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Performance Enhancement of the Existing Bridges Due to Overweight Vehicles with Multi-Axle Loading

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Abstract. This article presented the analytical results focused on the responses of the existing bridges in Thailand subjected to overweight vehicles. The bridges, span lengths ranging from 5 to 20 meters, were loaded by the overweight vehicles with multi-axle loading having gross weight of 400 tons. The rating factors of bridges were also performed. The bridge strengthening methods using carbon fiber reinforcement polymers and intended settlement technique were also presented.The results indicated that the load rating factors were increased and conformed to the load rating standards. The results of this study would be a reference data to establish an alternative plan of bridge strengthening to improve the safety of the bridges under a moving of overweight vehicles.

Introduction

With the increase in energy demand, the cooperative project between Thai and Lao government has been established. This mega project needs to construct dam and electricity power plant at Hong-Sa, the province close to the Thai-Lao boundary. This has led to increase frequency of transportations of heavy equipment imported from China pass through Thai Kingdom by both of ships and trucks.

Bridges are important elements in the transportation system. Supporting all vehicles to cross over any obstacle, the bridges must be safe to carry all loads over the lifetime. Since the weight of heavy equipment is typically greater than the weight of conventional trucks allowed by Department of Highways (DOH) of Thailand, the bridge assessment shall be conducted under a moving of the overweight vehicles. To ensure the bridge safety along the route of transportation, DOH allows the overweight vehicles to move over highway bridges by restricted conditions. In case the bridge repair and strengthening are required, those application methods shall be proposed with the analytical proving evidences to DOH.

Bridge design practices in Thailand have commonly referred to the design specifications specified by the American Association of State Highway and Transportation Officials (AASHTO) [1]. However, the designated vehicular loads, so called HS20-44 as shown in Fig.1, are unlike from Thai truck loads which are legally defined in the government gazettes and declarations issued by DOH [2-4]. Thus, the effects of bridge responses due to the differences of configurations together with total weights of Thai Trucks and AASHTO live loadings were widely studied. In Thailand, Sritanet et al. [5] and Vivithkeyoonwong et al. [6] studied the safety of girder-type bridges (span length up to 38 m) by comparing the bridge responses due to convoys of Thai trucks according to the declarations of DOH with HS20-44. The results from [5] showed that the stresses in bridge girders due to 38-ton semi-trailer and 35-ton trailer were approximately 26% and 23% greater than those calculated from HS20-44, respectively. Subsequently, Suparp et al. [7, 8] investigated the bridge responses of simple beam system with several span lengths ranging from 5 to 60 m due to HS20-44 and Thai trucks according to the government gazettes issued by the DOH. Likewise, the bridge responses of continuous beam system with the total length of the bridges ranging from 90 to 180 m were also studied [9]. The analytical results showed that the bridge response ratios were comparatively