Introduction
Cold-formed steel (CFS) has been widely used in buildings and bridges due to advantages of high strength-to-weight ratio, ease of fabrication and flexibility of sectional profiles, which lead to cost-effective designs and waste reduction.

Pre-buckling analysis
Bernoulli beam theory is used to conduct pre-buckling stress analysis on CFS channels under non-uniform temperatures.

Bernoulli equation:
\[ \frac{d^2 w}{d x^2} = \frac{M}{E I} \]

where:
- \( w \): deflection
- \( x \): length
- \( M \): bending moment
- \( E \): Young’s modulus
- \( I \): area moment of inertia

Nonlinear finite element analysis
Global buckling failure of simply supported CFS channel members under non-uniform temperatures were investigated. The failure modes were shown in consistence with the linear buckling modes given by modified FSM (Fig. 6 and Fig. 7).

Application of direct strength method
The DSM design formulas are examined using nonlinear FEA results. It was found that:
- For columns the DSM design curve proposed by Shahbazian and Wang[7] is applicable for slender members but would be unsafe for intermediate members.
- For beams the DSM design curve proposed by Kankanamge and Mahendran[5] for CFS under uniform temperatures would be unsafe when applied to the case of non-uniform temperatures.

Conclusions & future work
- Thermal bowing can significantly affect the global buckling behaviour but has almost no effect on the local buckling behaviour of columns.
- There is no remarkable difference in critical moment of local buckling between pure bending and UDL regardless the temperature distribution. However, considerable difference was found in critical moment of lateral-torsional buckling between pure bending and UDL.
- Fire expose surface has significant effect on the buckling of beams. The lowest critical buckling moment occurs when the fire is exposed on the compression side of the beam.
- Shift of buckling mode happens in beams when fire is exposed on the compressive side.
- Further FE analysis will be carried out on the failures of beams caused due to local and distortional buckling.

References