Non-dimensional compaction curves

by

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and

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It is customary to present the results of compaction tests by plotting dry density γ_d against gravimetric water content m. As an aid to interpretation, a few contours of air voids content are often plotted; the location of these contours depends on the density of solids γ_s. If results for several soils are to be plotted on the same diagram for comparative purposes, several sets of contours of air voids content are required, and confusion results. For such purposes it would be preferable to plot relative dry density Y against volumetric water content X, where;

$$Y = \frac{\gamma_d}{\gamma_s} \qquad \ldots(1)$$

and

$$X = \frac{v_w}{v_s} \qquad \ldots(2)$$

On such a diagram, there are unique sets of contours, which are independent of γ_s, for all the following five quantities;

Voids ratio, $$e = \frac{V_a+V_w}{V_s} = \frac{1}{Y} - 1 \qquad \ldots(3)$$

Porosity, $$n = \frac{V_a+V_w}{V_t} = 1-Y \qquad \ldots(4)$$

Air voids content, $$a = \frac{V_a}{V_t} = 1-Y-XY \qquad \ldots(5)$$

Degree of saturation, $$S_r = \frac{V_w}{V_a+V_w} = \frac{XY}{1-Y} \qquad \ldots(6)$$

Degree of aeration, $$S_a = \frac{V_a}{V_a+V_w} = \frac{1-Y-XY}{1-Y} \qquad \ldots(7)$$

V_a, V_w, V_s, V_t are the volumes of air, water, solids and total volume respectively.

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The various sets of contours may by plotted by calculating Y from,

Voids ratio : $$Y = \frac{1}{1+e} \quad \ldots(8)$$

Porosity : $$Y = 1-n \quad \ldots(9)$$

Air voids content : $$Y = \frac{1-a}{1+X} \quad \ldots(10)$$

Degree of saturation : $$Y = \frac{S_r}{X+S_r} \quad \ldots(11)$$

Since porosity and voids ratio are linear and non-linear functions of Y, and since,

$$S_a = 1-S_r \quad \ldots(12)$$

There are only two sets of contours of importance, those for a and S_r.

Values of Y for plotting contours of a and S_r and values of Y for various values of e can be calculated and are reported in Tabular forms by Rama Rao (1978).

Reference

RAMA RAO, R., (1978), "A Study of Swelling Clay" *Ph. D. Thesis*, University of Glasgow, Scotland.