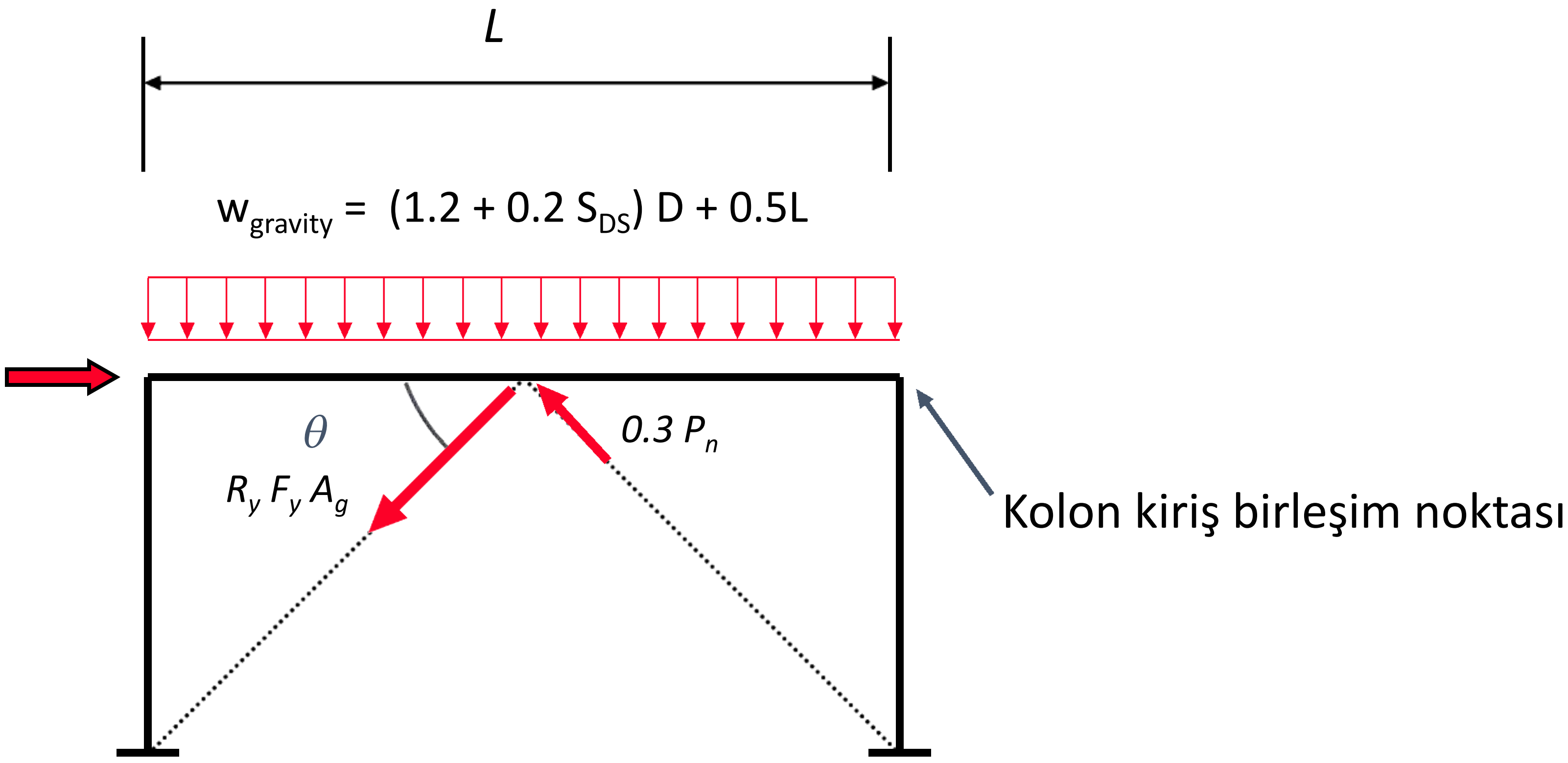
> 2t


'95年 2月19日


'95年 2月18日

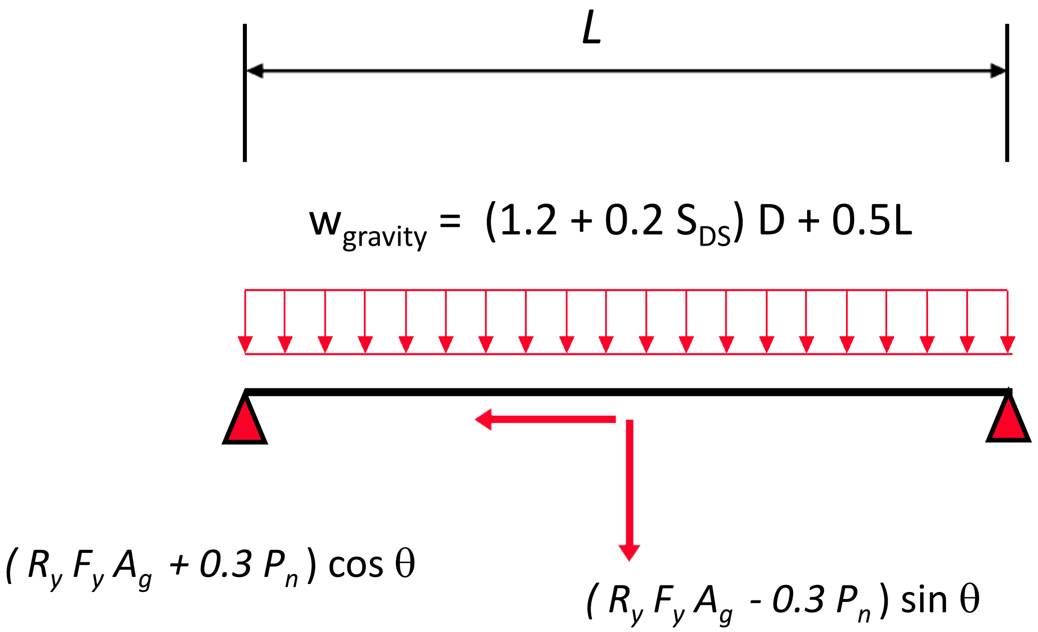
V tipi berkitmelerde

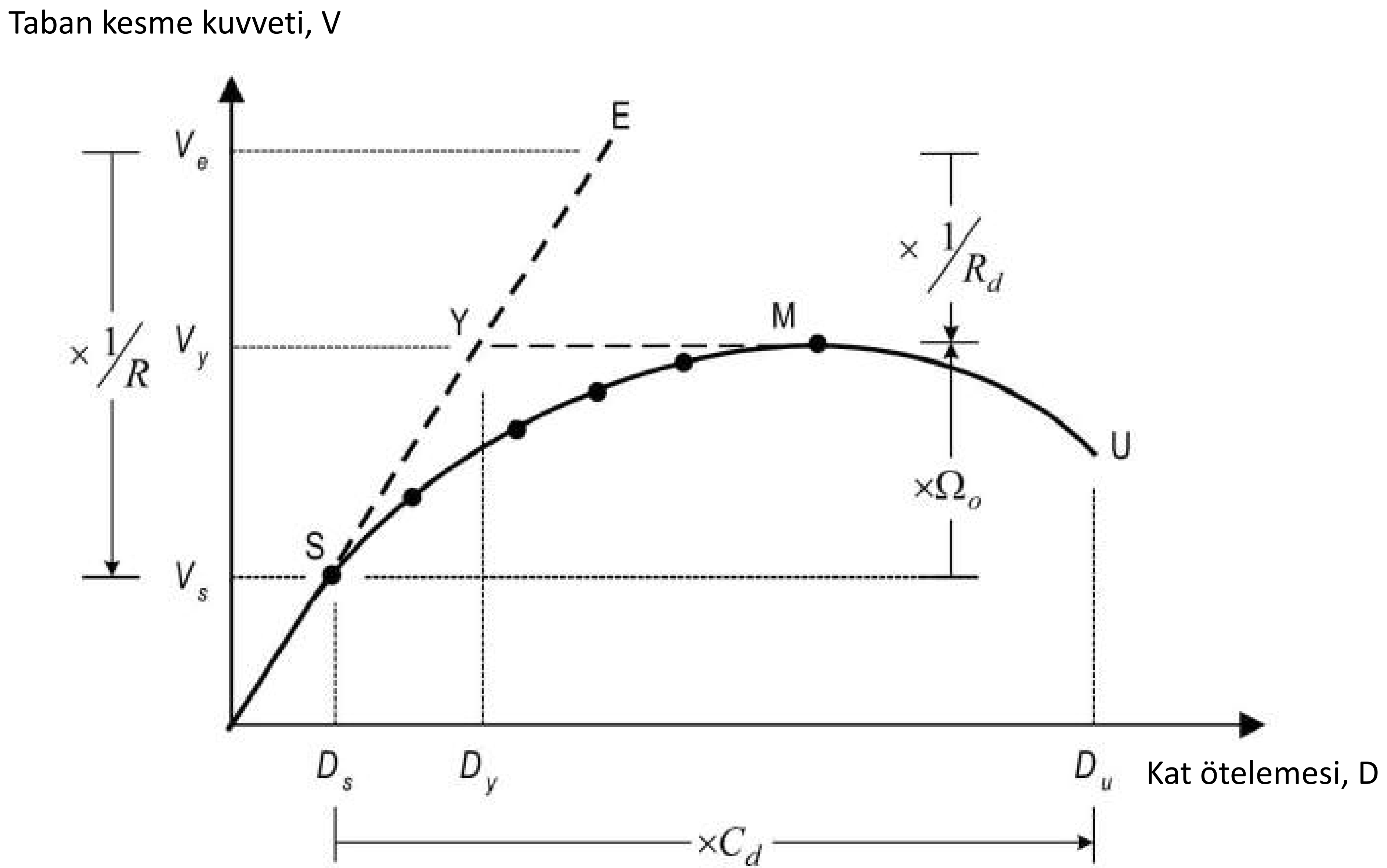




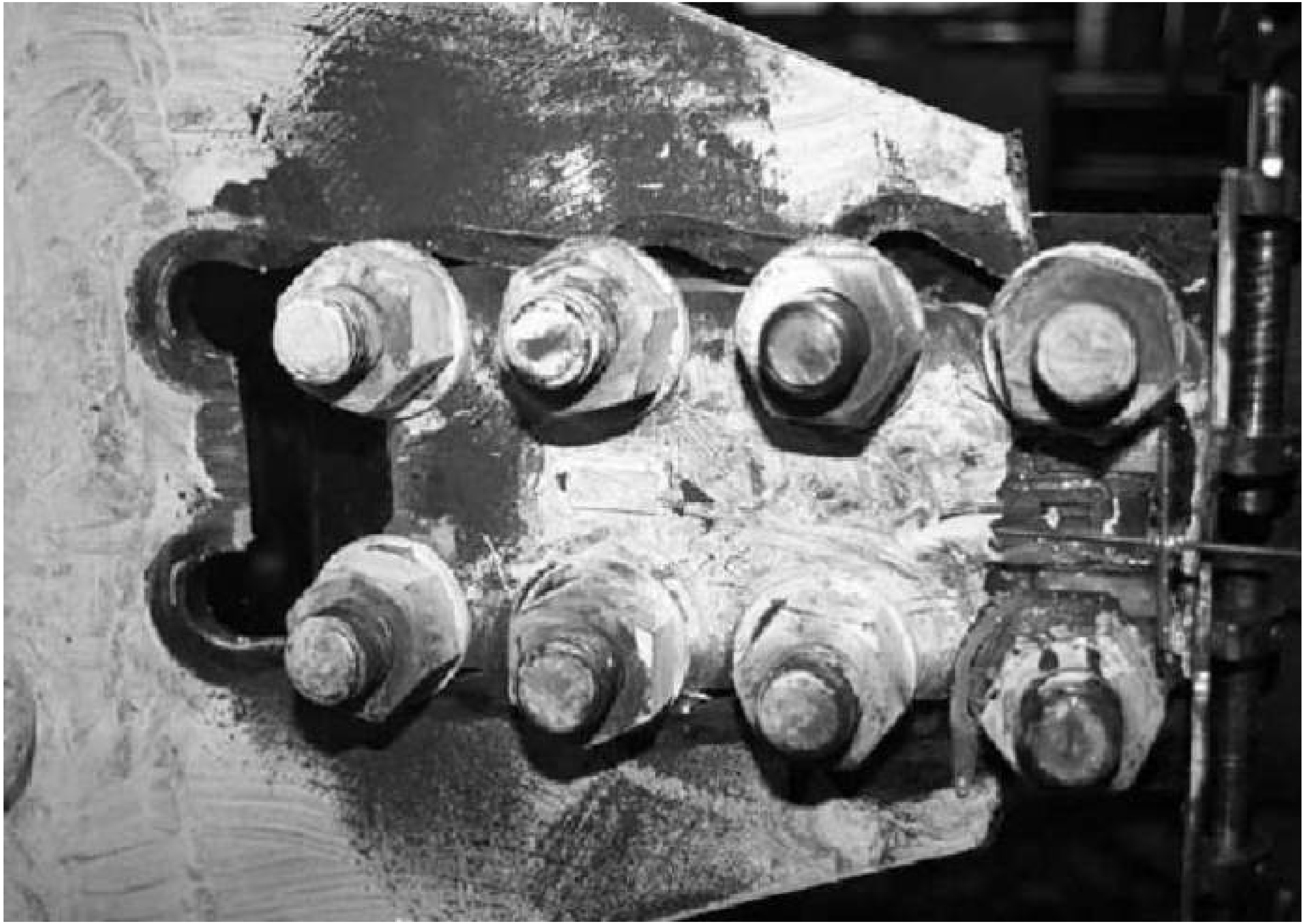
L
w_gravity = (1.2 + 0.2 S_DS) D + 0.5L
θ
R_y F_y A_g
0.3 P_n
Kolon kiriş birleşim noktası

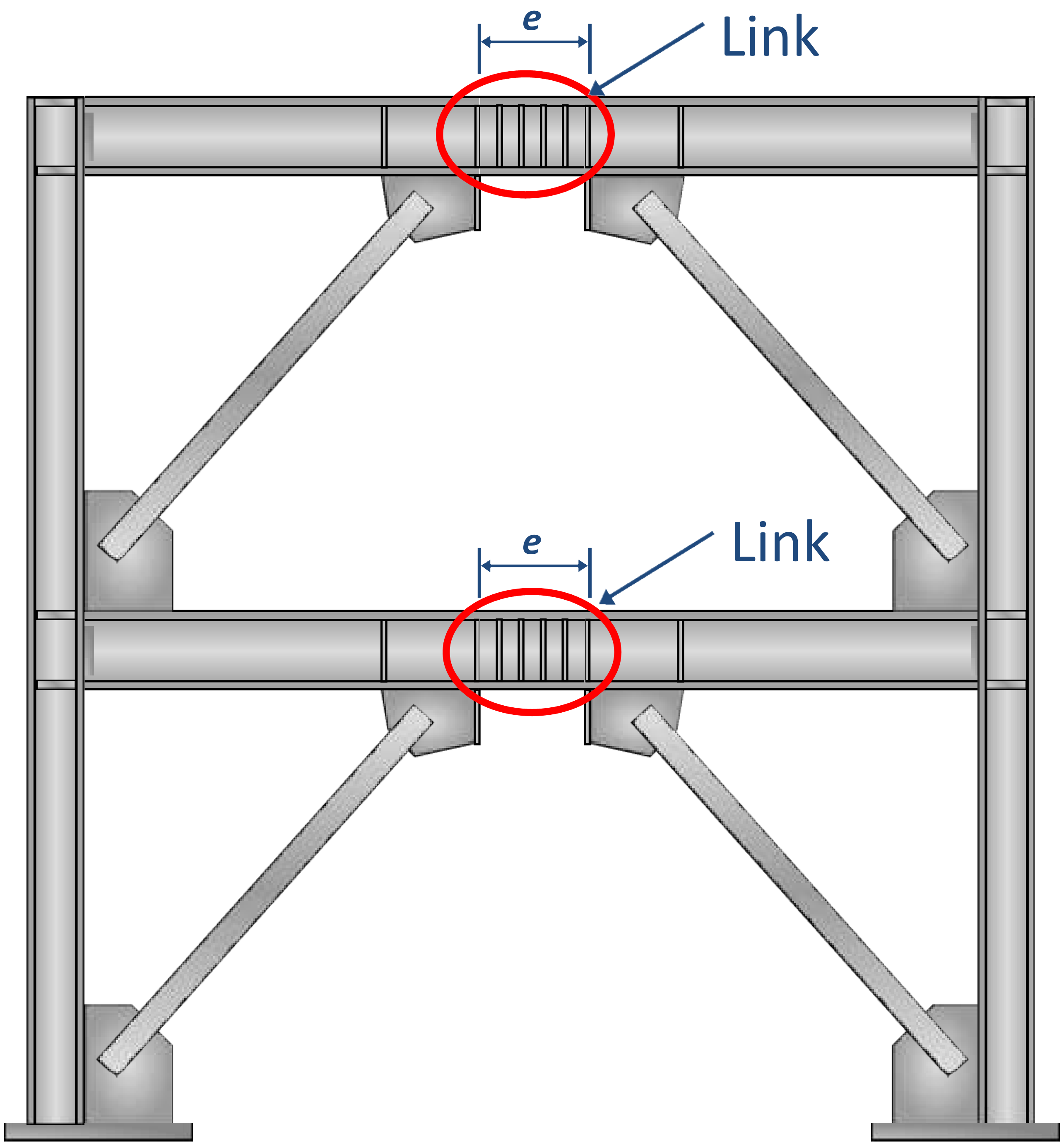
Kirişe etki eden yükler:



