

Fire Performance of KF57®

Composite slabs incorporating KF57® were tested by the Centre for Environmental, Safety and Risk Engineering to determine its insulation and integrity in accordance with the Building Code of Australia (BCA). It was found that ignition will not occur and the slab will achieve the necessary performance with respect to installation (provided the maximum temperature of the unexposed face does not exceed 275°). The standard fire tests concluded that KF57® slabs would achieve the fire resistance period for insulation and integrity for overall slab thickness as detailed below in Table 1.1.

Table 1.1 Minimum Slab Thickness (D_{CS}) for Insulation and Integrity

FRL (minutes)	Minimum Slab Thickness, D_{CS} (mm)
60	90
90	100
120	120
180	140

From the temperatures recorded on the top portion of the KF57® ribs, it was found that these ribs could contribute significantly to the positive bending capacity of the slab in fire conditions, thus reducing the area of additional bottom face reinforcing mesh required. The resulting reductions in reinforcing mesh areas are given below in Table 1.2.

Table 1.2 Reduction in Steel Mesh Area in Fire (mm^2/m) - KF57®

FRL (minutes)	Base metal thickness, t_{bm} (mm)		
	0.60	0.75	1.00
30	209	261	348
60	199	248	331
90	228	285	381
120	217	270	361
180	267	334	446

Testing

Standard fire tests were conducted on 120mm and 140mm thick KF57® composite slabs. These test slabs were three months old with a 28 day compressive strength of 27MPa and F81 mesh placed on top of the pans. The slabs were preheated to represent the longer term insitu moisture.

Combustible material such as cardboard, timber (pine) and nylon carpet were placed on the unexposed side of the slab in order to establish if these would ignite during testing. These combustibles were chosen as being representative of those likely to be in contact with the upper surface of the floor slab. The carpet (including its backing) was chosen as being representative of carpet with the least resistance to heating. Each were instrumented with thermocouples to give accurate measurements of temperatures within the slabs for various fire exposure periods.

The BCA specifies that floors must achieve satisfactory levels in the criteria of structural adequacy, integrity and insulation. These three criteria are defined in greater detail in AS1530.4. The performance objective and requirement associated with the provision of a fire-resistant floor is to prevent the spread of fire (upwards or downwards) for the nominated fire-resistance period. It is necessary that fire does not pass from one enclosure to the other, irrespective of whether this is due to collapse, formation of cracks and fissures, or excessive temperature rise.

A 120mm thick slab was exposed to standard fire tests of 120 minute duration, whilst a 140mm slab was exposed to standard fire tests of 180 minute duration. After testing, there were little signs of scorch marks and there was no ignition of the combustible materials. From observations, the formulation of the minimum slab thickness for insulation and integrity (Table 1.1) was obtained in accordance with the BCA, AS1530.4 and AS3600.

Contribution of Ribs

The contribution of the sheet steel ribs (the top portion of the ribs) was assessed by spot-welding thermocouples directly to the surface of the ribs to measure the temperature increase of the ribs under fire conditions. Table 1.3 summarises the temperature measured at various exposure periods, the values adopted for design and the corresponding strength reduction factor for the cold-formed sheeting, R_{sheet} .

Table 1.3 Strength Reduction Factor R_{sheet} at Top of Ribs

FRL (minutes)	Temperature at top of ribs		Strength reduction factor
	Average measured (°C)	Adopted value (°C)	R_{sheet}
60	295	300	0.95
90	400	400	0.82
120	490	500	0.56
180	590	600	0.35

Analysis

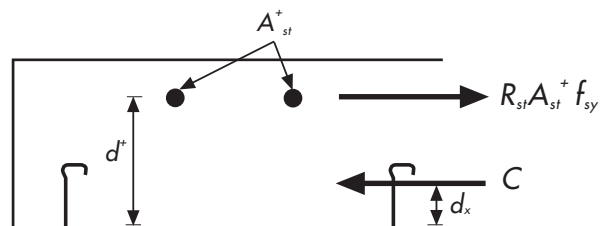
The following set of simplified equations have been formulated for the elevated temperature bending strength of both positive and negative moment regions of KF57® slabs. The method of analysis complies with the recommendations given in Clause 5.9 of AS3600.

$$\phi M_u^+ = \phi R_{st} A_{st}^+ f_{sy} d^+ \left[1 - \frac{0.6 R_{st} A_{st}^+ f_{sy}}{b d^+ f'_c} \right]$$

Negative Bending Capacity

$$\phi M_u^- = \phi R_{st} A_{st}^- f_{sy} (d^- - d_x)$$

Figure 1. Force Equilibrium in Negative Bending.



KF57® Composite Slab