

JUNE 2021

Fire Protection of Structural Steel

FP®-900 / FirePro®

FIRE RESISTING CONSTRUCTIONS
Solutions & Technical Manual



SOBEN INTERNATIONAL

High Performance Building Boards & Solutions for Sustainable Construction



Building With Confidence

A new benchmark for eco-friendly autoclaved cellulose fibre reinforced silicate matrix boards

Few versatile performance building boards offer both architectural envelope and strong technical specification as credible as the Soben International premium product range of eco-friendly autoclaved cellulose fibre reinforced silicate matrix boards. The line includes: fire protection calcium silicate boards, weather resistant fibre-cement boards and prefabricated panels. Since its establishment, Soben International has been a pre-eminent developer and manufacturer of high quality eco-friendly silicate matrix board solutions and has set a new benchmark for comparable products made in Asia.

With extensive product research and testing, our areas of expertise are sophisticated building solutions that tackle fire protection, multi-purpose constructions, façades and claddings where aesthetic finish and quality are of paramount importance.

Soben International high performance boards have been fully tested and certified by first class accredited laboratories and third party certification bodies to testify our commitment to performance, delivery of quality, and health and safety.

STRIVING FOR QUALITY PRODUCTS & PROFESSIONAL EXCELLENCE

FIRE-SAFE

Soben International Boards are prime protectants against fire damage. The range's high levels of fire resistance has been thoroughly tested and certified by official European laboratories.

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Quality Control and Quality Assurance programmes are in place in all Soben International divisions to guarantee that all orders of our fully tested products and solutions follow their ISO 9001, 14001 and CE Mark standards.

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Standing at the forefront of environmental innovation, Soben International is committed to sustaining and developing a commendable CSR record. Our solutions for eco building and sustainable development projects have all been certified by the appropriate Green Label authorities.

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REGISTERED TRADE MARK

FP®-900 is a registered trade name for the product marketed in Europe.

FirePro® is a registered trade name for the product marketed in Asia.



FP® FIRE RESISTING CONSTRUCTIONS

FP -900®/FIREPRO® FIRE PROTECTION OF STRUCTURAL STEEL

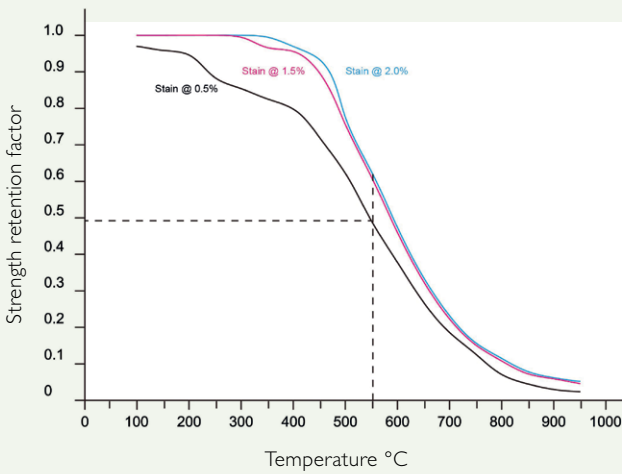


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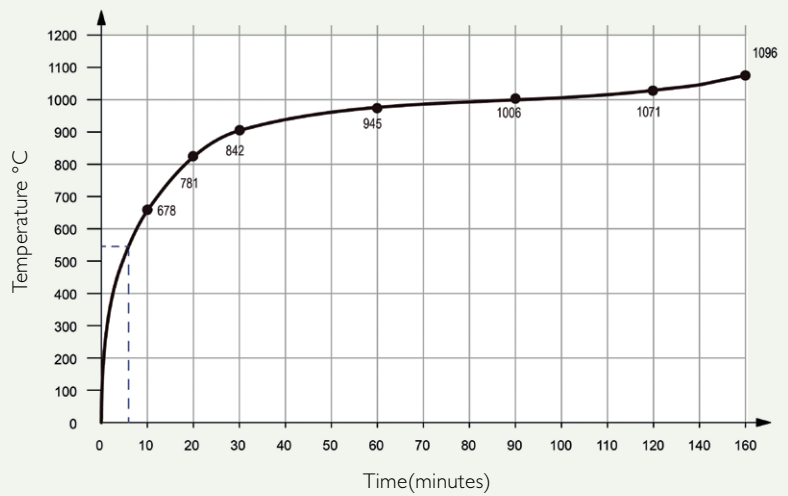
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FP®-900/FIREPRO® STRUCTURAL STEEL FIRE PROTECTION SYSTEMS

Fire protection of structural steel ensures structural adequacy of a loaded steel member or structure when it is exposed to fire. Steel in high temperature would lose its strength. Reduction of steel strength accelerates fast in elevated fire temperature beyond 400 °C. Default critical temperatures for steel columns and beams are 550 °C and 620 °C respectively in accordance with BS 5950: Part 8: Code of Practice for Fire Resistance Design. The steel strength retention is about 50% when the steel is heated up to the temperature at 550 °C. According to the cellulosic fire curve ISO 834 for a standard fire test of building elements, fire generates heat to reach the critical temperature of steel just a few minutes. Continuing high temperature would cause a failure of loadbearing capacity of an unprotected steel.



Strength retention factors for steel grades S275 to S355 of BS EN 10025 and BS EN 10210-1



Fire time-temperature curve, Cellulosic ISO 834



FP®-900/FirePro® fire protection of Steel Beam testing according to EN 13381-4.

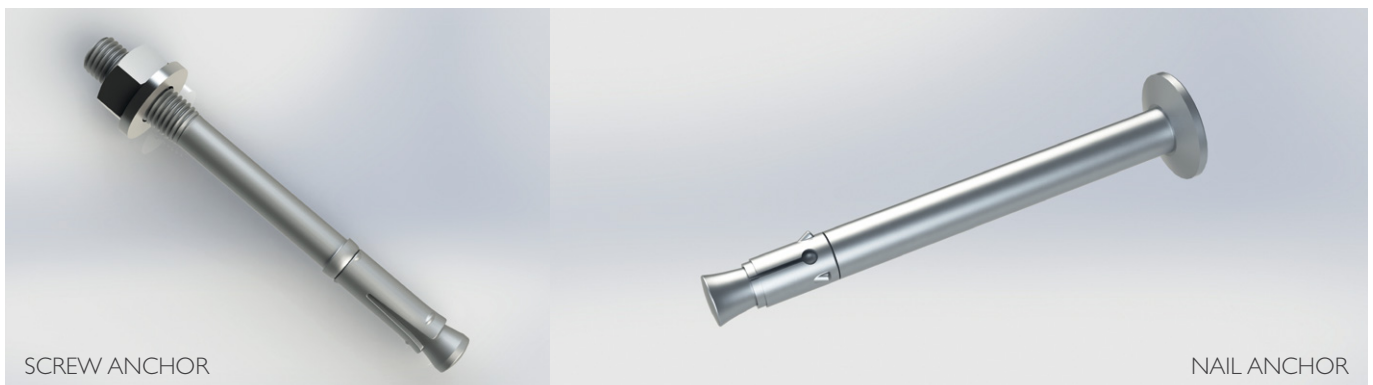
FP®-900/FirePro® provides fire protection of structural steel up to 240 minutes fire resistance rating. A series of FP®-900/FirePro® structural steel fire protection systems have been tested and developed to comply with a few countries' national fire standards, of which include BS 476: Part 21, EN 13381-4 and AS 1530.4. This technical manual focuses on FP®-900/FirePro® box protection systems in terms of BS 476: Part 21 and the current requirements in the UK for fire protection of structural steel stipulated in the 5th Edition of ASFP's Yellow Book. The Yellow Book had extensively elaborated the criteria of fire testing and extension of field applications of the steel protection systems both in British and European Standards. For further technical information of FP®-900/FirePro® structural steel protection systems in European or Australian Standard, please contact Soben International.

Similarly, the standard BS 476: Part 23: "Methods for determination of components to the fire resistance of a structure" defined the use of suspended ceilings for fire protection of structural floors with steel beam supports. For further information please read in conjunction with the Technical Manual for FP®-900/FirePro® ceilings and floors.

CONSIDERATIONS FOR FP®-900/FIREPRO® FIRE PROTECTION OF STRUCTURAL STEEL

Structural Steel	Fire protection is applicable to steel sections including structural steel beams, columns among other steel sections.									
Applications	FP®-900/FirePro® fire protection systems provide one to four sided fire protection of structural steel from 30 minutes to 240 minutes as well as various design temperature levels ranging from 350 °C to 750 °C.									
Fire Resistance	The protected structural steel elements are required to comply with a fire resistance performance in terms of BS 476: Part 2 I and the principle of 5 th edition of ASFP Yellow Book - Fire Protection for Structural Steel in Buildings.									
Board Thickness	The required FP®-900/FirePro® board thickness for a protected steel member is subject to the fire rating required and Am/V section factor of the steel.									
Steel Fastener	Size of self-tapping screws for fastening FP®-900/FirePro® boards to light gauge steel sections should have at least M3.5 at nominal 200mm centres. The steel screws should be zinc coated for rust resistance. Stainless steel fasteners are recommended at severe humid areas.									
Shot Fired Fastener	Shot fired fastening had been incorporated in FP®-900/FirePro® structural steel fire protection system testing. The light gauge steel sections are attached to the protected steel or supporting constructions with shot fired nails Ø 3.7 x minimum 16mm long at nominal 350mm centres.									
Steel Anchors	All-steel anchors are M6 expansion type. The minimum depth of engagement of the anchor into supporting constructions of concrete or masonry structures with respective to the fire ratings as follows.									
	<table border="1"> <thead> <tr> <th>Fire rating – minutes</th> <th>mm</th> <th>Minimum depth of anchor - mm</th> </tr> </thead> <tbody> <tr> <td>30 ~ 120</td> <td></td> <td>30mm</td> </tr> <tr> <td>180 ~ 240</td> <td></td> <td>40mm</td> </tr> </tbody> </table>	Fire rating – minutes	mm	Minimum depth of anchor - mm	30 ~ 120		30mm	180 ~ 240		40mm
Fire rating – minutes	mm	Minimum depth of anchor - mm								
30 ~ 120		30mm								
180 ~ 240		40mm								
Fire Rated Sealant	Where FP®-900/FirePro® fire protection boards abutting perimeter wall or floor constructions should be jointed tightly. In case of the construction surface is uneven, fire rated sealant should be applied to seal up any gaps at the joints. The sealant should be tested in accordance with BS 476: Part 20 or equivalent approval.									

TYPES OF ALL-STEEL EXPANSION ANCHOR



SCREW ANCHOR

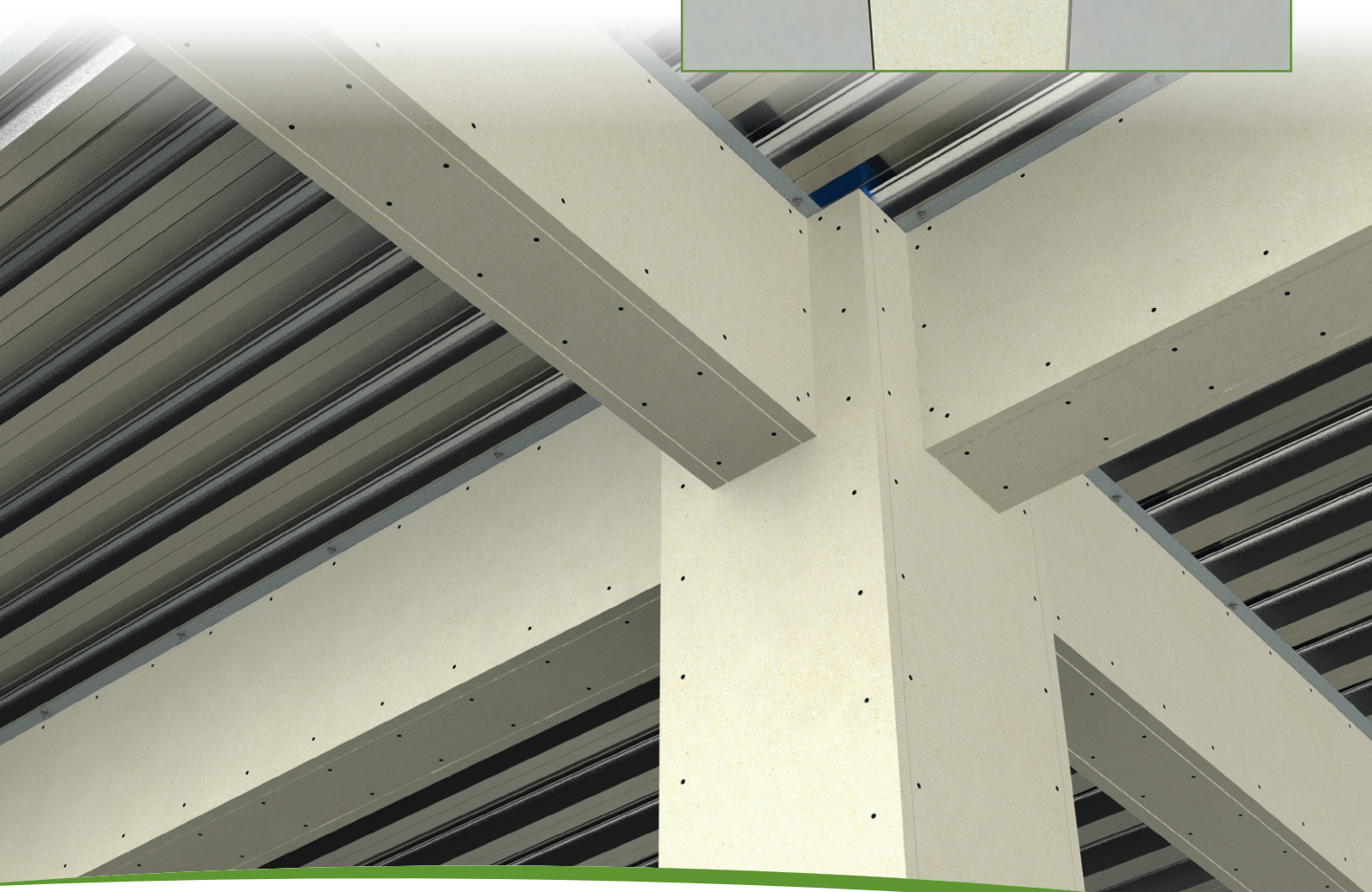
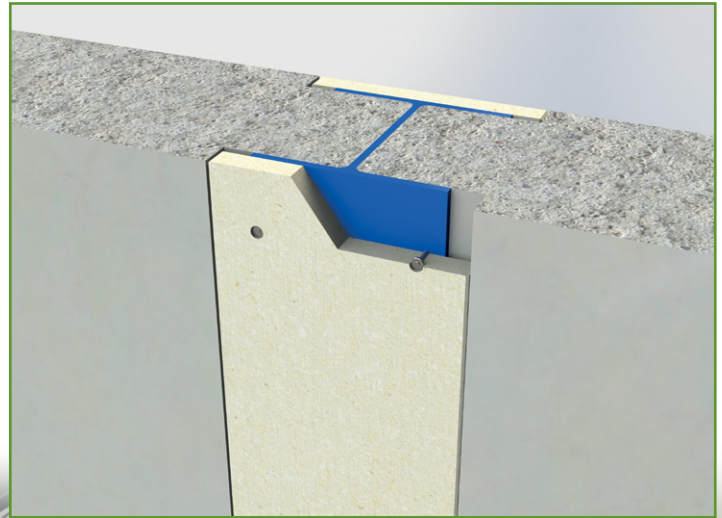
NAIL ANCHOR

FP®-900/FirePro® Fire Protection of Structural Steel STEEL ENCASEMENT



FIRE RATING

FRL	Up to 240 minutes
Standard	BS 476: Part 21
Approval	FIRES-FR-167-17-AUNE
	FIRES-FR-184-18-AUNE
	FIRES-AR-007-NUPE3
	FIRES-2019-004
	Warringtonfire WF 413009



