DEPARTMENT OF SOILS

Stresses and Deflections Induced by a Uniform Circular Load

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● THE Waterways Experiment Station, Corps of Engineers, is conducting a study of the distribution of stresses and deflections in soil masses (1). As a part of this study theoretical determinations have been made of the stresses and deflections induced in a homo-geneous, isotropic mass by a uniform circular load. These determinations consider a semi-infinite, elastic mass having a Poisson's ratio of 0.5.

Influence charts developed by Newmark (2, 3) were used to compute normal and shear stresses and vertical deflections at sufficient depths and offsets to determine the various stress and deflection patterns. These patterns were portrayed as families of curves and published in an appendix to a Waterways Expe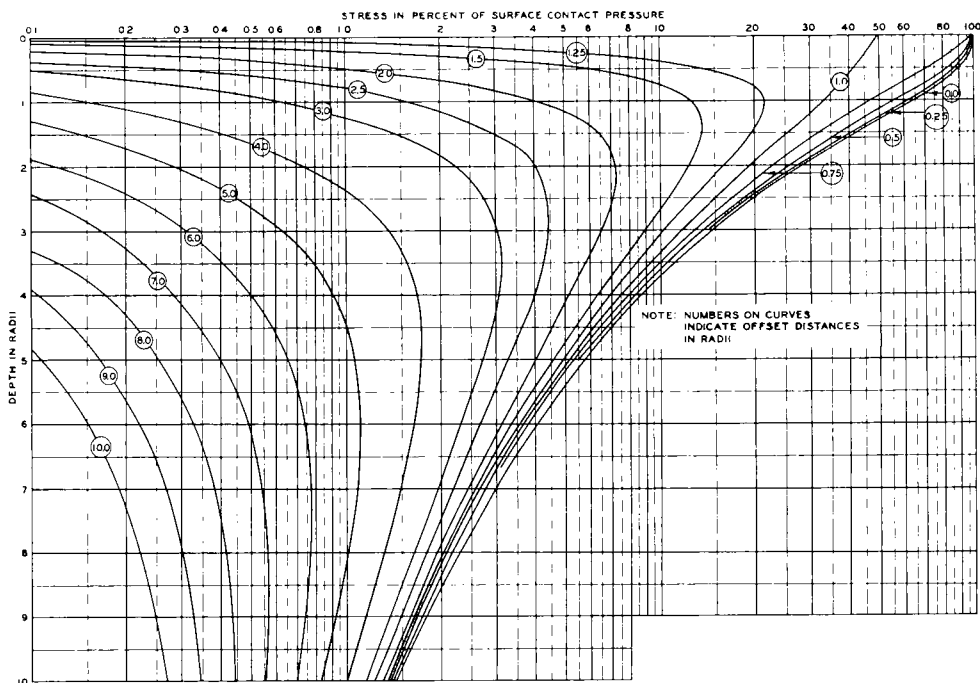riment Station report (4). However, since they represent a considerable expenditure of effort and may be of use to engineers concerned with soil mechanics it seems advisable to give them wider distribution by publication herein. Some similar work was published in tabular form by Barber in 1946
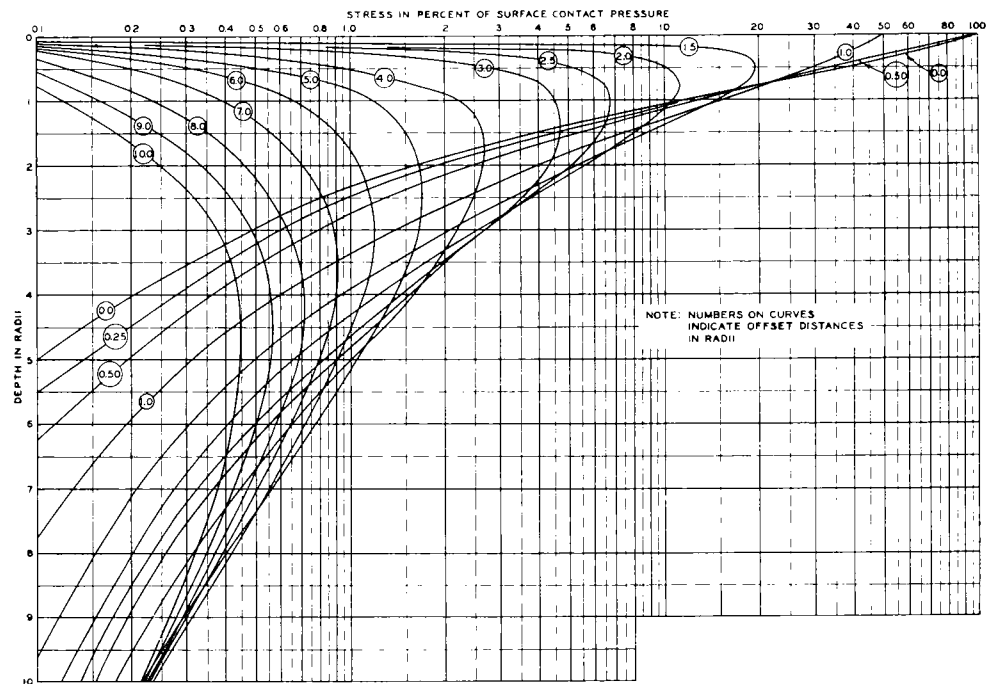

