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Ultimate strength performance of plasterboard lined steel stud walls under fire conditions

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Summary

Fire safety of light gauge cold-formed steel frame (LSF) stud wall systems is critical to the building design as their use has become increasingly popular in commercial, industrial and residential construction throughout Australia. These walls are made of a cold-formed steel frame lined with multiple plasterboards (up to 4 on each side) and are often used as load-bearing walls. Currently there is limited design information on LSF load bearing walls for use by Australian engineers and designers. Hence LSF wall manufacturers depend on full scale fire tests using the standard fire curve based on ISO834 and AS1530.4 to determine the fire resistance rating of their wall systems. AS1530.4 recommends that wall elements must satisfy three fire resistance requirements, namely, stability (load-bearing capacity), insulation and integrity (protecting the unexposed side from high temperatures, smoke and flame).

In this research, a series of 12 full scale fire tests of plasterboard lined steel stud walls were undertaken. The steel stud wall systems were made of 1.15 mm G500 grade steel and 16 mm fire resistant plasterboards. If increased fire rating is required, it is common practice to add more layers of plasterboard and/or use cavity insulation. However, in this test series a new composite unit comprising of two plasterboards with a thin insulation layer between them was also used on each side of the steel frame. This was expected to give a higher fire resistance rating.

Our tests have shown that the fire limit state was always corresponds to the collapse of steel studs (stability criterion). The studs could not support the applied loads as their mechanical properties deteriorated with increasing fire exposure while the thermal effects and associated deformations and stresses intensified. This paper presents the details of the full scale fire tests of LSF wall systems and the results. It discusses in detail the failure of studs and associated thermal and structural interactions that determine the fire limit state of LSF stud wall systems. Simple design rules are proposed, which can be used to predict the ultimate strength of LSF stud wall systems under fire conditions.

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