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16. Abstract

Drilled shafts, sometimes termed drilled piers, bored piles, or caissons, are frequently used in highway construction. Drilled shafts are employed in the construction of retaining walls, in the stabilization of slopes, and as foundations for bridges and overhead signs. Two general consideration are important concerning the use of drilled shafts: selection and implementation of suitable construction details, and consideration of all relevant factors in making a design. The manual presents a thorough treatment of factors involved in both construction and design.

Topics addressed in the chapters on construction include methods of excavation, casings and liners, drilling slurry, rebar cages, and design and placement of concrete. In addition, case studies are described where construction must be carried out under various conditions.

Design concepts for axial loading are presented and procedures are given for design in clay, sand, and rock, considering load transfer both in skin friction and end bearing.

Other topics that are addressed include specifications, inspections, tests for completed drilled shafts, defects and remedial measures, field load tests and cost estimation.

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drilled shafts, drilled piers, bored piles, caissons, drilling, concrete, soil exploration, axial loading, expansive soil, downdrag, non-destructive testing, field load tests, cost estimation, inspection.	

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which appropriate factors of safety are to be applied to obtain design loads.

$$q_{br} = F_r \, q_b \tag{11.5}$$

where

$$F_r = 2.5/\left[aB_b \text{ (in)} + 2.5b\right]; \; F_r \leq 1.0, \tag{11.6}$$

in which

$$a = 0.0071 + 0.0021 \, (L/B_b); \; a \leq 0.015 \tag{11.7}$$

$$b = 0.45 \left(c_{ub} \text{ (ksf)}\right)^{0.5}; \; 0.5 \leq b \leq 1.5 \tag{11.8}$$

The above expressions are based on load tests of large-diameter underreamed drilled shafts in very stiff clay and soft clay-shale (O'Neill and Sheikh, 1985; Sheikh, et al, 1985) and restrict q_{br} to be the net bearing stress at a base settlement of 2.5 inches. When half or more of the design load is carried in end bearing and a global factor of safety is applied, the global factor of safety should not be less than 2.5, even if soil conditions are well-defined, unless one or more site-specific load tests are performed.

Short-term Settlement

A number of experiments have been performed where the internal instrumentation in the drilled shaft allowed the load transfer in side resistance and in end bearing to be determined as a function of settlement. Curves for a number of cases have been normalized and are presented in Fig. 11.2 for side resistance and in Fig. 11.3 for end bearing. As may be seen,

