

Part 4

COMPACTION TESTING

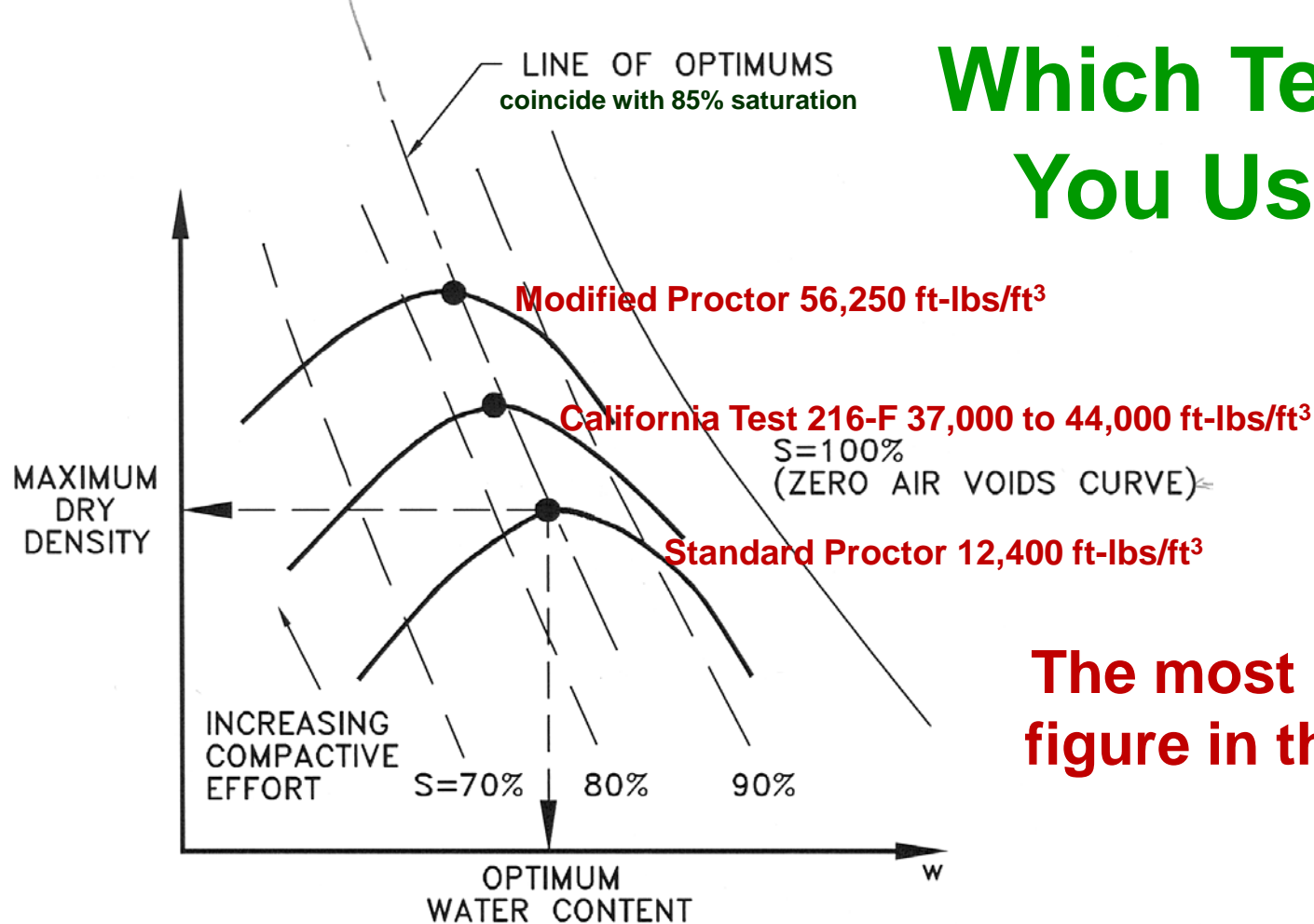


Runway Repairs

- Procedures were developed during the Second World War to run density tests in granular mixtures, and specify repairs and spot patches. These pictures are from Iwo Jima in July 1945



