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Taylor

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Howard P. J. Taylor
Editorial Advisory Board member

It was at the turn of the nineteenth and twentieth centuries that we became aware of the basic behaviour of reinforced concrete in flexure. In the previous hundred years, the position of the neutral axis in an elastic beam was the subject of continuing debate. At the beginning of the twentieth century, the first proposals for a model to describe the behaviour in shear, the truss analogy, were made and have been of use ever since. It is not surprising, therefore, that with the example of these protracted time lines the debate on shear persists.

There are good reasons why shear attracts so much research. Shear failures do occur, albeit rarely, but when they do so they can be dramatic, particularly in beams and slabs without links.

Our use of structural concrete has changed; much more attention is now being placed on seismic actions and on concrete members other than beams. The types of concrete that we use have also changed, not just with cements and admixtures but also, and possibly more importantly as far as shear is concerned, with the types of aggregates that we use. Aggregate changes include recycling, aggregate strength, maximum aggregate size and grading. These changes which influence how forces are transmitted across cracks in both beams unreinforced and reinforced in shear have all taken place in the last twenty years.

Shear also is described by researchers in terms of models of behaviour with links to theoretical approaches. Perhaps we should consider whether we are now at a stage where we need to investigate behaviour more, particularly on the subject of aggregate influences and, after this, reconsider our theories of shear behaviour and code regulation.

This themed issue of *Magazine of Concrete Research* gives us an opportunity to see how many of these factors are concerning today's researchers, to consider how the results of these apparently different topics are related and how they can be used in practice in design. There are six papers in this issue; two are theoretical, one experimental and three cover slab-type elements.

The papers have not been specially chosen or commissioned for the themed issue. They were submitted to the editors at about the same time and it was considered appropriate to publish them in a single issue to emphasise this increase in interest in the subject and to allow reflection on the topic of shear generally.

Theoretical approaches to the understanding of behaviour of reinforced concrete flexural members without links in shear have moved from purely empirical analyses of test results through a period when the internal force system was investigated (ACI, 1972) and, following that, the application of plastic theory. Empiricism, however, still has a major influence.

Flexural members with links have had a versatile theoretical model for shear behaviour for over a century, as already mentioned. The variable angle truss lower-bound method is the standard design method in the Eurocode. This method is attractive theoretically as it mirrors some of the observed effects of the angle of cracks changing, termed by many 'plastic redistribution', as failure is approached. This lower bound method also unites anchorage and shear in one model. It may, however, prove in the future to be limiting.

In the now withdrawn British Standard BS 8110 and in the ACI Code a method is used which takes an account of shear flow in cracked webs, justified experimentally, in addition to the truss action of the links, that is with a fixed truss angle and a concrete contribution. This method seems less comprehensive than the variable truss but yet may be a better approach to take account of new research on aggregate type and concrete grading with both upper and lower-bound solutions. The Canadian compression field approach also gives the opportunity to consider the contribution of the cracked zone of a beam and will also allow a design method to discriminate between aggregate types and strengths.

In this issue, the paper by Emiko *et al.* (2011) is experimental and explores the forces carried across cracked planes in lightweight concrete. Three of the papers mention aggregate and its influence in its ability to carry forces across a crack, its interlock.

Aggregate interlock is now coming more to the attention of researchers. Research in this area is on the list of the CEN Technical Committee 250 where further work is recommended ready for future revisions of EN 1990-2. How the influence of aggregate can be integrated into the different design models will be a problem for code writers in the future. Perhaps in framing investigational research current codification should be ignored less it influences the nature of experiment and drives us away from an objective study.

Now, as ever, we need practical research to investigate behaviour as materials and methods change, carried out with open minds and not driven by what we think we know already.

REFERENCES

ACI (American Concrete Institute) (1972) *Shear in Reinforced Concrete* (SP42). ACI, Detroit, MI.

Emiko L, Thamaraikkannan V, Huan WT and Thangayah T (2011) Shear transfer in lightweight concrete. *Magazine of Concrete Research* **64(6)**: 393–400, **doi**: 10.1680/macr.9.00162.