PRELIMINARY RECOMMENDATIONS FOR NEW RC FLEXURAL MEMBER

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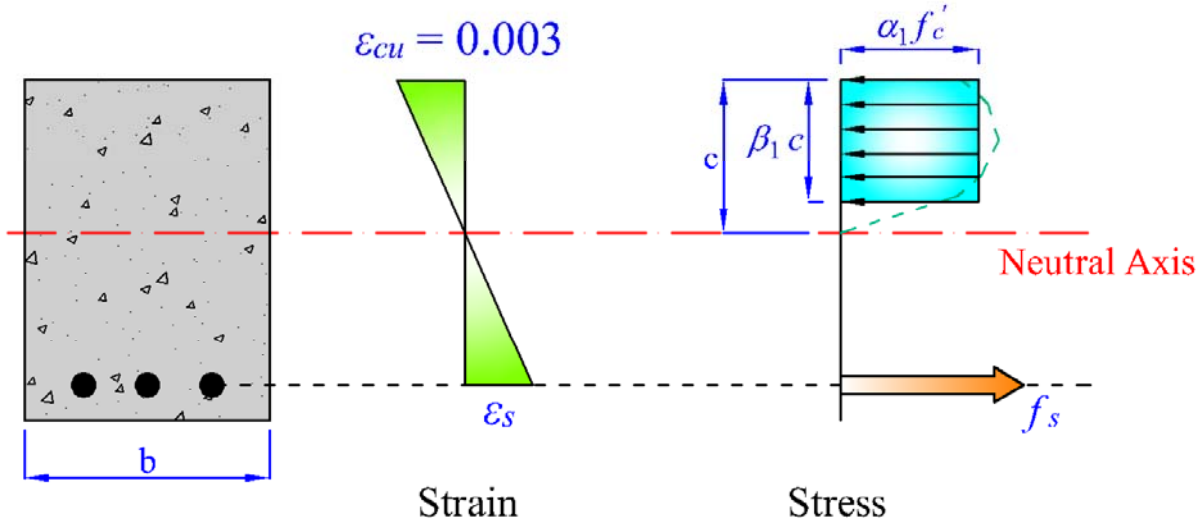
Outline

- ✓ **Flexural Design**
- ✓ **Detailing**

Flexural Member

Nominal Flexural Strength



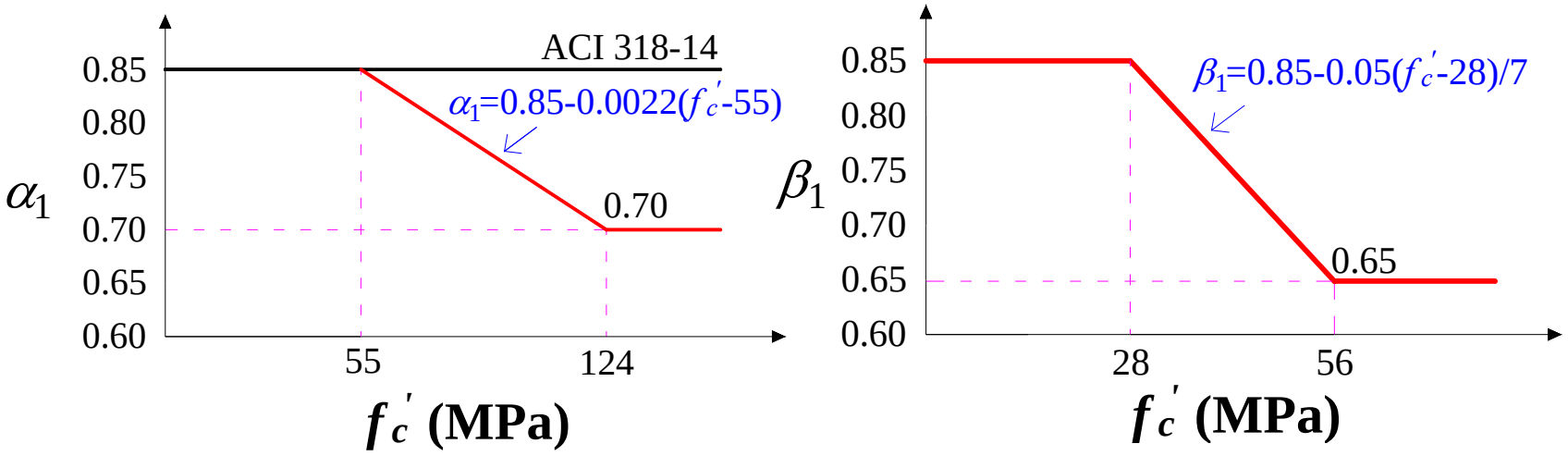
$$C_c = \alpha_1 \beta_1 f_c' b c$$

$$f_s = 685 \text{ MPa (100 ksi)} \quad \text{if } \varepsilon_s > \varepsilon_y$$

$$= E_s \varepsilon_s \quad \text{if } \varepsilon_s \le \varepsilon_y \quad (\varepsilon_y = 0.0034)$$

Flexural Member

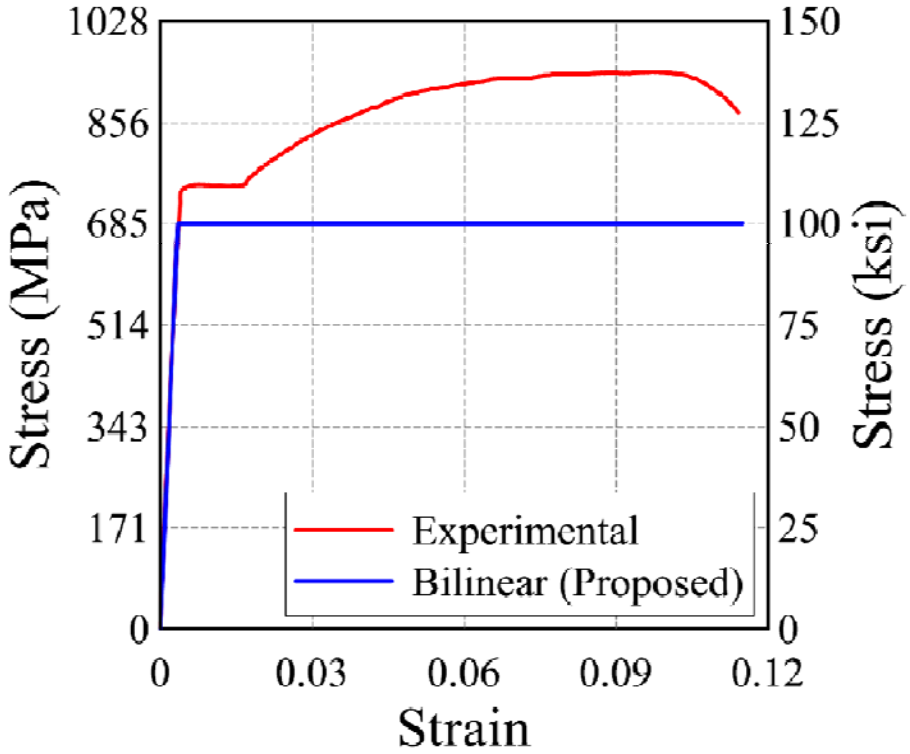
- Concrete (According to ACI ITG 4.3R-07)



