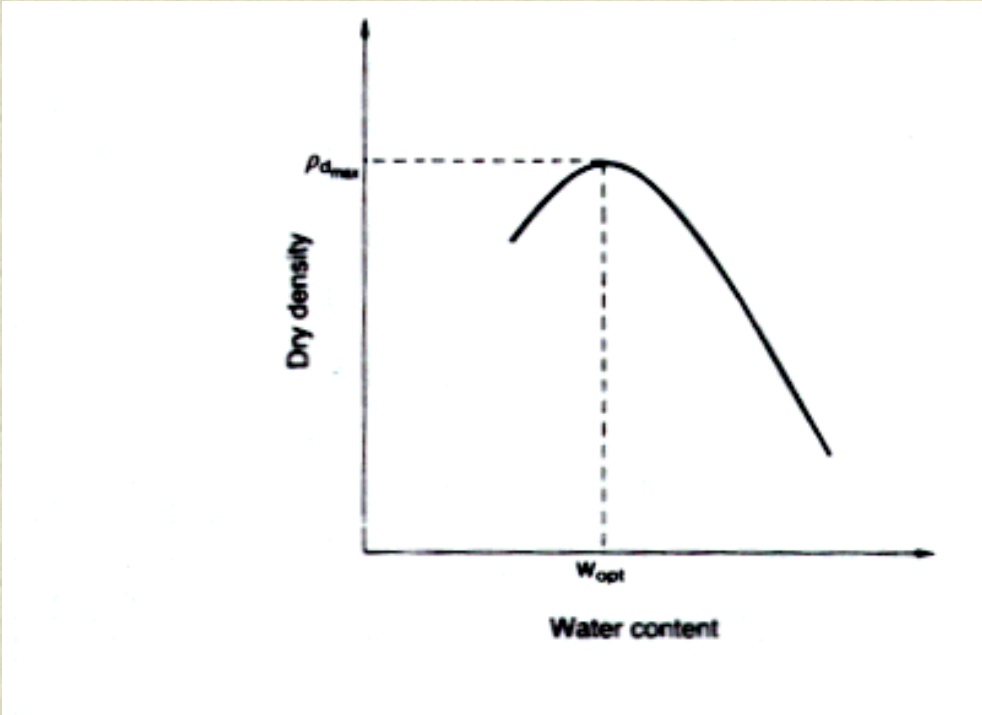
Interpretation of test results

Standard compaction is frequently specified for laboratory testing in Britain since many deposits have a natural moisture content at, or near to, the plastic limit. In drier climates, such as found in parts of America, the natural moisture contents can be less than the plastic limit and thus a heavier test is specified.

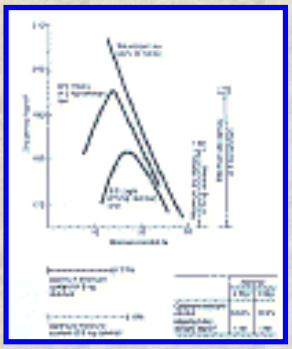
The laboratory compaction test, combined with a knowledge of natural moisture content, plasticity index and strength, provides a useful means of evaluating earthwork behaviour. For example, the above discussion indicates that it is unwise to place water-retaining earthworks drier than the optimum due to the high risk of swelling and risk of piping failure along incipient shear cracks.

An overall conclusion to be drawn is that the dry density v moisture content relationship obtained for a soil from a laboratory test is not property of a soil. The curve is a function of the mode and quantity of energy and the soil characteristics.

The following observations can be made from a typical compaction test.



1) With reference to the figure on the right. Increasing water content decreases the soil water suctions within the soil and makes it more workable, facilitating a reduction in air voids and increasing dry density. When the voids reduce to about 5% they tend to exist as occluded bubbles within the pores and the addition of further water further increases the void volume and causes the dry density to decrease. Since fine soils are low permeability, the water tends not to be displaced by compaction and the application of further rammer blows creates pulses of pore pressure in the relatively incompressible water and the soil flows plastically around the rammer. Thus for a given soil and compactive effort, there exists a moisture content, the optimum, at which the dry density attains a maximum value. For many soils under British conditions, this optimum for standard compaction is about 1% to 2% lower than the plastic limit.



2) The effect of varying the compactive effort is to vary the maximum dry density and optimum moisture content. For increasing effort, the maximum dry density and optimum moisture content. For increasing effort, the maximum dry density increases and the optimum moisture content decreases, see the thumbnail on the right.

3) The effort of varying the soil type produces curves similar in form to that shown the second figure. Well graded granular soils give higher dry densities than clays, and a pronounced peak to the curve normally indicates well-graded materials whilst a relatively smooth flat curve normally indicates a uniform grading.

Use of compaction test data in the field. Once the ideal moisture content and bulk density are determined in the lab this information can then be used during field compaction of the fill material. A portable nuclear soil density meter can be used to determine field moisture and density. The engineer on site can use this information to determine when field density is 90% of the lab derived value. At this point field compaction may be considered sufficient.

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