

**TATA STEEL**



## **ComFlor® manual**

Composite floor decking design and technical information



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# The ComFlor® range at a glance

## ComFlor® 46



Classic composite flooring profile, easily transported, simple and efficient.

- Nestable. The simple trapezoidal shape neatly fits one profile into another, allowing more square metres per bundle.
- Low transport cost. Results in reduced environmental impact and in less crane time.
- Fast laying.
- Economic.

## ComFlor® 51+



Contemporary new design of the original British re-entrant profile.

- Virtually flat soffit. Available in Colorcoat FD® pre-finished steel.
- Composite performance – floor slab. New embossments give even better shear key.
- Composite performance – beam. Due to effective shear stud performance.
- Fire and acoustic performance.
- Easy attachment for services.

## ComFlor® 60



Most successful new generation combined trapezoidal and re-entrant 60mm profile.

- Versatile. Combined round shouldered profile gives excellent span capability with straightforward service attachment.
- Low concrete and steel usage.
- Central stud placement.
- Closed ends and available in Colorcoat FD® pre-finished steel.
- 600mm cover, as recommended by Health and Safety guidelines.

## ComFlor® 80



Combined trapezoidal and re-entrant 80mm composite profile with long span capability.

- Versatile. Combined profile allows easy service attachment, with trapezoidal spanning ability.
- Reduces the number of secondary beams
- Central stud placement.
- Available in Colorcoat FD® pre-finished steel to the soffit.
- 600mm cover, as recommended by Health and Safety guidelines.

## ComFlor® 100



Strong long span composite profile for non-composite beams.

- Long span strength reduces or eliminates temporary propping.
- Fast laying.
- Suitable for use with concrete beams or non-composite steel beams.
- Nestable profile gives low transport and handling costs.

# Tata Steel

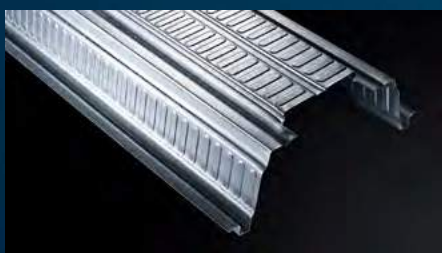
## ComFlor® 210



The original deep ultra long span composite profile introduced for the first Slimflor® systems.

- Efficient. Cross stiffener technology and deep profile shape provides a very efficient metal deck and composite slab.
- Especially suited to bear on the extended lower flange of a steel beam, can also be used on the top flange.
- Nestable profile gives low transport and handling costs.

## ComFlor® 225



High performance deep deck specifically designed for Slimdek® and all other integrated steel beam systems.

- Optimised profile design gives superb span capability and composite performance.
- Enables all the benefits of Slimdek® type systems. Including 6m unpropped spans, big open area and slimmer floor zone.
- Easy service attachment and integration.
- Provides reduced overall floor height with fewer steel beams which enables an extra floor every eight floors.

Tata Steel is one of Europe's leading steel producers. Our comprehensive range of high quality products and services are supported by steel making sites in the UK and the Netherlands, a European-wide distribution and service centre network and downstream businesses ranging from tubes and building systems to plating.

Our approach to business is unique. We believe our strength is how we build collaborative relationships that create new success for our customers, adding value to their business and helping them to perform in their markets.

As a company, we are dedicated to managing our operations responsibly and to continuously improving our performance. We operate in a way that is safe for our people and which respects the environment, with care towards the communities surrounding our operations and beyond.

### BIM (Building Information Modelling)

Technical details and drawings relating to ComFlor® products are available in BIM ready format and may all be accessed from our website, [www.tatasteelconstruction.com](http://www.tatasteelconstruction.com) by following the relevant links.

### Sustainability

Steel is an essential material, intrinsic to our way of life and to the products society will demand in a sustainable future. Steel is a material that is used, not consumed. It is recycled and used again, without any loss of quality, time after time. At Tata Steel, we are committed to making the products society needs and to making them in the most responsible way possible.

This means, practically, that we commit to:

- Producing steel products for the future.
- Investing in sustainable steel making.
- Improving our existing processes.
- Facilitating the recycling loop.

### Composite floor decking

Tata Steel produces the most extensive composite flooring range in Europe. ComFlor® from Tata Steel is a range of seven composite floor profiles, each designed specifically for a particular application area providing optimum performance and cost effectiveness.

The ComFlor® range offers many benefits including speed of installation, long spanning capabilities, lightweight buildings, excellent fire resistance, all responsibly sourced from our UK factory and certified to BES 6001.

Cover photo:  
Aldgate Tower, City of London



# Introducing ComFlor®

## Composite floor decking systems

ComFlor® is specifically designed for rapid installation of flooring and to facilitate lower mass buildings with long clear span composite concrete floors.

Large areas of ComFlor® can be easily craned into position and in excess of 400m<sup>2</sup> laid by one team per day. With minimal mesh or fibre reinforcement and pumped concrete, the completed floor can quickly follow.

### Composite floor decks

ComFlor® offers the widest range of composite floor decks, from ComFlor® 46 all the way to ComFlor® 100, the Tata Steel range provides the optimum solution for all over-beam applications. Covering unpropped construction from 2.5 to 4.5 metres each ComFlor® profile offers particular application benefits. The decks are suitable for conventional composite construction where the deck is placed onto the top flange of the steel support beam.

### Deep composite floor decks

ComFlor® 210 and ComFlor® 225 are both designed to be used with Tata Steel Slimdek® system, or other integrated beam system with asymmetric beams that allow the floor deck to land on the bottom flange. With typical unpropped spans extending to 6 metres and propped spans to 9 metres the deep decks provide clear open space between beams. The deck is contained within the beam depth, which provides a very shallow floor zone. The shape of the deck profiles allow for service integration and the whole system provides inherent fire resistance.

### Quality assurance

To provide the best quality and the most up to date design information, Tata Steel is quality assured to Quality Management standard BS ISO 9001 and Environmental Management standard BS EN ISO 14001. Tata Steel is an active member of MCRMA (Metal Cladding and Roofing Manufacturers Association), The SCI (Steel Construction Institute), BCSA (British Constructional Steelwork Association) and supports R&D throughout the industry.

### Professional support

Tata Steel maintains a friendly technical help desk which is freely available to all Consulting Engineers and Contractors to assist with composite flooring design issues.

The technical help desk is available on: 01244 892199.

Comprehensive ComFlor® 9 software is also freely available to all professionals who register at: [www.tatasteelconstruction.com](http://www.tatasteelconstruction.com)



BNP Paribas Real Estate HQ,  
6 Pancras Square, City of London

Steelwork contractor: Severfield

Decking installer: Composite Profiles

#### Key benefits:

##### ComFlor® composite floor deck range

- The most extensive cost-effective and efficient range of composite floor deck profiles in Europe.
- Seven unique profiles enable effective and efficient design.
- Fast build time provided by quick installation and prop free concrete floors.
- High levels of fire resistance from all ComFlor® slabs with zero soffit protection.
- Colorcoat FD® pre-finished steel soffits offer significant extra protection and corrosion resistance.
- Sustainable floor solutions:
  - Factory produced with the backing of a robust Quality Management and Environmental Management standards.
  - Full traceability of all components.
  - Certified 'Very Good' to BREs responsible sourcing standard BES 6001.
- Made in the UK, ComFlor® profiles are readily available for easy accessibility.
- Technical support and free ComFlor® 9 software to aid design.
- Health and Safety built in. Our ComFlor® range of profiles offer quick, safer installation, and are fully nestable for transportation.

#### Key benefits:

##### ComFlor® deep deck range

- Long spanning capability between beams.
- Used with integrated beams (Slimdek®, Slimflor® and others) where the deck lands on an extended lower flange, giving reduced overall floor height.
- Services incorporated into profile zone, providing cost-effective, minimal depth floor construction.
- Low vibration design to meet the most stringent vibration requirements.
- Excellent fire ratings.

##### Maximum sheet lengths

10m – ComFlor® deep decks.

12m – ComFlor® decks up to 100mm

# ComFlor®

## Span parameters

### Parameters assumed for quick reference span tables

#### Mesh

Refer to composite floor decks design information.

#### Spans

Measured centre to centre of supports.

#### Deck

Standard deck material specification to BS EN 10346.

#### Supporting Beam Width

The width of the supporting beam is taken at 152mm, except for deep decks which are assumed to bear on an extended bottom flange 400mm wide.

