SMD®
Structural Floor and Roof Solutions

Design Guide

Steel Fibre Reinforced Concrete Slabs on Metal Decking

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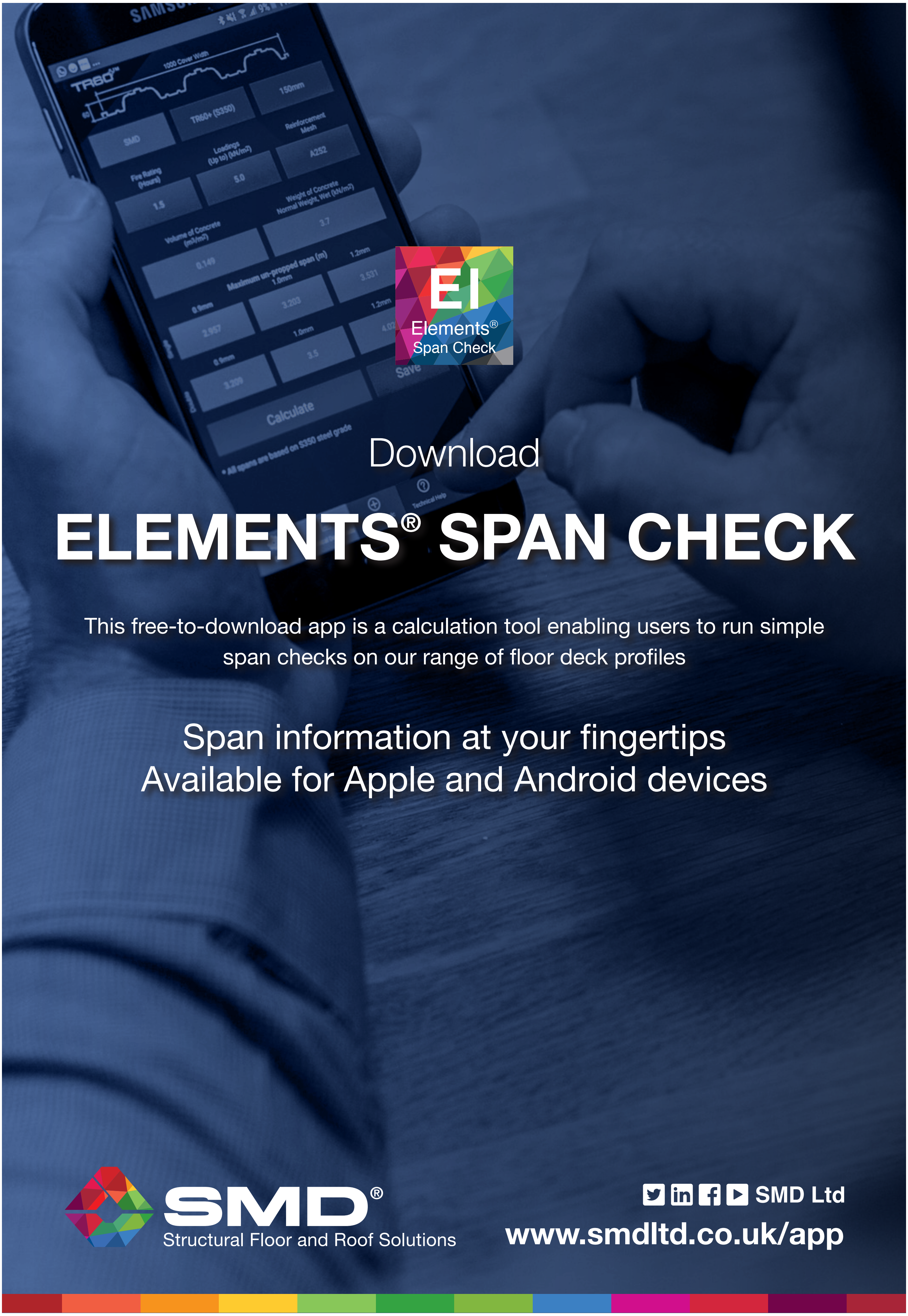
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INTRODUCTION

Steel Fibre Reinforced Concrete Slabs on Metal Decking

ArcelorMittal Wire Solutions has been one of the leading developers of steel fibre concrete technology for over 30 years. Steel fibre reinforced concrete is the most widely applied solution for industrial floors constructed on grade or pile supported. Based on this experience, TAB®Deck developed by ArcelorMittal Wire Solutions in conjunction with SMD, is today regularly used on our range of upper floor composite steel decks.

