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箱形梁剪力滞效应分析中的翘曲位移函数及广义内力研究

Study on warping displacement function and generalized internal force in shear lag effect analysis of box girder

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英文关键词:thin-walled box girder shear lag effect warping displacement function generalized internal force additional deflection

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中文摘要:

以薄壁箱梁的弯曲计算理论为基础,从分析翼缘板的面内剪切变形和弯曲剪力流的分布规律入手,从理论上证明二次抛物线是箱形梁剪力滞效应分析中的合理翘曲位移函数。选取剪力滞效应引起的附加挠度作为广义位移,用基于最小势能原理的能量变分法建立箱形梁剪力滞效应分析的控制微分方程和边界条件。对箱梁横截面上新出现的广义内力给出严密定义,并建立了剪力滞翘曲应力的简便计算公式,它与初等梁弯曲应力公式具有相同的形式。对一个简支箱梁模型的计算表明,计算值与实测值吻合良好,从而证实了本文的分析方法和建立的公式是正确的。不同于弯矩的分布,剪力滞广义力矩具有快速衰减的分布特征。对集中荷载作用下的简支箱梁算例,剪力滞效应使其跨中挠度增大达12%,工程实践中必须认真对待。

英文摘要:

Based on the flexural theory of thin-walled box girder,the curve of quadratic parabola is proved to be the reasonable form of the warping displacement function in the shear lag effect analysis of a box girder through investigating the in-plane shear deformation and the bending shear flow distribution in the flanges.The additional deflection induced by shear lag effect is adopted as the generalized displacement.The governing differential equations and the corresponding boundary conditions for shear lag effect of box girder are established by the energy calculus of variations based on the principle of minimum potential energy.The new generalized internal force is defined rigorously,and a simple and convenient formula of stress for shear lag warping is presented which has the same form as the bending stress of elementary beam.A simply supported box girder model is analyzed and the calculated results are in good agreement with the test results,validating the method and formula presented.The generalized moment for shear lag differs from the bending moment in distribution and attenuates quickly.For the simply supported box girder example under concentrated load,shear lag effect increases the mid-span deflection by 12%,which should be treated carefully in practice.

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