

구속조건이 콘크리트 응력-변형률 관계에 미치는 영향

Effect of confinement conditions on the stress-strain relations of concrete

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 Im, Seok-been Han, Taek-Hee Park, Nam-Hoi Kang, Young-Jong

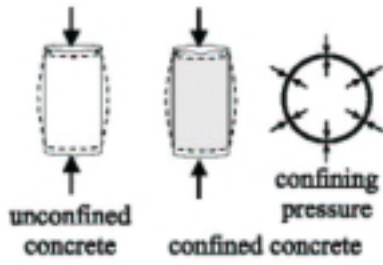
ABSTRACT

The confined concrete subjected multi-axial stresses have been known as the strength of concrete increases significantly. Many researchers have studied in confining effects of concrete, and now are studying in many fields. However, there are few passive confinements by steel tube. Although Mander et al. studied the concrete confined by transverse reinforcements, the confinement by steel tube differs from confining of reinforcements. To investigate the influence of concrete strength increased by confining conditions in steel, 51 specimens confined by different shapes and thicknesses of steel tube were tested and compared.

1.

가
 FRP(:Fiber reinforced polymer)
 가
 1 3 (confined concrete)
 1
 가
 (CFT : concrete filled steel tube)
 FRP
 FRP가
 가 FRP 가
 가

*
**

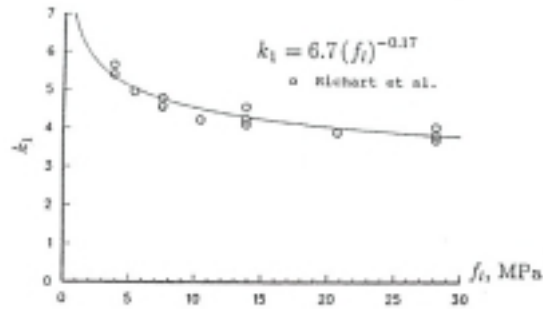


1.

(confining pressure)

$$f'_c = f'_c + k_1 f_l \quad - (1)$$

$$\epsilon_c = \epsilon_c \left(1 + k_2 \frac{f_l}{f'_c} \right) \quad - (2)$$



2.

k_1

2 Richart et al.(1928)

$k_1=4.1$

4.1

1949 Balmer

k_1 4.5 7.0

k_1

5.6

Sato

and Ibushi(1988)¹

k_1

Saatcioglu and

Razvi(1992)² Richart et al.(1928)

k_1

$$k_1 = 6.7 (f_c)^{-0.17} \quad - (3)$$

, f_l (uniform confining pressure)

(cube)

Kupfer et al.(1969)³

, Kupfer

(biaxial)

가

CFT

(2002)⁸,

(2004)⁹

가 (2001)⁷,

Richart et al.(1928)

(1),(2)

$k_1=4.1, k_2=5k_1$

1929

spiral

가

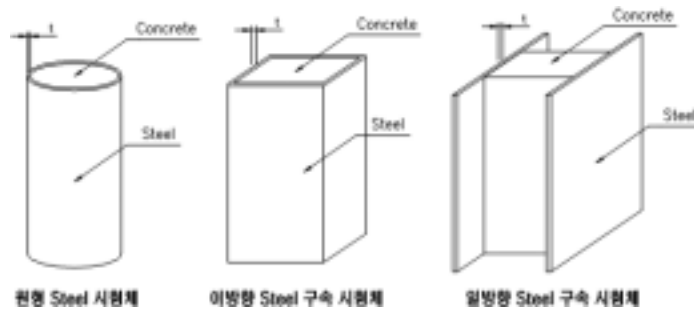
16% 가 , 가 (uniaxial test)
 al.⁴ (triaxial loading condition) 1970 Zimmerman et al.
 Richart et al. spiral Iyengar(1970)⁵
 Scott et al.(1982), Sheikh and Uzumeri(1980), Vellenas et al.(1977)
 Mander et al.(1984)⁶,

가 가 FRP CFT
 가 가 100%
 가 가

2.

2.1

3가 3 t=0.8, 1.0, 1.2, 1.6, 2.0mm 5
 100mm × 100mm × 200mm() 1.
 3EA 13mm, 210kg/cm²
 2 60I
 가 가
 28 243.5kg/cm²(2) 281.9kg/cm²(1)가
 (49) 264.7kg/cm² 301.2kg/cm²가
 가 가



3.