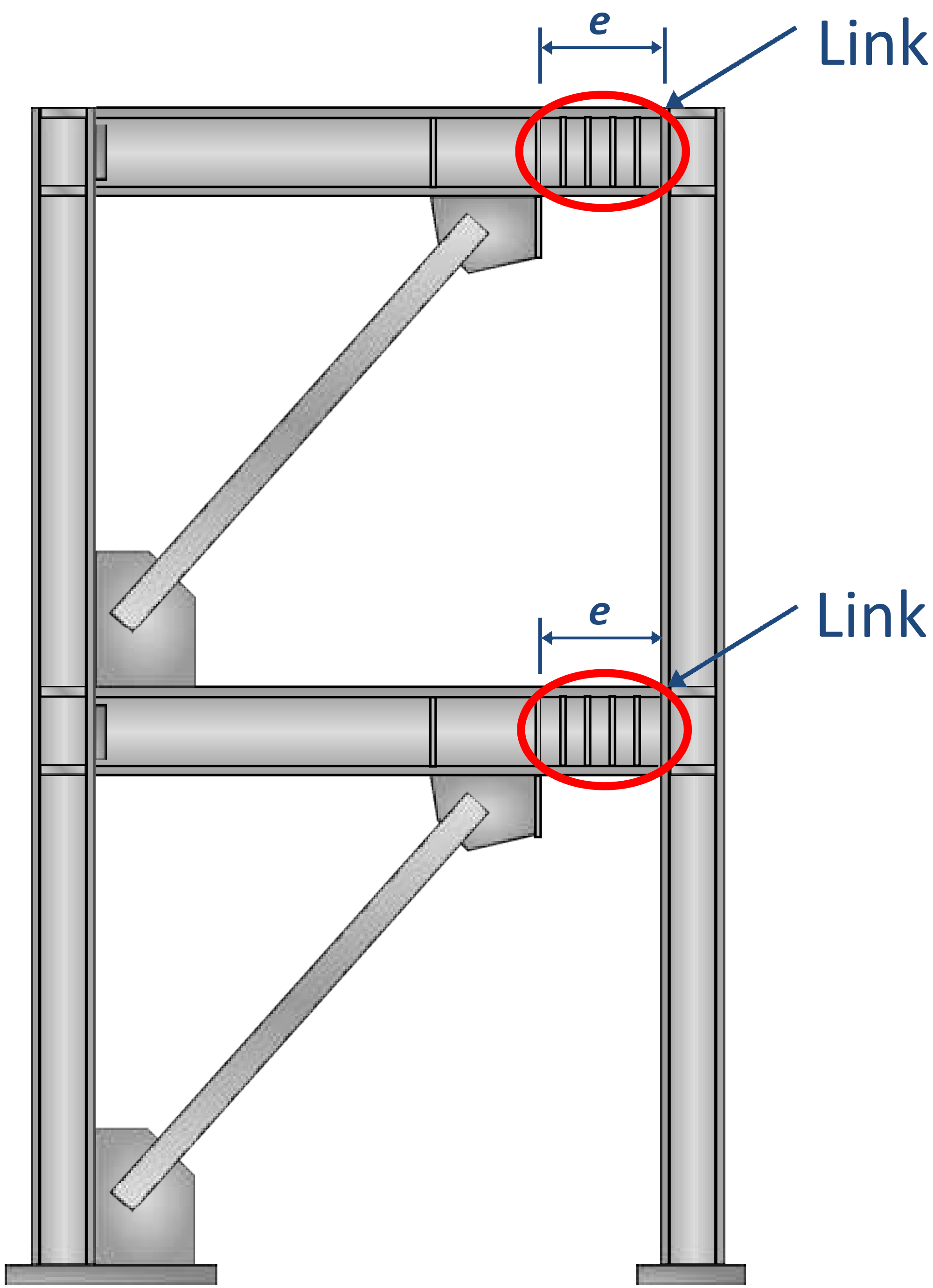


Taban kesme kuvveti, V
V_e
V_y
V_s
E
Y
M
S
U
$\times 1/R$
$\times 1/R_d$
$\times \Omega_o$
D_s
D_y
D_u
Kat ötelemesi, D
$\times C_d$

