EVALUATION ON SEISMIC RESISTANCE OF EXISTING BRIDGE IN VIETNAM BY DYNAMIC RESPONSE ANALYSIS

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1. INTRODUCTION

For almost the existing bridges has been ignored seismic design in Vietnam. Recently many modern bridges have constructed. Several earthquakes have happened in Vietnam and neighbors countries; therefore earthquake design will be required for Vietnam Bridge. This paper provides seismic analysis results one of the existing bridges in Vietnam. Thence, we discuss safety limit of this bridge when an earthquake occurs. This bridge was designed according to ASSHTO Specification by Vietnam consultant and completed in 2004.

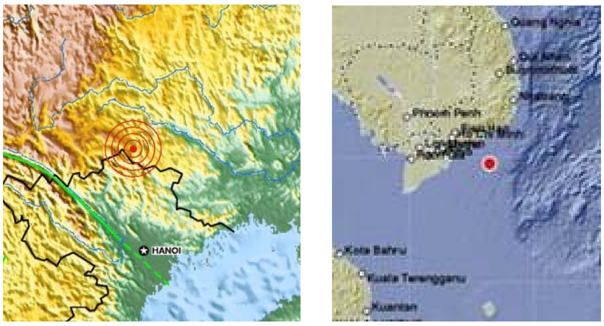

Fig 1: Recently earthquake location in Vietnam

2. PROJECT OUTLINE

2.1. Location

This Bridge is located in delta plain, South Vietnam that is separated by a dense river and canal network.

2.2. Soil condition

The soil investigation data obtained from the field survey such as boring, in-site test as SPT and laboratory tests, the strata within the exploration depth is briefly described by table below:

Table 1: Soil condition

Layer No.	Type of Layers	Thickness	Average N value	Unit weight, γ_t	Cohesion, C	Internal friction angle, ϕ
		(m)	(N)	(kN/m^3)	(kPa)	(°)
1	Silt	13.3	1	15.4	0.09	4°24'
2	Lean clay	2.7	6	18.2	0.18	14°00'
3	Lean clay	4	17	19.5	0.46	17°42'
4	Lean clay	10	8	18.8	0.18	14°36'
5	Clayey sand	1.5	15	18.1	0.15	14°30'
6	Lean clay	10.5	10	18.3	0.17	14°00'
7	Lean clay	6.5	14	19.1	0.38	16°18'

2.3. Structural type and analysis model

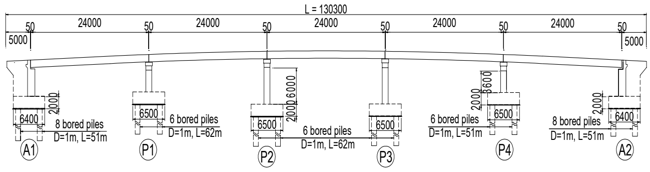

Fig 2: General structure of bridge

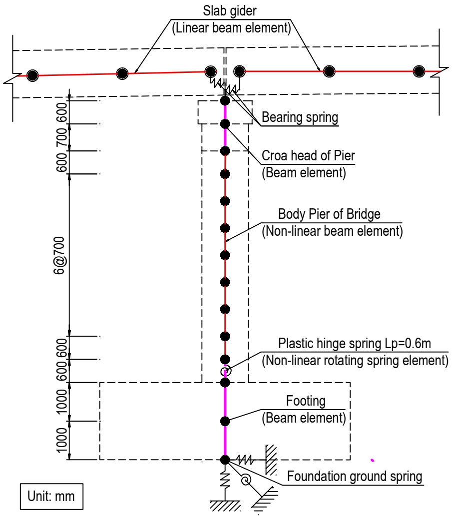

Fig 3: Analysis model of bridge

The bridge is composed of 5 simple spans with PC slab girder. Width of carriageway is 11m; arrangement of 12 PC slab girders, the distance between girders is 1m. Walkway is the same level to carriageway, lane separator is soft separator and width parapet is 0.5m, bearing shoe: imported rubber bearing. Substructures have constructed by RC on bored pile system.

3. DYNAMIC RESPONSE ANALYSES

3.1. Analysis outline

In order to investigate the response behavior and seismic resistance of bridge, numerical simulation used time-history response analysis is carried out. A non-linear analysis model of bridge is show in **Fig 3**. The model bridge is simple bridge with 5 slab spans, equipped with rubber bearings. However, these bearings aren't installed for seismic isolation system. The properties of superstructure and substructure are show in **Fig 2**.

