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SC902 Technical Advisory Note – PTA004

Intumescent Coat Back onto Secondary Members

Joints and connections are critical components of a structure which must be fire rated adequately to prevent progressive collapse of a structure under fire attack. AS4100 Cl12.10.1 requires connections to be fire protected with the maximum thickness of fire protection material needed by the connecting members [1]. In some cases when fire protected beams or columns interact with non-fire rated steel elements, there is a question regarding how the uncoated member should be treated.

Steel is a thermally high conductive material which if left unprotected and exposed to fire can result in rapid loss in strength and stiffness. For this reason, structural steel is fire rated to maintain its structural adequacy. Where intumescent coated steel meets unprotected steel there is concern that the unprotected steel can cause thermal transfer into the fire rated member. This configuration is usually found in circumstances where primary steel requires fire rating, but secondary members do not. This is depicted in Figure 1. below.

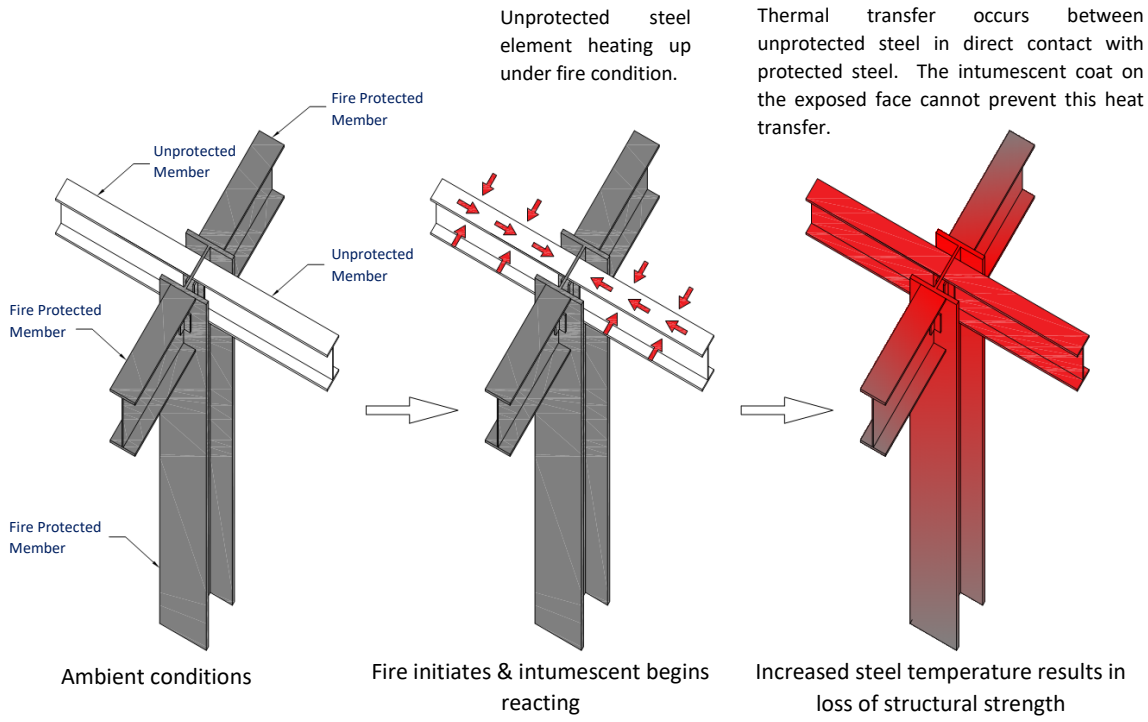


Figure 1. Unprotected steel in contact with protected steel.

A steel framed building may also have unprotected secondary beams when incorporated in a fire engineered design. For example, this can be achieved in designs where the composite floor has tensile membrane action, or the load ratio and fire severity are controlled by active systems.

In these particular design configurations, Permax recommend that **500mm of coat back** is provided onto the uncoated secondary member, in either direction to prevent heat transfer to the primary steel, as shown in Figure 2.