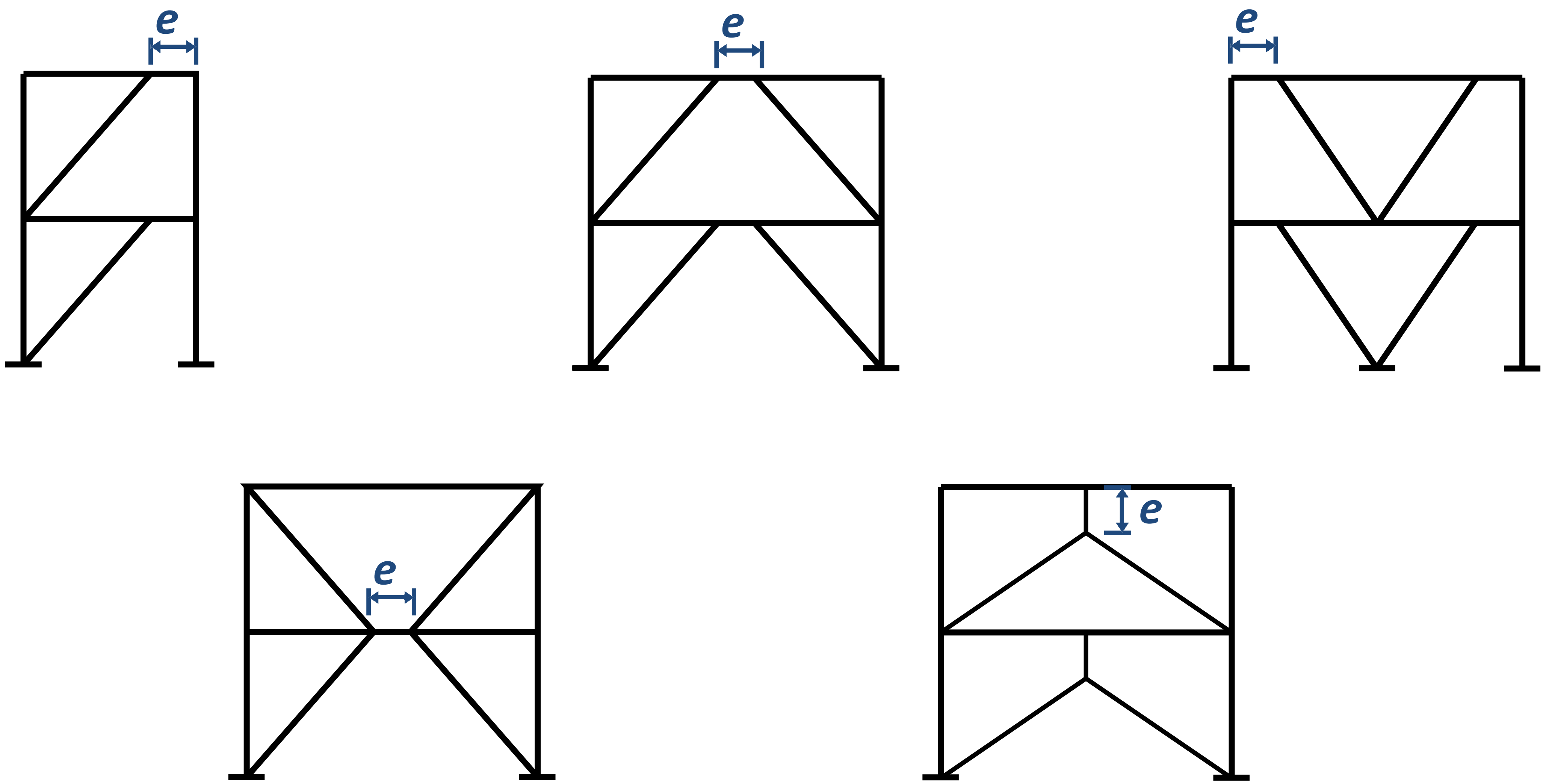




e
Link
e
Link


e
Link
e
Link

Some possible bracing arrangement for EBFS



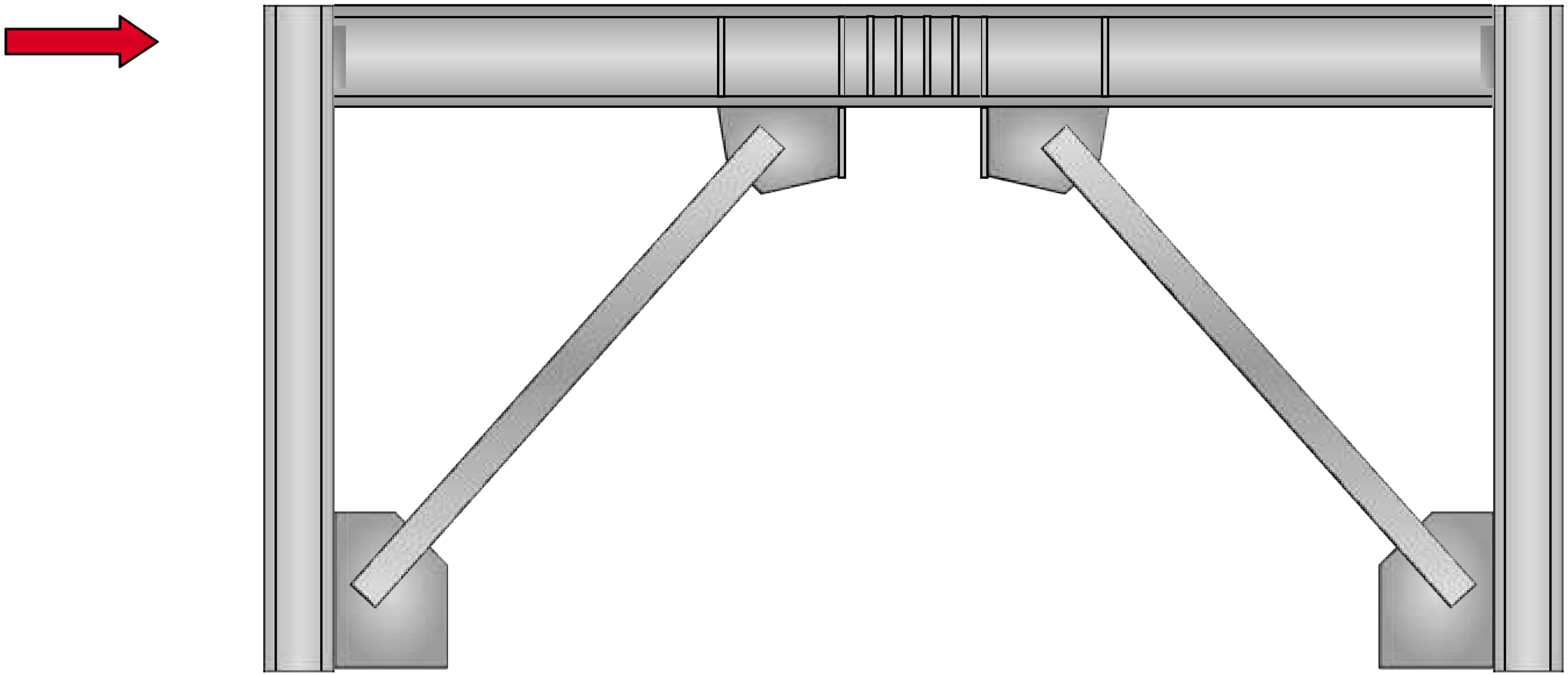

C
BB

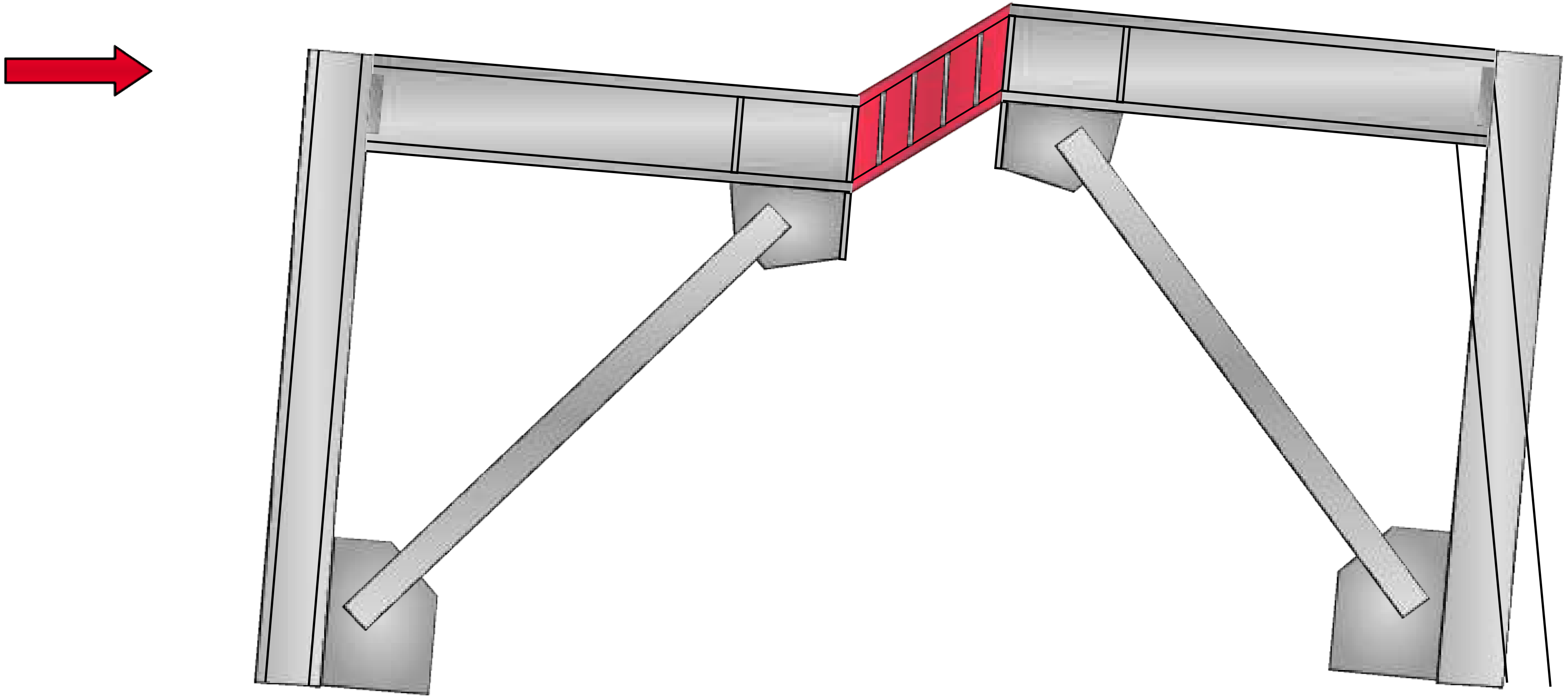

Herrick
4
KEEP OUT

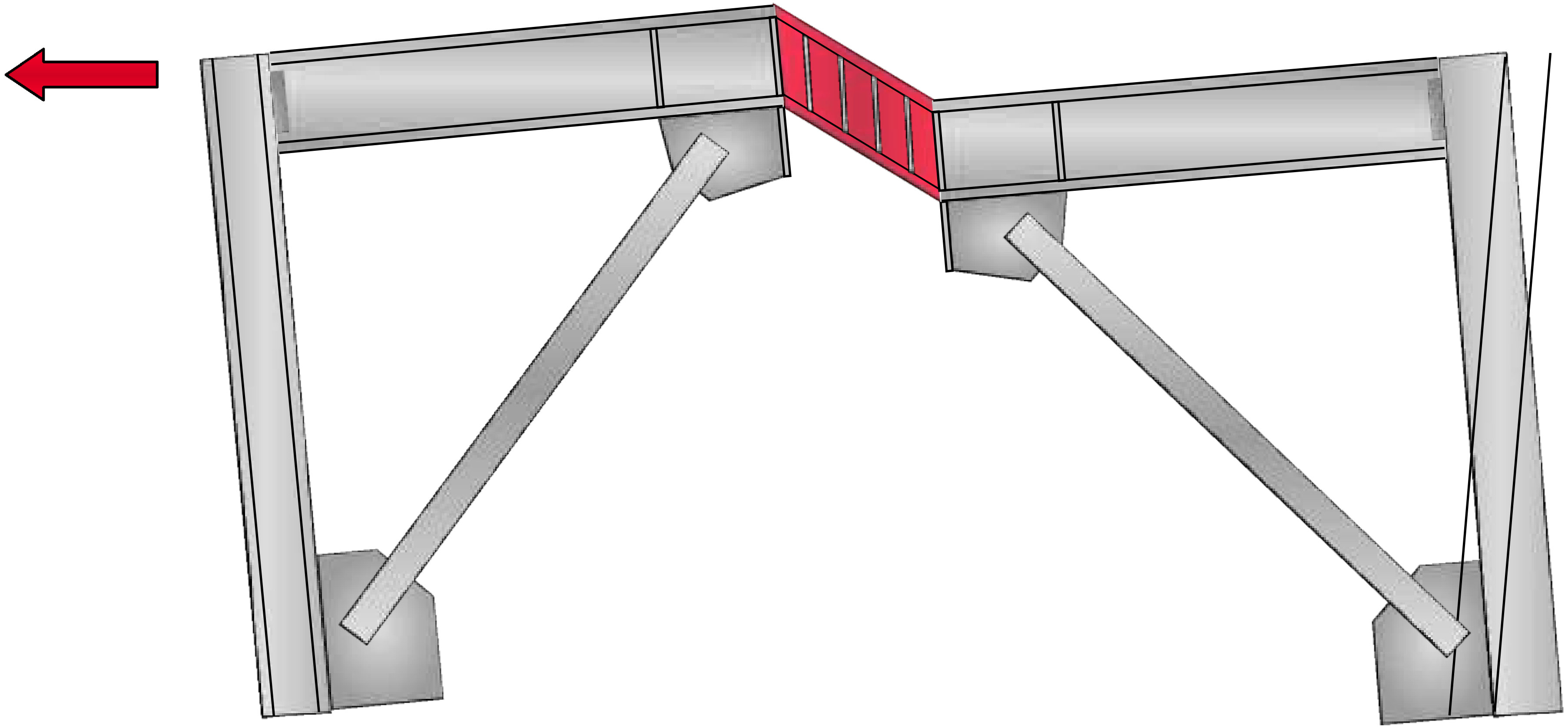

W&W STEEL CO
W&W STEEL CO

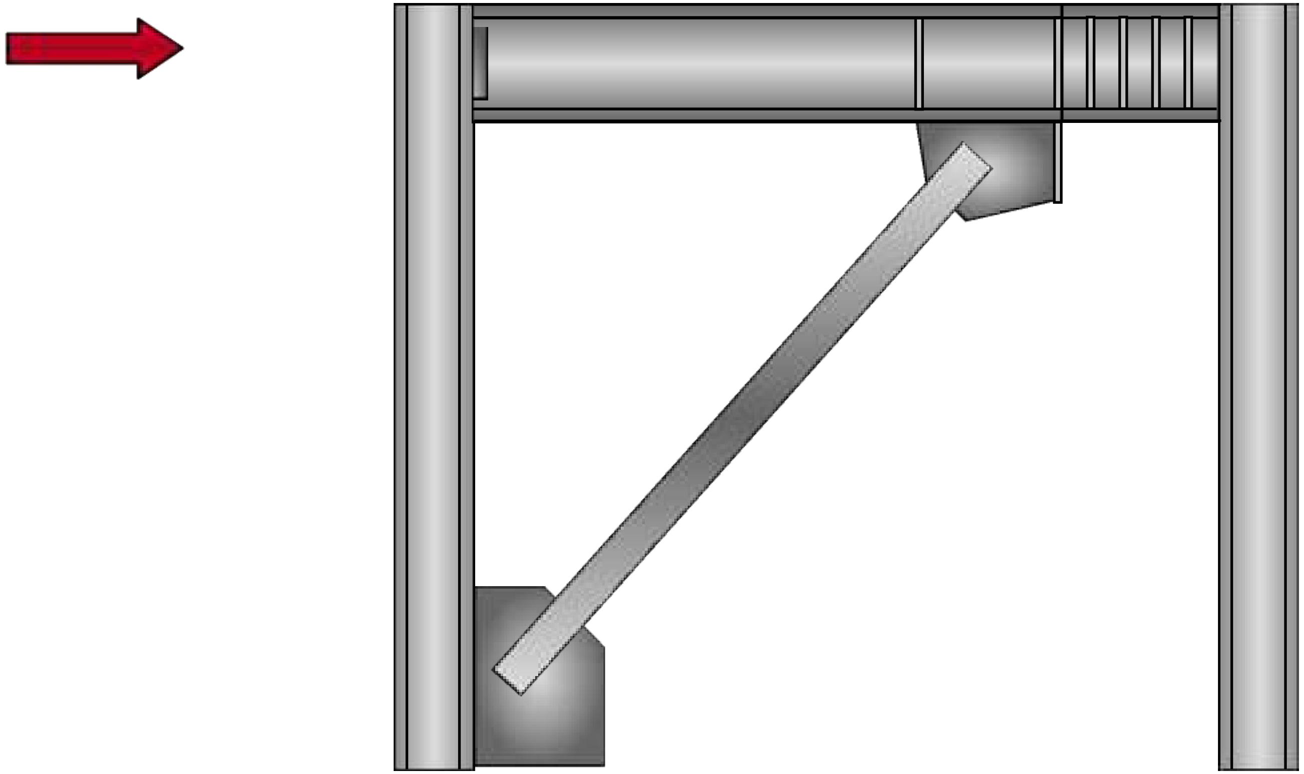

5 15 '99

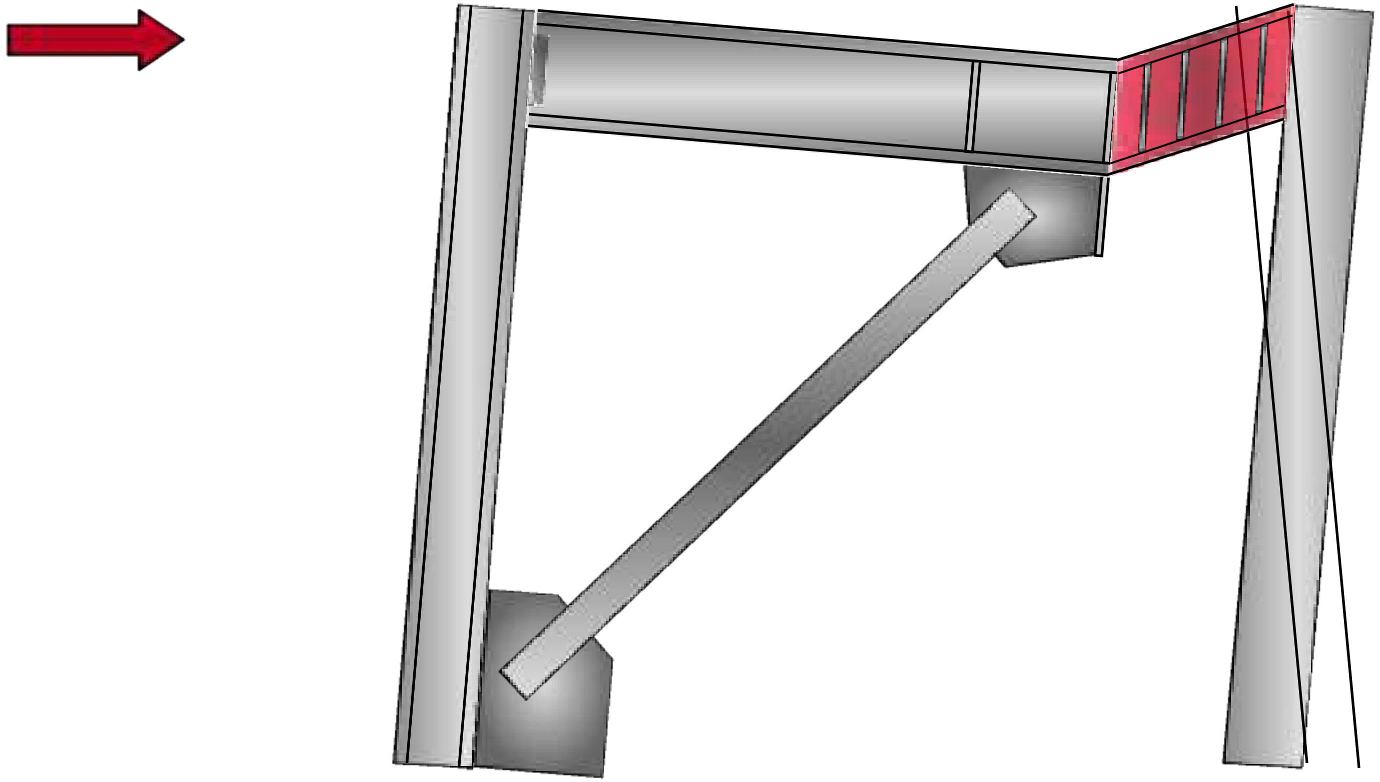
Elastik Ötesi Davranış (dışmerkez çapraz)

