Comparative Study of Highway Steel Girder Bridge between Japan and USA

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Summary

A comparative study of the design example of highway steel girder bridges is performed for the same design requirements using the design codes, AASHTO-LRFD of USA and Japanese Specifications. As a result, AASHTO-LRFD-based girder height is significantly smaller than the Japanese one, which results in difference in stiffness of the girders. Also, differences exist in other design provisions such as impact factors, spacing of cross frames, limitation of deflection, etc. A study for the benchmark design is also proposed to investigate the rationality of bridge design further.

Keywords: steel structures, steel bridges, structural design, bridge design, composite girder, highway bridges, LRFD, Japanese bridges

1. Introduction

It is an interesting topic to compare the design standards for the same structure among different countries because it leads to understand theories and background behind the structural design codes of those countries. This paper compares designs for a simply supported highway composite girder bridge using the Japanese and USA bridge codes under the same design conditions. Since it can be conceivable that there is not a big difference in the traffic situation in Japan and USA where the actual design live loads are considered similar, the comparison of the main girder sections as a design result is meaningful for comparison of the safety.

It is not reasonable to conclude which design method is more economical, the allowable stress design (ASD) or the limit state design (LSD), by the reason that one design method gives smaller girder section than the other. In changing the design method from ASD to LSD, the safety factor is generally determined by calibration in such a way to have the equivalent probability of failure, therefore it is not essentially related to the economic efficiency. The safety can be compared from the girder sections which are obtained as a design result as long as the loads and the structural materials are equivalent even if the design standards are different. It is the comparison of safety but not the comparison of economical efficiency.

2. Design codes

2.1 JSHB

Current Japanese Specifications for Highway Bridges (JSHB)[1] is based on the allowable stress design (ASD) philosophy. In ASD structures are designed such that the working stresses σ in the structure do not exceed the allowable stresses σ_a which contain the safety factor γ against the ultimate strength stresses σ_u as shown below.

$$\sigma < \sigma_a = \frac{\sigma_u}{\gamma} \tag{1}$$

The ultimate stresses include the effects of bending, shear, buckling, fatigue, etc.

2.2 AASHTO-LRFD

AASHTO published two design standards, namely, AASHTO Standard Specifications for Highway

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