표 1. 시험체의 종류

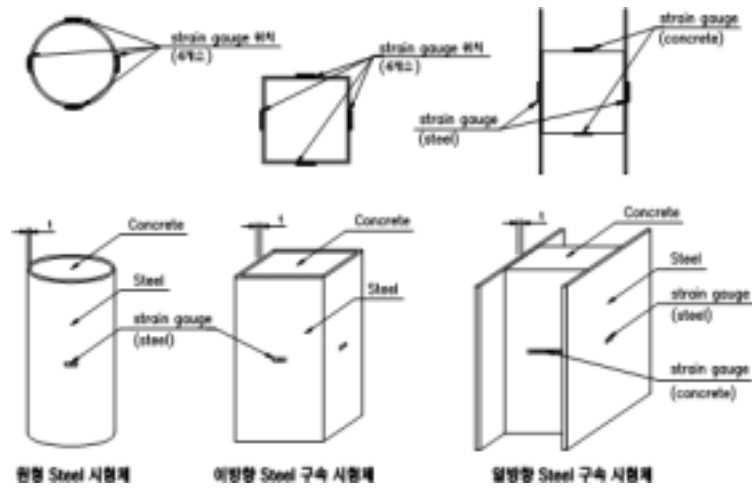
	(mm)		(mm)		(mm)
CSS - 1	0.8	R4S - 1	0.8	R2S - 1	0.8
CSS - 2	1.0	R4S - 2	1.0	R2S - 2	1.0
CSS - 3	1.2	R4S - 3	1.2	R2S - 3	1.2
CSS - 4	1.6	R4S - 4	1.6	R2S - 4	1.6
CSS - 5	2.0	R4S - 5	2.0	R2S - 5	2.0

2.2

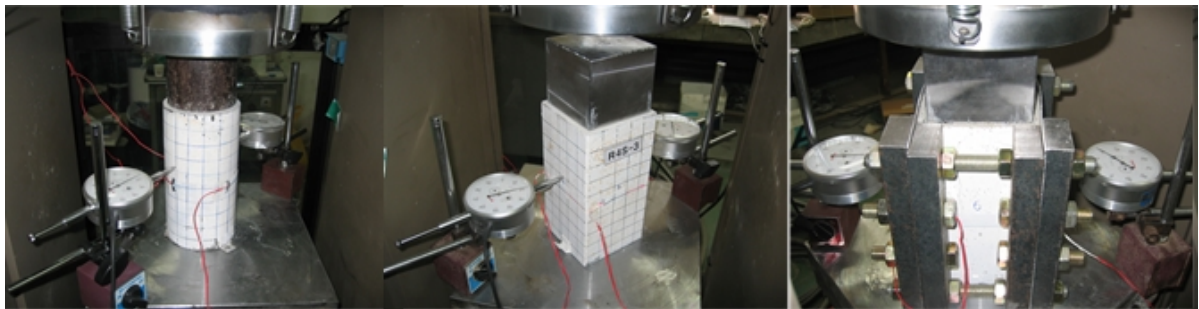
4. 2700kN UTM(MTS 815) controller
 box 가 가 .
 5. UCAM - 20A , 6. LVDT strain
 LVDT , MTS 815
 , UCAM MTS
 , 1 data . 0.01mm/sec MTS 815
 (displacement control mode) ,
 7. 가 , 가 UTM Stroke
 가 8. 가 .



4. 가 UTM (MTS 815)



5. strain gauge



6. LVDT

일방향 구속 실험틀

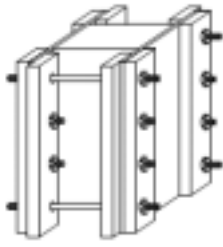
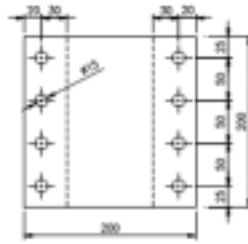
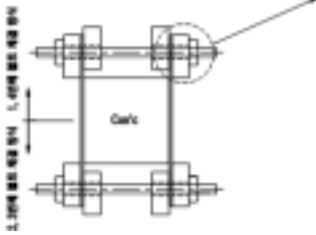