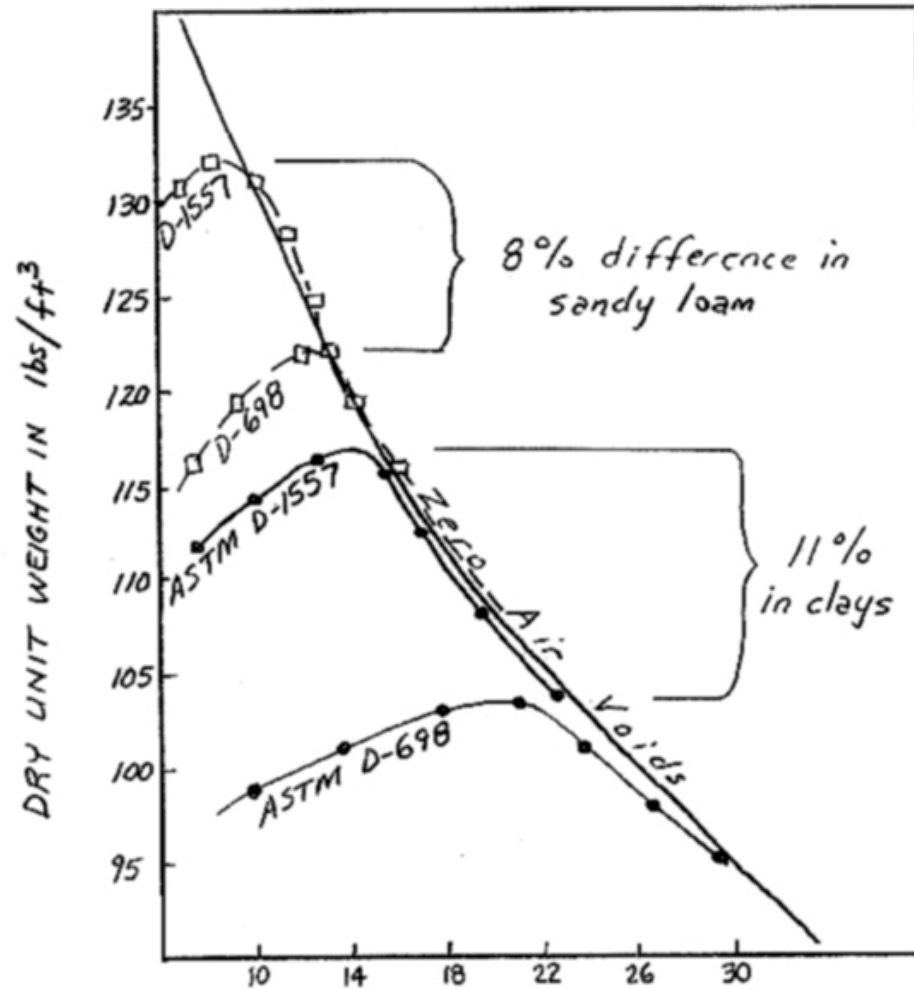
Which Test Are You Using?