Figure 1. Vertical stress, σ_z, uniform circular load.

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Figure 2. Horizontal stress, σ_p.

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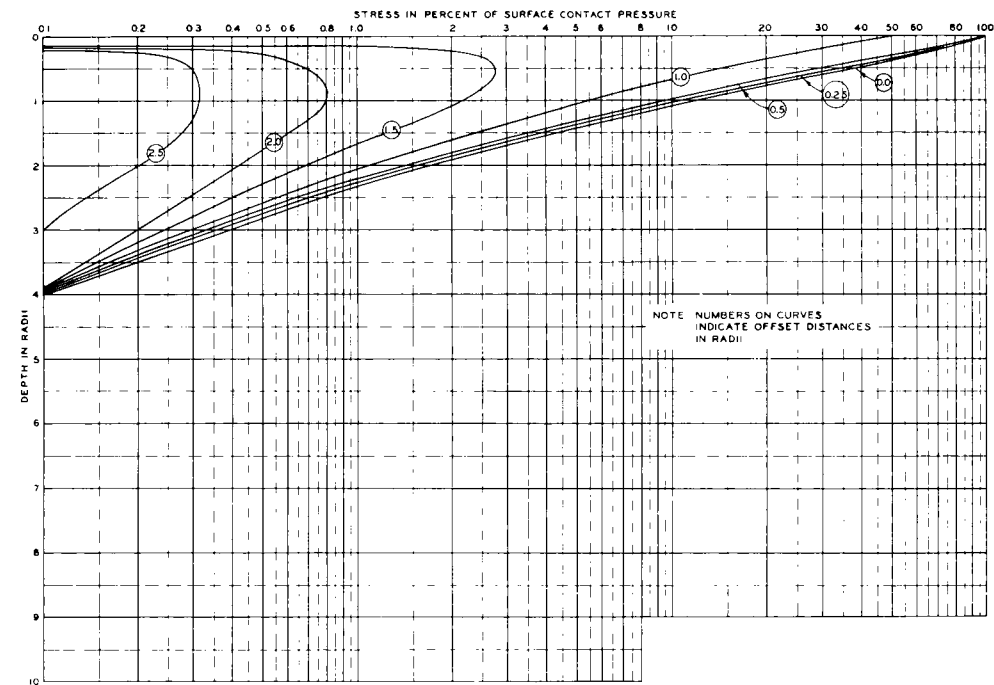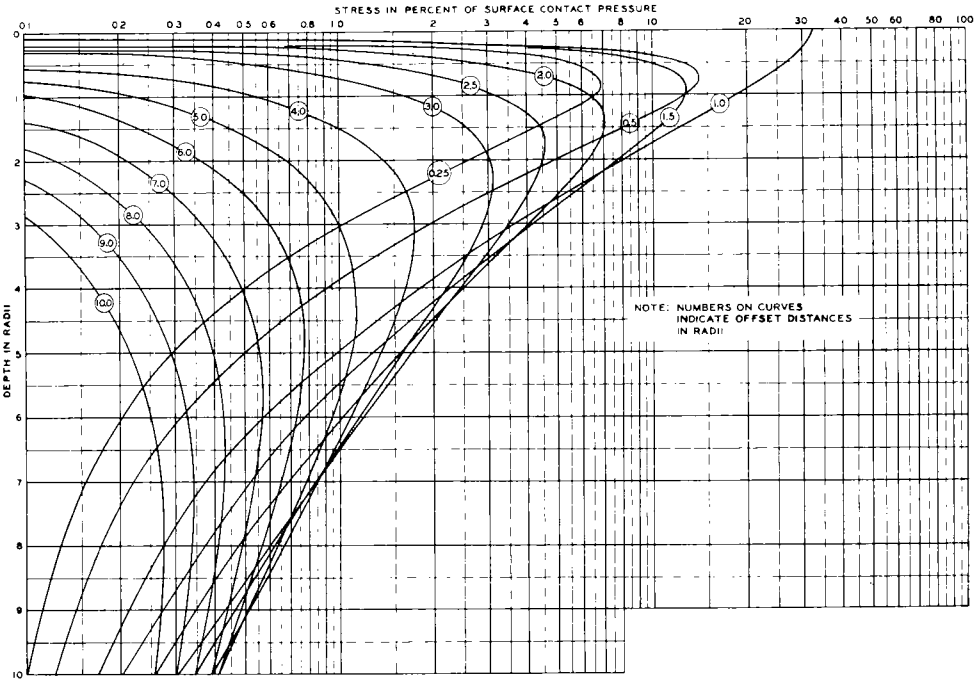Figure 3. Horizontal stress, σ_θ.