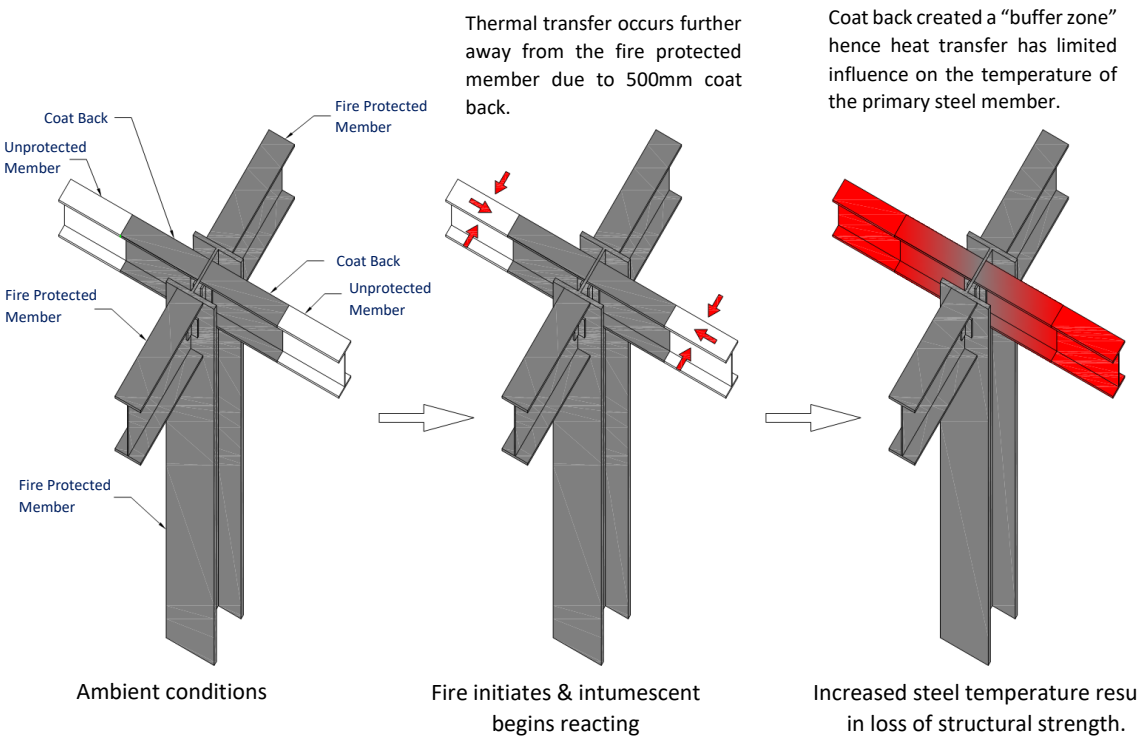


Figure 2. 500mm Coatback onto unprotected steel members.

More information on this requirement is explained below, in terms of industry standards and testing evidence.

Industry Guidance

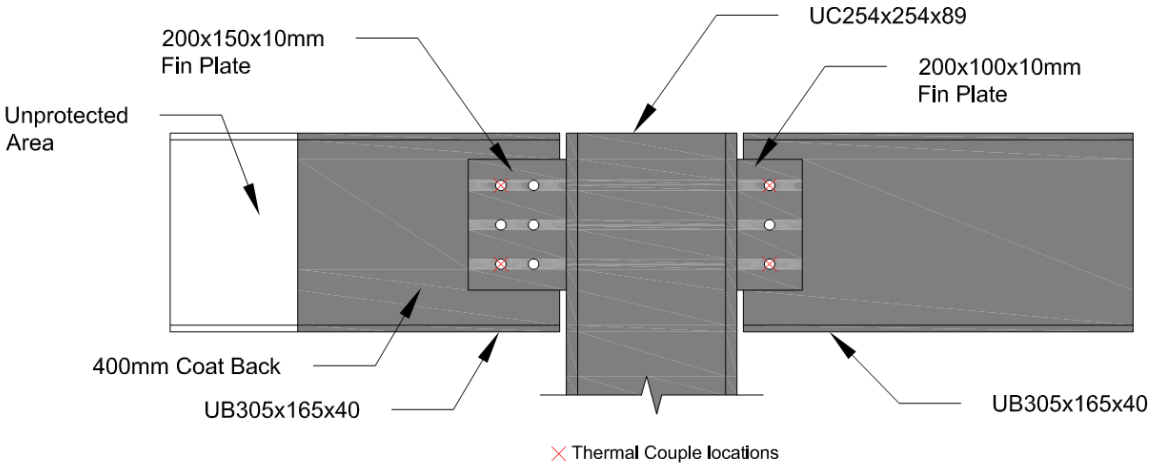
In the absence of Australian standards and regulations in regard to coat back onto secondary members, Permax must reference technical guidance documents generated by the Association of Specialist Fire Protection (ASFP) to recommend the required coat back distance.