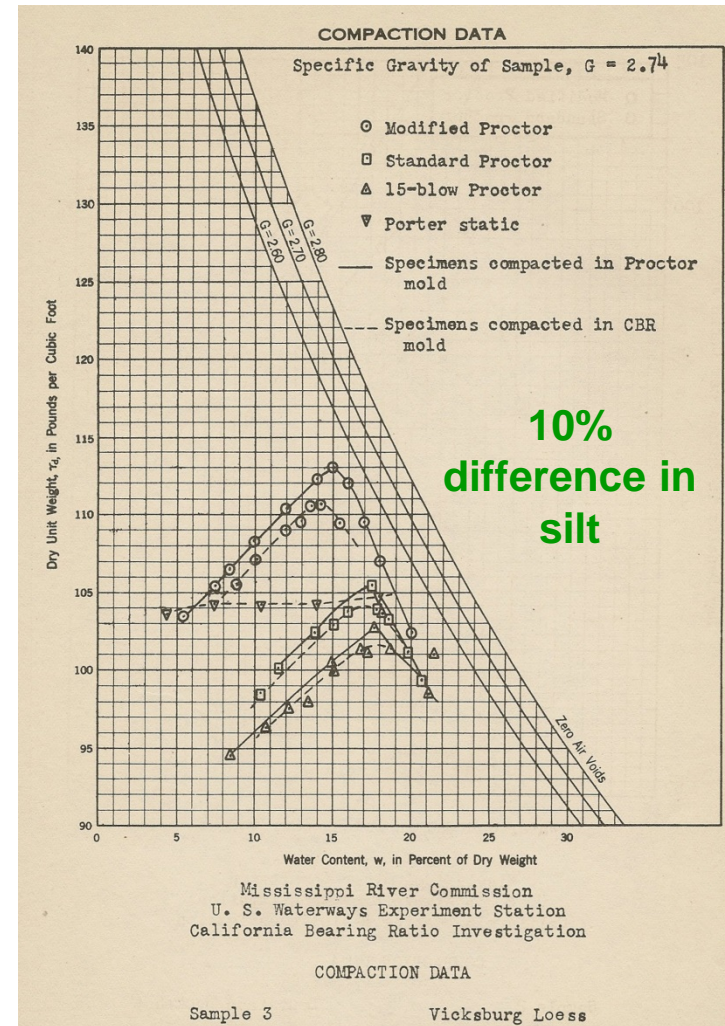
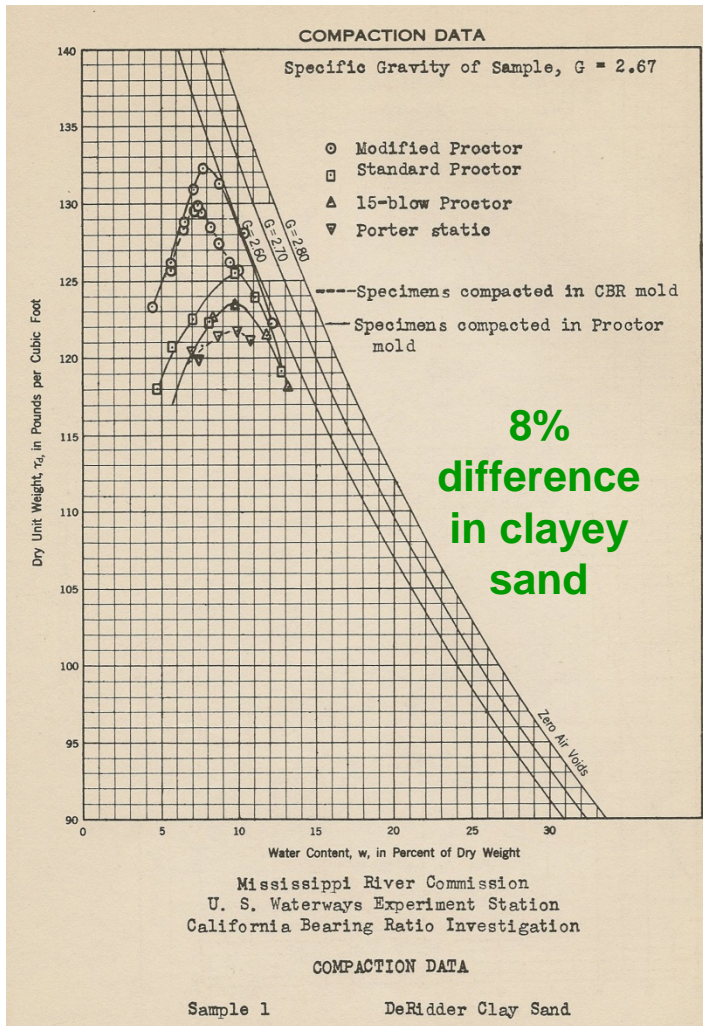
The most important figure in this lecture

