Canadian Sheet Steel Building Institute

Sheet Steel Facts 27

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Effects of Acoustic Perforations on the Bending Strength and Stiffness of Steel Roof Deck

Introduction

Cold formed steel roof deck is a standardized product manufacturered by a number of CSSBI member companies. Some of these roof deck products have a pattern of small holes punched into the web elements (perforated webs), as illustrated in the photograph in Figure 1, and are commonly referred to as "acoustic deck". In a typical acoustic deck the holes are 3 mm (0.125 in.) in diameter spaced on 9.5 mm (0.375 in.) staggered centres. The perforations would remove approximately 10% of the web area.

Acoustic deck is used because it can improve the sound transmission properties in a building as discussed in CSSBI Fact Sheet #16. The structural strength and stiffness of the standard roof deck is well known and can be calculated using the *North American Specification for Design of Cold-Formed Steel Members*, CSA-S136. The subject for this fact sheet is to document the effect the web perforations can have on the bending strength and stiffness of the deck.

Research Project Summary

A research project was carried out within the Canadian Cold Formed Steel Research Group at the University of Waterloo under the supervision of Professor Emeritus R.M. Schuster. The objective of this project was to conduct comparative flexural tests of plain and acoustic roof deck to determine the impact of the perforations on the strength and stiffness. The results are summarized in this bulletin, but the complete results are reported in *Flexural Strength and Stiffness of Acoustic Roof Decks*, Canadian Cold Formed Steel Research Group Report 06-09, June 2009.

The test matrix is provided in Table 1. The test specimen sizes were selected to be representative of the most common products used in Canada. Three tests were carried out in each configuration, resulting in a total of 24 tests.

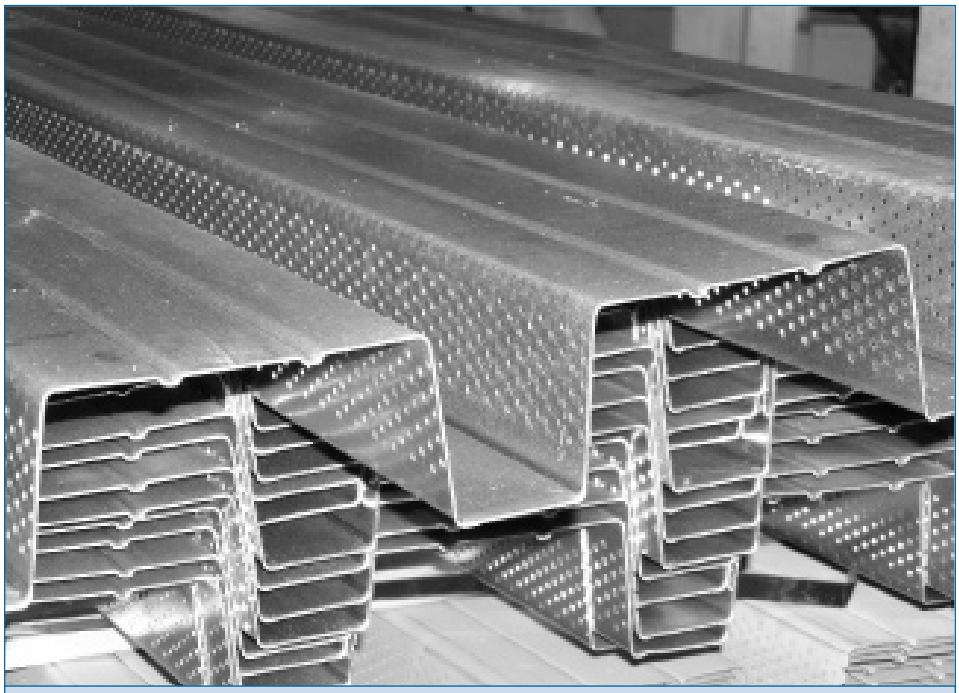

Figure 1: Photograph of Acoustic Deck

Deck Type	Deck Depth	Base Steel Thickness	Rib Spacing	Panel Width
Plain	38 mm (1.5 in.)	0.762 mm (0.030 in.) 1.22 mm (0.048 in.)	152 mm (6 in.)	914 mm (36 in.)
	76 mm (3 in.)	0.762 mm (0.030 in.) 1.22 mm (0.048 in.)	203 mm (8 in.)	610 mm (24 in.)
Acoustic	38 mm (1.5 in.)	0.762 mm (0.030 in.) 1.22 mm (0.048 in.)	152 mm (6 in.)	914 mm (36 in.)
	76 mm (3 in.)	0.762 mm (0.030 in.) 1.22 mm (0.048 in.)	203 mm (8 in.)	610 mm (24 in.)

Table 1: Test Matrix

Test Procedure and Results

The test procedure involved conducting two-point loading bending tests on simply supported deck specimens. All 38 mm (1.5 in.) deck specimens were 1.83 m (6 ft) in overall length and 914 mm (36 in.) in width, and all 76 mm (3 in.) specimens were 2.44 m (8 ft) in overall length and 610 mm (24 in.) in width. The two-point loading creates a constant moment region with no shear at mid-span between the loading points. Measurements were taken of the applied load and the resulting mid-span deflection for each test. In all cases failure at the ultimate load was caused by local buckling in the compression flange between the load points.

The effect of the web perforations on the **ultimate strength** was determined by comparing the failure loads for the acoustic deck to the failure loads for the corresponding plain deck. The test results showed that there was a reduction in the ultimate strength of the acoustic deck that depended on the deck depth and thickness. The thicker the base steel and the deeper the deck, the more effect the acoustic holes had on reducing the ultimate strength.

The effect of the web perforations on the **stiffness** of the deck was determined by comparing the slope of the load-deflection curves of the plain and acoustic deck in the initial linear region. A reduction in stiffness was observed that increased with the depth of deck but not the steel thickness.

Conclusions

Based on testing done for this program, CSSBI recommends the reductions shown in Table 2 for the 38 mm (1.5 in.) and 76 mm (3 in.) acoustic deck tested when product-specific data is not available. It should be noted that there may be variations in strength and stiffness reductions among the different steel deck manufacturers due to possible variations in rib geometrey, rib spacing and perforated band width.

Deck Depth	Strength Reduction (%)	Stiffness Reduction (%)
38 mm (1.5 in.)	5	No reduction
76 mm (3 in.)	10	5

Table 2: Acoustic Deck Reduction Factors versus Plain Deck

For More Information

For more information on sheet steel building products, or to obtain other CSSBI publications, contact the CSSBI at the address shown below or visit the website at www.cssbi.ca.