

## بررسی تأثیر محصورشدگی بتن در رفتار غیرخطی دیوارهای برشی بتن آرمه بالدار

علی خیرالدین<sup>۱\*</sup> و علیرضا مرتضایی<sup>۲</sup>

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(Kappos)

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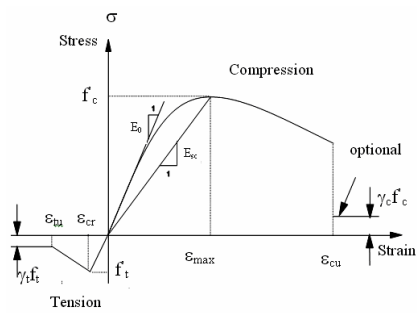
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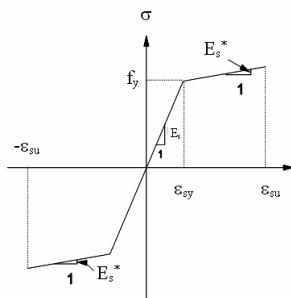
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Nonlinear Analysis of Concrete ) NONLACS2

[ ] (and steel structure



a) Plain Concrete



b) Steel Reinforcement

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$$\left[ \begin{matrix} \sigma_1 \\ \sigma_2 \end{matrix} \right] = \left( \begin{matrix} E_1 & \nu E_2 \\ \nu E_1 & E_2 \end{matrix} \right) \left[ \begin{matrix} \varepsilon_1 \\ \varepsilon_2 \end{matrix} \right] \quad (1)$$

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$$\sigma = \frac{E_0 \varepsilon}{1 + \left( \frac{E_0}{E_{sc}} - 2 \right) \left( \frac{\varepsilon}{\varepsilon_{max}} \right) + \left( \frac{\varepsilon}{\varepsilon_{max}} \right)^2} \quad (2)$$

$\left[ \begin{matrix} \sigma \\ \varepsilon \end{matrix} \right] = \left( \begin{matrix} E_{sc} & 0 \\ 0 & E_0 \end{matrix} \right) \left[ \begin{matrix} \varepsilon \\ \sigma \end{matrix} \right]$

$$\sigma = \sigma_c \left( \frac{\varepsilon}{\varepsilon_{cu}} \right) \exp \left( 1 - \frac{\varepsilon}{\varepsilon_{cu}} \right) \quad (3)$$

$\left[ \begin{matrix} \sigma \\ \varepsilon \end{matrix} \right] = \left( \begin{matrix} f'_c & 0 \\ 0 & \sigma_c \end{matrix} \right) \left[ \begin{matrix} \varepsilon \\ \sigma \end{matrix} \right]$

$(\varepsilon > \varepsilon_{tu})$                        $(\varepsilon > \varepsilon_{cu})$

$$\left[ \begin{matrix} \gamma_t f'_t & \gamma_c f'_c \\ \gamma_t & \gamma_c \end{matrix} \right] \left( \begin{matrix} - \\ - \end{matrix} \right) \quad (4)$$

$$D = \frac{1}{(1-\nu^2)} \begin{bmatrix} E_1 & \nu\sqrt{E_1 E_2} & 0 \\ \nu\sqrt{E_1 E_2} & E_2 & 0 \\ 0 & 0 & \frac{1}{4}(E_1 + E_2 - 2\nu\sqrt{E_1 E_2}) \end{bmatrix} \quad (5)$$

$E_2 \quad E_1$

$\nu$

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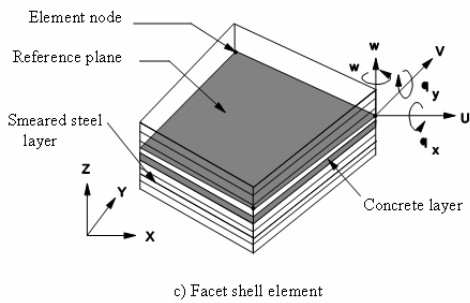
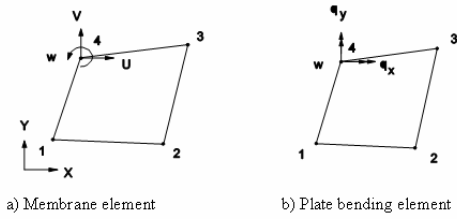
NONLACS2

