A COMPRESSION SPLITTING TEST FOR THE FRACTURE TOUGHNESS OF CONCRETE

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INTRODUCTION

The compressive strength is not the most suitable parameter for the assessment of cracking in brittle materials. Kendall (1) described the onset of instability in a pre-cracked specimen in compression by an energy theory of fracture. The pre-crack, in principle, divided the specimen into two struts which, provided certain conditions are met, came apart in an opening mode type of fracture. Kendall carried out a detailed testing programme on glassy materials and concluded that both the compressive splitting force and the mode of failure were influenced by the loading platen size as well as the specimen dimensions and its elastic properties. Later Karihaloo (2) proposed a compression splitting model which predicted the experimentally observed behaviour more accurately. This was made possible by recognizing that in compression testing a certain lateral constraint under the platen existed. Karihaloo concluded that, in addition to the factors mentioned by Kendall, the length of the pre-crack played an important role in controlling the failure load and the mode of failure. In a recent paper Karihaloo (3) calculated the fracture toughness of plain concrete employing rectangular prisms of 100 mm by 95 mm with a central pre-crack (145 or 175 mm) incorporated at one end.

In attempting to produce test specimens for concrete of more acceptable dimensions the authors have developed the compression splitting geometry shown in figure 1. The specimen is a 100 mm cube with two symmetrical notches resulting in symmetry about both axes.

TEST RESULTS AND DISCUSSION

The concrete mix used in this study had a cement: fine aggregate: coarse aggregate ratio of 1: 1.44: 2.16 and a

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water/cementitious material ratio of 0.35. The mix was modified by the addition of 24% microsilica and 3.5% superplasticizer by weight of cement. The cubes were cured in water at 50°C for 28 days. In all 11 notched specimens were tested. All cubes failed by splitting along the line containing the notches. The results for the failure loads are given in table 1. Load-deflection graphs for various notch and loading plate sizes are shown in figures 2 to 4. It can be seen that, after initial bedding-in of the plates, the results demonstrate linear elastic behaviour.

TABLE 1 – Failure Loads for various Platen Sizes and Notch Depths

w/d	a/d	Cube ref. no.	Split load (kN)	Average load(kN)	V (%)
0.15	0.30	106	77.8		
		74	74.3	75.7	2.4
		98	75.1		
0.15	0.35	70	54.8		
		81	62.4		
		65	59.3	58.8	6.5
0.20	0.30	57	87.3		
		95	95.6		
		64	87.8	90.2	5.2
0.20	0.35	113	76.0		
		86	79.4	77.7	3.1

V = Coefficient of variation

REFERENCES

(1) Kendall, K., Complexities of compression failure, Proceedings of the Royal Society London, Vol. A361, 1978, pp 245-263.

(2) Karihaloo, B.L., A note on complexities of compression failure, Proceedings of the Royal Society London, Vol. A368, 1979, pp 483-493.

(3) Karihaloo, B.L., Fracture toughness of plain concrete from compression splitting tests, The International Journal of Cement Composites and Lightweight Concrete, Vol. 8, No. 4, November 1986, pp 251-259.

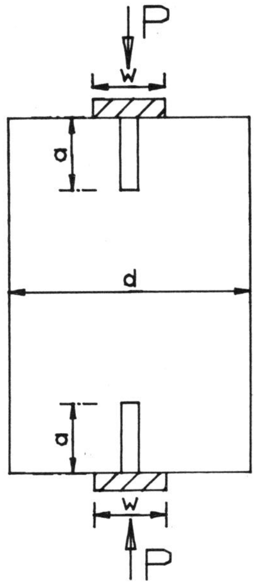

FIGURE 1 TEST SPECIMEN

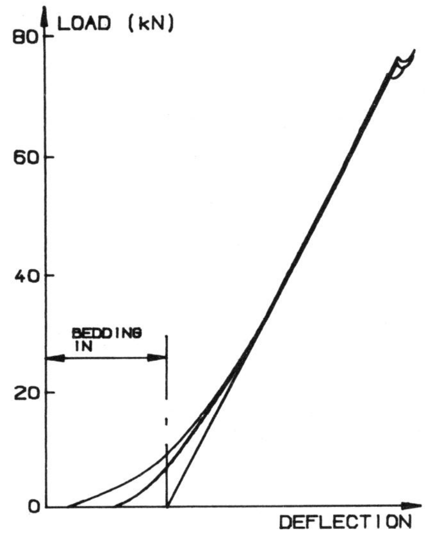

FIGURE 2 LOAD-DEFLECTION GRAPHS FOR W/d 0.15 AND a/d 0.3

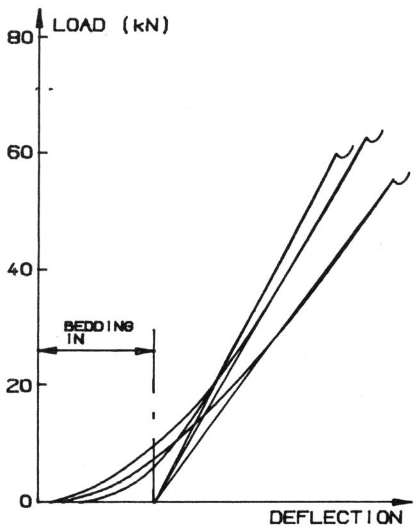

FIGURE 3 LOAD-DEFLECTION GRAPHS FOR W/d 0.15 AND a/d 0.35

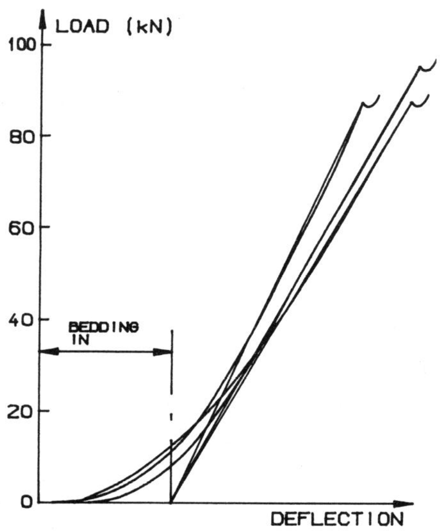

FIGURE 4 LOAD-DEFLECTION GRAPHS FOR W/d 0.20 AND a/d 0.3