DMT-predicted vs observed settlements: a review of the available experience

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ABSTRACT: This paper presents a compilation of documented case histories including comparisons of DMT-predicted vs observed settlements, in order to review the available experience on the use of DMT for settlement calculations and to evaluate the accuracy of settlement predictions based on DMT. The available data indicate that, in general, the constrained modulus obtained by DMT (M_{DMT}) can be considered a reasonable "operative modulus" (relevant to foundations in "working conditions") for settlement predictions based on the traditional linear elasticity approach. Attention is also given to the determination of the strain range appropriate to M_{DMT}, in view of the possible use of M_{DMT} for settlement predictions based on non linear methods taking into account the decay of soil stiffness with strain level.

1 INTRODUCTION

Predicting settlements of shallow foundations is probably the No. 1 application of the DMT, especially in sands, where undisturbed sampling and estimating compressibility are particularly difficult.

This paper presents a compilation of documented case histories (available to the writers) including comparisons of DMT-calculated vs observed settlements, in order to evaluate the accuracy of settlement predictions based on DMT. The database includes several contributions, ranging from well-documented cases to semi-qualitative assessments of DMT-predicted vs observed behavior or simple comparisons between moduli/settlements obtained by DMT and by other methods. The data are critically reviewed and summarized.

The available experience, reviewed in this paper, indicates, in general, satisfactory agreement between DMT-predicted and observed settlements. In most cases the constrained modulus obtained by DMT (M_{DMT}) proved to be a reasonable "operative modulus" (relevant to foundations in "working conditions") for settlement predictions based on the traditional linear elasticity approach.

2 CONSTRAINED MODULUS *M* FROM DMT

The most significant stiffness parameter for settlement analyses obtained from DMT is the constrained modulus M (often designated as M_{DMT}), defined as the vertical drained confined (1-D) tangent modulus at ?'$_{vo}$ (same as $E_{oed} = 1/m_v$ obtained by oedometer).

M_{DMT} is obtained by applying to the dilatometer modulus $E_D = 34.7\,(p_1 - p_0)$ – "intermediate" modulus derived from the DMT readings p_0 and p_1 by simple theory of elasticity – the correction factor R_M, according to the expression $M_{DMT} = R_M\,E_D$. The equations defining R_M as a function of the material index I_D and the horizontal stress index K_D were established by Marchetti (1980). $R_M = f\,(I_D, K_D)$ is not a unique proportionality constant relating M_{DMT} to E_D. The value of R_M varies mostly in the range 1 to 3 and increases with K_D (major influence).

The reasons for applying the correction R_M to E_D are listed in TC16 (2001). In general the "uncorrected" modulus E_D should not be used as such in deformation analyses, but only in combination with I_D, K_D by use of M_{DMT}, primarily because E_D lacks information on stress history and lateral stresses, reflected to some extent by K_D. The necessity of stress history for a realistic assessment of settlements has been emphasized by many researchers (e.g. Leonards & Frost 1988, Massarsch 1994).

M_{DMT} is to be used in the same way as if it was obtained by oedometer and introduced in one of the available procedures for calculating settlements. If required, the Young's modulus E (not to be confused with the dilatometer modulus E_D) can be derived from M_{DMT} using the theory of elasticity, that, e.g. for a Poisson's ratio ? = 0.2, provides $E = 0.9\,M$,