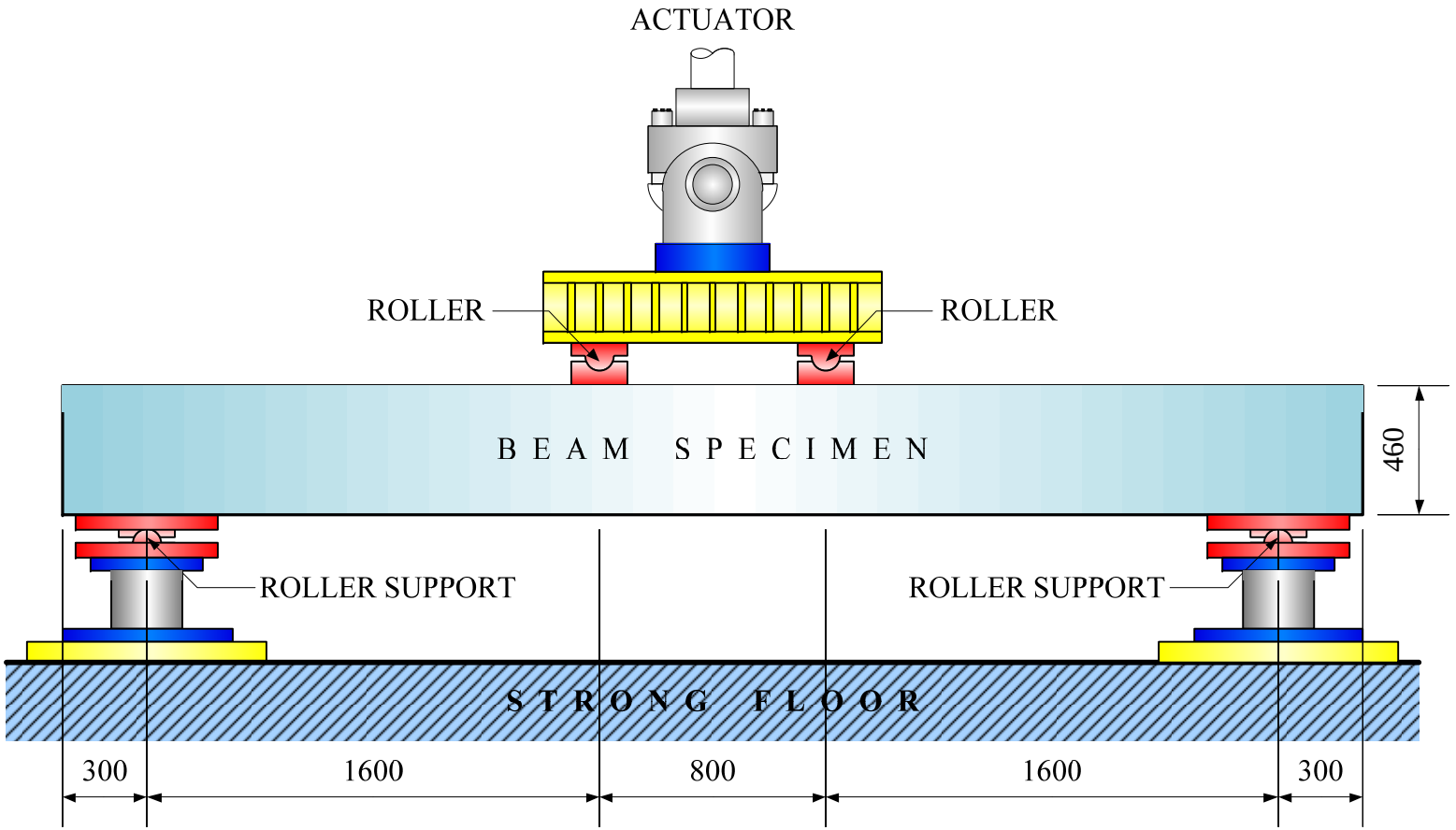
(remains the same)

Flexural Member

—SD 685 High-Strength Steel

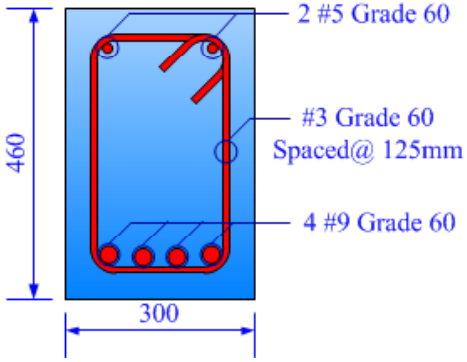
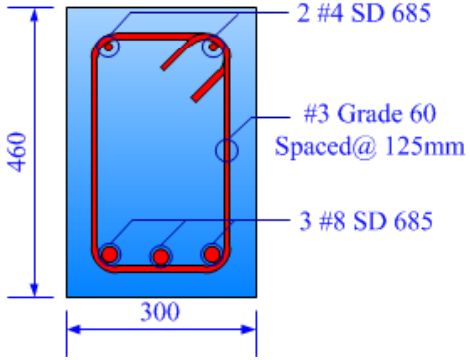
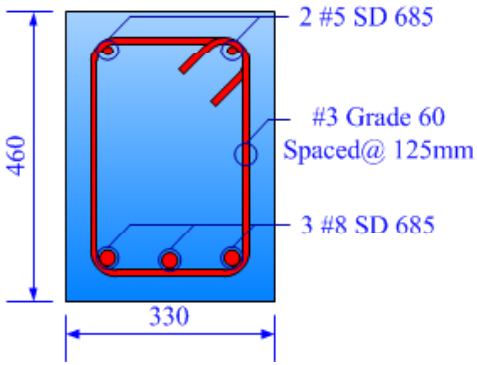