The ASFP Technical Guidance Document 8 (TGD 8), Code of practise for specification & on-site installation of intumescent coatings for fire protection of structural steelwork, states the following:

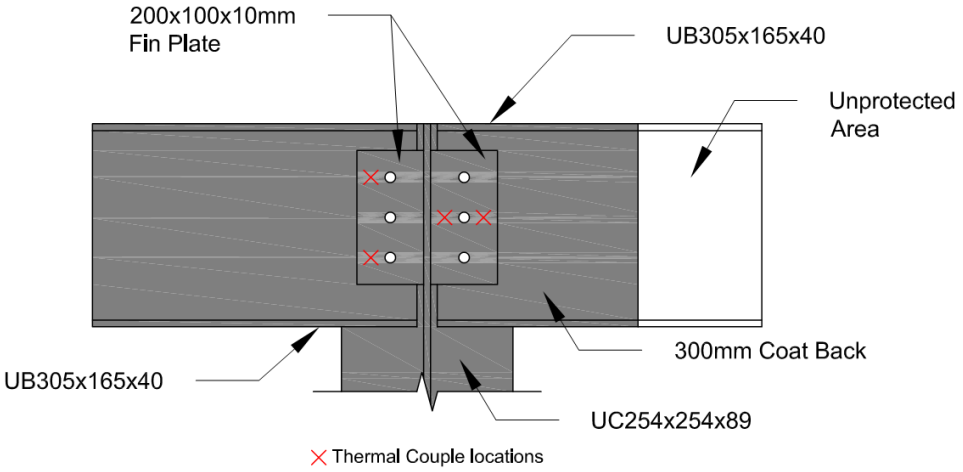
> ***"The potential for heat transfer from unprotected structural steel into protected structural steel must be considered. It is normally considered good practice to protect the adjoining 500mm of 'unprotected' structural steel to limit unwanted heat transfer."*** *[2]*

Testing Evidence

An experimental study has been conducted by researchers at The University of Manchester on the effects of partial fire protection on temperature developments in steel joints protected by intumescent coatings. The research involved fire tests on steel joints with different lengths of intumescent coat back and comparing it to a system with the full beam and column coated [3]. Figure 3. below describes the coat back configurations tested.



(a) 400 mm coat back test configuration



(b) 300 mm coat back test configuration.

Figure 3. Tested Coat Back Configurations

The following configurations were tested and compared with one another:

1. Fully coated beam and column section.
2. Coated column and coat back of a short segment onto secondary steel.
3. Full protection of structural column only.

Thermocouples were placed at the cleat plates to determine the difference between the temperature profiles for the above configuration. The two lengths of coat back tested were 400 mm past the column and 300 mm past the column onto secondary members, with an undisclosed intumescent product applied to achieve a 60 minute FRL for a 550C critical steel temperature.

It was found that the difference in temperature curves at the joints for the partially 400 mm protected beam and fully protected beam was approximately 20°C [3]. This indicated that a length of 400mm coat back was able to effectively achieve almost full protection to the connection components for the 60 minute FRL [3].

When comparing the temperature at the joint of the fully coated beam and column with the 300mm partially protected beam and column, the temperature difference was 50°C [3]. Therefore, indicating a higher steel temperature at the joint which could affect the full fire protection of the connection. When only the column was protected, with no coat back, the temperatures in the connection joints were substantially higher than a fully protected joint with coat back. This is due to the heat conduction through the unprotected connection components and beam [3].

Permax Conclusions

The experimental investigation referenced above proved that, in order to ensure the primary member and joints perform as a fully protected member, without compromising the fire protection a coat back distance should be provided.

Permax can advise that a coat back of 500mm is recommended to prevent heat transfer based on the industry guidelines and test evidence discussed herein.

Please contact Permax directly if the reader is interested in accessing any of the referenced literature.

References

[1] Standards Australia , *AS4100-1998 Steel Structures,* NSW: Standards Australia, 1998.

[2] Association for Specialist Fire Protection, *TGD 8- Code of practice for junctions between different fire protection systems when applied to load bearing structural steel elements.,* Association for Specialist Fire Protection, 2010.

[3] Y. W. C. B. X.H. Dai, “Effects of Partial Fire Protection on Temperature Developments in Steel Joints Protected by Intumecent Coating,” *Fire Safety Journal,* vol. 44, pp. 376-386, 2008.