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Performance of Two-way Concrete Slabs Reinforced with Perforated Steel Plates

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Abstract

In this study, perforated steel plates are proposed to reinforce concrete slabs. Three slab specimens reinforced with perforated steel plates and three slab specimens reinforced conventionally were cast and tested to failure. Test results and analysis show that slabs reinforced with perforated plates provide higher cracking strength, ductility, energy absorption capacity and ultimate strength than slabs reinforced with conventional reinforcement. Improve in force transfer between steel and concrete can facilitate the use of perforated plates in various applications, specially those made of composite materials with high tensile strength.

Keywords: Two-way slabs, Reinforced concrete, Perforated plates, test

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cm* cm* cm
 * * /

mm mm PSPS-1
 PPS-2 ()
 mm mm PPS-3
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OR-3 OR-2 OR-1

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OR-1 / mm cm* cm

OR-3 PPS-2 PPS-1

OR-2 PPS-3

) OR-1

PPS-2 PPS-1 (mm

PPS-3 ASTM

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$$\sigma_{up} = \text{kg/cm}^2 \quad \epsilon_{yp} = / \quad \sigma_{yp} = \text{kg/cm}^2$$

$$\sigma_{yb} = \text{kg/cm}^2$$

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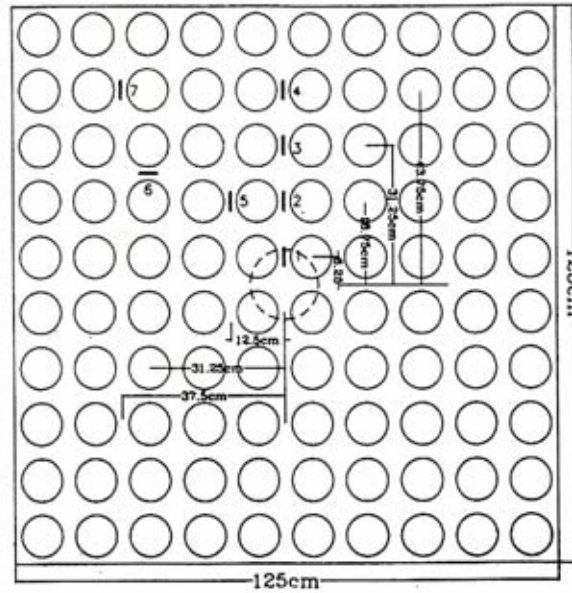
$$\sigma_{ub} = \text{kg/cm}^2 \quad \epsilon_{yb} = /$$

/ mm

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cm kg/cm²

mm



(PSPS-1)