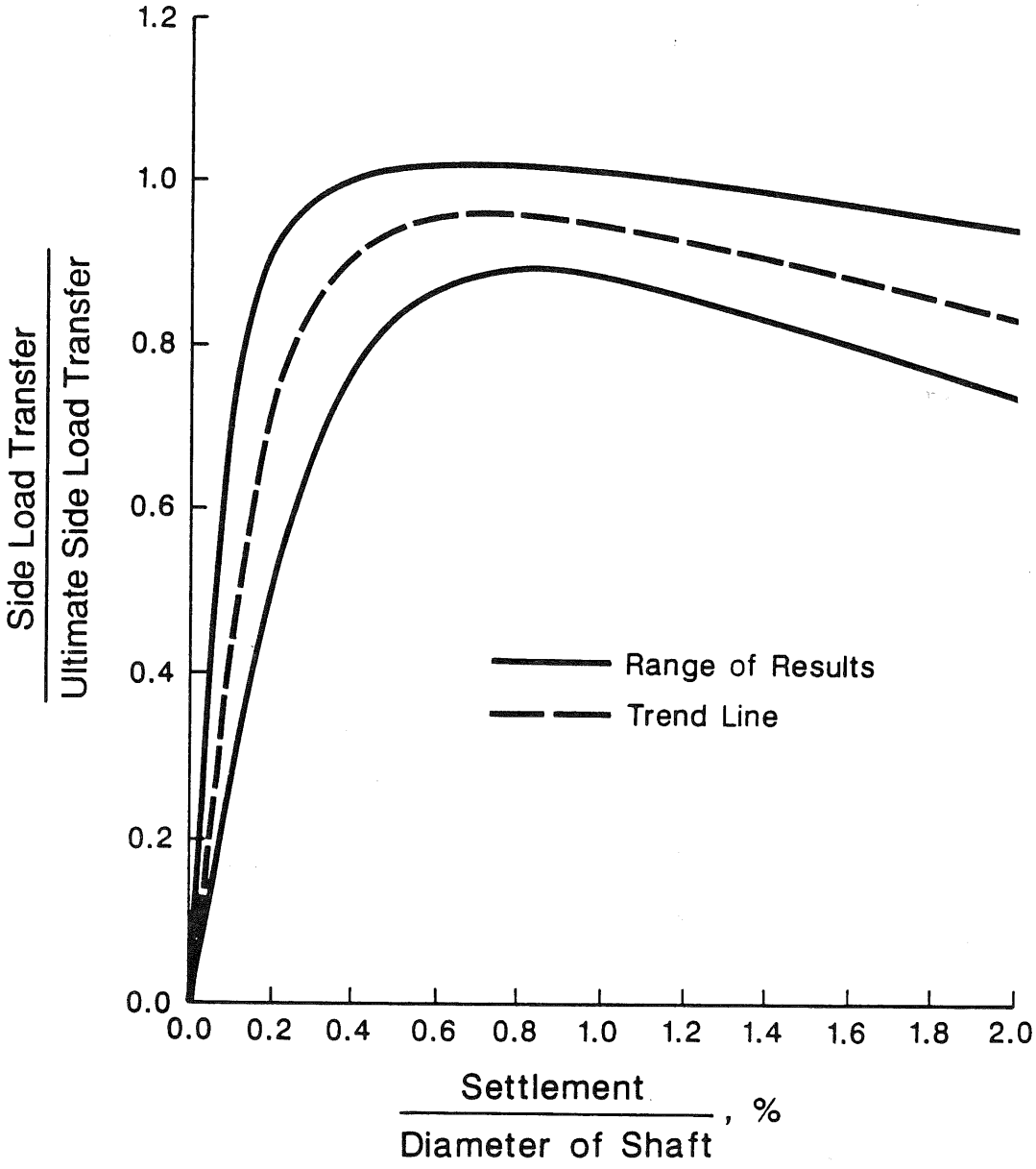

Figure 11.2. Normalized curves showing load transfer in side resistance versus settlement for drilled shafts in clay.