#### Prop width

Assumed to be 100mm.

#### Shear studs

One weld through shear stud per trough is assumed to be included for ComFlor® 46, 51+, 60 and 80. Weld through shear studs are not used with ComFlor® 100, 210 or 225.

#### Construction Stage Deflection

Where additional loads due to ponding of wet concrete are ignored when determining the loading, a more onerous deflection limit is used to check the decking at serviceability. In these cases, the mid-span deflection should be limited to the lesser of the effective span/180 and 20mm. Where additional loads due to ponding of wet concrete are included, the mid-span deflection should be limited to the lesser of effective span/130 and 30mm

#### Normal Stage Deflection

In the composite normal stage, the total deflection should not exceed  $L/250$ .

#### Concrete grade

The concrete is assumed to be Normal Concrete (NC) Grade C30/37 with a maximum aggregate size of 20mm. The wet and dry weights for normal concrete are taken as 25 and 24kN/m<sup>3</sup> respectively. For lightweight aggregate concrete (LWAC), wet and dry weights are taken as 20 and 19kN/m<sup>3</sup> respectively. The modular ratio is 10 for normal concrete and 15 for lightweight aggregate concrete.

#### Construction load

The construction loads ( $Q_c$ ) during the casting of concrete are specified in BS EN 1991-1-6 Clause 4.11.2. The general load across the deck is 0.75kN/m<sup>2</sup>, with an additional of 10% of the slab weight or 0.75kN/m<sup>2</sup>, whichever is greater, over a 3m × 3m working area. This area should be treated as a moveable patch load that should be applied to cause maximum effect. Further guidance is given in SCI Publication AD 346.

### Applied load

The total applied loads stated in the Eurocode tables covers an allowable unfactored total load of either 5.00, 7.50 or 10.00kN/m<sup>2</sup>, which represents three typical cases, as specified in the table below. The total load combination is made up of an imposed live load, ceilings and services, finishes and partition loads. However the dead load of the slab itself has already been taken into account and need not be considered as part of the applied load. The three typical load cases of 5.00, 7.50 or 10.00kN/m<sup>2</sup> have been given the imposed load categories of C, C and E, with their corresponding psi factors given in Table A1.1 of BS EN 1990:2002+A1.

#### Loading combination (kN/m<sup>2</sup>)

Category	C	C	E
Imposed	3.00	4.00	7.50
C&S	0.50	1.00	1.00
Finishes	0.50	1.50	1.50
Partitions	1.00	1.00	0.00
<b>Total</b>	<b>5.00</b>	<b>7.50</b>	<b>10.00</b>

**Note:** Please contact the Technical Department reference the loading method for the current British Standard tables. The Technical Department at Tata Steel offers a comprehensive advisory service on design of composite flooring, which is available to all specifiers and users. Should queries arise which are not covered by this literature or by the ComFlor® 9 software, please contact us.

### Fire Engineering

Within ComFlor® 9, two fire design methods exist. The capacity of the composite slab in fire may be calculated using either 'Mesh and Deck Method' (mesh only and no trough bar reinforcement) or 'Bar Method' (trough bottom bar reinforcement only with no contribution from the mesh and profile).

### Fire insulation

The minimum slab thickness indicated in each table, for each fire rating satisfies the fire insulation requirements of Tables 7.1 and 7.2 of SCI Publication P359 'Composite Design of Steel Framed Buildings'.

### Span/depth ratio

Slab span to depth ratios for simply supported, end span, internal span and cantilevers are limited to 20, 26, 30 and 8 in accordance with BS EN 1992-1-1, 7.4, for lightly stressed concrete.

### Anti-crack mesh

As a minimum requirement where the control of crack width is of no interest, BS EN 1994-1-1, 9.8.1(2) recommends that where continuous slabs are designed as simply-supported in accordance with BS EN 1994-1-1, 9.4.2(5), the cross-sectional area of the anti-crack reinforcement above the ribs should be not less than 0.2% of the cross-sectional area of the concrete above the ribs for unpropped construction, and 0.4% of this cross-sectional area for propped construction. The mesh shown in these quick reference tables, complies with this clause.

### Bar reinforcement

Where used, bar reinforcement is placed at one bar per profile trough. The axis distance of bar reinforcement defines the distance from the bottom of the ribs to the centre of the bar, which has a minimum value of 25mm, and a maximum value of the profile height.

**Note:** Please contact the Technical Department for any British Standard references to the above parameters.

## Using these reference tables

The quick reference load/span tables for each composite ComFlor® deck are intended as a guide for initial design, based on the parameters stated on page 6. ComFlor® 46, 100 and 210 are currently to British Standard, whereas ComFlor® 51<sup>+</sup>, 60, 80 and 225 are to the Eurocode requirements. Detailed design can be carried out using the new ComFlor® 9 design software, which allows Eurocode or British Standard design for ComFlor® 51<sup>+</sup>, 60, 80 and 225 and British Standard design for ComFlor® 46, 100 and 210.

The tables are designed to optimise the span in the construction stage, with the minimum amount of reinforcement needed to achieve the relevant imposed loading and fire resistance. However, in certain conditions where slender slabs are subjected to the higher imposed loads (and depending on whether mesh or bottom bar only is selected for fire resistance), then the limiting design mechanism becomes associated with the normal stage slab bending and/or vertical shear capacity, and not construction stage.

# ComFlor® 46

Classic composite flooring profile, easily transported, simple and efficient

ComFlor® 46 was our first composite flooring profile, introduced in the early 1980s and is still popular today for its primary characteristics of being nestable, easily transported, simple and efficient. It is particularly suited for export or difficult access sites, due to the large area of flooring that will fit into a container and because the deck is fast and easy to lay.

#### Nestable

The simple trapezoidal shape neatly nests one profile into another, allowing more square metres per bundle.

#### Low transport cost

Reduces environmental impact.

#### Fast laying

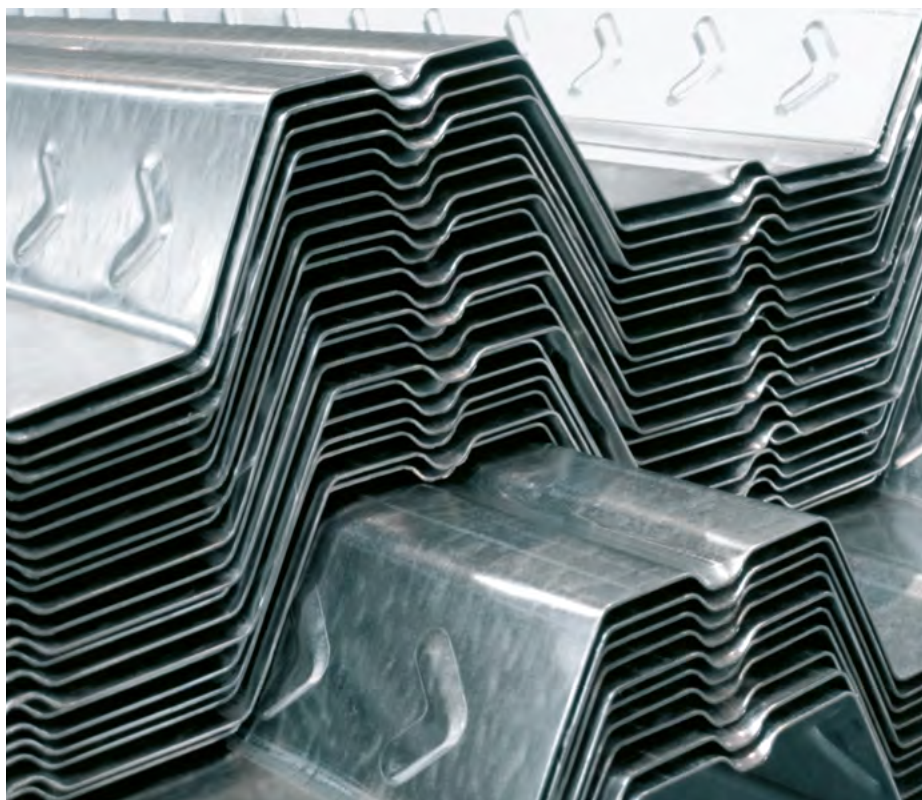
As simple to install as a roof deck, the concrete can soon be poured.