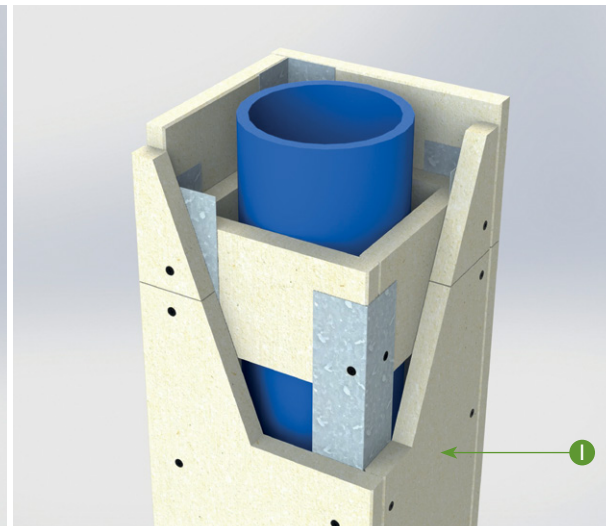
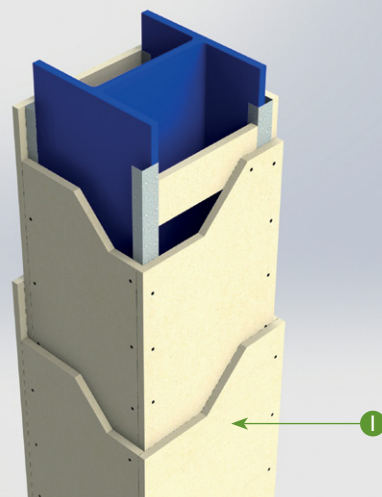
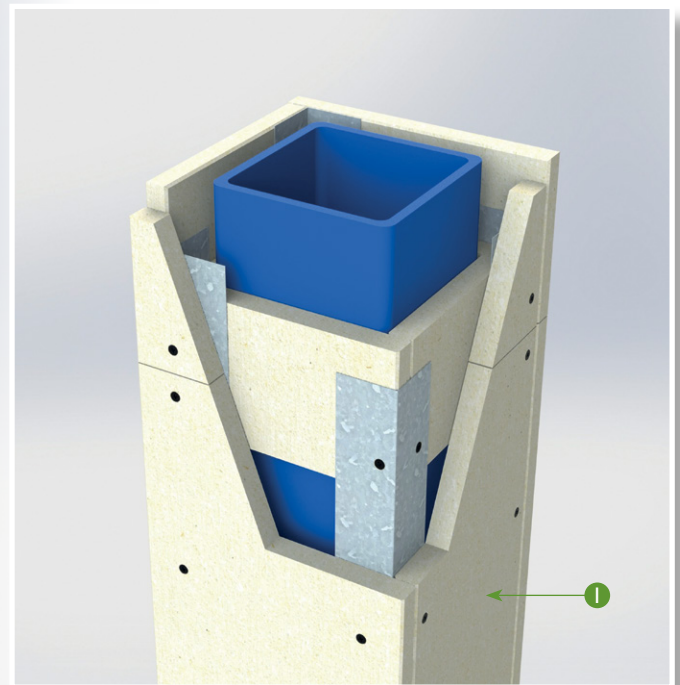
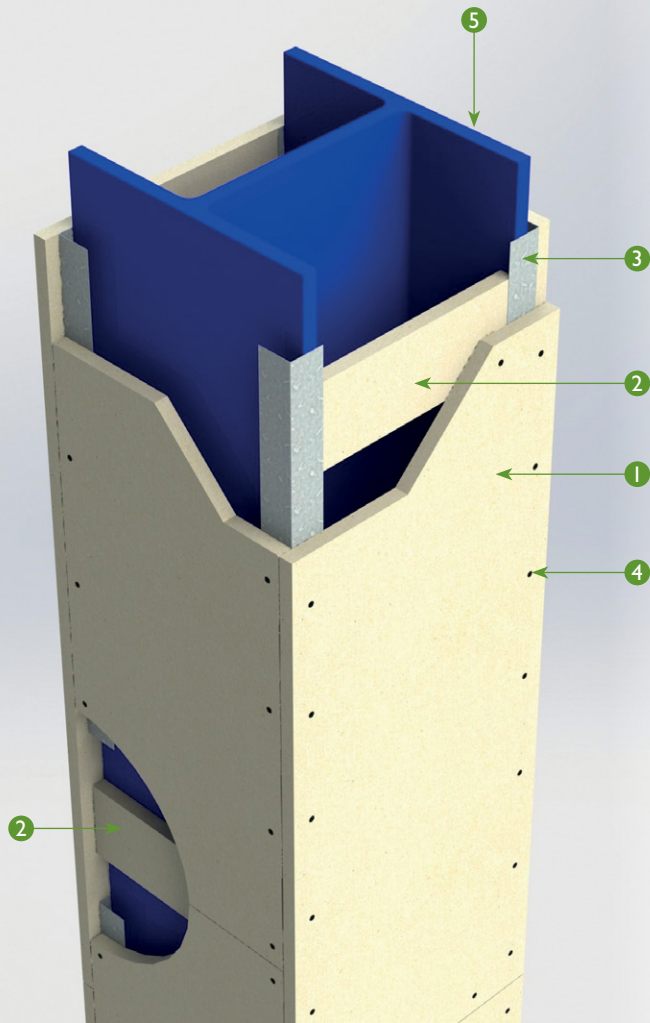
FP®-900/FIREPRO® STEEL ENCASEMENT

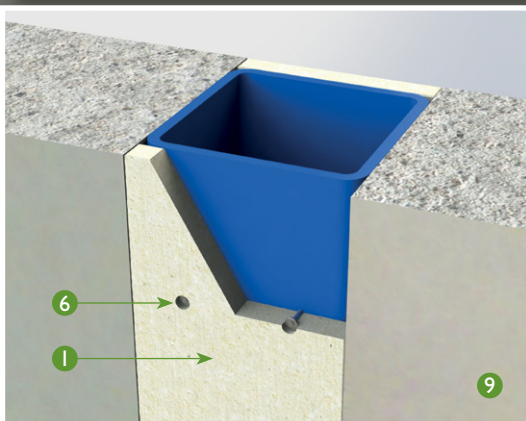
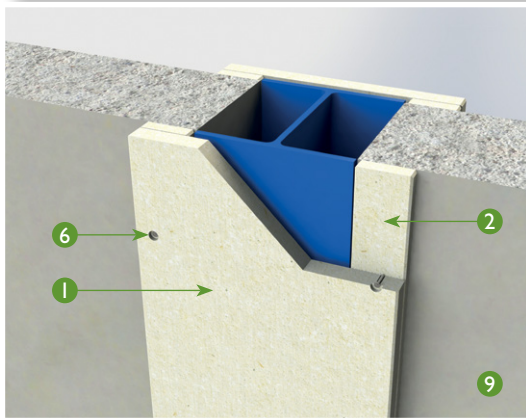
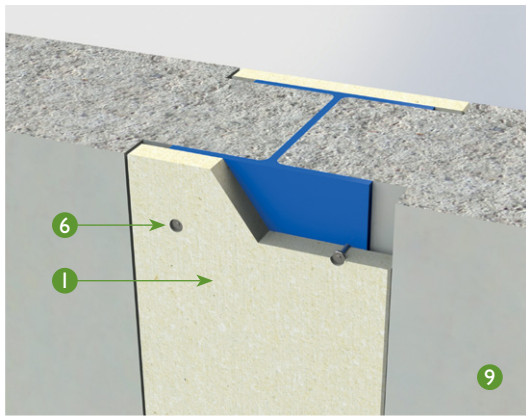
FP®-900/FirePro® fire protection steel systems may consist single layer or two-layer of FP®-900/FirePro® board for steel encasement subject to the A/V section factor and fire rating required for a steel section. Auxiliary light gauge steel profiles for board fixing ensure that the protective boards are firmly attached to the steel section of which may be severely deflected in the fire. Nonetheless, the auxiliary steel profiles do not apply on, either the boards directly fixed onto the supporting construction or small sections with steel flange width less than 100mm which edge fixing is adopted..

FIRE PROTECTION OF STEEL COLUMNS

FOUR SIDED FIRE PROTECTION OF COLUMNS

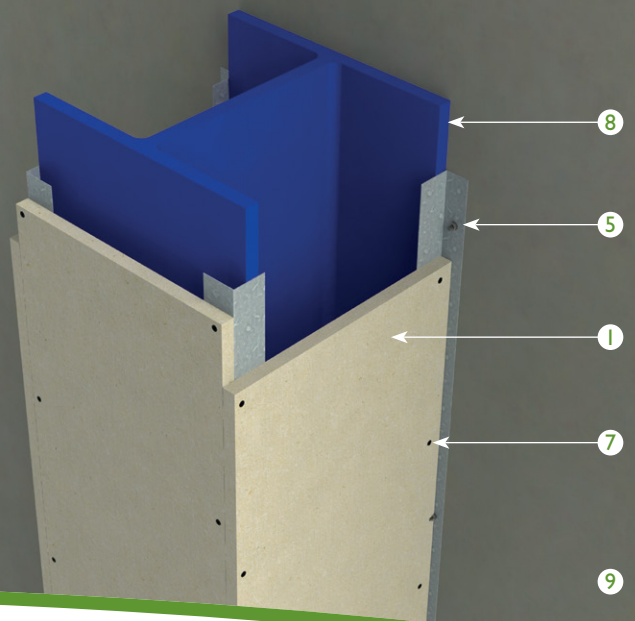
1. FP®-900/FirePro® board in single or two-layer
2. FP®-900/FirePro® backing strip 100mm wide at board joints
3. Light gauge steel profile
 - U-channel 50mm web x 32mm flange x 0.5mm thick, or
 - Angle minimum 30mm x 30mm x 0.5mm thick
4. Self-tapping screws minimum M3.5 x 35mm at nominal 200mm centres
5. Steel column



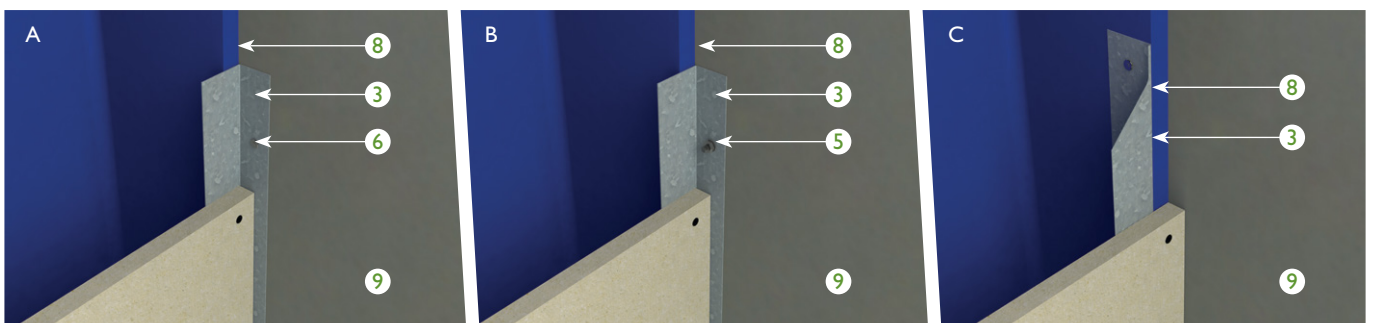


ONE TO THREE SIDED FIRE PROTECTION OF COLUMNS

1. FP®-900/FirePro® board in single or two-layer
2. FP®-900/FirePro® strip minimum 50mm wide
3. Light gauge steel profile
 - U-channel 50mm web x 32mm flange x 0.5mm thick, or
 - Angle minimum 40mm x 40mm x 0.5mm thick
4. Angle minimum 40mm x 40mm x 0.5mm thick fixed onto the wall or steel column
5. M6 screw anchors at nominal 500mm centres or
6. Shot fired nails minimum Ø 3.7 at nominal 350mm centres.
7. Self-tapping screws minimum M3.5 x 35mm at nominal 200mm centres
8. Steel column
9. Masonry wall / fire rated wall



Alternative fixing to the supporting construction

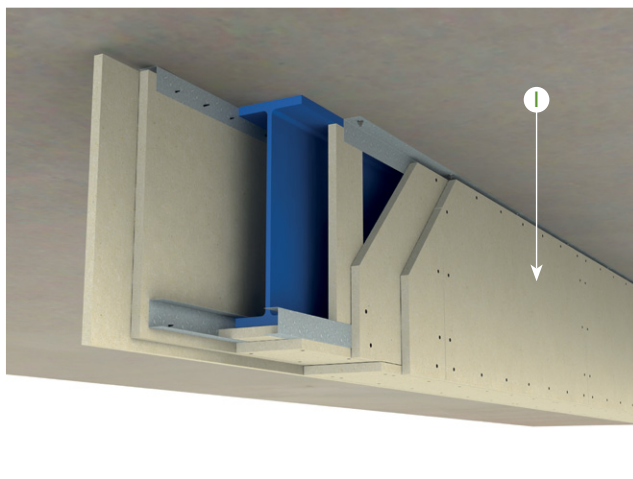
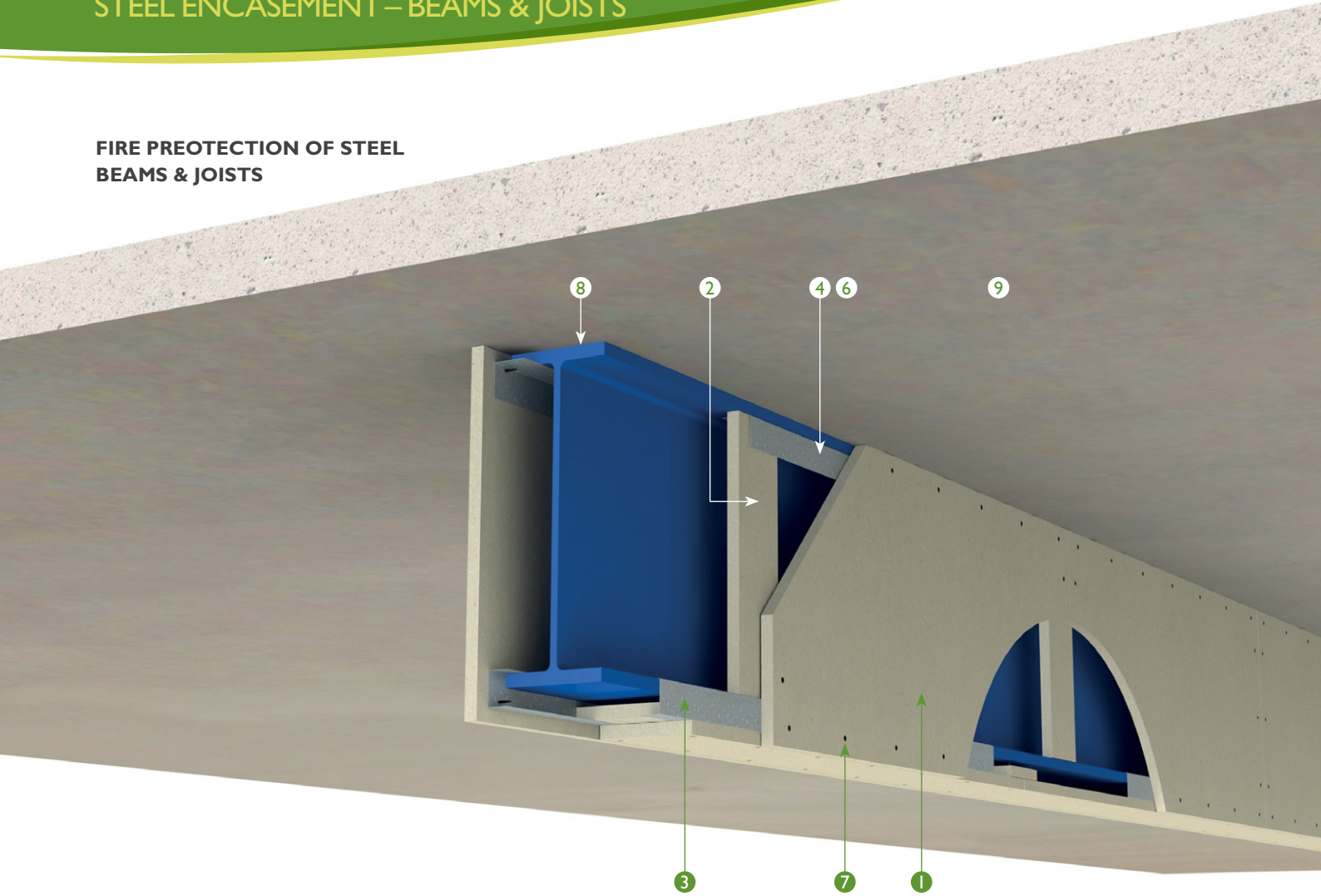