Plate hole 위치



1EA 당 (총 8EA 소요)

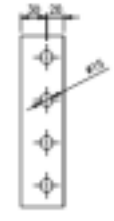
평면도(실험틀 전체)



정면도

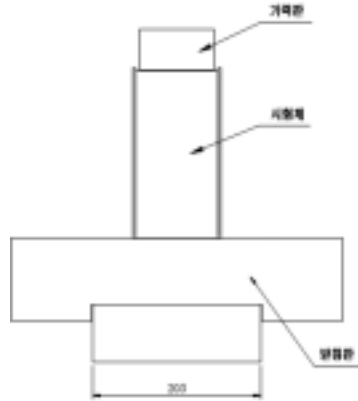


측면도



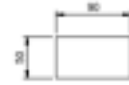
7.

실험 측면도

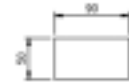


unit : mm

4각형 거목관



원형 거목관



8. 가

3.

3.1

2, 3

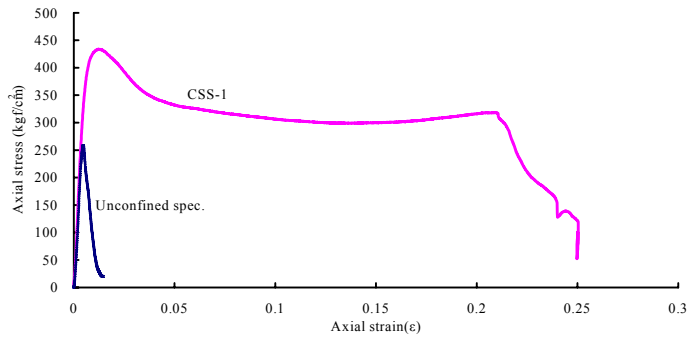
표 2. 원형 구속 시험체의 콘크리트 강도 증진 효과 (타설 2의 경우)

	(mm)	(kg/cm ²)	(kg/cm ²)	가 (%)
CSS-1	0.8	434.1	175.7	67.995
CSS-2	1.0	468.4	210	81.269
CSS-3	1.2	537.1	278.7	107.856
CSS-4	1.6	614.6	356.2	137.848
CSS-5	2.0	748.2	489.8	189.551
CSS	-	258.4	-	-

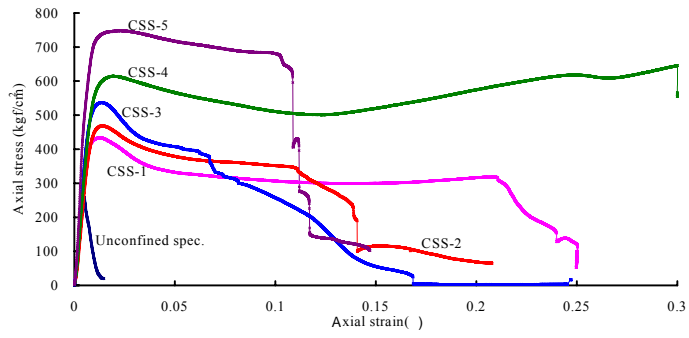
표 3. 사각형 이방향 구속 시험체의 콘크리트 강도 증진 효과 (타설 1의 경우)

	(mm)	(kg/cm ²)	(kg/cm ²)	가 (%)
R4S-1	0.8	347.5	-8.8	-2.470
R4S-2	1.0	360.8	4.5	1.263
R4S-3	1.2	384.9	28.6	8.027
R4S-4	1.6	425.7	69.4	19.478
R4S-5	2.0	459.8	103.5	29.049
R4S	-	356.3	-	-

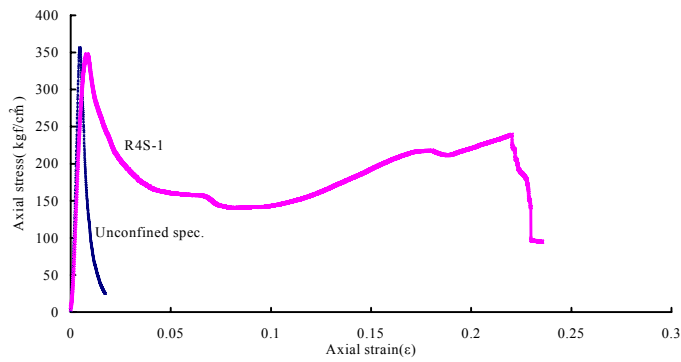
9~12.



