III-276 ANALYTICAL AND EXPERIMENTAL RESULTS OF REINFORCED EARTH RETAINING WALLS

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INTRODUCTION

The main findings of this paper is to understand the basic behavior of the reinforced earth considering the yield strength of the overall structures, pullout forces of strips and the deformation behavior in the limit state.

REINFORCED EARTH MODEL

The model tests performed in this study were housed in a box of 30 cm x 50 cm x 41.5 cm high. The horizontal and vertical spacing of the strips are,respectively, 10 cm and 3.1 cm,while the height of the wall is 31 cm. The soil used as backfill was uniformly fine sand.The major components of the reinforced earth wall are shown in Fig.1.An average density of sand was found to be 1.5g/cc.The angle of internal friction of the sand was $39^0 15'$ and the angle of skin friction at the soil strip interface was $23^0 56'$. Two pressure cells were carefully installed near the center of the skin element to measure the horizontal earth pressure,while other two cells were placed flat on the surface to measure the vertical pressure.The speed of pullout tests were fixed to be 6 mm/min.

INTERPRETATION OF TEST RESULTS

Based on the results of the capacity test,the Coulomb force method(CFM) and Coulomb moment method have been used for the comparison with the experimental results. The safety factors from CFM and CMM can be expressed as follows:-

$$F_{cf} = \frac{4\ W \tan\phi u}{K_A\ \gamma' H^2\ S} \sum_{i=N}^{n} (i\gamma X + q) [L - (n - i) X \tan (45^0 - \phi / 2)] \quad \text{and}$$

$$F_{cm} = \frac{12\ W\ X \tan\phi u}{K_A\ \gamma'' H^3\ S} \sum_{i=N}^{n} (n - i) (i\gamma X + q) * [L - (n - i) X \tan (45^0 - \phi/2)]$$

Where, $\gamma' = \gamma + 2q/H$ and $\gamma'' = \gamma + 3q / H$. Again α and β can be written as :- $\alpha = \tan\phi u / \tan\phi ul$ and $\beta = \tan\phi u / \tan\phi uL$, Where,$\phi u = 3/5\phi$.Here, H = total height of the wall, L = Length of strip ; W = Width of strip ; ϕ = The angle of internal friction of sand; $\tan\phi u$ = The coefficient of friction between sand and strip; $\tan\phi uL$ and $\tan\phi ul$ are ,respectively,the coefficient of internal sliding friction due to the total length of strip and effective length of strip; γ = Unit weight of soil;q = Surcharge pressure and , S and X , respectively,the horizontal and vertical spacing of strips.

RESULTS AND DISCUSSIONS

The pullout force and the time relationship under different surcharge loads are shown in Fig.2. The pullout force and vertical earth pressure are linearly related.The measured vertical earth pressure is a function of the frictional ratios (α, β) as shown in Fig. 3.Fig.4. shows the coefficient of friction versus $1/\sigma_v$. Here, σ_v = The average of measured vertical earth pressure. The coefficient of frictional sliding resistance are given in Fig. 5. The vertical load increase ,the coefficients of frictional sliding resistance decrease and it seems to be constant when the coefficient of friction value will be approximately 0.444 as obtained by direct shear test. The frictional coefficient value mainly depends on the length and width of the strips,applied load and backfill materials.The safety factors from CFM and CMM can be written as :- $F_{cf} = 0.76\ W + 0.02$ ($p = 0.99$); $F_{cm} = 0.38\ W + 0.01$ ($p = 0.99$); $F_{cf} = 0.05\ L - 0.13$ ($p = 0.97$); $F_{cm} = 0.04\ L - 0.32$ ($p = 0.98$). Where, p = Coefficient of correlation. The yield strength(Y_s) can be expressed as:- $Y_s = 302.5\ W - 25.26$ ($p = 0.96$) and $Y_s = 84.25\ L - 875.83$. The lateral movement of the skin and horizontal earth pressure during applied loading are given in Fig. 6. The lateral deformation are increasing uniformly with the increment of applied load upto 215.628 Kg. Beyond this load, the deformation changed very rapidly with load and until the sudden failure occured. The deformation behavior of the skin substantially depends on the incremental of applied load, and the horizontal earth pressure differ considerably the Rankine linear distribution. The arching effect may be the reason for this difference. The failure surface in the backfill are given in Fig. 7. The potential slip surface may be a circle or logarighmic spiral.

