SHAKING TABLE TESTS ON A MODEL RETAINING WALL

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SYNOPSIS

Shaking table tests of a model gravity retaining wall are described. The tests were designed to check the validity of the simple analytical model of wall behaviour proposed by Elms and Richards in a companion paper. The results show that the wall translates outwards in a stepwise fashion under strong shaking as predicted by the analytical model, and that with one minor exception the assumptions underlying the model appear correct.

1. INTRODUCTION

In a companion paper, Elms and Richards (1) present a new method for designing gravity retaining walls. The possibility of large translation of the wall under seismic loading is recognized. Their design procedure is based upon a simple analytical model(2) which considers the equilibrium of a wall under Mononobe-Okabe earth pressures, resistance of the wall base, and the wall inertia force. This paper describes shaking table tests of a model retaining wall, undertaken to verify the general correctness of the Richards and Elms theoretical model, and to check the validity of its assumptions.

2. TEST SETUP

The tests used a 2.4 m long glass-sided rectangular tank, 510 mm wide, mounted on the University of Canterbury 65 kN electro-hydraulic shaking table, which has been described elsewhere(3). The shaking table motion could be programmed either by a function generator or by an analogue signal on F.M. tape. Both steady-state sinusoidal table motion and scaled earthquake accelerograms were used. Figure 1 shows an overall view of the test setup.

A 300 mm high model wall, backfilled to 250 mm above its base was placed at approximately the two-thirds points of the tank as shown in Figure 2. The depth of soil beneath the wall base was 100 mm in all tests.

Bending moment, and vertical and horizontal shear forces on the rear face of the model wall were measured by a pair of identical load cells. Outputs from the load-cell strain-gauge bridges were amplified by a dynamic strain amplifier and recorded on a multi-channel highspeed chart recorder. Other instrumentation included a pair of displacement transducers to record displacements of the top and of the base of the wall relative to the tank, and two accelerometers measuring the tank (ground) motion, and the motion of the wall base. These, too, were recorded on the chart recorder. Further details of the instrumentation may be found in the senior author's report(4).

Brighton Beach sand was used in all tests. It is a fairly uniform fine-to-medium sand with an angle of internal friction, measured by direct shear tests, of about 30 degrees.

Seals between the model wall and the plate-glass sides of the tank, separated by a gap of 2 mm, were made with two layers of P.V.C. insulating tape stuck to the model wall and then back-to-back to form a fairly stiff skirt which trailed against the glass. These seals also served to keep the model wall aligned correctly.

Finally, since wall weight is an important parameter in the theoretical model, provision was made to add masses to the model in the form of steel plates bolted to the wall base. The resulting low centre of gravity ensured translational rather than rotational, motion of the wall.

3. SHAKING TABLE TESTS

The series of tests carried out can be divided as follows into three classes, depending on the type of excitation used and whether or not it was strong enough to cause yielding of the backfill and corresponding relative displacement of the wall model.

Class 1. Periodic excitation, no yielding, at 2.5, 5.0, 10 and 15 Hz and acceleration amplitudes of 0.05g, 0.10g, ... until yielding was imminent.

Class 2. Periodic, 5 Hz excitation with an acceleration amplitude of 0.44g, sufficient to cause wall translation.

Class 3. Scaled El Centro, 1940, N-S and 1966, Parkfield, California, array No. 2 horizontal accelerogram component.

The tests were repeated with a number of different wall weights. Results from the Class 1 tests principally gave information about dynamic soil pressures; Class 2 and Class 3 tests checked the general validity of the analytical model, examined yielding thresholds, and checked the kinematic assumptions of the Richards and Elms model.

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