III-B 340 Transmission Of Tensile Force Along The Reinforcement And Displacement Of Geosynthetic Reinforced Wall

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1 INTRODUCTION

Reinforced earth walls began to be used widely during the early 1970 's when, firstly steel strips and more recently geosynthetics have been included in the construction of reinforced earth walls. Since the tensile stiffness of geosynthetic is lower than steel, it elongates considerably under tensile forces causing problems of displacement to retaining walls. This paper presents the results of a study to evaluate the displacement of a geosynthetic reinforced earth wall and the transmission of tensile force along the reinforcement using a small model.

2 SAMPLES AND TEST PROCEDURE

The typical arrangement for the testing apparatus is shown in Fig : 1 and its dimensions are 300mm wide by 600mm long by 450mm high. A jack was placed at the front of the wall and the wall was hinged at its bottom. Dry Aio sand was used as the backfilling material (Gs=2.62, Dmax=2.0, ϕ =43.9° and Dr=50%). Rubber and high density polyethylene (HDPE) were used as the strip reinforcement. Fine Toyoura sand was glued to the reinforcement surface so that the reinforcement had a uniform surface roughness. The jack was pulled at a rate of 0.3mm/min until the wall became independent and the measurements of reaction force on the jack, front wall displacement, end displacement of reinforcement and strain along the reinforcement were taken.

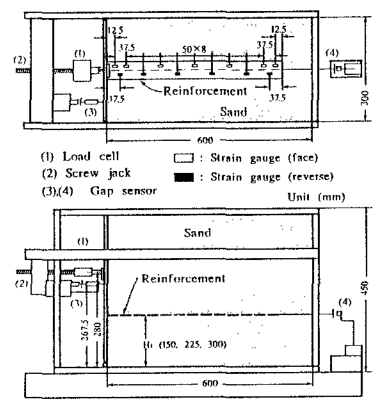

Fig 1 : Typical arrangement of the moving wall apparatus

3 DISCUSSION OF RESULTS

The failure plane which divides the active zone from the elastic equilibrium zone can be observed for a non-reinforced wall as shown in Fig 2. Using Rankine's formula, the angle of shearing resistance of the sand was found to be ϕ=42.6°. This value is in close agreement with that found using triaxial tests. Fig 3 shows the relationship of wall reaction force (Fw) to normalized wall displacement (X/H). The black circle markers indicate the results for a non-reinforced wall. For a very small wall displacement, X/H=0.001~0.002, the wall force changes from a force at rest to an active force. In the case of the reinforced wall, Fw decreases to zero as X/H increases and from this moment onwards, all the active force was taken by the front tensile force of the reinforcement (T_R) causing the wall to be independent of the jack. The value of $T_R=(P_A - Fw) \times H_D/Hi$ ------ (1), where P_A is the active force, Fw is the wall reaction force, H_D is the center of active force from the bottom and Hi is the height of the reinforcement from the bottom. As the tensile stiffness (E*) of the reinforcement increases, the wall displacement decreases for full transfer of active force to the reinforcement.

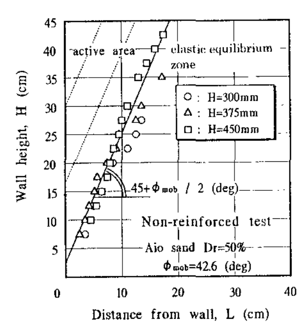

Fig 2 : Failure plane of non-reinforced wall

Fig 4 is the distribution of tensile force along the reinforcement (Ti) when wall becomes independent with varying overburden pressure. It can be seen that, as the overburden pressure increases, the higher is the tensile force being transmitted along the reinforcement. The friction at any point along the reinforcement can be found using equation $\tau = 1/2B \times \delta T/\delta L$ -------(2), where B is the width of the reinforcement and $\delta T/\delta L$ is the curve gradient. Since the value of 1/2B is constant as seen in equation 2, the friction is proportional to $\delta T/\delta L$. The friction is large at the front and gradually reduces as the distance from the wall (Ld) increases.

Fig 5 shows the distribution of Ti when the wall becomes independent for reinforcements of different tensile stiffness (E^*). At a distance from the wall, Ld=2.5~7.5, the friction is zero since the curves are almost horizontal ($\delta T/\delta L$=0). From Fig 2, it is seen that the zone between Ld=2.5~7.5 is located in the active zone and it can be concluded that the friction is zero in this region. In the case of HDPE (E^*=333 kgf/cm), the reinforcement acts as if it is a rigid material with friction almost uniformly mobilized and the value of $\delta T/\delta L$ constant along the reinforcement (Schlosser F. 1978). For R2 (E^*=15 kgf/cm) and R3 (E^*=23 kgf/cm) deformation of the reinforcement predominates with a large friction at the front and gradually reduces as Ld increases (Schlosser F. 1978).

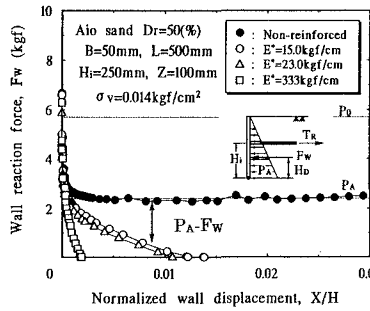

Fig 3 : Wall reaction force against normalized wall displacement

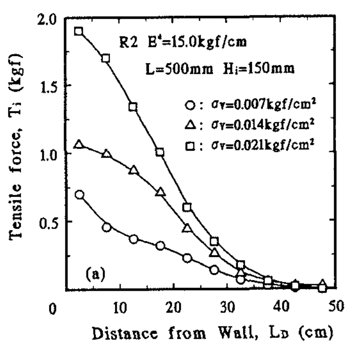

Fig 4 : Tensile force distribution along the reinforcement (influence of the overburden pressure)

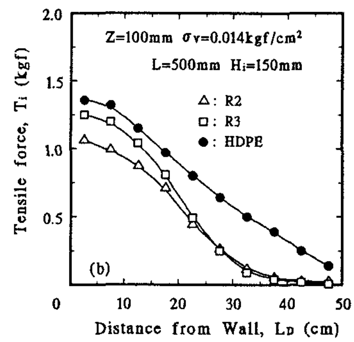

Fig 5 : Tensile force distribution along the reinforcement (influence of the tensile stiffness)

4 CONCLUSIONS

The higher the tensile stiffness of the reinforcement, the smaller is the wall displacement for full transfer of active force to the reinforcement. The transmission of the tensile force along the reinforcement is dependent on the tensile stiffness of the reinforcement. For reinforcement with higher value of tensile stiffness, friction is uniformly mobilized along the reinforcement while for material with lower tensile stiffness, deformation predominates with greatest friction at the front and gradually reduces as the distance from wall increases.

REFERENCES

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