Flexural Member

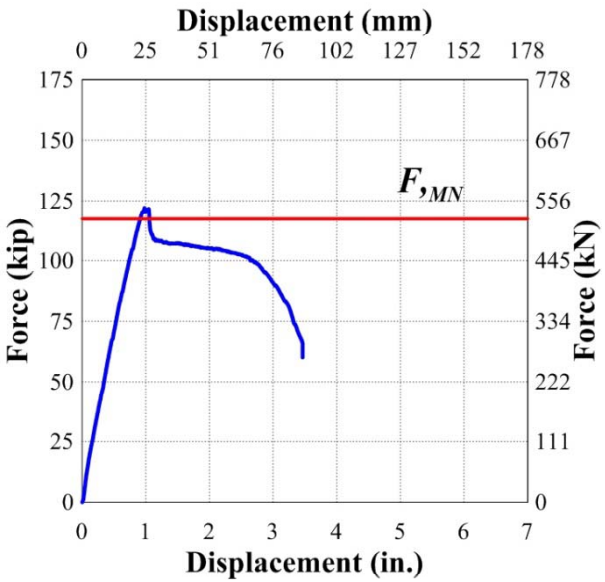


TEST SETUP FOR MONOTONIC LOADING

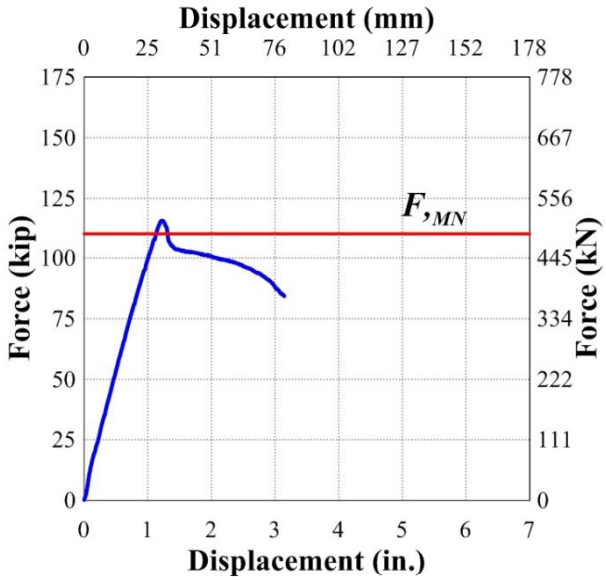
Flexural Member

	SC	S1	S2
Beam Design			
f_c'(psi)	4813 (α_1=0.85)	4962 (α_1=0.85)	5668 (α_1=0.85)
s / d_b	7.87	9.84	7.87
ε_t	0.0045	0.0049	0.0068

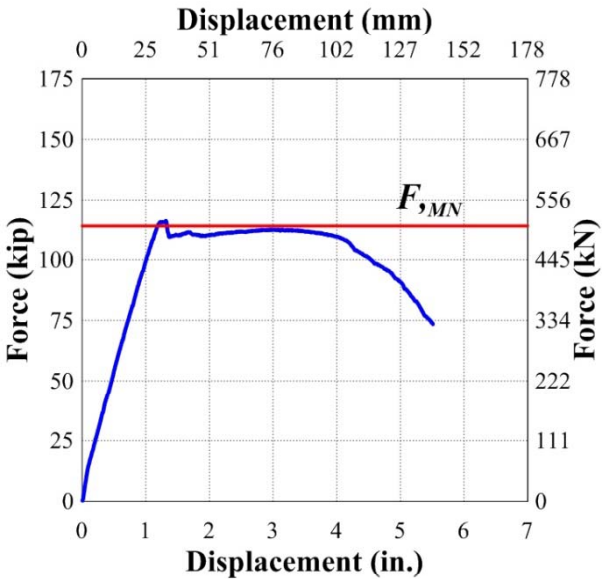
Flexural Member



SC

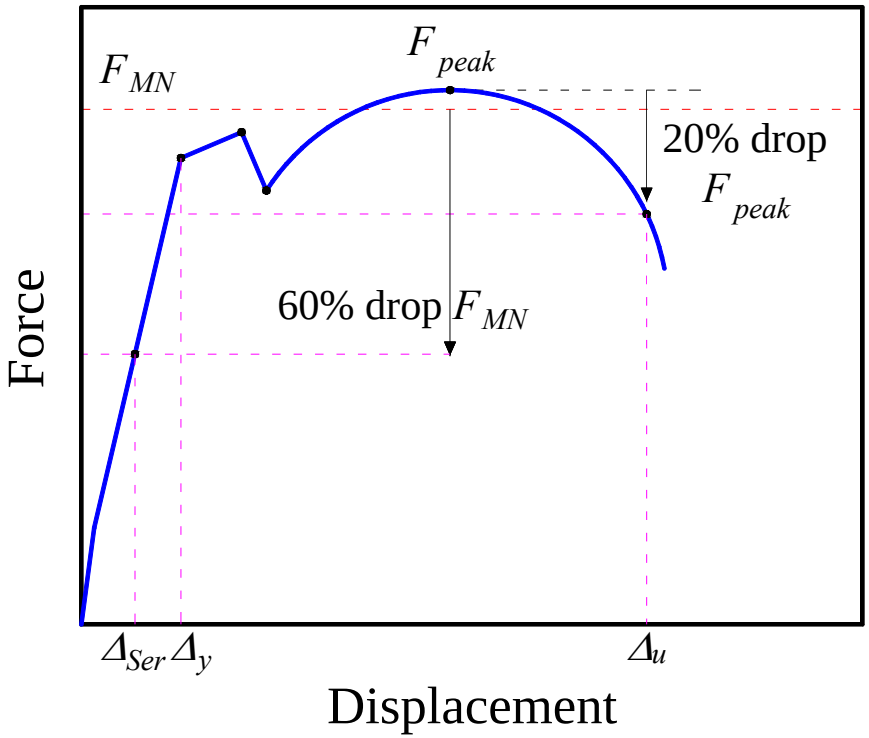


S1



S2

Flexural Member



	SC	S1	S2
ε_t	0.0045	0.0049	0.0068
$\frac{\Delta_u}{\Delta_y}$	3.5	2.98	4.82
$\frac{\Delta_u}{\Delta_{Ser}}$	5.6	4.45	7.58