PSPS-1	/	/	/
PSPS-2	/	/	/
PSPS-3	/	/	/
OR-1	/	/	/
OR-2	/	/	/
OR-3	/	/	/

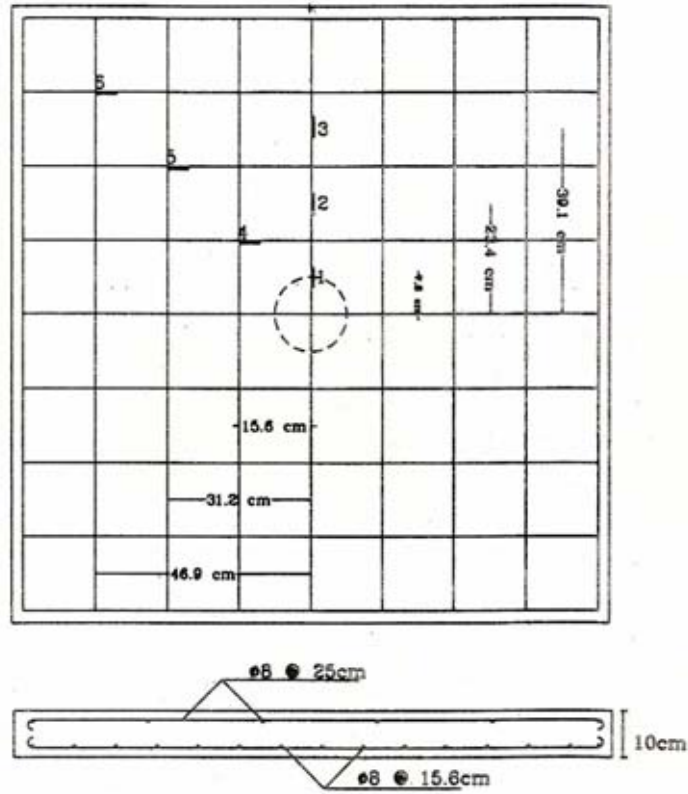
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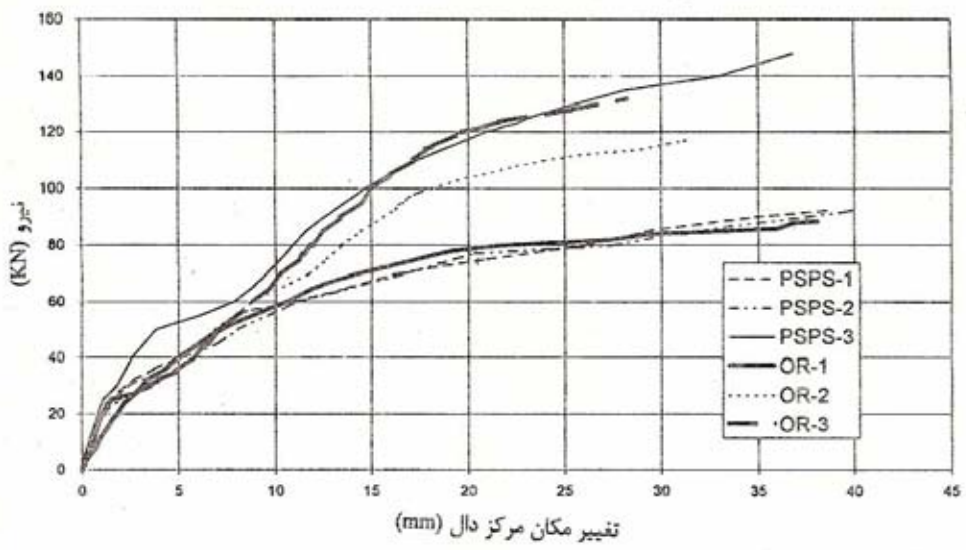
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(OR-1)

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	f'_c (kg/cm ²)	$P_{cr}^{(1)}$ (kg)	$\Delta_{cr}^{(1)}$ (mm)	$P_y^{(2)}$ (kg)	$\Delta_y^{(2)}$ (mm)	$P_u^{(3)}$ (kg)	$\Delta_u^{(3)}$ (mm)	$\mu = \frac{\Delta_u}{\Delta_y}$	(ton-cm)	$\frac{P_\sigma}{P_u}$
PSPS-1			/		/		/	/	/	/
PSPS-2			/		/		/	/	/	/
PSPS-3			/		/		/	/	/	/
OR-1			/		/		/	/	/	/
OR-2			/		/		/	/	/	/
OR-3			/		/		/	/	/	/

-1

-2

-3

kg PSPS-1

kg OR-3 / kg

kg PSPS-2

9250

PSPS-3 OR-1 mm

OR-3 OR-3 kg

OR-3 PSPS-3 PSPS-2 PSPS-1 OR-1

PSPS-3 % % ()

