

Concrete research in the universities

University College London

An investigation has been carried out into the effect of vibration on the hydration of Portland cement. Professor Collins, in a study of emulsions, had previously ascertained that solids absorbed liquids to a greater depth of penetration when subjected to an oscillating pressure than to a static one. Consequently, it was thought that if vibration were applied to a cement mix, an increased rate of hydration might be obtained. The mixing water might be driven further into the cement particles which themselves might be reduced in size by friction, thus presenting a larger surface area for absorption.

From preliminary absorption tests carried out on small solid samples of roofing tile, a material which is chemically inert to water, it was concluded that the required condition for increased absorption under vibration was that there should be relative motion between sample and water. In the material tested, however, the increase in absorption was only 3 per cent even when this condition was fulfilled.

Proceeding to tests on samples of cement paste, the degree of hydration of the Portland cement used was investigated in three ways :

- (1) by measuring the loss in weight of samples of set cement paste heated to a temperature of between 110 and 550° C to drive off chemically combined water ;
- (2) by taking temperature-time curves for the cement paste as it set and hardened, during the first 18 hours or so. Any difference in the rates of hydration between vibrated and non-vibrated cement paste would be expected to appear in these curves ;
- (3) by making thin sections (about 30 microns) and examining them microscopically for any significant difference in particle size between vibrated and non-vibrated cement paste.

Care was taken in all these tests to control the factors which affect hydration. Thus the same cement was

used for all the tests, and the vibrated and non-vibrated samples to be compared were made under the same conditions of mixing and curing.

The vibration apparatus used consisted of a table supported on two steel bars acting as springs, the pull on the springs being provided by an electromagnet. The frequency of vibration could be varied by altering the span of the steel bars ; the amplitude and acceleration were controlled by the electrical input.

From the tests carried out under various conditions of vibration, water-cement ratio and age, no significant difference could be observed in the amount of water lost on heating of vibrated and non-vibrated pastes. Of 60 tests, 52 gave differences of not more than 5 per cent ; 33 showed more hydration when vibrated, 21 showed less and 6 showed no difference. Nor was there any appreciable difference shown between the temperature-time curves, or in the particle size in the vibrated and non-vibrated thin sections.

It was concluded from these results and the preliminary tests that vibration did not appreciably affect the hydration of Portland cement, and that water-cement ratio had the same significance whether or not the mix was vibrated.

University of Sheffield

The main programme of concrete research carried out in the laboratories of the Civil Engineering Department with financial support from the Cement and Concrete Association is concerned with the strength of beams in combined bending and torsion. Two types of beam are being tested ; rolled steel joists encased in concrete and normal reinforced concrete beams with shear reinforcement. The Department's 200 ton Amsler testing machine has been adapted for the work by the addition of a four-point loading arm, torsion brackets and bearings allowing rotation about the centroid of the test specimen. (Figures 1 and 2.) Electrical resistance

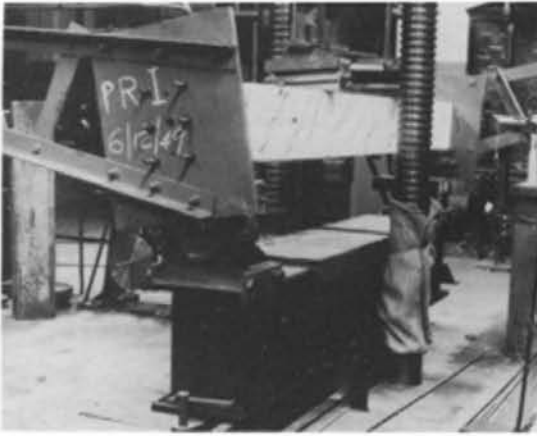


Figure 1.

