

A comparison of creep, elasticity and strength of concrete in tension and in compression*

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The paper by Dr Brooks and Professor Neville is very informative. On the strength development of concrete, they say that the "tensile and compressive strength exhibit similar characteristics under drying conditions". Table 1 of their paper shows that both the compressive and the tensile strength increased on air-drying. However, these findings on the tensile strength of concrete are not in complete agreement with those of Johnston⁽¹⁾, Ward⁽²⁾ and Haque⁽³⁾, who observed a loss in the tensile strength of concrete on air- and oven-drying. The loss in tensile strength on drying has been attributed to microcracking, which is of critical importance in the determination of the tensile strength. Further, the concept of 'drying strengthening' does not seem to hold in the case of tensile strength of concrete, where strengthening effects of moisture removal are more than offset by the weakening effects of microcracking in the specimens.

It has been well documented that the modulus of elasticity of concrete decreases with increased drying and the results reported in the paper corroborate the earlier findings. Haque and Cook⁽⁴⁾ have also reported that the dynamic modulus of the concrete system decreases on desorption and attributed this to some irreversible changes in the structure of the hardened cement paste and to shrinkage-induced microcracking.

The observation by Dr Brooks and Professor Neville "that that tensile basic creep is mainly irreversible" was also reported by myself⁽⁵⁾ for the desiccated sealed concrete specimens. This does establish the overriding importance of microcracking in the tensile creep of the concrete system. The authors' finding that "basic creep in tension is greater than basic creep in compression" can also be explained on the premises of microcracking as a dominant mechanism of tensile creep of concrete^(5,6).

Reply by the authors

Dr Haque's contribution is interesting and calls for a reply.

Although we stated that "tensile and compressive strengths exhibit similar characteristics under drying conditions", we also pointed out that the compressive strength shows an initial increase in strength when concrete is exposed to drying conditions, which is followed by a slower retrogression of strength, probably owing to the presence of shrinkage-induced microcracking (text on page 136 and Table 3). Therefore, our findings are not really at variance with those

reported in the references quoted by Dr Haque. The extent of microcracking, and hence the values of tensile and compressive strengths, must depend upon the rate of drying and upon the time when this occurs, viz. before or after the concrete has been loaded.

Regarding the role of microcracking in creep, we are of the opinion that, for compressive stress-strength ratios of 0.3, the contribution of microcracking to basic creep in compression is small. If microcracking were a predominant factor in basic creep of saturated concrete under compression, we would expect supporting evidence by way of a decrease in the modulus of elasticity and, in our tests,

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this was not the case. Likewise, for saturated concrete, the modulus of elasticity in tension did not decrease with age. It is because of the lack of such supporting evidence that we concluded that micro-cracking does not significantly contribute to basic

creep in tension. Our findings are, strictly speaking, limited to the experiments performed, and we cannot say that the existence of extensive creep due to micro-cracking under other test conditions is precluded.

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