Compression Tests of Longitudinally Stiffened Plates Undergoing Distortional Buckling

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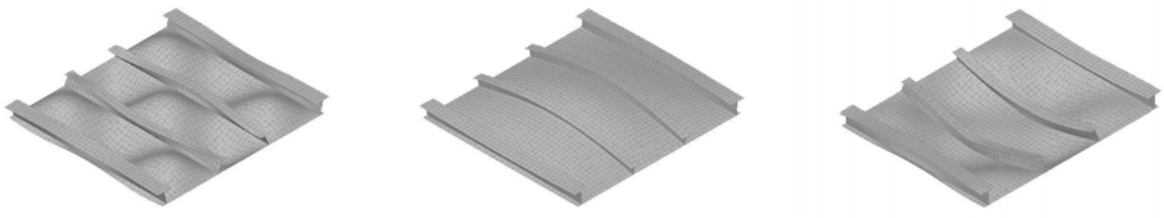
Summary

This paper describes a series of compression tests performed on longitudinally stiffened plates fabricated from mild steel plates of thickness 4.0 mm with nominal yield stress of 240MPa. The stiffened plates with a range of rigidities of longitudinal stiffeners were tested to failure. The ultimate strength and performance of the longitudinally stiffened plate in compression undergoing distortional buckling or interaction between local and distortional buckling were investigated experimentally and theoretically. The compression tests indicated that the critical buckling mode was dependent mainly on the rigidity of the longitudinal stiffeners and the width-thickness ratio of sub-panels. A noticeable interaction between local and distortional buckling was also observed for some stiffened plates. A significant post-buckling strength reserve was shown for those sections with distortional buckling or with interaction between local and distortional buckling. A limiting strength curve for distortional buckling for stiffened plates was studied. Simple design strength formulae in the Direct Strength Method have been proposed to account for the interaction between local and distortional buckling of stiffened plates. The strength curves proposed were compared with the test results. The adequacy of the strength curve was confirmed. A set of conclusions was drawn from the experimental studies as to the buckling behaviour of stiffened plates.

Keywords: stiffened plates; longitudinal stiffeners; sub-panels; local buckling; distortional buckling; buckling interaction; Direct Strength Method.

1. Introduction

Stiffened steel plates with longitudinal stiffeners have been used widely in steel structures such as steel box girders, box columns and pylons for cable bridges. When compressed or bended, the stiffened plate may buckle in either local buckling mode (anti-symmetric mode) or distortional buckling mode (symmetric mode). The two basic buckling modes of longitudinally stiffened plates shown in Figs. 1(a) and (b) depend mainly on the in-plane flexural rigidity of the longitudinal stiffeners and the width-thickness ratio of sub-panels. According to the section geometries, the basic buckling modes may be interacted with each other as shown in Fig. 1(c).



(a) local buckling *(b) distortional buckling* *(c) mixed mode buckling*

Fig. 1: Buckling modes of stiffened plates subjected to uniform compression

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