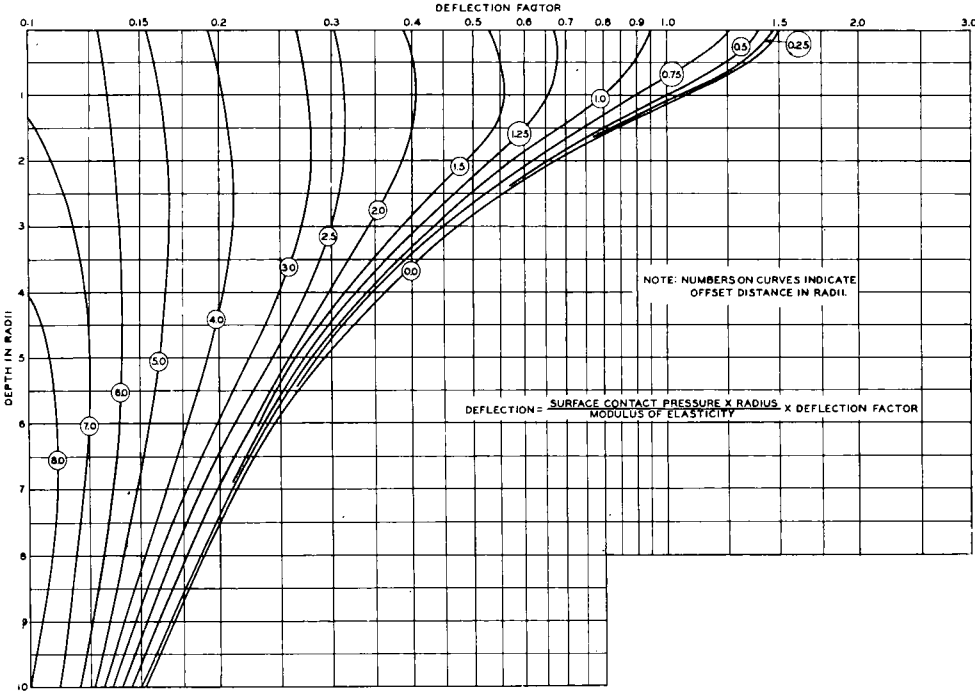Figure 4. Shear stress, $\tau_{\rho z}$.

Figure 5. Vertical deflection.

(5). The work here is in the form of curves and includes somewhat wider limits.

The normal stresses treated are the vertical stress, σ_z, the radial horizontal stress, σ_ρ, and the tangential horizontal stress, σ_θ. The shear stress treated is that acting vertically on a tangential plane, $\tau_{\rho z}$, or radially on a horizontal plane, the two being equal. Because of the symmetry of the loading the remaining shear stresses are equal to zero; thus, the four stresses presented are adequate to define completely the state of stress at a point. The deflection treated is vertical deflection, W_z. It is portrayed as a factor such that:

$$W_z = \frac{\text{load intensity} \times \text{radius}}{\text{modulus of elasticity}} \times$$
$$\text{deflection factor}$$

The various stress patterns and the deflection pattern are presented in the five figures as families of curves of stress or deflection versus depth.[1] The patterns are established

[1] The computational work which forms the basis of the curves presented here was accomplished by personnel of the Reports and Special Projects Section while it was under the direction of S. M. Fergus (1).

within a depth of 10 radii and an offset of 10 radii.

REFERENCES

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2. NEWMARK, NATHAN M., *Influence Charts for Computation of Stresses in Elastic Foundations*, University of Illinois Engineering Experiment Station Bulletin No. 338, November 1942.
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4. Corps of Engineers, Waterways Experiment Station, *Homogeneous Clayey Silt Test Section; Report No. 1, Investigations of Pressures and Deflections for Flexible Pavements.* Technical Memorandum No. 3-323, Vicksburg, Miss., March 1951.
5. BARBER, E. S., *Application of Triaxial Compression Test Results to the Calculation of Flexible Pavement Thickness*, Highway Research Board *Proceedings*, 1946.