% OR-3 -

PSPS-3 OR-3 OR-1 PSPS-2 PSPS-1

/ kg OR-2 kg

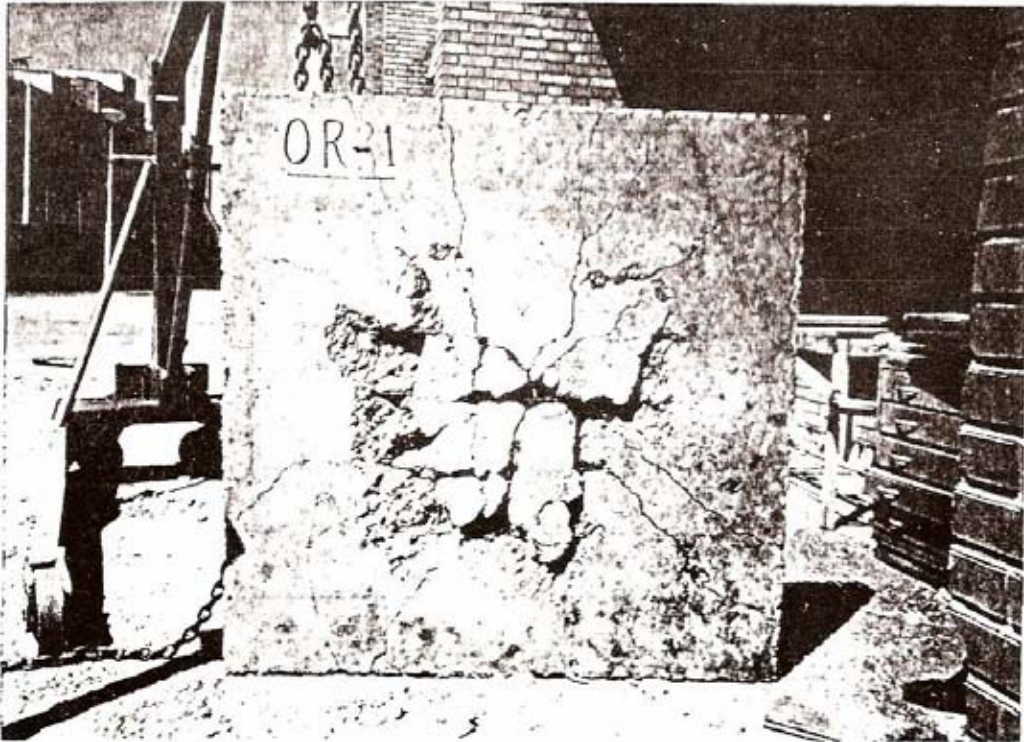
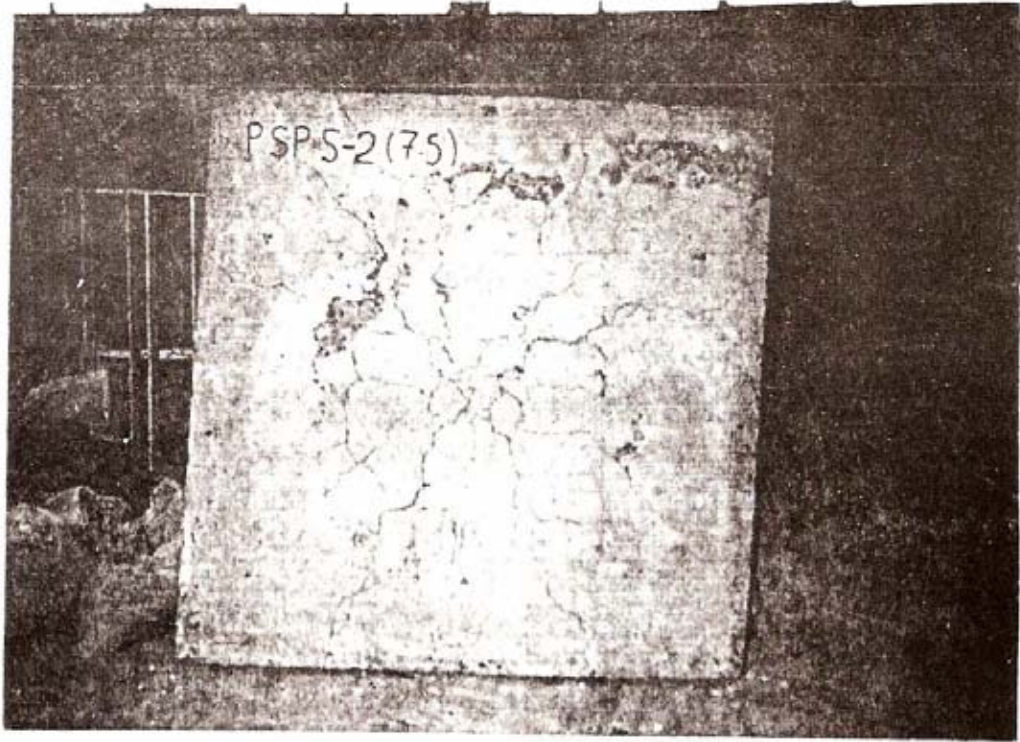
/ mm

PSPS-3

() PSPS-1

kg PSPS-3 PSPS-2

/



$$\left(\mu = \frac{\Delta_u}{\Delta_y} \right)$$

(.)

