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Editorial comment

OUR DICTIONARY DEFINES CONCRETE as “ a composition of stone chippings, sand, gravel, pebbles, etc. formed into a mass with cement ” but as every schoolboy knows it is really a polyphase visco-elastic material composed of brittle particulate matter in a thixotropic matrix.

For more than a century, if we consider only concrete of the present-day kind, but for more than two millenia if we include lime-bonded materials, it has been implicit in the design of concrete structures that the material of which they are composed is essentially elastic.

If the loads are low enough and are applied for short enough periods of time this assumption of the nature of concrete is adequate to ensure the safety and stability of structures. Now low load levels are usually associated with high safety factors and low efficiency, and in recent years structural engineers have been exploring more sophisticated methods of using concrete whereby the traditional high safety margins, which are really factors of ignorance, can legitimately be reduced. The impetus for this new approach arises not only from the great potential economic benefits but also from the intellectual challenge which it poses to the materials scientist to define more closely the properties of concrete and to the structural engineer to make use of them.

There has also been a growing feeling that the statistical evaluation of the performance of structures with time as an essential parameter should supersede classical methods of design with their assumptions of permanence. All this demands more precise knowledge of the time-dependence of the strains which develop in concrete under self-generated and applied stresses,

not only when it has hardened but from the moment when it is placed.

Since the ingredients of concrete are largely ill-defined, it is perhaps over-optimistic to expect that its stress-strain relationships under all conditions of loading will ever be characterized precisely but the material is sufficiently uniform to suggest that the study of selected aspects of its visco-elastic behaviour will be rewarding.

Current research on the properties of concrete as a material of construction is thus concentrated on such problems as: What constitutes an adequate definition of a criterion of failure, or, alternatively, what is meant by the strength of concrete? Is the performance of concrete in a structure determined essentially by its strain capacity? If concrete creeps at stress levels below those which cause early failure, what can be regarded as its long-term strength under sustained load?

In the study of problems of this kind the chemist, the physicist and the mathematician can all make a contribution and it is characteristic of present-day materials research that it is being done no longer by the engineer alone but by his colleagues of these other basic disciplines.

Concrete has the exceptional advantage of being a cheap structural material which passes through a stage in which it is essentially fluid and hence can be formed to any shape. It is perhaps not too much to hope that in the present century designers can be given sufficient information about its properties to enable them to exploit this freedom to the fullest extent and create buildings of novel and elegant forms which achieve a structural economy at present out of reach.