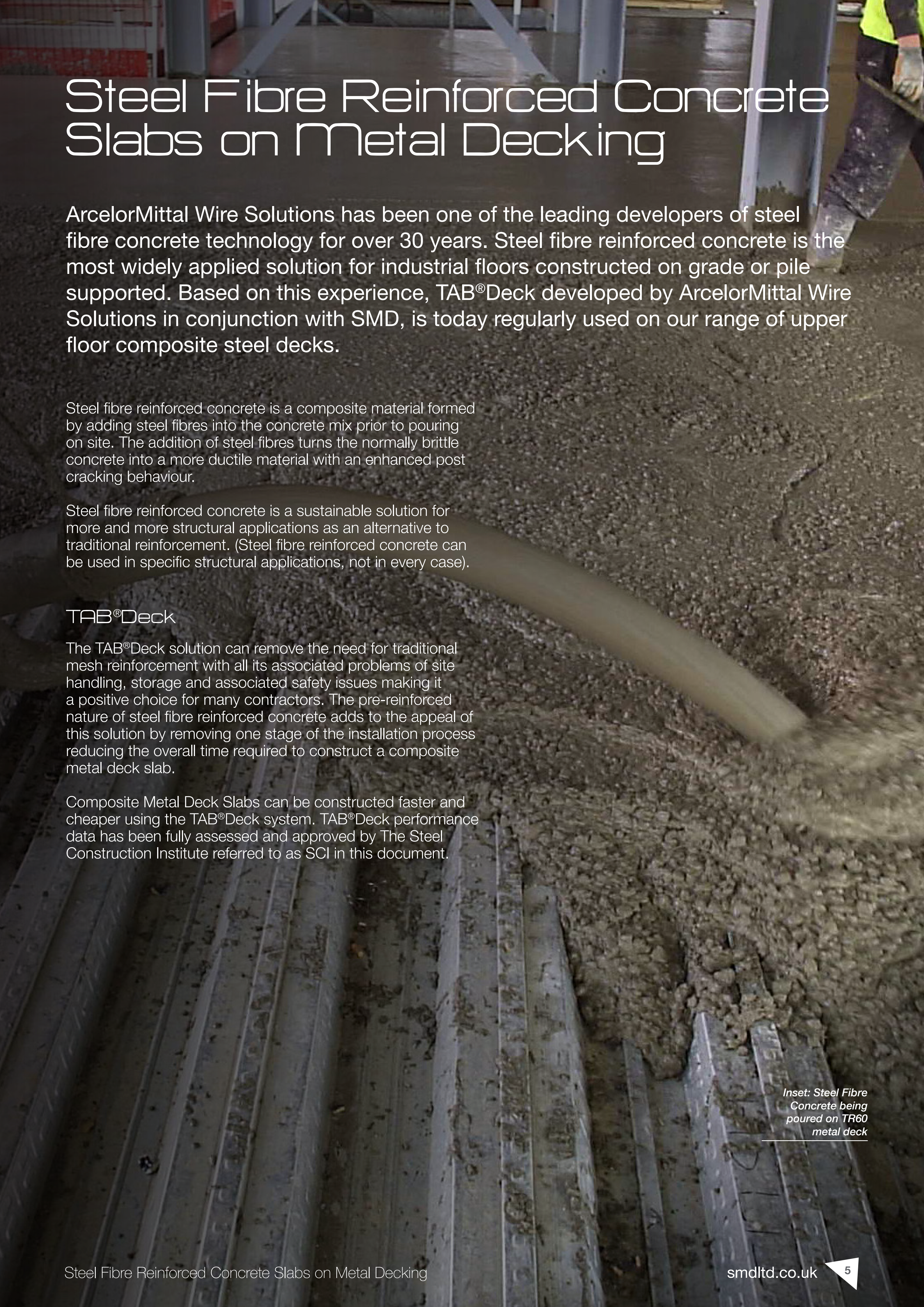
Steel fibre reinforced concrete is a composite material formed by adding steel fibres into the concrete mix prior to pouring on site. The addition of steel fibres turns the normally brittle concrete into a more ductile material with an enhanced post cracking behaviour.

Steel fibre reinforced concrete is a sustainable solution for more and more structural applications as an alternative to traditional reinforcement. (Steel fibre reinforced concrete can be used in specific structural applications, not in every case).

TAB®Deck

The TAB®Deck solution can remove the need for traditional mesh reinforcement with all its associated problems of site handling, storage and associated safety issues making it a positive choice for many contractors. The pre-reinforced nature of steel fibre reinforced concrete adds to the appeal of this solution by removing one stage of the installation process reducing the overall time required to construct a composite metal deck slab.

Composite Metal Deck Slabs can be constructed faster and cheaper using the TAB®Deck system. TAB®Deck performance data has been fully assessed and approved by The Steel Construction Institute referred to as SCI in this document.



Inset: Steel Fibre Concrete being poured on TR60 metal deck

Design Notes

SMD Metal Decking with ArcelorMittal TAB®Deck System

Advantages of using the TAB®Deck system

- Concrete pre-reinforced requiring little or no mesh fixing
- Easily and safely installed in any location
- Faster to install saving time and money
- Removes the need for storing mesh and accessories on site
- No need to lift and handle reinforcing mesh
- No mesh resulting in time and crane hire savings

Crack Control Requirement

The use of ArcelorMittal TAB®Deck can meet the crack control design requirements specified by BS EN 1994-1-1 for composite slabs and therefore remove the need for traditional mesh reinforcement. Depending on the steel fibre type, dosage and slab depth applicable, the TAB®Deck solution can meet this requirement.

