

World Congress and Exhibition on Construction & Steel Structure

November 16-18, 2015 Dubai, UAE

Buckling capacity of pre-twisted steel columns: Experiments and finite element study

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Buckling is a mode of failure that is mainly observed in compression members due to structural instability. Inducing a natural pre-twist along the length of a column section makes the column have a different resistance at every point along its centroidal axis. A pre-twisted column in 3D-space has its strong flexural plane weakened and its weak flexural plane strengthened, leading to a net favorable effect on the buckling strength of the pre-twisted column. The proposed research focuses on studying the effect of pre-twisting on the buckling capacity of steel columns. Experimental and numerical investigations of pre-twisted steel columns with different slenderness ratios were carried out. Linear perturbation analysis was conducted for several universal column cross-sections for various lengths, a set of pre-twisting angles ranging 0° - 180° and different boundary conditions. A number of pre-twisted columns were then tested to examine the elastic and inelastic behavior of one of the universal steel columns. The experimental results were utilized to verify and develop a set of non-linear finite element models including the material and geometric non-linearities. The FE models were utilized to conduct a parametric study including several more lengths and twisting angles. It was found that pre-twisting is most effective with elastic buckling since it is mainly controlled by the moment of inertia of the column in opposition to inelastic buckling which is additionally affected by material yielding. It was also noticed that fixed-ended conditions ensured better buckling capacity improvement as compared to pinned-ended columns in both elastic and inelastic zones.

Biography

Farid Abed is an Associate Professor of Civil Engineering at the American University of Sharjah, UAE. He earned his PhD in 2005 in Structures/Mechanics from Louisiana State University (LSU), USA. He taught for three years in the area of structures at Bradley University and LSU. He has more than four years of industrial experience working as a Civil Engineer in the Middle East. He has published more than 40 peer-reviewed articles and conference proceedings. His research interests include computational solids and structural mechanics, advanced structural analysis, advanced mechanics of materials, composite materials and non-linear finite element analysis.

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