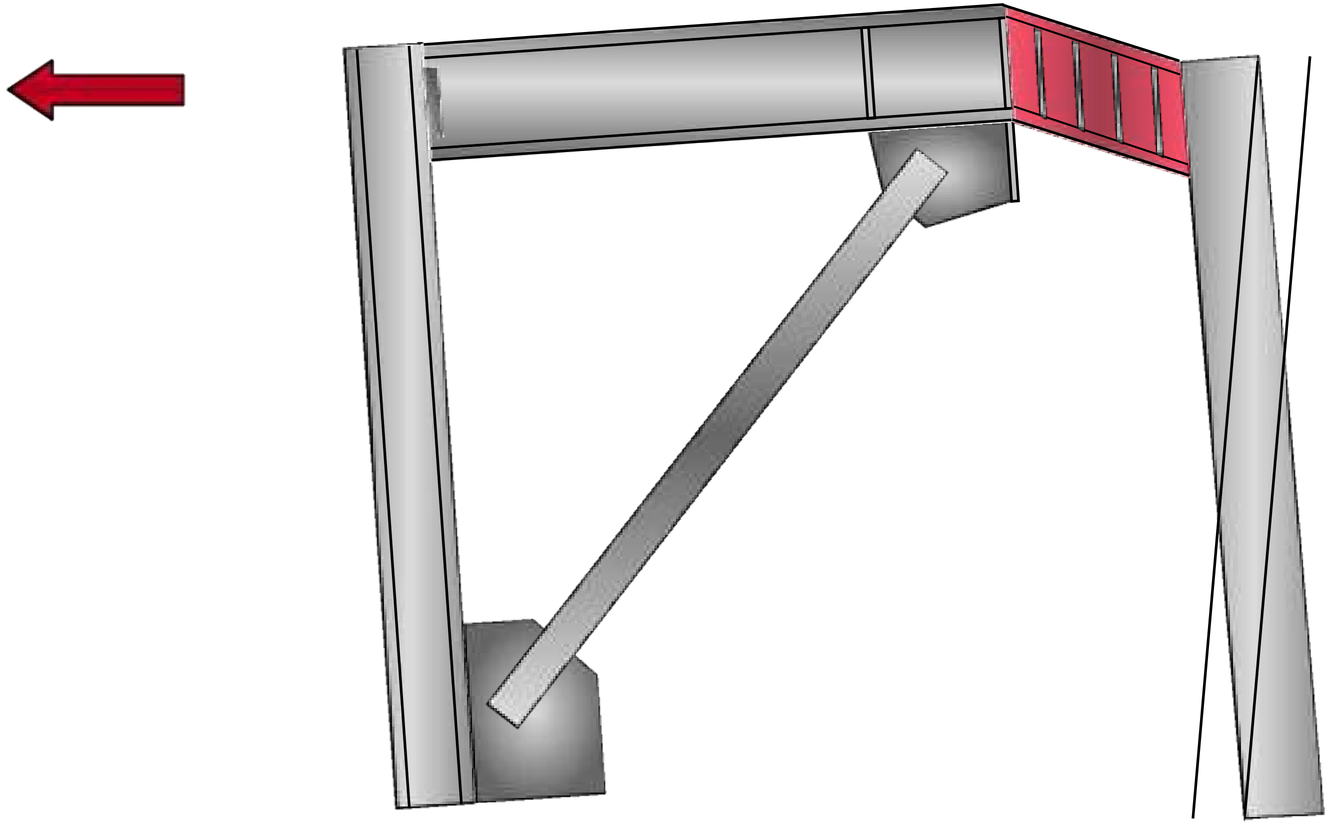


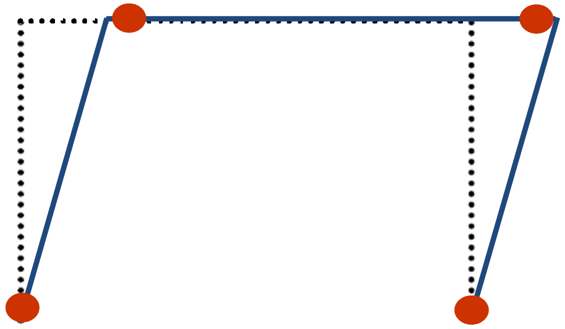




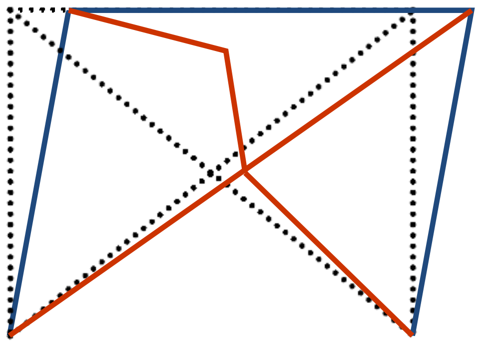




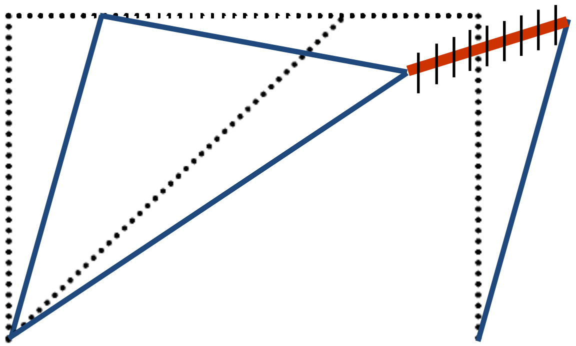




MRF



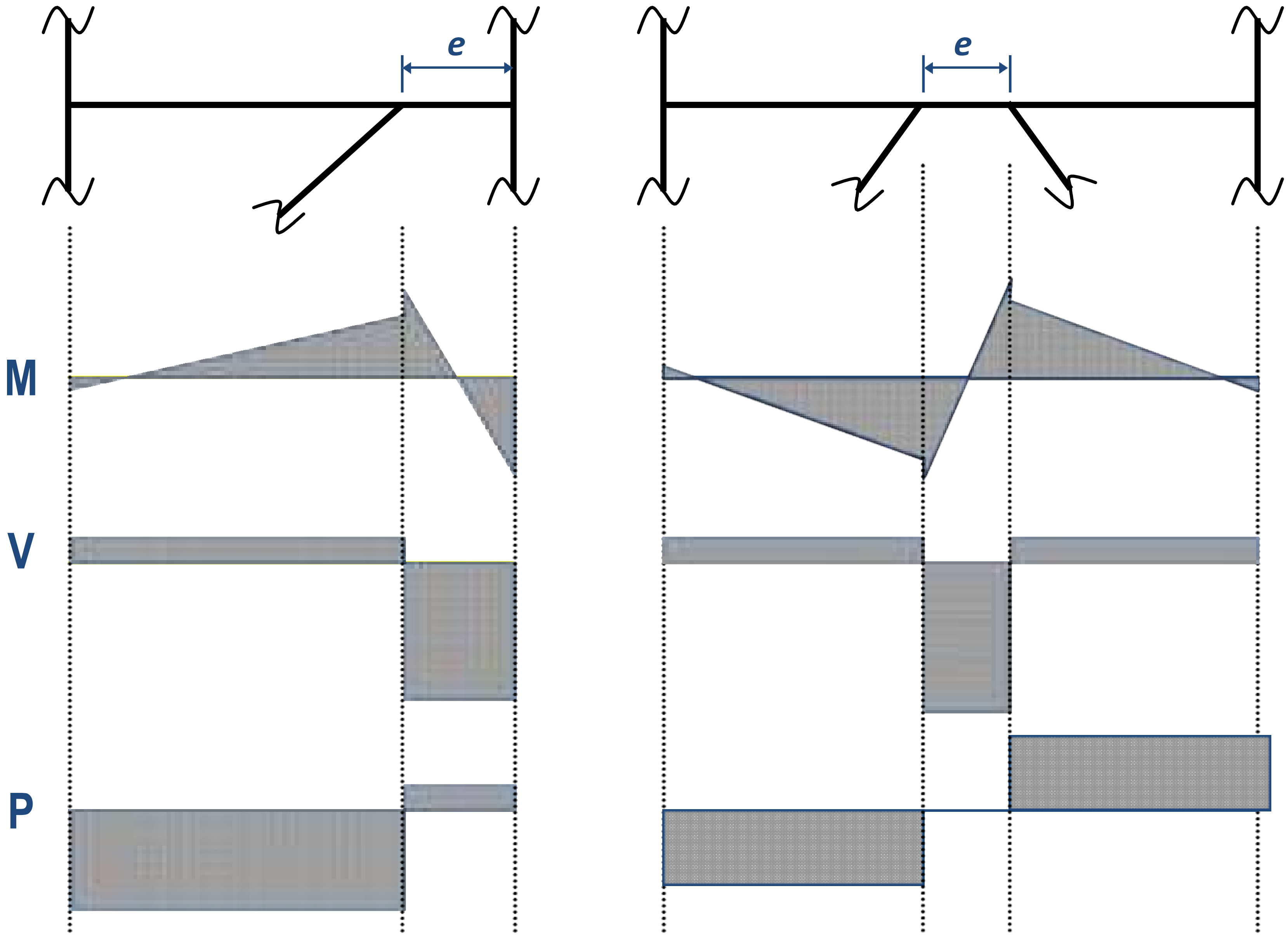
CBF



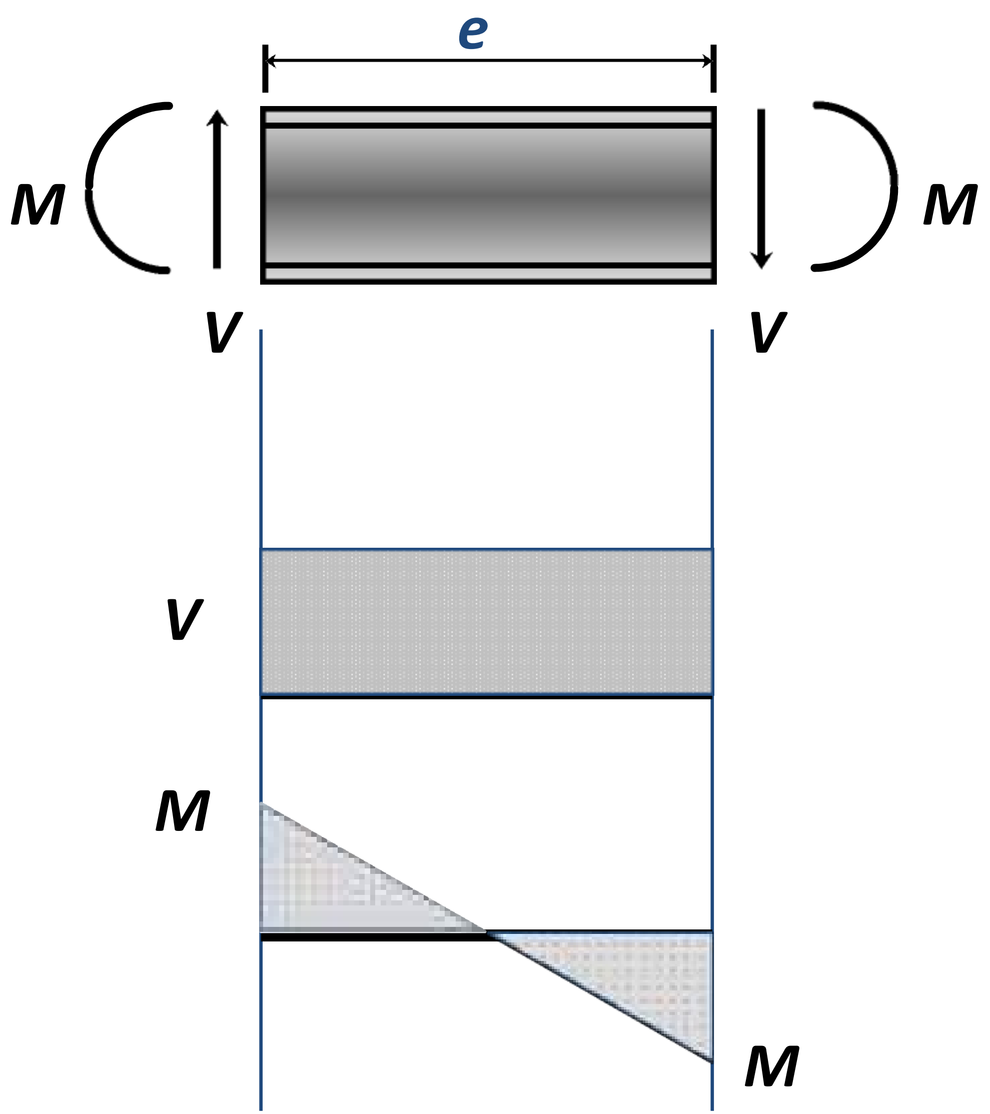
EBF

Enerji harcama mekanizmaları

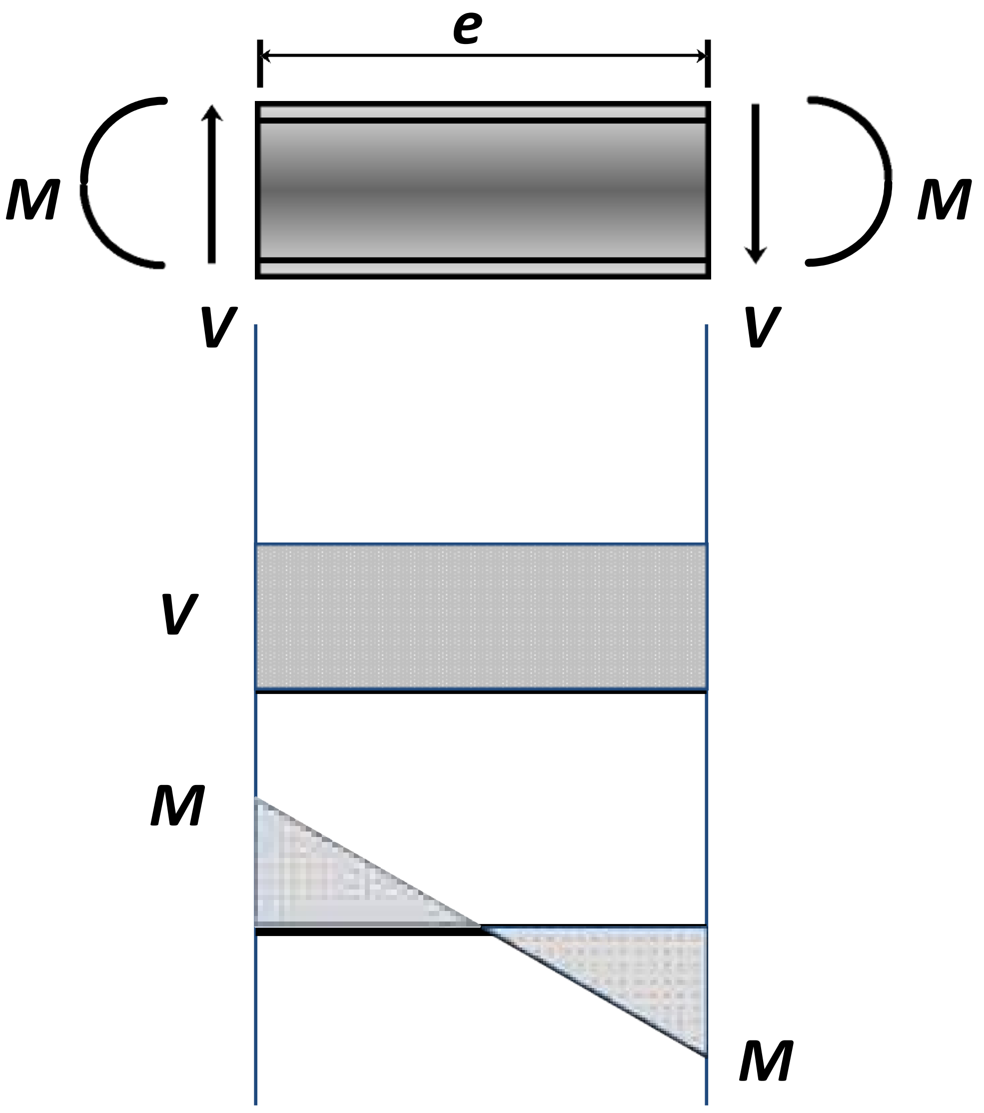
Link eleman davranışı



Link eleman davranışı, kesme ve eğilme momenti



Link Behavior

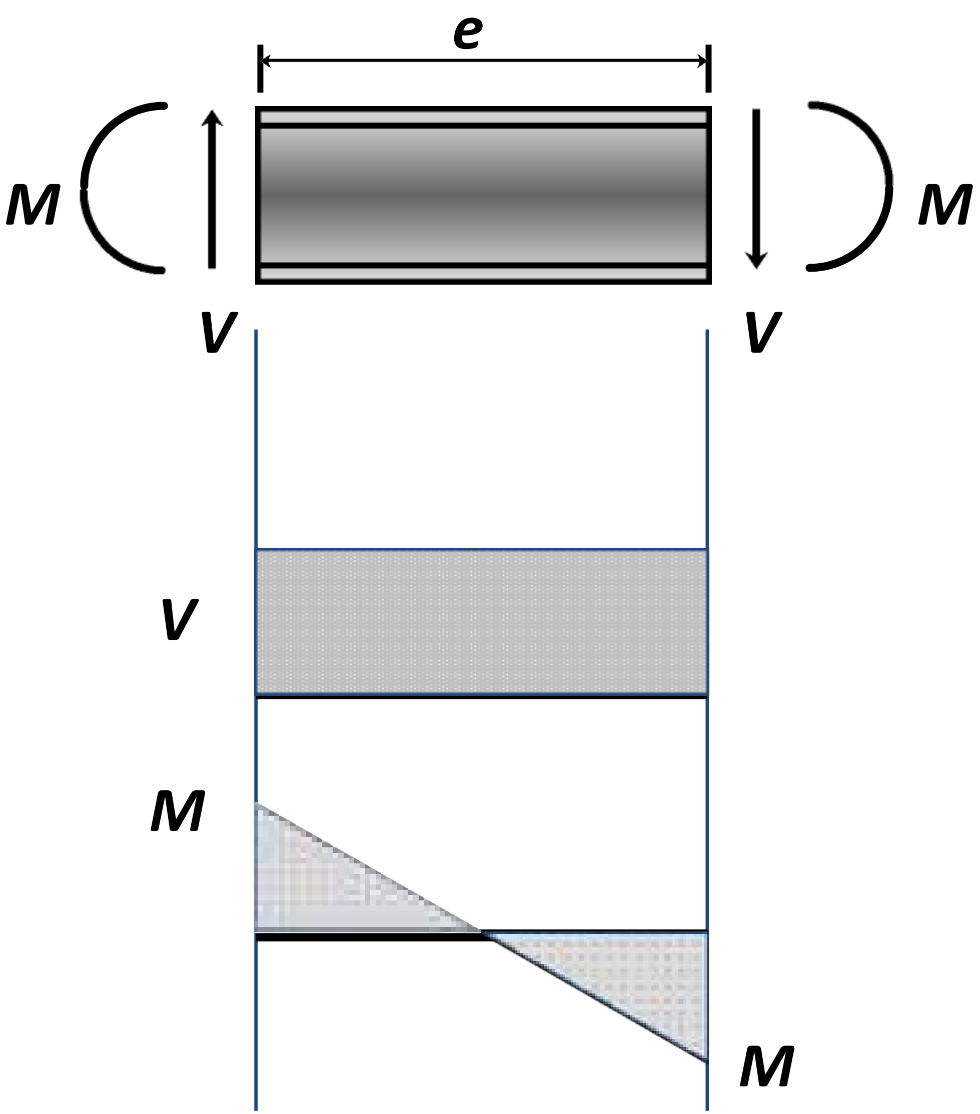


<u>Kesme akmasının oluşacağı an:</u>

$$V = V_p = \underbrace{0.6\, F_y}_{\text{Çeliğin kesme akma gerilmesi}} \underbrace{(d - 2t_f)\, t_w}_{\text{Link elemanın gövde alanı}}$$

V_p = link elemanın kesma akma dayanımı

Link Behavior

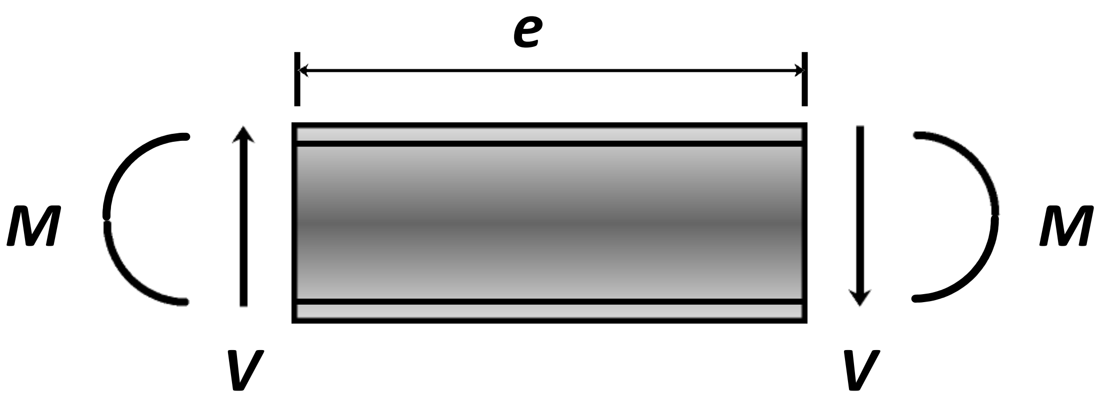


Eğilme akmasının oluştuğu durum:

$$M = M_p = Z\,F_y$$

M_p = Plastik moment kapasitesi

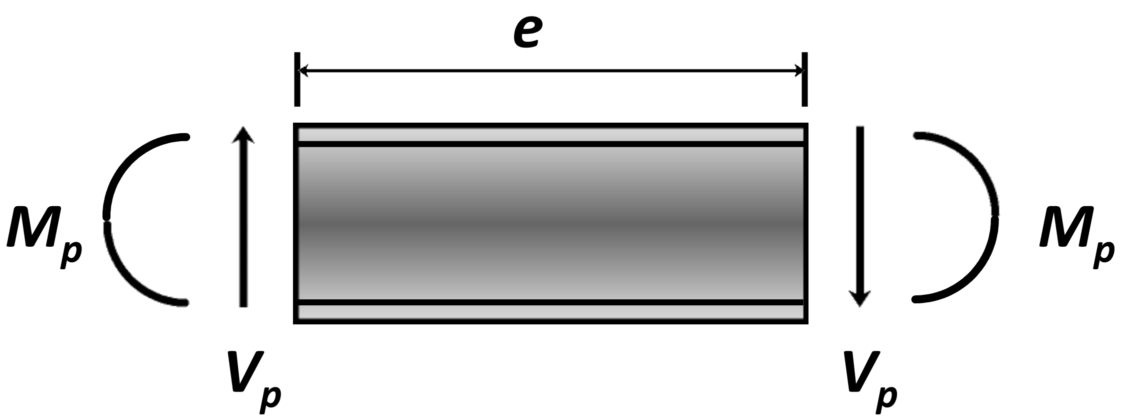
Link Behavior



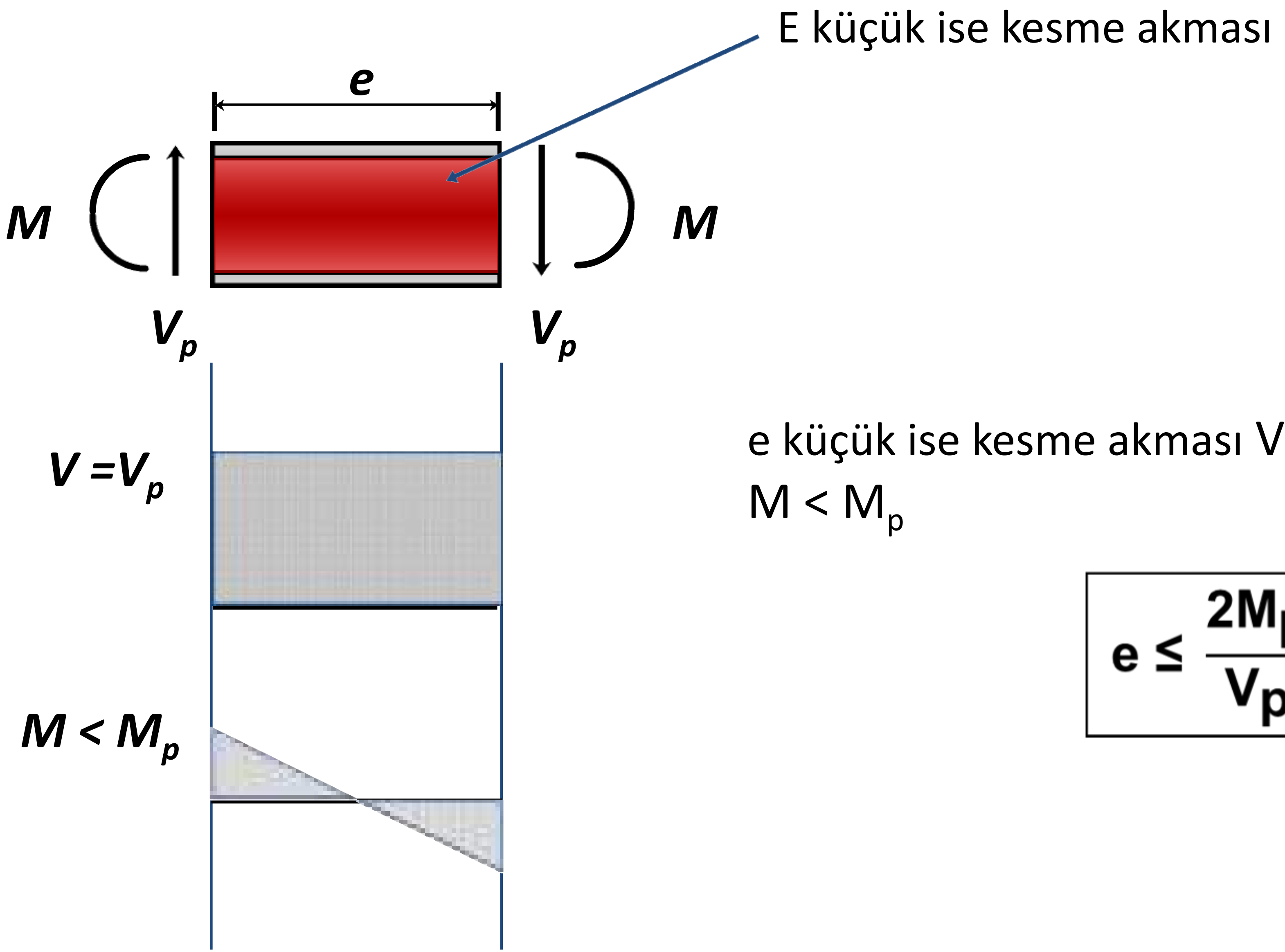
Static equilibrium of link: V*e* = 2M or:

$$\boxed{e = \frac{2M}{V}}$$

Kesme vs. Eğilme akması:

