TABLE 4.3 SPT HAMMER EFFICIENCIES (Adapted from Clayton, 1990).

Country	Hammer Type (per Figure 4.10)	Hammer Release Mechanism	Hammer Efficiency E_m
Argentina	Donut	Cathead	0.45
Brazil	Pin weight	Hand dropped	0.72
China	Automatic	Trip	0.60
	Donut	Hand dropped	0.55
	Donut	Cathead	0.50
Colombia	Donut	Cathead	0.50
Japan	Donut	Tombi trigger	0.78–0.85
	Donut	Cathead 2 turns + special release	0.65–0.67
UK	Automatic	Trip	0.73
US	Safety	2 turns on cathead	0.55–0.60
	Donut	2 turns on cathead	0.45
Venezuela	Donut	Cathead	0.43

$$N_{60} = \frac{E_m C_B C_S C_R N}{0.60} \tag{4.1}$$

Where:

N_{60} = SPT N value corrected for field procedures
E_m = hammer efficiency (from Table 4.3)
C_B = borehole diameter correction (from Table 4.4)
C_S = sampler correction (from Table 4.4)
C_R = rod length correction (from Table 4.4)
N = measured SPT N value

Many different hammer designs are in common use, none of which is 100 percent efficient. Some common hammer designs are shown in Figure 4.10, and typical hammer efficiencies are listed in Table 4.3. Many of the SPT-based design correlations were developed using hammers that had an efficiency of about 60 percent, so Equation 4.2 corrects the results from other hammers to that which would have been obtained if a 60 percent efficient hammer was used.

The SPT data also may be adjusted using an *overburden correction* that compensates for the effects of effective stress. Deep tests in a uniform soil deposit will have higher N values than shallow tests in the same soil, so the overburden correction adjusts the measured N values to what they would have been if the vertical effective stress, σ_z', was 100 kPa (2000 lb/ft^2). The corrected value, $(N_1)_{60}$, is (Liao and Whitman, 1985):

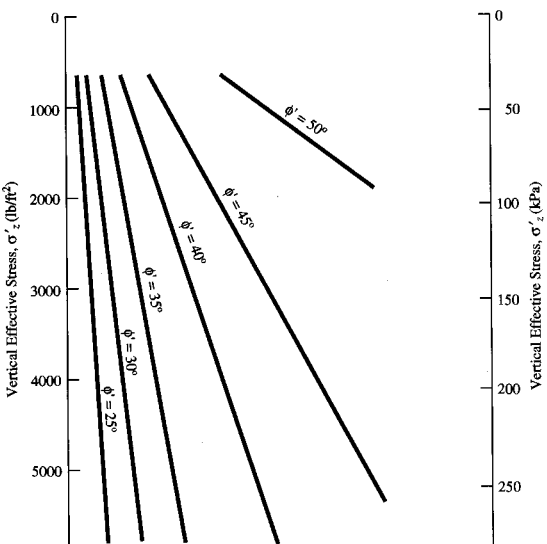

Figure 4.11 Empirical correlation between N_{60} and ϕ' for uncemented sands (Adapted from DeMello, 1971).

Example 4.1

A 6-inch diameter exploratory boring has been drilled through a fine sand to a depth of 19 ft. An SPT N-value of 23 was obtained at this depth using a USA safety hammer with a standard sampler. The boring then continued to greater depths, eventually encountering the groundwater table at a depth of 35 ft. The unit weight of the sand is unknown. Compute $(N_1)_{60}$, ϕ', and D_r at the test location, and use this data to classify the consistency of the sand.

Solution

Per Table 3.2, SP soils above the groundwater table typically have a unit weight of 95 to 125 lb/ft^3. The measured N-value of 23 suggests a moderately dense sand, so use $\gamma = 115$ lb/ft^3. Therefore, at the sample depth: