EXPERIMENTAL AND ANALYTICAL STUDY ON LOAD-CARRYING BEHAVIOR OF BAILEY BRIDGE

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1. INTRODUCTION

Bailey bridge is originally designed for temporary use in the case such as military operations and recovering a damaged bridge due to a disaster. Since bailey bridge requires no heavy equipment to transport and build, furthermore its modular structure enables a flexible structural form to fit itself to various uses. Bailey bridge, hence, has been utilized for long-term service in many developing countries because of insufficient financial resources for construction and maintenance of bridges as well as machinery resources. However, a bailey bridge is designed and manufactured with no expectation for a long-term service as a permanent bridge. In addition, most of the organizations which own a Bailey bridge are lacking in comprehension and experience for proper maintenance of the type of bridge. Therefore many bailey bridges have some structural problems due to aging deteriorations or accidental damages through a period of their long-term service. In this study, loading test with actual bailey bridges and structural analysis were conducted to investigate load-carrying behavior of several type of Bailey bridges.

2. FIELD MEASUREMENT IN LAOS

2.1 Overviewing bridges and measurement

Bailey bridge consists of several kinds of unit assembled with basic components and is adaptable to various requirements such as dimensions; length and the number of spans, the volume of load suffering and so by changing structural composition. In this study, the target bridges are three bailey bridges in Laos, Bridge A, B, and C; Bridge A has a single span with double main truss panel shown in **Fig. 1**, Bridge B has a single span with triple main truss panel, and Bridge C has continuous 2-spans with double main truss panel.

In order to investigate the load-carrying behavior of the target bridges, loading tests were conducted with a load truck and tools for measuring displacement and acceleration. The observation points for displacement were set mainly at the middle and a quarter of a span to identify static behavior. In addition, vibration under traffic loads was also measured to obtain the dynamic behavior and characteristics of the target bridge at the same time.

2.2. Measurement

At the static loading test, displacements under a truck were measured at the object points. The truck was loaded 15 tons of gross weight located at the middle span of the bridge.

Fig. 1 Target bridge A: single span with double panel

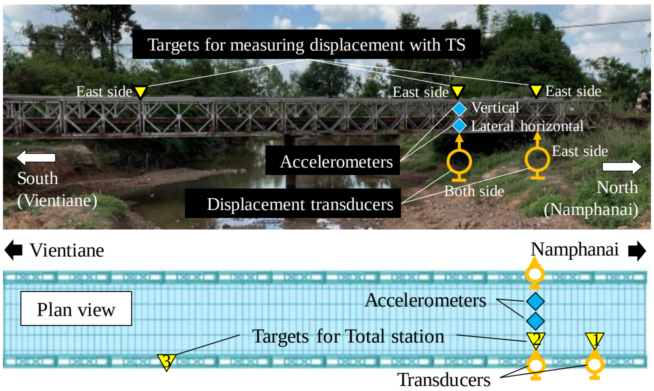

Fig. 2 Measurement plan for Bridge C: continuous two-spans with double panel

Table 1 Measurement plan for Bridge C

Object	Location in a span	Number	Equipment
Displacement	the middle	2; 1 at each side	Transducer
	a quarter	1	
	the middle	2; 1 at each span	Total station (TS)
	a quarter	1	
Acceleration	the middle	2; vertical and horizontal directions	Accelerometer

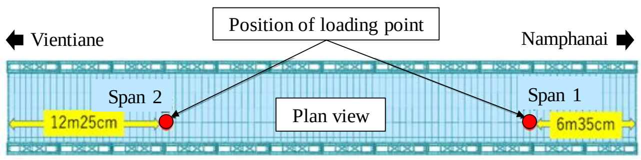

Fig. 3 Loading points (of rear axle) for Bridge C

Measurement plan and loading points for Bridge C are shown in **Fig. 2**, **Table 1** and **Fig. 3**, respectively. Displacements at each point were measured with displacement transducers and a total station. On the other hand, a series of accelerations, in horizontal and lateral-horizontal directions, was measured under the ordinary traffic using ser-

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vo-type accelerometers.