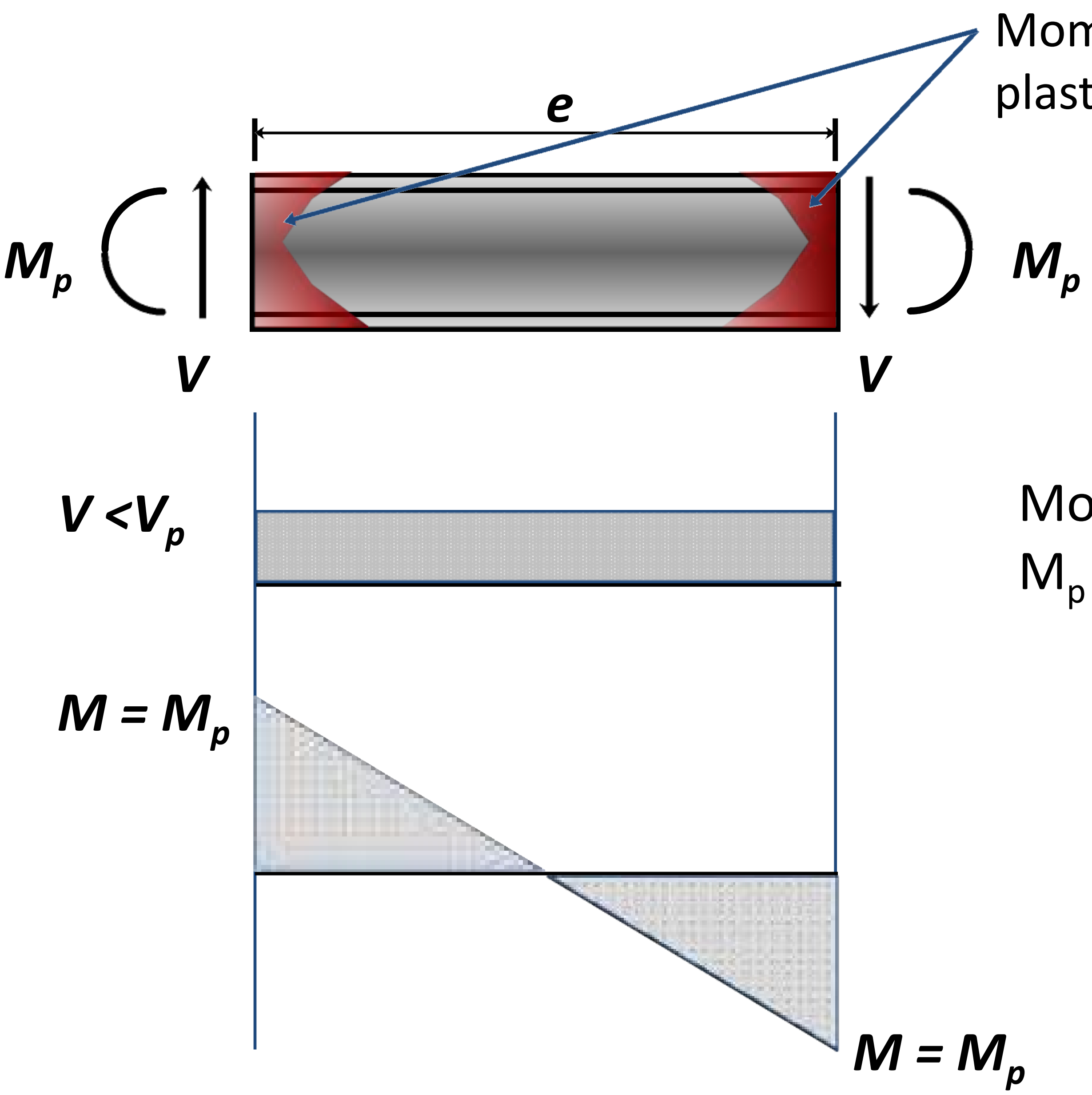


$$\boxed{e = \frac{2M_p}{V_p}}$$



e küçük ise kesme akması $V = V_p$ ve $M < M_p$

$$\boxed{e \leq \frac{2M_p}{V_p}}$$

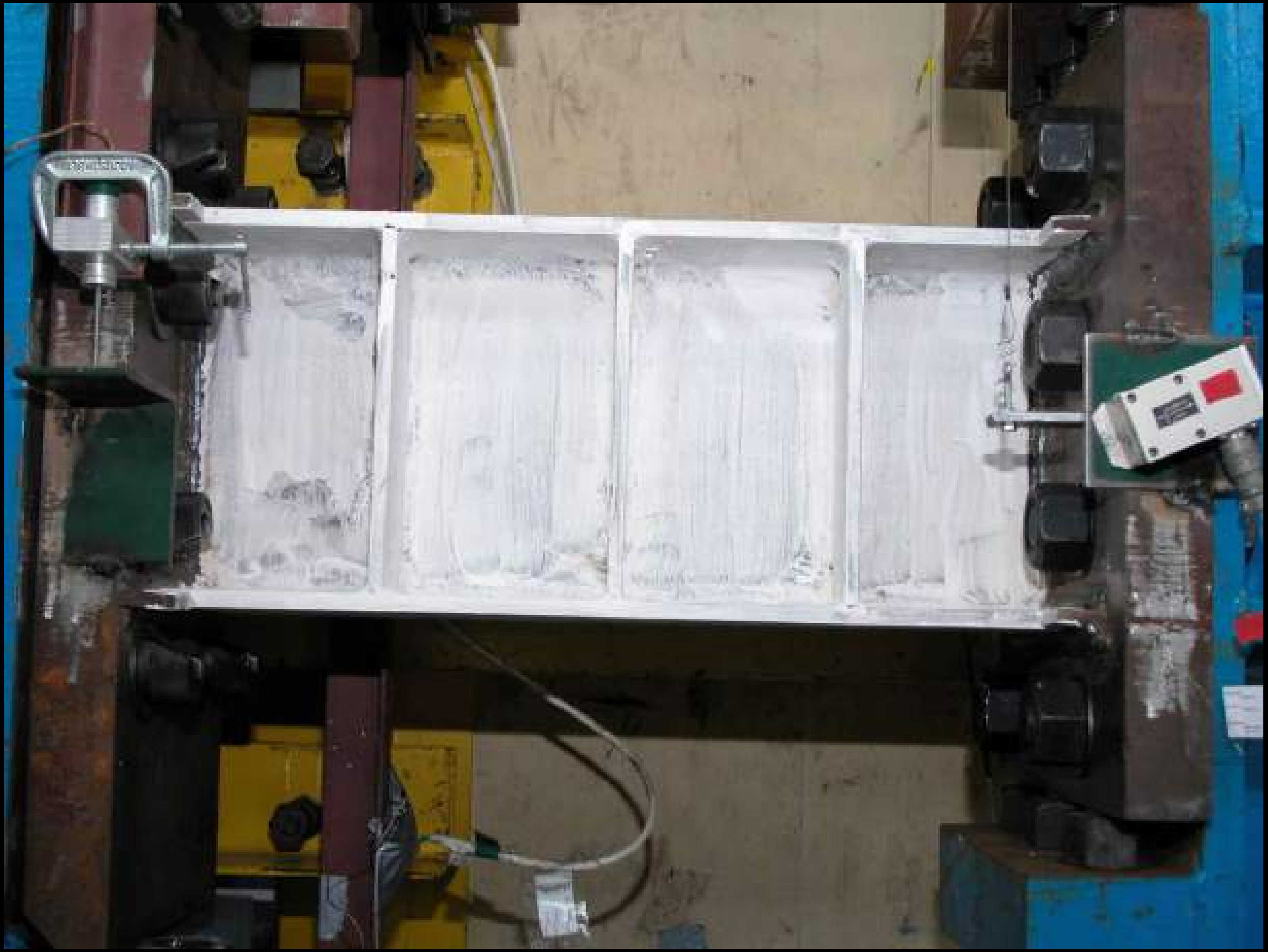


Momentten dolayı plastikleşme $M = M_p$ ve $V < V_p$

$$\boxed{e \geq \frac{2M_p}{V_p}}$$

Experimental Performance of a Shear Link

W10x33 (A992) e = 23" = 1.1 M_p/V_p

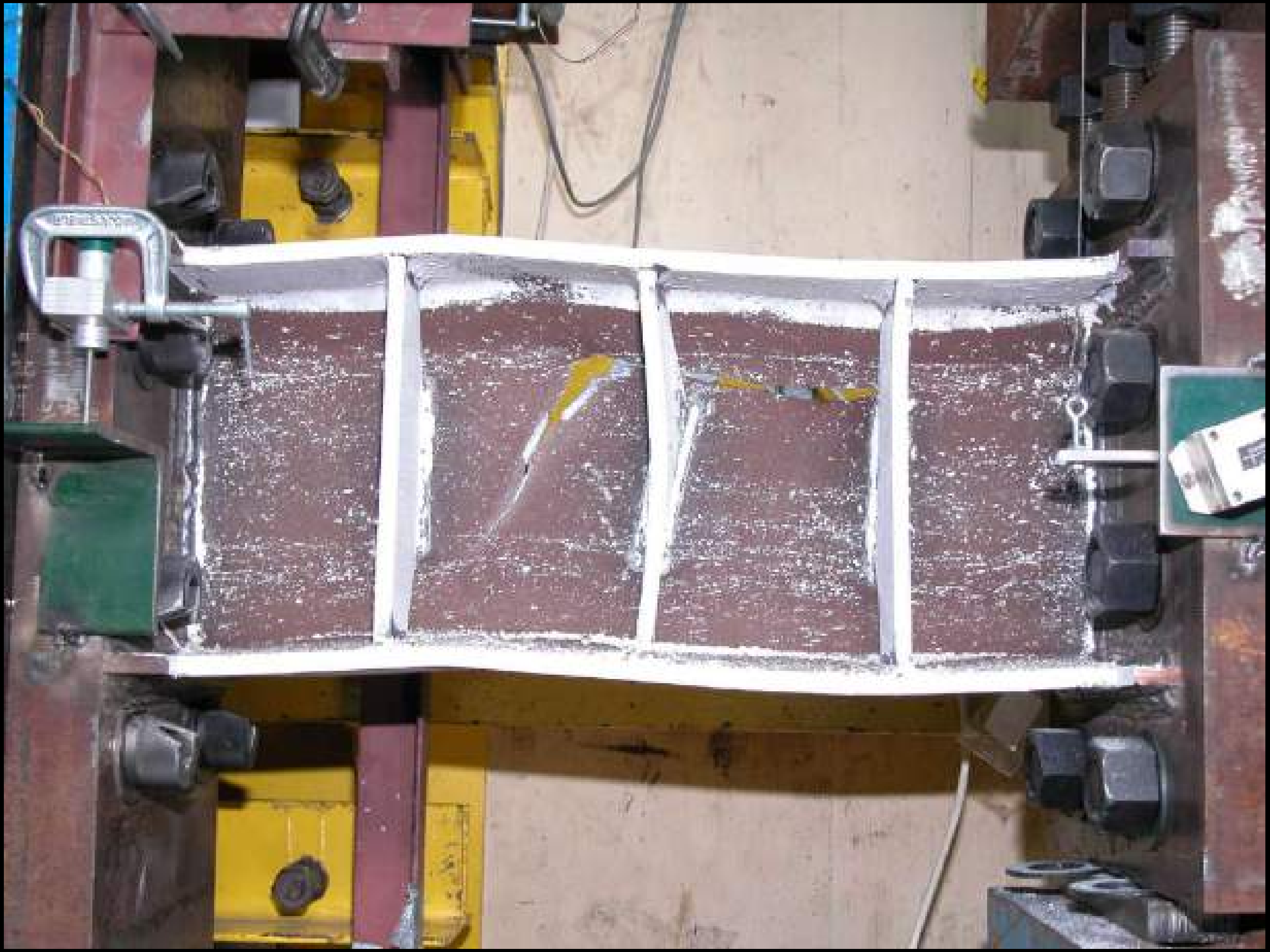


Experimental Performance of a Shear Link

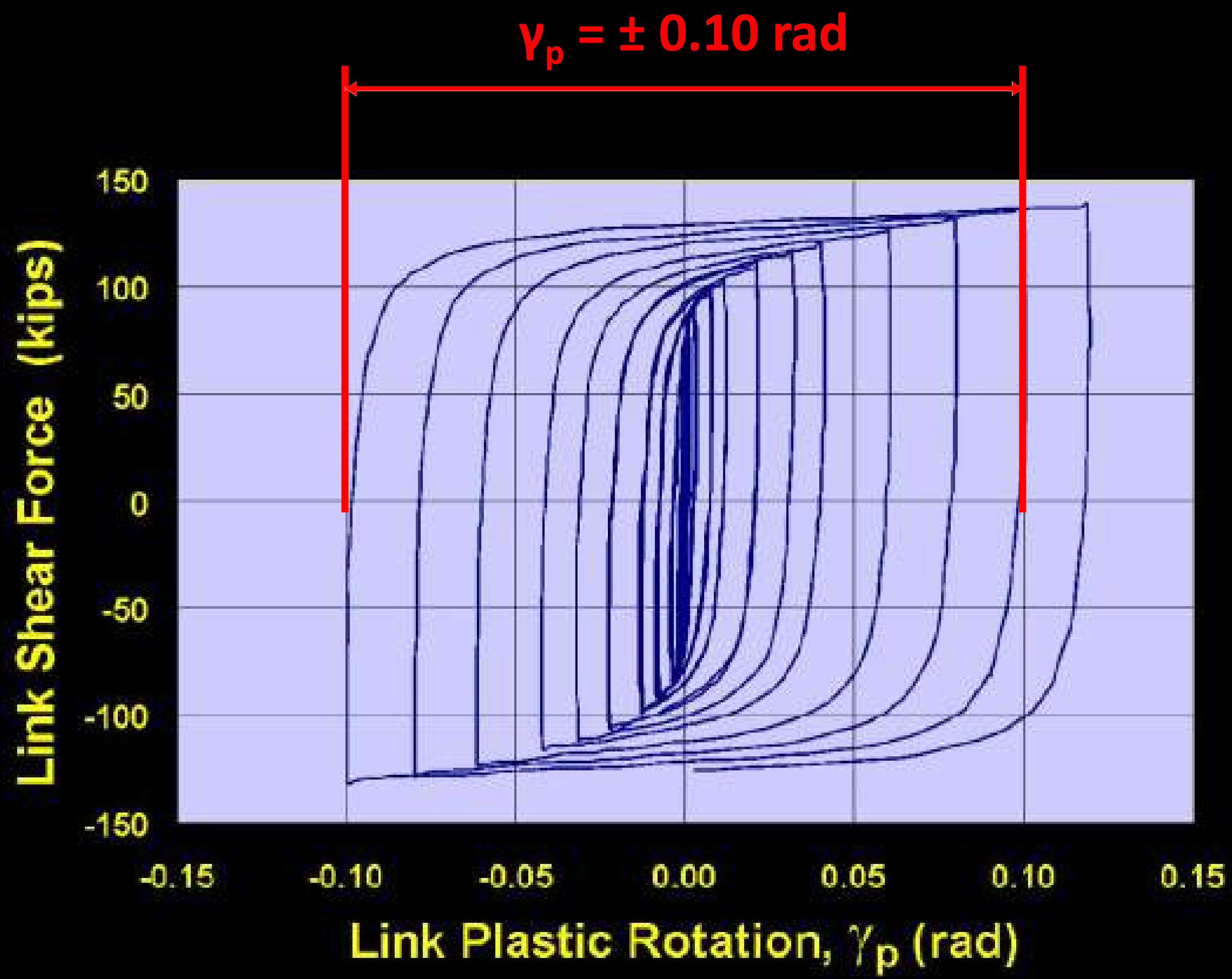
W10x33 (A992) e = 23" = 1.1 M_p/V_p

Experimental Performance of a Shear Link

W10x33 (A992) e = 23" = 1.1 M_p/V_p

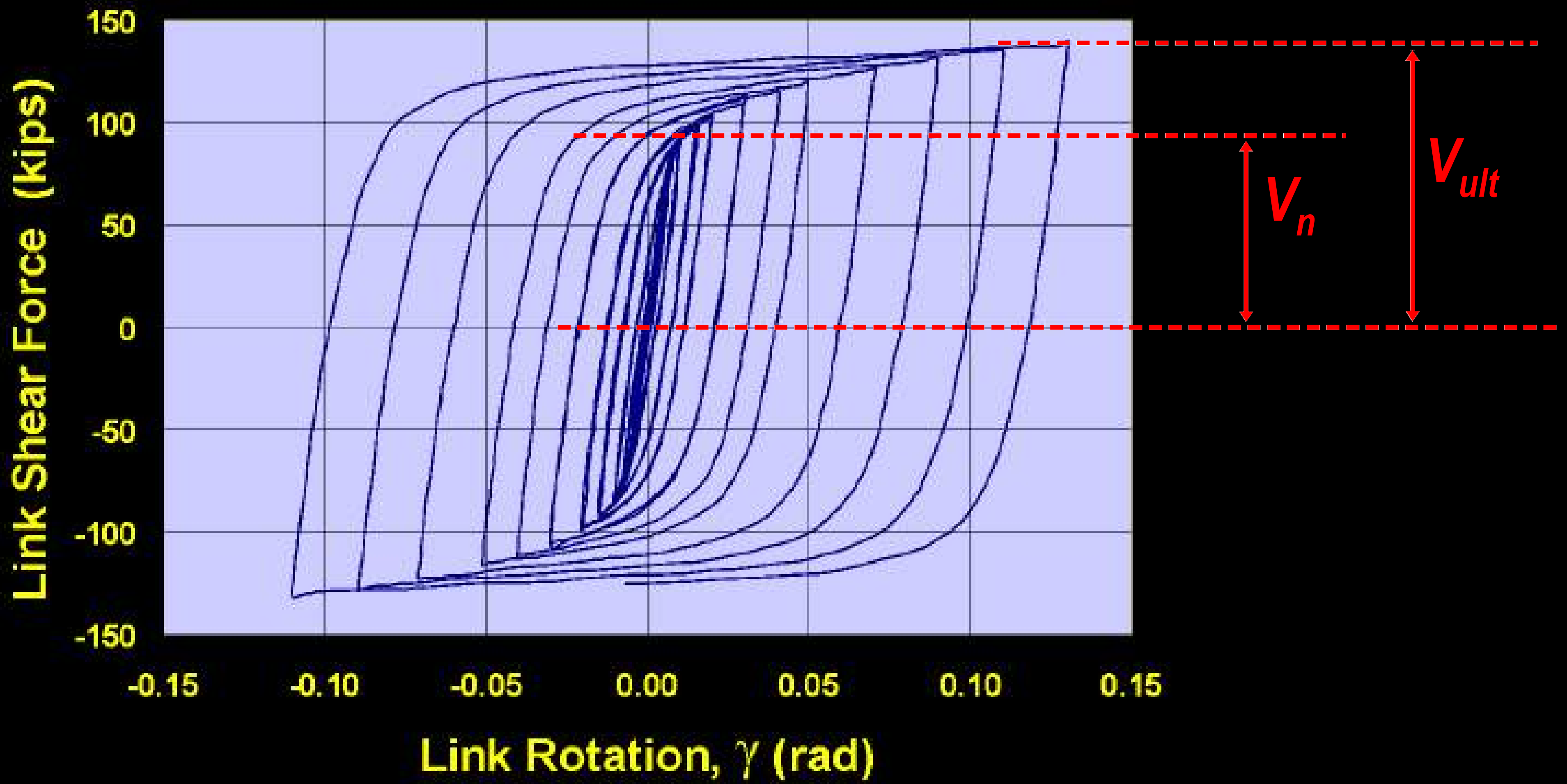


Link Elemanının deneysel performansı