FP®-900/FirePro®

Fire Protection of Structural Steel

STEEL ENCASEMENT – BEAMS & JOISTS

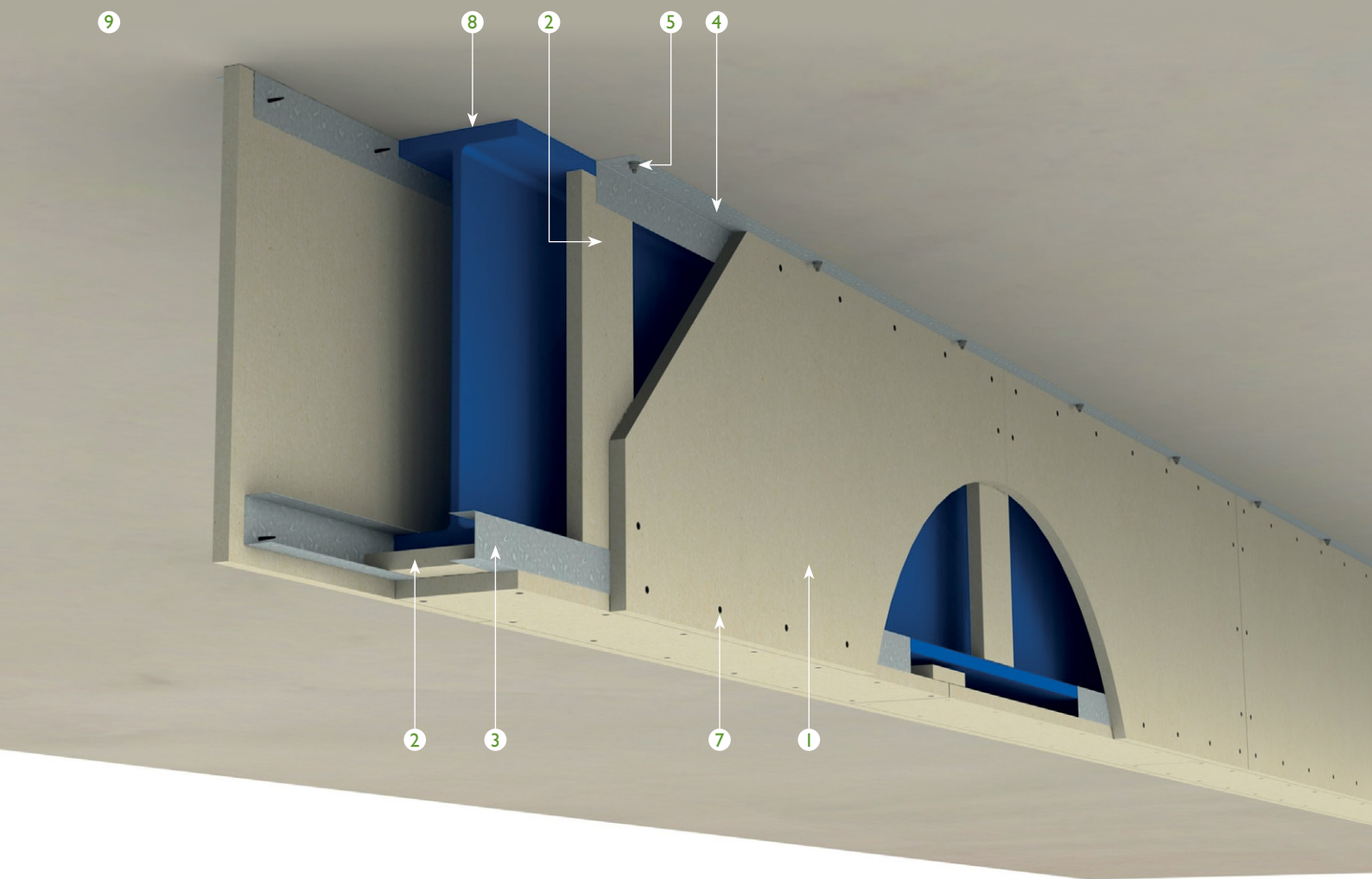
FIRE PROTECTION OF STEEL BEAMS & JOISTS



ONE TO THREE SIDED FIRE PROTECTION OF BEAMS

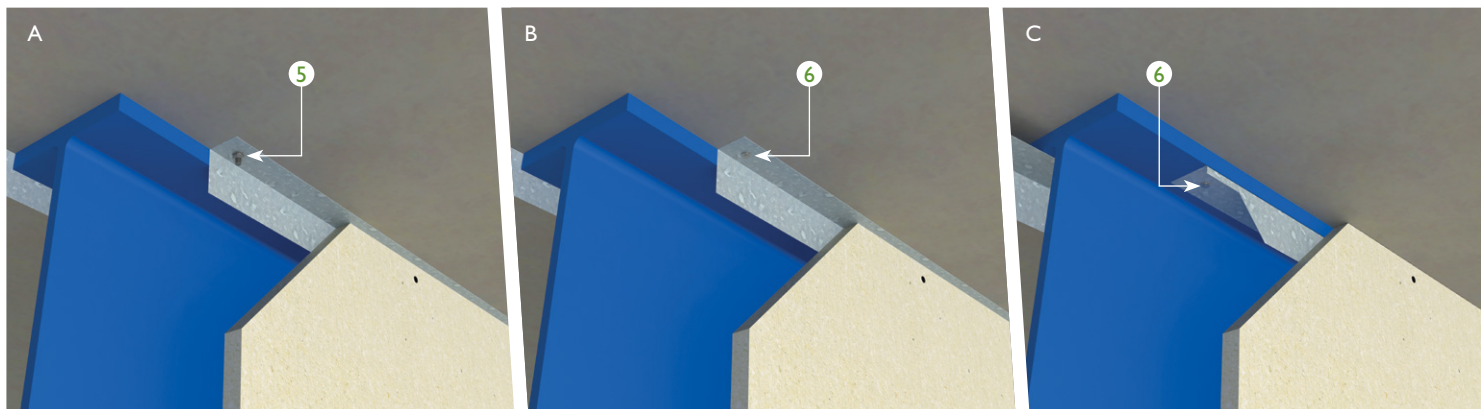
1. FP®-900/FirePro® board in single or two-layer
2. FP®-900/FirePro® backing strip 100mm wide at maximum 1220mm centres behind the board joints
3. U-channel 50mm web x 32mm flange x 0.5mm thick, or
4. Angle minimum 40mm x 40mm x 0.5mm thick fixed onto the floor or steel beam
5. M6 steel anchors at nominal 500mm centres or
6. Shot fired nails minimum \varnothing 3.7 at nominal 350mm centres.
7. Self-tapping screws minimum M3.5 x 35mm at nominal 200mm centres
8. Steel beam
9. Floor slab

FP®-900/FirePro®
Fire Protection of Structural Steel
STEEL ENCASEMENT – BEAMS & JOISTS



Alternative Fixing

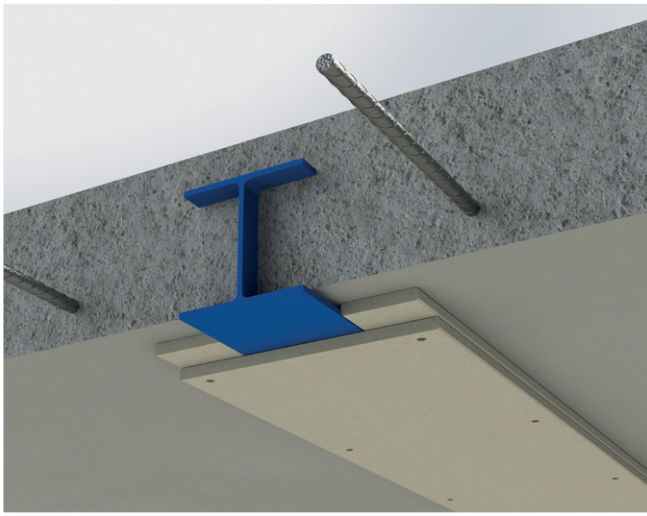
- A.** Steel angles attach to the soffit of floor by screw anchors.
- B.** Steel angles attach to the soffit of floor by shot fired nails.
- C.** Steel angles attach to the flange of beam by shot fired nails.



FP®-900/FirePro® Fire Protection of Structural Steel STEEL ENCASEMENT – BEAMS & JOISTS

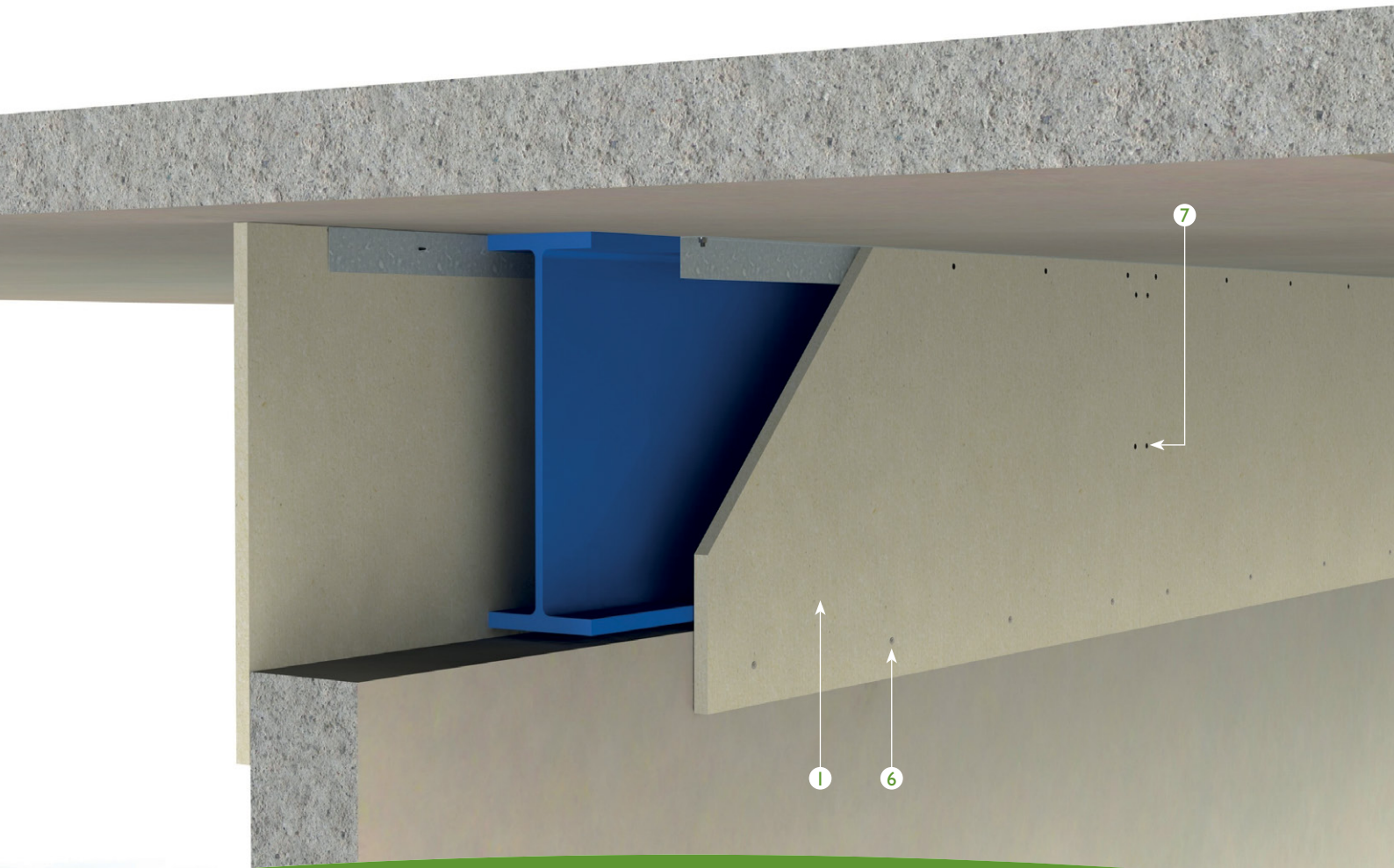
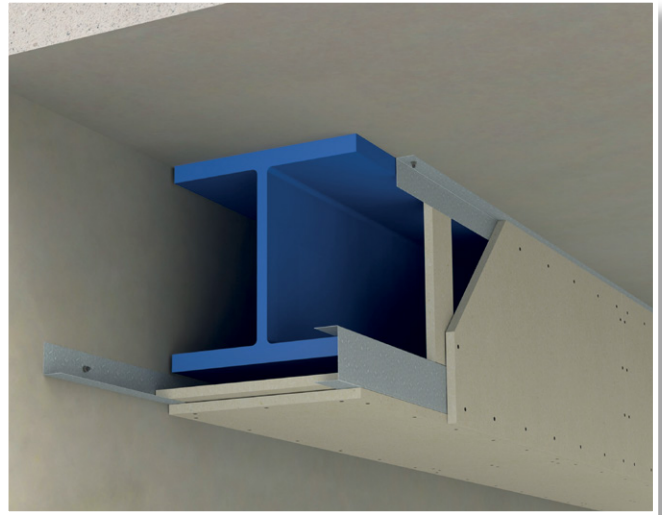


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ONE SIDED PROTECTION

TWO SIDED PROTECTION



DECK VOIDS ABOVE COMPOSITE AND NON-COMPOSITE BEAMS

Composite steel deck floors comprise reinforced concrete cast on top of profiled steel decking, which acts as formwork during construction and external reinforcement at the final stage. The profiled metal deck form may be either re-entrant (dovetail) or trapezoidal.

ASFP provides a guidance on fire protection of steel beams supporting profiled steel decking. With a dovetail profile, the void is small and no action is generally necessary. With trapezoidal profiles, the void is comparatively large. This creates a situation where some actions are required to balance the impact of the added heating of the top flange.

Steel Construction Institute & ASFP had conducted a research on the effect of not filling voids above composite beams and released SCI P109 technical report: The fire resistance of composite beams, Steel Construction 1991. The report provided a technical guide and recommendations for beams with unfilled voids against fire. This guidance for beams with sufficient protection to prevent temperature rises of 620 °C is reproduced in the table below.



RE-ENTRANT (DOVETAIL) PROFILED STEEL DECK



TRAPEZOIDAL PROFILED STEEL DECK

Recommendations for beams with unfilled voids[#]

Trapezoidal deck only - beam type	Fire protection on beam	Fire resistance - minutes		
		Up to 60	90	Over 90
Composite	Passive (non-reactive) and reactive	Increase thickness by 20% or assess thickness using A/V increased by 30%*	Increase thickness by 30% or assess thickness using A/V increased by 50%*	Fill voids
		*The least onerous option may be used		
Non-composite		Fill voids		

[#] See A.3.5 and Table 20 of ASFP Yellow Book - 5th Edition referenced above

Note: The above is an issue for trapezoidal, but not dovetail deck, where the void is not filled. It is necessary to make adaptations to the structural fire protection thicknesses. Nonetheless, all voids should be filled when the beam forms part of a compartment wall.

Materials used on filling the voids

The voids must be filled by the non-combustible material which should be with proven fire stopping ability.



