LATERAL SWELLING PRESSURES IN COMPACTED OKLAHOMA COHESIVE SOILS

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ABRIDGMENT

• STRUCTURAL damage resulting from swelling pressures developed in compacted clay soils has been studied and documented by numerous authors. During the early 1960's, several reports (1, 2, 3) indicated that the lateral component (perpendicular to direction of compaction) of those swelling pressures was a primary cause of much of the damage to structures such as foundation walls and buried conduits. Lateral subgrade expansion has also produced tensile stresses in Oklahoma pavement systems of sufficient magnitude to result in longitudinal cracking of pavement components (4).

The purposes of the study described here were to develop instrumentation for direct measurement of lateral swelling pressure of compacted soils and to measure the relative magnitudes of lateral swelling pressure for 2 Oklahoma cohesive soils of moderate to high plasticity and swell potential, as influenced by initial moisture content, dry density, compaction mode and energy, and lateral swell. In addition, vertical swelling pressure data were collected and correlated with lateral swelling pressure data. The sample preparation procedures included varying the compaction mode and energy for initial moisture contents 4 to 6 percent above and below optimum moisture content for the 2 soils. More detailed information is available elsewhere (5).

The lateral swelling pressure was measured by a modified version of a device described by Frost (6). The apparatus, shown in Figure 1, is made entirely of Lucite and has a pressure transducer and strip-chart recorder to measure and record lateral swelling pressure.

A compacted sample surrounded by filter paper and a rubber membrane was placed in the cell, and the cell was filled with de-aired distilled water. Water from the reservoir was introduced to the sample under back pressure, causing the swelling pressure to develop. Because the system was sealed, the water surrounding the sample maintained (for all practical purposes) 0 deformation and transmitted the developed swelling pressure to the pressure transducer, which translated the force to an electric signal for the strip-chart recorder.

Each sample was allowed to take in water and develop swelling pressure until it stabilized at a maximum value. Water was then removed from the Lucite chamber through a burette in the top of the pressure transducer assembly, with resulting lateral expansion of the sample, to allow its swelling pressure to decrease to 0. The system was then resealed, and the swelling pressure was allowed to redevelop. That process was repeated until the incremental lateral swell was so small that essentially no water could be removed.

The influences of initial moisture content, dry density, and compacted soil structure on lateral swelling pressure were found to be highly interrelated for samples compacted with a given compactive effort, as shown by Figure 2. At initial moisture contents below optimum, the trend toward decreasing lateral swelling pressure with increasing initial moisture content is offset by the tendency toward increased lateral

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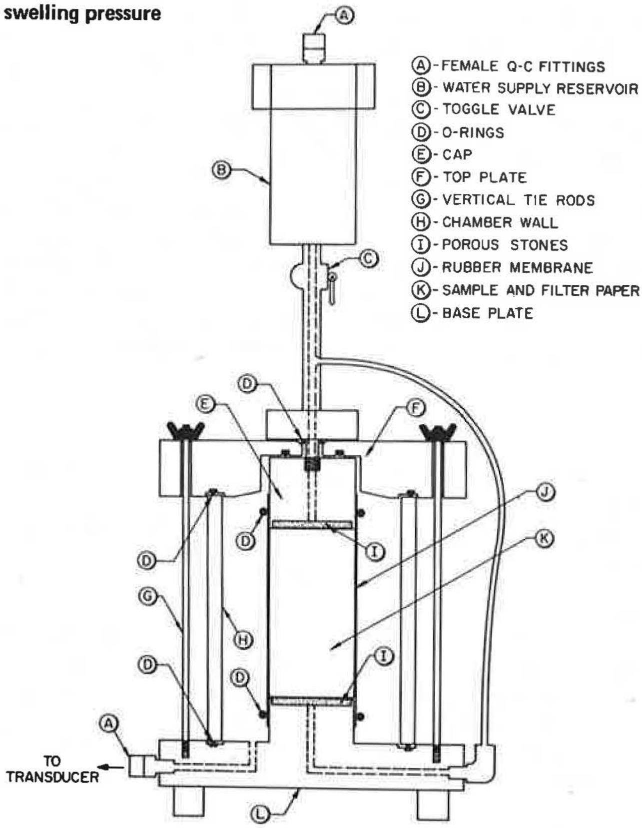

Figure 1. Lateral swelling pressure apparatus.