#### Economic

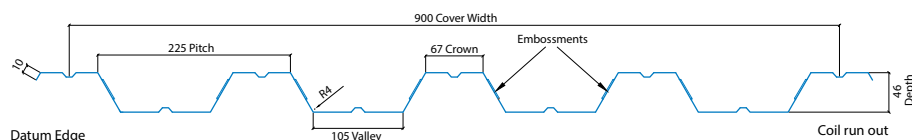
Relatively low cost and concrete use compared to re-entrant profiles.

#### Efficient to export

Maximises the square meterage in each container.



# Design information



## ComFlor® 46 Composite slab - volume and weight (BS values)

Slab depth (mm)	Concrete volume (m <sup>3</sup> /m <sup>2</sup> )	Weight of concrete (kN/m <sup>2</sup> )			
		Normal weight concrete		Lightweight concrete	
		Wet	Dry	Wet	Dry
96	0.077	–	–	1.43	1.35
106	0.087	2.04	2.00	1.61	1.53
110	0.091	2.13	2.09	1.69	1.60
120	0.101	2.37	2.32	1.88	1.78
130	0.111	2.60	2.55	2.06	1.95
140	0.121	2.84	2.78	2.25	2.13
150	0.131	3.08	3.01	2.43	2.31
160	0.141	3.31	3.24	2.62	2.48
170	0.151	3.55	3.47	2.81	2.66
180	0.161	3.78	3.70	2.99	2.84
190	0.171	4.02	3.93	3.18	3.01
200	0.181	4.25	4.16	3.37	3.19
250	0.231	5.43	5.32	4.30	4.07



### Notes

- Deck and beam deflection (ie, ponding) is not included in the table.
- Deck and mesh weight is not included in the weight of concrete figures.
- British Standard density of concrete is taken as:

Normal weight (wet)	2400kg/m <sup>3</sup>
Normal weight (dry)	2350kg/m <sup>3</sup>
Lightweight (wet)	1900kg/m <sup>3</sup>
Lightweight (dry)	1800kg/m <sup>3</sup>

## ComFlor® 46 (S280) Section properties (per metre width)

Nominal thickness (mm)	Design thickness (mm)	Cross section area (mm <sup>2</sup> /m)	Profile weight (kN/m <sup>2</sup> )	Height to neutral axis (mm)	Moment of inertia (cm <sup>4</sup> /m)		Ultimate moment capacity (kNm/m)	
					Sagging	Hogging	Sagging	Hogging
0.90	0.86	1137	0.09	20.38	41.50	–	4.63	4.67
1.20	1.16	1534	0.13	20.44	53.00	–	5.99	6.23

Section properties in the above table conform to BS 5950

### Design Notes:

#### Deck material

Tata Steel Galvatite®, hot dip zinc coated steel to BS EN 10346 S280GD+Z275, with guaranteed minimum proof strength of 280N/mm<sup>2</sup> and zinc coating of total mass 275g/m<sup>2</sup> (including both sides). This is sufficient for internal floors in a non-aggressive environment, which satisfies the requirement in Clause 4.2 BS EN 1994-1-1 - the exposed surfaces of the steel decking shall be adequately protected to resist the particular atmospheric conditions. A zinc coating, if specified, should conform to the requirements of BS EN 10346. The specification may be varied, depending on service conditions.

#### Anti-crack mesh

As a minimum requirement where the control of crack width is of no interest, BS EN 1994-1-1, 9.8.1(2) recommends that, where continuous slabs are designed as simply-supported in accordance with BS EN 1994-1-1, 9.4.2(5), the cross-sectional area of the anti-crack reinforcement above the ribs should be

not less than 0.2% of the cross-sectional area of the concrete above the ribs for unpropped construction, and 0.4% of this cross-sectional area for propped construction. The mesh specified in the quick reference Eurocode tables, complies with this clause.

Where forklift truck (or other similar concentrated loading) is expected, 0.5% minimum percentage reinforcement should be used over the supports and the previous stated percentages elsewhere to control cracking. For further information refer to SCI AD 150.

In accordance with Steel Construction Institute (SCI) P300 'Composite Slabs and Beams Using Steel Decking: Best Practice for Design and Construction, a nominal cover of 25mm is stated for an exposure level XC1, for all concrete cylinder strengths for both normal (C25/30 to C40/50) and lightweight concrete (LC25/28 to LC32/35). This nominal cover of 25mm is the minimum cover of 15mm plus a fixing tolerance of 10mm.

#### Supporting beam width

For all ComFlor® 46 load/span tables, the width of the support beam used is assumed to be 152mm.

#### Fire design

The capacity of a composite slab with nominal anti-crack mesh in fire is calculated in accordance with Steel Construction Institute NCCI PN005 'Fire resistance design of composite slab'. Two fire-design methods can be used in the ComFlor® 9 software, namely 'Mesh and Deck Fire Method' or 'Bar Fire Method'. For further details of the performance of composite slabs with nominal anti-crack mesh in fire, please contact the technical team.

#### Technical services

The Technical Department at Tata Steel offers a comprehensive advisory service on the design of composite flooring, which is available to all specifiers and users. Should queries arise which are not covered by this literature or by the ComFlor® 9 software, please contact us.

## ComFlor® 46 / Simple Mesh and Deck Fire Method / Unpropped

Double span (m) - Normal weight concrete - British Standard - Beam width 152mm



Props	Fire period	Slab depth (mm)	Mesh 0.1% min.reqd.	Total applied load (kN/m <sup>2</sup> )					
				5.00	7.50	10.00	5.00	7.50	10.00
				0.90mm			1.20mm		
None	60 minutes	120	A142	2.97 (A142)	2.97 (A142)	2.96 (A252)	3.26 (A142)	3.26 (A193)	3.26 (A252)
		130	A142	2.87 (A142)	2.87 (A142)	2.87 (A193)	3.22 (A142)	3.22 (A142)	3.22 (A252)
		140	A142	2.79 (A142)	2.79 (A142)	2.79 (A142)	3.19 (A142)	3.19 (A142)	3.19 (A193)
		150	A142	2.71 (A142)	2.71 (A142)	2.71 (A142)	3.11 (A142)	3.11 (A142)	3.11 (A193)
		160	A142	2.62 (A142)	2.62 (A142)	2.62 (A142)	3.04 (A142)	3.04 (A142)	3.04 (A142)
		170	A193	2.53 (A193)	2.53 (A193)	2.53 (A193)	2.97 (A193)	2.97 (A193)	2.97 (A193)
		180	A193	2.45 (A193)	2.45 (A193)	2.45 (A193)	2.90 (A193)	2.90 (A193)	2.90 (A193)
		190	A193	2.38 (A193)	2.38 (A193)	2.38 (A193)	2.83 (A193)	2.83 (A193)	2.83 (A193)
		200	A193	2.31 (A193)	2.31 (A193)	2.31 (A193)	2.77 (A193)	2.77 (A193)	2.77 (A193)
None	90 minutes	130	A142	2.87 (A142)	2.87 (A193)	2.86 (A252)	3.22 (A142)	3.21 (A252)	3.21 (A393)
		140	A142	2.79 (A142)	2.79 (A142)	2.78 (A193)	3.19 (A142)	3.18 (A193)	3.18 (A252)
		150	A142	2.71 (A142)	2.71 (A142)	2.71 (A193)	3.11 (A142)	3.11 (A193)	3.11 (A252)
		160	A142	2.62 (A142)	2.62 (A142)	2.62 (A142)	3.04 (A142)	3.04 (A142)	3.04 (A193)
		170	A193	2.53 (A193)	2.53 (A193)	2.53 (A193)	2.97 (A193)	2.97 (A193)	2.97 (A193)
		180	A193	2.45 (A193)	2.45 (A193)	2.45 (A193)	2.90 (A193)	2.90 (A193)	2.90 (A193)
		190	A193	2.38 (A193)	2.38 (A193)	2.38 (A193)	2.83 (A193)	2.83 (A193)	2.83 (A193)
		200	A193	2.31 (A193)	2.31 (A193)	2.31 (A193)	2.77 (A193)	2.77 (A193)	2.77 (A193)
None	120 minutes	140	A142	2.79 (A142)	2.78 (A193)	2.78 (A252)	3.18 (A193)	3.18 (A252)	3.17 (A393)
		150	A142	2.71 (A142)	2.71 (A193)	2.70 (A252)	3.11 (A142)	3.11 (A252)	3.10 (A393)
		160	A142	2.62 (A142)	2.62 (A142)	2.62 (A193)	3.04 (A142)	3.04 (A193)	3.04 (A252)
		170	A193	2.53 (A193)	2.53 (A193)	2.53 (A193)	2.97 (A193)	2.97 (A193)	2.97 (A252)
		180	A193	2.45 (A193)	2.45 (A193)	2.45 (A193)	2.90 (A193)	2.90 (A193)	2.90 (A252)
		190	A193	2.38 (A193)	2.38 (A193)	2.38 (A193)	2.83 (A193)	2.83 (A193)	2.83 (A193)
		200	A193	2.31 (A193)	2.31 (A193)	2.31 (A193)	2.77 (A193)	2.77 (A193)	2.77 (A193)

