III-388 EFFECTS OF STEEL BAR ON CUT SLOPE

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1. PREFACE: In south of KYUSHU there are some Tertiary deposits, alternating sandstone and mudstone, reinforced by nailing of steel bars. For this kind slope, bending stress of the steel bar may be play a important role in the stability of the slope. In this report, field loading and laboratory test were both down. Some results are described as follows.

2. METHOD OF EXPERIMENT:

2.1 In-situ test: A projecting part in the slope of a mountain was picked as the experimental sample with an area of about 2.4 m² (2.2 m length, 1.1 m width). Fig. 1 shows the outline of the in-situ test. The sandstone and mudstone interface was assumed as a sliding surface. Three steel bars, spacing at about 0.55 m, were vertically embedded in the surface of slope but the steel bars were not vertical to the assumed sliding surface. The length and diameter of steel bar are 1.0 m and 20 mm respectively. Loads were produced by three synchronous jacks with direction parallel to the assumed sliding surface and every position of the jack was fixed so as to aim at each steel bar, respectively.

2.2 Laboratory test: In Fig.2, One concrete block was put on the other (dimensions: 1.8× 0.9× 0.15m), with mudstone powder being completely spread (thickness: 2 cm)between the two concrete blocks. Two steel bars with 12 mm diameter were inserted in the holes (diameter: 60 mm). The rest of the space of each hole fully filled with soil cement. Correspondingly, four steel plates 120 mm × 120 mm were used as covers for the holes; two for each hole. Lastly, it was necessary to apply nuts for fixing each end of steel bar on the steel plates. The upper concrete block was loaded and the lower concrete block was perfectly fixed.

3. RESULTS OF EXPERIMENT AND DISCUSSION: Figs. 3, 4 show the distributions of bending strain and axial strain of three steel bars when the load is 3.0 tf. The larger bending strain occurs at 40 cm and 60 cm marks of steel bar. And the larger axial strain occurs in the 40 cm -- 80 cm range. Thus, the distribution form of bending is almost similar to the test results (see Figs. 5, 6) in laboratory.

Figs. 5 and 6 show the distribution of bending strain of steel bar in laboratory test when the tightening force of steel were 20 kgf and 700 kgf , respectively. Five or six sets data correspond to five or six kinds of loads (100, 200, 300, 400, 500, or 600 kgf) in each Fig.. When the load is 500kgf, the absolute maximum bending strain exceeds 2000 μ in Fig.5 or nearly equal to 1500 μ in Fig.6 occurring near the center of upper part and the center of lower part in the steel bar. In these figures the distributions of bending strain seem to be anti-symmetric around the crossover point between the sliding surface and steel bar, although the values of bending strain corresponding to every steel bar have small difference for each load.The maximum values of axial strain in steel bars are only about 200 μ and 300 μ for two cases. Comparing the value of axial strain and that of bending strain, the axial strain is so small that it can be neglected.

4. CONCLUSION: Depending on the results of in-situ test and laboratory test, the following conclusions can be summarized as follows: 1) Once the steel bar is rightly vertical to the sliding surface, the bending stress in steel bar will play a main role. But the angle between steel bar and sliding surface is smaller less than 90 degrees, there are bending stress and axial stress. 2) The distribution of bending strain in steel bar is anti-symmetric about a crossing point with sliding surface. Absolute maximum values of bending strains occur on marks below and near the sliding surface, respectively for in-situ test and laboratory test. If there is axial strain in steel bar, the section with the maximum value of axial strain is below and near the sliding surface too. 3) When tightening force of steel bar becomes very large (here is 35 times), the load-bearing capacity of steel bar will increase.

