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Enhance fire safety and cut costs with concrete protection systems - perfect for new build and retrofit applications

Concrete is well known for its high compressive strength. When reinforced with steel, it creates structural members such as loadbearing floors, columns, beams, and walls that have high resistance to deflection. However, with regards to fire resistance, maintaining adequate structural performance during a fire requires almost double the thickness of concrete needed compared to structures that are not exposed to fire. Heat transfer through the concrete or spalling, which leads to direct exposure of the steel reinforcing component, can cause structural failure during a fire event.

Figure 1 *- Unprotected concrete structural failure: exposure of steel reinforcing due to concrete spalling – (Fire spalling of concrete – A historical overview, Robert E. Jansson 2013).*

The Fire Resistance Level (FRL) or Fire Resistance Period (FRP) for concrete is defined by 3 criteria when subject to a standard fire endurance test:

- **Structural Adequacy,** the duration that the element will resist collapse
- **Integrity,** the duration that the element will prevent the passage of fire from one side to the other
- **Insulation,** the resistance to heat transfer from the fire exposed side of the element to the unexposed side

After the incipient fire, fires within a building often display three distinct phases - growth, steady burning, and decay. These phases vary significantly based on the fuel load, fuel type, and ventilation conditions.

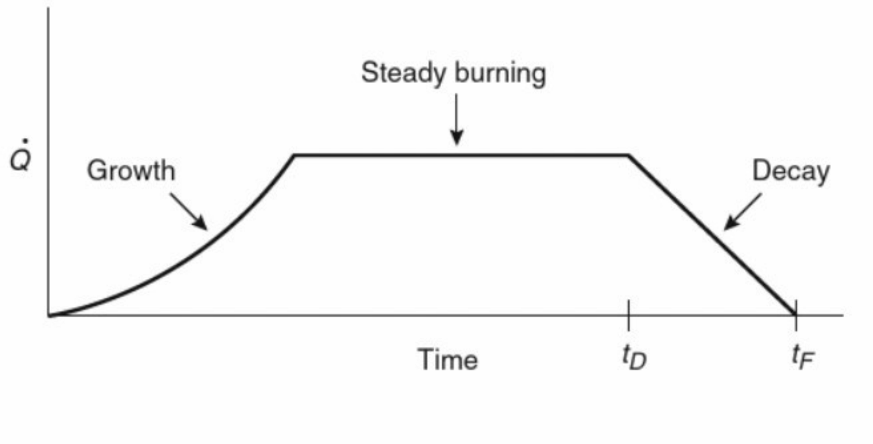


__Figure 2__ - Heat release phases of building fires, SFPE Handbook of Fire Protection Engineering, edited by Morgan J. Hurley, et al., Springer New York, 2015.

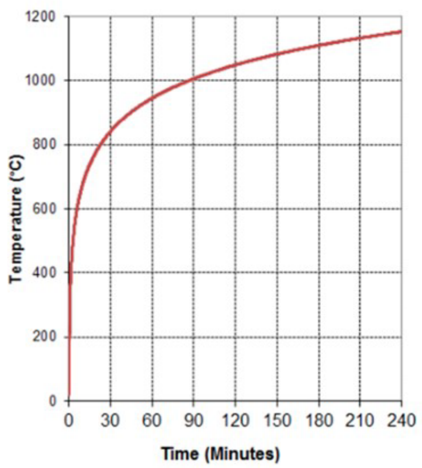
AS1530.4 provides a heating regime that, while not exactly representing the heat release rate profile of a true fire, enables the comparison and evaluation of the fire performance of protected and unprotected reinforced concrete construction elements. This is done by subjecting them to the same controlled exposure.

AS1530.4 (2014)

Standard Fire Endurance Test

T = 345 log10(8t + 1) + 20

345 x log10 (8 x 240 min +1) + 20 = 1153



Time (t) min	Prescribed furnace temperature (T), °C
0	20
5	576
10	679
15	738
30	841
60	945
90	1006
120	1049
180	1110
240	1153
360	1213

__Figure 3__ - AS1530.4 heating regime

__Table 1__ Compares the slab thickness requirements for a range of AS1530.4 fire exposure durations, and additionally describes the depth of concrete required to protect the embedded steel reinforcing (axis distance).

Table 1 - FIRE RESISTANCE PERIODS (FRP) FOR INSULATION AND STRUCTURAL ADEQUACY – ADAPTED FROM AS3600 (2018) , TABLES 5.5.1 & 5.5.2(a)			
FRP for structural adequacy (mm)	Fire Resistance periods (FRP's) for insulation for slabs	Minimum dimensions (mm) for structural adequacy for flat slabs including flat plates	
	Slab thickness	Slab thickness	Axis distance (a_s)
30	60	150	10
60	80	180	15
90	100	200	25
120	120	200	35
180	150	200	45
240	175	200	50

TBA Firefly™ Intubatt® Concrete Protection is a tested system that allows structural engineers to design fire-resistant concrete structures with a 40% reduction in concrete. Its superior insulation at high temperatures enables these structures to maintain their structural adequacy under fire.

Figure 4 *- Test specimen with 1200 x 600 x 500mm TBA Firefly™ Intubatt® installed – ready for 240 minutes exposure (Warringtonfire FRT210062)*

The TBA Firefly™ Intubatt® is an innovative and lightweight system designed for fire stopping large holes in floors and walls, as well as linear gap seals. It is a 50 mm thick mineral fibre board made from basalt rock with an endothermic and ablative coating on each side. This system enables a reduction in concrete thickness for fire-exposed concrete while maintaining structural adequacy due to its superior insulation at high temperatures.

Recently, this system was tested to AS1530.4 (2014) using a 120 mm thick concrete slab protected with a 50 mm lining of TBA Firefly™ Intubatt®. The slab was then subjected to 4 hours of the AS1530.4 (2014) fire endurance curve, which reaches 1153^{o}C at 240 minutes.

Additionally, the slab was point loaded with 2400 kg, and the deflection and temperatures were measured at critical locations.

The test data shows that 50 mm TBA Firefly™ Intubatt® installed on the underside of floors or both sides of walls can upgrade 100 mm concrete steel-reinforced elements to provide 240/240/240 and provide equivalent insulation to 145 mm of concrete for 4 hours of fire resistance protection.

Figure 5 – Cross section / Arrangement of 120 mm thick reinforced concrete floor slab with 50mm thick TBA Firefly Intubatt fastened to the underside (exposed side).

Figure 6 – Point loading of the slab whilst on the furnace

Figure 7 – View of the fire exposed side at the conclusion of the test

The TBA Firefly™ Intubatt® system offers several benefits for building designers

Firstly, it can be used as a potential retrofit for changing the building use or occupancy. In cases where a change of building classification type requires a greater FRL of floors and walls, the system can be installed to meet the necessary requirements.

Secondly, for new builds, the system enables lighter structures with a 40% reduction in concrete mass while achieving equivalent fire resistance through the incorporation of TBA Firefly™ Intubatt® protection. This can lead to cost savings in materials and construction time.

Finally, the system also allows for thinner floors, saving up to 100 mm per floor where an unprotected 250 mm floor slab would be required. This reduction in thickness can provide additional cost savings and increased design flexibility.

Gavin Williams, Technical Manager, TBA Firefly™

Our updated RIR is readily accessible via the TBA Firefly App, or by contacting us at sales@tbafirefly.com.au or 02 8004 3333 for further information.

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