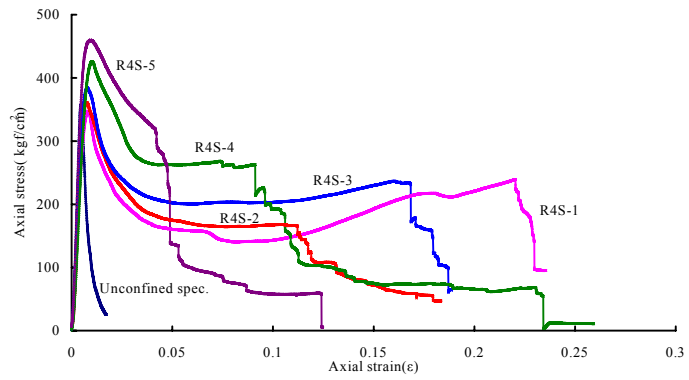
9. unconfined specimen CSS - 1 -
 (2)



10. CSS - (2)



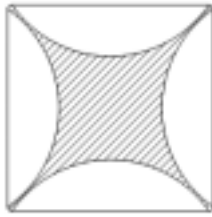
11. unconfined specimen R4S-1 - (1)



12. R4S - (1)

3.2

190% 가 가 , 2 가 29% 가 가
가



사각형 2방향 구속 시험체의 유효 구속 영역

13.



원형 구속 시험체의 유효 구속 영역

Mander
D)
2

Mander

13.

0.25D

(

가
20

가

가 가

(10. CSS - 4) 가

(UTM 815) Stroke

14

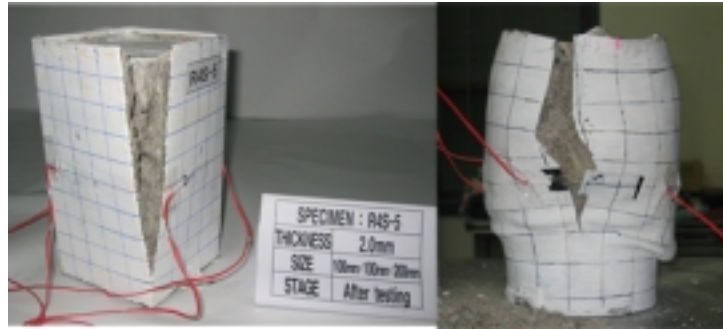
가

imperfection

가

가

(imperfection)



14.

imperfection

4.

가

가

가

가

가

가 가

가가

1. Sato, T., and Ibushi, K. (1988). "Effect of confinement on ductile behavior of reinforced concrete short columns." *Trans. of the Japan Concrete Inst, Japan Concrete Institute*, 10(5), 337-344

2. Saatcioglu, M. and Razvi, S. R., "Strength and ductility of confined concrete," *Journal of Structural Engineering*,

Vol. 118, No. 6, pp. 1560 - 1607

3. Kupfer, H., Hilsdorf, H. K., and Rusch, H., "Behavior of Concrete under biaxial stresses," *ACI Journal, Proceedings V. 66, No. 8, Aug. 1969, pp. 656 - 666*
4. Laddie L. Mills, and Roger M. Zimmerman, " Compressive Strength of plain concrete under multiaxial loading conditions," *ACI Journal, Vol. 67, No.10, Oct., pp. 802 - 807*
5. Iyengar, K. T. R. J., Desayi, P., and Reddy, K. N., "Stress - strain characteristics of concrete confined in steel blinders," *Magazine of Concrete Research, Vol. 22, No. 72, 1977, pp. 173 - 184*
6. Mander, J. B., Priestly, M. J. N., and Park, R., "Theoretical Stress - Strain Model for Confined Concrete," *Journal of Structural Engineering, ASCE, V. 114, No. 8, Aug. 1988, pp. 1804 - 1826*
7. , " R.C " , , , 2001
8. , " " , , , 2002
9. , " RC " , , , 2004