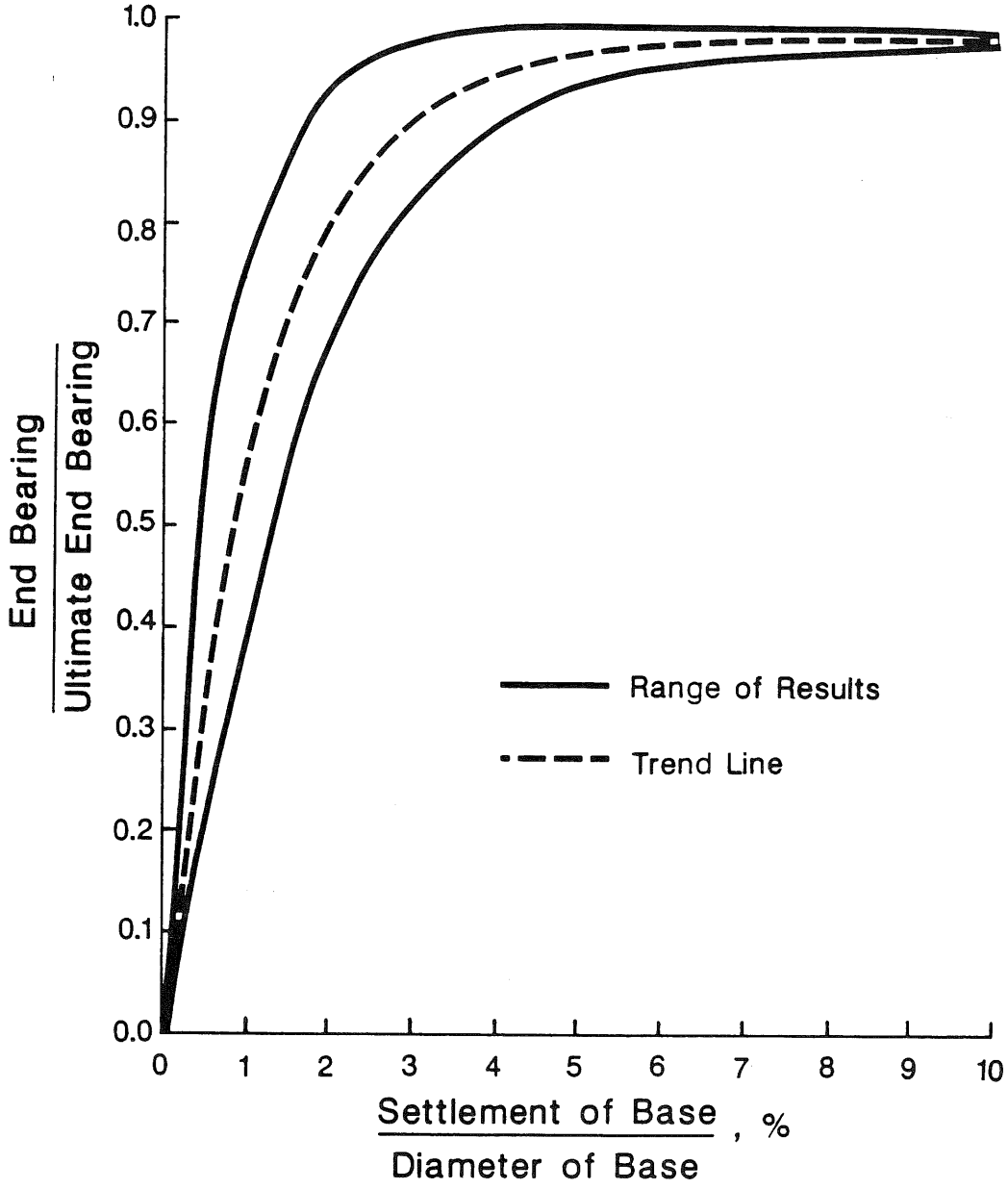

Figure 11.3. Normalized curves showing load transfer in end bearing versus settlement for drilled shafts in clay.

