

From Chapter 5

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Visual Examination Test. Determine the color, grain size, and grain shape of the coarse-grained portion of a soil by visual examination. The grain-size distribution may be estimated. To observe these properties, dry a sample of the material and spread it on a flat surface.

In soil surveys in the field, color is often helpful in distinguishing among various soil strata, and from experience with local soils, color may aid in identifying soil types. Since the color of a soil often varies with its moisture content, the condition of the soil when color is determined must always be recorded. Generally, more contrast occurs in these colors when the soil is moist, with all the colors becoming lighter as the moisture contents are reduced. In fine-grained soils, certain dark or drab shades of gray or brown (including almost-black colors) are indicative of organic colloidal matter ((OL) and (OH)). In contrast, clean and bright-looking colors (including medium and light gray, olive green, brown, red, yellow, and white) are usually associated with inorganic soils. Soil color may also indicate the presence of certain chemicals. Red, yellow, and yellowish-brown soil may be a result of the presence of iron oxides. White to pinkish colors may indicate the presence of considerable silica, calcium carbonate, or (in some cases) aluminum compounds. Grayish-blue, gray, and yellow mottled colors frequently indicate poor drainage.

Estimate the maximum particle size for each sample, thereby establishing the upper limit of the grain-size distribution curve for that sample. The naked eye can normally distinguish the individual grains of soil down to about 0.07 mm. All particles in the gravel and sand ranges are visible to the naked eye. Most of the silt particles are smaller than this size and are invisible to the naked eye. Material smaller than 0.75 mm will pass the Number 200 sieve.

Perform the laboratory mechanical analysis whenever the grain-size distribution of a soil sample must be determined accurately; however, the grain-size distribution can be approximated by visual inspection. The best way to evaluate a material without using laboratory equipment is to spread a portion of the dry sample on a flat surface. Then, using your hands or a piece of paper, separate the material into its various grain-size components. By this method, the gravel particles and some of the sand particles can be separated from the remainder. This will at least give you an opportunity to estimate whether the total sample is to be considered coarse-grained or fine-grained, depending on whether or not more than 50 percent of the material would pass the Number 200 sieve. Percentage of values refers to the dry weight of the soil fractions indicated as compared

to the dry weight of the original sample. A graphical summary of the procedure is shown in [Figure 5-2](#).

