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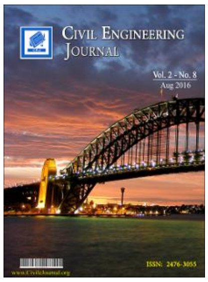

Investigating the Local Buckling of Rectangular Corrugated Plates

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Abstract

With advances in technology in recent years, the use of orthotropic materials to exclude the mechanical deficiencies of homogeneous plates has increased. Sinusoidal corrugated plates are known as orthotropic plates, as a result of changes in their mechanical properties in two orthogonal directions. Since use of corrugated plates, in particular steel shear walls instead of flat steel plates, has increased, the present study investigated local buckling of sinusoidal corrugated plates under uniform uniaxial loading on the transverse edges of the plate (vertical loading on the sinusoidal wave of corrugated plates), using the Galerkin method. This method is very powerful with regard to solving differential equations, and directly uses these equations in the process of problem-solving. Finally, the results obtained for the critical buckling load of sinusoidal corrugated metal plates and the results relating to the metal homogeneous flat plates were compared using the same supporting conditions and loading.

Keywords: Sinusoidal Corrugated Plates; Local Buckling; Rectangular Plate; Uniform Loading; Orthotropic.

1. Introduction

With the worldwide development of the construction industry, the quality and speed of construction is highly regarded and continues to evolve. Structures with cold-rolled steel walls have emerged as one of the modern manufacturing innovations of this industry, and this type of structure has become a serious competitor to those constructed from low-level traditional steel and concrete. In the United States of America, shear walls with corrugated plates have been used in the industry since 1946 [1]. Leo and Edlund [2] examined buckling of trapezoidal corrugated plates by using the finite-strip method under thin-walled structures, while Qiang et al. [3] discussed local buckling of the compression flange of H-beams with corrugated webs. Liew et al. [4] investigated buckling of metal sinusoidal and trapezoidal corrugated rectangular plates using a mesh-free Galerkin method based on first-order shear deformation theory under uniform loading, perpendicular to the edge of the plate in the sinusoidal waves of metal corrugated plates. Kabir and Karbasi [5] examined the shear buckling of thin-steel shear walls with smooth and corrugated plates, while Babaqassabha and Shaghaghi Moghaddam [6] studied the numerical analysis of composite flat and corrugated sandwich buckling plates with a soft core. In addition, Babaqassabha and Abkenari [7] investigated free vibration of a corrugated composite sandwich plate with an aluminum flat coating. Garivani and Moqimi [8] evaluated the performance of a steel plate beam with corrugated web, while Esmaeilzadeh and Shabanzadeh [9] studied the use of corrugated plate instead of simple plate in steel shear walls. Rostami et al [10] examined the elastic shear buckling resistance of zigzag corrugated steel plates, and Nakhaei et al. [11] assessed the system behavior of non-prismatic plate beam and trapezoidal corrugated plates using ABAQUS software. Moodi and Ghasemi [12] examined shear buckling of steel corrugated webs (corrugated cardboard), while Valadi and Aghajari [13] examined the impact of different widths of corrugated zigzag plates on the seismic behavior of corrugated steel shear walls under monotonic and cyclic loading. However, no previous study has examined buckling of sinusoidal corrugated plates under uniform loading perpendicular to sinusoidal waves, so we investigated local buckling of sinusoidal corrugated plates under uniaxial uniform loading on the transverse edges of the plates (loading perpendicular to the sinusoidal wave of corrugated

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