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SYNOPSIS In this paper studies carried out on an instrumented 4.0 m high reinforced earth wall have been described. The shape of potential failure surface was found bi-linear. Stability analysis based on computation using classical Renkine's theory was found applicable.

INTRODUCTION

Economical improvement of mechanical properties of soil is one of the aims of a geotechnical engineer. Reinforced soil technique is a method by which overall stability of the soil can be improved. The most common use of reinforced soil is in the construction of reinforced earth wall. The design of a reinforced earth wall requires its analysis against external stability and internal stability. The external stability comprises of checking the safety of wall as a rigid block. In internal stability the competency of the reinforcements provided at different heights is examined against tension and pullout.

The analysis of a reinforced wall requires identification of rupture surface during pullout failure, as the effective length of the reinforcement contributing in developing frictional resistance is the portion of the reinforcement lying outside the wedge. Further, the earth pressure distribution behind the wall is required for the design.

In this investigation performance of a prototype wall of 4.0 m high having instrumented reinforcing strips have been studied with the above aims.

DEVELOPMENT OF EXPERIMENTAL PROGRAMME

Soil and Reinforcement

Dry Amanatgarh sand (SP, D_{10} = 0.185 mm, C_u = 1.30) at a density of 1.6 gm/cc (D_r = 60%) was used as soil fill. Three reinforcing materials namely (i) Bamboo strips (R_1), (ii) Aluminium strips (R_2) and (iii) Nylon Niwar (R_3) were used. Reinforcing strips of materials R_1 and R_2 were instrumented with strain gauges pasted on both sides of strips to meassure tension induced in the strips with location and magnitude of maximum tension.

Test Set-up and Procedure

Tank to monitor a 4.0 m high and 2.4 m long reinforced earth retaining wall as fabricated (Fig. 1 on next page). Rainfall technique was used for depositing the sand using a movable trolly with perforated bottom. Precast concrete panels were used as the facing of the wall (Figs. 2 and 3).

Fig. 2. **Skin Panels, Clamps and Laying of Reinforcing Strips**

Telescopic method usually adopted in field was used for the construction of the test wall. As mentioned earlier sand was deposited using rainfall technique. Temporary clamps (Fig. 2) made of angle iron pieces were used to keep the panels in alignment. Reinforcing strips were fastened by iron clamps (Jaws), as shown in Fig. 2, were attached to the studs of concrete panels with nuts and bolts. The details of the tests are given elsewhere (Khan, 1991).

Summary of tests, performed is given in Table 1.