Link elemanların akma ötesi davranışı

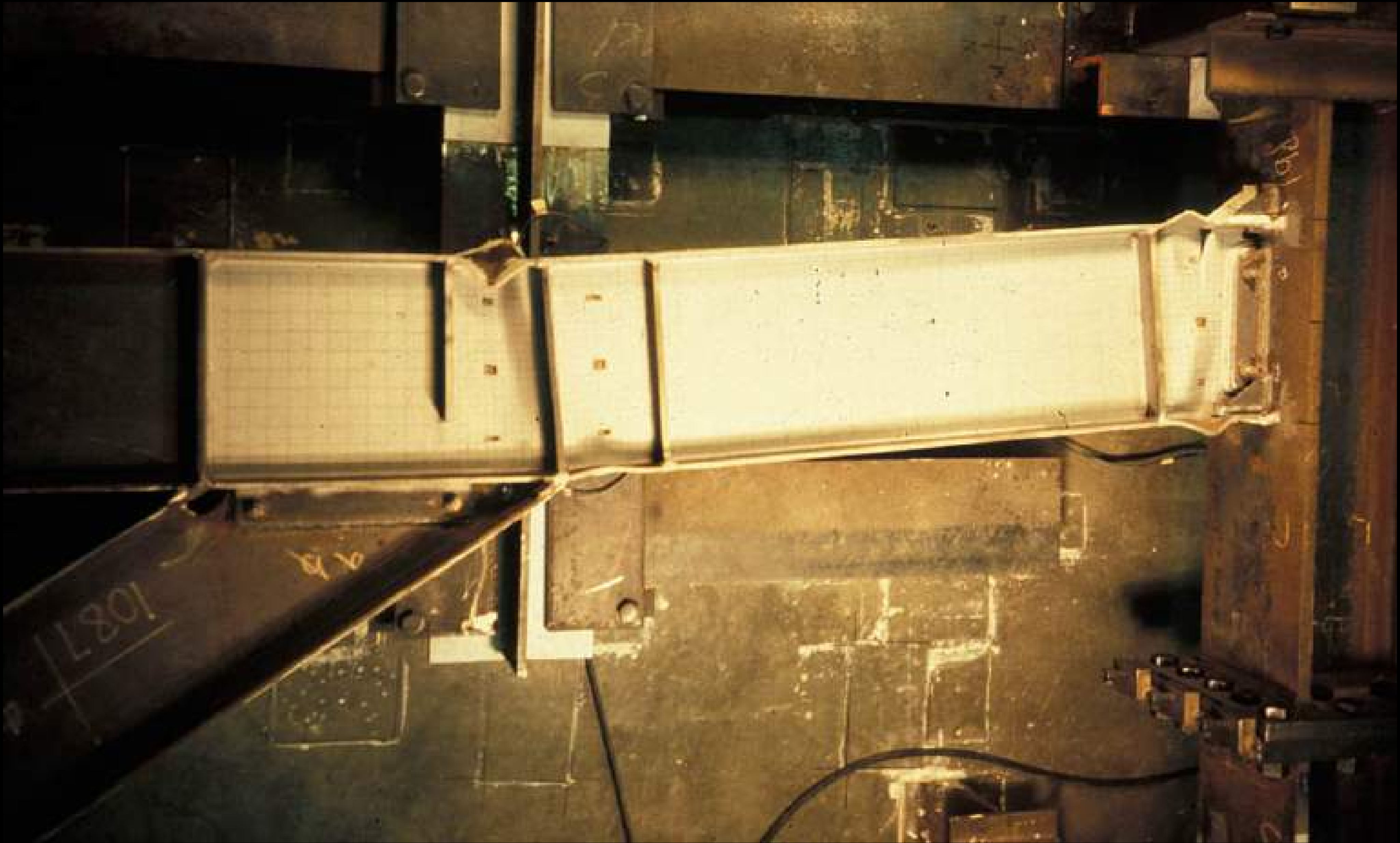
Strain hardening-Pekleşme



$V_{ult} \approx$ (1.25 to 1.5) $\times V_n$

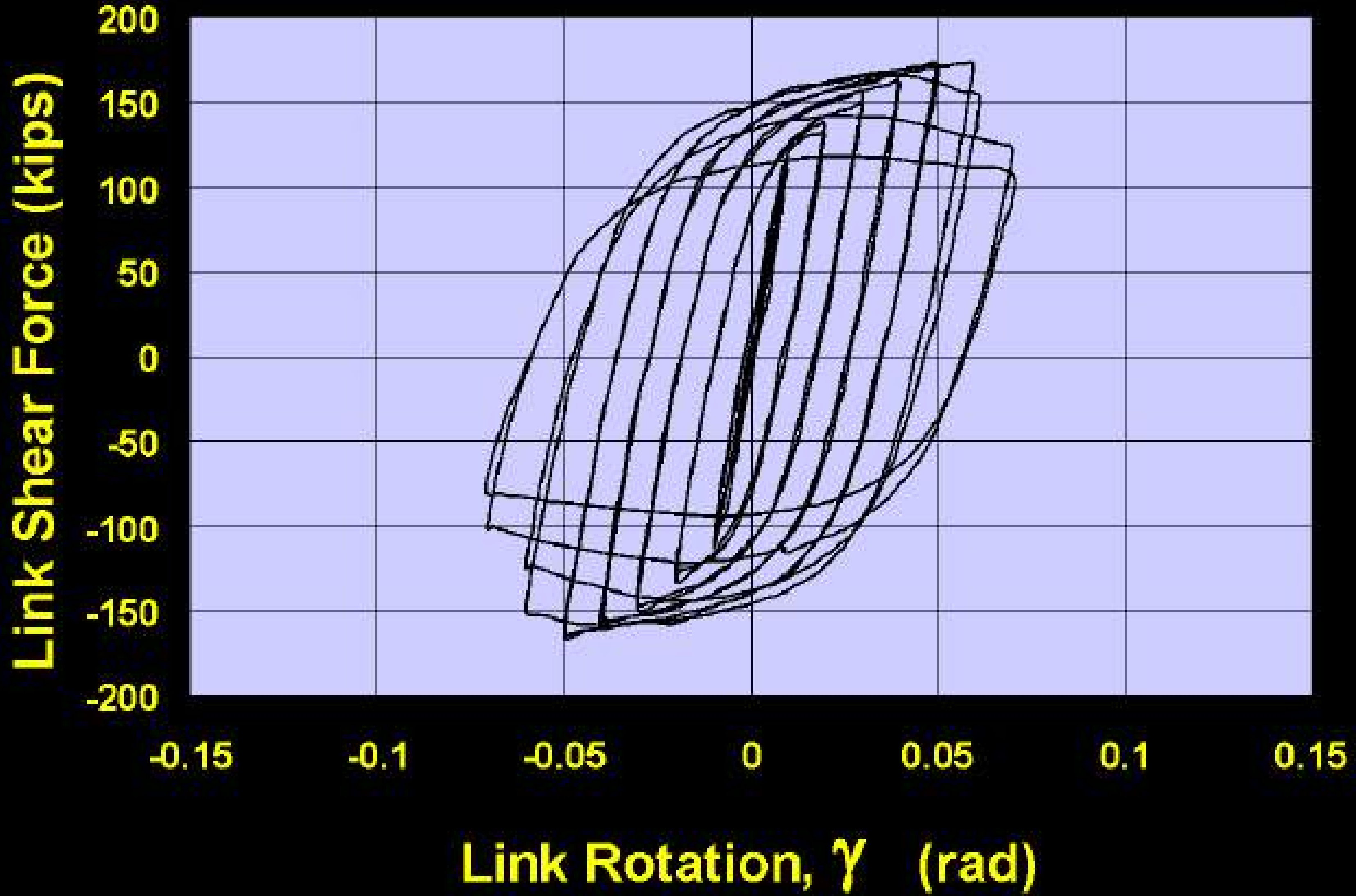
Experimental Performance of a Flexural Yielding Link

W12x16 (A36) e = 44" = 3.4 M_p/V_p

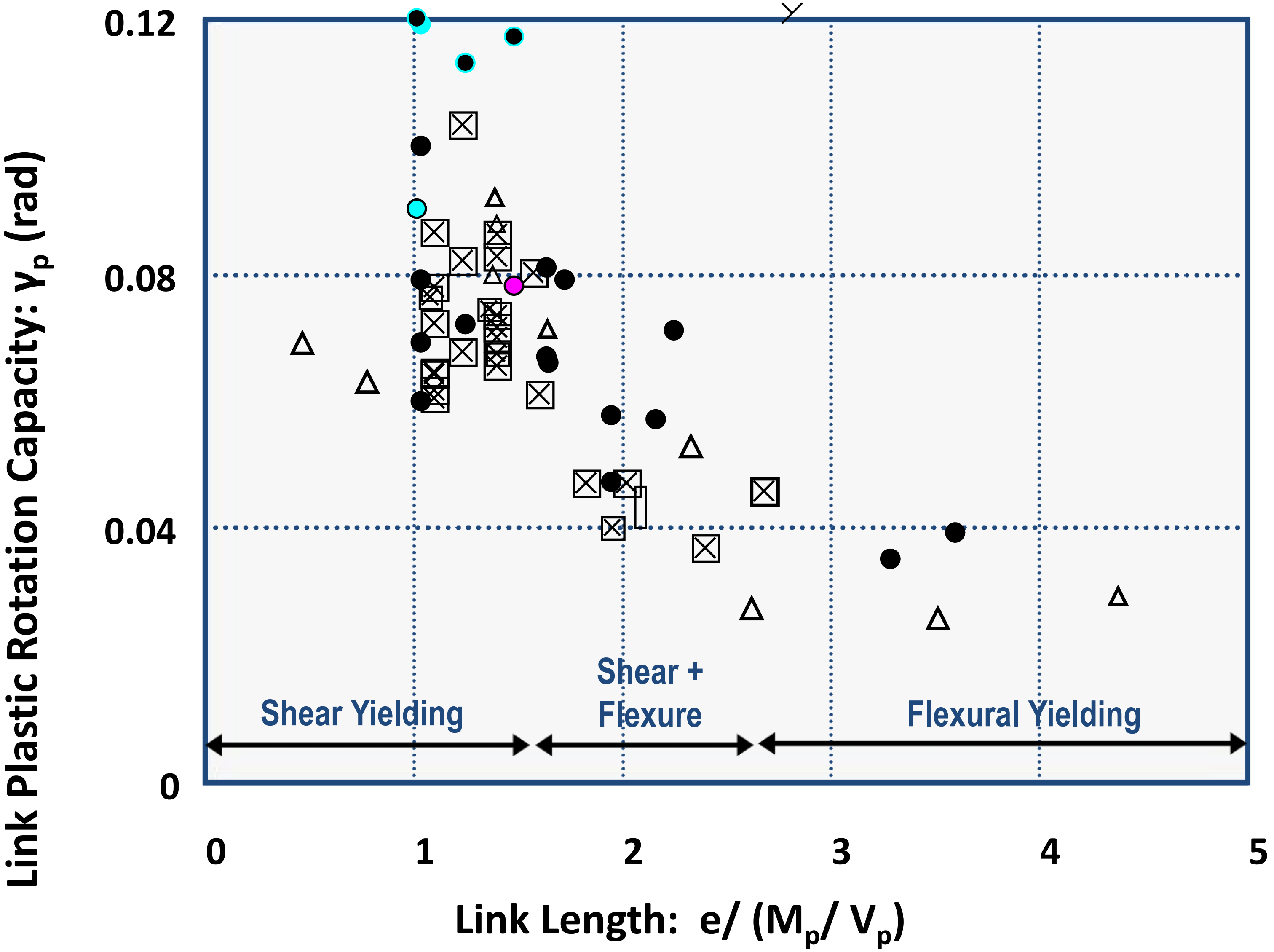


Experimental Performance of an Intermediate (Shear & Flexural Yielding) Link

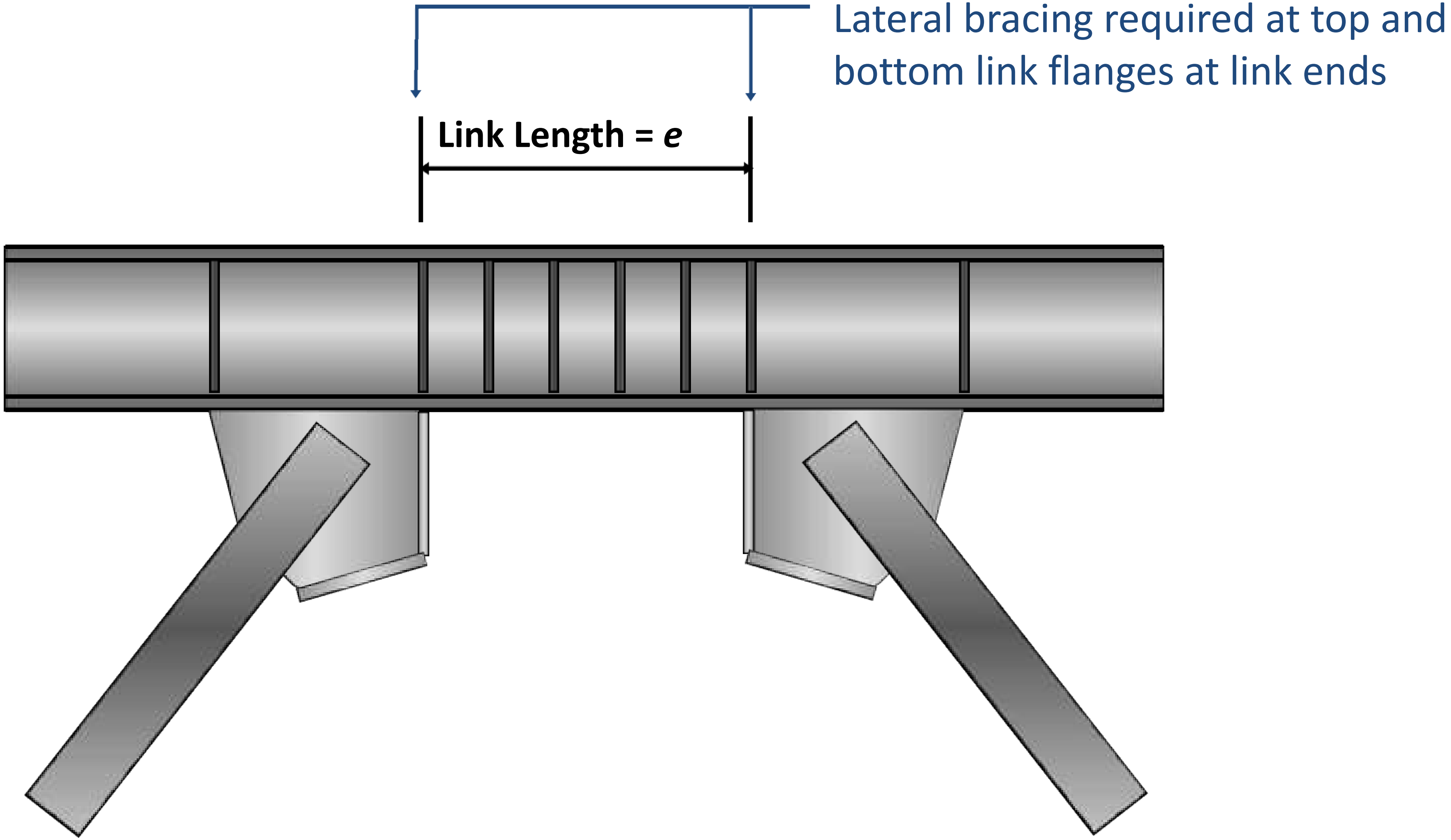
W16x36 (A992) e = 48" = 2 M_p/V_p



Experimentally Determined Link Plastic Rotation Capacities



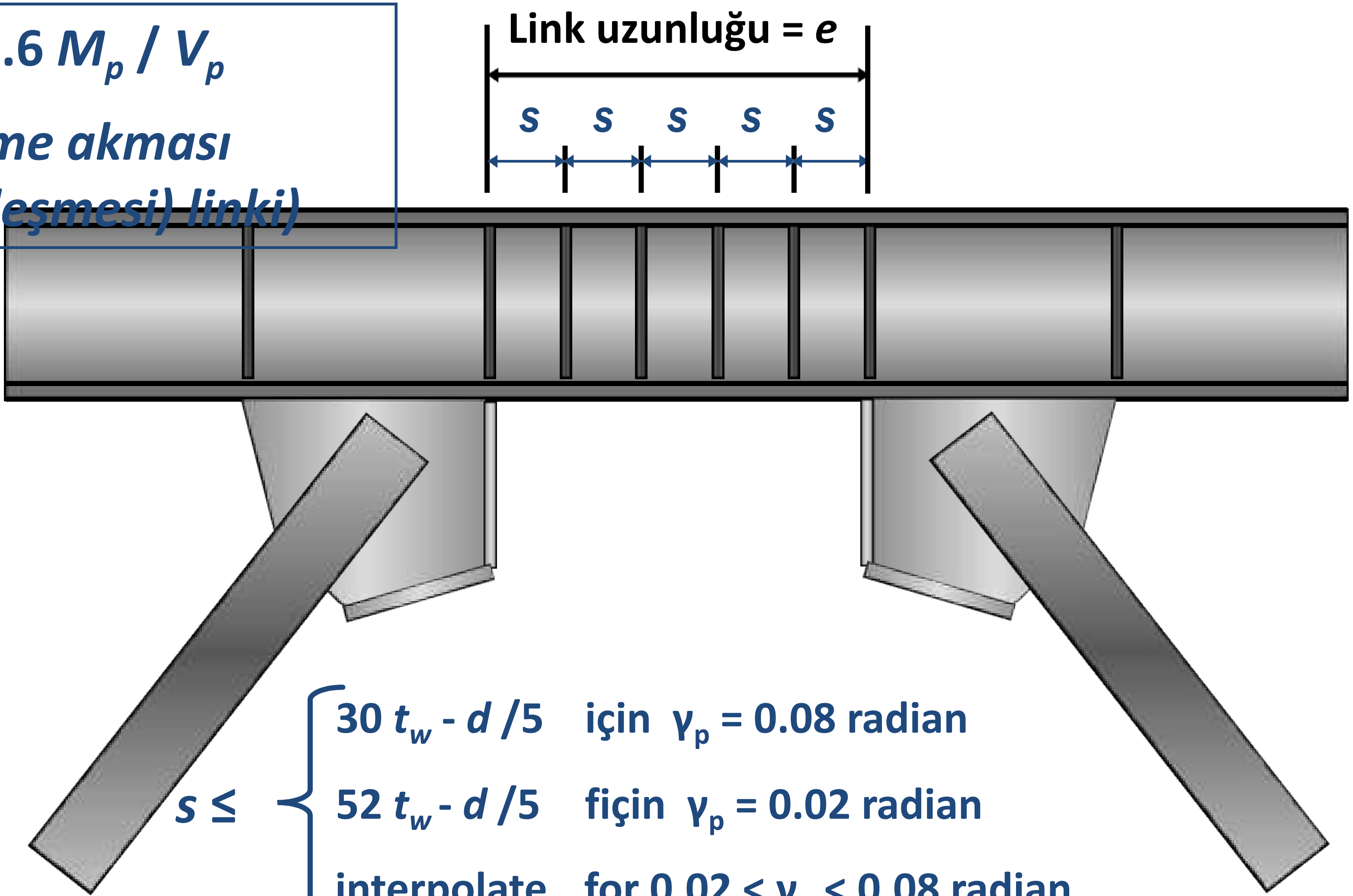
F3.4b Lateral Bracing of Link



Link Rijitleştiricileri

$e \leq 1.6\, M_p \,/\, V_p$

(Kesme akması (plastikleşmesi) linki)

