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Design of Socketed Drilled Shafts in Limestone[a]

Discussion by J. M. Amir,[4] Fellow, ASCE

The development of suitable drilling equipment during the last years has in many cases made piling (or socketing) in rock a viable foundation option. Since foundations penetrating into rock derive a substantial part of their capacity from sidewall shear, therefore the problem of quantifying the allowable sidewall shear has an important economic significance. The authors have made an interesting contribution toward this end, but some points mentioned in the paper call for some clarification.

TABLE 3. Allowable Sidewall Shear in Piles—Israeli Practice (Amir 1989)

Rock hardness (1)	Uniaxial compressive strength (TSF)[a] (2)	Allowable sidewall shear (TSF)[b] (3)
Very soft	10–30	0.5
Low	30–100	1.0
Medium	100–250	2.0
Hard	250–700	4.0
Very hard	700–2,000	8.0

[a]"A guide" (1976).
[b]Where rock is extremely jointed, use 50% of the proposed value.

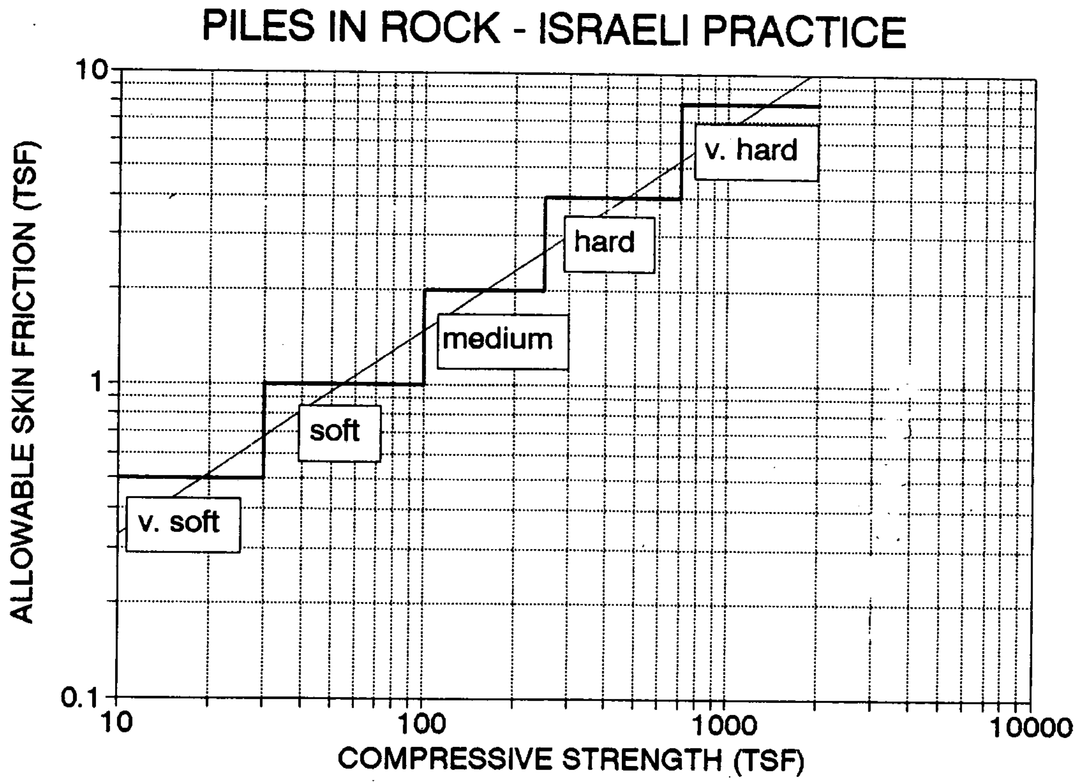

FIG. 5. Log-Log Scale

[a]October 1992, Vol. 118, No. 10, by M. C. McVay, F. C. Townsend, and R. C. Williams (Paper 26688).
[4]Pres., Amir Geotech. Engrg. Ltd., P.O. Box 3, Ramat Hasharon 47100, Israel.

1. To many engineers, a penetration resistance N of 10 (or even 30) blows would seem rather low for any kind of limestone. As it presumably is a common value in Florida limestones, some elaboration on the geology of this formation would be beneficial.

2. The suggested design method is based on tests carried out on intact cores. Since admittedly the Florida limestones possess discontinuities, the effect of those on the sidewall must be accounted for.

3. The load tests used to calibrate the suggested design method were compressive on certain sites and tensile on others, and the authors tacitly assume the equivalence of both testing modes. Since in fissured rock there is evidence to the contrary (Amir 1983), this assumption is not self-evident. Comparative testing, performed on the same site, could have shed some light on this issue.

Considering the question of allowable sidewall shear, the extensive experience gained in Israel in all rock types may be of interest to some readers. On many sites, where low-rise residential buildings are planned, economical reasons, as well as the variability of the rock, make exploratory drilling impractical. The allowable sidewall shear in the foundation piles is solely based on visual determination of the rock hardness (Table 3).

The relationship given in Table 3, although being no more than a rule of thumb, agrees reasonably well with the correlations quoted by the authors. This relationship is approximately linear on a log-log scale (Fig. 5), and represented by (10).

$$f_{sa} = 0.075 q_u^{0.65} \quad (10)$$

In discontinuous rock, a power of q_u less than 1 is appropriate, because the harder the rock the more important is the reduction of mass strength caused by discontinuities. The exponent of 0.65 falls within the values given by the first seven references quoted by the authors while the coefficient of 0.075 accounts for the safety factor and for normal rock defects.

APPENDIX. REFERENCES

Amir, J. M. (1983). "Interpretation of load tests on piles in rock." *Proc. 7th Asian Reg. Conf.* SMFE, Haifa

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