Field Density Test

A. Rubber-Balloon Method

1) Position the density plate on a flat surface and set the volume measuring apparatus in the recessed hole in the density plate.
2) Hold the apparatus down firmly in position, open the control valve, pump the balloon down with the rubber bulb until the water level in the graduated cylinder has reached its lowest position, and record this volume which is the initial reading.
3) Pump the balloon back into the cylinder by inverting the rubber bulb, and close the control valve.
4) Place the density plate in a level position on the material to be tested, dig a test hole about 4 in. in diameter and 4 in. deep, retain all the material which is removed from the hole, then measure and record the mass of the excavated soil.
5) Set the apparatus in the recess in the density plate, hold it down firmly, open the control valve, pump the balloon into the hole, and record the lowest point reached by the water in cylinder which is the final reading.
6) Invert the pressure-vacuum bulb and pump the balloon back into the cylinder.
7) Subtract the initial reading from the final reading and obtain the volume of the hole in cubic feet.
8) Mix the material thoroughly and secure a representative sample of not less than 100 gm for moisture determination.
9) Make density calculations based on volume of the test hole and dry or wet weight (as required) of materials removed.

B. Sand-Cone Method

1) Place the empty sand-cone apparatus upright on a firm level surface, close the valve and fill the funnel with sand.
2) Open valve and, keeping funnel at least half full of sand, fill the apparatus.
3) Close the valve sharply, empty excess sand, and weigh.
4) Determine the weight of sand required to fill the funnel by seating the inverted apparatus on a plane surface, opening the valve until the sand stops running, closing the valve sharply and weighing. (When the base plate is used it should be considered a part of the funnel).
5) Replace the sand removed in the funnel determination, close the valve and weigh.
6) Seat the density plate, if any, on the test hole, center the sand-cone apparatus, open the valve and, after the sand has stopped flowing, close the valve.
7) Weigh the apparatus with remaining sand.
8) Determine the volume of the jar and attachment up to and including the valve orifice by weighing the empty apparatus, filling with water until it appears over the valve, weighing the filled apparatus, and measuring the temperature of the water.
C. Nuclear Moisture - Density Measurements

Radioactive materials used in moisture-density devices emit four types of radiation:

- alpha particles
- beta particles
- gamma rays (photons) (for density measurement)
- neutrons (for moisture measurement)

1) Density measurement: source of gamma rays is cesium, half life = 30 years

- Backscatter: number of backscattered gamma rays detected by the counter is related to material total density.
- Direct Transmission: number of rays directly or indirectly detected by the counter is dependent on density of material.

2) Moisture measurement: source of neutrons is beryllium which must be bombarded by americium before it releases the neutrons.

Only backscatter is used. Penetrating power of neutrons depends on material composition rather than density. They are slowed down most effectively by material containing hydrogen atoms such as water and polyethylene.

3) Safety - only properly trained, authorized users may handle the equipment. Users must wear radiation badges to measure cumulative radiation. Safe storage and protection are legally mandated.

4) Measurement characteristics

Density:

   i) Backscatter
       depth of measurement: 2 to 3 inches
       range: 70 to 170 lb/cu ft
       accuracy ± 1.5 pcf

   ii) Direct transmission
       depth of measurement: 2 to 8 inches
       range: 70 to 170 pcf
       accuracy: ± 0.5 pcf

Moisture:

   depth of measurement: 5 inches
   range: 0 to 40 lb/cu ft
   accuracy ± 0.25 pcf