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Editorial comment

THE STATESMEN OF THE NATIONS are continually hoping to find peaceful solutions to their problems and it is perhaps appropriate that at the same time concrete technologists should be turning their thoughts to non-destructive as well as destructive methods of testing concrete. Two papers in this issue of the *Magazine of Concrete Research* deal with non-destructive testing by methods which are a further sign of the times in that they bring electronic engineering to the study of properties of concrete.

One piece of equipment, described by Elvery and Vale, is a complicated stop-watch which measures the time taken for an ultrasonic pulse to travel through a piece of concrete, and it is used in conjunction with a form of ruler to measure the distance travelled by the pulse. One can therefore calculate by simple arithmetic the velocity of the pulse in the concrete. In itself the velocity of the pulse in the concrete is of no interest to most concrete technologists; however, since this velocity depends on the elastic properties of the concrete, it can be related to other at present more useful properties such as compressive strength, flexural strength, Young's modulus and Poisson's ratio, if something is known of the characteristics of the concrete.

The other piece of equipment referred to by King and Lee reminds one of the pipes in an organ; the air in the organ pipes vibrates at the natural frequency, and different frequencies are obtained by having a range of pipes of different lengths. The "electro-dynamic" test for concrete substitutes a specimen of standard dimensions for the organ pipe. The specimen is "excited" mechanically at one end through a variable frequency oscillator and when the maximum energy is transmitted to the other end the concrete is vibrating in resonance and the frequency of the vibration is noted. Since the natural frequency of vibration depends only on the length of the specimen, its density and Young's modulus for the material, the last mentioned can then be calculated. It should be noted, however, that the value obtained is the dynamic modulus—the value for infinitesimal strains—and not the static modulus normally required for the purposes of structural design.

The determination of the ultrasonic pulse velocity has the advantage that it can be made on any concrete—research specimens or structural members—provided that there is access to opposite sides and that the thickness can be measured. The disadvantage is that the result has little meaning unless it can be compared with the value for nominally similar concrete of known quality, or until more experience is accumulated relating the pulse velocity to the other characteristics and properties of concrete. At a recent discussion on ultrasonic testing held at the Institution of Structural Engineers, there was no restraint on the part of speakers to point out the difficulties in using the technique under site conditions, although its usefulness as a research tool was acknowledged. Like all new toys the ultrasonic test has to be treated almost with reverence, but in the hands of those who have got to know it these difficulties are often no more than one would expect to find if one looked at the cube test, for example, with the same critical eye as has been used to inspect this new toy. The technique has been applied to comparing doubtful and acceptable units, to measure variation in quality within a unit, to supplement destructive tests on precast units, and to assess the equivalent compressive strength or Young's modulus in a structure by comparing tests on specimens made from the same concrete.

The advantage of the electro-dynamic test is that a recognized property of the concrete is measured directly; however, the test can only be carried out on specially made specimens, and it is therefore virtually restricted to research, although it has been used as a control test for concrete produced for a dam. Within these limitations it has the advantage that it is less sensitive than the ultrasonic test to the surface characteristics of the concrete and is therefore particularly useful in tests to observe the deterioration of concrete under adverse conditions.

In investigations to determine the behaviour of concrete under adverse conditions non-destructive tests are very much more useful than destructive tests since the progress of a single specimen can be followed, thus eliminating the variation between the specimens. The number of specimens required in such an investigation will also thereby be reduced.

There is little doubt that these new techniques provide us with two more valuable tools for research on concrete. Their development for site use is still in its infancy, but some progress has been made. It may not be too wild a dream to suggest that the routine non-destructive testing of the concrete in a structure—under controlled conditions, as with all testing—will become a common practice.

ERRATA

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p. 62. Equation (6) should read: $\mu_2 = \frac{1}{2R}\left(\frac{f_L}{f_T}\right)^2 - 1$

p. 101, col. 1, line 21. For " thickness ratio " read " Poisson's ratio "