Seismic Resistance Assessment of Multi-Span Continuous Bridge in Vietnam by Dynamic Response Analysis

Tran Viet Hung
PhD candidate
Civil & Environmental Eng., Waseda University
Tokyo, Japan
tranviethung@moegi.waseda.jp

Tran Viet Hung, born 1980, received his civil engineering degree from the Univ. of Vietnam.

Osamu Kiyomiya
Professor
Civil & Environmental Eng., Waseda University
Tokyo, Japan
k9036@waseda.jp

Osamu Kiyomiya, born 1948, received his civil engineering degree from the Univ. of Japan.

Tongxiang An
Doctor
Institute for Sci. and Eng, Waseda University
Tokyo, Japan
antongxiang@ybb.ne.jp

Tongxiang An, born 1965, received his civil engineering degree from the Univ. of China.

Summary

The response of the bridge subjected to seismic excitation can be evaluated by dynamic response analysis method. Vietnam is located at moderate seismic area; however, the seismic design has been introduced to secure the essential and important bridges. In this study, a typical concrete girder bridge in Vietnam (multiple frames in the longitudinal direction) is used to seismic resistance evaluations. These evaluations are performed by performing nonlinear dynamic response analysis on FEA method. It is found that the stopper and the rubber gasket influence on response of the bridge during Level 1 and Level 2 earthquakes.

Keywords: seismic resistance; non-linear dynamic response analysis; continuous bridge.

1. Introduction

The current Vietnam Specification for bridge design including seismic design for bridge was established based on AASHTO LRFD 1998 and official applied in 2005. As for the essential bridges, the seismic design can be conducted by single-mode elastic method or uniform load elastic method according to Vietnam Specification [1]. The seismic design based on Japan Specification must be carried out by static analysis for level 1 and level 2 earthquakes, and dynamic analysis for level 2 earthquake is also essential for not simple bridges, as to the seismic load used in the design is modified by the zone factor [3]. In this paper, the aseismicity of the continuous bridges in Vietnam will be discussed and evaluated with the dynamic analysis method according to Japan Specification.

2. Description of the bridge

The multi-span continuous bridge representative of typical bridges in Vietnam is evaluated under this study. The superstructure is a hollow slab beam structure with 8 continuous spans. The total length of the bridge is 250 m. The bridge consists of 3 rigid frame piers and 4 bent piers. The pier columns and the abutments are fabricated by RC and the bored cast-in-place piles are driven under the footing. The rubber bearing supports are installed in the bent piers.

