STRESS DISTRIBUTIONS OF REINFORCEMENT STEEL BARS ON CUT SLOPE

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1.PREFACE: In recent years, steel bar as a reinforcement material to stabilize slopes have been successfully used. If the slope is composed of Tertiary deposit; alternating sandstone and mudstone, the bending stress of steel bar is not unimportant, adversely, becoming large. It is clear that not only is there bending strain but also its value is far greater than that of axial strain in the steel bar when the steel bar is inserted vertically to the sliding surface as reported by the authors before.In this paper, results obtained from the mole test in the laboratory have been presented.

2. LABORATORY TEST METHOD: Four sets of concrete blocks with same dimensions (1.8×0.9×0.15m) were made. The difference between them is the angle of holes (90,80,70 and 60 degrees). A set of them is shown in fig.1 in which the upper and lower concrete block are applied to imitate two sandstone layers. Mudstone powder (smaller than 2mm in grain size) was completely spread (thickness: 2cm) between the two concrete blocks to represent the mudstone layer. Steel bars (diameter: 13mm) were put in the holes (diameter: 73mm) and the rest of the space was fully filled with soil cement. Plates and nuts are applied for fixing each steel bar. The lower concrete block was fixed and the upper concrete block will be pushed by jacks.

3. RESULTS OF TEST: For every inclined angle three tests have been done, i.e, a total of twelve tests. Figs.2 and 3 show the distributions (steelbar No.1) of bending strain and axial strain for the first test when the inclined angle of steel bar is 70 degrees. The bending strain seem to be anti-symmetric around the crossover point between the sliding surface and steel bar. When the loading is 500 kg the absolute maximum bending strain (in micro-units) 1952 occurring near the center of upper part in the steel bar and axial strain is only 59.5. In figs. 4 and 5, before the loading is less than 100 kg bending strain and axial strain are all around zero. When the loading is between 200kg and 400kg, the approximate distributions of all curves are linear. In fig.6 when inclined angle of steel bar is 90, 80, 70 and 60 degrees the maximum percentage of bending strain and maximum axial strain are 103.9%, 98.6%, 97.3% 95.2% and 1.5%, 9.1% 8.6%, 9.0% in the twelve tests, respectively. In fig.7 under the same strain the allowable force per one steel bar will be increasing with variation of angle from 80 to 60 degrees. It is abnormal that the value of allowable force at angle 80 degree is small as compared with that at angle 90 degree. It is caused by the test error.

4. CONCLUSION AND DISCUSSION: Based on a series of tests' results with respect to the effects of steel bar on cut-slope, the following observations have been made:1) The distribution of bending strain in steel bar is anti-symmetric about a crossing point with sliding surface and that of axial strain is fairly constant along the steel bar. 2) The absolute maximum value of bending strains occurs at the center of upper part of steel bar. 3) The bending stress of steel bar will play a main role in resisting the sliding force in cut-slope during the inclined angle between 90 - 60 degrees.
4) The bending strain will decrease with variation of the inclined angle from 90 - 60 degrees under same loading. This means the allowable force for steel bar will increase under the same strain as the angle is changed within the above range.
As fig. 7 depicts, the value at the inclined angle of 60 degrees is not as expected. Therefore this figure only expresses one way to establish the relation between allowable force and inclined angle for a particular strain. More experiments will be done in the future.

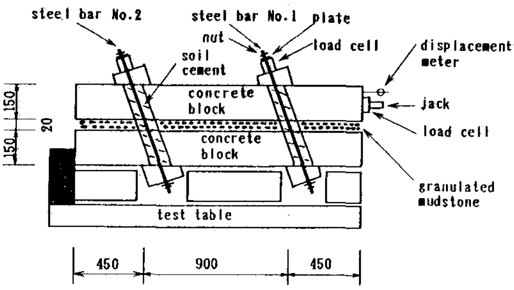

Fig.1 Outline of test

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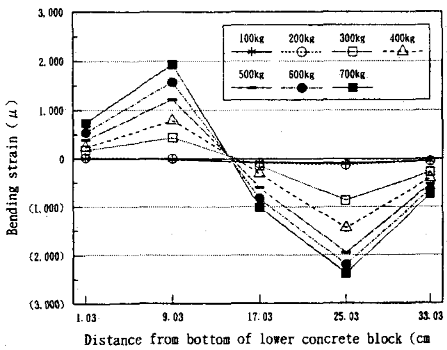

