



ASFP TECHNICAL GUIDANCE NOTE 009:2008

Guidance note for the fire protection of steel beams with web openings

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‘Fire protection of steel beams with web openings’

In the last five years there have been many developments in the fire protection of beams with web openings. For most cellular beams, i.e., beams with circular openings, fire protection requirements can be ascertained using simple tabular guidance, based on product specific testing to the ASFP fire test protocol for beams with circular web openings. *However, for beams with rectangular openings or with a combination of circular and rectangular openings, there are no straightforward methods for assessing the fire protection requirements.* Structural designers should make themselves aware of the limitations of current fire design guidance when designing beams with web openings that will require fire protection. If the beam geometry required is outside those limits then the structural designer should make arrangements to supply the appropriate limiting temperatures to the fire protection specialist.

This ASFP Guidance Note provides an overview of the SCI publications that have appeared and in some cases been withdrawn as the work on the fire resistance of these structural members has progressed. It also reviews the design options that are available for beams with web openings and provides advice on sources of further information where required, but it provides no new guidance.

The procedure for testing and assessing the performance of reactive coatings (intumescent paints) for use on cellular beams has now been developed by ASFP in consultation with SCI and the fire testing laboratories. A number of intumescent coating manufacturers have tested their products in accordance with this testing protocol. Given this development SCI believe it is appropriate to withdraw their generic guidance for the fire protection of cellular beams in favour of product-specific guidance.

Published Design Guidance

As research in the area has developed, a number of documents offering design guidance have been produced; these are summarised in the table below and their status given.

SCI Ref	Description	Status
AD269	Interim guidance on the fire protection of beams with circular web openings	Withdrawn
RT983	Interim guidance on the fire protection of beams with circular web openings	Withdrawn
RT1006	Commissioned by Westok Ltd to extend the scope of the guidance given by RT983 for beams designed using Cellbeam	Withdrawn (see AD308)
AD299	Provides background information on the development of RT1085	Current
RT1085	Published as a replacement to RT983.	To be withdrawn April 2008
AD308	Notification of the withdrawal of RT1006. Generic temperatures for Westok beams are no longer required as ‘Cellbeam Automate V6.1’ now includes a fire design module.	Current
RT1187	This document will describe the basis of the product-specific design guidance currently available from intumescent manufacturers	To be published

The ASFP 'Yellow Book' entitled 'Fire protection for structural steel in buildings: 4th Edition' includes new guidance on the fire protection of cellular beams and castellated sections. Section 6 of that document includes Section 6.1 providing guidance for the use of boards and sprays and relies on the provision of the Limiting Temperature by the designer, whereas Section 6.2 provides guidance for intumescent coatings. Section 6.3 describes the fire testing protocol for reactive coatings.

Design Methods

For optimum economy and structural safety, the structural engineer should give the fire protection supplier appropriate limiting temperatures for each structural member, on the drawings and in the fire protection specification. This is particularly important for beams with large web openings, as the limiting temperatures depend on the beam geometry, load level and load distribution properties with which the structural designer will be more familiar than the fire protection specialist.

The SCI recommends that limiting temperatures for beams with web openings protected using an intumescent coating are obtained using one of the following three options. These design options are not new guidance and have been described previously in AD299. In all cases SCI recommend that the fire protection product applied to the steelwork should be tested and assessed in accordance with the ASFP protocol for cellular beams.

If fire protection requirements cannot be ascertained using Option 1 (limited to beams with circular openings) or Option 2, *structural designers should take responsibility for determining limiting temperatures using the advanced analysis methods described in Option 3.*

Option 1: Tables of limiting temperatures, used for beams with circular openings.

Simplified guidance is available from the intumescent fire protection manufacturers in the form of tables of limiting temperatures from product specific RT's, *but only for beams with circular web openings and geometrical limitations apply to the positions and sizes of the openings.* The structural designer should supply suitable information on the geometry and loading, to enable the fire protection manufacturer to determine an appropriate limiting temperature for the beam. Further advice is given in RT1187.

Option 2: Proprietary Software

Proprietary beam design software that explicitly calculates the load carrying capacity for beams with web openings at the fire and ultimate limit states may be used. The development of such software should be based on the observed temperature distribution throughout similar beams for different coating thicknesses and the observed performance of beams in loaded fire resistance tests. The software will usually provide the values of limiting temperature [*sometimes the fire protection system thickness will be provided*] that are needed for the structural drawings and the fire protection specification.

Proprietary software that covers the room temperature and fire design of their particular product is currently available from Fabsec and Westok. It should be noted that the results of analysis based on proprietary software are only applicable to that structural product protected in accordance with the guidance provided by the software supplier.

Option 3: Advanced analysis [the option for rectangular openings]

Beams that are outside the scope of the fire protection manufacturers product-specific limiting temperature tables (notably beams with rectangular or elongated circular openings) and which have not been designed using proprietary software will need to be evaluated using advanced analysis in order to determine the appropriate limiting temperature. As this advanced analysis is closely related to the structural design it should be undertaken by the structural designer or a suitability qualified consultant.

The structural model used for this purpose should take account of all practical modes of failure for beams with web openings and the thermal model should permit a suitable temperature distribution to be applied to the cross section. The thermal model should take account of the increase in temperature of the web posts relative to the flanges and the effect of section asymmetry on top flange temperature. The performance of the intumescent coating applied to the beam should be compatible with this assumed temperature distribution used in the structural analysis. *This can only be proven by demonstrating stickability using the appropriate web post widths in loaded fire tests.* Data on the appropriate temperature distribution may be obtained from fire tests on protected sections or alternatively the thermal distribution given in RT1187 may be applied.

References

1. The ASFP publication 'Fire Protection for Structural Steel in Buildings: 4th Edition' is available from www.asfp.co.uk and can be downloaded free of charge. Printed copies can be provided at a nominal charge
2. All the Advisory desk notes (including the withdrawn notes) and current Steel Construction Institute reports are available on www.Steelbiz.org.
3. This Guidance Note is largely based on Steel Construction Institute AD 319 which was subsequently published in New Steel Construction March 2008



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