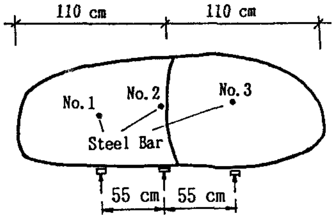


Fig. 1 PLAN-VIEW OF IN-SITU TEST

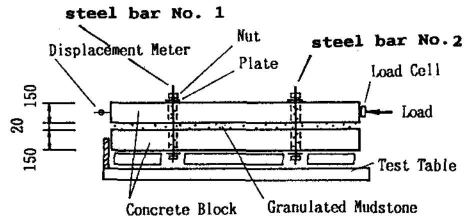


Fig. 2 OUTLINE OF LABORATORY TEST (mm)

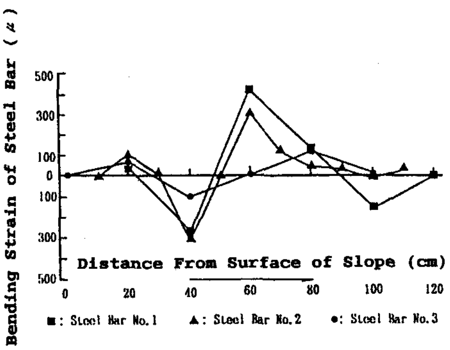


Fig. 3 DISTRIBUTION OF BENDING STRAIN OF STEEL BAR (For 3.0 tf)

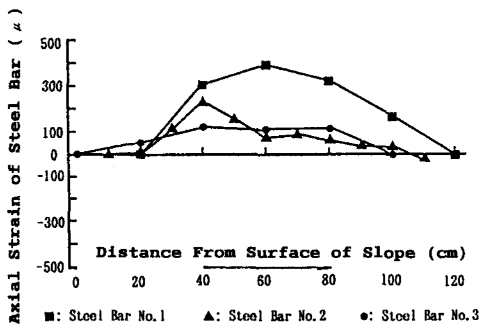
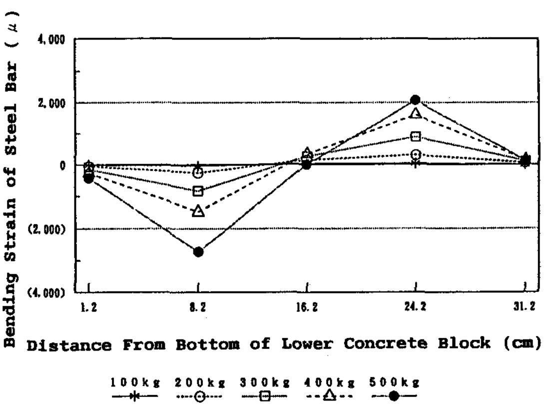
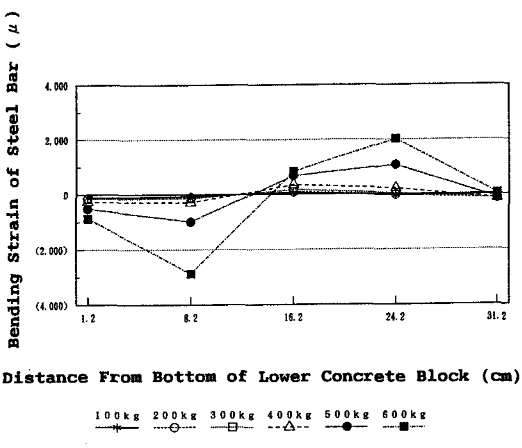


Fig. 4 DISTRIBUTION OF AXIAL STRAIN OF STEEL BAR (For 3.0 tf)



steel bar No. 1

Fig. 5 DISTRIBUTION OF BENDING STRAIN OF STEEL BAR (Tightening Force of Steel Bar P=20 kgf)



steel bar No. 1

Fig. 6 DISTRIBUTION OF BENDING STRAIN OF STEEL BAR (Tightening Force of Steel Bar P=700 kgf)

REFERENCES: (1) Hayashi,S., Ochiai,H., Tayama,S., and Sakai,A. 1986. Effect if top plates on mechanism of soil-reinforcement of cut off slope with steel bars, JSCE, No.367,VI. (2) Yokota,H., Zhou,J.M. 1992. Nailing reinforcement and bending stress of steel bar, JSCE, III.