Nominal Reinforcement at Intermediate Supports

Continuous composite slabs are typically designed as simply supported with nominal steel fabric reinforcement provided over intermediate supports. The cross section area of reinforcement in a longitudinal direction should be not less than 0.2% of the cross sectional area of concrete above the deck ribs. Depending on the steel fibre type, dosage and slab depth applicable, the TAB®Deck solution can meet this requirement.

Transverse Reinforcement

The cross section area of transverse reinforcement in the form of steel mesh reinforcement should be not less than 0.2% of the cross section area of the cross sectional area of concrete above the deck ribs. Depending on the steel fibre type, dosage and slab depth applicable, the TAB®Deck solution can meet this requirement.

Concentrated Loads

A line load running parallel to the span should be treated as a series of concentrated loads.

Where there are concentrated point loads or line loads, transverse reinforcement should be placed on or above the profiled steel sheets. It should have a cross section area of not less than 0.2% of the cross sectional area of concrete above the deck ribs. This transverse reinforcement should be ductile. TAB®Deck can meet this requirement when used in conjunction with traditional rebar or mesh reinforcement.

For further design advice regarding concentrated loads and the requirement for additional reinforcement, contact SMD or ArcelorMittal Wire Solutions.

Intermediate Supports in Propped Construction or Special Finishes

In situations with a higher risk of cracking such as over intermediate supports for propped construction or where a special floor finish is to be applied, additional reinforcement is required. BS EN 1994-1-1 specifies more severe reinforcement requirements increased to 0.4% of the cross sectional area of concrete above the deck ribs. Depending on the steel fibre type, dosage and slab depth applicable, the TAB®Deck solution may require traditional rebar or wire mesh to meet this requirement.

Situations when additional reinforcement may be required

TAB®Deck can be used to replace the traditional mesh reinforcement used for crack control and fire requirements (refer load span tables or SMD Elements® Design Software).

However, additional reinforcement may be required in the following situations:

- For continuous slab spans and/or loading conditions, including concentrated loads, which exceed the capacity given by the published fire load / span tables.
- For single span slabs with over 30 minute fire rating, bottom reinforcement bars will normally be required; size and quantity to be determined by the load / span criteria.
- Cantilever slabs should be designed as reinforced concrete with top reinforcement by the structural engineer.
- Trimming reinforcement around square or round holes with an opening greater than 300mm but not exceeding 700mm. Where openings exceed 700mm, additional trimming beams will be required (to be designed and supplied by others).
- For edge composite beams where the distance from the edge of the concrete flange to the nearest row of shear connectors is less than 300mm, transverse U-Bar reinforcement will be required and is to be designed by the structural engineer.
- At Construction / Day Joints within the slab pour adequate continuity reinforcement will be required.

Guidance for Installing Service Holes in the Composite Slab

When it is necessary to form service holes in the composite slab, the following general guidelines should be followed for openings at right angles to the deck span.

1. Up to 300mm opening, no special treatment is required. Prior to casting the concrete the opening is boxed out. When the slab has cured the deck is then cut using non-percussive methods.

2. Openings greater than 300mm but less than 700mm. Additional reinforcement is required around the opening. The design should generally be in accordance with Eurocode 2 when forming the hole as described above. Items 1 and 2 relate to isolated single holes and not to a series of holes transverse

to the direction of span, holes in groups should be considered as a single overall opening dimension. In both cases 1 and 2 the metal decking should not be cut until the slab has cured.

3. Greater than 700mm. Structural trimming steelwork is required to be designed by the project engineer and supplied by a steelwork fabricator.

These are guidelines only and the project engineer should check particular requirements. SMD and ArcelorMittal Wire Solutions cannot take design responsibility for any additional framing or slab reinforcement for holes or openings.

TAB®Deck Steel Fibre Reinforced Concrete

Concrete Mix

The specific mix design will always depend on the local materials available but must follow these basic guidelines:

- Cement – minimum 350kg/m³ of CEM I or CEM IIIA
- Aggregates – maximum 20mm
- Fines content – minimum 450kg/m³ of smaller than 200μ including cementitious content
- Water/Cement ratio ≤ 0.50
- Minimum Slump – 70mm (before the addition of steel fibres and super-plasticizer).

Note - Where super-plasticizer is added at the concrete batching plant target slump at site is 170mm.

ArcelorMittal Wire Solutions can provide advice on individual mix designs and check their suitability for specific projects.

Addition of TAB®Deck Steel Fibres to the Concrete Mix

Steel fibres should be added at the desired dosage rate (20-30kg/m³ of HE++ or 25-35kg/m³ of HE to suit specific slab design) into the concrete mixer either at the batching plant or on the job site. Some ready-mix suppliers have suitable facilities for loading the steel fibres into the mixer at the batching plant. Where these do not exist the steel fibres can be added at the plant or job site using conveyor belts or “blast” machines.