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[D]

$$[D] = \begin{bmatrix} 0 & 0 & 0 \\ 0 & E_2 & 0 \\ 0 & 0 & \beta G \end{bmatrix} \quad \begin{matrix} \sigma_1 \\ \sigma_2 \\ \tau_{xy} \end{matrix} \quad \begin{matrix} f_t' \\ f_t' \\ \tau_{xy} \end{matrix} \quad \begin{matrix} 0 < \beta \leq 1.0 \\ \sigma_2 > f_t' \\ 0 < \beta \leq 1.0 \end{matrix} \quad ( )$$

$$[D] = \begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & \beta G \end{bmatrix} \quad \begin{matrix} \sigma_1 \\ \sigma_2 \\ \tau_{xy} \end{matrix} \quad \begin{matrix} f_t' \\ f_t' \\ \tau_{xy} \end{matrix} \quad \begin{matrix} 0 < \beta \leq 1.0 \\ \sigma_2 > f_t' \\ 0 < \beta \leq 1.0 \end{matrix} \quad ( )$$



NONLACS2

$$\epsilon_{tu} = 0.004 e^{-0.008 h} \quad (\epsilon_{tu} \geq \epsilon_{cr}) \quad ( )$$

$\epsilon_{cr}$  mm      h

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$$k = 1 + a(\rho_w \frac{f_y}{f_c})^b \quad (1)$$

$$\frac{b}{a} \quad (2)$$

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u

u

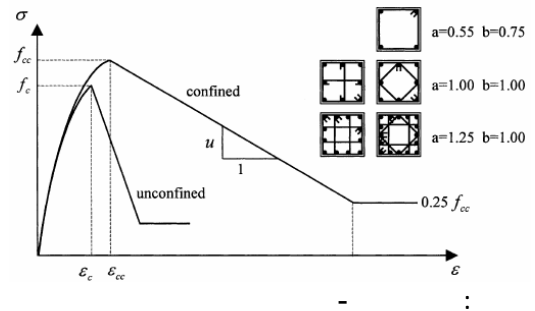
$$u = \frac{0.5f_{cc}}{0.75\rho_w\sqrt{b_c/S_w} + \frac{3+0.29f_c/k}{145f_c/k-1000}\varepsilon_{cc}} \quad (3)$$

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$S_w$

$b_c$



$$\frac{\sigma_2 - \varepsilon_2}{k^2, k} \quad (4)$$

u

$$\frac{\sigma_2 - \varepsilon_2}{k^2, k} \quad (5)$$

$$\frac{\sigma_2 - \varepsilon_2}{k^2, k} \quad (6)$$

$$k \cdot (\varepsilon_2^*) \quad (7)$$

$$k^2 \cdot \sigma_2^* \quad (8)$$

$$(\quad) k \quad (9)$$

$$(\quad) K^2 \quad (10)$$

$$f_{cc} = k \cdot f_c \quad (11)$$

$$\sigma_1 - \varepsilon_1 \quad (12)$$

$$\varepsilon_{cc} = k^2 \cdot \varepsilon_c \quad (13)$$

$$f_{cc} \quad f_c \quad (14)$$

$$\varepsilon_{cc} \quad \varepsilon_c \quad (15)$$

K

K

$\rho_w$

$f_y$

[ ]

K

$f_c$

:

(MPa)	(MPa)		
		/	

(k)	(MPa)	
/	/	Sw14
/	/	Sw15
/	/	Sw16
/	/	Sw21
/	/	Sw22
/	/	Sw23

$\times$   $\times$   $( = )$   
 $\times$   $( = )$   $\times$   
 SW16, SW15,  
 SW23, SW22, SW21 SW14  
 ( )

( )

K

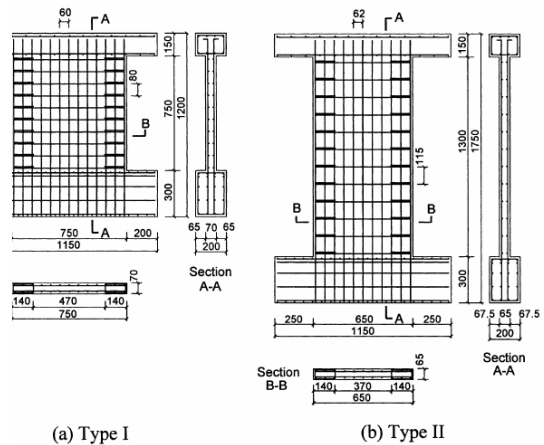
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جدول ۳: بارهای افقی و قائم وارد به دیوارهای آزمایش شده توسط لفاس و همکاران.