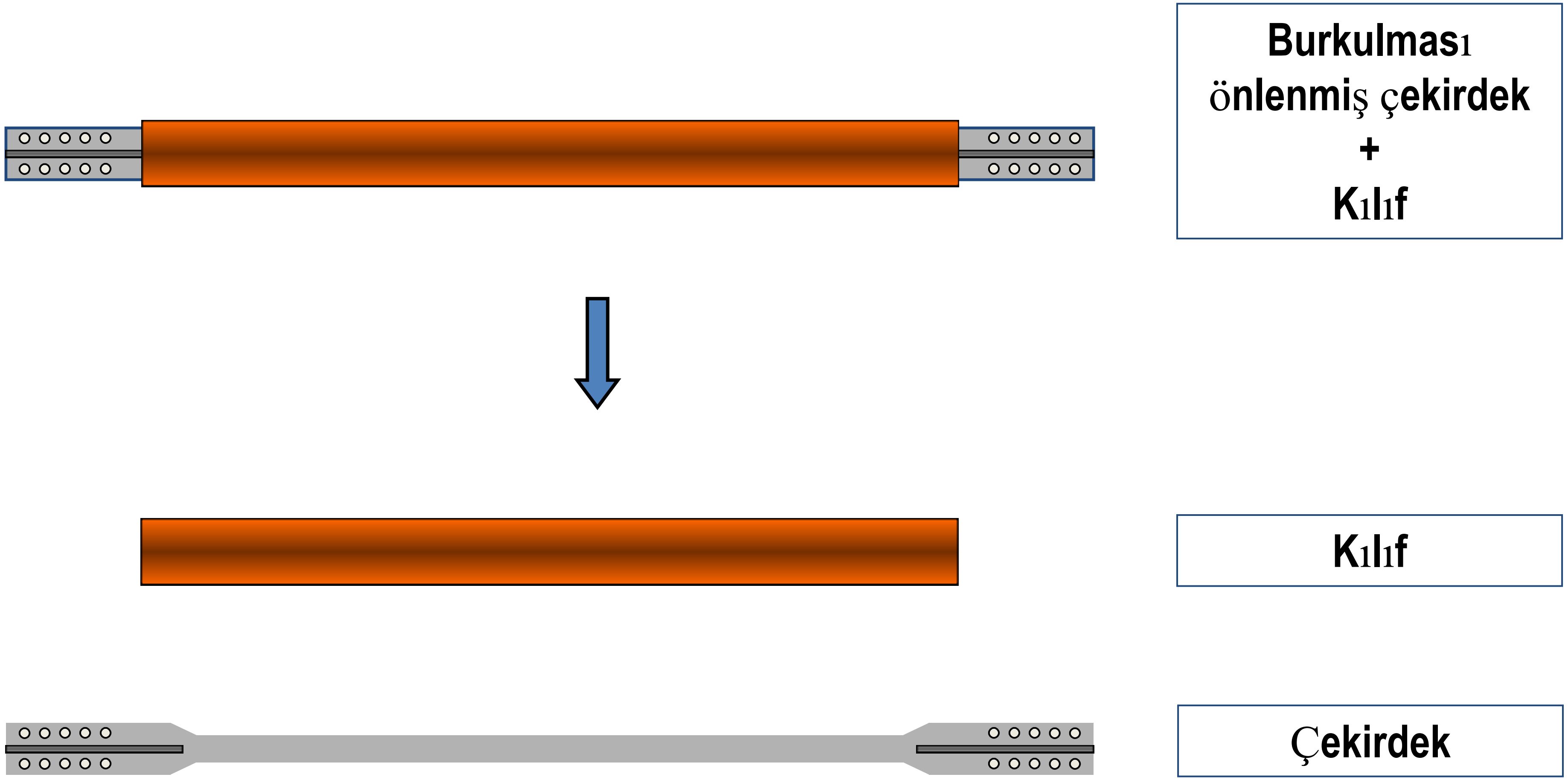


$$s \leq \begin{cases} 30\, t_w - d/5 & \text{için } \gamma_p = 0.08 \text{ radian} \\ 52\, t_w - d/5 & \text{fiçin } \gamma_p = 0.02 \text{ radian} \\ \text{interpolate} & \text{for } 0.02 < \gamma_p < 0.08 \text{ radian} \end{cases}$$

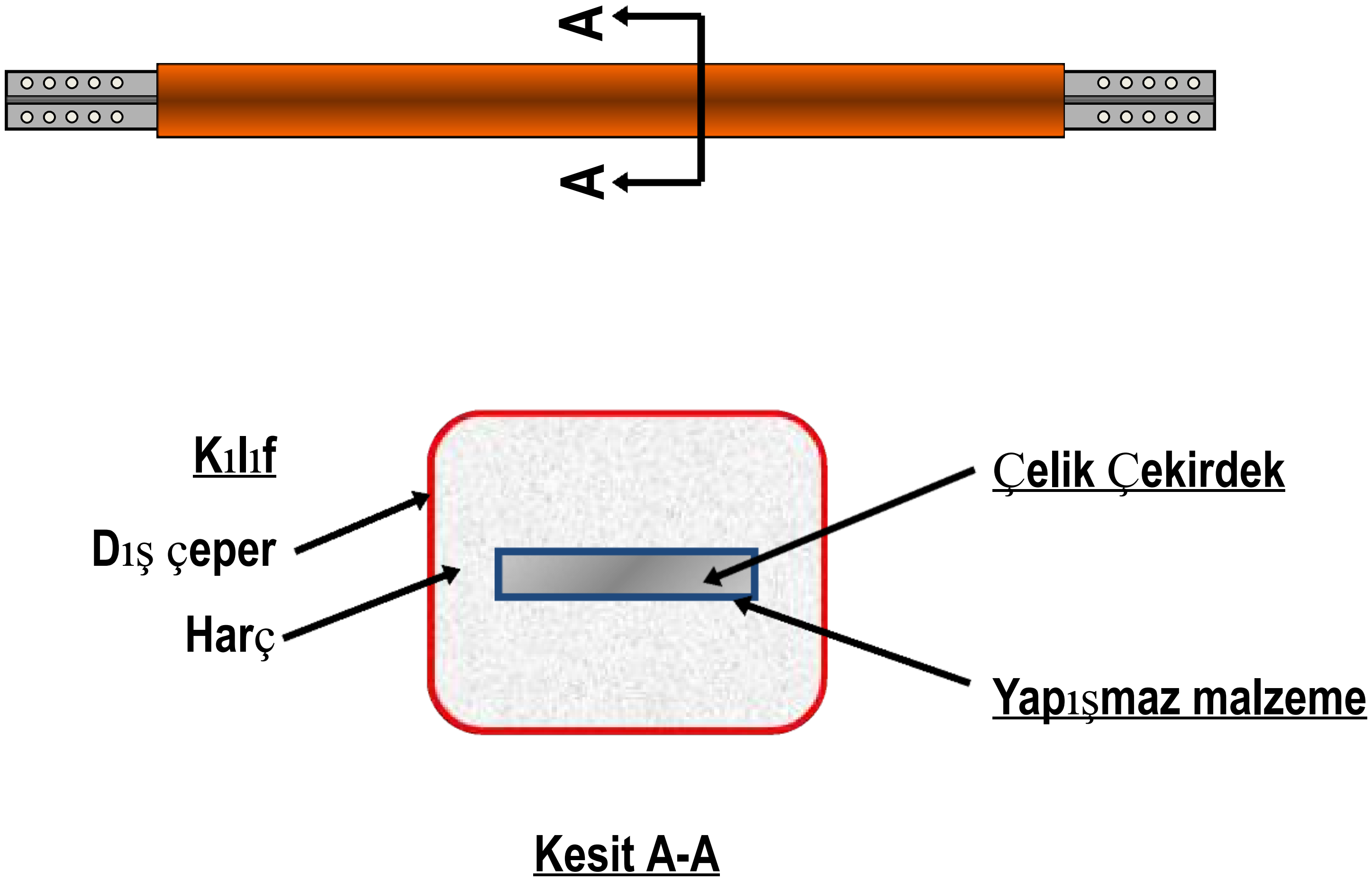
t_w = link gövde kalınlığı $\quad$ d = link derinliği

Burkulması Önlenmiş Çaprazlar (B.Ö.Ç.)

Buckling-Restrained Brace



Buckling-Restrained Brace

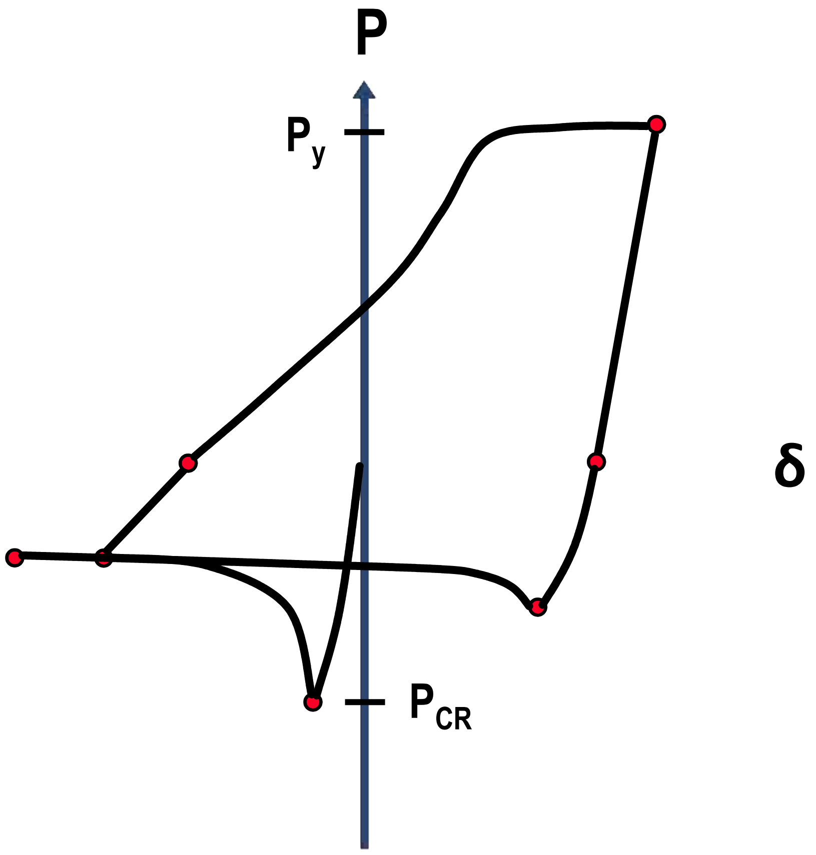


B.Ö.Ç.

Casing is debonded from steel core

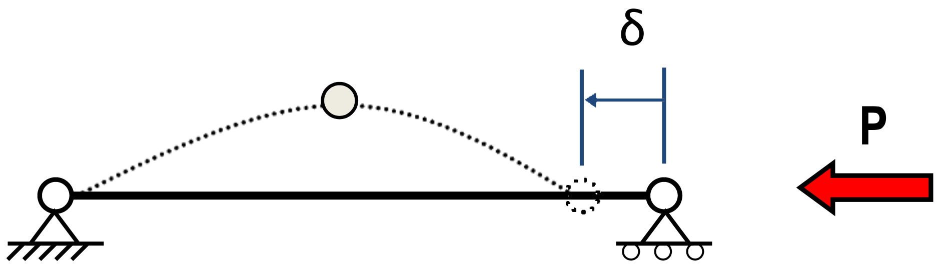
- Kılıf P yükünün taşınmasına (eksenel yük) yardım etmez
- Eğilme rijitliği çelik çekirdeğin burklmasını engeller.

Merkezi Çapraz davranışı

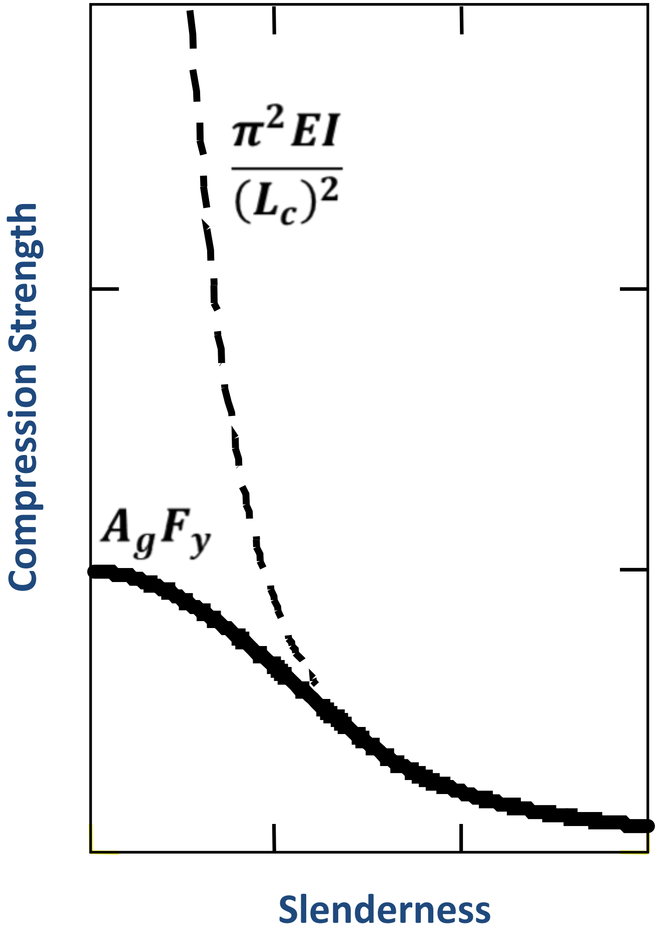


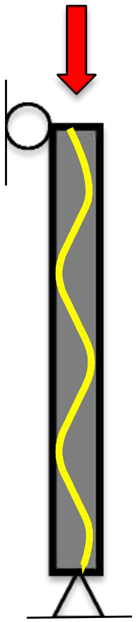
Conventional Brace:

- Çekme de akma (***ductile***)
- Basınçta burkulma (***nonductile***)
- Çekme ve basınç etkisi altında görünür farklı davranış.



Eksenel yük altında çapraz davranışı

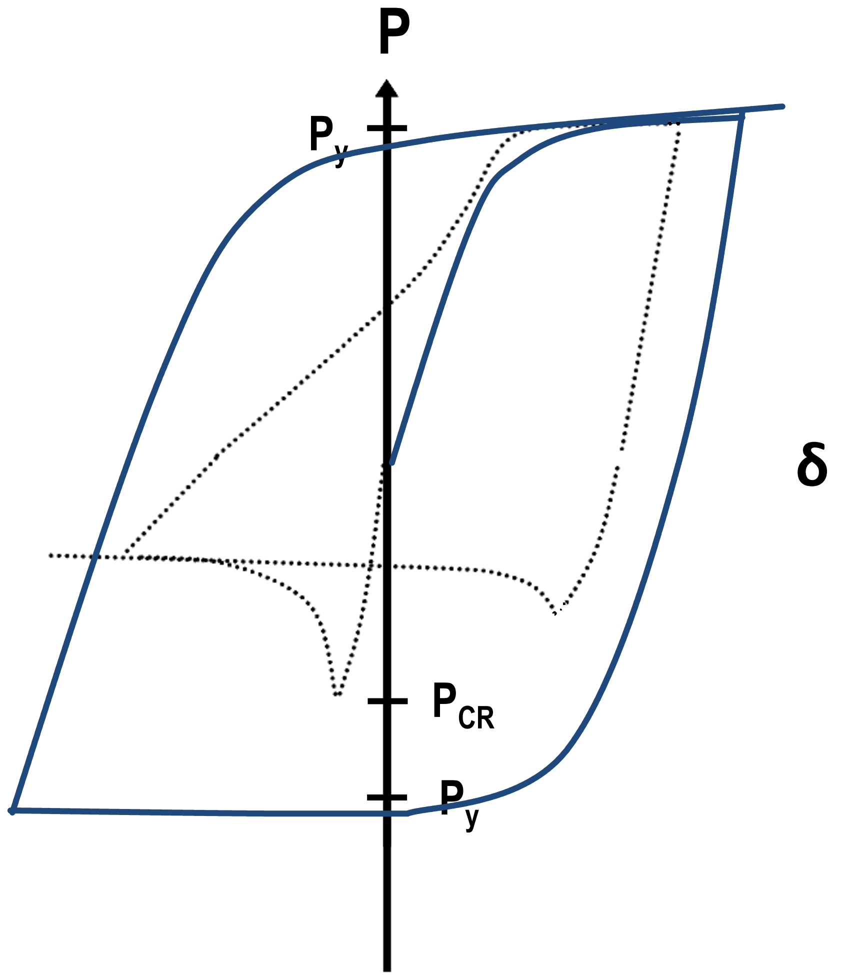




B.Ö.Ç.:

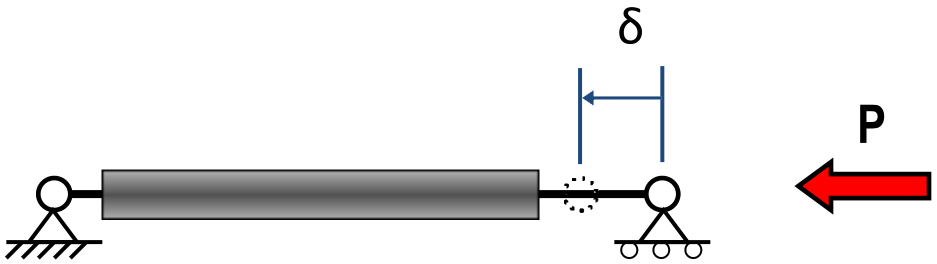
- Çekirdek narinliği neredeyse sıfır, çekme ve basınçta akma
- Kılıfta eksenel yük neredeyse sıfır.

Tekrarlı yük altında B.Ö.Ç. davranışı

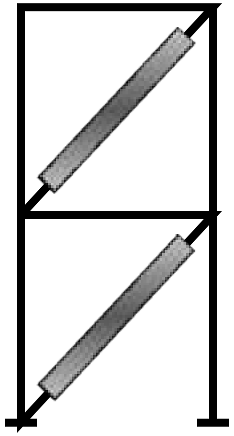


B.Ö.Ç.:

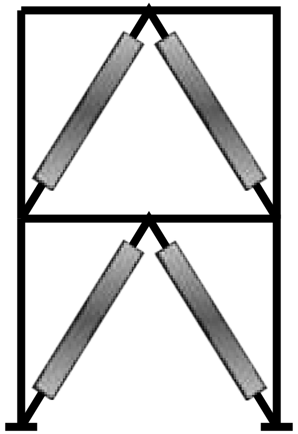
- Çekmede akma (***ductile***)
- Basınçta akma (***ductile***)
- Çekme ve basınç altında benzer davranış.