FIRE PROTECTION OF BRACING MEMBERS

Fire protection of wind and stability bracing in a structure is generally not necessary. The fire Eurocodes give no guidance on this, however BS 5950: Part 8: Code of practice for fire resistant design recommends that the fire protection thickness should be based on the section factor of the steel bracing member, or a value of 200m^{-1} , whichever is the smaller value. The standard also states that in some cases, it might not be necessary to apply fire protection of bracing members and consideration should be given to:

1. Shielding bracing from fire by installing it in shafts or within walls.
2. The use of infill masonry walls, which can provide the sufficient shear capacity during a fire instead of relying on the steel bracing systems.
3. The possibility that only bracing systems within a fire compartment might be subjected to elevated temperatures and the other unaffected bracing system might be sufficient to provide the required stability at the fire limit state.
4. The possibility that the steel beam to column connections might have sufficient stiffness to ensure stability at the fire limit state.

Assessment of fire protection requirements for bracing#

Building	Degree of fire protection to bracing system
Single storey - not more than 8m to eaves	None
Single storey - more than 8m to eaves	Generally none
Two storey	Generally none, wall and frame stiffness will contribute considerably to stability
Other multi-storey	Protected to achieve required fire resistance. However the selection of thickness may be based on allowable reductions in applied loads in fire given in BS 5950: Part 8 :2003 or BS EN 1990

See A.2.5 and Table 15 of ASFP Yellow Book - 5th Edition referenced above

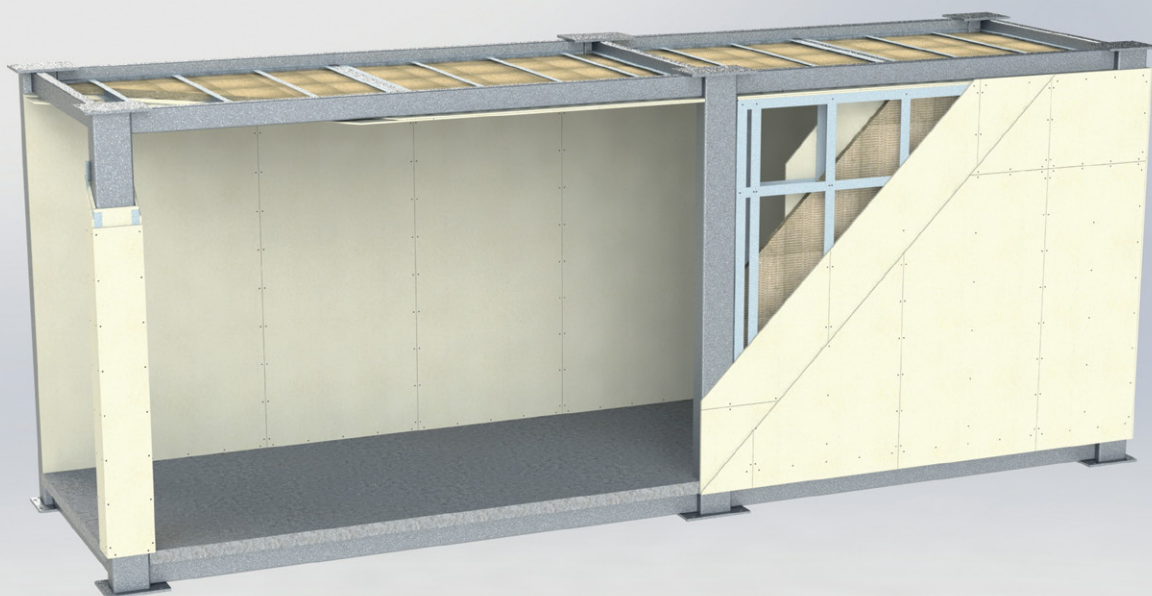
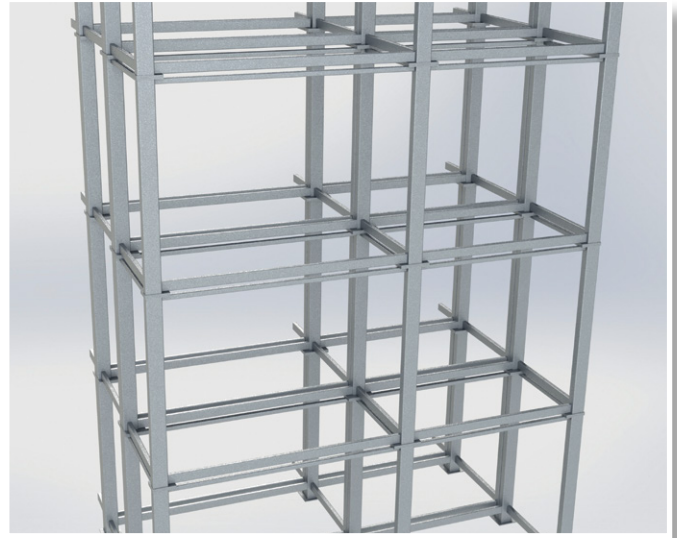
FP®-900/FirePro® Fire Protection of Structural Steel MODULAR CONSTRUCTION



FIRE PROTECTION OF MODULES BUILT WITH STEEL

Modular construction is a process in which a building is prefabricated off-site under factory controlled conditions. A building is produced in many identical modules which are assembled together on site. Steel framed modules are commonly adopted as they are light-in-weight facilitating transportation and site installation. Soben International provides fire protection solutions for modular construction with a range of FP® passive fire protection systems for steel or composite structures, fire compartment floors and walls. Being in the supply chain of modular construction over 15 years, Soben has broad experiences in assisting many clients and contractors to complete their modular construction projects. These completed projects are chained brand hotels, student accommodations and commercial buildings located in Europe, Asia and Australasia. Besides FP® fire protection solution, Soben International WeatherPro® weather resistant heavy duty fibre cement is a favourable flooring board material applied in the modules of these completed projects.

Unlike the conventional build where fire resisting constructions in a steel framed building are applied quite straightforward after the structural frame is erected on site, modular construction is more complicated. Each modular system has its unique design for off-site fabrication and on-site installation. Therefore, applying fire protection, especially at all interfaces among modules require sophisticated fire protection systems as well as fire insulation of wall and floor compartments should be considered as a whole. Further details please enquire Soben International.




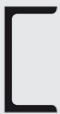




FP®-900/FirePro® fire protection of steel module up to 240 minutes fire rating |

SECTION FACTOR (A/V) OF STEEL SECTIONS

A steel section with a large surface area (A) will receive more heat than one with a smaller surface area. Also, the greater the volume (V) of the section, the greater is the heat sink. It therefore follows, that a small thick section will have a slower rate of temperature increase in a fire when compared to a large thin one. The Section factor (A/V) is thus a measure of the rate at which a section will heat up in a fire. The Section Factor of a steel section is used to determine the required protective board thickness.

Table S1

STEEL SECTION	CALCULATION OF Am FOR BOX PROTECTION				
	4 sides	3 sides	3 sides	2 sides	1 side
 Universal beams, Universal columns & Joists	$2B+2D$ 	$B+2D$ 	$B+2d$ 	$B+D$ 	B 
 Structural & Rolled tees	$2B+2D$ 	$B+2D$ 	$B+2D$ 		
 Angles	$2B+2D$ 	$B+2D$ 	$2B+D$ 		
 Channels	$2B+2D$ 	$B+2D$ 	$2B+D$ 		
 Square or Rectangular Hollow Sections	$2B+2D$ 	$B+2D$ 	$2B+D$ 		
 Circular Hollow Sections	πD 	Note. The air space created in boxing a section improves the insulation and a value of A_m/V^* , and therefore A_m , higher than profile protection would be anomalous. Hence A_m is calculated based on the circumference of the circular hollow section, not $4D$. *Section factor A_m/V per meter = H_p/A			

An example of calculation
 A_m/V for a metre length of UB
 $406 \times 178 \times 85\text{kg/m}$

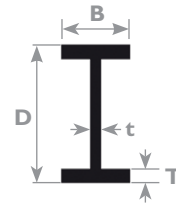
Four sided exposure
 $A_m = 2B+2D$
 $= (2 \times 181.9) + (2 \times 417.2)$
 $= 1196.4\text{mm} (1.196\text{m})$
 $A_m/V = 1.196/0.01077$
 $= 110.04\text{m}^{-1}$

Three sided exposure
 $A_m = B+2D$
 $= (181.9) + (2 \times 417.2)$
 $= 1016.3\text{mm} (1.0163\text{m})$
 $A_m/V = 1.0163/0.01077$
 $= 94.36\text{m}^{-1}$

FP®-900/FirePro® Fire Protection of Structural Steel SECTION FACTOR A_m/V



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Section factor A_m/V
Box protection

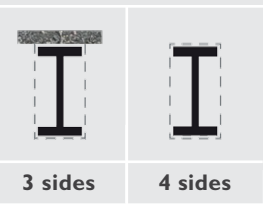


Table S2 - Universal Beams

DESIGNATION		Depth of section D	Width of section B	Thickness		Area of section	Section factor A_m/V	
Serial size	Mass			Web t	Flange T		3 sides	4 sides
mm	Kg/m	mm	mm	mm	mm	cm ²	m ⁻¹	m ⁻¹
1016 x 305	487	1036.1	308.5	30.0	54.1	619.9	40	45
	438	1025.9	305.4	26.9	49.0	556.6	40	50
	393	1016.0	303.0	24.4	43.9	500.2	45	55
	349	1008.1	302.0	21.1	40.0	445.2	50	60
	314	1000.0	300.0	19.1	35.9	400.4	55	65
	272	990.1	300.0	16.5	31.0	346.9	65	75
	249	980.2	300.0	16.5	26.0	316.9	70	80
	222	970.3	300.0	16.0	21.1	282.8	80	90
914 x 419	388	921.0	420.5	21.4	36.6	494.2	45	55
	343	911.8	418.5	19.4	32.0	437.3	50	60
914 x 305	289	926.6	307.7	19.5	32.0	368.3	60	65
	253	918.4	305.5	17.3	27.9	322.8	65	75
	224	910.4	304.1	15.9	23.9	285.6	75	85
	201	903.0	303.3	15.1	20.2	255.9	80	95
838 x 292	226	850.9	293.8	16.1	26.8	288.6	70	80
	194	840.7	292.4	14.7	21.7	246.8	80	90
	176	834.9	291.7	14.0	18.8	224.0	90	100
762 x 267	197	769.8	268.0	15.6	25.4	250.6	70	85
	173	762.2	266.7	14.3	21.6	220.4	80	95
	147	754.0	265.2	12.8	17.5	187.2	95	110
	134	750.0	264.4	12.0	15.5	170.6	105	120
686 x 254	170	692.9	255.8	14.5	23.7	216.8	75	90
	152	687.5	254.5	13.2	21.0	194.1	85	95
	140	683.5	253.7	12.4	19.0	178.4	90	105
	125	677.9	253.0	11.7	16.2	159.5	100	115
610 x 305	238	635.8	311.4	18.4	31.4	303.3	50	60
	179	620.2	307.1	14.1	23.6	228.1	70	80
	149	612.4	304.8	11.8	19.7	190.0	80	95
610 x 229	140	617.2	230.2	13.1	22.1	178.2	80	95
	125	612.2	229.0	11.9	19.6	159.3	90	105
	113	607.6	228.2	11.1	17.3	143.9	100	115
	101	602.6	227.6	10.5	14.8	128.9	110	130
610 x 178	100	607.4	179.2	11.3	17.2	128.0	110	125
	92	603.0	178.8	10.9	15.0	117.0	120	135
	82	598.6	177.9	10.0	12.8	104.0	130	150
533 x 312	273	577.1	320.2	21.1	37.6	348.0	40	50
	219	560.3	317.4	18.3	29.2	279.0	50	65
	182	550.7	314.5	15.2	24.4	231.0	60	75
	151	542.5	312.0	12.7	20.3	192.0	75	90

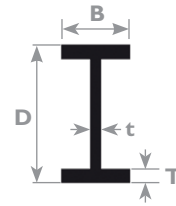
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Fire Protection of Structural Steel

SECTION FACTOR A_m/V



SOBEN INTERNATIONAL



Section factor A_m/V Box protection

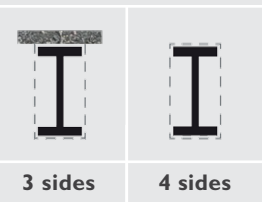


Table S2 - Universal Beams

DESIGNATION		Depth of section D	Width of section B	Thickness		Area of section	Section factor A_m/V	
Serial size	Mass			Web t	Flange T		3 sides	4 sides
mm	Kg/m	mm	mm	mm	mm	cm ²	m ⁻¹	m ⁻¹
533 x 210	138	549.1	213.9	14.7	23.6	176.0	75	85
	122	544.5	211.9	12.7	21.3	155.4	85	95
	109	539.5	210.8	11.6	18.8	138.9	95	110
	101	536.7	210.0	10.8	17.4	128.7	100	115
	92	533.1	209.3	10.1	15.6	117.4	110	125
	82	528.3	208.8	9.6	13.2	104.7	120	140
533 x 210	92	533.1	209.3	10.1	15.6	117.4	110	125
	82	528.3	208.8	9.6	13.2	104.7	120	140
533 x 165	85	534.9	166.5	10.3	16.5	108.0	115	130
	75	529.1	165.9	9.7	13.6	95.2	130	145
	66	524.7	165.1	8.9	11.4	83.7	145	165
457 x 191	161	492.0	199.4	18.0	32.0	206.0	60	65
	133	480.6	196.7	15.3	26.3	170.0	70	80
	106	469.2	194.0	12.6	20.6	135.0	85	100
	98	467.2	192.8	11.4	19.6	125.3	90	105
	89	463.4	191.9	10.5	17.7	113.8	100	115
	82	460.0	191.3	9.9	16.0	104.5	105	125
	74	457.0	190.4	9.0	14.5	94.6	115	135
	67	453.4	189.9	8.5	12.7	85.5	130	150
457 x 152	82	465.8	155.3	10.5	18.9	104.5	105	120
	74	462.0	154.4	9.6	17.0	94.5	115	130
	67	458.0	153.8	9.0	15.0	85.6	125	145
	60	454.6	152.9	8.1	13.3	76.2	140	160
	52	449.8	152.4	7.6	10.9	66.6	160	180
406 x 178	85	417.2	181.9	10.9	18.2	109.0	95	110
	74	412.8	179.5	9.5	16.0	94.5	105	125
	67	409.4	178.8	8.8	14.3	85.5	115	140
	60	406.4	177.9	7.9	12.8	76.5	130	155
	54	402.6	177.7	7.7	10.9	69.0	145	170
406 x 140	53	406.6	143.3	7.9	12.9	67.9	140	160
	46	403.2	142.2	6.8	11.2	58.6	160	185
	39	398.0	141.8	6.4	8.6	49.7	190	215
356 x 171	67	363.4	178.1	9.1	15.7	85.5	105	125
	57	358.0	172.2	8.1	13.0	72.6	120	145
	51	355.0	171.5	7.4	11.5	64.9	135	160
	45	351.4	171.1	7.0	9.7	57.3	150	180
356 x 127	39	353.4	126.0	6.6	10.7	49.8	165	195
	33	349.0	125.4	6.0	8.5	42.1	195	225
305 x 165	54	310.4	166.9	7.9	13.7	68.8	115	140
	46	306.6	165.7	6.7	11.8	58.8	135	160
	40	303.4	165.0	6.0	10.2	51.3	150	185
305 x 127	48	311.0	125.3	9.0	14.0	61.2	120	145
	42	307.2	124.3	8.0	12.1	53.4	140	160
	37	304.4	123.4	7.1	10.7	47.2	155	180

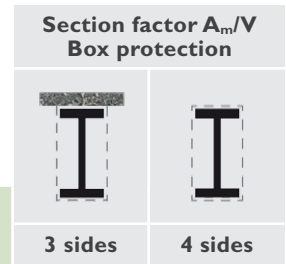
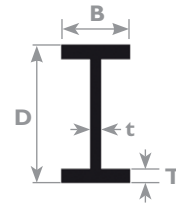