2.3. Result of measurement

Vertical displacement at each point on Bridge C under static loading are shown in **Table 2** and **Table 3**, which were measured with transducers and total station, respectively. In the tables, positive values indicate deflection and negative values indicate that the corresponding points were lifted due to loading. Displacement at a quarter of span could not be measured by transducers possibly due to a mechanical defect in the cable. **Fig. 4** shows the acceleration response in vertical and lateral-horizontal direction under the ordinary traffic at that time. The dynamic response shows significant behavior in a lateral direction beyond expectations. One of the major reason for the behavior is considered to be poor or detached connections between members.

3. STRUCTURAL ANALYSIS

The axial loading of the modified finite element model and the nodal load is shown in **Fig. 5** and **Table 4** shows a measured and analysis values comparison. The analysis results smaller than the measured. Although it can be assumed that the model is more rigid, and it can be represented the initial state. In order to confirm that the model shows the initial state, created a model representing a cross-sectional defect state. The defect was expressed by simply halve the cross section. When the cross-section of bridge member is halved, all displacements become large values, it is considered that the analysis value approaches the actual measurement value when the cross-section of the member is reduced. Therefore, it is possible to assume that the built model shows the initial state of the bridge.

4. CONCLUSIONS

Bailey bridge is originally designed for temporary use. Yet, it has been utilized for long-term service in many developing countries with improper maintaining. In order to establish an effective and reasonable maintenance of the bridge the actual behavior condition, deterioration and the damage should be studied. This study was employed computer-based Finite Element Analysis in conjunction with load testing data. The bridge model was created with reference to the measured value obtained by the in-situ measurement, and the validity was examined.

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REFERENCE

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Table 2 Vertical displacement under static loading measured with transducers (Bridge C)

Location of loading	Vertical displacement [mm]	
	1/4 of span (East side)	The middle of span on West side
Span 1	2.0	37.5
Span 2	-0.5	-7.8

Table 3 Vertical displacement under static loading measured with total station (Bridge C)

Location of loading	Vertical displacement [mm]		
	Point1 (1/4 of span)	Point 2 (1/2 of span)	Point 3
Span 1	10	9	-4
Span 2	-3	-3	9

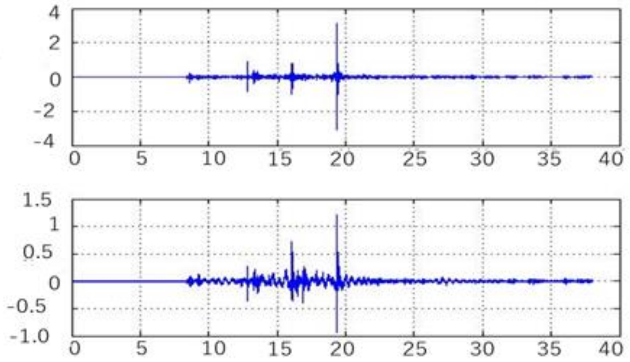

Fig. 4 Vertical(upper) and Horizontal(lower) acceleration response

Table 4 Comparison of intact state and cross-sectional defect state

Point	Actual value	Analysis value		Compare 3/2
	1	2	3	
	Ave. value	Initial condition state	Cross section defect state	
1	11	4.75	5.22	109.9%
2	10	5.54	5.86	105.8%
3	-3	-1.12	-1.18	105.4%

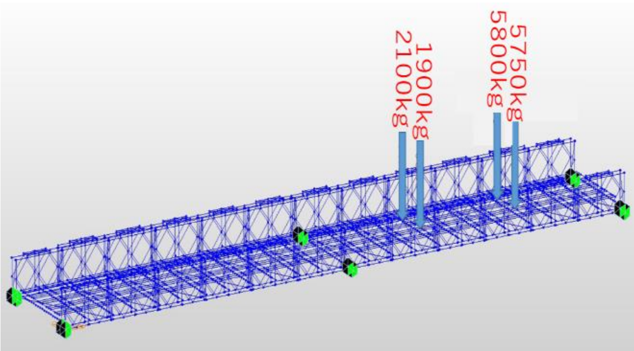

Fig. 5 Finite element analysis model and loading condition at analysis