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Lateral-Torsional Buckling of Steel Girder Systems Braced by Solid Web Crossbeams

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Abstract : Lateral-torsional bracing members are critical to the stability of girder systems during the construction phase of steel-concrete composite bridges, and the interaction effect of multiple girders plays an essential role in the determination of buckling load. In this paper, an investigation is conducted on the lateral-torsional buckling behavior of the steel girder system which is composed of three or four I-shaped girders and braced by solid web crossbeams. The buckling load for such girder system is comprehensively analyzed and an analytical solution is developed for uniform pressure loading conditions. Furthermore, post-buckling analysis including initial geometric imperfections is performed and parametric studies in terms of bracing density, stiffness ratio as well as the number and spacing of girders are presented in order to find the optimal bracing plans for an arbitrary girder layout. The theoretical solution of critical load on account of local buckling mode shows good agreement with the numerical results in eigenvalue analysis. In addition, parametric analysis results show that both bracing density and stiffness ratio have a significant impact on the initial stiffness, global stability and failure mode of such girder system. Taking into consideration the effect of initial geometric imperfections, an increase in bracing density between adjacent girders can effectively improve the bearing capacity of the structure, and higher beam-girder stiffness ratio can result in a more ductile failure mode.

Keywords : bracing member, construction stage, lateral-torsional buckling, steel girder system
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