The steel fibres should be added at a rate of 30-40kg per minute. If using a conveyor belt the steel fibres should be spread on the belt, not heaped, to avoid clumps of steel fibres. The maximum drum rotation should be 12-15 revolutions per minute. The truck mixer should be rotated at full speed for 8-12 minutes after adding the steel fibres.

Adding steel fibres to the concrete mix will typically reduce the slump of the concrete mix by around 35mm. It is recommended therefore that a Super-Plasticiser be added to the concrete before the addition of the steel fibres to raise the steel fibre concrete slump to the required level. This is particularly important when the concrete is to be pumped.

Note: When pumping TAB®Deck steel fibre reinforced concrete a minimum 125mm diameter hose should be used.

Installation of TAB®Deck Steel Fibre Reinforced Concrete

TAB®Deck steel fibre reinforced concrete should be installed, cured and finished in exactly the same way as plain concrete.

Fire Design of TAB®Deck Steel Fibre Reinforced Concrete

The fire resistance of concrete composite slabs reinforced with 30kg/m3 of HE 1/50 steel fibres has been investigated by SCI.

The conclusions drawn with respect to the structural performance of the TR60+, TR80+ and R51+ composite deck slabs in fire conditions are based on the results of fire tests carried out by Warringtonfire on behalf of SMD and ArcelorMittal Wire Solutions.

The fire test results have been used to calibrate a structural model developed by SCI. This model was subsequently used to produce fire design tables for composite slabs constructed using SMD TR60+, TR80+ and R51+ decking and concrete reinforced with steel fibre dosage options based on the design properties indicated below.

TAB®Deck Types and dosages

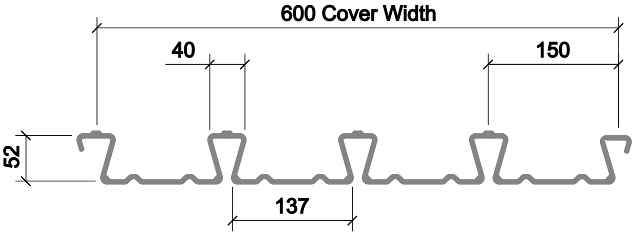
The tables contained in this document are based on HE 1/50 steel fibres at the same design dosage (30kg/m³) as that used in the test specimens. Our product pages include fire design tables for resistance periods of 60, 90 and 120 minutes for all SMD composite decking profiles.

For full design notes relating to these tables and designs using other steel fibre type/dosage combinations or outside the scope of the tables on our product pages, refer SMD Elements™ Design Software, The SMD White Book (version 3 onwards) or contact ArcelorMittal Wire Solutions for further design information.

Further steel fibre type/dosage options are available in The SMD White Book providing design flexibility to suit specific design requirements. These other steel fibre options are based on steel fibre concrete tensile resistance values ($\sigma_{t,pl}$) obtained from tests carried out by ArcelorMittal. For further information contact fibresupport@arcelormittal.com.

PRODUCTS

R51+™

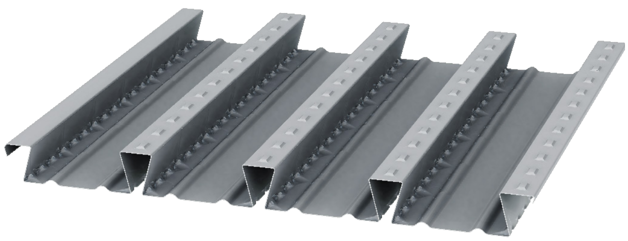


Description

Updated from the original R51 product in 2018, this profile is available in S350 and S450 grades to provide the designer greater flexibility. R51+ is a traditional re-entrant profile commonly used on inner city multi-storey projects, where the structural zone and storey height is reduced, due to the relatively thin slab depth required to achieve a typical one hour fire rating.

Benefits

- 102mm minimum slab depth
- Optimised to maximise structural efficiency of steel
- 150mm trough spacings provide flexibility for stud placement



Profile Properties

Thickness mm		Steel Grade N/mm²			Coatings and Options						Weight		Moment of Inertia	Height of Neutral	Area of Steel
Nominal	Design Thickness (bare steel)	S250	S350	S450	Galv (Z275)	HD (ZM310)	Plastisol (PF)	Interior Liner	Perfo-rated	Crushed Ends	kg/m²	kN/m²	cm⁴/m	Axis mm	mm²/m
0.80	0.76	-	✓	-	✓	✓	-	-	-	-	12.02	0.118	56.90	15.80	1464
0.90	0.86	-	✓	✓	✓	✓	-	-	-	-	13.54	0.133	61.27	16.20	1657
1.00	0.96	-	✓	✓	✓	✓	-	-	-	-	15.01	0.147	68.73	16.50	1845
1.20	1.16	-	✓	✓	✓	✓	-	-	-	-	17.98	0.176	85.60	17.00	2223

Section properties are calculated assisted by testing in accordance with Eurocode 3.

