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# Designing Seismic Resilient Railway Structures Combining Japanese Seismic and ASHTO Design Standards

**Christian HAUSSNER, M.Eng.**
Engineer Class 1, Railway Planning Department
Oriental Consultants Global Co., Ltd.
Tokyo, Japan
haussner@ocglobal.jp

Geotechnical Engineer with focus in planning, design, interface management and seismic design of mass transit superstructures.

**Dr. Takayuki OMORI**
Deputy General Manager, Overseas Division
Oriental Consultants Co., Ltd.
Tokyo, Japan
ohmori@oriconsul.com

Chief Bridge and Civil designer of over 100 bridges in Japan and overseas, some of which have been awarded for their engineering excellence.

**Dr. Nobuyuki MATSUMOTO**
Advisory Executive, Railway Division
Pacific Consultants Co., Ltd. (PCKK)
Tokyo, Japan
nobuyuki.matsumoto@ss.pacific.co.jp

Executive Advisor at PCKK and former Head Researcher of Structural Mechanics Laboratory at the Railway Technical Research Institute (RTRI), Japan.

**Isao NAMIKAWA, M. Eng.**
Manager
Pacific Consultants Co., Ltd. (PCKK)
Tokyo, Japan
isao.namikawa@tk.pacific.co.jp

Registered Structural Engineer (Japan) with over 20 years of desn experience of Road Bridges in Japan.

**Nobuyoshi KAWAI**
Senior Manager, Railway Planning Division
Oriental Consultants Global Co., Ltd.
Tokyo, Japan
kawain@ocglobal.jp

Project Manager with over 25 years of experience in railway projects in over 15 countries.

**Peter ESMALLA, M. Eng.**
Engineer Class 3, Road Planning Division
Oriental Consultants Global Co., Ltd.
Tokyo, Japan
p.esmalla@ocglobal.jp

Junior Bridge Engineer with experience in the planning and design of road and railway bridges.

**Contact:** haussner@ocglobal.jp

## 1 Abstract

This paper introduces the seismic design conducted for the railway viaducts in a highly seismic region in Metro Manila, Philippines, in accordance with the local bridge seismic design standard (DPWH-BSDS, 2013), AASHTO Guide Specifications for Load Resistance Factor Design Seismic Bridge Design (LRFD-S) and the Japanese Seismic Design Standard for Railway Structures and Commentary (JDSRS) for making reference to the anti-derailment check under Level 1 Earthquakes (1:100 return period).

The authors concluded that for level 1 earthquakes the seismic design for short piers (h<10m) and piers located in stiff soils, the seismic design was governed by the DPWH-BSDS and AASHTO LRFD-S due to its larger seismic coefficient for structures with short natural periods. Therefore, the initial structural sizes, reinforcement arrangement and number of piles did not need to be modified. On the other hand however, tall piers (h>10m) located in soft soils, the design is governed by the JDSRS due to its stipulated larger seismic coefficients for structures with a longer natural periods. In this regard, in order to limit the transverse natural period requirements of the JDSRS as part of the anti-derailment check, the sub-structural members needed to be increased in size by approximately 20% - 50%, re-arrange the pier steel reinforcement, and to increase the number of bored piles.

**Keywords:** seismic design; railway; viaduct; seismic coefficient; level 1 earthquake; derailment; transverse natural period

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