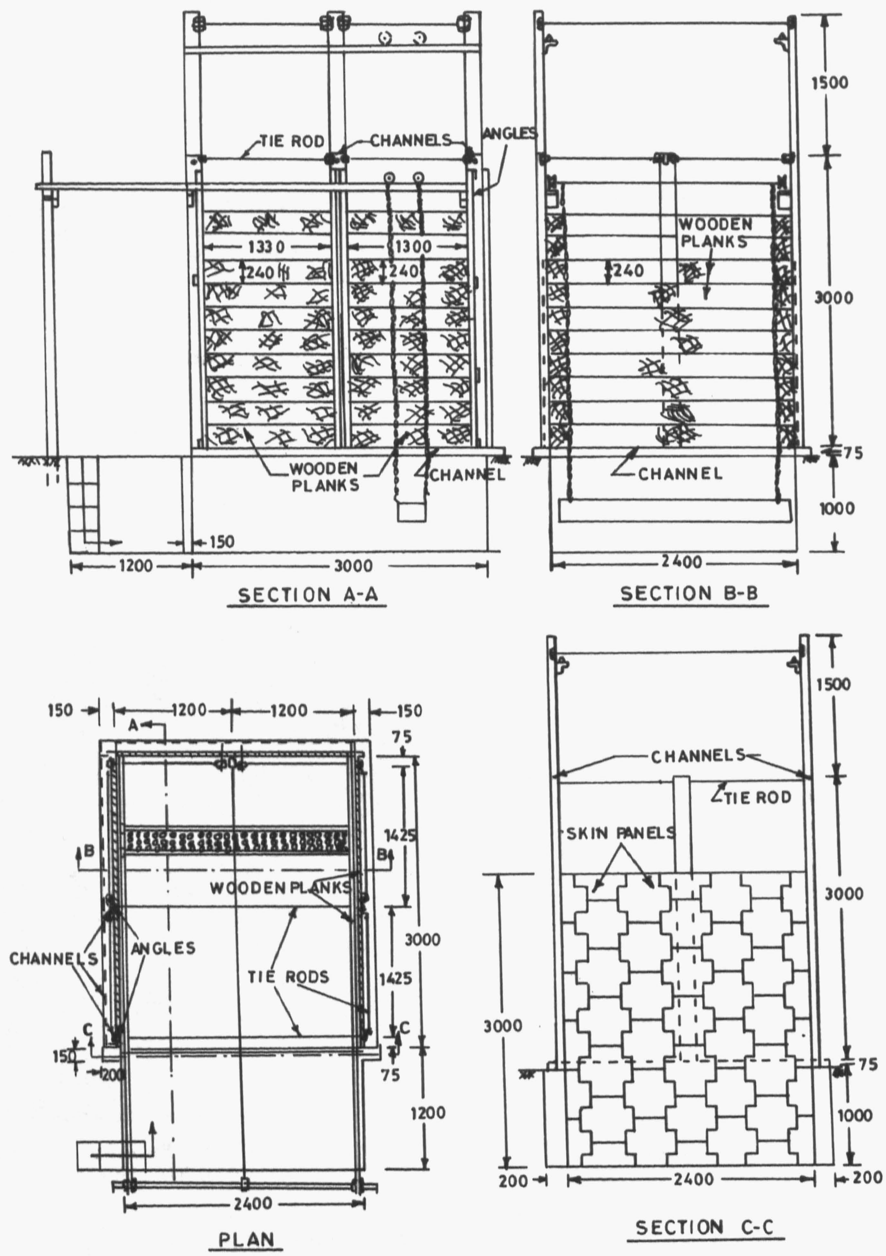

FIG. 1 -DETAILS OF TANK SET-UP

Fig. 3. Sand Filling Process

is evident from this plot that a bilinear failure plane shown by thick line is the most probable one.

The maximum tension value obtained from horizontal strip was divided by both vertical and horizontal spacings to give the pressure intensity at the location of that strip. Using this concept, pressure distributions along the height of the wall were obtained both in Tests No. P-1 and P-3 and are shown in Figs. 6a and 6b respectively. Rankine's earth pressure line has also been plotted on these figures. A comparison of the two indicated that Rankine's theory predicts earth pressure in reinforced earth wall reasonably.

In all the tests (P-1 to P-4), deflected position of wall facing was recorded and are shown in Figs. 6a and 6b, for Tests P-1 and P-3. Similar observations were noted for other tests (P-2 and P-4). The observations indicated that panels behave as fexible elements.

TABLE I. Summary of Tests Performed

Test No.	Reinforcement	Length of Reinforcement (cm)	Horizontal Spacing (cm)	Vertical Spacing (cm)	Height of Wall Achieved (cm)	Remarks
P-1	R-1*	200	20	25	400	No failure, no excessive deflection
P-2	R-1*	100	20	25	300	- do -
P-3	R-2*	100	20	25	400	- do -
P-4	R-3	100	20	25	275	Execussive deflection due to faulty connections.
P-5	-	-	-	-	60	Without reinforcement.

* Instrumented with strain gauges.

RESULTS AND INTERPRETATION

As mentioned above, the reinforcing strips in tests No. P-1, P-2 and P-3 were instrumented with strain gauges to measure the tension along the length of strips. The strain gauges in Test No. 2 did not work satisfactorily. Therefore, the test data on tension values obtained in tests No. P-1 and P-3 have been analysed.

