The Evolving Metropolis
2019 IABSE Congress
New York City

IABSE 90 YEARS

Research on Extending Span of Box Girder Bridge with Corrugated Steel Webs up to 300m

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1 Abstract

In order to promote the application of steel-concrete composite structure in mountainous areas in China, a conceptual design for a PC continuous rigid frame box-girder bridge with corrugated steel webs and main span of 300 m was performed in the present paper. The combined corrugated steel web was proposed to increase the compressive area and improve the stability performance; thus, the self-weight of the composite box-girder bridge is significantly reduced. Flexural capacity of the whole section had been calculated with a single-beam model for the ultimate limit state (ULS). For the service limit state (SLS) design, the calculation for the composite box-girder bridge was conducted with the spatial grid model (SGM), from which 27 complete checking stresses in three layers (i.e. outside, inside and middle planes) of concrete plates and steel webs in every cross-section could be obtained. The stress history under construction stage was incorporated into the results obtained by SGM. Moreover, the stress states and stability performance for the composite box-girder bridge constructed were evaluated. The present investigation can provide references for the design and construction of the composite box-girder bridge with corrugated steel webs for long spans.

Keywords: composite box-girder bridge; corrugated steel webs; SGM; complete checking stresses; stability.

2 Introduction

In the mountainous areas of China, long span PC girder bridges are demanded, due to the benefits, including cheap to build, convenient to transport materials to the sites and suitable for construction in those areas with the cast-in-situ balanced cantilever method. However, it's true that the live load accounts for only 10-15% of the bending moment for PC girder bridges with span larger than 200m and the majority of the effect is caused by dead weight. Therefore, the main reason that such a long span bridge is hard to design is that dead load of the bridge is too heavy. Furthermore, reducing the self-weight becomes the most crucial problem in the bridge design for the mountainous areas.

For bridge structures, the longer the span length becomes, the larger the girder depth becomes, which means that the self-weight can be reduced by replacing the concrete webs with the steel webs. And among many kinds of steel-concrete composite bridges, the bridge with corrugated steel webs has many advantages, such as the improvement of efficiency of prestressing caused by the "accordion effect", reduction of the creep and shrinkage effect because of weak constraints between top flanges and bottom flanges and the faster and simpler construction method [1].

https://doi.org/10.2749/newyork.2019.1874
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