Multi span (m) - Normal weight concrete - British Standard - Beam width 152mm



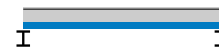
Props	Fire period	Slab depth (mm)	Mesh 0.1% min.reqd.	Total applied load (kN/m <sup>2</sup> )					
				5.00	7.50	10.00	5.00	7.50	10.00
				0.90mm			1.20mm		
None	60 minutes	120	A142	2.90 (A142)	2.90 (A142)	2.90 (A193)	3.27 (A142)	3.27 (A142)	3.26 (A252)
		130	A142	2.87 (A142)	2.87 (A142)	2.88 (A193)	3.19 (A142)	3.19 (A142)	3.19 (A193)
		140	A142	2.82 (A142)	2.82 (A142)	2.82 (A142)	3.12 (A142)	3.12 (A142)	3.11 (A193)
		150	A142	2.74 (A142)	2.74 (A142)	2.74 (A142)	3.05 (A142)	3.05 (A142)	3.05 (A142)
		160	A142	2.67 (A142)	2.67 (A142)	2.67 (A142)	3.02 (A142)	3.02 (A142)	3.02 (A142)
		170	A193	2.60 (A193)	2.60 (A193)	2.60 (A193)	2.97 (A193)	2.97 (A193)	2.97 (A193)
		180	A193	2.53 (A193)	2.53 (A193)	2.53 (A193)	2.91 (A193)	2.91 (A193)	2.91 (A193)
		190	A193	2.45 (A193)	2.45 (A193)	2.45 (A193)	2.86 (A193)	2.86 (A193)	2.86 (A193)
		200	A193	2.38 (A193)	2.38 (A193)	2.38 (A193)	2.80 (A193)	2.80 (A193)	2.80 (A193)
None	90 minutes	130	A142	2.87 (A142)	2.87 (A193)	2.87 (A252)	3.19 (A142)	3.19 (A193)	3.17 (A393)
		140	A142	2.82 (A142)	2.82 (A142)	2.81 (A193)	3.12 (A142)	3.11 (A193)	3.11 (A252)
		150	A142	2.74 (A142)	2.74 (A142)	2.74 (A193)	3.05 (A142)	3.05 (A142)	3.05 (A193)
		160	A142	2.67 (A142)	2.67 (A142)	2.67 (A142)	3.02 (A142)	3.02 (A142)	3.02 (A193)
		170	A193	2.60 (A193)	2.60 (A193)	2.60 (A193)	2.97 (A193)	2.97 (A193)	2.97 (A193)
		180	A193	2.53 (A193)	2.53 (A193)	2.53 (A193)	2.91 (A193)	2.91 (A193)	2.91 (A193)
		190	A193	2.45 (A193)	2.45 (A193)	2.45 (A193)	2.86 (A193)	2.86 (A193)	2.86 (A193)
		200	A193	2.38 (A193)	2.38 (A193)	2.38 (A193)	2.80 (A193)	2.80 (A193)	2.80 (A193)
None	120 minutes	140	A142	2.82 (A142)	2.81 (A193)	2.81 (A252)	3.11 (A193)	3.11 (A252)	3.10 (A393)
		150	A142	2.74 (A142)	2.74 (A193)	2.73 (A252)	3.05 (A142)	3.05 (A193)	3.04 (A252)
		160	A142	2.67 (A142)	2.67 (A142)	2.66 (A193)	3.02 (A142)	3.02 (A193)	3.02 (A252)
		170	A193	2.60 (A193)	2.60 (A193)	2.60 (A193)	2.97 (A193)	2.97 (A193)	2.96 (A252)
		180	A193	2.53 (A193)	2.53 (A193)	2.53 (A193)	2.91 (A193)	2.91 (A193)	2.91 (A193)
		190	A193	2.45 (A193)	2.45 (A193)	2.45 (A193)	2.86 (A193)	2.86 (A193)	2.86 (A193)
		200	A193	2.38 (A193)	2.38 (A193)	2.38 (A193)	2.80 (A193)	2.80 (A193)	2.80 (A193)

Spans are based on beam centres, with a 152mm flange width and a minimum end bearing of 50mm.

## ComFlor® 46 / Bar Fire Method / Unpropped

Single span deck, single-span slab (m) - Normal weight concrete - British Standard - Beam width 152mm

Note: A single-span deck will require trough bar reinforcement whether the concrete slab is single or continuous span, using Bar Fire Method.



Props	Fire period	Slab depth (mm)	Mesh 0.1% min.reqd.	Total applied load (kN/m <sup>2</sup> )					
				5.00	7.50	10.00	5.00	7.50	10.00
				0.90mm			1.20mm		
None	60 minutes	120	A142	2.47 (8)	2.47 (8)	2.47 (8)	2.80 (8)	2.80 (8)	2.80 (10)
		130	A142	2.44 (8)	2.44 (8)	2.44 (8)	2.72 (8)	2.72 (8)	2.72 (10)
		140	A142	2.37 (8)	2.37 (8)	2.37 (8)	2.65 (8)	2.65 (8)	2.65 (8)
		150	A142	2.31 (8)	2.31 (8)	2.31 (8)	2.59 (8)	2.59 (8)	2.59 (8)
		160	A142	2.25 (8)	2.25 (8)	2.25 (8)	2.53 (8)	2.53 (8)	2.53 (8)
		170	A193	2.19 (8)	2.19 (8)	2.19 (8)	2.47 (8)	2.47 (8)	2.47 (8)
		180	A193	2.15 (8)	2.15 (8)	2.15 (8)	2.42 (8)	2.42 (8)	2.42 (8)
		190	A193	2.10 (8)	2.10 (8)	2.10 (8)	2.37 (8)	2.37 (8)	2.37 (8)
		200	A193	2.06 (8)	2.06 (8)	2.06 (8)	2.33 (8)	2.33 (8)	2.33 (8)
None	90 minutes	130	A142	2.44 (8)	2.43 (10)	2.43 (10)	2.72 (8)	2.72 (10)	2.71 (12)
		140	A142	2.37 (8)	2.37 (8)	2.36 (10)	2.65 (8)	2.65 (10)	2.65 (10)
		150	A142	2.31 (8)	2.31 (8)	2.30 (10)	2.59 (8)	2.59 (10)	2.59 (10)
		160	A142	2.25 (8)	2.25 (8)	2.25 (8)	2.53 (8)	2.53 (8)	2.53 (10)
		170	A193	2.19 (8)	2.19 (8)	2.19 (8)	2.47 (8)	2.47 (8)	2.47 (10)
		180	A193	2.15 (8)	2.15 (8)	2.15 (8)	2.42 (8)	2.42 (8)	2.42 (8)
		190	A193	2.10 (8)	2.10 (8)	2.10 (8)	2.37 (8)	2.37 (8)	2.37 (8)
		200	A193	2.06 (8)	2.06 (8)	2.06 (8)	2.33 (8)	2.33 (8)	2.33 (8)
None	120 minutes	140	A142	2.36 (10)	2.36 (10)	2.36 (12)	2.65 (10)	2.65 (12)	2.65 (12)
		150	A142	2.31 (8)	2.30 (10)	2.30 (10)	2.59 (10)	2.58 (12)	2.58 (12)
		160	A142	2.25 (8)	2.25 (10)	2.24 (10)	2.53 (10)	2.53 (10)	2.52 (12)
		170	A193	2.19 (8)	2.19 (10)	2.19 (10)	2.47 (10)	2.47 (10)	2.47 (12)
		180	A193	2.15 (8)	2.15 (8)	2.14 (10)	2.42 (8)	2.42 (10)	2.42 (10)
		190	A193	2.10 (8)	2.10 (8)	2.10 (10)	2.37 (8)	2.37 (10)	2.37 (10)
		200	A193	2.06 (8)	2.06 (8)	2.06 (8)	2.33 (8)	2.33 (10)	2.33 (10)

