Small-Scale Footing Studies on Sand and Clay

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ABRIDGMENT

•SMALL-SCALE footings having circular, rectangular and square contact areas were subjected to a constant rate of penetration ranging from 0.2 to 1,750 in./min. Pressure sinkage relationships were obtained for footing penetrations up to 4 in. to determine the influence of sinkage rate and footing geometry on load sinkage characteristics of soils. Particular attention was given to the initial portions of the load sinkage curves to determine typical failure patterns and bearing capacities.

Test soils consisted of a wet Ottawa sand, prepared by flooding the entire soil bin and then compacting by quick drainage, and a remolded Boston blue clay. Control parameters measured in each test condition were moisture content and density. Operational principles of the loading device are shown in Figure 1.

With increased rates of penetration, the resistance of both soils to penetration increased. Typical pressure sinkage curves with rates of sinkage as a parameter are shown in Figures 2 and 3 for sand and clay, respectively. In sand, 60 in./min was observed as the critical deformation rate at which the mode of failure changed. For sinkage rates slower than 60 in./min, local shear failure was predominant, and for higher sinkage general shear failure was predominant. These conclusions

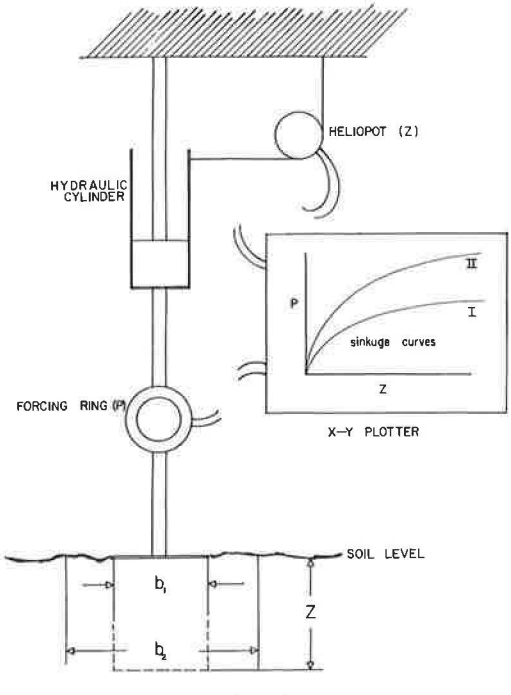

Figure 1. Load sinkage bevameter diagram.

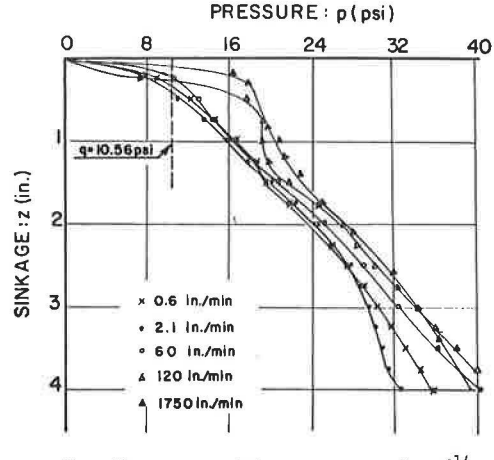

Figure 2. Pressure-sinkage curves for $2^1/_2$-in. diameter footing in sand.

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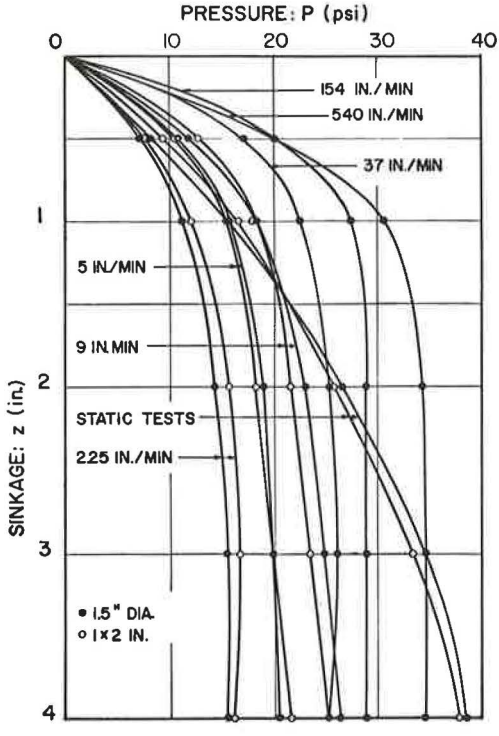

Figure 3. Pressure-sinkage curves at seven rates of loading for remolded clay.

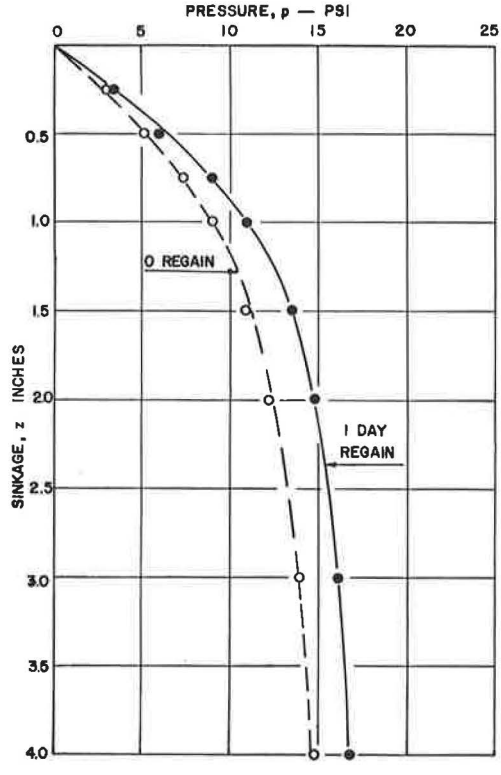

Figure 4. Thixotropic regain of resistance to footing sinkage in remolded clay.

were true for all except for the $^3/_4$- by 4-in. footings which failed due to general shear failure occurring at all sinkage rates tested. Local shear failure pattern was indicated from the remolded clay with all the small-scale footings investigated under the various penetration rates.

The increase in strength with increased rates of penetration was attributed to inertia effects in both soils and also to the change in the mode of failure in sand and to the plastic resistance in clay. The ultimate bearing capacity of clay occurred at excessive footing sinkages; therefore, it became apparent that the safe soil pressure of a remolded soft clay has to be based on settlement considerations.

In sand, the measured bearing capacity values at sinkage rates higher than 120 in./min were found to be twice as high as one would expect from static tests. The low deformation rate tests obtained in sand were in reasonable agreement with Terzaghi's bearing capacity theory; however, no agreement between theory and experiments were noted in the clay.

The significance of thixotropic regain characteristics of Boston blue clay after remolding is demonstrated in Figure 4, which shows the influence of a regain period of 1 day in connection with resistance to sinkage of a 3.5-in. diameter footing. The results would tend to confirm the influence of thixotropic regain characteristics on the strength of the clay as obtained from the static loading test. The loading period involved a time element of 2 weeks, which has been found to be very significant relative to an increase in resistance to sinkage.