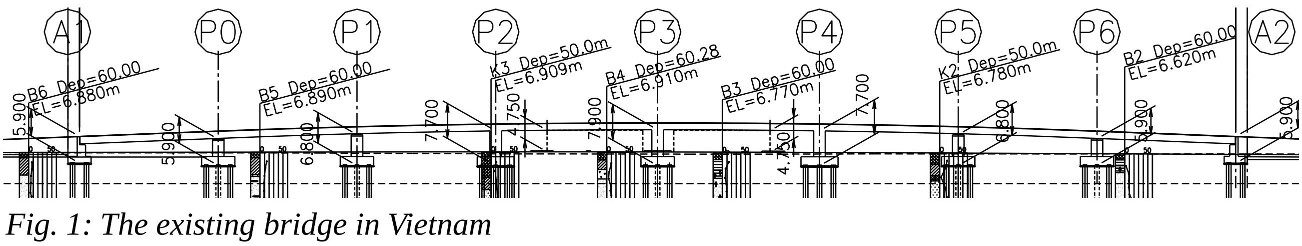

Fig. 1: The existing bridge in Vietnam

https://doi.org/10.2749/222137809796067858
Distributed by structurae

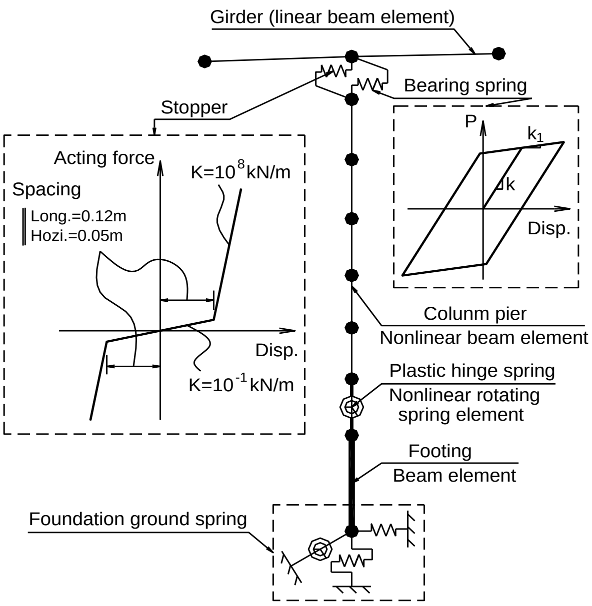

Fig. 2: Modelling of the bridge pier

3. Analytical modelling

According to the seismic design specified in Japan Specifications for Highway Bridge, a nonlinear analysis model of the bridge is made. Fig. 2 shows modeling of the bridge pier which is made to estimate seismic resistance of the bridge. Two ground acceleration records in Japan are adopted as input data at the ground level (Tsugaru Ohhashi (1983) for Level 1 and Kushirogawa (1994) for Level 2).

4. Seismic response of multi-span continuous concrete girder bridge

The result in Fig. 3 and Fig. 4 shows the maximum rotation angles of P2 are 4.149×10^{-5} rad and 3.67×10^{-2} rad for case of stopper with Level 1 and Level 2, respectively.

The analysis shows that the pier P2 is within elastic state, no serious damage is evaluated for Level 1 earthquake motion. For Level 2 earthquake motion, the maximum displacements at the top of the pier are 10.13 cm. Almost other piers have damage and the residual displacement limit of the pier $\delta/h \leq 1/100$ is not satisfied. Where δ is displacement at top of the pier, h is height of the pier.

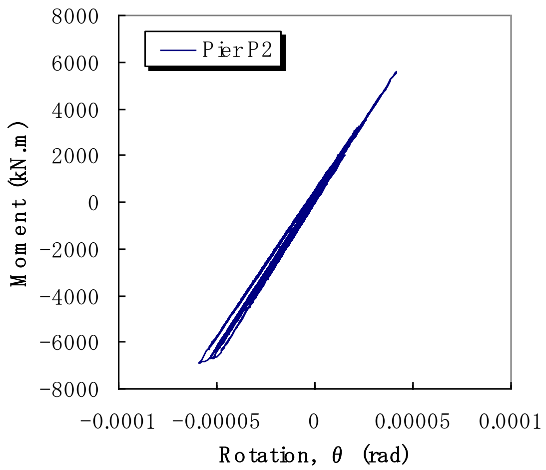

Fig. 3: Response of the pier P2 for Level 1 at the plastic hinge

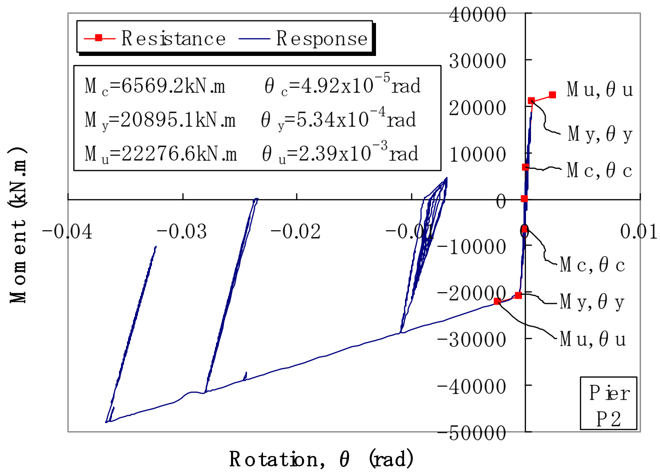

Fig. 4: Response of the pier P2 for Level 2 at the plastic hinge

5. Conclusions

Based on the results of this comprehensive analytical study according to Japanese Specification-2002, the following specific conclusions can be made about the seismic response of this bridge: the bridge is secure from Level 1 earthquake motion; the deformation of the pier is large and the damage may occur at the plastic hinge of the pier for Level 2 earthquake motion.

References

[1] 22TCN 272-05, *Specification for bridge design*, Ministry of Transport of Vietnam, 2005.

[2] TCXDVN 375, *Design of structures for earthquake resistance*, Vietnam Ministry of Construction, 2006.

[3] *Specification of highway bridges - Part V seismic design*, Japan Road Association, 2002.