Double span (m) - Normal weight concrete - British Standard - Beam width 152mm



Props	Fire period	Slab depth (mm)	Mesh 0.1% min.reqd.	Total applied load (kN/m <sup>2</sup> )					
				5.00	7.50	10.00	5.00	7.50	10.00
				0.90mm			1.20mm		
None	60 minutes	120	A142	2.96 (8)	2.95 (10)	2.95 (10)	3.26 (8)	3.25 (10)	3.25 (12)
		130	A142	2.86 (8)	2.86 (8)	2.86 (10)	3.21 (8)	3.21 (10)	3.21 (10)
		140	A142	2.78 (8)	2.78 (8)	2.78 (10)	3.18 (8)	3.18 (10)	3.18 (10)
		150	A142	2.70 (8)	2.70 (8)	2.70 (8)	3.11 (8)	3.11 (8)	3.10 (10)
		160	A142	2.61 (8)	2.61 (8)	2.61 (8)	3.04 (8)	3.04 (8)	3.03 (10)
		170	A193	2.52 (8)	2.52 (8)	2.52 (8)	2.97 (8)	2.97 (8)	2.97 (8)
		180	A193	2.44 (8)	2.44 (8)	2.44 (8)	2.89 (8)	2.89 (8)	2.89 (8)
		190	A193	2.37 (8)	2.37 (8)	2.37 (8)	2.83 (8)	2.83 (8)	2.83 (8)
		200	A193	2.30 (8)	2.30 (8)	2.30 (8)	2.77 (8)	2.77 (8)	2.77 (8)
None	90 minutes	130	A142	2.86 (10)	2.86 (10)	2.85 (12)	3.21 (10)	3.21 (12)	3.20 (16)
		140	A142	2.78 (10)	2.78 (10)	2.77 (12)	3.18 (10)	3.17 (12)	3.17 (12)
		150	A142	2.70 (8)	2.70 (10)	2.70 (10)	3.10 (10)	3.10 (10)	3.10 (12)
		160	A142	2.61 (8)	2.61 (10)	2.61 (10)	3.03 (10)	3.03 (10)	3.03 (12)
		170	A193	2.52 (8)	2.52 (8)	2.52 (10)	2.96 (10)	2.96 (10)	2.96 (12)
		180	A193	2.44 (8)	2.44 (8)	2.44 (10)	2.89 (8)	2.89 (10)	2.89 (10)
		190	A193	2.37 (8)	2.37 (8)	2.37 (8)	2.83 (8)	2.83 (10)	2.83 (10)
		200	A193	2.30 (8)	2.30 (8)	2.30 (8)	2.77 (8)	2.77 (8)	2.77 (10)
None	120 minutes	140	A142	2.78 (10)	2.77 (12)	2.76 (16)	3.17 (12)	3.16 (16)	3.16 (16)
		150	A142	2.70 (10)	2.69 (12)	2.69 (12)	3.10 (12)	3.09 (16)	3.09 (16)
		160	A142	2.61 (10)	2.60 (12)	2.60 (12)	3.03 (12)	3.03 (12)	3.02 (16)
		170	A193	2.52 (10)	2.52 (10)	2.51 (12)	2.96 (10)	2.96 (12)	2.95 (16)
		180	A193	2.44 (8)	2.44 (10)	2.44 (10)	2.89 (10)	2.89 (12)	2.89 (12)
		190	A193	2.37 (8)	2.37 (10)	2.37 (10)	2.83 (10)	2.82 (12)	2.82 (12)
		200	A193	2.30 (8)	2.30 (10)	2.30 (10)	2.77 (10)	2.77 (10)	2.76 (12)

Figures in brackets represent the diameter of bar required – one bar in each deck trough positioned 25mm above the trough.

## ComFlor® 46 / Bar Fire Method / Propped

Propped deck, single or continuous slab (m) - Normal weight concrete - British Standard - Beam width 152mm  
(Note: For Simple Mesh and Deck Fire Method) load/span tables, please refer to the Technical Department.)



Props	Fire period	Slab depth (mm)	Mesh 0.1% min.reqd.	Total applied load (kN/m <sup>2</sup> )					
				5.00	7.50	10.00	5.00	7.50	10.00
				0.90mm			1.20mm		
1 line	60 minutes	120	A142	4.79 (32)	4.40 (32)	4.05 (32)	4.85 (32)	4.46 (32)	4.18 (32)
		130	A142	4.80 (16)	4.66 (32)	4.28 (25)	5.20 (32)	4.79 (32)	4.49 (32)
		140	A142	4.68 (12)	4.66 (16)	4.47 (20)	5.50 (32)	5.11 (32)	4.79 (32)
		150	A142	4.53 (12)	4.51 (16)	4.51 (16)	5.49 (16)	5.35 (32)	5.09 (32)
		160	A142	4.39 (12)	4.39 (12)	4.37 (16)	5.35 (16)	5.33 (16)	5.22 (25)
		170	A193	4.26 (10)	4.26 (12)	4.24 (16)	5.22 (12)	5.20 (16)	5.20 (16)
		180	A193	4.15 (10)	4.14 (12)	4.14 (12)	5.08 (12)	5.06 (16)	5.06 (16)
		190	A193	4.04 (10)	4.04 (10)	4.03 (12)	4.95 (12)	4.93 (16)	4.93 (16)
		200	A193	3.93 (10)	3.93 (10)	3.93 (12)	4.83 (12)	4.83 (12)	4.81 (16)
1 line	90 minutes	130	A142	4.80 (16)	4.66 (32)	4.28 (25)	5.20 (32)	4.79 (32)	4.49 (32)
		140	A142	4.66 (16)	4.63 (20)	4.47 (20)	5.50 (32)	5.11 (32)	4.79 (32)
		150	A142	4.51 (16)	4.51 (16)	4.48 (20)	5.47 (20)	5.35 (32)	5.09 (32)
		160	A142	4.37 (16)	4.37 (16)	4.35 (20)	5.35 (16)	5.32 (20)	5.22 (25)
		170	A193	4.24 (16)	4.24 (16)	4.24 (16)	5.20 (16)	5.17 (20)	5.17 (20)
		180	A193	4.14 (12)	4.12 (16)	4.12 (16)	5.08 (16)	5.03 (20)	5.03 (20)
		190	A193	4.03 (12)	4.02 (16)	4.02 (16)	4.93 (16)	4.93 (16)	4.91 (20)
		200	A193	3.93 (12)	3.93 (12)	3.91 (16)	4.81 (16)	4.81 (16)	4.79 (20)
1 line	120 minutes	140	A142	4.63 (20)	4.59 (25)	4.47 (25)	5.50 (32)	5.11 (32)	4.79 (32)
		150	A142	4.48 (20)	4.48 (20)	4.44 (25)	5.43 (25)	5.35 (32)	5.09 (32)
		160	A142	4.37 (16)	4.35 (20)	4.35 (20)	5.32 (20)	5.27 (25)	5.22 (25)
		170	A193	4.24 (16)	4.22 (20)	4.22 (20)	5.17 (20)	5.13 (25)	5.13 (25)
		180	A193	4.12 (16)	4.12 (16)	4.10 (20)	5.03 (20)	5.03 (20)	5.00 (25)
		190	A193	4.02 (16)	4.02 (16)	4.00 (20)	4.91 (20)	4.91 (20)	4.87 (25)
		200	A193	3.91 (16)	3.91 (16)	3.91 (16)	4.80 (16)	4.79 (20)	4.79 (20)

Figures in brackets represent the diameter of bar required – one bar in each deck trough positioned 25mm above the trough.

BNP Paribas Real Estate HQ,  
6 Pancras Square, City of London  
Steelwork contractor: Severfield  
Decking installer: Composite Profiles



# ComFlor® 51+

Contemporary new design of the original British re-entrant profile

ComFlor® 51+ is a completely new profile that is the latest evolution of a long line of re-entrant profile design, the favoured profile shape for a vast number of projects in Britain since the 1970s. It provides a virtually flat soffit and the best available composite deck fire performance for both slab and beams. The new embossments give excellent composite slab strength characteristics and the classic re-entrant profile shape the most effective shear stud interaction. Dovetail grooves at 150mm centre provide the best possible anchorage for services underneath.