Fire Insulation Thickness

Minimum Insulation Thickness (x) of Concrete (mm)

Fire Rating	NWC	LWC
1.0 Hour	100	100
1.5 Hour	110	105
2.0 Hour	125	115
3.0 Hour	150	135
4.0 Hour	170	150

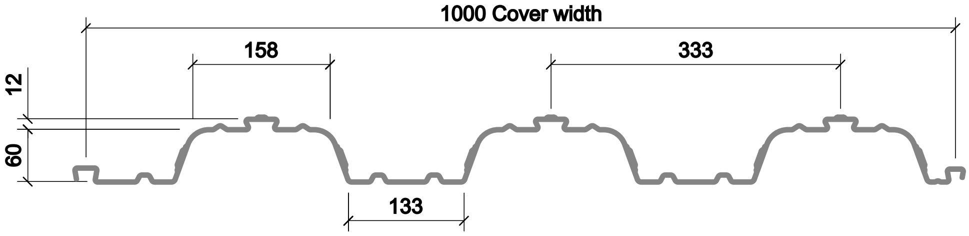
The image and table above details the minimum insulation thickness required to suit fire design criteria in accordance with SCI PN005c-GB or BS5950 Part 8.

Concrete Volume and Weight

Slab Depth mm	Volume of Concrete m³/m²	Weight of Concrete (Normal Weight) Wet (kN/m²)	Weight of Concrete (Normal Weight) Dry (kN/m²)	Weight of Concrete (Lightweight) Wet (kN/m²)	Weight of Concrete (Lightweight) Dry (kN/m²)
130	0.121	3.03	2.91	2.43	2.31
150	0.141	3.53	3.39	2.83	2.70
200	0.191	4.78	4.59	3.84	3.65

Deflection – This table is based on concrete poured to a constant thickness and does not take account for deflection of the decking or supporting beams (as a guide, to account for the deflection of the decking, a concrete volume of span/250 should be added to the figures indicated). Concrete Weight – These tables indicate concrete weight only and do not include the weight of decking or reinforcement. Concrete weights are based on the concrete densities specified in BS EN 1991-1-1 as follows: Normal Weight Concrete – 2550kg/m³ (wet) and 2450 kg/m³ (dry). Lightweight Concrete – 2050kg/m³ (wet) and 1950 kg/m³ (dry).

TR60+™

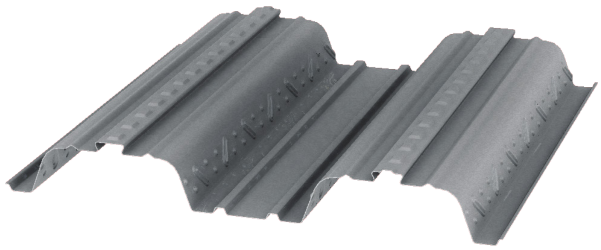


Description

The TR60 profile was SMD's first trapezoidal profile, added to our product range in 1992. Further research and development in recent years has seen our trapezoidal products evolve into the TR+ range. The TR60+ profile enables un-propped spans in excess of 3.5m.

Benefits

- Reduced concrete volume
- Enhanced speed of installation due to the 1m cover width
- Trough stiffeners positioned to ensure central stud position



Profile Properties

Thickness mm		Steel Grade N/mm²			Coatings and Options						Weight		Moment of Inertia	Height of Neutral	Area of Steel
Nominal	Design Thickness (bare steel)	S250	S350	S450	Galv (Z275)	HD (ZM310)	Plastisol (PF)	Interior Liner	Perfo-rated	Crushed Ends	kg/m²	kN/m²	cm⁴/m	Axis mm	mm²/m
0.90	0.86	-	✓	✓	✓	✓	-	-	-	-	10.03	0.098	93.50	33.60	1216
1.00	0.96	-	✓	✓	✓	✓	-	-	-	-	11.12	0.109	102.10	33.60	1355
1.20	1.16	-	✓	✓	✓	✓	-	-	-	-	13.33	0.131	119.80	33.70	1633

Section properties are calculated assisted by testing in accordance with Eurocode 3.

Fire Insulation Thickness

Minimum Insulation Thickness (x) of Concrete (mm)

Fire Rating	NWC	LWC
1.0 Hour	60	60
1.5 Hour	70	70
2.0 Hour	80	80
3.0 Hour	115	100
4.0 Hour	130	115

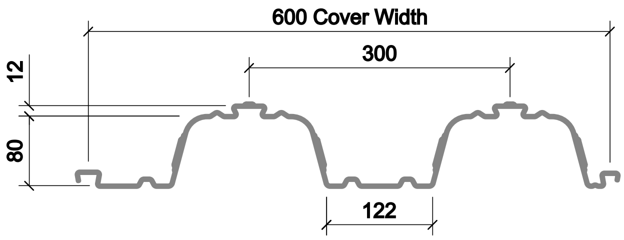
The image and table above details the minimum insulation thickness required to suit fire design criteria in accordance with SCI PN005c-GB or BS5950 Part 8.