Table S2 - Universal Beams

DESIGNATION		Depth of section D	Width of section B	Thickness		Area of section	Section factor A_m/V Box protection	
Serial size	Mass			Web t	Flange T		3 sides	4 sides
mm	Kg/m	mm	mm	mm	mm	cm ²	m ⁻¹	m ⁻¹
305 x 102	33	312.7	102.4	6.6	10.8	41.8	175	200
	28	308.7	101.8	6.0	8.8	35.9	200	230
	25	305.1	101.6	5.8	7.0	31.6	225	255
254 x 146	43	259.6	147.3	7.2	12.7	54.8	120	150
	37	256.0	146.4	6.3	10.9	47.2	140	170
	31	251.4	146.1	6.0	8.6	39.7	165	200
254 x 102	28	260.4	102.2	6.3	10.0	36.1	175	200
	25	257.2	101.9	6.0	8.4	32.0	190	225
	22	254.0	101.6	5.7	6.8	28.0	220	255
203 x 133	30	206.8	133.9	6.4	9.6	38.2	145	180
	25	203.2	133.2	5.7	7.8	33.0	170	210
203 x 102	23	203.2	101.8	5.4	9.3	29.4	175	205
178 x 102	19	177.8	101.2	4.8	7.9	24.3	190	230
152 x 89	16	152.4	88.7	4.5	7.7	20.3	195	235
127 x 76	13	127.0	76.0	4.0	7.6	16.5	200	245

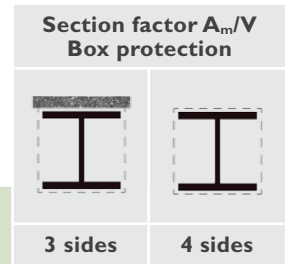
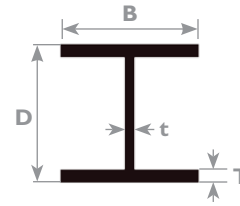
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SECTION FACTOR A_m/V

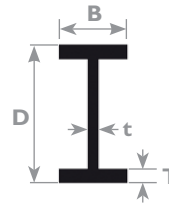


Table S3 - Universal Columns



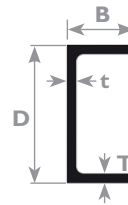
DESIGNATION		Depth of section D	Width of section B	Thickness		Area of section	Section factor A_m/V Box protection	
Serial size	Mass			Web t	Flange T		3 sides	4 sides
mm	Kg/m	mm	mm	mm	mm	cm ²	m ⁻¹	m ⁻¹
356 x 406	1086	569.5	454.4	78.0	125.0	1387.0	10	15
	990	549.7	448.3	71.9	115.0	1263.0	10	15
	900	531.4	442.3	65.9	106.0	1150.0	15	15
	818	514.1	436.9	60.5	97.0	1044.0	15	20
	744	497.8	432.1	55.6	88.9	948.0	15	20
	677	483.1	427.8	51.2	81.5	863.0	15	20
	634	474.6	424.0	47.6	77.0	807.5	15	20
	551	455.6	418.5	42.1	67.5	701.9	20	25
	467	436.6	412.2	35.8	58.0	594.9	20	30
	393	419.0	407.0	30.6	49.2	500.6	25	35
	340	406.4	403.0	26.6	42.9	433.0	30	35
	287	393.6	399.0	22.6	36.5	365.7	30	45
235	381.0	394.8	18.4	30.2	299.4	40	50	
356 x 368	202	374.6	374.7	16.5	27.0	257.2	45	60
	177	368.2	372.6	14.4	23.8	225.5	50	65
	153	362.0	370.5	12.3	20.7	194.8	55	75
	129	355.6	368.6	10.4	17.5	164.3	65	90
305 x 305	283	365.3	322.2	26.8	44.1	360.4	30	40
	240	352.5	318.4	23.0	37.7	305.8	35	45
	198	339.9	314.5	19.1	31.4	252.41	40	50
	158	327.1	311.2	15.8	25.0	201.4	50	65
	137	320.5	309.2	13.8	21.7	174.4	55	70
	118	314.5	307.4	12.0	18.7	150.2	60	85
	97	307.9	305.3	9.9	15.4	123.5	75	100
254 x 254	167	289.1	265.2	19.2	31.7	212.9	40	50
	132	276.3	261.3	15.3	25.3	168.1	50	65
	107	266.7	258.8	12.8	20.5	136.4	60	75
	89	260.3	256.3	10.3	17.3	113.3	70	90
	73	254.1	254.6	8.6	14.2	93.1	80	110
203 x 203	127	241.4	213.9	18.1	30.1	162.0	45	55
	113	235.0	212.1	16.3	26.9	145.0	45	60
	100	228.6	210.3	14.5	23.7	127.0	55	70
	86	222.2	209.1	12.7	20.5	109.6	60	80
	71	215.8	206.4	10.0	17.3	90.4	70	95
	60	209.6	205.8	9.4	14.2	76.4	80	110
	52	206.2	204.3	7.9	12.5	66.3	95	125
	46	203.2	203.6	7.2	11.0	58.7	105	140
152 x 152	51	170.2	157.4	11.0	15.7	65.2	75	100
	44	166.0	155.9	9.5	13.6	56.1	85	115
	37	161.8	154.4	8.0	11.5	47.1	100	135
	30	157.6	152.9	6.5	9.4	38.3	120	160
	23	152.4	152.2	5.8	6.8	29.8	155	210

Table S4 - Joists



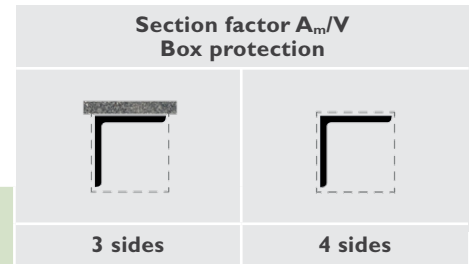
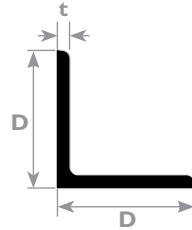
DESIGNATION		Depth of section D	Width of section B	Thickness		Area of section	Section factor A_m/V Box protection	
Serial size	Mass			Web t	Flange T		3 sides	4 sides
mm	Kg/m	mm	mm	mm	mm	cm ²	m ⁻¹	m ⁻¹
203 X 152	52.3	203.2	152.4	8.9	16.5	66.6	85	105
152 X 127	37.3	152.4	127.0	10.4	13.2	47.5	90	120

Table S5 - Parallel Flange Channels



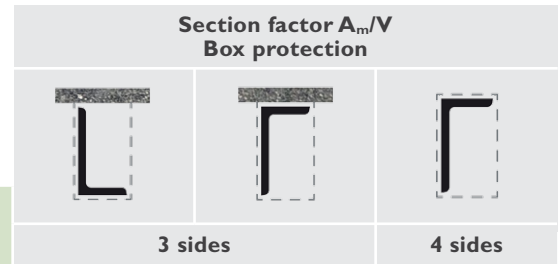
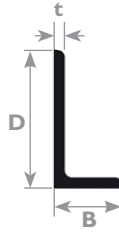
DESIGNATION		Depth of section D	Width of section B	Thickness		Area of section	Section factor A_m/V Box protection		
Serial size	Mass			Web t	Flange T		3 sides	3 sides	4 sides
mm	Kg/m	mm	mm	mm	mm	cm ²	m ⁻¹	m ⁻¹	m ⁻¹
430 x 100	64.4	430	100	11.0	19.0	82.1	115	75	130
380 x 100	54.0	380	100	9.5	17.5	68.7	125	85	140
300 x 100	45.5	300	100	9.0	16.5	58.0	120	85	140
300 x 90	41.4	300	90	9.0	15.5	52.8	130	90	150
260 x 90	34.8	260	90	8.0	14.0	44.4	135	100	160
260 x 75	27.6	260	75	7.0	12.0	35.1	170	115	190
230 x 90	32.2	230	90	7.5	14.0	41.0	135	100	155
230 x 75	25.7	230	75	6.5	12.5	32.7	165	115	185
200 x 90	29.7	200	90	7.0	14.0	37.9	130	100	155
200 x 75	23.4	200	75	6.0	12.5	29.87	160	115	185
180 x 90	26.1	180	90	6.5	12.5	33.2	135	110	165
180 x 75	20.3	180	75	6.0	10.5	25.9	170	125	195
150 x 90	23.9	150	90	6.5	12.0	30.4	130	110	160
150 x 75	17.9	150	75	5.5	10.0	22.8	165	130	200
125 x 65	14.8	125	65	5.5	9.5	18.8	170	135	200
100 x 50	10.2	100	50	5.0	8.5	13.0	190	155	230

Table S6 – Equal Angles



DESIGNATION		Mass per metre	Area of section	Section factor A_m/V Box protection	
Size D x D	Thickness t			3 sides	4 sides
mm	mm	Kg/m	cm ²	m ⁻¹	m ⁻¹
200 x 200	24	71.1	90.6	65	90
	20	59.9	76.3	80	105
	18	54.2	69.1	85	115
	16	48.5	61.8	95	130
150 x 150	18	40.1	51.0	90	120
	15	33.8	43.0	105	140
	12	27.3	34.8	130	170
	10	23	29.3	155	205
120 x 120	15	26.6	33.9	105	140
	12	21.6	27.5	130	175
	10	18.2	23.2	155	205
	8	14.7	18.7	190	255
100 x 100	15	21.9	27.9	110	145
	12	17.8	22.7	130	175
	10	15.0	19.2	155	210
	8	12.2	15.5	195	260
90 x 90	12	15.9	20.3	135	175
	10	13.4	17.1	160	210
	8	10.9	13.9	195	260
	7	9.6	12.2	220	295

Table S7– Unequal Angles



DESIGNATION		Mass per metre	Area of section	Section factor A_m/V		
Size D x B	Thickness t			3 sides		4 sides
mm	mm	Kg/m	cm ²	m ⁻¹	m ⁻¹	m ⁻¹
200 x 150	18	47.1	60.0	90	85	115
	15	39.6	50.5	110	100	140
	12	32	40.8	135	125	170
200 x 100	15	33.7	43.0	115	95	140
	12	27.3	34.8	145	115	170
	10	23.0	29.2	170	135	205
150 x 90	15	26.6	33.9	115	95	140
	12	21.6	27.5	140	120	175
	10	18.2	23.2	170	145	205
150 x 75	15	24.8	31.7	120	95	140
	12	20.2	25.7	145	115	175
	10	17.0	21.7	175	140	210
125 x 75	12	17.8	22.7	145	120	175
	10	15.0	19.1	170	145	210
	8	12.2	15.5	210	180	260
100 x 75	12	15.4	19.7	140	125	180
	10	13.0	16.6	165	150	210
	8	10.6	13.5	205	185	260
100 x 65	10	12.3	15.6	170	145	210
	8	9.9	12.7	210	180	260
	7	8.8	11.2	235	205	295

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SECTION FACTOR A_m/V



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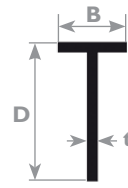


Table S8 – Tees Split from UK Beams

DESIGNATION		Depth of section B	Width of section D	Web Thickness t	Area of section	Section factor A_m/V Box protection	
Serial size	Mass					3 sides	4 sides
mm	Kg/m	mm	mm	mm	cm ²	m ⁻¹	m ⁻¹
254 x 343	62.6	253.0	338.9	11.7	79.7	115	150
305 x 305	119	311.4	317.9	18.4	152.0	60	85
	89.5	307.1	310.0	14.1	114.0	80	110
	74.6	304.8	306.1	11.8	95.0	95	130
229 x 305	69.9	230.2	308.5	13.1	89.1	95	120
	62.5	229.0	306.0	11.9	79.7	105	135
	56.5	228.2	303.7	11.1	72.0	115	150
	50.6	227.6	301.2	10.5	64.5	130	165
178 x 305	50.1	179.2	303.7	11.3	63.9	125	150
	46.1	178.8	301.5	10.9	58.7	135	165
	40.9	177.9	299.3	10.0	52.1	150	185
312 x 267	136.7	320.2	288.8	21.1	174.0	50	70
	109.4	317.4	280.4	18.3	139.0	65	85
	90.7	314.5	275.6	15.2	116.0	75	100
	75.3	312.0	271.5	12.7	95.9	120	120
210 x 267	69.1	213.9	274.5	14.7	23.6	85	110
	61.0	211.9	272.2	12.7	77.7	95	125
	54.5	210.8	269.7	11.6	69.4	110	140
	50.5	210.0	268.3	10.8	64.3	115	150
	46.0	209.3	266.5	10.1	58.7	125	160
	41.1	208.8	264.1	9.6	52.34	140	180
165 x 267	42.3	166.5	267.1	10.3	54.0	130	160
	37.4	165.9	264.5	9.7	47.6	145	180
	32.8	165.1	262.4	8.9	41.9	165	205
191 x 229	80.7	199.4	246.0	18.0	103.0	65	85
	66.6	196.7	240.3	15.3	84.9	80	105
	52.9	194.0	234.6	12.6	67.4	100	125
	49.1	192.8	233.5	11.4	62.6	105	135
	44.6	191.9	231.6	10.5	58.9	115	150
	41.0	191.3	229.9	9.9	52.2	125	160
	37.1	190.4	228.4	9.0	47.3	135	175
	33.5	189.9	226.6	8.5	42.8	150	195
152 x 229	41.0	155.3	232.8	10.5	52.3	120	150
	37.1	154.4	230.9	9.6	47.2	130	165
	33.6	153.8	228.9	9.0	42.8	145	180
	29.9	152.9	227.2	8.1	38.1	160	200
	26.1	152.4	224.8	7.6	33.3	180	225

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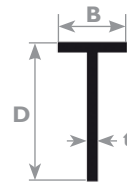
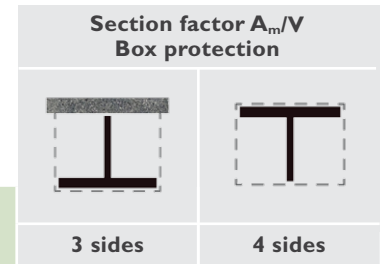
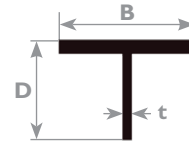


Table S8 – Tees Split from UK Beams

DESIGNATION		Depth of section B	Width of section D	Web Thickness t	Area of section	Section factor A_m/V Box protection	
Serial size	Mass					3 sides	4 sides
mm	Kg/m	mm	mm	mm	cm ²	m ⁻¹	m ⁻¹
178 x 203	42.6	181.9	208.6	10.9	54.3	110	145
	37.1	179.5	206.3	9.5	47.2	125	165
	33.5	178.8	204.6	8.8	42.8	140	180
	30.0	177.9	203.1	7.9	38.3	155	200
	27.0	177.7	201.2	7.7	34.5	170	220
140 x 203	26.6	143.3	203.3	7.9	34	160	205
	23.0	142.2	201.5	6.8	29.3	185	235
	19.5	141.8	198.9	6.4	24.8	215	275
171 x 178	33.5	173.2	181.6	9.1	42.7	125	165
	28.5	172.2	178.9	8.1	36.3	145	195
	25.5	171.5	177.4	7.4	32.4	160	215
	22.5	171.1	175.6	7.0	28.7	180	240
127 x 178	19.5	126.0	176.6	6.6	24.9	195	245
	16.5	125.4	174.4	6.0	21.1	225	285
165 x 152	27.0	166.9	155.1	7.9	34.4	140	185
	23.0	165.7	153.2	6.7	29.4	160	215
	20.1	165.0	151.6	6.0	25.7	185	245
127 x 152	24.0	125.3	155.4	9.0	30.6	140	185
	20.9	124.3	153.5	8.0	26.7	160	210
	18.5	123.4	152.1	7.1	23.6	180	235
102 x 152	16.4	102.4	156.3	6.6	20.9	200	245
	14.1	101.8	154.3	6.0	17.9	230	285
	12.4	101.6	152.5	5.8	15.8	255	320
146 x 127	21.5	147.3	129.7	7.2	27.4	150	200
	18.5	146.4	127.9	6.3	23.6	170	235
	15.5	146.1	125.6	6.0	19.8	200	275
102 x 127	14.1	102.2	130.1	6.3	18.0	200	260
	12.6	101.9	128.5	6.0	16.0	225	290
	11.0	101.6	126.9	5.7	14.0	255	325
133 x 102	15.0	133.9	103.3	6.4	19.1	180	250
	12.5	133.2	101.5	5.7	16.0	210	295

