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Work Theme B: Structural engineering on modern steel construction
B3 International practice on engineering design and management

Project Title:

b) "Vibration Measurement and Modal Identification of Standing Seam Metal Roofing System and their Applications in Model Updating of the Clip Stiffness"

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Project Outline:

Under combined wind and temperature actions, the clips in certain regions of metal roofs may be subjected to severe repeated loads, and thus sustain damage. Advances in design methods make it reasonable to assume the structural adequacy of purlins in bending resistance, and therefore clip damage is one of the main concerns for this kind of roofs.

Visual inspection is currently the only way to detect damage in metal roofs. However, when inspections are carried out on the roof, clips are often hidden by metal panels, and, when carried out under the roof, they are often blocked by purlins and the lower parts of metal panels. Undetected clip damage can thus accumulate, significantly reducing the system's loading resistance and increasing the risk of catastrophic failure. Furthermore, clip damage reduces the stiffness of individual metal panels, resulting in differential movements at the seams and leakage.

When a clip is damaged, its stiffness is reduced. Changes in the stiffness distribution of a metal roof alter its dynamic characteristics. According to measured results from a full-scale metal roof test panel in (Tremblay et al., 2008), the changes in natural frequency resulting from clip damage are at a detectable level. It is therefore possible to detect damaged clips by calculating their stiffness values following the model updating method. To implement this idea in practice, it is necessary to develop a class of representative models to represent the dynamic behaviour of a metal roofing system.

There are three main objectives of the proposed project. They are:

1. To develop a modelling method that captures the dynamic behaviour of a metal roofing system.
2. To develop a full-scale indoor test panel of a metal roofing system for ambient tests in different damage scenarios.
3. To develop a system identification to extract useful dynamic characteristics from the measured vibration data of the metal roofing system.