Concrete Volume and Weight

Slab Depth mm	Volume of Concrete m³/m²	Weight of Concrete (Normal Weight) Wet (kN/m²)	Dry (kN/m²)	Weight of Concrete (Lightweight) Wet (kN/m²)	Dry (kN/m²)
130	0.096	2.40	2.31	1.93	1.84
150	0.116	2.90	2.79	2.33	2.22
200	0.166	4.15	3.99	3.34	3.17

Deflection – This table is based on concrete poured to a constant thickness and does not take account for deflection of the decking or supporting beams (as a guide, to account for the deflection of the decking, a concrete volume of span/250 should be added to the figures indicated). Concrete Weight – These tables indicate concrete weight only and do not include the weight of decking or reinforcement. Concrete weights are based on the concrete densities specified in BS EN 1991-1-1 as follows: Normal Weight Concrete – 2550kg/m³ (wet) and 2450 kg/m³ (dry). Lightweight Concrete – 2050kg/m³ (wet) and 1950 kg/m³ (dry).

TR80+™

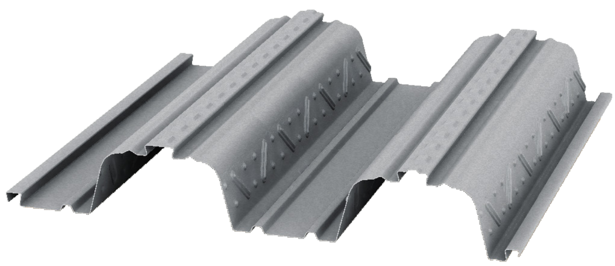


Description

Initially added to our product range in 2002, the original TR80 has undergone further research and development, evolving to the popular TR80+ profile in use today. This 80mm deep trapezoidal profile offers long un-propped spans reducing the number of structural support members required, making it a popular choice for low to medium storey buildings.

Benefits

- Reduced concrete volume compared to other deck available
- 140mm slab depth required to achieve a typical one hour fire rating
- TAB-Deck™ fibre concrete option



Profile Properties

Thickness mm		Steel Grade N/mm²			Coatings and Options						Weight		Moment of Inertia	Height of Neutral	Area of Steel
Nominal	Design Thickness (bare steel)	S250	S350	S450	Galv (Z275)	HD (ZM310)	Plastisol (PF)	Interior Liner	Perfo-rated	Crushed Ends	kg/m²	kN/m²	cm⁴/m	Axis mm	mm²/m
0.90	0.86	-	✓	✓	✓	✓	✓	-	-	✓	11.33	0.111	172.90	42.30	1385
1.00	0.96	-	✓	✓	✓	✓	-	-	-	✓	12.54	0.123	192.30	42.40	1539
1.20	1.16	-	✓	✓	✓	✓	✓	-	-	✓	15.06	0.148	231.10	42.50	1860

Section properties are calculated assisted by testing in accordance with Eurocode 3.

Fire Insulation Thickness

Minimum Insulation Thickness (x) of Concrete (mm)

Fire Rating	NWC	LWC
1.0 Hour	60	60
1.5 Hour	70	70
2.0 Hour	80	80
3.0 Hour	115	100
4.0 Hour	130	115

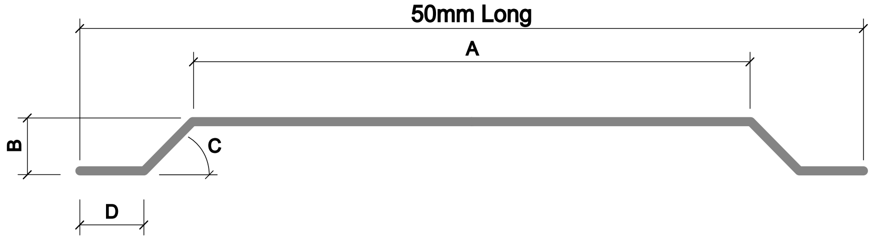
The image and table above details the minimum insulation thickness required to suit fire design criteria in accordance with SCI PN005c-GB or BS5950 Part 8.

Concrete Volume and Weight

Slab Depth mm	Volume of Concrete m³/m²	Weight of Concrete (Normal Weight) Wet (kN/m²)	Weight of Concrete (Normal Weight) Dry (kN/m²)	Weight of Concrete (Lightweight) Wet (kN/m²)	Weight of Concrete (Lightweight) Dry (kN/m²)
140	0.096	2.40	2.31	1.93	1.84
150	0.106	2.65	2.55	2.13	2.03
200	0.156	3.90	3.75	3.14	2.98

Deflection – This table is based on concrete poured to a constant thickness and does not take account for deflection of the decking or supporting beams (as a guide, to account for the deflection of the decking, a concrete volume of span/250 should be added to the figures indicated). Concrete Weight – These tables indicate concrete weight only and do not include the weight of decking or re-inforcement. Concrete weights are based on the concrete densities specified in BS EN 1991-1-1 as follows: Normal Weight Concrete – 2550kg/m³ (wet) and 2450 kg/m³ (dry). Lightweight Concrete – 2050kg/m³ (wet) and 1950 kg/m³ (dry).