نام مدل	بار قائم		بار / تغییر مکان افقی	
	بار قائم وارده (kN)	بار قائم نرمالایز شده* (kN)	حداکثر بار افقی (mm)	تغییر مکان در بار افقی حداکثر (mm)
SW14	۰	۰	۲۶۵	۱۱,۲۱
SW15	۱۸۵	۰,۱	۳۲۰	۸,۰۵
SW16	۴۶۰	۰,۲	۳۵۵	۵,۷۸
SW21	۰	۰	۱۲۷	۲۰,۶۱
SW22	۱۸۲	۰,۱	۱۵۰	۱۵,۳۰
SW23	۳۴۳	۰,۲	۱۸۰	۱۳,۱۹

\* بار قائم نرمالایز شده، نسبت بار قائم وارده به ظرفیت باربری قائم سازه می‌باشد.



(a) Type I

(b) Type II

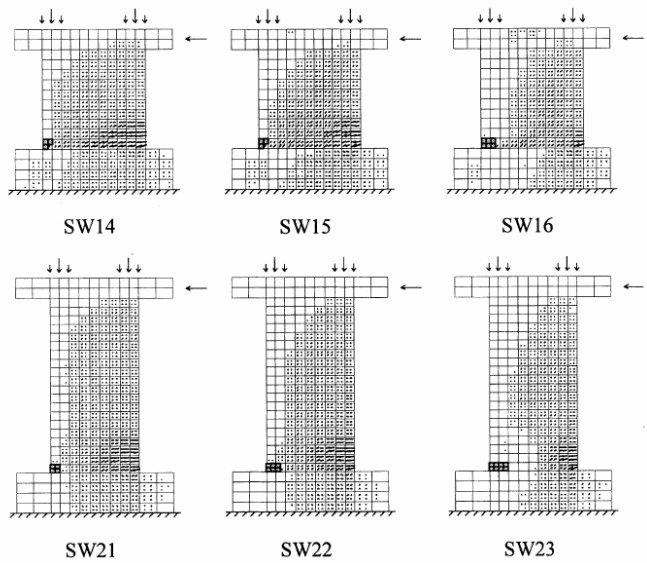
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(b) Experimental

(a) Analytical



.SW14

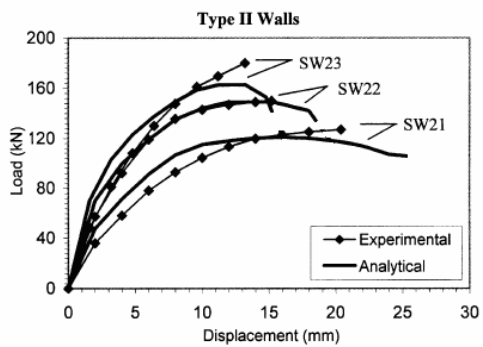
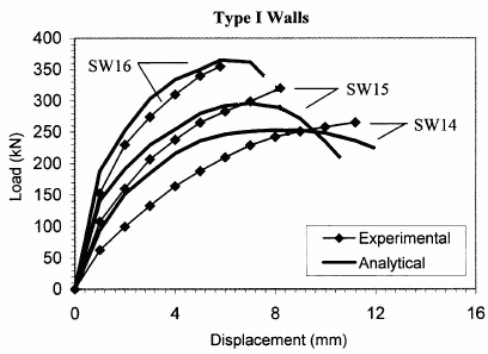
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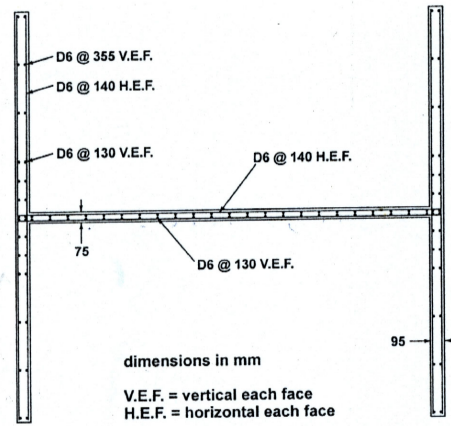
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(MPa)	(MPa)	(MPa)	
/			/

