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TABLE 1—DETAILS OF TEST SPECIMENS

Specimen designation*	Applied axial load	Concrete compressive strength, psi	Vertical reinforcement			Detail type†	Transverse reinforcement					
			Bars	Nominal yield strength, ksi	Percent		Bar size	Nominal yield strength, ksi	Spacing, in.‡	Area (a_{sh}), in.²	Percent§	Percent of ACI**
D60-7-4-2⅝-0.2P	0.2 P_0††	7790‡‡	8 - #6	60	2.44	1	#4	60	2⅝	0.4	2.73	142
D60-7-3C-1⅝-0.2P	0.2 P_0	7370‡‡	8 - #6	60	2.44	2	#3	60	1⅝	0.33	3.82	150
D60-15-4-2⅝-0.2P	0.2 P_0	14,620‡‡	8 - #6	60	2.44	1	#4	60	2⅝	0.4	2.73	69
D60-15-3C-1⅝-0.2P	0.2 P_0	14,540‡‡	8 - #6	60	2.44	2	#3	60	1⅝	0.33	3.82	76
D120-15-3C-2⅝-0.2P	0.2 P_0	14,730‡‡	8 - #6	60	2.44	2	#3	120	2⅝	0.33	2.36	107
D120-15-3C-1⅝-0.2P	0.2 P_0	14,750‡‡	8 - #6	60	2.44	2	#3	120	1⅝	0.33	3.82	150
D60-4-3C-2⅝-0.2P	0.2 P_0	3810§§	8 - #6	60	2.44	2	#3	60	2⅝	0.33	2.36	180
D60-4-3C-2⅝-0.4P	0.4 P_0	3910§§	8 - #6	60	2.44	2	#3	60	2⅝	0.33	2.36	180
D60-15-3C-1⅝-0.3P	0.3 P_0	15,050	8 - #6	60	2.44	2	#3	60	1⅝	0.33	3.82	74

*Specimen designation: DA-B-C-D-E, where A = nominal yield strength of transverse reinforcement; B = nominal compressive strength of concrete; C = 4- #4 peripheral ties = 3C-#3 peripheral ties and #3 cross ties; D = spacing of transverse reinforcement over critical region; E = level of applied axial load.

†See Fig. 4 for description of each detail type.

‡Spacing of transverse reinforcement in potential plastic hinge region of test columns (see Fig. 3).

§Ratio of volume of transverse reinforcement over spacing S to core volume of concrete confined by transverse reinforcement (measure out-to-out).

**Ratio of area of transverse reinforcement provided over that required by seismic provisions of ACI 318-89.

††P_0 is column axial load capacity, defined as follows: $P_0 = 0.85 f'_c (A_g - A_{st}) + A_{st} f_y$, where f'_c is concrete compressive strength at time of testing, ksi; A_g is gross area of column cross section, in.²; A_{st} is total area of logitudinal steel, in.², and f_y is yield strength of logitudinal steel obtained from coupon tests, ksi.

‡‡Concrete compressive strength at time of testing based on average of three 4 x 8-in. cylinder compression tests.

§§Concrete compressive strength at time of testing based on average of three 4 x 8-in. cylinder compression tests.

TABLE 2 —MAXIMUM MEASURED AND CALCULATED MOMENT CAPACITIES

Test	M_{MAX} experimental, in.-kips	M_{ACI} in.-kips	M_{REV} in.-kips	$\frac{M_{MAX}}{M_{ACI}}$	$\frac{M_{MAX}}{M_{REV}}$
D60-7-4-2⅝-0.2P	2195	1762	—	1.25	—
D60-7-3C-1⅝-0.2P	2104	1714	—	1.23	—
D60-15-4-2⅝-0.2P	2402	2588	2300	0.93	1.04
D60-15-3C-1⅝-0.2P	2612	2577	2291	1.01	1.14
D120-15-3C-2⅝-0.2P	3362	2600	2312	0.91	1.02
D120-15-3C-1⅝-0.2P	2550	2602	2313	0.98	1.1
D60-4-3C-2⅝-0.2P	1533	1275	—	1.2	—
D60-4-3C-2⅝-0.4P	1489	1375	—	1.08	—
D60-15-3C-1⅝-0.3P	2691	3104	2395	0.87	1.12

TABLE 3—EFFECT OF AXIAL COMPRESSION ON DUCTILITY AND DRIFT RATES

Column	f'_c, MPa	$P/(A_g f'_c)$, percent	Drift, percent
C168	85	28	3.8
C173	85	51	2.0
C167	67	31	4.0
C171	67	57	1.4
C163	86	63	1.2
C165	116	42	2.0
C164	86	63	4.4
C166	116	42	4.8
C175	91	35	3.0
C177	91	52	1.6

Note: v and f'_c are in MPa.