STEEL FIBRES



Description

For many years, steel fibre reinforced concrete has primarily been used in non-structural applications like industrial flooring and shotcrete. This is due to the fact that with traditional steel fibre dosage rates, steel fibre reinforced concrete shows a semi-ductile, strain softening post-cracking behaviour. Due to the development of new, better performing steel fibres, the scope of applications for steel fibre reinforced concrete has been significantly widened.

Today, steel fibres can be used as the sole reinforcement or combined with traditional reinforcement such as rebar, wire mesh or pre-stressing elements in numerous applications.

In all these applications, the use of steel fibres helps to control and reduce shrinkage cracking and allows the steel fibre reinforced concrete element to reach full ductility even though plain concrete is a brittle material.

Applications

- Flooring applications
- Housing applications
- Structural applications

Product Properties

Product	Diameter (mm)	Length (mm)	Tensile Strength N/mm²	Rod Wire*	B (mm)	C (mm)	D (mm)
HE	1.0	50	1,150	C4D or C7D	1.8	45°	1 - 4
HE++	1.0	50	1,800	C36D	1.8	45°	1 - 4

* According to EN 10016-2. Steel fibre in accordance with EN 14889-1 type 1, cold-drawn wire and ASTM A820/A820M-04 type I, cold-drawn wire. Quality system ISO 9001 and ISO 14001.

Tolerances and Further Information

- Wire diameter ± 0,04 mm
- Steel fibre length +2/-3 mm
- Hook depth B +1/-0 mm
- Camber of the steel fibre max. 5% of A
- Torsion angel of the steel fibre < 30°
- Number of steel fibres per kg = 3,100
- Total steel fibre length per 10 kg = 1,575 m

ArcelorMittal

COMPOSITE BEAM DESIGN

Composite Beam Design

TAB®Deck Steel Fibre Reinforced Concrete

Shear Stud Connectors

From a number of shear stud push tests it has been demonstrated that the resistance of through-deck welded shear studs is similar in specimens using concrete reinforced with a dosage of 30 kg/m³ of ArcelorMittal Wire Solutions HE 1/50 steel fibres (TAB®Deck), when compared to identical specimens using conventional mesh reinforcement. The presence of steel fibres resulted in a significant enhancement to the ductility, for single and pairs of studs.

Longitudinal Shear

Testing has shown that in composite beam applications, the longitudinal shear resistance of floor slabs reinforced with 30 kg/m³ of HE 1/50 steel fibres is, in most cases, sufficient so as not to require provision of additional transverse reinforcement. For example, a dosage of 30 kg/m³ of HE 1/50 steel fibres was sufficient to provide a longitudinal shear resistance equivalent to an A393 mesh in a 150mm solid slab with f_{cu} = 30N/mm². When 30 kg/m³ of HE 1/50 steel fibres are used in combination with conventional reinforcement, it may be possible to gain enhancement compared to cases when bars are embedded within plain concrete.

Design Rules

When profiled steel sheeting is oriented with the ribs parallel to the longitudinal axis of the beam (i.e. at primary beam positions) the longitudinal shear resistance may not be sufficient when the concrete is only reinforced with 30 kg/m³ of steel fibres. In such cases, supplementary transverse reinforcement in the form of conventional bars should be provided. Although the tests undertaken so far indicate that an enhancement of approximately 10% can be achieved when steel fibres are used in combination with conventional reinforcement bars, there is insufficient data at this time to allow improved design equations to be developed. As a consequence of this, when supplementary reinforcement bars are provided, the steel fibres should be ignored and the design carried out according to the requirements given in Eurocode 4, 6.2.4 or Clause 5.6 of BS5950-3: 1990.

BS5950-3: 1990

For design in accordance with BS5950-3: 1990, the following equation should be used when a normal weight concrete slab is reinforced with 30 kg/m³ of TAB®Deck steel fibres.

$$v_r = 2.7A_{cv} + v_p$$

$$\text{but } 30\text{ N/mm}^2 \leq f_{cu} \leq 45\text{N/mm}^2$$

Where A_{cv} is the mean cross-sectional area per unit length of the beam of the concrete shear surface under consideration and v_p is the contribution of the profiled steel sheeting, if applicable, calculated to Clause 5.6.4 of BS5950-3: 1990.

Eurocode 4

For design in accordance with Eurocode 4, the following equation should be used when normal weight concrete slab is reinforced with 30 kg/m³ of steel fibres.

$$F_d = \frac{Vf_{ck}}{2}\Delta_x h_f \frac{1}{Y_M} + v_{pd}$$

$$\text{but } 20\text{ N/mm}^2 \leq f_{ck} \leq 30\text{N/mm}^2$$

Where h_f is the effective thickness of the concrete flange, Δ_x is the length under consideration (half the span for a simply supported beam with UDL), f_{ck} is the characteristic compressive cylinder strength of concrete, Y_M is the partial factor of safety (= 1.5), V is the strength reduction factor for concrete cracked in shear;

$$= 0.38\left[1 - \frac{f_{ck}}{250}\right]$$

and v_{pd} is the contribution of the profiled steel sheeting if applicable, calculated according to BS EN 1994-1-1 clause 6.6.6.4.