- **Compaction tests results vary with the input compactive effort, usually measured in foot-pounds per cubic foot of soil.**
- **The line of optimum moisture contents is usually around 85% saturation and the optimum moisture content decreases with increasing compactive effort.**

COMPARISON BETWEEN ASTM D-698-70 and ASTM D-1557-78

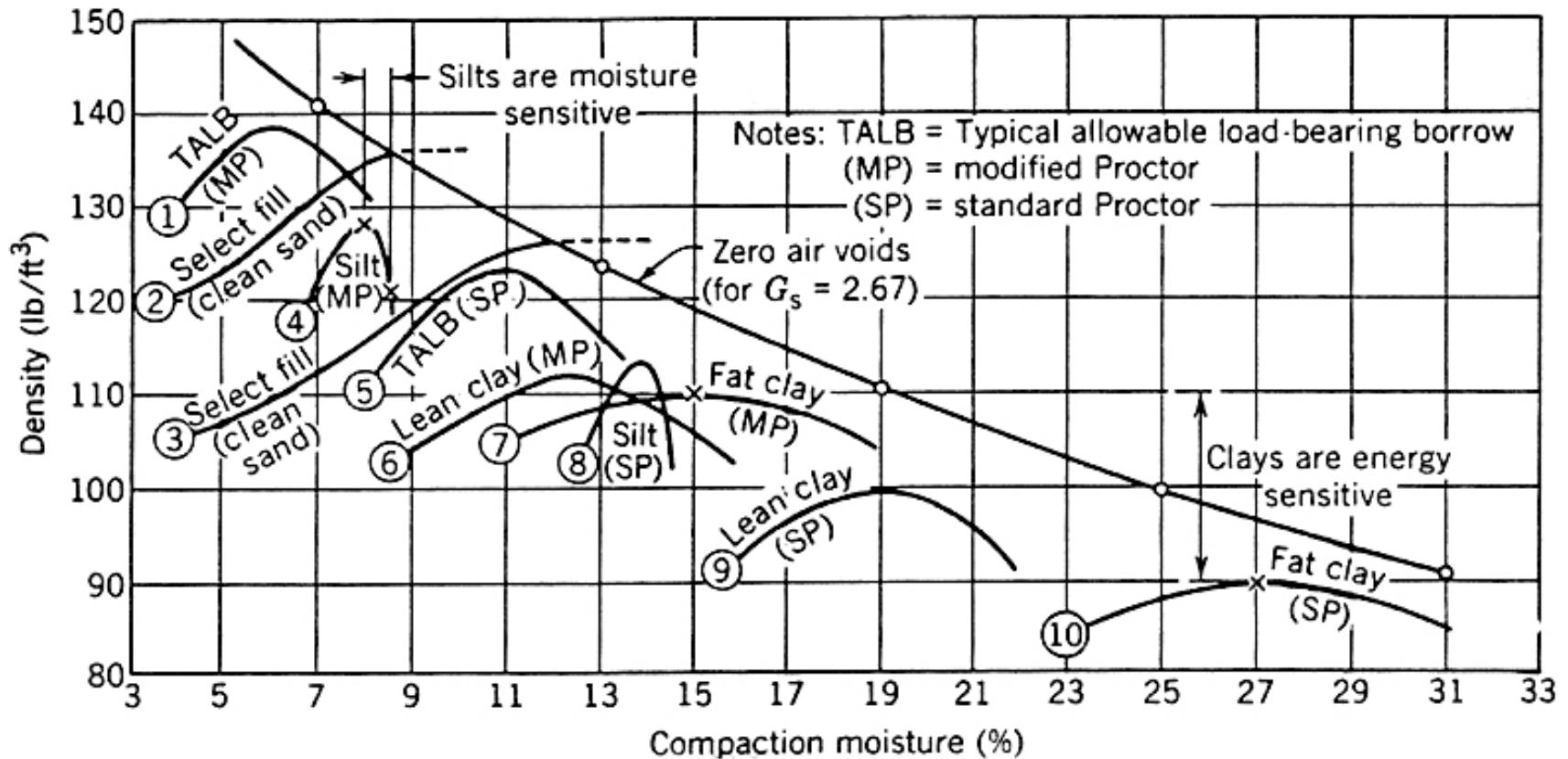


- The Standard Proctor test (ASTM D698) employs 12,400 ft-lbs/ft³ of soil, while the Modified Proctor (ASTM D1557) uses 56,250 ft-lbs/ft³. This typically leads to variances between 8% and 11%, as shown above.