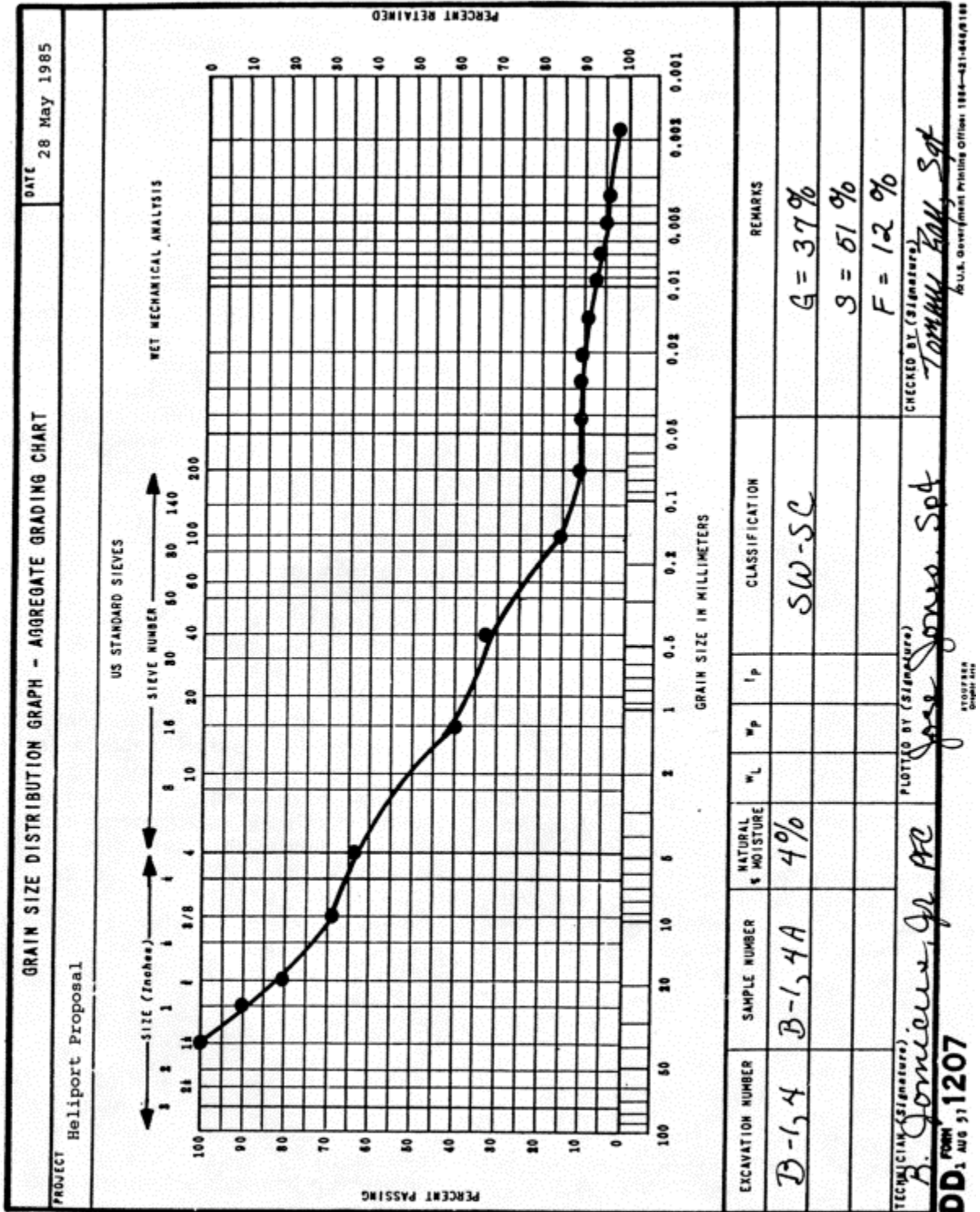


Figure 5-2. Graphical summary of grain-size distribution.

If you believe the material is coarse-grained, then consider the following criteria:

- Does less than 5 percent pass the Number 200 sieve?
- Are the fines nonplastic?

If both criteria can be satisfied and there appears to be a good representation of all grain sizes from largest to smallest, without an excessive deficiency of any one size, the material may be said to be well-graded ((GW) or (SW)). If any intermediate sizes appear to be missing or if there is too much of any one size, then the material is poorly graded ((GP) or (SP)). In some cases, it may only be possible to take a few of the standard sieves into the field. When this is the case, take the Number 4, Number 40, and Number 200 sieves. The sample may be separated into gravels, sands, and fines by use of the Number 4 and Number 200 sieves. However, if there is a considerable quantity of fines, particularly clay particles, separation of the fines can only be readily accomplished by washing them through the Number 200 sieve. In such cases, a determination of the percentage of fines is made by comparing the dry weight of the original sample with that retained on the Number 200 sieve after washing. The difference between these two is the weight of the fines lost in the washing process. To determine the plasticity, use only that portion of the soil passing through a Number 40 sieve.

Estimating the grain-size distribution of a sample using no equipment is probably the most difficult part of field identification and places great importance on the experience of the individual making the estimate. A better approximation of the relative proportions of the components of the finer soil fraction may sometimes be obtained by shaking a portion of this sample into a jar of water and allowing the material to settle. It will settle in layers, with the gravel and coarse sand particles settling out almost immediately. The fine sand particles settle within a minute; the silt particles require as much as an hour; and the clay particles remain in suspension indefinitely or until the water is clear. In using this method, remember that the gravels and sands settle into a much more dense formation than either the silts or clays.

The grain shape of the sand and gravel particles can be determined by close examination of the individual grains. The grain shape affects soil stability because of the increased resistance to displacement found in the more irregular particles. A material with rounded grains has only the friction between the surfaces of the particles to help hold them in place. An angular material has this same friction force, which is increased by the roughness of the surface. In addition, an interlocking action is developed between the particles, which gives the soil much greater stability.

A complete description of a soil should include prominent characteristics of the undisturbed material. The aggregate properties of sand and gravel are described qualitatively by the terms "loose," "medium," and "dense." Clays are described as "hard," "stiff," "medium," and "soft."

These characteristics are usually evaluated on the basis of several factors, including the relative ease or difficulty of advancing the drilling and sampling tools and the consistency of the samples. In soils that are described as "soft," there should be an indication of whether the material is loose and compressible, as in an area under

cultivation, or spongy (elastic), as in highly organic soils. The moisture condition at the time of evaluation influences these characteristics and should be included in the report.