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Journal of Constructional Steel Research 61 (2005) 984–1006
JOURNAL OF CONSTRUCTIONAL STEEL RESEARCH
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An investigation of lightly profiled sandwich panels subject to local buckling and flexural wrinkling effects

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Received 19 April 2004; accepted 9 December 2004

Abstract

Sandwich panels exhibit various types of failure modes depending on the steel face used. For the flat and lightly profiled sandwich panels, flexural wrinkling is an extremely important design criterion as the behaviour of these panels is governed mainly by flexural wrinkling. However, in the lightly profiled panels, when the depth or spacing of the ribs increases, flat plate buckling between the ribs occurs leading to the failure of the entire panel due to the interaction between local buckling and flexural wrinkling modes. Current design formulae for sandwich panels do not consider such interactive buckling effects. To obtain a safe design solution, this interactive buckling behaviour should be taken into account in the design of lightly profiled sandwich panels. Therefore a research project was undertaken to investigate the interactive buckling behaviour of lightly profiled panels with varying depths and spacings of the ribs using a series of experiments and finite element analyses. A new improved design formula was developed for the safe and economical design of lightly profiled panels that takes into account the interaction between local buckling and flexural wrinkling. This paper presents the details of this investigation, the results and the new design formula.
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Keywords: Sandwich panels; Lightly profiled faces; Flexural wrinkling; Local buckling; Interactive buckling; Rib depth

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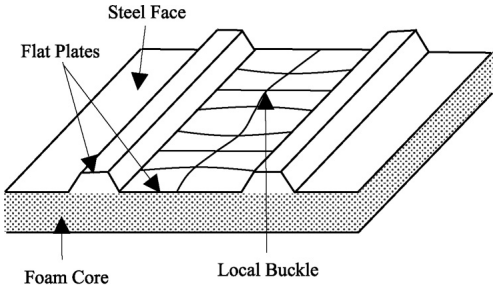
doi:10.1016/j.jcsr.2004.12.008



(a) Local buckling of fully profiled sandwich panels.

(b) Flexural wrinkling of lightly profiled panels [9].

Fig. 1. Local buckling and flexural wrinkling of sandwich panels.

1. Introduction

Structural sandwich panels can be produced by using three different types of steel faces, namely, flat, lightly profiled and fully profiled faces. Local buckling of flat plate elements is the critical failure mode for fully profiled sandwich panels (Fig. 1(a)) whereas flat and lightly profiled panels undergo a flexural wrinkling type failure (Fig. 1(b)). In the case of flexural wrinkling, a series of short wave buckles develop first in the compression steel face and the wrinkling failure follows when one of the buckles collapses. Flexural wrinkling of sandwich panels is a form of local instability of compression steel faces associated with short waves of buckling. Unlike local buckling, flexural wrinkling failure does not include any postbuckling strength, and occurs in the elastic region at a stress well below the yield stress of the steel. Flat and lightly profiled sandwich panels are always susceptible to wrinkling failures and hence flexural wrinkling is an extremely important design criterion for the panels with flat and lightly profiled faces.

Lightly profiled sandwich panels are generally considered to be those panels with a rib depth of less than 2 mm (see Fig. 1(b)). Past research [2,3,10] has shown that even with such a small profile depth a significant increase in wrinkling stress can result along with good aesthetic appearance when compared to the flat panels. As sandwich panels

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