Table S9 – Tees Split from UK Columns



DESIGNATION		Depth of section B	Width of section D	Web Thickness t	Area of section	Section factor A_m/V	
Serial size	Mass					3 sides	4 sides
mm	Kg/m	mm	mm	mm	cm ²	m ⁻¹	m ⁻¹
305 x 152	79.0	311.2	163.5	15.8	100.7	65	95
	68.4	309.2	160.2	13.8	87.2	70	110
	58.9	307.4	157.2	12.0	75.1	85	125
	48.4	305.3	153.9	9.9	61.7	100	150
254 x 127	83.5	265.2	1144.5	19.2	106.0	50	75
	66.0	261.3	138.1	15.3	84.1	65	95
	53.5	258.8	133.3	12.8	68.2	75	115
	44.4	256.3	130.1	10.3	56.7	90	135
	36.5	254.6	127.0	8.6	46.6	110	165
203 x 102	63.7	213.9	120.7	18.1	81.2	55	80
	56.7	212.1	117.5	16.3	72.3	60	90
	49.8	210.3	114.3	14.5	63.4	70	100
	43.0	209.1	111.0	12.7	54.8	80	115
	35.5	206.4	107.8	10.0	45.2	95	140
	30.0	205.8	104.7	9.4	38.2	110	165
	26.0	204.3	103.0	7.9	33.1	125	185
	23.0	203.6	101.5	7.2	29.4	140	210
152 x 76	25.6	157.4	85.1	11.0	32.6	100	150
	22.0	155.9	83.0	9.5	28.0	115	170
	18.5	154.4	80.8	8.0	23.6	135	200
	15.0	152.9	78.7	6.5	19.1	180	240
	11.5	152.2	76.1	5.8	14.6	210	310

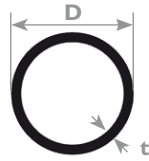
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SECTION FACTOR A_m/V



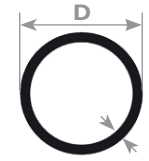
**Table S10 -
Circular Hollow Sections**



Section factor A_m/V
Box protection



DESIGNATION		Mass per metre	Area of section	Section factor A_m/V
Outside diameter	Thickness t			
mm	mm	Kg/m	cm ²	m ⁻¹
21.3	2.6	1.2	1.5	440
	2.9	1.3	1.7	400
	3.2	1.4	1.8	370
26.9	2.6	1.6	2	425
	2.9	1.7	2.2	385
	3.2	1.9	2.4	355
33.7	2.6	2.0	2.5	415
	2.9	2.2	2.8	375
	3.2	2.4	3.1	345
	3.6	2.7	3.4	310
42.4	4.0	2.9	3.7	285
	2.6	2.6	3.3	410
	2.9	2.8	3.6	370
	3.2	3.1	3.9	340
	3.6	3.4	4.4	305
48.3	4.0	3.8	4.8	275
	5.0	4.6	5.9	230
	2.9	3.3	4.1	365
	3.2	3.6	4.5	335
	3.6	4.0	5.1	300
60.3	4.0	4.4	5.6	270
	5.0	5.3	6.8	225
	2.9	4.1	5.2	360
	3.2	4.5	5.7	330
	3.6	5.0	6.4	295
76.1	4.0	5.5	7.1	270
	5.0	6.8	8.7	220
	2.9	5.2	6.7	358
	3.2	5.8	7.3	325
	3.6	6.4	8.2	290
	4.0	7.1	9.1	265
88.9	5.0	8.8	11.2	215
	6.3	10.8	13.8	175
	2.9	6.2	7.8	355
	3.2	6.8	8.6	325
	3.6	7.6	9.7	290
	4.0	8.9	10.7	260
	5.0	10.3	13.2	260
114.3	6.3	12.8	16.3	170
	3.2	8.8	11.2	320
	3.6	9.8	12.5	285
	4.0	10.9	13.9	260
	5.0	13.5	17.2	210
6.3	16.8	21.4	170	

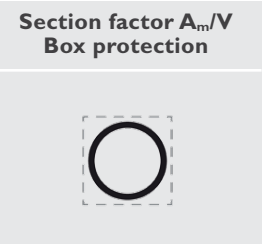
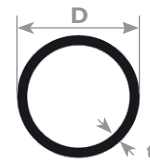


Section factor A_m/V
Box protection



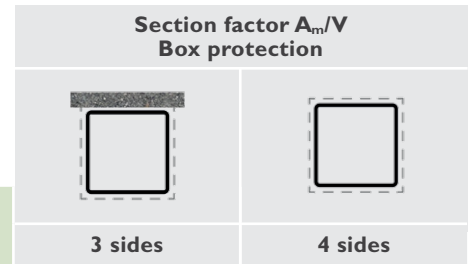
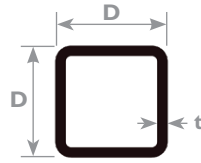
DESIGNATION		Mass per metre	Area of section	Section factor A_m/V
Outside diameter	Thickness t			
mm	mm	Kg/m	cm ²	m ⁻¹
139.7	3.2	10.8	13.7	320
	3.6	12.1	15.4	285
	4.0	13.4	17.1	255
	5.0	16.6	21.2	205
	6.3	20.7	26.4	165
	8.0	26.0	33.1	135
	10.0	32.0	40.7	110
168.3	5.0	20.1	25.7	205
	6.3	25.2	32.1	165
	8.0	31.6	40.3	130
	10.0	39.0	49.7	105
	12.5	48.0	61.2	85
193.7	5.0	23.3	29.6	205
	6.3	29.1	37.1	165
	8.0	36.6	46.7	130
	10.0	45.3	57.7	105
	12.5	55.9	71.2	85
	5.0	26.4	33.6	205
219.1	6.3	33.1	42.1	165
	8.0	41.6	53.1	130
	10.0	51.6	65.7	105
	12.5	63.7	81.1	85
	14.2	71.8	91.4	75
	16.0	80.1	102.0	65
	5.0	29.5	37.6	205
244.5	6.3	37.0	47.1	165
	8.0	46.7	59.4	130
	10.0	57.8	73.7	105
	12.5	71.5	91.1	85
	14.2	80.6	103.0	75
	16.0	90.2	115.0	65
273.0	5.0	33.0	42.1	205
	6.3	41.4	52.8	160
	8.0	52.3	66.6	130
	10.0	64.9	82.6	105
	12.5	80.3	102.0	85
	14.2	90.6	115.0	75
	16.0	101	129.0	65

Table S10 - Circular Hollow Sections



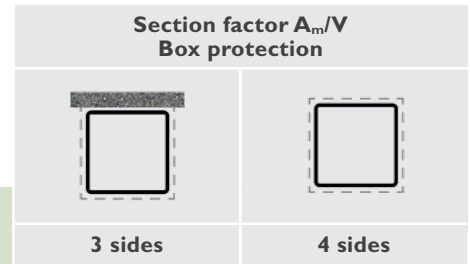
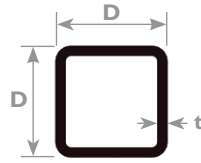
DESIGNATION		Mass per metre	Area of section	Section factor A_m/V Box protection
Outside diameter	Thickness t			
mm	mm	Kg/m	cm ²	m ⁻¹
323.9	5.0	39.3	50.1	205
	6.3	49.3	62.9	160
	8.0	62.3	79.4	130
	10.0	77.4	98.6	105
	12.5	96.0	122.0	85
	14.2	108	138.0	75
	16.0	121	155.0	65
355.6	6.3	54.3	69.1	160
	8.0	68.6	87.4	130
	10.0	85.2	109.0	100
	12.5	106	135.0	85
	14.2	120	152.0	75
	16.0	134	171.0	65
406.4	6.3	62.2	79.2	160
	8.0	78.6	100.0	130
	10.0	97.8	125.0	100
	12.5	121	155.0	80
	14.2	137	175.0	75
	16.0	154	196.0	65
457.0	6.3	70.0	89.2	160
	8.0	88.6	113.0	130
	10.0	110	140.0	105
	12.5	137	175.0	80
	14.2	155	198.0	75
	16.0	174	222.0	65
508.0	6.3	77.9	99.3	160
	8.0	98.6	126.0	125
	10.0	123	156.0	100
	12.5	153	195.0	80
	14.2	173	220.0	75
	16.0	194	247.0	65

Table S11 - Square Hollow Sections



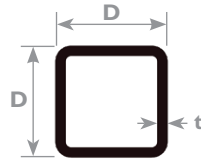
DESIGNATION		Mass per metre	Area of section	Section factor A_m/V Box protection	
Size D x D	Thickness t			3 sides	4 sides
mm	mm	Kg/m	cm ²	m ⁻¹	m ⁻¹
40 x 40	3.0	3.4	4.3	275	370
	3.2	3.6	4.6	260	350
	3.6	4.0	5.1	235	315
	4.0	4.4	5.6	215	290
	5.0	5.3	6.7	180	240
50 x 50	3.0	4.4	5.5	270	365
	3.2	4.6	5.9	255	340
	3.6	5.1	6.5	230	305
	4.0	5.6	7.2	210	280
	5.0	6.9	8.7	175	230
	6.3	8.3	10.6	140	190
60 x 60	3.0	5.3	6.7	270	360
	3.2	5.6	7.2	250	335
	3.6	6.3	8.0	225	300
	4.0	6.9	8.8	205	275
	5.0	8.4	10.7	170	225
	6.3	10.3	13.1	140	185
	8.0	12.5	16.0	115	150
70 x 70	3.0	6.2	7.9	265	355
	3.2	6.6	8.4	250	335
	3.6	7.4	9.4	225	300
	4.0	8.2	10.4	205	270
	5.0	10.0	12.7	165	220
	6.3	12.3	15.6	135	180
	8.0	15.0	19.2	110	145
	8.0	15.0	19.2	110	145
80 x 80	3.0	7.12	9.1	265	350
	3.2	7.6	9.7	250	330
	3.6	8.5	10.9	220	295
	4.0	9.4	12.0	200	270
	5.0	11.6	14.7	165	220
	6.3	14.2	18.1	135	180
	8.0	17.5	22.4	110	145
	8.0	17.5	22.4	110	145
90 x 90	3.6	9.7	12.3	220	295
	4.0	10.7	13.6	200	265
	5.0	13.1	16.7	160	215
	6.3	16.2	20.7	130	175
	8.0	20.1	25.6	105	140
100 x 100	3.6	10.8	13.7	220	295
	4.0	11.9	15.2	200	265
	5.0	14.7	18.7	160	215
	6.3	18.2	23.2	130	175
	8.0	22.6	28.8	104	140
	10.0	27.4	34.9	90	115

Table S11 - Square Hollow Sections



DESIGNATION		Mass per metre	Area of section	Section factor A_m/V Box protection	
Size D x D	Thickness t			3 sides	4 sides
mm	mm	Kg/m	cm ²	m ⁻¹	m ⁻¹
120 x 120	4.0	14.4	18.4	195	260
	5.0	17.8	22.7	160	215
	6.3	22.2	28.2	130	170
	8.0	27.6	35.2	105	140
	10.0	33.7	42.9	85	115
	12.5	40.9	52.1	70	95
140 x 140	5.0	21.0	26.7	160	210
	6.3	26.1	33.3	130	170
	8.0	32.6	41.6	100	135
	10.0	40.0	50.9	85	110
	12.5	48.7	62.1	70	90
150 x 150	5.0	22.6	28.7	160	210
	6.3	28.1	35.8	125	170
	8.0	35.1	44.8	100	135
	10.0	43.1	54.9	85	110
	12.5	52.7	67.1	70	90
	16.0	65.2	83.0	55	75
160 x 160	5.0	24.1	30.7	160	210
	6.3	30.1	38.3	125	170
	8.0	37.6	48.0	100	135
	10.0	46.3	58.9	85	110
	12.5	56.6	72.1	70	90
	14.2	63.3	80.7	60	80
	16.0	70.2	89.4	55	75
180 x 180	5.0	27.3	34.7	155	210
	6.3	34.0	43.3	125	170
	8.0	42.7	54.4	100	135
	10.0	52.5	66.9	80	110
	12.5	64.4	82.1	65	90
	14.2	72.2	92.0	60	80
	16.0	80.2	102.0	55	70
	16.0	80.2	102.0	55	70
200 x 200	5.0	30.4	38.7	155	210
	6.3	38.0	48.4	125	165
	8.0	47.7	60.8	100	135
	10.0	58.8	74.9	85	110
	12.5	72.3	92.1	65	90
	14.2	81.1	103.0	60	80
	16.0	90.3	115.0	55	70
	16.0	90.3	115.0	55	70

Table S11 - Square Hollow Sections



DESIGNATION		Mass per metre	Area of section	Section factor A_m/V Box protection	
Size D x D	Thickness t			3 sides	4 sides
mm	mm	Kg/m	cm ²	m ⁻¹	m ⁻¹
250 x 250	5.0	38.3	48.7	155	205
	6.3	47.9	61.0	125	165
	8.0	60.3	76.8	100	130
	10.0	74.5	94.9	80	105
	12.5	91.9	117.0	65	85
	14.2	103.0	132.0	60	75
	16.0	115.0	147.0	55	70
260 x 260	6.3	49.9	63.5	125	165
	8.0	62.8	80.0	100	130
	10.0	77.7	98.9	80	105
	12.5	95.8	122.0	65	85
	14.2	108.0	137.0	60	75
	16.0	120.0	153.0	55	70
300 x 300	6.3	57.8	73.6	125	165
	8.0	72.8	92.8	100	130
	10.0	90.2	115.0	80	105
	12.5	112.0	142.0	65	85
	14.2	126.0	160.0	60	75
	16.0	141.0	179.0	50	70
350 x 350	8.0	85.4	109.0	100	130
	10.0	106.0	135.0	80	105
	12.5	131.0	167.0	65	85
	14.2	148.0	189.0	55	75
	16.0	166.0	211.0	50	70
400 x 400	8.0	97.9	125.0	100	130
	10.0	122.0	155.0	80	105
	12.5	151.0	192.0	65	85
	14.2	170.0	217.0	55	75
	16.0	191.0	243.0	50	70
	20.0	235.0	300.0	40	55

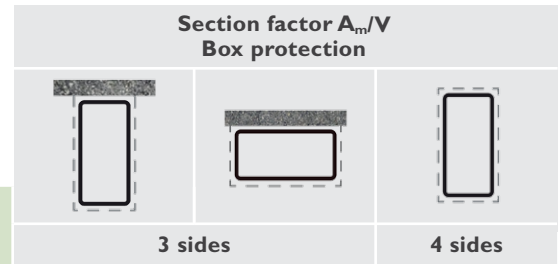
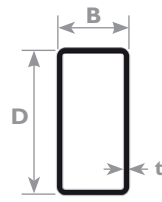
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SECTION FACTOR A_m/V



