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Comparative analysis and applicability of optimal composite sections for small to middle span girder bridges

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1 Abstract

Paper reports findings from parametric analysis of open section constant height composite bridges with considered spans ranging from 20 to 70 m (for larger spans closed box girder section is recommended). For these spans, girder structural system is analyzed for permanent and traffic loads, and thus steel quantity determined according to Eurocode limit states. For each span, possible sections comprise various "I" girder types and various number of girders determined from variable bridge width, distinguishing two groups of sections – sections with only two main girders (comprising hunched deck plate of variable thickness) and sections with more than two girders (comprising constant thickness deck plate). Other considered parameters are section height, steel flange width and occurrence of web stiffeners for buckling verification. Analysis is performed on finite element models, according to typical construction stages, where composite section is activated only for loads applied after in-situ concreating of deck slab. For each variable set, needed steel quantity is recorded. Graphical representation of all results is plotted in diagrams, showing section types and steel quantity for a given range of span lengths. In conclusion, comments are given for use of composite cross sections according to the bridge span length and width.

Keywords: composite bridge, open section, "I" girder, steel quantity, parametric analysis, optimal

2 Introduction

2.1 Motivation for this research

Since the benefits of employing a composite action between steel and concrete have been recognized [1], composite bridges soon became a competitive solution for crossings with ranging spans from small (20 m) to middle (130 m). Common spans in practice range between 40 and 90 m for open sections and 70 to 120 m for closed box sections [2]. Advantages in comparison to prestressed concrete girder bridges are larger span to height ratio, smaller dead load, fast erection and often better durability. Erection method of concrete bridges for spans larger than 40 m comprise an expensive scaffolding or launching equipment which drives the overall cost of construction high. For even higher spans (more than 70 m) free cantilevering method for concrete segments can be considered, but the cost of such an erection is also considerable due to more prestressing needed. Thus, major discussion nowadays is the cost of a composite bridge in comparison to a concrete one. Steel being a more expensive material and requiring more work related

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