#### Virtually flat soffit

For a clean aesthetic appeal.

#### Composite performance – floor slab

New embossments on ComFlor® 51+ give even better shear key, the re-entrant profile an excellent point load resistance.

#### Composite performance – beam

The classic re-entrant profile shape provides the most effective shear stud performance of all composite profiles.

#### Fire and acoustic performance

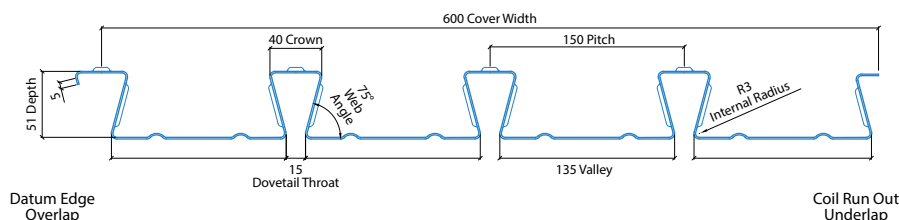
The low intrusion of the re-entrant profile into the concrete allows both a good fire rating and airborne sound reduction from a relatively slim slab. The flat soffit provides excellent fire protection to the top flange of the beam.

#### Easy attachment for services

Dovetail grooves at 150mm centre offer the best possible anchorage for services underneath.



# Design information



## ComFlor® 51+ Composite slab - volume and weight (EC values)

Slab depth (mm)	Concrete volume (m <sup>3</sup> /m <sup>2</sup> )	Weight of concrete (kN/m <sup>2</sup> )			
		Normal weight concrete		Lightweight concrete	
		Wet	Dry	Wet	Dry
101	0.091	2.27	2.18	1.82	1.73
110	0.100	2.50	2.40	2.00	1.90
120	0.110	2.75	2.64	2.20	2.09
130	0.120	3.00	2.88	2.40	2.28
140	0.130	3.25	3.12	2.60	2.47
150	0.140	3.50	3.36	2.80	2.66
160	0.150	3.75	3.60	3.00	2.85
170	0.160	4.00	3.84	3.20	3.04
180	0.170	4.25	4.08	3.40	3.23
190	0.180	4.50	4.32	3.60	3.42
200	0.190	4.75	4.56	3.80	3.61
250	0.240	6.00	5.76	4.80	4.56



### Notes

- Deck and beam deflection (ie, ponding) is not included in the table.
- Deck and mesh weight is not included in the weight of concrete figures.
- Eurocode density of concrete is taken as:

Normal weight (wet)	25kN/m <sup>3</sup>
Normal weight (dry)	24kN/m <sup>3</sup>
Lightweight (wet)	20kN/m <sup>3</sup>
Lightweight (dry)	19kN/m <sup>3</sup>

## ComFlor® 51+ (S350) Section properties (per metre width)

Nominal thickness (mm)	Design thickness (mm)	Cross section area (mm <sup>2</sup> /m)	Profile weight (kN/m <sup>2</sup> )	Height to neutral axis (mm)	Moment of inertia (cm <sup>4</sup> /m)		Ultimate moment capacity (kNm/m)	
					Sagging	Hogging	Sagging	Hogging
0.90	0.86	1578	0.13	15.90	60.44	42.56	5.70	6.78
1.00	0.96	1762	0.14	16.50	67.09	50.49	6.78	8.17
1.20	1.16	2137	0.17	16.80	82.60	69.00	8.94	10.96

Section properties in the above table conform to BS 5950 and Eurocode

### Design Notes:

#### Deck material

Tata Steel Galvatite®, hot dip zinc coated steel to BS EN 10346 S350GD+Z275, with guaranteed minimum proof strength of 350N/mm<sup>2</sup> and zinc coating of total mass 275g/m<sup>2</sup> (including both sides). This is sufficient for internal floors in a non-aggressive environment, which satisfies the requirement in Clause 4.2 BS EN 1994-1-1 - the exposed surfaces of the steel decking shall be adequately protected to resist the particular atmospheric conditions. A zinc coating, if specified, should conform to the requirements of BS EN 10346. The specification may be varied, depending on service conditions.

#### Anti-crack mesh

As a minimum requirement where the control of crack width is of no interest, BS EN 1994-1-1, 9.8.1(2) recommends that, where continuous slabs are designed as simply-supported in accordance with BS EN 1994-1-1, 9.4.2(5), the cross-sectional area of the

anti-crack reinforcement above the ribs should be not less than 0.2% of the cross-sectional area of the concrete above the ribs for unpropped construction, and 0.4% of this cross-sectional area for propped construction. The mesh specified in the quick reference Eurocode tables, complies with this clause.

Where forklift truck (or other similar concentrated loading) is expected, 0.5% minimum percentage reinforcement should be used over the supports and the previous stated percentages elsewhere to control cracking. For further information refer to SCI AD 150.

In accordance with Steel Construction Institute (SCI) P300 'Composite Slabs and Beams Using Steel Decking: Best Practice for Design and Construction, a nominal cover of 25mm is stated for an exposure level XC1, for all concrete cylinder strengths for both normal (C25/30 to C40/50) and lightweight concrete (LC25/28 to LC32/35). This nominal cover of 25mm is the minimum cover of 15mm plus a fixing tolerance of 10mm.

#### Supporting beam width

For all ComFlor® 51+ load/span tables, the width of the support beam used is assumed to be 152mm.

#### Fire design

The capacity of a composite slab with nominal anti-crack mesh in fire is calculated in accordance with Steel Construction Institute NCCI PN005 'Fire resistance design of composite slab'. Two fire-design methods can be used in the ComFlor® 9 software, namely 'Mesh and Deck Fire Method' or 'Bar Fire Method'. For further details of the performance of composite slabs with nominal anti-crack mesh in fire, please contact the technical team.

#### Technical services

The Technical Department at Tata Steel offers a comprehensive advisory service on the design of composite flooring, which is available to all specifiers and users. Should queries arise which are not covered by this literature or by the ComFlor® 9 software, please contact us.

## ComFlor® 51+ / Mesh and Deck Fire Method / Unpropped

Single span deck continuous slab (m) - Normal weight concrete - Eurocode - Beam width 152mm  
 (Note: Single span deck single span slab is only permitted using Bar Fire Method.)