Table S12 - Rectangular Hollow Sections



DESIGNATION		Mass per metre	Area of section	Section factor A_m/V Box protection		
Size D x B	Thickness t			3 sides		4 sides
mm	mm	Kg/m	cm ²	m ⁻¹	m ⁻¹	m ⁻¹
50 x 30	3.0	3.4	4.3	300	255	370
	3.2	3.6	4.6	285	240	350
	3.6	4.0	5.1	255	215	315
	4.0	4.4	5.6	235	200	290
	5.0	5.3	6.7	195	165	240
60 x 40	3.0	4.4	5.5	290	255	365
	3.2	4.6	5.9	275	240	340
	3.6	5.1	6.5	245	215	305
	4.0	5.6	7.2	225	195	280
	5.0	6.9	8.7	185	160	230
	6.3	8.3	10.6	150	135	190
80 x 40	3.0	5.3	6.7	300	240	360
	3.2	5.6	7.2	280	225	335
	3.6	6.3	8.0	250	200	300
	4.0	6.9	8.8	230	185	275
	5.0	8.4	10.0	190	150	225
	6.3	10.3	13.1	155	125	185
	8.0	12.5	16.0	125	100	150
90 x 50	3.0	6.2	7.9	290	240	355
	3.2	6.6	8.4	275	225	335
	3.6	7.4	9.4	245	205	300
	4.0	8.2	10.4	225	185	270
	5.0	10.0	12.7	185	150	220
	6.3	12.3	15.6	150	125	180
	8.0	15.0	19.2	120	100	150
100 x 50	3.0	6.7	8.5	295	235	355
	3.2	7.1	9.1	275	220	330
	3.6	8.0	10.1	250	200	300
	4.0	8.8	11.2	225	180	270
	5.0	10.8	13.7	185	150	220
	6.3	13.3	16.9	150	120	180
	8.0	16.3	20.8	120	100	145
	10.0	19.6	24.9	100	80	120
100 x 60	3.0	7.2	9.1	285	240	350
	3.2	7.6	9.7	270	230	330
	3.6	8.5	10.9	240	205	295
	4.0	9.4	12.0	220	185	270
	5.0	11.6	14.7	180	150	220
	6.3	14.2	18.1	145	125	180
	8.0	17.5	22.4	120	100	145

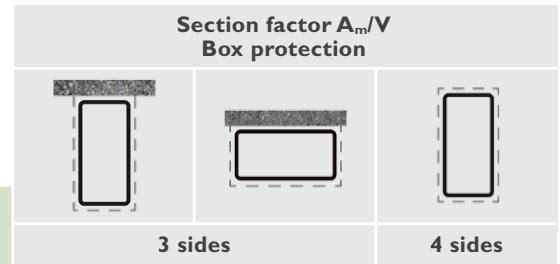
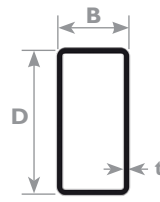
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SECTION FACTOR A_m/V



Table S12 - Rectangular Hollow Sections



DESIGNATION		Mass per metre	Area of section	Section factor A_m/V Box protection		
Size D x B	Thickness t			3 sides		4 sides
mm	mm	Kg/m	cm ²	m ⁻¹	m ⁻¹	m ⁻¹
120 x 60	3.6	9.7	12.3	245	195	300
	4.0	10.7	13.6	220	180	265
	5.0	13.1	16.7	180	145	215
	6.3	16.2	20.7	145	120	175
	8.0	20.1	25.6	120	95	140
	10.0	24.3	30.9	100	80	120
120 x 80	3.6	10.8	13.7	235	205	295
	4.0	11.9	15.2	210	185	265
	5.0	14.7	18.7	175	150	215
	6.3	18.2	23.2	140	120	175
	8.0	22.6	28.8	115	100	140
	10.0	27.4	34.9	95	80	115
150 x 100	4.0	15.1	19.2	210	185	260
	5.0	18.6	23.7	170	150	215
	6.3	23.1	29.5	135	120	170
	8.0	28.9	36.8	110	95	135
	10.0	35.3	44.9	90	80	115
	12.5	42.8	54.6	75	65	95
150 x 125	4.0	16.6	21.2	200	190	260
	5.0	20.6	26.2	165	155	210
	6.3	25.6	32.6	130	125	170
	8.0	32	40.8	105	100	135
	10.0	39.2	49.9	85	80	110
	12.5	47.7	60.8	70	70	90
160 x 80	4.0	14.4	18.4	220	175	260
	5.0	17.8	22.7	180	145	215
	6.3	22.2	28.2	145	115	170
	8.0	27.6	35.2	115	95	140
	10.0	33.7	42.9	95	75	115
	12.5	40.9	52.1	80	65	95
200 x 100	5.0	22.6	28.7	175	140	210
	6.3	28.1	35.8	140	115	170
	8.0	35.1	44.8	110	90	135
	10.0	43.1	54.9	95	75	110
	12.5	52.7	67.1	75	60	90
	16.0	65.2	83.0	60	50	75
200 x 120	5.0	24.1	30.7	170	145	210
	6.3	30.1	38.3	140	115	170
	8.0	37.6	48.0	110	95	135
	10.0	46.3	58.9	90	75	110
	12.5	56.6	72.1	75	65	90
	14.2	63.3	80.7	65	55	80
	16.0	70.2	89.4	60	50	75

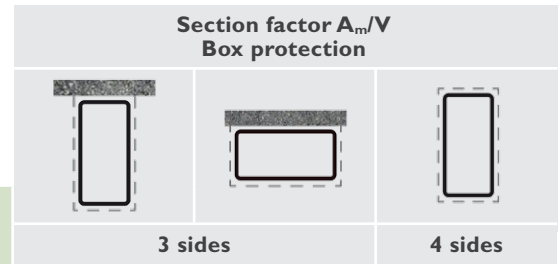
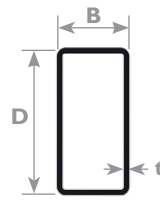
FP®-900/FirePro®

Fire Protection of Structural Steel

SECTION FACTOR A_m/V

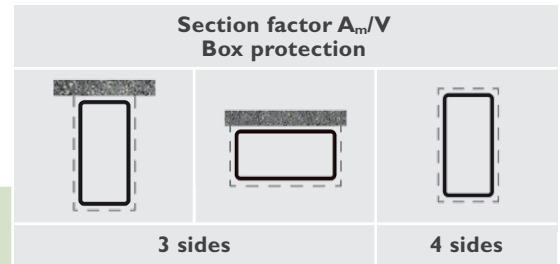
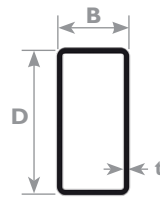


Table S12 - Rectangular Hollow Sections



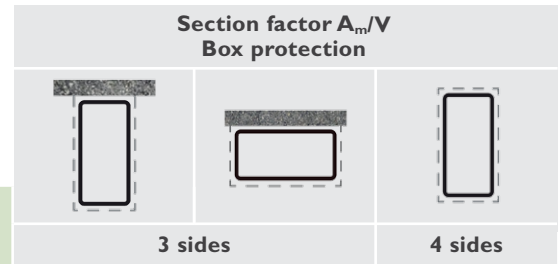
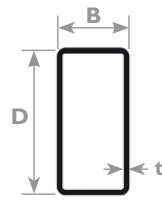
DESIGNATION		Mass per metre	Area of section	Section factor A_m/V Box protection		
Size D x B	Thickness t			3 sides		4 sides
mm	mm	Kg/m	cm ²	m ⁻¹	m ⁻¹	m ⁻¹
200 x 150	5.0	26.5	33.7	165	150	210
	6.3	33.0	42.1	135	120	170
	8.0	41.4	52.8	105	95	135
	10.0	51.0	64.9	80	80	110
	12.5	62.5	79.6	70	65	90
	14.2	70.0	89.2	65	60	80
	16.0	77.7	99.0	55	55	70
250 x 100	5.0	26.5	33.7	180	135	210
	6.3	33.0	42.1	145	110	170
	8.0	41.4	52.8	115	85	135
	10.0	51.0	64.9	95	70	110
	12.5	62.5	79.6	75	60	90
	14.2	70.0	89.2	70	50	80
	16.0	77.7	99.0	65	45	70
250 x 150	5.0	30.4	38.7	170	145	210
	6.3	38.0	48.4	135	115	165
	8.0	47.7	60.8	110	90	135
	10.0	58.8	74.9	90	75	110
	12.5	72.3	92.1	75	60	90
	14.2	81.1	103.0	65	55	80
	16.0	90.3	115.0	60	50	70
250 x 200	10.0	66.7	84.9	85	80	110
	12.5	82.1	105.0	70	65	90
	14.2	92.3	118.0	60	55	80
260 x 140	5.0	30.4	38.7	170	140	210
	6.3	38.0	48.4	140	115	165
	8.0	47.7	60.8	110	90	135
	10.0	58.8	74.9	90	75	110
	12.5	72.3	92.1	75	60	90
	14.2	81.1	103.0	65	55	80
	16.0	90.3	115.0	60	50	70
300 x 100	5.0	30.4	38.7	180	130	210
	6.3	38.0	48.4	145	105	165
	8.0	47.7	60.8	115	85	135
	10.0	58.8	74.9	95	70	110
	12.5	72.3	92.1	80	55	90
	14.2	81.1	103.0	70	50	80
	16.0	90.3	115.0	65	45	70
300 x 150	8.0	54.0	68.8	110	90	130
	10.0	66.7	84.9	90	70	110
	12.5	82.1	105.0	75	60	90
	14.2	92.3	118.0	65	55	80
	16.0	103.0	131.0	60	50	70

Table S12 - Rectangular Hollow Sections



DESIGNATION		Mass per metre	Area of section	Section factor A_m/V		
Size D x B	Thickness t			3 sides		4 sides
mm	mm	Kg/m	cm ²	m ⁻¹	m ⁻¹	m ⁻¹
300 x 200	5.0	38.3	48.0	165	145	205
	6.3	47.9	61.0	135	115	165
	8.0	60.3	76.8	105	95	130
	10.0	74.5	94.9	85	75	105
	12.5	91.9	117.0	70	60	85
	14.2	103.0	132.0	60	55	75
	16.0	115.0	147.0	55	50	70
300 x 250	6.3	52.8	67.3	130	120	165
	8.0	66.5	84.8	100	95	130
	10.0	82.4	105.0	85	80	105
	12.5	102.0	130.0	65	65	85
	14.2	115.0	146.0	60	55	75
	16.0	128.0	163.0	55	50	70
350 x 150	6.3	47.9	61.0	140	110	165
	8.0	60.3	76.8	110	85	130
	10.0	74.5	94.9	90	70	105
	12.5	91.9	117.0	75	55	85
	14.2	103.0	132.0	65	50	75
	16.0	115.0	147.0	60	45	70
350 x 250	6.3	57.8	73.6	130	115	165
	8.0	72.8	92.8	105	95	130
	10.0	90.2	115.0	85	75	105
350 x 250	12.5	112.0	142.0	70	60	85
	14.2	126.0	160.0	60	55	75
	16.0	141.0	179.0	55	50	70
400 x 120	6.3	49.9	63.5	145	100	165
	8.0	62.8	80.0	115	80	130
	10.0	77.7	98.9	95	65	105
	12.5	95.8	122.0	75	55	85
	14.2	108.0	137.0	70	50	80
	16.0	120.0	153.0	65	45	70
400 x 150	6.3	52.8	67.3	145	105	165
	8.0	66.5	84.8	115	85	130
	10.0	82.4	105.0	90	70	105
	12.5	102.0	130.0	75	55	85
	14.2	115.0	146.0	65	50	75
	16.0	128.0	163.0	60	45	70
400 x 200	6.3	57.8	73.6	140	110	165
	8.0	72.8	92.8	110	90	130
	10.0	90.2	115.0	90	70	105
	12.5	112.0	142.0	70	60	85
	14.2	126.0	160.0	65	50	75
	16.0	141.0	179.0	60	45	70

Table S12 - Rectangular Hollow Sections



DESIGNATION		Mass per metre	Area of section	Section factor A_m/V		
Size D x B	Thickness t			3 sides		4 sides
mm	mm	Kg/m	cm ²	m ⁻¹	m ⁻¹	m ⁻¹
400 x 300	8.0	85.4	109	105	95	130
	10.0	106.0	135	85	75	105
	12.5	131.0	167	70	60	85
	14.2	148.0	189	60	55	75
	16.0	166.0	211	55	50	70
450 x 250	8.0	85.4	109	105	90	130
	10.0	106.0	135	85	70	105
	12.5	131.0	167	70	60	85
	14.2	148.0	189	65	50	75
	16.0	166.0	211	55	45	70
500 x 200	8.0	85.4	109	110	85	130
	10.0	106.0	135	90	70	105
	12.5	131.0	167	75	55	85
	14.2	148.0	189	65	50	75
	16.0	166.0	211	60	45	70
500 x 300	8.0	97.9	125	105	90	130
	10.0	122.0	155	85	75	105
	12.5	151.0	192	70	60	85
	14.2	170.0	217	60	50	75
	16.0	191.0	243	55	45	70
	20.0	235.0	300	45	40	55

FP®-900/FirePro® Fire Protection of Structural Steel PROTECTION SYSTEMS



FP®-900/FIREPRO® FIRE PROTECTIVE BOARD

FP®-900/FirePro® fire protection structural steel systems have been tested and demonstrated fire resistance of up to 240 minutes in compliance with BS 476: Part 21, EN 13381-4 and the principles of Yellow Book 5th Edition of ASFP. A full appraisal of fire protection of structural steel has been issued by Warringtonfire UK, an accredited and internationally recognized fire testing laboratory. The required protective board thickness with respect to the fire rating and steel section factor are given in the tables below.

Section factor m ⁻¹	FP®-900/FIREPRO® 30 MINUTES FIRE PROTECTION OF STRUCTURAL STEEL									
	Required board thickness - mm for a design temperature °C									
	350	400	450	500	550	600	620	650	700	750
50	18	18	18	18	18	18	18	18	18	18
55	18	18	18	18	18	18	18	18	18	18
60	18	18	18	18	18	18	18	18	18	18
65	18	18	18	18	18	18	18	18	18	18
70	18	18	18	18	18	18	18	18	18	18
75	18	18	18	18	18	18	18	18	18	18
80	18	18	18	18	18	18	18	18	18	18
85	18	18	18	18	18	18	18	18	18	18
90	18	18	18	18	18	18	18	18	18	18
95	18	18	18	18	18	18	18	18	18	18
100	18	18	18	18	18	18	18	18	18	18
105	18	18	18	18	18	18	18	18	18	18
110	18	18	18	18	18	18	18	18	18	18
115	18	18	18	18	18	18	18	18	18	18
120	18	18	18	18	18	18	18	18	18	18
125	18	18	18	18	18	18	18	18	18	18
130	18	18	18	18	18	18	18	18	18	18
135	18	18	18	18	18	18	18	18	18	18
140	18	18	18	18	18	18	18	18	18	18
145	18	18	18	18	18	18	18	18	18	18
150	18	18	18	18	18	18	18	18	18	18
155	18	18	18	18	18	18	18	18	18	18
160	18	18	18	18	18	18	18	18	18	18
165	18	18	18	18	18	18	18	18	18	18
170	18	18	18	18	18	18	18	18	18	18
175	18	18	18	18	18	18	18	18	18	18
180	18	18	18	18	18	18	18	18	18	18
185	18	18	18	18	18	18	18	18	18	18
190	18	18	18	18	18	18	18	18	18	18
195	18	18	18	18	18	18	18	18	18	18
200	18	18	18	18	18	18	18	18	18	18
205	18	18	18	18	18	18	18	18	18	18
210	18	18	18	18	18	18	18	18	18	18
215	18	18	18	18	18	18	18	18	18	18
220	18	18	18	18	18	18	18	18	18	18
225	18	18	18	18	18	18	18	18	18	18
230	18	18	18	18	18	18	18	18	18	18
235	18	18	18	18	18	18	18	18	18	18
240	18	18	18	18	18	18	18	18	18	18
245	18	18	18	18	18	18	18	18	18	18
250	18	18	18	18	18	18	18	18	18	18
255	18	18	18	18	18	18	18	18	18	18
260	18	18	18	18	18	18	18	18	18	18
265	18	18	18	18	18	18	18	18	18	18
270	18	18	18	18	18	18	18	18	18	18
275	18	18	18	18	18	18	18	18	18	18
280	18	18	18	18	18	18	18	18	18	18
285	18	18	18	18	18	18	18	18	18	18

Note: Critical temperature at 550°C for 4 sided protection of steel columns and beams.
 Critical temperature at 620°C for 3 sided protection of steel beams.
 The above data provided complies with BS 476: Part 21 and Yellow Book 5th Edition of ASFP.