PSPS-2 PSPS-1

/ / OR-1

. / OR-1

OR-1 PSPS-1

PSPS-2

OR-3 PSPS-3

PSPS-2 PSPS-1

ACI

PSPS-1

PSPS-2

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%

PSPS-1

$$M_u = \rho f_y d^2 \left(1 - 0.59 \rho \frac{f_y}{f'_c} \right) \quad ()$$

PSPS-2

PSPS-3

PSPS-2

PSPS-3

PSPS-2

%

PSPS-3

d= cm

%

PSPS-3

OR-1

:(P_u)_{flex}

OR-1

$$P_{flex} = 8 \rho f_y d^2 \left(1 - 0.59 \rho \frac{f_y}{f'_c} \right) \quad ()$$

PSPS-2 PSPS-1

)

/ /

OR-1

$$\rho = \frac{A_s}{bd} = 1.25 \quad (\rho_{ave})$$

$$\rho = 1.25 \quad (\rho \quad)$$

$$() \quad (P_u)_{flex}$$

OR-3

ρ

%

OR-1

%

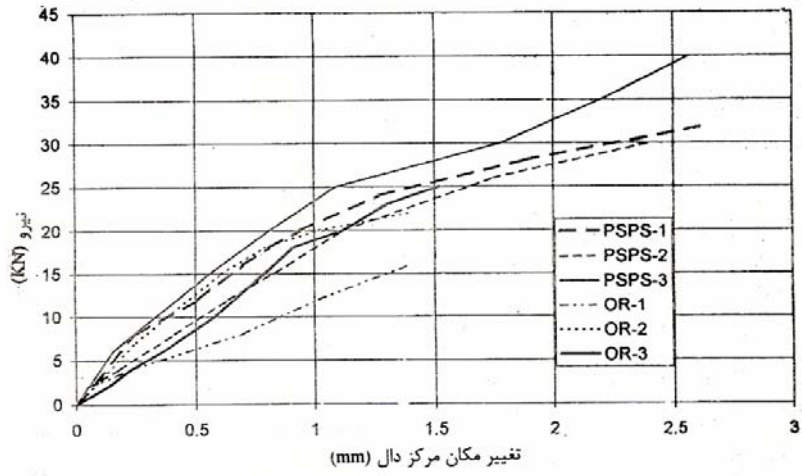
PSPS-1

PSPS-3

$$(P_u)_{pun}$$

%

PSPS-2



OR-1 PSPS-1 ()

OR-1 PSPS-2 PSPS-1 OR-1 PSPS-2

() OR-1

	(cm ³)	(kg)	OR-1
PSPS-1		/	- /
PSPS-2		/	+ /
OR-1		/	—

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- [1] Park, R and Paulay, T., "Reinforced Concrete Structures", John Wiley and Sons Inc. 1975, 769p.
 - [2] "Building Code Requirements for Reinforced Concrete (ACI 318-99)", ACI Pub., 1999, 391p.
 - [3] Marzouk, H. and Hussein, A., "Experimental Investigation on the Behavior of High-Strength Concrete Slabs", ACI Structural Journal, Nov-Dec. 1991, PP. 701-713.
 - [4] Elgabry, A.A. and Ghali, A., "Design of Stud-Shear Reinforcement for Slabs", ACI Structural Journal, May-June 1990, PP. 350-361.
 - [5] Ghali, A. and Hammill, N., "Effectiveness of Shear Reinforcement in Slabs", Concrete International, ACI, Jan. 1992, PP. 60-65.
 - [6] Khaloo, A.R., and Ahmad, S.H., "Behavior of Concrete under Combined Shear and Compressive Stresses", ACI Materials Journal, V. 85, No. 6, Nov-Dec. 1988, pp. 551-559.
 - [7] Clarke, J.L. and Birjandi, F.K., "Punching Shear Resistance of Lightweight Aggregate Concrete Slabs", Magazine of Concrete Research, No. 152, 1990, PP. 171-176.

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