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THE TEST RESULTS OF STRAIN DISTRIBUTION ON THE CONCRETE SLAB UNDER THE ELASTIC BOUNDARY CONDITIONS

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1. INTRODUCTION

Especially after the disasters of the Hansin Earthquake, use of elastic supports to absorb the vibrating energy of earthquake loading has been speeded up. In the process, effect of the vertical elasticity on the slab due to the live load has not been given much thought. In contrary, due to the larger differential settlement of two adjacent girders, when elastic boundary is used, an additional moment in the transverse direction is presumed. A steel- concrete composite simple span bridge specimen is set up to investigate the effect on the slab behaviour due to the changes from rigid to elastic supports and the results are reported in this paper.

2. THE TEST SPECIMEN

The testing is conducted with a composite simple span specimen composed of pre cast concrete slabs on two steel girders as shown in Fig. 1. The specimen size is about 1/6 of an actual simple span bridge. Strain gages are fixed on the bottom surface of the section a- a in the longitudinal direction. Strain in the transverse direction is measured along the sections b- b and c- c (bottom surface only) and displacements at the mid- span of the girders are also measured. Loading is conducted at two different locations, panel 5 and 7 for every selected bearing conditions. Testing is done under the 3 different support conditions and those support conditions are given in Table 1. The stiffness for the bearing material is selected to be about 1/6 (same as the specimen size) of the actual bearing material used in practice[1].

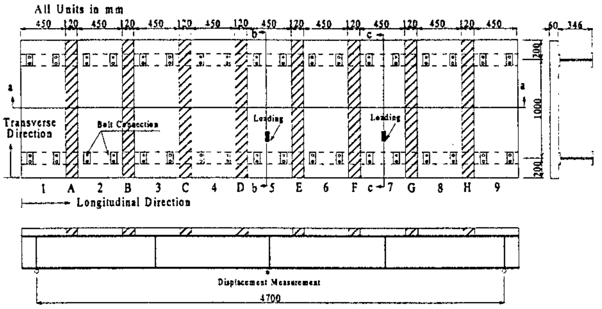

Fig. 1 The Test Specimen

Table 1 Property of Elastic Bearing Materials

BOUNDARY TYPES	VERTICAL SPRING CONSTANT (Kgf/cm)
RIGID CONDITION	Infinity (∞)
ELASTIC CONDITION #1	56,700
ELASTIC CONDITION #2	40,000

3. THE TEST RESULTS

3.1 Strain Distribution along the Longitudinal Direction

A linear analysis of the test specimen under the rigid boundary condition is performed for the design load of 1 ton (loaded on plate 5) and the result for the strain distribution in the section a- a is shown in Fig. 2. The agreement between the test and analysis results validates the legitimacy of the test. Fig. 3 indicate the strain distributions along the section a- a with respect to the changing boundary conditions. Fig. 3(a) represents the loading location on the panel 5 and (b) is the counterpart when the panel 7 is loaded. Fig. 3 shows only small variations of strain along the longitudinal direction when the boundary conditions are changed. If simple spans are converted to a continuous structures, these strain values are expected to drop(in their

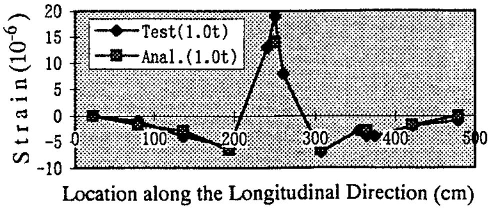

Fig. 2 Comparison of Test and Analysis Results

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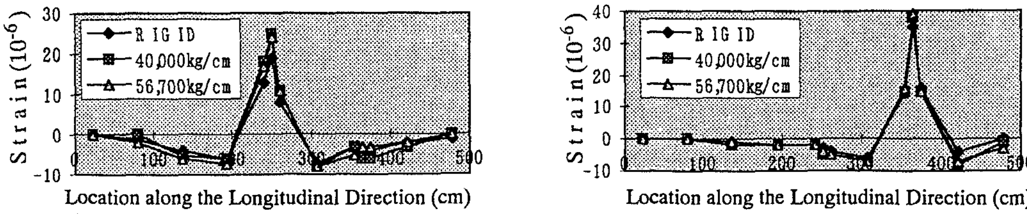
absolute values) at the middle of the span and rise at the end of the span. The observation of the longitudinal strain distribution points out that the usage of elastic boundary may be practised as it has been without causing any additional stress in the longitudinal direction.



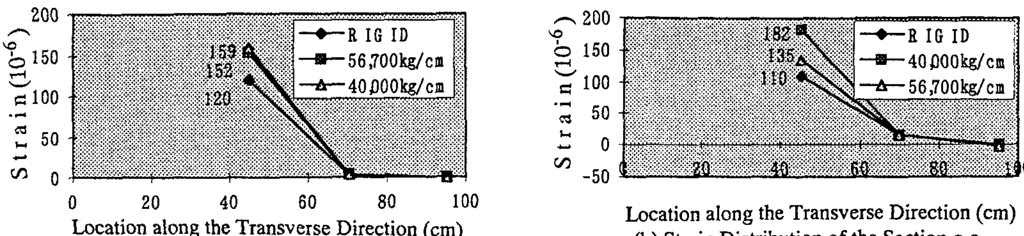
(a) Strain Distribution (Loading on Panel 5)

(b) Strain Distribution (Loading on Panel 7)

Fig. 3 Longitudinal Strain Distribution along the Section a-a with Respect to Boundary Conditions

3.2 Strain Distribution along the Transverse Direction.

Strain distributions in the section b-b and c-c with respect to the change of boundary condition are shown in Fig. 4. The loading positions are panel 5 and 7 for Figs. 4(a) and (b), respectively. Slab moment



(a) Strain Distribution of the Section b-b

(b) Strain Distribution of the Section c-c

Fig. 4 Transverse Strain Distribution with Respect to Boundary Condition

equivalent to 120×10^{-6} of strain is 325 Kgf·m/m. As rigid bearing is changed to elastic bearing (spring constant=56,700Kgf/cm), strain at the panel 5 (refer to Fig. 4a) indicates 152×10^{-6}. This represent 415 Kgf·m/m of moment in the transverse direction. About 27 % increase of strain is observed. This increase of moment is due to a larger differential displacement between two main girders when elastic bearing is in place. The measured and analysed differential settlements of two main girders at the mid-span when the load is on the panel 5 is given in Table 2. Both Fig. 4(a) and Table 2 indicate a rapid increase of their respective values as the boundary conditions are changed form rigid to elastic with the spring constant of 56,700 Kgf/cm. Afterward, a steady increase can be seen with the decrease of the spring constant.

Table 2 Differential Settlement of Two Girders at the Mid-Span When Loaded on the Panel 5

B.C. / Source	Rigid	56,700Kgf/cm	40,000Kgf/cm
Test	0.026 cm	0.037 cm	0.039 cm
Analysis	0.025 cm	0.031 cm	0.033 cm

4. CONCLUSION

Simple span bridges are tested to study the behaviour of slab in the transverse direction by changing the boundary conditions. The test result indicates a much increase of strain in the transverse direction when rigid boundary conditions are changed to the elastic ones. This increase of strain can be attributed to the large differential settlement between two main girders when the elastic supports are in place. The usage of elastic supports to prevent damages from earthquake exposes the slab to a higher stress. This may cause a faster fatigue deterioration due to everyday traffic load[2].

REFERENCES

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