Figures 4a and 4b shows typical tension curves for two bamboo strips obtained in Test No. P-1 and P_3. Similar plots were prepared for other strips of these tests.

Firstly, the location of the points where maximum tension occurs in the various strips were noted. As the failure of the wall may take place by rupturing of the strips, the locus of maximum tension will indicate the probable rupture surface. A similar study was also done on 1.0 m high model retaining wall. Figure 5 shows the points of maximum tension obtained both from 1.0 m high model and 4.0 m high retaining walls. It

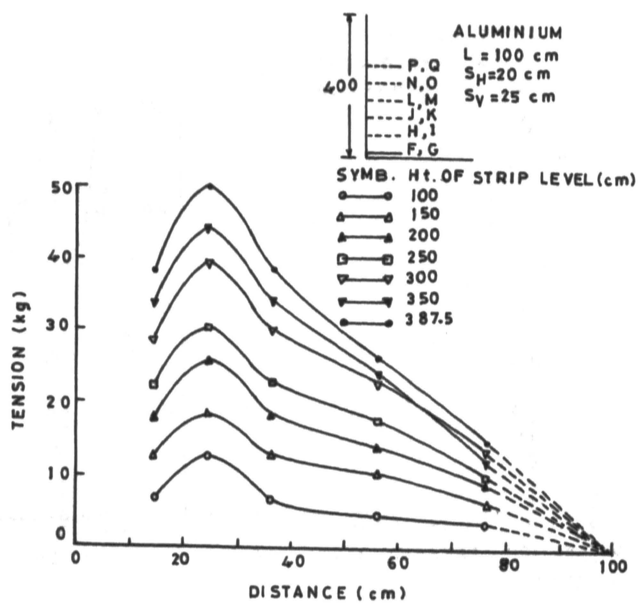

FIG.4a – TENSILE FORCE DISTRIBUTION ON STRIP F

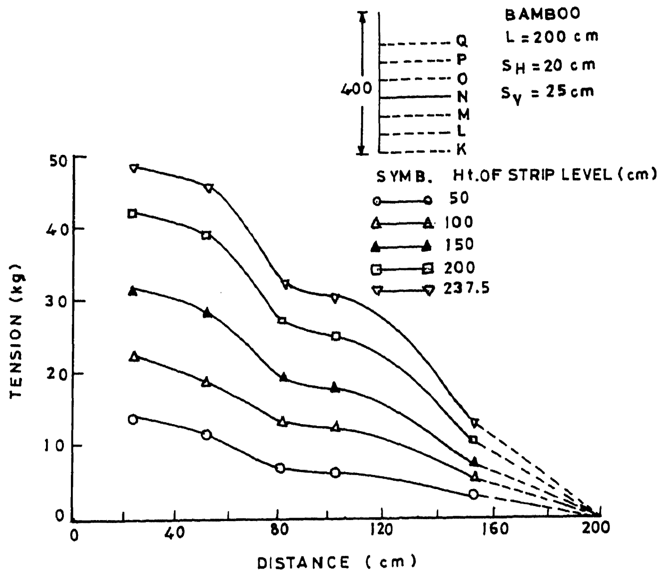

FIG.4b – TENSILE FORCE DISTRIBUTION ON STRIP N

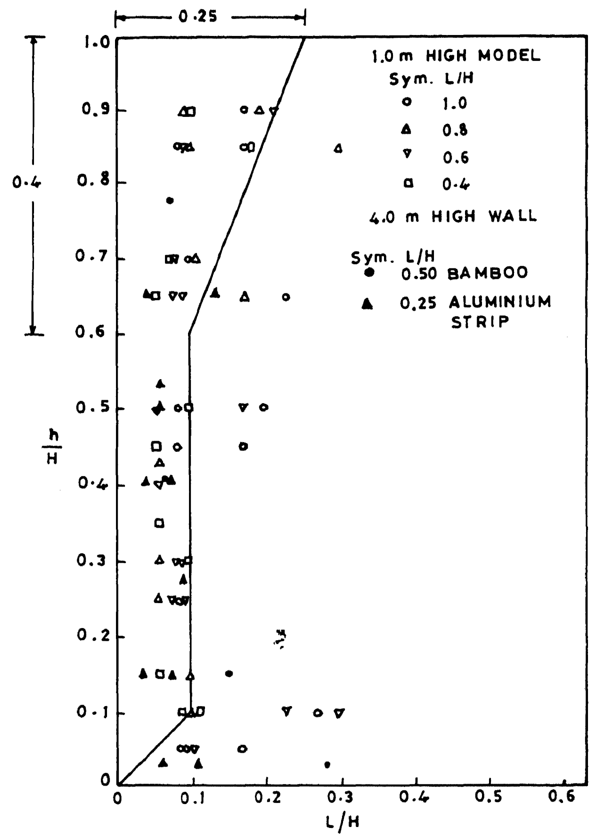

FIG.5 – LOCATION OF MAXIMUM TENSION IN STRI[

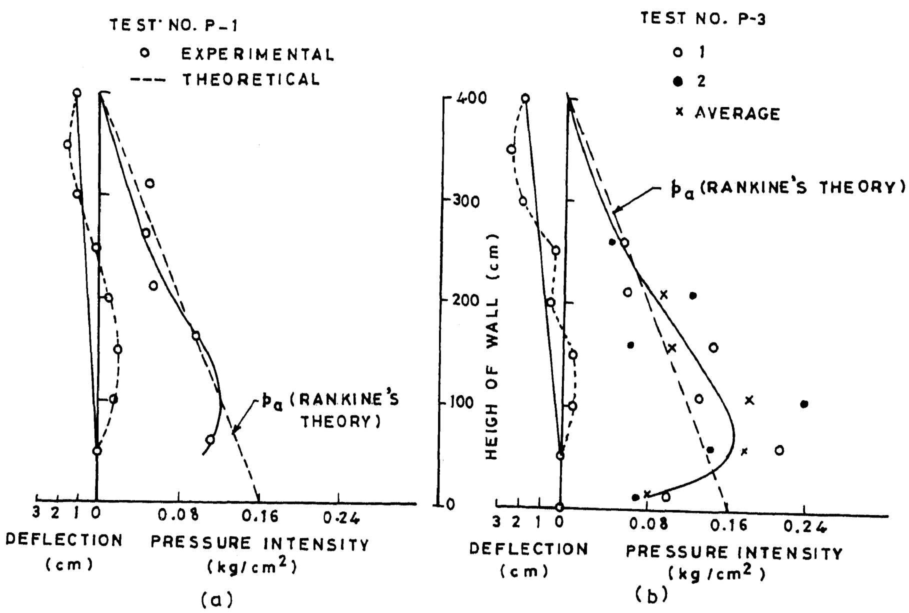

FIG.6 — PRESSURE DISTRIBUTION AND DEFLECTED POSITION OF 4.0m HIGH WALL

Test No.5 was performed without any reinforcement in the fill. It was noted that the panels could resist the earth pressure only of 60 cm high fill. It clearly demonstrates the effectiveness of using the reinforcement for the construction of high retaining walls.

CONCLUSIONS

1. The wall of precast concrete panels could be erected only upto 60 cm height if reinforcement is not placed in the backfill.
2. The height of reinforced earth wall depends on the amount of the reinforcement.
3. The shape of potential failure surface, obtained by joining locus of points of maximum tension in strips, is bilinear.
4. The deformation of the wall indicated that the skin panels behave as flexible members.
5. Earth pressure distribution suggested by Rankine (1857) holds good.

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REFERENCE

Khan, I.N. (1991), "A Study of Reinforced Earth Wall and Retaining Wall with Reinforced Backfill", Ph.D. Thesis, Civil Engineering Department, University of Roorkee, Roorkee (India).