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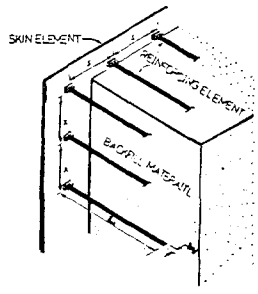

Fig.1. Major Components of Reinforced Earth Wall

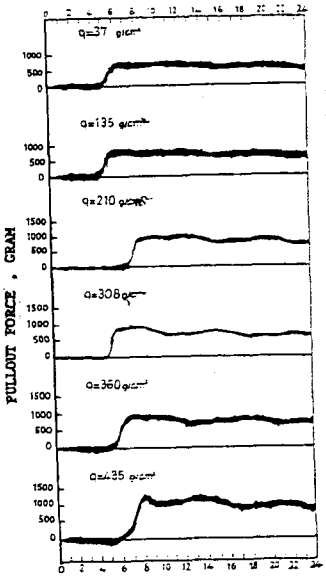

Fig.2. Pullout Force at Limit State

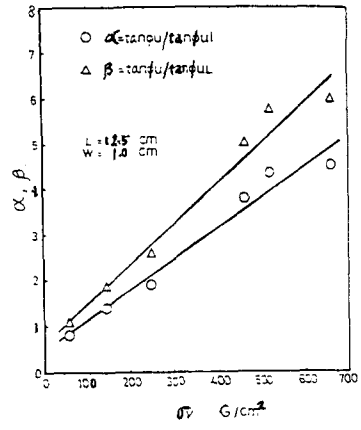

Fig.3. Frictional Coefficient Ratios Vs Vertical Stress

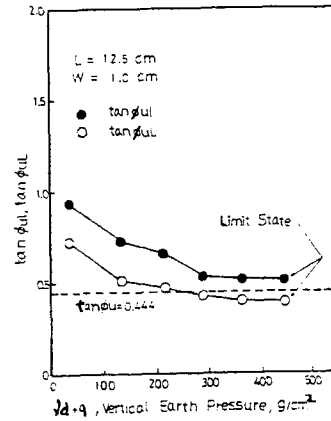

Fig.5. Coefficient of Frictional Sliding Resistance

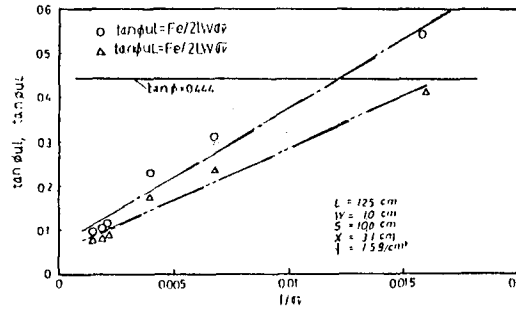

Fig.4. Reciprocal of Vertical Stress Vs Frictional Coefficient Curves

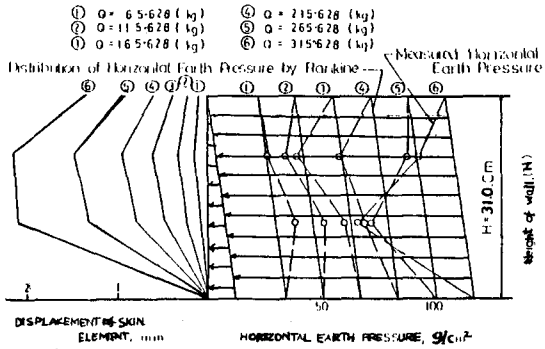

FIg.6.-Displacement of Skin Element and Horizontal Earth pressure

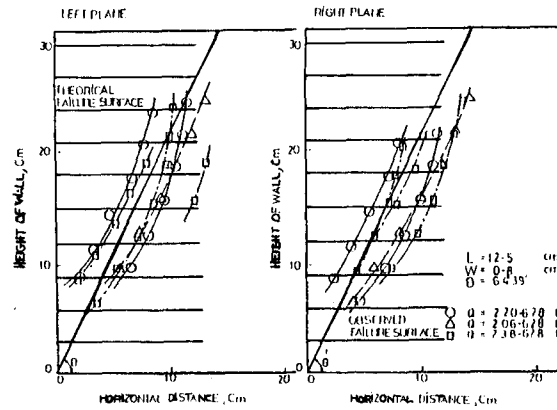

Fig.7.-Failure Surface in the backfill

CONCLUSIONS

The lateral earth pressure and the pull-out force depend on the frictional sliding resistance in the limit state. The measured lateral earth pressure can be approximated by the Rankine theory. The direct shear test is adequate for the coefficient of frictional sliding resistance between the sand and the strip. The orientation of average failure planes inclined at an angle of $45^0 + \phi/2$ approximately from the horizontal at the base and then tends to become slightly more vertical with increasing height. The deformation is large enough to generate a complete mobilization of the soil resistance to shearing along the considered potential slip surface. It seems reasonable to believe that the forces in the reinforcing strips are sensitive to the mobilised friction or adhesion in the limit state.

NOTATION:- CMM = Coulomb Moment Method.