Flexural Member

- Tension Controlled and Compression Controlled

$$\text{Compression-Controlled} : \varepsilon_s = \frac{685\ (\text{MPa})}{200,000\ (\text{MPa})} \approx 0.0034$$

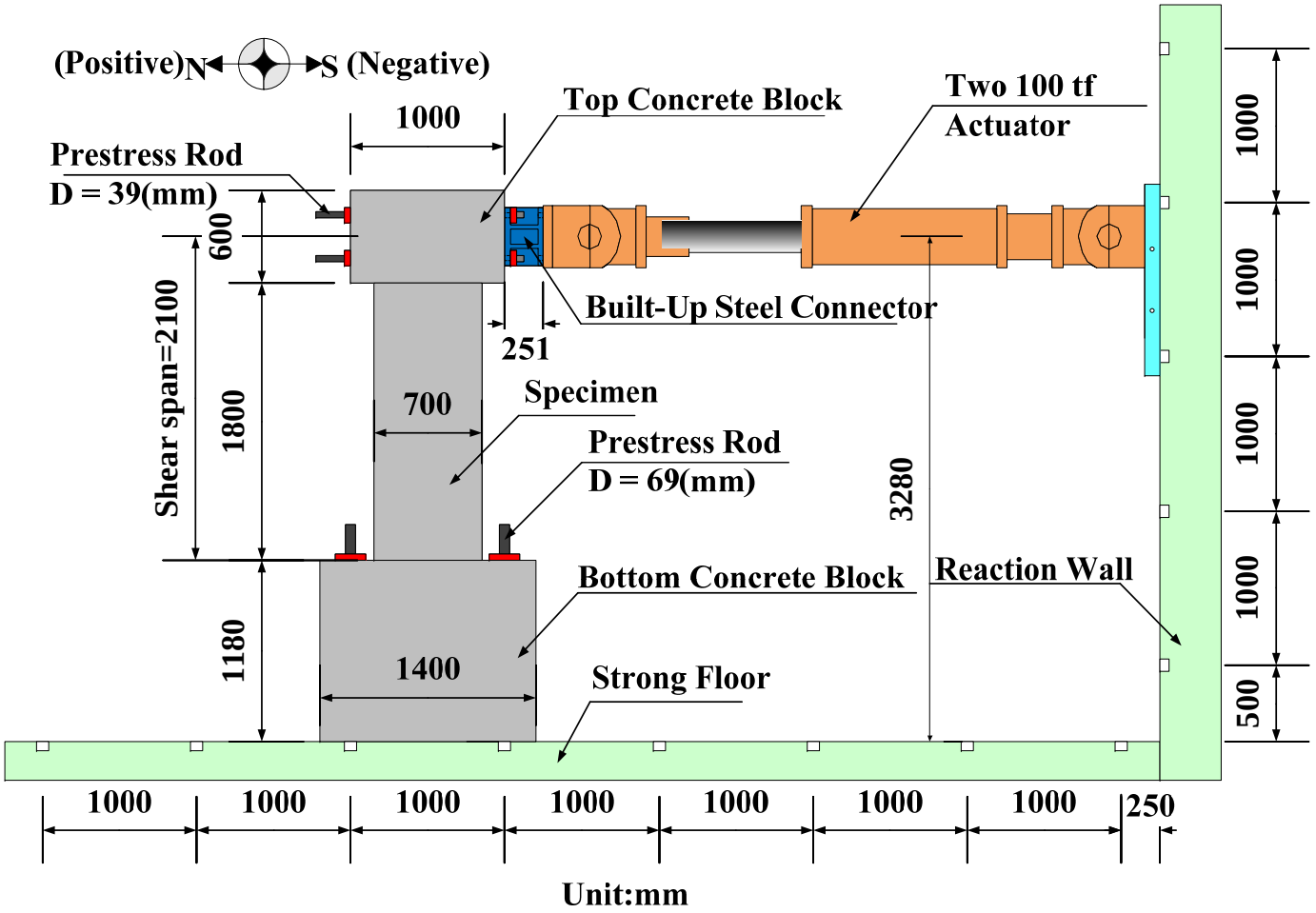
$$\text{Tension-Controlled} : \varepsilon_s = 0.007$$

- Spacing limit for Monotonic Load

$$s = 8d_b$$

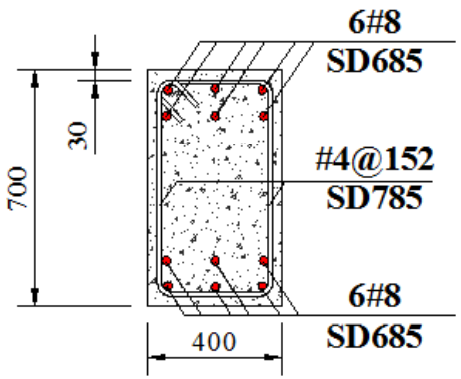
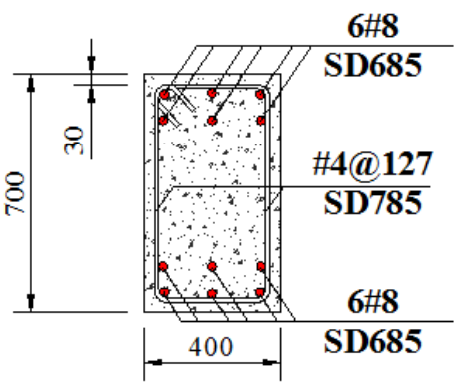
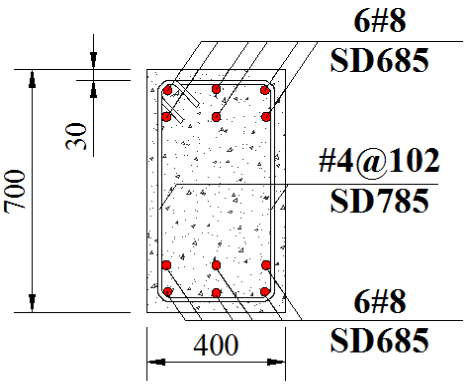
  - ► Based on experimental evidence