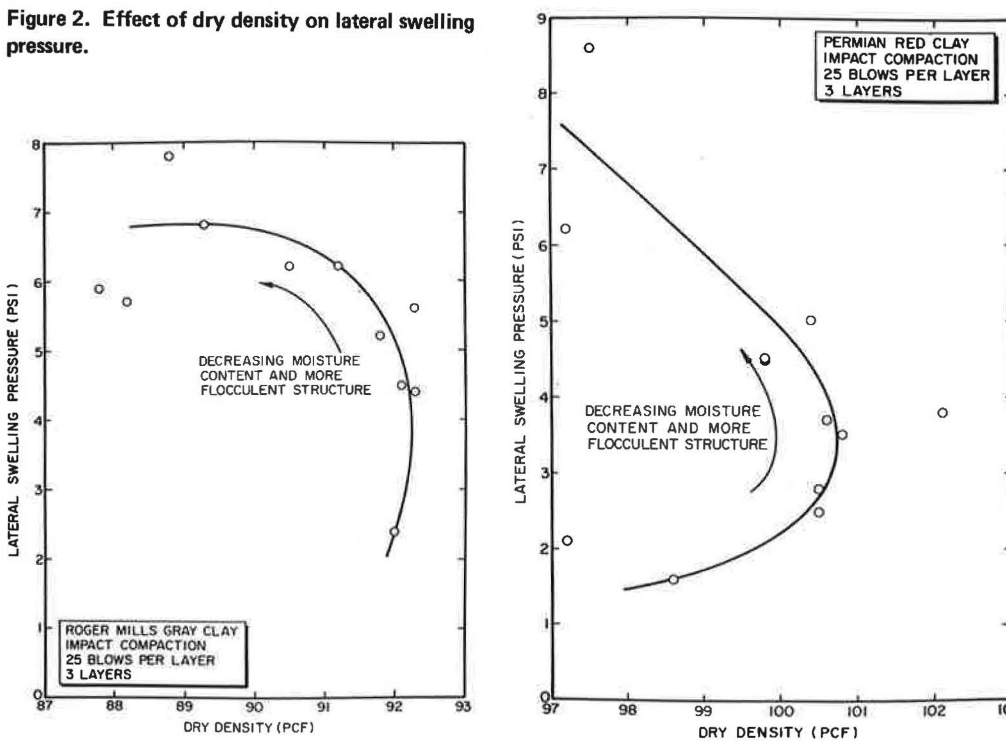

Figure 2. Effect of dry density on lateral swelling pressure.

pressure with increasing dry density; thus, a relatively constant magnitude of lateral swelling pressure results. At initial moisture contents slightly below and above optimum, the dry density does not change rapidly, so the effects of moisture content and compacted soil structure determine the swelling behavior. At initial moisture contents above optimum, the influence of increasing moisture content and decreasing dry density combines to reduce the lateral swelling pressure. For both soils, the final moisture content was primarily a function of initial moisture content and was relatively insensitive to dry density. For both soils, the vertical swelling pressure exceeded the lateral swelling pressure for nearly all initial conditions. A maximum lateral swelling pressure of approximately 6.5 lb/in.^{2} was obtained for both soils. The swelling ratio (lateral swelling pressure/vertical swelling pressure) was found to be approximately equal to 1.0 for both soils at moisture contents on the dry side of optimum. At moisture contents above optimum, the swelling ratio is essentially constant between 0.50 and 0.65.

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