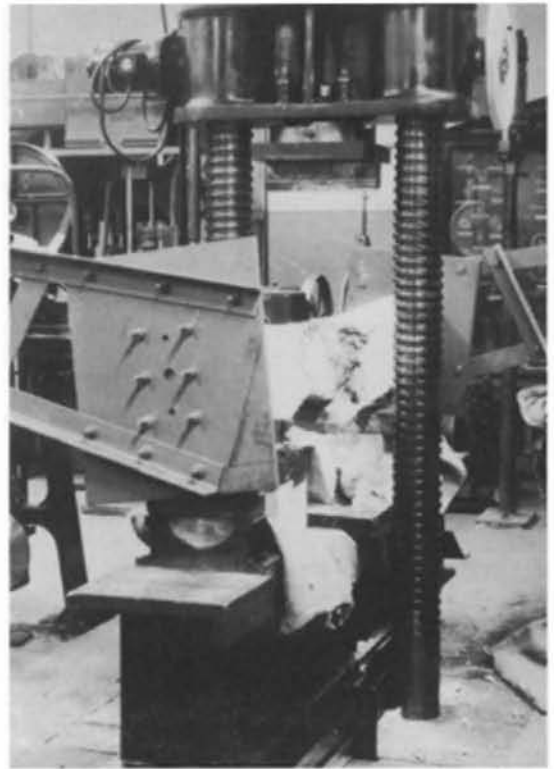


Figure 2.

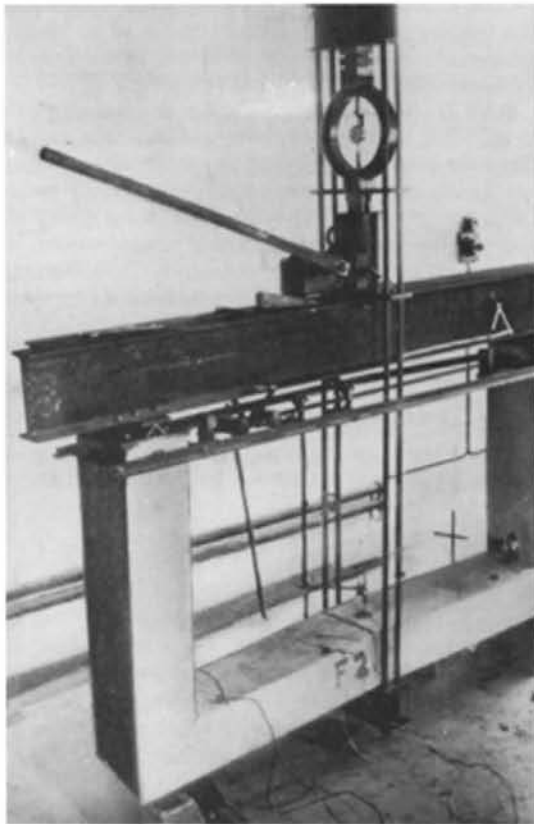


Figure 3.

strain gauges are used to measure strains on the surface of the concrete. Strains in the longitudinal reinforcement and in the stirrups are measured with Huggenberger Tensometers, the steel being exposed locally for the purpose.

An investigation on the strength of "no-fines" concrete, using both Portland cement and aluminous cement, has been completed, and the results will be published shortly.

A loading frame has been constructed for experiments on single-bay portal frames (Figure 3), and two frames have been tested. Electrical resistance strain gauges are being used for measuring strains on the surface of the concrete and in the main reinforcement; the latter gauges are attached to the reinforcement prior to casting.

An investigation on the ultimate strength of prestressed concrete beams is now in its preliminary stages. It is proposed to test both pre-tensioned and post-tensioned beams, using 12 gauge wire with an ultimate tensile strength of 127 tons per sq. in. for the former, and $\frac{1}{2}$ in. diameter bars with an ultimate tensile strength of 65 tons per sq. in. for the latter. In the first series of tests the beams will be reinforced symmetrically so as to give a uniform distribution of prestress throughout the section.

Work is also proceeding on the strength of two-way slabs acted on by concentrated loads, and on the stress distribution in bent-up bars used as shear reinforcement.