The design resistance given by the above equations is comparable to that provided by an A393 mesh as shown in the table on page 15.

Further comparisons of longitudinal shear resistance for each profile at different slab depths using TAB®Deck HE 1/50 steel fibres at a dosage of 30kg/m³ compared to conventional mesh fabric can be found on page 15. These tables are in accordance with the above equation for Eurocode 4 based upon 0.9mm gauge S350 grade decking, 500N/mm² grade reinforcement and NWC with a cylinder strength of 25N/mm².

Composite Beam Design

TAB®Deck Steel Fibre Reinforced Concrete

Profile	Slab Depth mm	Concrete Cross Section (mm²)	A142 Vr † (N/mm)	A142 Vr ‡ (N/mm)	A193 Vr † (N/mm)	A193 Vr ‡ (N/mm)	A252 Vr † (N/mm)	A252 Vr ‡ (N/mm)	A393 Vr † (N/mm)	A393 Vr ‡ (N/mm)	Steel fibre Reinforced Concrete (30 kg/m³) Vr † (N/mm)	Steel fibre Reinforced Concrete (30 kg/m³) Vr ‡ (N/mm)
R51+	100	91000	522.3	61.7	544.5	83.9	570.2	109.6	631.5	170.9	600.3	139.7
	110	101000	522.3	61.7	544.5	83.9	570.2	109.6	631.5	170.9	628.8	168.2
	120	111000	522.3	61.7	544.5	83.9	570.2	109.6	631.5	170.9	657.3	196.7
	130	121000	522.3	61.7	544.5	83.9	570.2	109.6	631.5	170.9	685.8	225.2
	140	131000	522.3	61.7	544.5	83.9	570.2	109.6	631.5	170.9	714.3	253.7
	150	141000	522.3	61.7	544.5	83.9	570.2	109.6	631.5	170.9	742.8	282.2
	160	151000	522.3	61.7	544.5	83.9	570.2	109.6	631.5	170.9	771.3	310.7
	170	161000	522.3	61.7	544.5	83.9	570.2	109.6	631.5	170.9	799.8	339.2
	180	171000	522.3	61.7	544.5	83.9	570.2	109.6	631.5	170.9	828.3	367.7
	190	181000	522.3	61.7	544.5	83.9	570.2	109.6	631.5	170.9	856.8	396.2
	200	191000	522.3	61.7	544.5	83.9	570.2	109.6	631.5	170.9	885.3	424.7
TR60+	120	86000	408.6	61.7	430.8	83.9	456.4	109.6	517.7	170.9	517.9	171.0
	130	96000	408.6	61.7	430.8	83.9	456.4	109.6	517.7	170.9	546.4	199.5
	140	106000	408.6	61.7	430.8	83.9	456.4	109.6	517.7	170.9	574.9	228.0
	150	116000	408.6	61.7	430.8	83.9	456.4	109.6	517.7	170.9	603.4	256.5
	160	126000	408.6	61.7	430.8	83.9	456.4	109.6	517.7	170.9	631.9	285.0
	170	136000	408.6	61.7	430.8	83.9	456.4	109.6	517.7	170.9	660.4	313.5
	180	146000	408.6	61.7	430.8	83.9	456.4	109.6	517.7	170.9	688.9	342.0
	190	156000	408.6	61.7	430.8	83.9	456.4	109.6	517.7	170.9	717.4	370.5
	200	166000	408.6	61.7	430.8	83.9	456.4	109.6	517.7	170.9	745.9	399.0
TR80+	120	86000	434.1	61.7	456.3	83.9	482.0	109.6	543.3	170.9	486.4	114.0
	130	96000	434.1	61.7	456.3	83.9	482.0	109.6	543.3	170.9	514.9	142.5
	140	106000	434.1	61.7	456.3	83.9	482.0	109.6	543.3	170.9	543.4	171.0
	150	116000	434.1	61.7	456.3	83.9	482.0	109.6	543.3	170.9	571.9	199.5
	160	126000	434.1	61.7	456.3	83.9	482.0	109.6	543.3	170.9	600.4	228.0
	170	136000	434.1	61.7	456.3	83.9	482.0	109.6	543.3	170.9	628.9	256.5
	180	146000	434.1	61.7	456.3	83.9	482.0	109.6	543.3	170.9	657.4	285.0
	190	156000	434.1	61.7	456.3	83.9	482.0	109.6	543.3	170.9	685.9	313.5
	200	166000	434.1	61.7	456.3	83.9	482.0	109.6	543.3	170.9	714.4	342.0

† Secondary beam with continuous decking perpendicular to the longitudinal axis of the beam (with deck contribution v_{pd}).

‡ Primary beam with decking parallel to the longitudinal axis of the beam (no deck contribution).

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