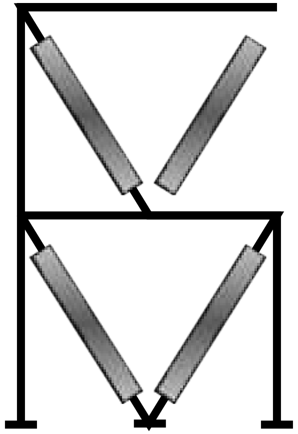
Böç Yerleşimleri



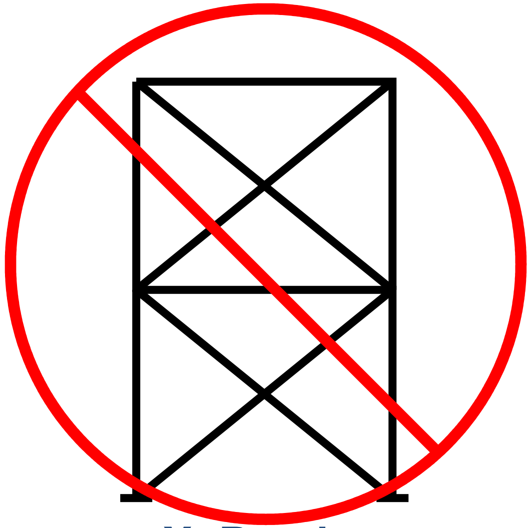
Single Diagonal



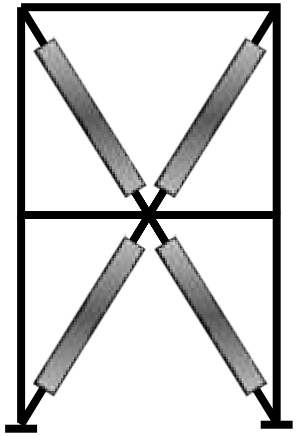
Inverted V- Bracing



V- Bracing



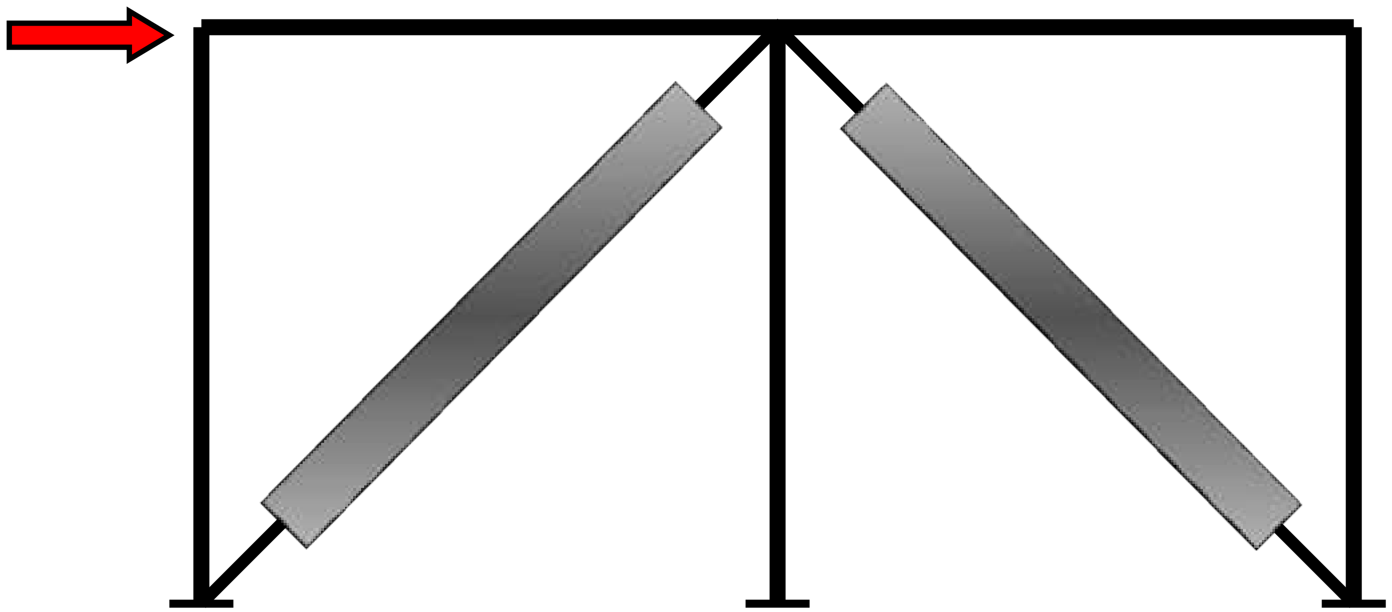
X- Bracing



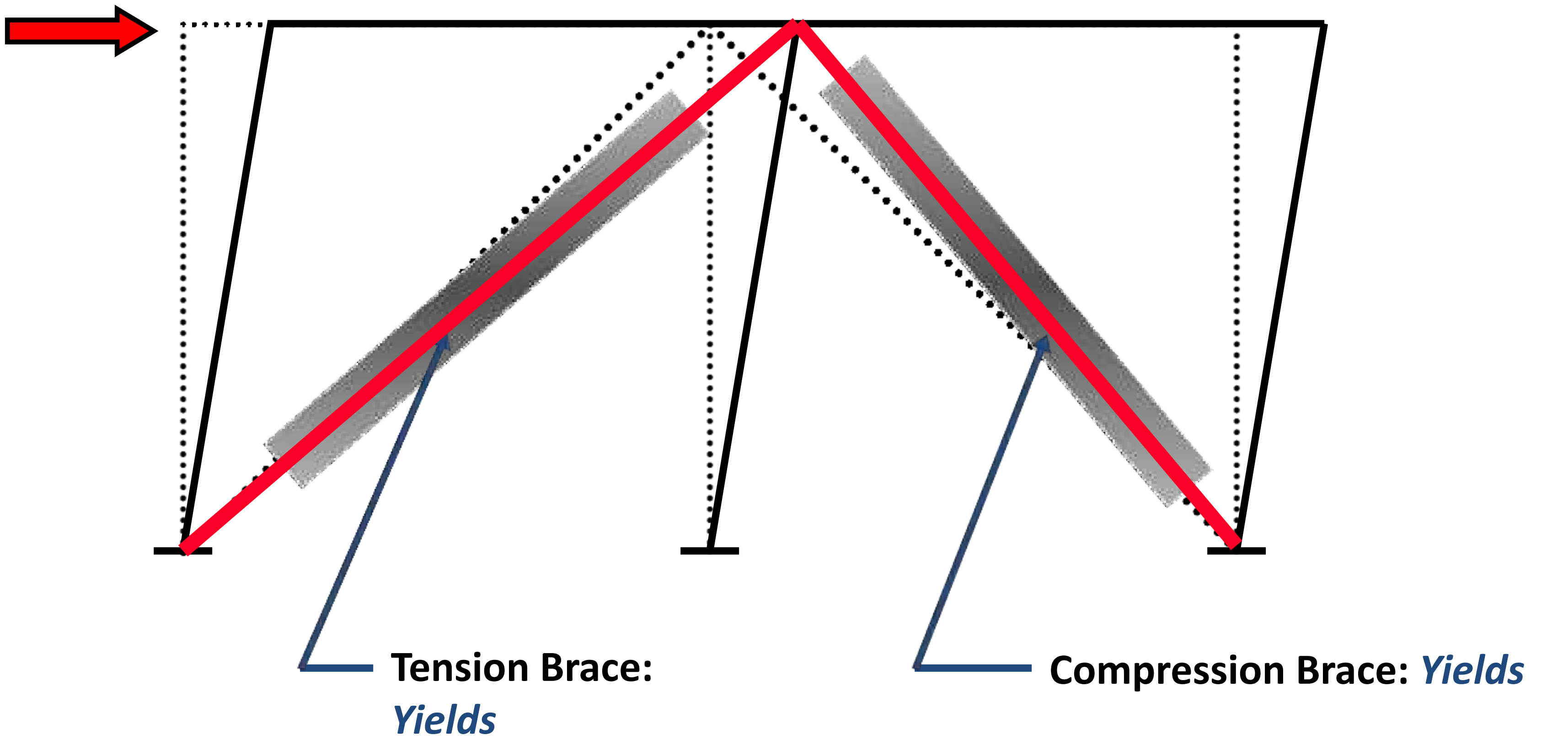
Two Story X- Bracing


Herrick
4 5 2006

Inelastic Response of BRBFs under Earthquake Loading

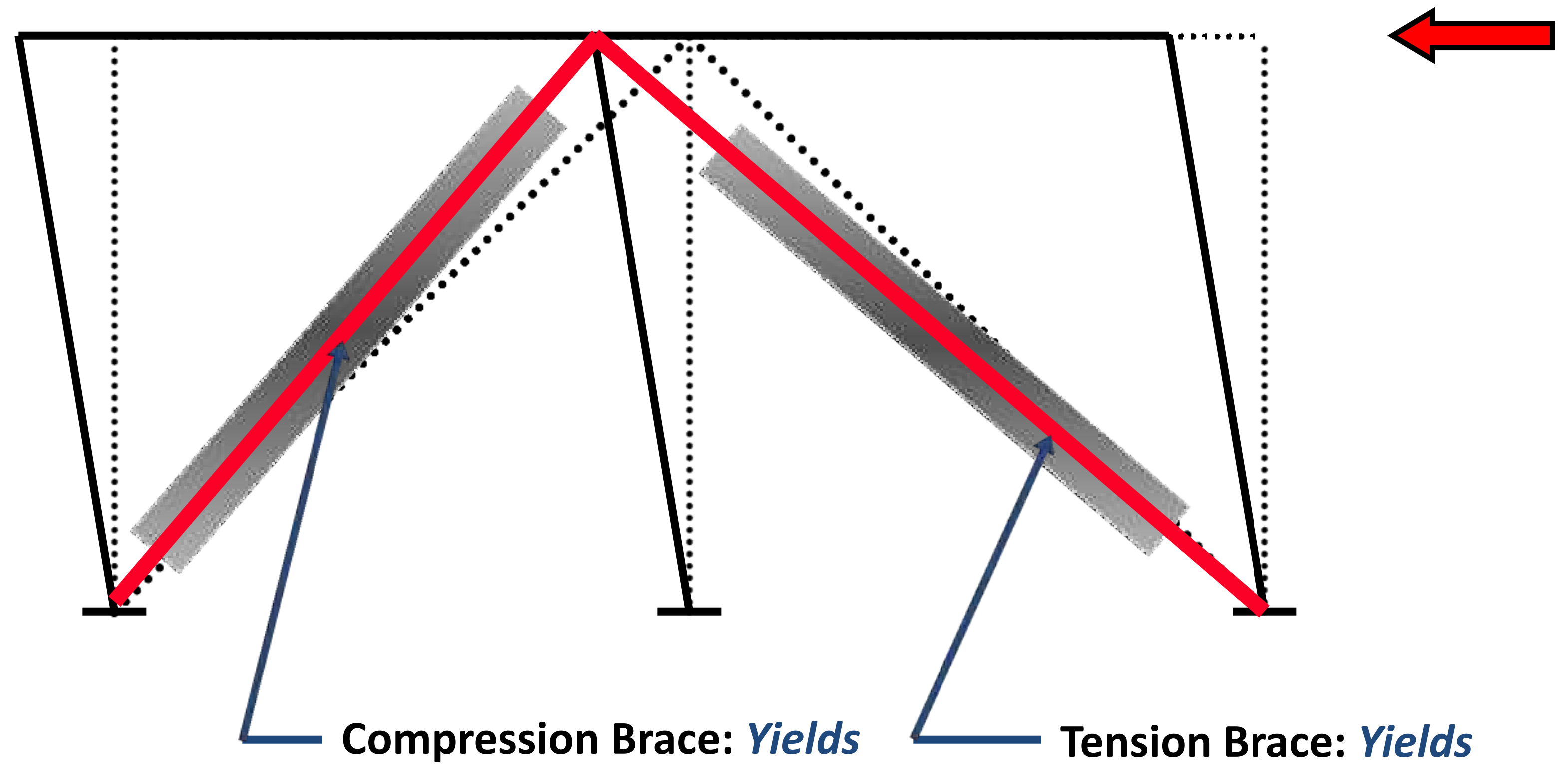


Inelastic Response of BRBFs under Earthquake Loading



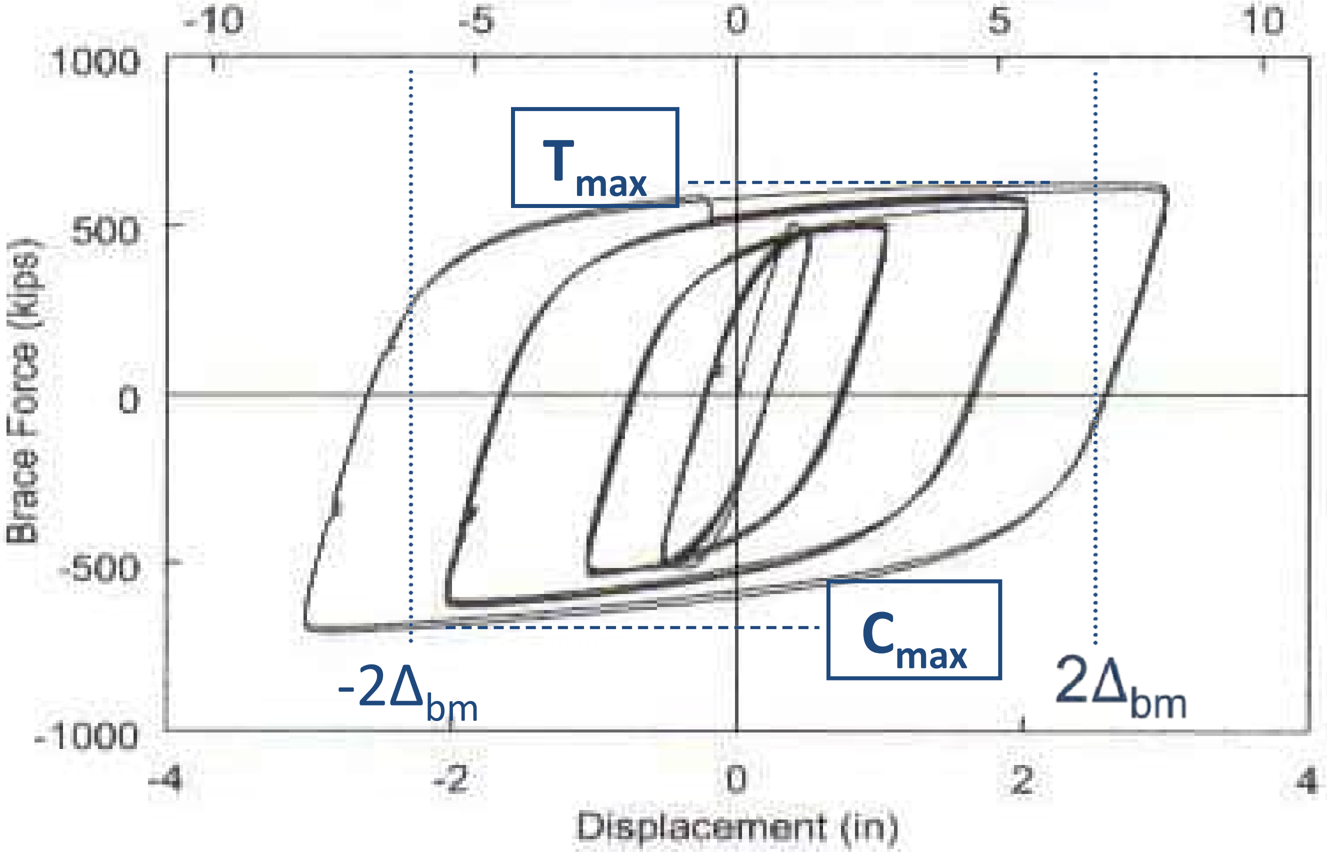
Columns and beams: *remain essentially elastic*

Inelastic Response of BRBFs under Earthquake Loading



Columns and beams: *remain essentially elastic*

B.Ö.Ç. Tekrarlı yükleme testi



$$\omega = \frac{T_{max}}{F_{ysc} A_{sc}} \qquad \beta = \frac{C_{max}}{T_{max}}$$

Çapraz dayanımı

Çekme

Düzeltilmiş çapraz dayanımı = $\boldsymbol{\omega R_y P_{ysc}}$

Basınç

Düzeltilmiş çapraz dayanımı = $\boldsymbol{\beta \omega R_y P_{ysc}}$

ω = Pekleşme düzeltme katsayısı

β = Basınç dayanımı düzeltme katsayısı

Deprem yönetmeliği ve testlerden kontrol edin.

$\boldsymbol{R_y = 1.0}$ P_{syc} test edilerek bulunmuş F_{ysc} ile hesaplanırsa

<u>Birleşim Dayanımı</u>

Çekme veya basınç etkisi altında birleşim dayanımı aşağıdaki formül ile hesaplanmalıdır.

$$\boxed{P_u = 1.1\ \beta\ \omega\ R_y\ P_{ysc} / \alpha_s}$$

Bu sunum aşağıdaki yayın, kitap ve sunumlardan yararlanılarak hazırlanmıştır

- Shen, J., AdvancedSteelStructures, ClassNotes, IIT, 2009.
- Dr SeshuAdluri,Structural Steel Design lecture notes
- Salmon, C.G. and Johnson, J.E., Steel Structures, HapperCollins HapperCollins.
- AISC, Manual of Steel Construction, 13rd Edition.
- M.D. Engelhardt, University of Texas at Austin, AISC, V.1, 2007.
- AISC360-10, SpecificationforStructural SteelBuildings, 2010.
- Ders Notları, Andrew Whittaker
- Afet Bölgelerinde Yapılacak Binalar Hakkında Yönetmelik
- https://www.aisc.org/university-programs/educators/teaching-aids/ta-teaching-the-principles-of-seismic-resistant-design-of-steel-building-structures/