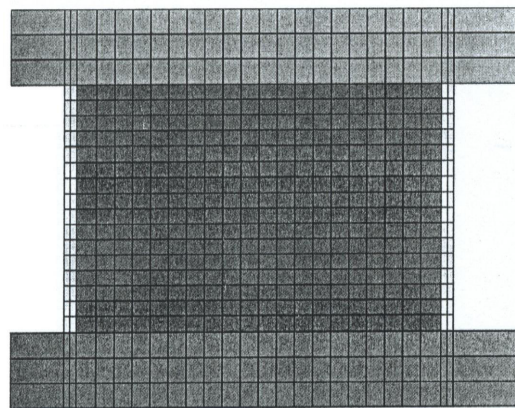


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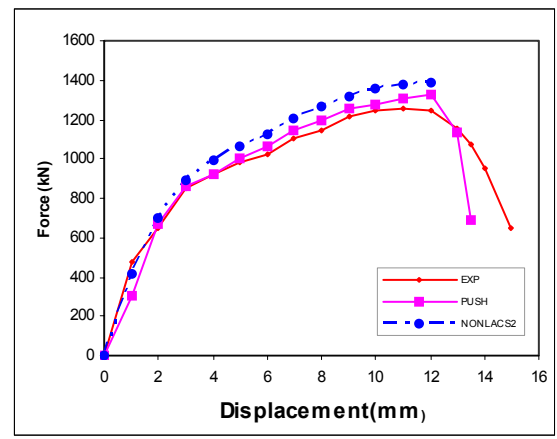


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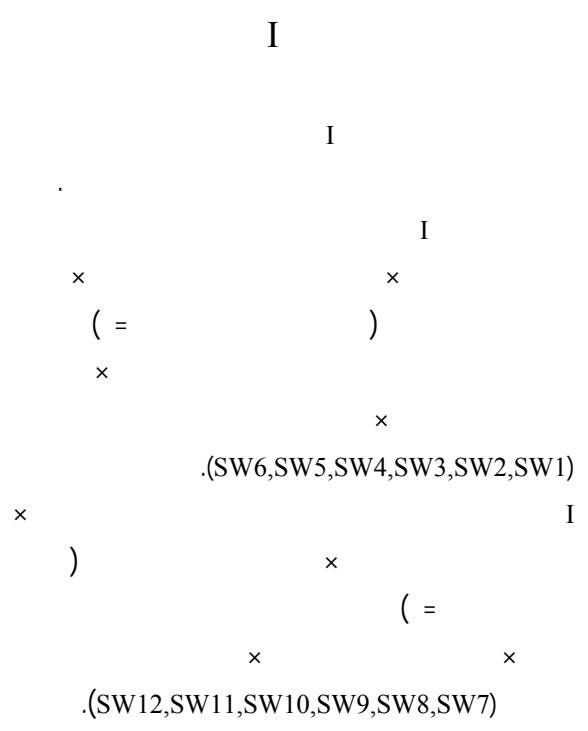
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/	/		SW1
/	/		SW2
/	/		SW3
/	/		SW4
/	/		SW5
/	/		SW6
/	/		SW7
/	/		SW8
/	/		SW9
/	/		SW10
/	/		SW11
/	/		SW12



