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Lateral-torsional buckling of coped beams with corrugated webs

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STATEMENT

This dissertation is submitted to Ain Shams University for the degree of Master of Science in Civil Engineering (Structural).

The work included in this thesis has been carried out by the author in the Department of Structural Engineering, Ain Shams University, from October 2011 to March 2015.

No part of this thesis has been submitted for a degree or a qualification at any other university or institute.

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ABSTRACT

This thesis deals with lateral torsional buckling of Coped beams with corrugated webs. Three-dimensional models are developed using a finite-element software package ABAQUS to investigate the influence of copes on the lateral-torsional buckling resistance of beams with corrugated webs.

It was found that there is a considerable reduction in the ultimate capacity of beams due to coping. This reduction depends upon the cope length and cope depth compared to un-coped corrugated beams. The coped beams with corrugated webs still have higher capacity than coped beams with flat webs.

In addition, due to the low stiffness in the longitudinal direction of the beam and the absence of the flange in the coped region, the web will have the tendency to elongate and the corrugation will flatten. These phenomena affect displacements both vertically and laterally, and result in large deformation that is not acceptable in engineering purposes. Strengthening solution is introduced in this research to solve this problem.

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NOTATIONS

a	length of flat panel
b	projection length of inclined panel
b_f	width of flange
c	length of inclined panel
C_b	equivalent moment coefficient, depending upon loading conditions
C_c	cope length
C_f	width of compression flange from the web-flange joint to the free edge of the flange
$C_{w,FEM}$	warping constant of I-girder with corrugated webs from finite element analysis
$C_{w,Flat}$	warping constant of I-girder with flat webs
$C_{w,co}$	warping constant of I-girder with corrugated webs
C_w	warping constant
C_w^*	warping constant of I-girder with corrugated webs from result of Lindner
D	beam depth
d	depth of corrugation
d_{Cc}	cope depth
d_{avg}	average corrugation depth
d_{max}	maximum depth of corrugation
E	modulus of elasticity of steel
e_o	maximum magnitude of initial imperfection
f_y	yield stress of material
G	shear modulus of flat plates
G_{co}	shear modulus of corrugated plates
h_o	depth of beam at coped region $= D - d_{Cc}$
h_w	height of corrugated webs
$I_{x,co}$	second moment of inertia about strong axis(x-axis) of I-girder with corrugated webs
I_x	moment of inertia of I-section about x–x axis