Discussion on paper published in
Magazine of Concrete Research
1999, **51**, No. 4, 263–267

Equipment for tensile testing of fresh concrete

D. J. Hannant, J. Branch and M. Mulheron

Contribution by D. M. F. Orr *University College Cork*

An apparatus with a similar purpose to that designed by the authors was described in the *Magazine of Concrete Research* in 1971.¹ Since cracking of fresh concrete occurs in the cement matrix, this apparatus was designed to measure the shrinkage characteristics of plastic mortars rather than of concrete. In phenomenological investigations, a high degree of similitude between the conditions in the prototype and the conditions under which tests are carried out, is desirable. Thus, to gain an understanding of when shrinkage cracking is likely to occur, it is desirable to measure shrinkage forces in restrained specimens and so the apparatus was designed to measure forces produced by restrained shrinkage, in addition to carrying out direct tension tests and measuring linear shrinkage. The apparatus was contained within a chamber within which ambient conditions, and thus the rate of shrinkage, could be controlled.

The results obtained indicated that there is an initial period of time when fresh mortar does not crack, followed by a period within which cracking may occur and after which plastic shrinkage cracking no longer takes place. The extension of this research from mortars to concrete is worthwhile. Tests under appropriate

ambient conditions would enable the period to be defined, when special curing precautions should be applied to prevent plastic shrinkage cracks occurring in concrete.

Reply by the authors

In 1971, Professor Orr stated ‘cracking due to plastic shrinkage is a phenomenon which is, as yet, not well understood’. Thirty years later the same can still be said, particularly for high-strength concrete and Professor Orr’s contribution is therefore very welcome. His view that cracking in mortar is dependent on the interaction between cracking stress and restrained shrinkage stress is a hypothesis for high-strength concrete which we are currently researching on an EPSRC-sponsored contract. However, there are many factors affecting restrained shrinkage stress, such as rate of negative pore pressure development, drying rate, rate of change of tensile failure stress and the linear shrinkage with the associated creep. The prediction of plastic shrinkage cracking in any given situation is therefore very difficult to achieve.

As ever, the choice of a best mix to resist plastic

Discussion

shrinkage cracking still remains as much of an art as a science but slow progress is being made by several research organisations to understand and overcome the difficulties involved.

References

1. ORR D. M. F. and HAIGH G. F. An apparatus for measuring the shrinkage characteristics of plastic mortars. *Magazine of Concrete Research*, 1971, **23**, No. 74, 43–48.