The ground is soft with average N value at less than 20. The dynamic characteristic value of surface ground domi-

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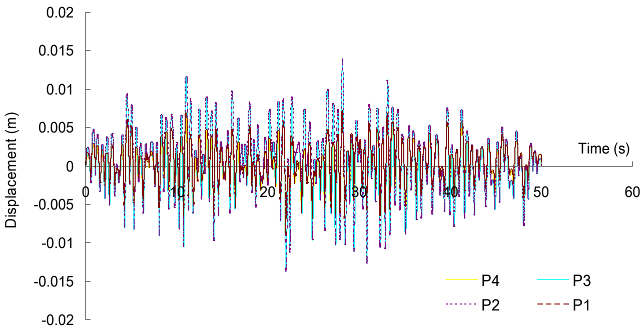
-nates period is T_G=1.18s, i.e. type III ground according to the seismic designs specified in Specifications for Highway Bridges: Seismic Design. Modeling of pier was a nonlinear rotating spring that modeled a plastic hinge with L_p=0.6m ($0.1D \leqq L_p \leqq 0.5D$, D=1.2m), the pier was model by a non-linear beam element; the rubber bearing was spring element; the girder and footing was linear beam elements. The hysteresis property of the pier was the Takeda model.

The input earthquake ground motion was provided in Specifications for Highway Bridges. The dynamic analysis was performed using the New-mark β method and time interval was 0.01s. Rayleigh damping model was used.

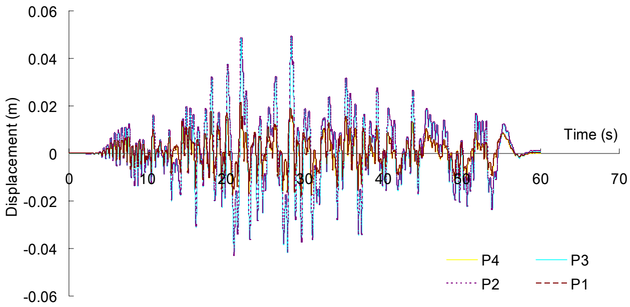
3.2. Analysis results

a) Response displacement of pier

Fig 4 shows the results of horizontal displacement time history of the pier's top. These results shows the maximum response displacement of the pier's top was 0.014m, 0.05m responsible with level 1 wave and level 2 wave respectively.



a) Input level 1 wave (input acc = 1.40m/s^2)



b) Input level 2 wave (input acc = 4.38m/s^2)

Fig 4: Horizontal displacement of the pier's top

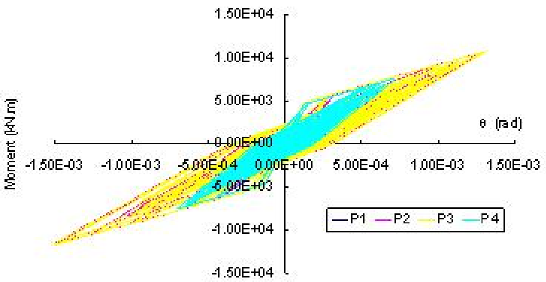


Fig 5: M - θ response of plastic hinge

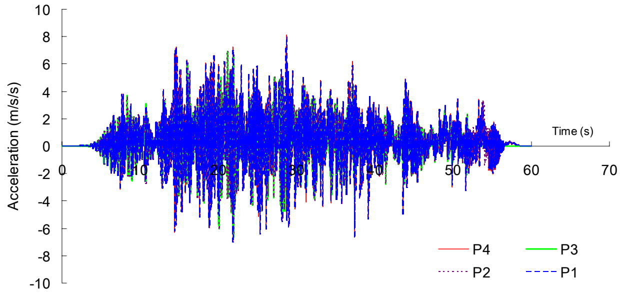


Fig 6: Horizontal acceleration of the pier's top

The maximum for horizontal acceleration of the pier's top is 8.1m/s^2. This response displacement is not enough to cause the collapse to bridge structure.

Table 2: Shear capacity of piers

Pier	Calculated shear strength (kN)	Nominal shear strength (kN)	Check
P1	1825	2064.40	OK
P2	1869	2064.30	OK
P3	1741	2064.30	OK
P4	1791	2064.40	OK

b) Horizontal displacement of bearing

Table 3: Max. for horizontal displacement of bearings

Location	Left side (m)	Right side (m)
Bearing of P1	0.0397	0.1199
Bearing of P2	0.0919	0.0768
Bearing of P3	0.0768	0.0914
Bearing of P4	0.1195	0.0400

Table 3 shows the results of horizontal displacement of bearings when input level 2 wave. The maximum displacement was 0.12m.

4. CONCLUSION

From seismic analysis results for existing bridges in Vietnam shows the bridge design is suitable and safety when earthquake occurs. For the bridge have a soft ground condition designed by ASSHTO, dynamic response analysis based on Japanese seismic design shown the bridge isn't collapse at the pier and drop at the girder. In the future, we must evaluate seismic resistance long span bridge in Vietnam.

5. REFERENCES

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