Flexural Member

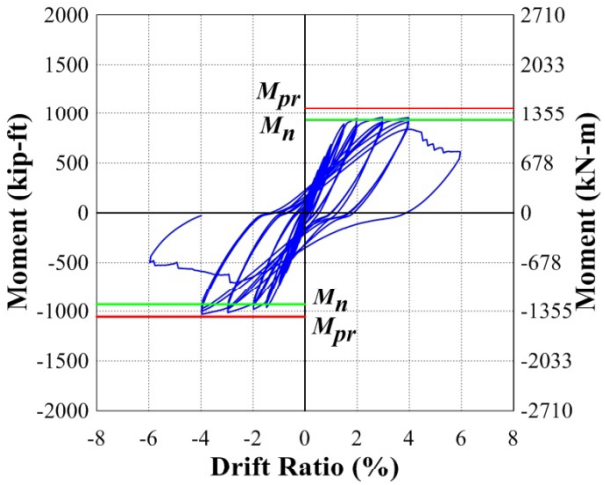


TEST SETUP FOR CYCLIC LOADING

Flexural Member

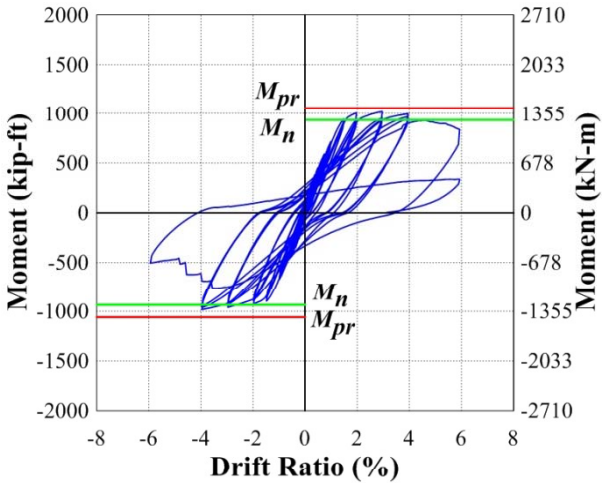
Beam Design			
f_c'(psi)	12070 (α_1=0.79)	12690 (α_1=0.78)	12370 (α_1=0.78)
s / d_b	6	5	4
ε_t	0.0141	0.0145	0.0143
$\frac{V_n . a}{M_{pr}}$	0.89	1.06	1.32

Flexural Member



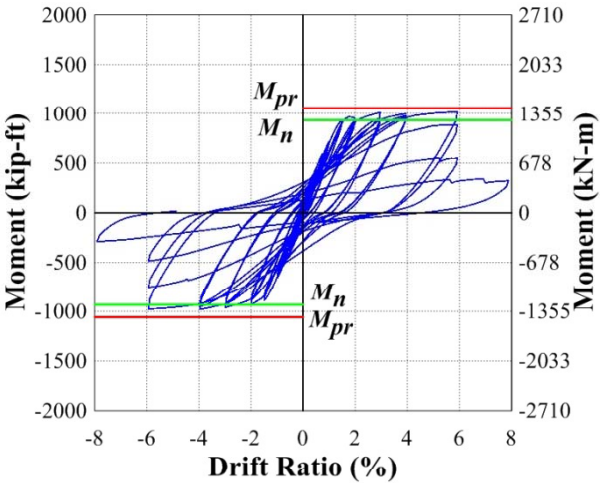
$s/d_b = 6$

UDR = 4.90 %



$s/d_b = 5$

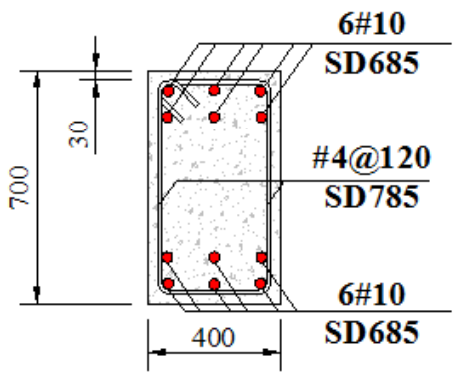
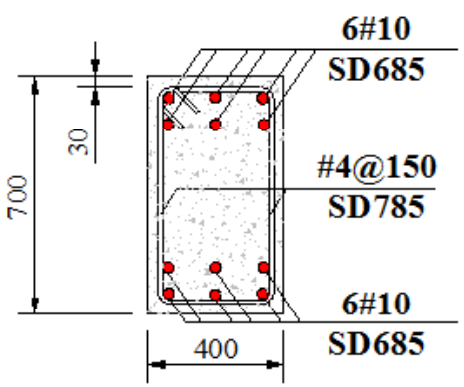
UDR = 5.35 %



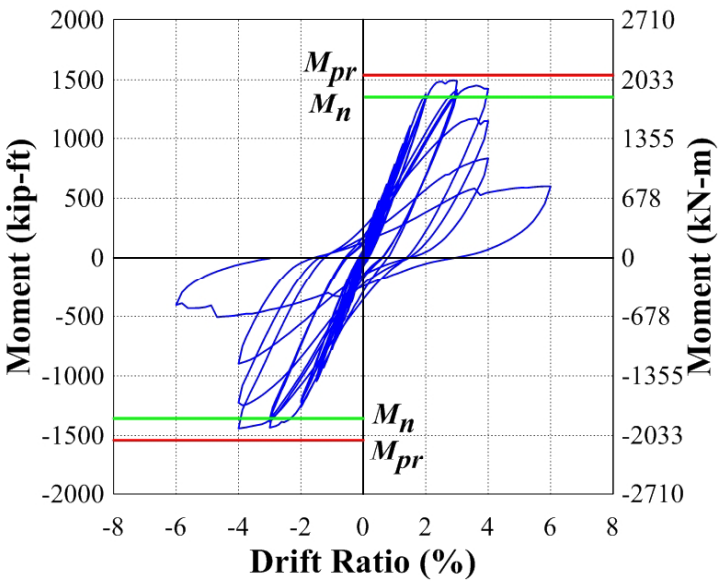
$s/d_b = 4$

UDR = 5.93 %

Flexural Member

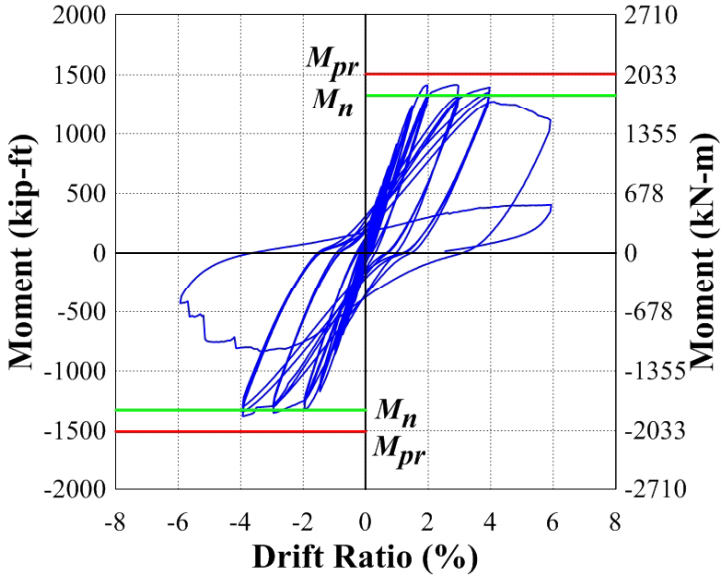
Beam Design		
f_c'(psi)	11090 (α_1=0.80)	10710 (α_1=0.81)
s / d_b	3.78 (4.00)	4.72 (5.00)
ε_t	0.0099	0.0099
$\frac{V_n . a}{M_{pr}}$	0.77	0.63