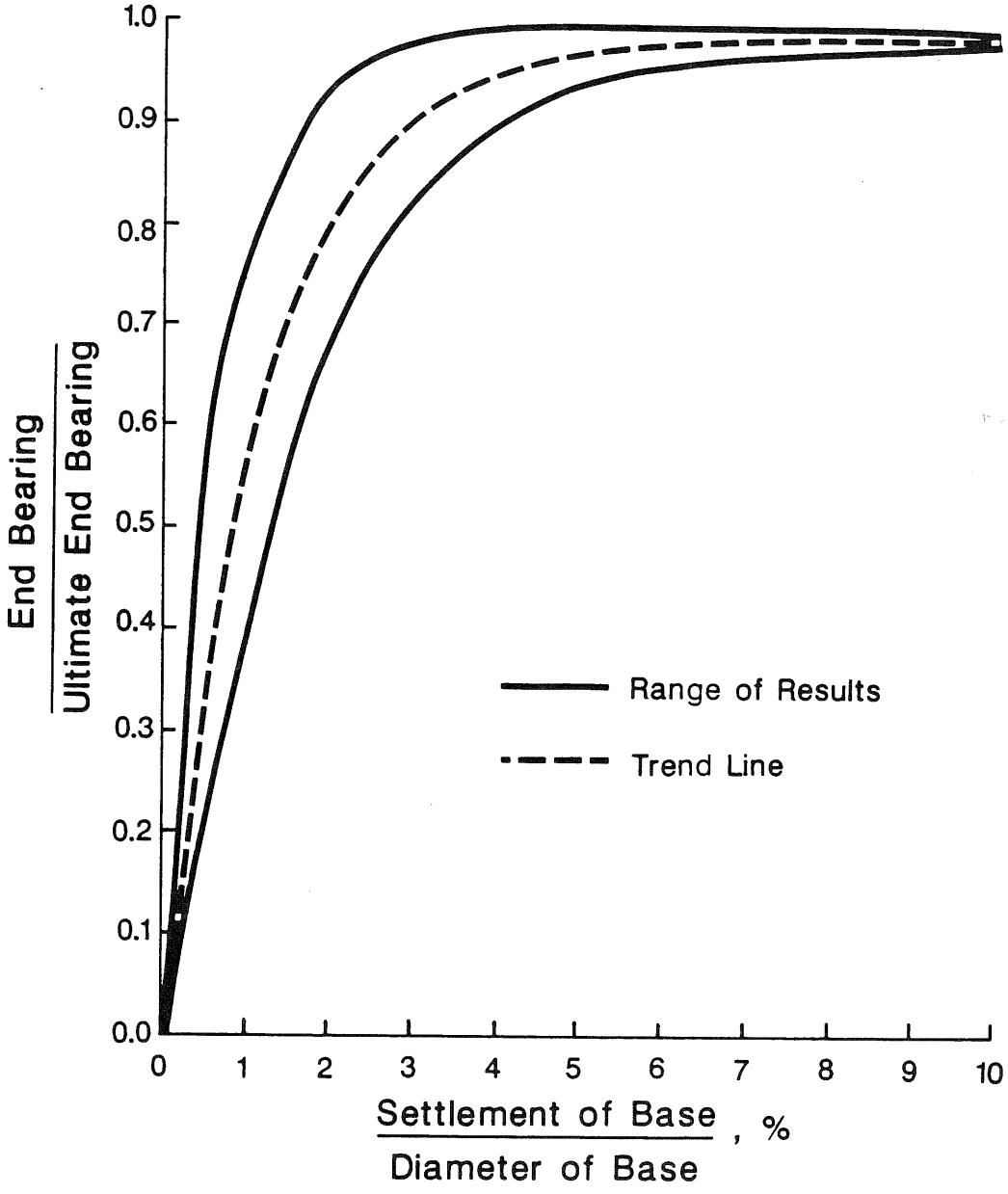

Figure 11.3. Normalized curves showing load transfer in end bearing versus settlement for drilled shafts in clay.

there is a considerable amount of scatter in the results. However, the curves are useful to the designer in estimating the short-term settlement and in adjusting the allowable load if the total or differential settlement appear to be too great. Normally, if the procedures for establishing ultimate loads in this manual are followed, short-term settlement should be restricted to values of less than one inch when appropriate factors of safety are applied.

With regard to the load transfer in side resistance, it is important to note that the values that are shown were obtained for particular depths and that the elastic shortening of the drilled shaft is taken into account. For drilled shafts that are relatively short, the elastic shortening will have little influence on its performance. But for relatively long shafts the engineer may need to take the elastic shortening into account in estimating the settlement of the top of the shaft by a procedure such as is described in Appendix C.

The settlement due to long-term loading must be computed site by site using consolidation theory and cannot be generalized. However, long-term settlement will not be too significant at many sites where the clays are heavily overconsolidated. Drilled shafts are installed less frequently in normally consolidated clays where settlement due to consolidation could be significant.

Design for Sand

Side Resistance

The shear strength of sands and other cohesionless soils are characterized by an angle of internal friction that ranges from about 30 degrees upward, depending on the characteristics