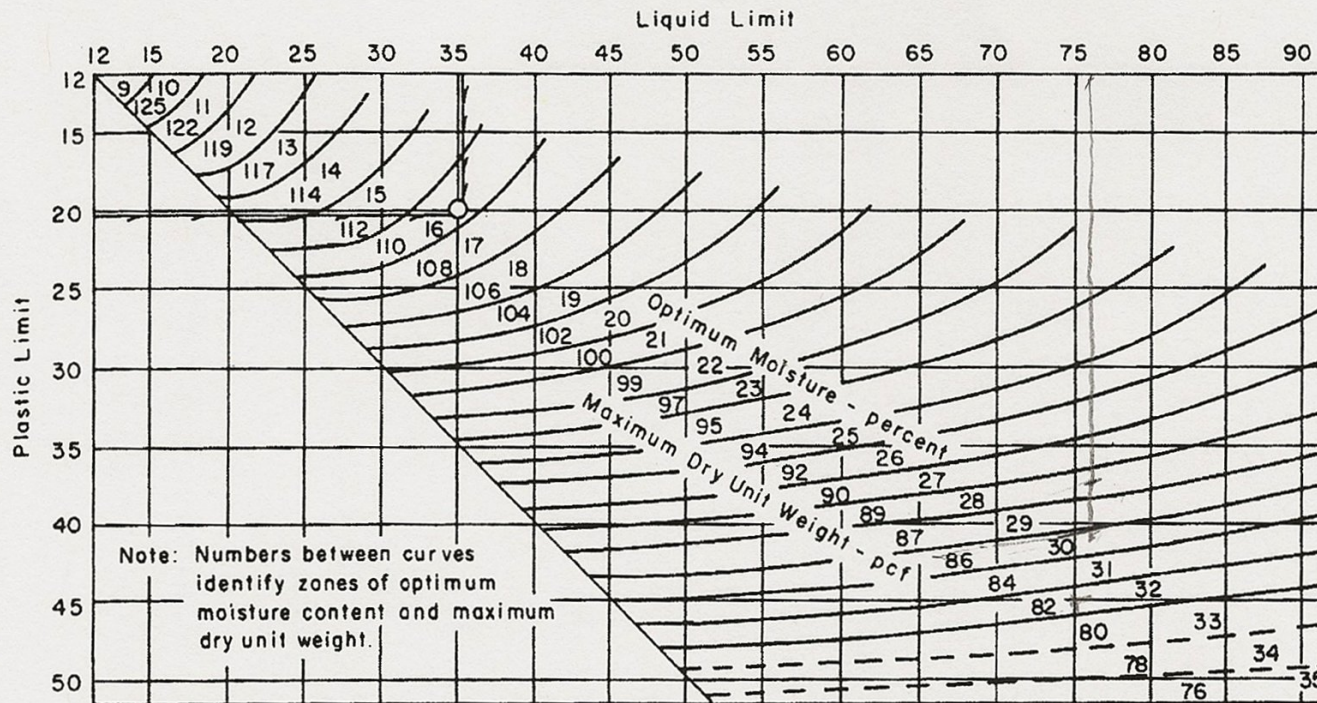


- Comparisons between Modified Proctor, Standard Proctor, 15-blow Proctor, and Porter static compaction tests on samples of silt and clayey sand by the Army Corps of Engineers in 1945.