Table SB 2

FP®-900/FIREPRO® 60 MINUTES FIRE PROTECTION OF STRUCTURAL STEEL										
Section factor m⁻¹	Required board thickness - mm for a design temperature °C									
	350	400	450	500	550	600	620	650	700	750
50	18	18	18	18	18	18	18	18	18	18
55	18	18	18	18	18	18	18	18	18	18
60	19	18	18	18	18	18	18	18	18	18
65	19	18	18	18	18	18	18	18	18	18
70	20	18	18	18	18	18	18	18	18	18
75	20	18	18	18	18	18	18	18	18	18
80	20	18	18	18	18	18	18	18	18	18
85	21	18	18	18	18	18	18	18	18	18
90	21	18	18	18	18	18	18	18	18	18
95	21	18	18	18	18	18	18	18	18	18
100	21	19	18	18	18	18	18	18	18	18
105	22	19	18	18	18	18	18	18	18	18
110	22	19	18	18	18	18	18	18	18	18
115	22	19	18	18	18	18	18	18	18	18
120	22	20	18	18	18	18	18	18	18	18
125	23	20	18	18	18	18	18	18	18	18
130	23	20	18	18	18	18	18	18	18	18
135	23	20	18	18	18	18	18	18	18	18
140	23	21	18	18	18	18	18	18	18	18
145	23	21	18	18	18	18	18	18	18	18
150	24	21	19	18	18	18	18	18	18	18
155	24	21	19	18	18	18	18	18	18	18
160	24	21	19	18	18	18	18	18	18	18
165	24	21	19	18	18	18	18	18	18	18
170	24	22	19	18	18	18	18	18	18	18
175	24	22	20	18	18	18	18	18	18	18
180	24	22	20	18	18	18	18	18	18	18
185	25	22	20	18	18	18	18	18	18	18
190	25	22	20	18	18	18	18	18	18	18
195	25	22	20	18	18	18	18	18	18	18
200	25	22	20	18	18	18	18	18	18	18
205	25	23	20	18	18	18	18	18	18	18
210	25	23	20	19	18	18	18	18	18	18
215	25	23	21	19	18	18	18	18	18	18
220	25	23	21	19	18	18	18	18	18	18
225	25	23	21	19	18	18	18	18	18	18
230	26	23	21	19	18	18	18	18	18	18
235	26	23	21	19	18	18	18	18	18	18
240	26	23	21	19	18	18	18	18	18	18
245	26	23	21	19	18	18	18	18	18	18
250	26	23	21	20	18	18	18	18	18	18
255	26	23	21	20	18	18	18	18	18	18
260	26	24	21	20	18	18	18	18	18	18
265	26	24	22	20	18	18	18	18	18	18
270	26	24	22	20	19	18	18	18	18	18
275	26	24	22	20	19	18	18	18	18	18
280	26	24	22	20	19	18	18	18	18	18
285	26	24	22	20	19	18	18	18	18	18

Note: Critical temperature at 550°C for 4 sided protection of steel columns and beams.
 Critical temperature at 620°C for 3 sided protection of steel beams.
 The above data provided complies with BS 476: Part 21 and Yellow Book 5th Edition of ASFP.

Table SB 3 **FP®-900/FIREPRO® 90 MINUTES FIRE PROTECTION OF STRUCTURAL STEEL**

Section factor m ⁻¹	Required minimum board thickness - mm for a design temperature °C									
	350	400	450	500	550	600	620	650	700	750
50	22	19	18	18	18	18	18	18	18	18
55	23	20	18	18	18	18	18	18	18	18
60	24	20	18	18	18	18	18	18	18	18
65	24	21	18	18	18	18	18	18	18	18
70	25	22	19	18	18	18	18	18	18	18
75	25	22	19	18	18	18	18	18	18	18
80	26	23	20	18	18	18	18	18	18	18
85	27	23	21	18	18	18	18	18	18	18
90	27	24	21	18	18	18	18	18	18	18
95	27	24	22	19	18	18	18	18	18	18
100	28	25	22	19	18	18	18	18	18	18
105	28	25	22	20	18	18	18	18	18	18
110	29	26	23	20	18	18	18	18	18	18
115	29	26	23	21	18	18	18	18	18	18
120	29	26	24	21	19	18	18	18	18	18
125	30	27	24	21	19	18	18	18	18	18
130	30	27	24	22	20	18	18	18	18	18
135	30	27	25	22	20	18	18	18	18	18
140	31	28	25	22	20	19	18	18	18	18
145	31	28	25	23	21	19	18	18	18	18
150	31	28	25	23	21	19	18	18	18	18
155	31	28	26	23	21	20	19	18	18	18
160	32	29	26	24	22	20	19	18	18	18
165	32	29	26	24	22	20	19	18	18	18
170	32	29	26	24	22	20	20	19	18	18
175	32	29	27	24	22	21	20	19	18	18
180	33	30	27	24	23	21	20	19	18	18
185	33	30	27	25	23	21	20	19	18	18
190	33	30	27	25	23	21	21	20	18	18
195	33	30	27	25	23	22	21	20	18	18
200	33	30	28	25	23	22	21	20	18	18
205	34	30	28	25	23	22	21	20	18	18
210	34	31	28	25	24	22	21	20	19	18
215	34	31	28	26	24	22	21	21	19	18
220	34	31	28	26	24	22	22	21	19	18
225	34	31	28	26	24	22	22	21	19	18
230	34	31	28	26	24	23	22	21	19	18
235	34	31	29	26	24	23	22	21	19	18
240	35	31	29	26	24	23	22	21	20	18
245	35	32	29	26	25	23	22	21	20	18
250	35	32	29	27	25	23	22	22	20	18
255	35	32	29	27	25	23	23	22	20	18
260	35	32	29	27	25	23	23	22	20	18
265	35	32	29	27	25	23	23	22	20	19
270	35	32	29	27	25	24	23	22	20	19
275	36	32	29	27	25	24	23	22	20	19
280	36	32	29	27	25	24	23	22	21	19
285	36	32	30	27	25	24	23	22	21	19

Note: Critical temperature at 550°C for 4 sided protection of steel columns and beams.
 Critical temperature at 620°C for 3 sided protection of steel beams.
 The above data provided complies with BS 476: Part 21 and Yellow Book 5th Edition of ASFP.

Table SB 4

FP®-900/FIREPRO® 120 MINUTES FIRE PROTECTION OF STRUCTURAL STEEL										
Section factor m⁻¹	Required board thickness - mm for a design temperature °C									
	350	400	450	500	550	600	620	650	700	750
50	27	23	20	18	18	18	18	18	18	18
55	28	24	21	18	18	18	18	18	18	18
60	29	25	22	19	18	18	18	18	18	18
65	29	26	23	20	18	18	18	18	18	18
70	30	27	24	21	18	18	18	18	18	18
75	31	28	25	22	19	18	18	18	18	18
80	32	29	26	23	20	18	18	18	18	18
85	32	29	26	23	21	18	18	18	18	18
90	33	30	27	24	21	19	18	18	18	18
95	34	31	28	25	22	20	19	18	18	18
100	34	31	28	25	23	20	19	18	18	18
105	35	32	29	26	24	21	20	19	18	18
110	35	32	29	26	24	22	21	19	18	18
115	36	33	30	27	25	22	21	20	18	18
120	36	33	30	27	25	23	22	21	18	18
125	37	34	31	28	25	23	22	21	19	18
130	37	34	31	28	26	24	23	22	19	18
135	38	34	31	29	26	24	23	22	20	18
140	38	35	32	29	27	25	24	22	20	18
145	38	35	32	29	27	25	24	23	20	18
150	39	35	32	30	27	25	24	23	21	18
155	39	36	33	30	28	26	25	23	21	19
160	40	36	33	30	28	26	25	24	21	19
165	40	36	33	30	28	26	25	24	22	19
170	40	37	33	31	28	26	26	24	22	20
175	40	37	34	31	29	27	26	25	22	20
180	41	37	34	31	29	27	26	25	23	20
185	41	37	34	31	29	27	26	25	23	21
190	41	38	34	32	29	27	27	25	23	21
195	42	38	35	32	30	28	27	26	23	21
200	42	38	35	32	30	28	27	26	24	21
205	42	38	35	32	30	28	27	26	24	22
210	42	38	35	32	30	28	27	26	24	22
215	43	39	35	33	30	28	28	26	24	22
220	43	39	36	33	30	29	28	27	24	22
225	43	39	36	33	31	29	28	27	24	22
230	43	39	36	33	31	29	28	27	25	23
235	43	39	36	33	31	29	28	27	25	23
240	44	40	36	33	31	29	28	27	25	23
245	44	40	36	33	31	29	28	27	25	23
250	44	40	36	34	31	29	29	27	25	23
255	44	40	37	34	31	30	29	28	25	23
260	44	40	37	34	32	30	29	28	26	23
265	44	40	37	34	32	30	29	28	26	24
270	-	40	37	34	32	30	29	28	26	24
275	-	41	37	34	32	30	29	28	26	24
280	-	41	37	34	32	30	29	28	26	24
285	-	41	37	34	32	30	29	28	26	24

Note: Critical temperature at 550°C for 4 sided protection of steel columns and beams.
 Critical temperature at 620°C for 3 sided protection of steel beams.
 The above data provided complies with BS 476: Part 21 and Yellow Book 5th Edition of ASFP.

Table SB 5

FP®-900/FIREPRO® 180 MINUTES FIRE PROTECTION OF STRUCTURAL STEEL										
Section factor m⁻¹	Required board thickness - mm for a design temperature °C									
	350	400	450	500	550	600	620	650	700	750
50	35	32	29	25	22	19	18	18	18	18
55	37	34	31	27	24	21	19	18	18	18
60	38	35	32	29	26	23	21	19	18	18
65	40	37	33	30	27	24	23	21	18	18
70	41	38	35	31	29	26	25	23	19	18
75	42	39	36	33	30	27	26	24	20	18
80	43	40	37	34	31	28	27	25	22	18
85	44	41	38	35	32	29	28	26	23	19
90	-	42	39	36	33	30	29	28	24	21
95	-	43	40	36	34	31	30	28	25	22
100	-	44	40	37	35	32	31	29	26	23
105	-	-	41	38	35	33	32	30	27	23
110	-	-	42	39	36	34	32	31	28	24
115	-	-	42	39	37	34	33	31	28	25
120	-	-	43	40	37	35	34	32	29	26
125	-	-	44	40	38	35	34	32	29	26
130	-	-	44	41	38	36	35	33	30	27
135	-	-	-	41	39	36	35	33	30	27
140	-	-	-	42	39	37	35	34	31	28
145	-	-	-	42	39	37	36	34	31	28
150	-	-	-	43	40	37	36	35	32	28
155	-	-	-	43	40	38	37	35	32	29
160	-	-	-	43	40	38	37	35	32	29
165	-	-	-	44	41	38	37	36	33	30
170	-	-	-	44	41	39	38	36	33	30
175	-	-	-	44	41	39	38	36	33	30
180	-	-	-	-	42	39	38	37	33	30
185	-	-	-	-	42	39	38	37	34	31
190	-	-	-	-	42	40	39	37	34	31
195	-	-	-	-	42	40	39	37	34	31
200	-	-	-	-	43	40	39	37	34	31
205	-	-	-	-	43	40	39	38	35	32
210	-	-	-	-	43	41	39	38	35	32
215	-	-	-	-	43	41	40	38	35	32
220	-	-	-	-	44	41	40	38	35	32
225	-	-	-	-	44	41	40	38	35	32
230	-	-	-	-	44	41	40	39	35	32
235	-	-	-	-	44	41	40	39	36	33
240	-	-	-	-	44	42	40	39	36	33
245	-	-	-	-	44	42	41	39	36	33
250	-	-	-	-	-	42	41	39	36	33
255	-	-	-	-	-	42	41	39	36	33
260	-	-	-	-	-	42	41	39	36	33
265	-	-	-	-	-	42	41	40	36	33
270	-	-	-	-	-	42	41	40	37	34
275	-	-	-	-	-	43	41	40	37	34
280	-	-	-	-	-	43	41	40	37	34
285	-	-	-	-	-	43	42	40	37	34

Note: Critical temperature at 550°C for 4 sided protection of steel columns and beams.
 Critical temperature at 620°C for 3 sided protection of steel beams.
 The above data provided complies with BS 476: Part 21 and Yellow Book 5th Edition of ASFP.

Table SB 6 **FP®-900/FIREPRO® 240 MINUTES FIRE PROTECTION OF STRUCTURAL STEEL**

Section factor m ⁻¹	Required board thickness - mm for a design temperature °C									
	350	400	450	500	550	600	620	650	700	750
50	44	41	38	35	32	29	27	25	20	18
55	-	43	40	37	34	31	30	28	23	18
60	-	-	42	39	36	33	32	30	26	21
65	-	-	44	41	38	35	34	32	28	23
70	-	-	-	42	40	37	36	34	30	25
75	-	-	-	44	41	38	37	35	31	27
80	-	-	-	-	42	40	38	36	33	28
85	-	-	-	-	43	41	39	38	34	30
90	-	-	-	-	44	42	41	39	35	31
95	-	-	-	-	-	43	41	40	36	32
100	-	-	-	-	-	44	42	41	37	33
105	-	-	-	-	-	44	43	41	38	34
110	-	-	-	-	-	-	44	42	38	34
115	-	-	-	-	-	-	-	43	39	35
120	-	-	-	-	-	-	-	43	40	36
125	-	-	-	-	-	-	-	44	40	36
130	-	-	-	-	-	-	-	44	41	37
135	-	-	-	-	-	-	-	-	41	37
140	-	-	-	-	-	-	-	-	42	38
145	-	-	-	-	-	-	-	-	42	38
150	-	-	-	-	-	-	-	-	42	39
155	-	-	-	-	-	-	-	-	43	39
160	-	-	-	-	-	-	-	-	43	39
165	-	-	-	-	-	-	-	-	43	40
170	-	-	-	-	-	-	-	-	44	40
175	-	-	-	-	-	-	-	-	44	40
180	-	-	-	-	-	-	-	-	44	40
185	-	-	-	-	-	-	-	-	-	41
190	-	-	-	-	-	-	-	-	-	41
195	-	-	-	-	-	-	-	-	-	41
200	-	-	-	-	-	-	-	-	-	41
205	-	-	-	-	-	-	-	-	-	42
210	-	-	-	-	-	-	-	-	-	42
215	-	-	-	-	-	-	-	-	-	42
220	-	-	-	-	-	-	-	-	-	42
225	-	-	-	-	-	-	-	-	-	42
230	-	-	-	-	-	-	-	-	-	42
235	-	-	-	-	-	-	-	-	-	43
240	-	-	-	-	-	-	-	-	-	43
245	-	-	-	-	-	-	-	-	-	43
250	-	-	-	-	-	-	-	-	-	43
255	-	-	-	-	-	-	-	-	-	43
260	-	-	-	-	-	-	-	-	-	43
265	-	-	-	-	-	-	-	-	-	43
270	-	-	-	-	-	-	-	-	-	43
275	-	-	-	-	-	-	-	-	-	44
280	-	-	-	-	-	-	-	-	-	44
285	-	-	-	-	-	-	-	-	-	44

Note: Critical temperature at 550°C for 4 sided protection of steel columns and beams.
 Critical temperature at 620°C for 3 sided protection of steel beams.
 The above data provided complies with BS 476: Part 21 and Yellow Book 5th Edition of ASFP.



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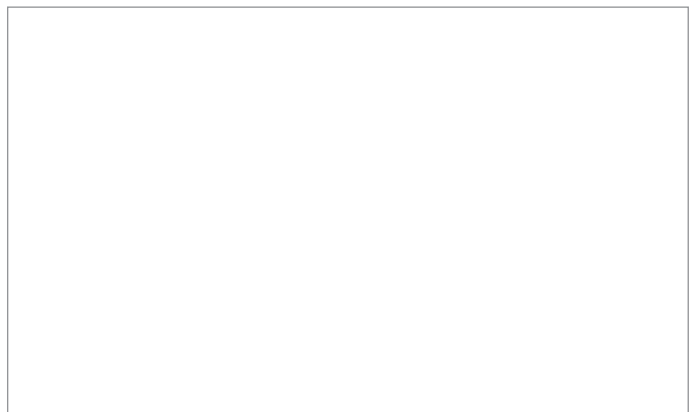
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