TABLE 4—EFFECT OF CONCRETE COMPRESSIVE STRENGTH

Group No.	Test	f'_c, psi	Transverse reinforcement, percent-ACI	Δ_{MAX}, in.	Maximum drift index, percent
1	D60-7-4-2⅝-0.2P	7790	142	1.4	3.9
	D60-15-4-2⅝-0.2P	14,620	69	1.04	2.9
2	D60-7-3C-1⅝-0.2P	7370	150	1.84	5.1
	D60-15-3C-1⅝-0.2P	14,540	76	1.44	4.0

TABLE 5—EFFECT OF YIELD STRENGTH

Test	f'_c, psi	Yield strength, ksi	Δ_{MAX}, in.	Maximum drift index, percent	Percent of ACI
D60-15-3C-1⅝-0.2P	14,540	60	1.44	4.0	76
D120-15-3C-1⅝-0.2P	14,750	120	1.40	3.9	150
D120-15-3C-2⅝-0.2P	14,730	120	1.84	2.8	107

TABLE 6—EFFECT OF STEEL YIELD STRENGTH F_{yt} ON DUCTILITY AND DRIFT RATIOS (4)

Column	f'_c, MPa	$P/(A_g f'_c)$, percent	ρ_s, percent	f_{yt}, MPa	$\rho_s f_{yt} f/f'_c$	Drift, percent
C163	86	63	4.37	328	0.17	1.2
C164	86	63	4.37	792	0.40	4.4
C165	116	42	4.37	328	0.12	2.0
C166	116	42	4.37	792	0.30	4.8
C170	67	57	2.60	316	0.12	1.0
C171	67	57	2.25	833	0.28	1.4
C172	67	57	2.08	1362	0.42	2.0
C178	100	35	1.82	744	0.14	1.0
C180	100	35	1.55	344	0.05	1.0
C181	100	35	1.28	1126	0.14	2.0

Note: v and f'_c are in MPa.

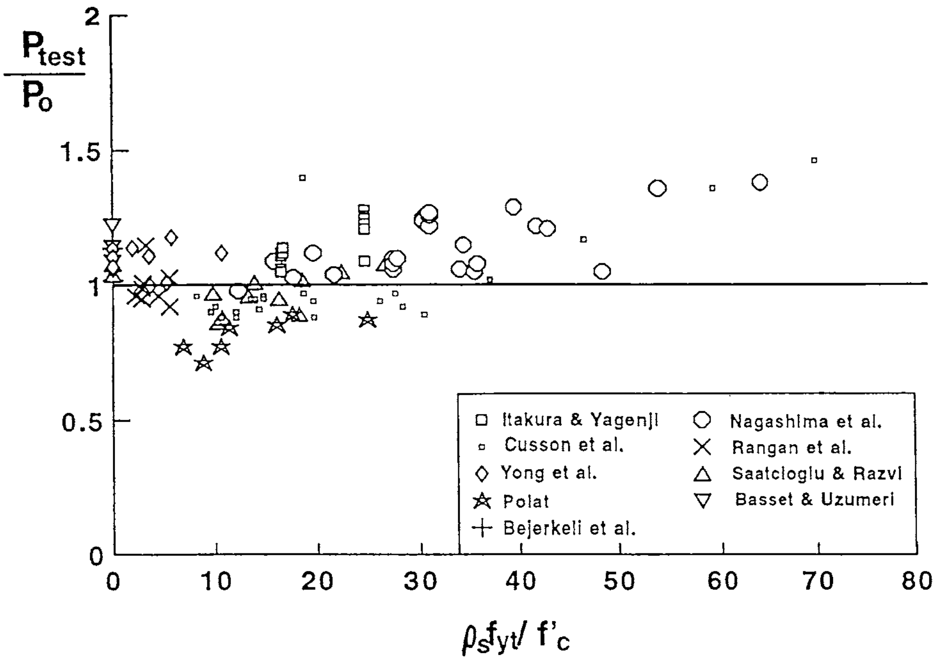

Fig. 1—Colums with different concrete strengths showing similar axial strain ductility ratios (adapted from Reference 4)