SPECTRUM OF CURVES



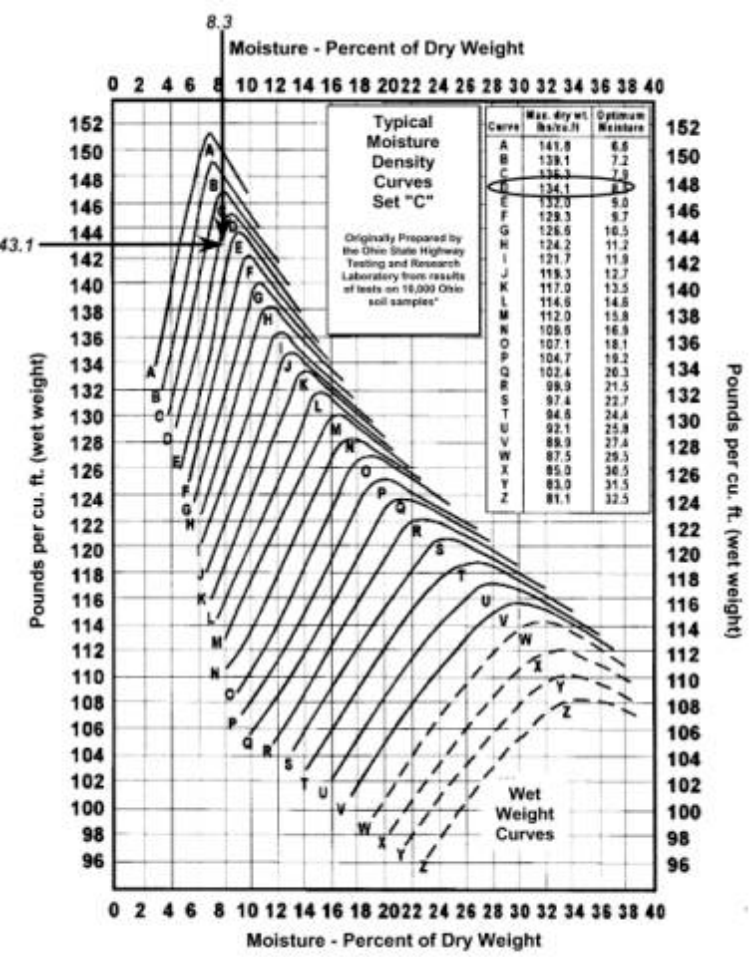
- The **maximum achievable density** depends on the type of material, as well as the input energy during compaction. It is commonly used for diatomaceous earth and halloysitic clays.



Example: Given: Plastic limit - 20
Liquid limit - 35
Find: Average maximum dry unit weight and optimum moisture content.
Answer: 110 pcf dry unit weight and 16 percent moisture.

Figure 109. Relation of average maximum dry unit weight and optimum moisture content (AASHTO T99-49) to plastic limit and liquid limit (135).

- Average maximum dry unit weight and optimum moisture content achieved by standard Proctor Tests (ASTM D698) with plastic limit (PL) and liquid limit (LL). This is a key figure to consult when compacting expansive clay soils. Taken from “Factors Influencing Compaction” (1962), HRB Report 319.**



*Computer re-drawn February 1996

Curve Fitting and Speedy Moisture Meters



The **Speedy Moisture Meter** is a portable system comprising a vessel with an integral pressure gauge a weighing scale in a portable case.

- Family of **expected wet density compaction curves**, based on 18,000 compaction tests compiled by the Ohio DOT

A small sample of the material is prepared, weighed and placed into the vessel. The reagent is then added and the vessel is sealed and shaken to mix the reagent with the sample.



- **Compaction curves should be prepared for all types of soil in the project area, before earthwork commences.** If different soils are mixed, then “check points” should be calculated to ascertain the optimum moisture level for the soil mixture being placed and tested. A great deal of judgment is required when performing such work.



- **Most field compaction tests are now made using nuclear density gages that employ a cesium element.**
- **Nuc gages can have significant errors if the extendable probe is located next to a rock > 3 inches across. In rocky fills the operator should always rotate the probe 90 degrees and take a second reading, recoding the lower of the two values.**