Flexural Member



$s/d_b = 4$

UDR = 4.00 %



$s/d_b = 5$

UDR = 5.15 %

- Spacing limit (conservatively)

  $s \leq 5d_b$

- f_{yt} for shear resistance ≤ 600 MPa

PRELIMINARY RECOMMENDATIONS FOR NEW RC SQUAT WALL

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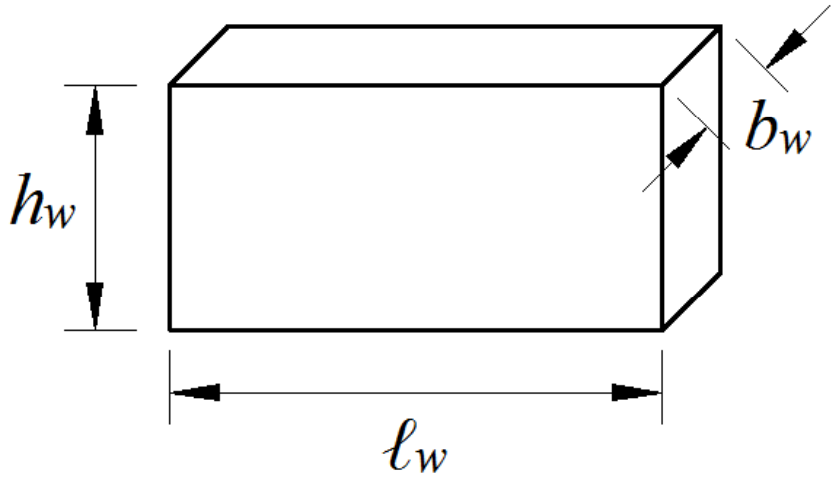
Outline

- Definition
- Design
  - Axial – Flexure
  - Shear
- Detailing
- Experimental Verification

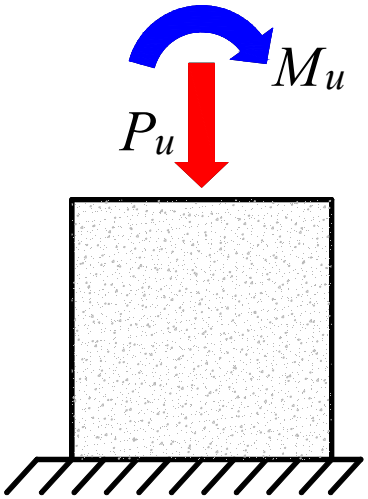
Definition :

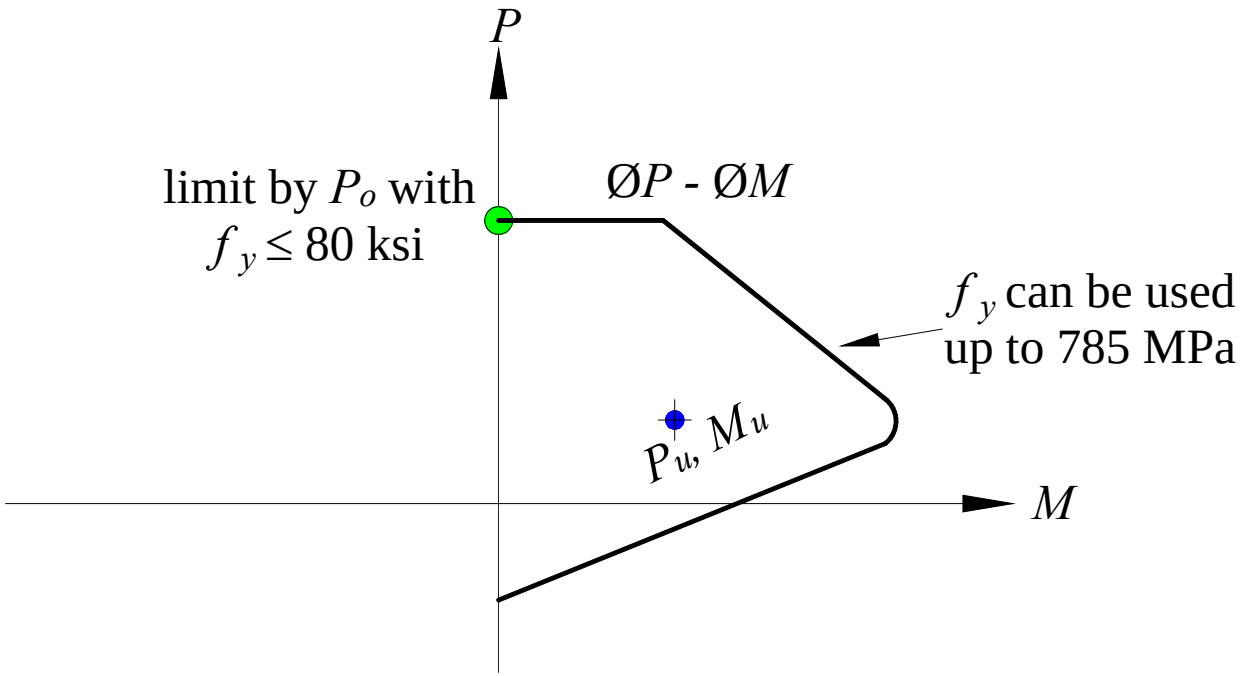
$$\frac{h_w}{\ell_w} \leq 1.5 \text{ and } \frac{\ell_w}{b_w} > 6.0$$



DESIGN :

Axial - Flexure





- Ensure P_u, M_u is within the $\emptyset P - \emptyset M$ curve

DESIGN :

