Editorial comment

MODELS ARE EXCITING increasing interest among structural engineers and research workers, because there are still many structures which cannot be calculated fully, even with such aids as electronic digital computers. The scaling-down process using a modified concrete material, however, has its limitations. Other materials are, therefore, being tried, in the attempt to reduce the size and cost of models and to achieve quicker results.

During the last two years reinforced plaster models have been used for research at the University of Birmingham.[1] It is claimed that they reproduce the inelastic behaviour and the ultimate load characteristics of reinforced concrete structures. These models are valuable to the designer, who is able to study the modes of collapse of different kinds of plane and space frames, and to estimate the collapse load which, in many cases, he may not be able to calculate at all by other means. Reinforced plaster models can be tested after a day or so, instead of the month needed for conventional specimens, and so it is possible for a research worker to check each step in his reasoning by properly designed experiments. Such models are equally valuable as teaching aids for undergraduate courses in engineering.

At Northampton College, London, on the other hand, the possibility is being explored of making models of reinforced concrete members in reinforced epoxy resin. A brittle resin with a ratio of crushing to rupture strength similar to that of concrete is being selected, and various reinforcing materials are being tried out. It is hoped to use these materials for frozen-stress examination of the elastic stress distribution in reinforced concrete members.

A very different type of model at the same college is that of a commercial non-tilting rotating-drum concrete mixer (one-third scale) which is being used to investigate the mechanics of this type of mixer. (The full-scale mixer has already been tested by Murdock[2].)

Other research at this college is on the effects on the mechanical properties of mild-steel reinforcing bar of different methods and speeds of cold-working (by stretching or twisting or both), of ageing and of cold brittleness.

Research now under way at the University of Illinois is expected to provide the basis for more rational and more consistent methods of design for the several types of reinforced concrete floor slabs now in use. The experimental and analytical programme includes flat-plate, flat-slab, and two-way slab types of construction.

The project involves co-ordinated and parallel tests on the two principal types of concrete floors now in common use: slabs supported only at the columns, such as the flat plate or flat slab; and slabs supported on the four sides of each panel by beams spanning between the columns.

Tests are being made on quarter-scale models of typical floor systems, each consisting of nine square panels arranged three by three. The panel size in the prototype floor is 20 ft square.

The first test was made on a model of a typical flat-plate floor without drop panels or column capitals. The prototype was designed as a typical structure according to the ACI Building Code, for a total design live load of 70 lb/ft^2. The second test specimen was a typical flat slab designed for 200 lb/ft^2 live load, and provided with drop panels and square columns and capitals. In both specimens, wide shallow-spandrel beams were provided on two adjacent edges, whilst deep narrow beams were used on the other two edges.

The third test will be on a typical two-way slab designed according to Method 1 of the ACI Code, for a live load of 70 lb/ft^2. The beams spanning between the columns will be relatively deep and stiff to conform with the assumptions on which the requirements of the ACI Code are based. The fourth specimen will also be a two-way slab, but the beams will be shallower and less stiff than those for the more typical design.

Uniform load is simulated in the tests by a system of concentrated loads applied through 8 in. square bearing plates at 16 points in each 5 ft square panel. Any panel or combination of panels can be loaded separately. Measurements made during the tests include: deflexions at 33 locations, strains in the reinforcement and concrete at over 300 locations, and reactions at each column.

The measurement of reactions at the base of each column is a particularly important feature of the tests because of the highly indeterminate nature of the structure. Each column is pinned at its base and supported on a tripod of hollow steel bars. Strains measured on each of the three tripod legs provide data from which the three reaction components can be computed.

Each slab has been subjected to an extensive series of tests at different levels and patterns of loading.

The reading, recording and reduction of the great volume of data from electrical strain gauges has been greatly facilitated by the use of various electronic aids.

Limit analyses of the " yield-line " type have been made for all the structures tested. Elastic analyses, at first limited, are now greatly extended by the use of the ILLIAC digital computer at the University of Illinois.

The project is under the over-all direction of Dr C. P. Siess, Professor of Civil Engineering.

REFERENCES

1. BROCK, G. Direct models as an aid to reinforced concrete design. *Engineering*. Vol. 187, No. 4857. 10th April, 1959. pp. 468–470.
2. MURDOCK, L. J. *The efficiency of concrete mixing plant*. Thesis presented to the University of London for the degree of Ph.D. 1947.