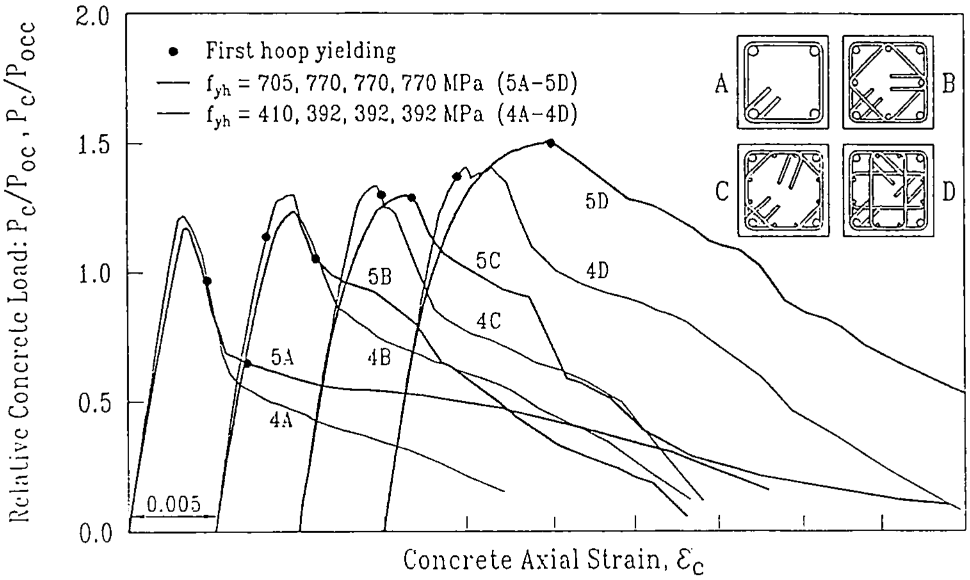

Fig. 2—Effect of transverse reinforcement yield strength (adapted from Reference 9)

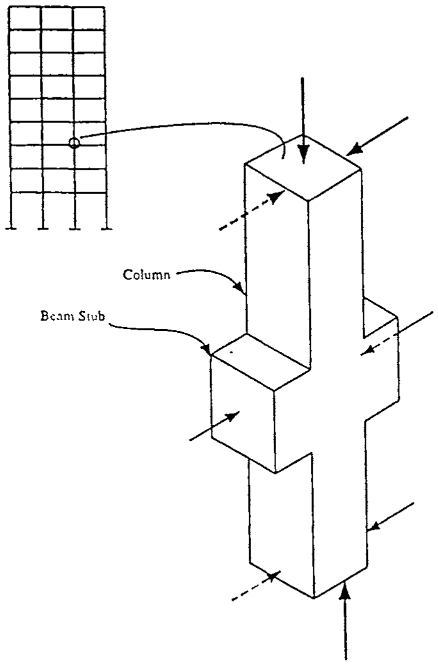

Fig. 3—Overall view of test specimens

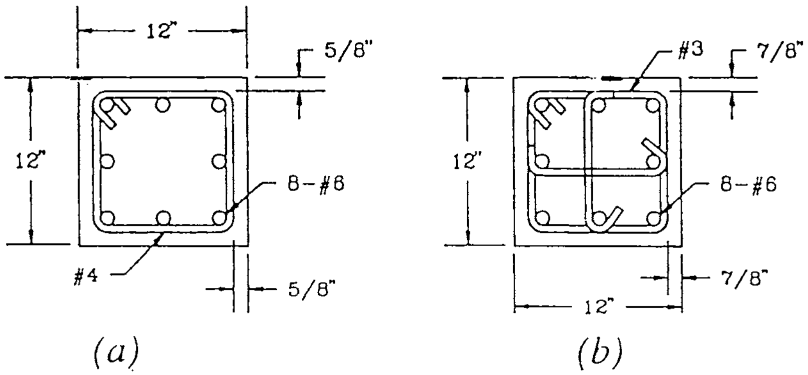

Fig. 4—Details of transverse reinforcement (a) Type I, single peripheral hoops; (b) Type II, peripheral hoops and cross ties