Fig. 2 Distribution of bending strain
Steel bar is inclined at 70° to holizontal
(steel bar No. 1 of 1st test)

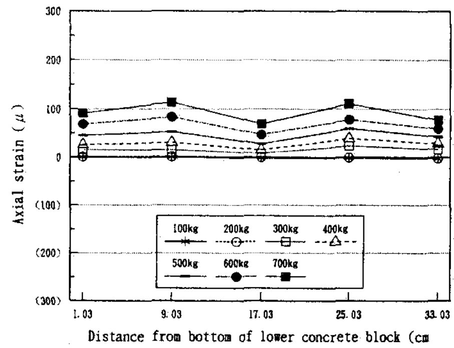

Fig. 3 Distribution of axial strain
Steel bar is inclined at 70° to holizontal
(steel bar No. 1 of 1st test)

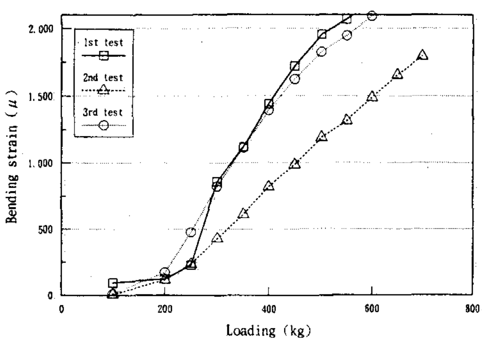

Fig. 4 Relation between bending strain and loading (steel bar No. 1)
Steel bar is inclined at 70° to horizontal

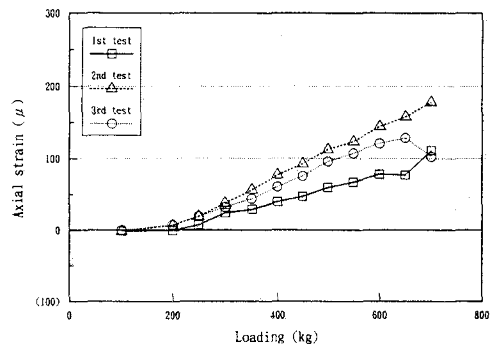

Fig. 5 Relation between axial strain and loading
Steel bar is inclined at 70° to horizontal
steel bar No. 1

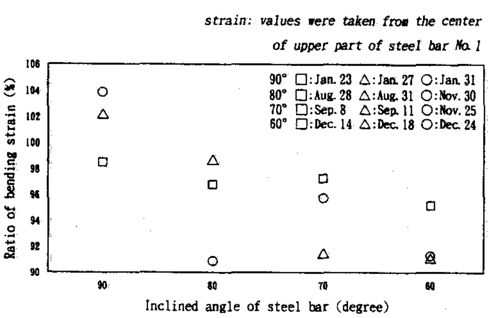

Fig. 6 Relation between ratio of bending strain to total strain and inclined angle of steel bar (loading=400 kg)

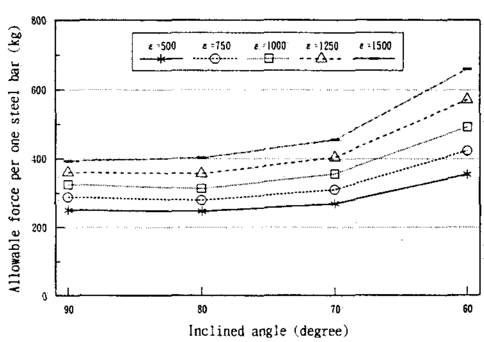

Fig. 7 Relation between allowable force per one steel bar and inclined angle
(steel bar No. 1)

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