Shear

$$V_n = A_{cv}\left(3\sqrt{f'_c} + \rho_t f_{yt}\right)$$

A_{cv} : gross−section area of the wall

f_{yt} : ≤ 600 MPa

$\sqrt{f'_c}$: limit to 0.7 MPa (100 psi)

- Ensure $V_n \geq \frac{M_n}{h_w}$

DETAILING :

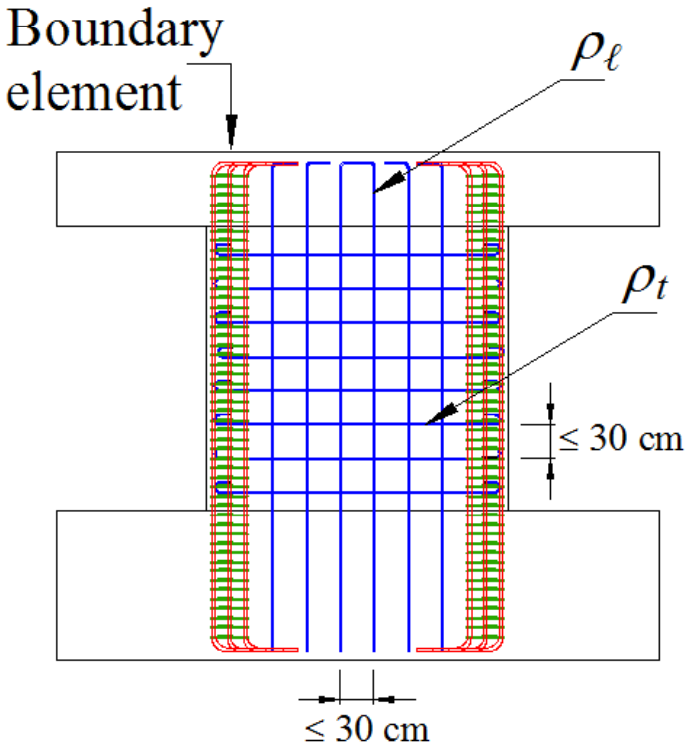
1. ρ_ℓ should be at least ρ_t

2. Spacing of distributed $\left\{\begin{matrix}\text{vertical}\\\text{horizontal}\end{matrix}\right\}$ web reinforcement $\leq$ 30 cm (12 in.)

3. $V_u \leq \varnothing 10\sqrt{f'_c}\,A_{cv}$

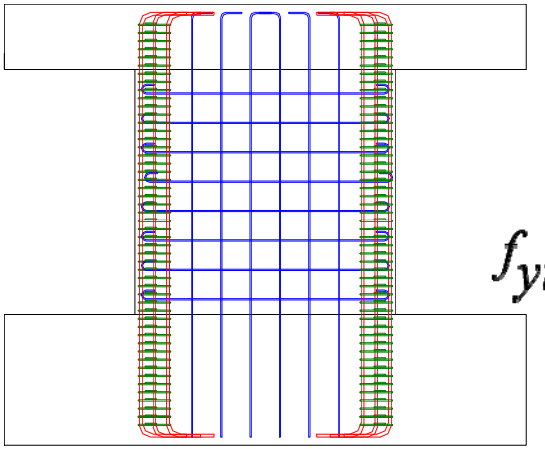
   $\Rightarrow$ suggest to be less than $\varnothing 8\sqrt{f'_c}\,A_{cv}$

4. Satisfy boundary element requirements as current ACI Building Code (318-14)



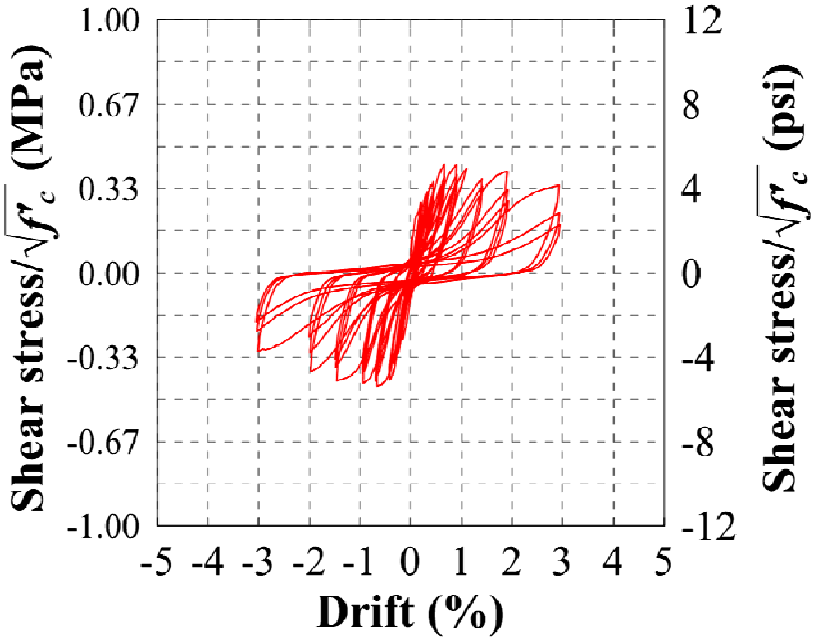
EXPERIMENTAL VERIFICATION:

M1

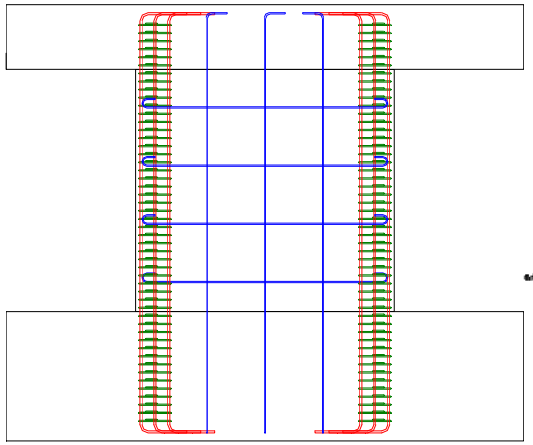


$$\frac{V_n}{M_n / a} = 1.20$$

f_{yt} = test material

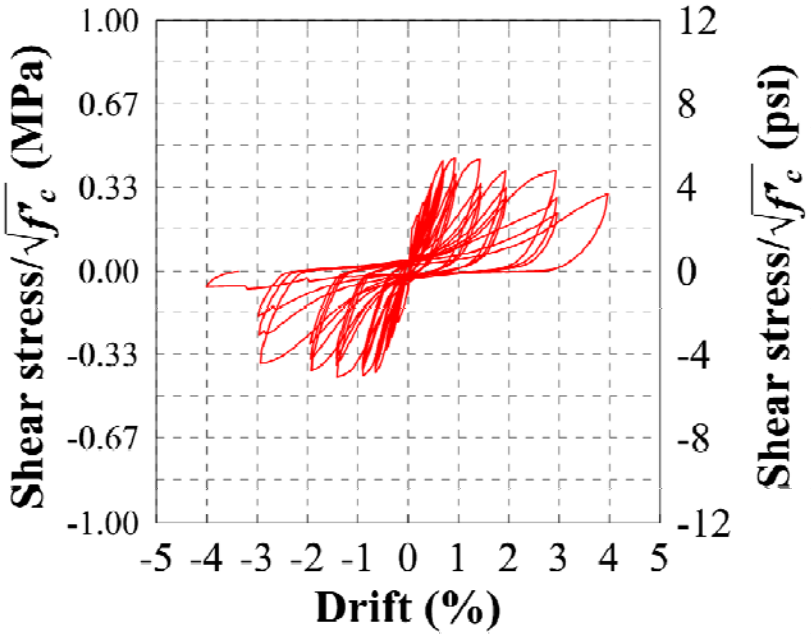


M2



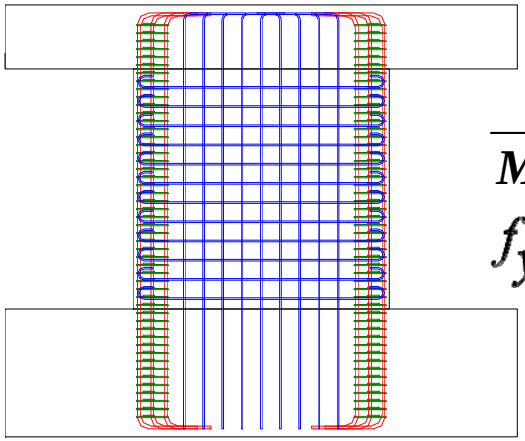
$$\frac{V_n}{M_n / a} = 1.05$$

f_{yt} = 600 MPa



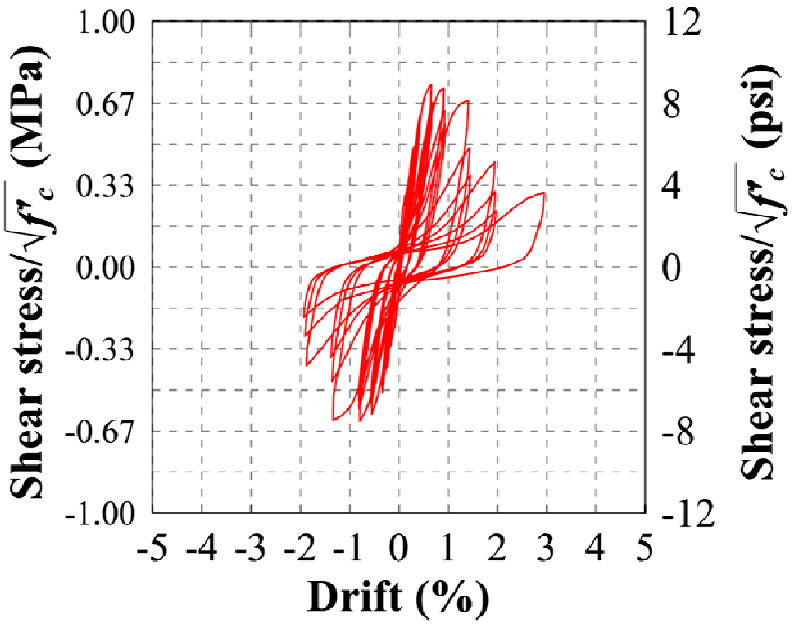
EXPERIMENTAL VERIFICATION:

H1

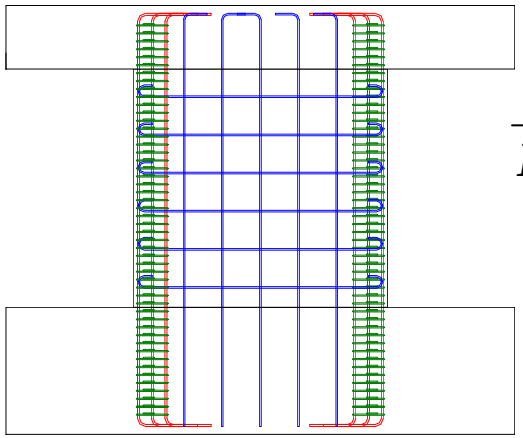


$$\frac{V_n}{M_n / a} = 1.28$$

f_{yt} = test material

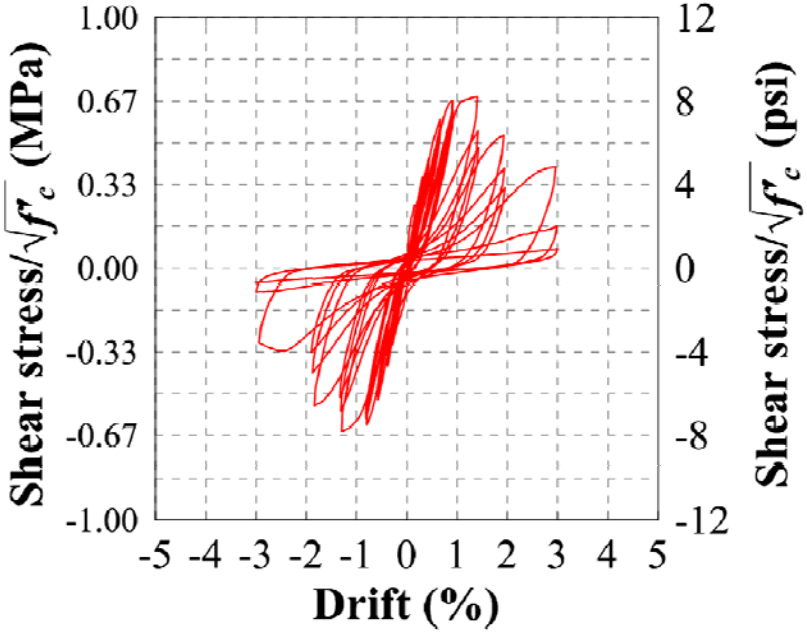


H2



$$\frac{V_n}{M_n / a} = 1.05$$

f_{yt} = 600 MPa



Thank you
for your attention !