Props	Fire period	Slab depth (mm)	Mesh 0.2% min.reqd*	Total applied load (kN/m <sup>2</sup> )								
				5.00	7.50	10.00	5.00	7.50	10.00	5.00	7.50	10.00
				0.90mm			1.00mm			1.20mm		
None	60 minutes	101	A142	2.79 (A142)	2.79 (A142)	2.79 (A193)	3.01 (A142)	3.01 (A142)	3.01 (A193)	3.37 (A142)	3.37 (A142)	3.37 (A252)
		110	A142	2.72 (A142)	2.72 (A142)	2.72 (A142)	2.94 (A142)	2.94 (A142)	2.94 (A142)	3.29 (A142)	3.29 (A142)	3.29 (A193)
		120	A142	2.65 (A142)	2.65 (A142)	2.65 (A142)	2.86 (A142)	2.86 (A142)	2.86 (A142)	3.21 (A142)	3.21 (A142)	3.21 (A142)
		130	A193	2.61 (A142)	2.61 (A193)	2.61 (A193)	2.79 (A193)	2.79 (A193)	2.79 (A193)	3.14 (A193)	3.14 (A193)	3.14 (A193)
		140	A193	2.59 (A193)	2.59 (A193)	2.59 (A193)	2.73 (A193)	2.73 (A193)	2.73 (A193)	3.07 (A193)	3.07 (A193)	3.07 (A193)
		150	A252	2.52 (A252)	2.52 (A252)	2.52 (A252)	2.67 (A252)	2.67 (A252)	2.67 (A252)	3.01 (A252)	3.01 (A252)	3.01 (A252)
		160	A252	2.47 (A252)	2.47 (A252)	2.47 (A252)	2.61 (A252)	2.61 (A252)	2.61 (A252)	2.95 (A252)	2.95 (A252)	2.95 (A252)
		170	A252	2.41 (A252)	2.41 (A252)	2.41 (A252)	2.56 (A252)	2.56 (A252)	2.56 (A252)	2.89 (A252)	2.89 (A252)	2.89 (A252)
		180	A393	2.36 (A393)	2.36 (A393)	2.36 (A393)	2.51 (A393)	2.51 (A393)	2.51 (A393)	2.83 (A393)	2.83 (A393)	2.83 (A393)
		190	A393	2.31 (A393)	2.31 (A393)	2.31 (A393)	2.46 (A393)	2.46 (A393)	2.46 (A393)	2.78 (A393)	2.78 (A393)	2.78 (A393)
200	A393	2.27 (A393)	2.27 (A393)	2.27 (A393)	2.42 (A393)	2.42 (A393)	2.42 (A393)	2.74 (A393)	2.74 (A393)	2.74 (A393)		
None	90 minutes	110	A142	2.72 (A142)	2.72 (A193)	2.71 (A393)	2.94 (A142)	2.93 (A193)	2.92 (A393)	3.29 (A142)	3.29 (A252)	3.27 (2xA252)
		120	A142	2.65 (A142)	2.65 (A142)	2.65 (A252)	2.86 (A142)	2.86 (A142)	2.86 (A252)	3.21 (A142)	3.21 (A193)	3.20 (A393)
		130	A193	2.61 (A193)	2.61 (A193)	2.61 (A193)	2.79 (A193)	2.79 (A193)	2.79 (A193)	3.14 (A193)	3.14 (A193)	3.14 (A252)
		140	A193	2.59 (A193)	2.59 (A193)	2.59 (A193)	2.73 (A193)	2.73 (A193)	2.73 (A193)	3.07 (A193)	3.07 (A193)	3.07 (A252)
		150	A252	2.52 (A252)	2.52 (A252)	2.52 (A252)	2.67 (A252)	2.67 (A252)	2.67 (A252)	3.01 (A252)	3.01 (A252)	3.01 (A252)
		160	A252	2.47 (A252)	2.47 (A252)	2.47 (A252)	2.61 (A252)	2.61 (A252)	2.61 (A252)	2.95 (A252)	2.95 (A252)	2.95 (A252)
		170	A252	2.41 (A252)	2.41 (A252)	2.41 (A252)	2.56 (A252)	2.56 (A252)	2.56 (A252)	2.89 (A252)	2.89 (A252)	2.89 (A252)
		180	A393	2.36 (A393)	2.36 (A393)	2.36 (A393)	2.51 (A393)	2.51 (A393)	2.51 (A393)	2.83 (A393)	2.83 (A393)	2.83 (A393)
		190	A393	2.31 (A393)	2.31 (A393)	2.31 (A393)	2.46 (A393)	2.46 (A393)	2.46 (A393)	2.78 (A393)	2.78 (A393)	2.78 (A393)
		200	A393	2.27 (A393)	2.27 (A393)	2.27 (A393)	2.42 (A393)	2.42 (A393)	2.42 (A393)	2.74 (A393)	2.74 (A393)	2.74 (A393)
None	120 minutes	125	A193	2.62 (A193)	2.62 (A193)	2.61 (A393)	2.82 (A193)	2.82 (A193)	2.82 (A393)	3.18 (A193)	3.17 (A252)	3.17 (A393)
		130	A193	2.61 (A193)	2.61 (A193)	2.61 (A252)	2.79 (A193)	2.79 (A193)	2.78 (A393)	3.14 (A193)	3.14 (A193)	3.13 (A393)
		140	A193	2.59 (A193)	2.59 (A193)	2.59 (A252)	2.73 (A193)	2.73 (A193)	2.72 (A252)	3.07 (A193)	3.07 (A193)	3.07 (A393)
		150	A252	2.52 (A252)	2.52 (A252)	2.52 (A252)	2.67 (A252)	2.67 (A252)	2.66 (A252)	3.01 (A252)	3.01 (A252)	3.01 (A252)
		160	A252	2.47 (A252)	2.47 (A252)	2.47 (A252)	2.61 (A252)	2.61 (A252)	2.61 (A252)	2.95 (A252)	2.95 (A252)	2.95 (A252)
		170	A252	2.41 (A252)	2.41 (A252)	2.41 (A252)	2.56 (A252)	2.56 (A252)	2.56 (A252)	2.89 (A252)	2.89 (A252)	2.89 (A252)
		180	A393	2.36 (A393)	2.36 (A393)	2.36 (A393)	2.51 (A393)	2.51 (A393)	2.51 (A393)	2.83 (A393)	2.83 (A393)	2.83 (A393)
		190	A393	2.31 (A393)	2.31 (A393)	2.31 (A393)	2.46 (A393)	2.46 (A393)	2.46 (A393)	2.78 (A393)	2.78 (A393)	2.78 (A393)
		200	A393	2.27 (A393)	2.27 (A393)	2.27 (A393)	2.42 (A393)	2.42 (A393)	2.42 (A393)	2.74 (A393)	2.74 (A393)	2.74 (A393)

Double span (m) - Normal weight concrete - Eurocode - Beam width 152mm



Props	Fire period	Slab depth (mm)	Mesh 0.2% min.reqd*	Total applied load (kN/m <sup>2</sup> )								
				5.00	7.50	10.00	5.00	7.50	10.00	5.00	7.50	10.00
				0.90mm			1.00mm			1.20mm		
None	60 minutes	101	A142	3.09 (A142)	3.09 (A142)	3.08 (A393)	3.35 (A142)	3.35 (A193)	3.34 (A393)	3.88 (A142)	3.88 (A252)	3.47 (A393)
		110	A142	3.08 (A142)	3.08 (A142)	3.08 (A252)	3.27 (A142)	3.27 (A142)	3.26 (A393)	3.79 (A142)	3.78 (A193)	3.77 (2xA193)
		120	A142	3.00 (A142)	3.00 (A142)	2.99 (A193)	3.18 (A142)	3.18 (A142)	3.18 (A193)	3.69 (A142)	3.69 (A142)	3.68 (A393)
		130	A193	2.91 (A193)	2.91 (A193)	2.91 (A193)	3.17 (A193)	3.17 (A193)	3.17 (A193)	3.59 (A193)	3.59 (A193)	3.59 (A252)
		140	A193	2.84 (A193)	2.84 (A193)	2.84 (A193)	3.10 (A193)	3.10 (A193)	3.10 (A193)	3.51 (A193)	3.51 (A193)	3.51 (A193)
		150	A252	2.77 (A252)	2.77 (A252)	2.77 (A252)	3.02 (A252)	3.02 (A252)	3.02 (A252)	3.43 (A252)	3.43 (A252)	3.43 (A252)
		160	A252	2.71 (A252)	2.71 (A252)	2.71 (A252)	2.95 (A252)	2.95 (A252)	2.95 (A252)	3.42 (A252)	3.42 (A252)	3.42 (A252)
		170	A252	2.65 (A252)	2.65 (A252)	2.65 (A252)	2.89 (A252)	2.89 (A252)	2.89 (A252)	3.37 (A252)	3.37 (A252)	3.37 (A252)
		180	A393	2.59 (A393)	2.59 (A393)	2.59 (A393)	2.82 (A393)	2.82 (A393)	2.82 (A393)	3.30 (A393)	3.30 (A393)	3.30 (A393)
		190	A393	2.54 (A393)	2.54 (A393)	2.54 (A393)	2.77 (A393)	2.77 (A393)	2.77 (A393)	3.23 (A393)	3.23 (A393)	3.23 (A393)
200	A393	2.49 (A393)	2.49 (A393)	2.49 (A393)	2.71 (A393)	2.71 (A393)	2.71 (A393)	3.17 (A393)	3.17 (A393)	3.17 (A393)		
None	90 minutes	110	A142	3.08 (A193)	3.07 (A393)	2.96 (2xA252)	3.27 (A193)	3.26 (A393)	2.98 (2xA252)	3.77 (A393)	3.77 (2xA252)	3.02 (2xA252)
		120	A142	3.00 (A142)	2.99 (A252)	2.98 (A393)	3.18 (A142)	3.18 (A252)	3.17 (2xA252)	3.69 (A193)	3.67 (A393)	3.66 (2xA393)
		130	A193	2.91 (A193)	2.91 (A193)	2.91 (A393)	3.17 (A193)	3.17 (A252)	3.16 (A393)	3.59 (A193)	3.58 (A393)	3.58 (2xA252)
		140	A193	2.84 (A193)	2.84 (A193)	2.84 (A252)	3.10 (A193)	3.10 (A193)	3.09 (A393)	3.51 (A193)	3.51 (A252)	3.50 (2xA252)
		150	A252	2.77 (A252)	2.77 (A252)	2.77 (A252)	3.02 (A252)	3.02 (A252)	3.02 (A252)	3.43 (A252)	3.43 (A252)	3.43 (2xA193)
		160	A252	2.71 (A252)	2.71 (A252)	2.71 (A252)	2.95 (A252)	2.95 (A252)	2.95 (A252)	3.42 (A252)	3.42 (A252)	3.41 (A393)
		170	A252	2.65 (A252)	2.65 (A252)	2.65 (A252)	2.89 (A252)	2.89 (A252)	2.89 (A252)	3.37 (A252)	3.37 (A142)	3.37 (A252)
		180	A393	2.59 (A393)	2.59 (A393)	2.59 (A393)	2.82 (A393)	2.82 (A393)	2.82 (A393)	3.30 (A393)	3.30 (A393)	3.30 (A393)
		190	A393	2.54 (A393)	2.54 (A393)	2.54 (A393)	2.77 (A393)	2.77 (A393)	2.77 (A393)	3.23 (A393)	3.23 (A393)	3.23 (A393)
		200	A393	2.49 (A393)	2.49 (A393)	2.49 (A393)	2.71 (A393)	2.71 (A393)	2.71 (A393)	3.17 (A393)	3.17 (A393)	3.17 (A393)
None	120 minutes	125	A193	2.95 (A193)	2.95 (A252)	2.94 (2xA252)	3.17 (A193)	3.16 (A393)	3.15 (2xA252)	3.64 (A252)	3.63 (A393)	3.61 (2xA393)
		130	A193	2.91 (A193)	2.91 (A252)	2.91 (A393)	3.17 (A193)	3.16 (A393)	3.16 (2xA252)	3.59 (A252)	3.58 (A393)	3.57 (2xA393)
		140	A193	2.84 (A193)	2.84 (A193)	2.83 (A393)	3.10 (A193)	3.10 (A252)	3.09 (2xA252)	3.51 (A193)	3.50 (A393)	3.50 (2xA252)
		150	A252	2.77 (A252)	2.77 (A252)	2.77 (A252)	3.02 (A252)	3.02 (A252)	3.02 (A393)	3.43 (A252)	3.42 (A393)	3.42 (2xA252)
		160	A252	2.71 (A252)	2.71 (A252)	2.71 (A252)	2.95 (A252)	2.95 (A252)	2.95 (A252)	3.42 (A252)	3.42 (A252)	3.41 (2xA252)
		170	A252	2.65 (A252)	2.65 (A252)	2.65 (A252)	2.89 (A252)	2.89 (A252)	2.89 (A252)	3.37 (A252)	3.37 (A252)	3.37 (A393)
		180	A393	2.59 (A393)	2.59 (A393)	2.59 (A393)	2.82 (A393)	2.82 (A393)	2.82 (A393)	3.30 (A393)	3.30 (A393)	3.30 (A393)
		190	A393	2.54 (A393)	2.54 (A393)	2.54 (A393)	2.77 (A393)	2.77 (A393)	2.77 (A393)	3.23 (A393)	3.23 (A393)	3.23 (A393)
		200	A393	2.49 (A393)	2.49 (A393)	2.49 (A393)	2.71 (A393)	2.71 (A393)	2.71 (A393)	3.17 (A393)	3.17 (A393)	3.17 (A393)