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SW7, SW1

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kN kN

SW9,SW3

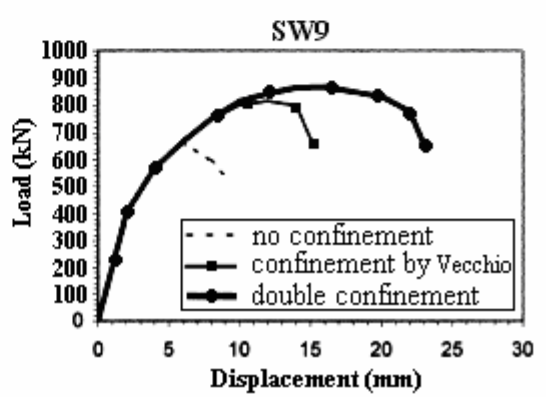
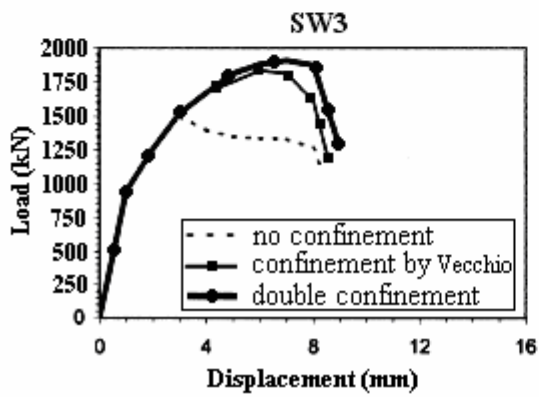
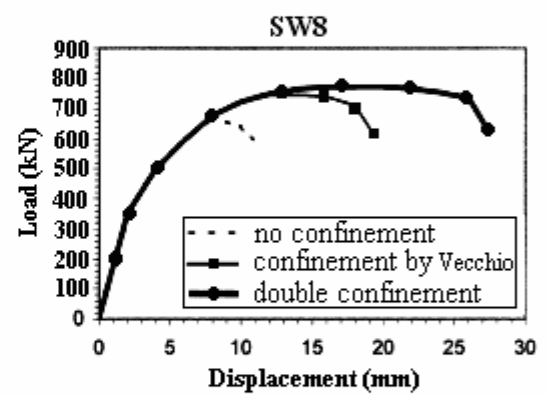
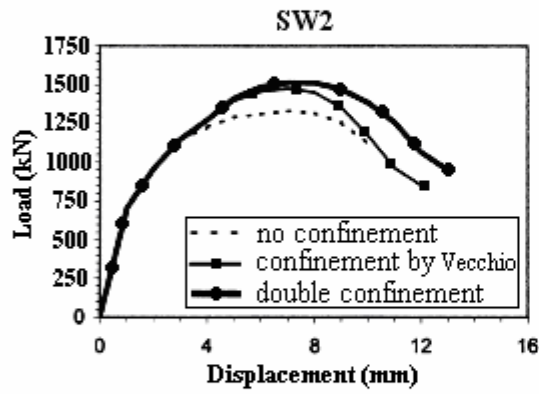
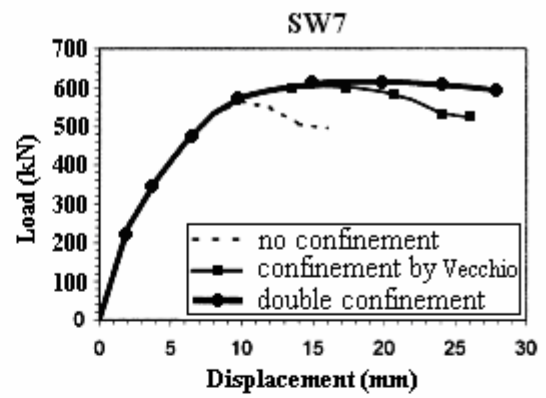
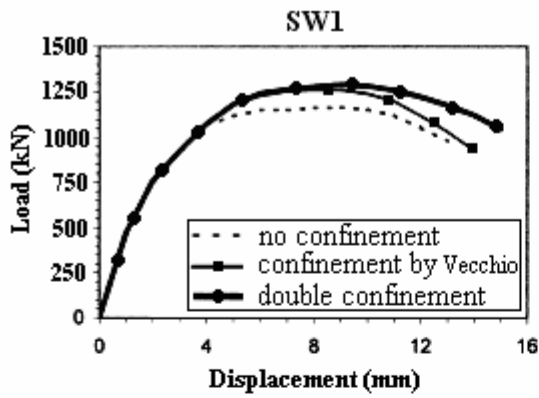
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(mm)	(mm)	(kN)	*	(kN)	
/	/				SW1
/	/				SW1
/	/				SW1
/	/		/		SW2
/	/		/		SW2
/	/		/		SW2
/	/		/		SW3
/	/		/		SW3
/	/		/		SW3
/	/				SW7
/	/				SW7
/	/				SW7
/	/		/		SW8
/	/		/		SW8
/	/		/		SW8
/	/		/		SW9
/	/		/		SW9
/	/		/		SW9

\*

SW8,SW2



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- 1 - Flanged Shear Wall  
2 - Post peak Softening  
3 - Aggregate Interlock  
4 - Dowel Action  
5 - Tension Stiffening  
6 -Smeard
-