Spans are based on beam centres, with a 152mm flange width and a minimum end bearing of 50mm.

\* In accordance with BS EN 1994-1-1 Clause 9.8.1 (2) - Where the continuous slabs are designed as simply-supported in accordance with 9.4.2 (5), the minimum cross-sectional area of anti-crack mesh reinforcement above the ribs should not be less than 0.2% of the cross-sectional area of concrete above the ribs for unpropped construction. In order to maximise the FIRE LIMIT STATE spans, increased mesh sizing is required as specified in the above Mesh and Deck Fire Method tables.

Figures in brackets represent the diameter of bar required – one bar in each deck trough positioned 25mm above the trough.

## ComFlor® 51+ / Bar Fire Method / Unpropped

Single span deck, single span slab (m) - Normal weight concrete - Eurocode - Beam width 152mm



Props	Fire period	Slab depth (mm)	Mesh 0.2% min. reqd.*	Total applied load (kN/m <sup>2</sup> )								
				5.00	7.50	10.00	5.00	7.50	10.00	5.00	7.50	10.00
None	60 minutes			0.90mm			1.00mm			1.20mm		
		101	A142	2.78 (8)	2.78 (8)	2.78 (8)	3.00 (8)	3.00 (8)	3.00 (8)	3.36 (8)	3.36 (8)	3.36 (10)
		110	A142	2.71 (8)	2.71 (8)	2.71 (8)	2.93 (8)	2.93 (8)	2.93 (8)	3.28 (8)	3.28 (8)	3.28 (8)
		120	A142	2.65 (8)	2.65 (8)	2.65 (8)	2.85 (8)	2.85 (8)	2.85 (8)	3.21 (8)	3.21 (8)	3.21 (8)
		130	A193	2.61 (8)	2.61 (8)	2.61 (8)	2.78 (8)	2.78 (8)	2.78 (8)	3.13 (8)	3.13 (8)	3.13 (8)
		140	A193	2.58 (8)	2.58 (8)	2.58 (8)	2.72 (8)	2.72 (8)	2.72 (8)	3.07 (8)	3.07 (8)	3.07 (8)
		150	A252	2.52 (8)	2.52 (8)	2.52 (8)	2.66 (8)	2.66 (8)	2.66 (8)	3.00 (8)	3.00 (8)	3.00 (8)
		160	A252	2.46 (8)	2.46 (8)	2.46 (8)	2.60 (8)	2.60 (8)	2.60 (8)	2.94 (8)	2.94 (8)	2.94 (8)
		170	A252	2.41 (8)	2.41 (8)	2.41 (8)	2.55 (8)	2.55 (8)	2.55 (8)	2.89 (8)	2.89 (8)	2.89 (8)
		180	A393	2.36 (8)	2.36 (8)	2.36 (8)	2.50 (8)	2.50 (8)	2.50 (8)	2.83 (8)	2.83 (8)	2.83 (8)
190	A393	2.31 (8)	2.31 (8)	2.31 (8)	2.45 (8)	2.45 (8)	2.45 (8)	2.78 (8)	2.78 (8)	2.78 (8)		
200	A393	2.27 (8)	2.27 (8)	2.27 (8)	2.41 (8)	2.41 (8)	2.41 (8)	2.73 (8)	2.73 (8)	2.73 (8)		
None	90 minutes	110	A142	2.71 (8)	2.71 (8)	2.71 (10)	2.93 (8)	2.92 (10)	2.92 (10)	3.28 (8)	3.28 (10)	3.27 (12)
		120	A142	2.65 (8)	2.65 (8)	2.65 (8)	2.85 (8)	2.85 (8)	2.85 (10)	3.21 (8)	3.20 (10)	3.20 (10)
		130	A193	2.61 (8)	2.61 (8)	2.61 (8)	2.78 (8)	2.78 (8)	2.78 (10)	3.13 (8)	3.13 (10)	3.13 (10)
		140	A193	2.58 (8)	2.58 (8)	2.58 (8)	2.72 (8)	2.72 (8)	2.72 (8)	3.07 (8)	3.07 (8)	3.06 (10)
		150	A252	2.52 (8)	2.52 (8)	2.52 (8)	2.66 (8)	2.66 (8)	2.66 (8)	3.00 (8)	3.00 (8)	3.00 (10)
		160	A252	2.46 (8)	2.46 (8)	2.46 (8)	2.60 (8)	2.60 (8)	2.60 (8)	2.94 (8)	2.94 (8)	2.94 (8)
		170	A252	2.41 (8)	2.41 (8)	2.41 (8)	2.55 (8)	2.55 (8)	2.55 (8)	2.89 (8)	2.89 (8)	2.89 (8)
		180	A393	2.36 (8)	2.36 (8)	2.36 (8)	2.50 (8)	2.50 (8)	2.50 (8)	2.83 (8)	2.83 (8)	2.83 (8)
		190	A393	2.31 (8)	2.31 (8)	2.31 (8)	2.45 (8)	2.45 (8)	2.45 (8)	2.78 (8)	2.78 (8)	2.78 (8)
		200	A393	2.27 (8)	2.27 (8)	2.27 (8)	2.41 (8)	2.41 (8)	2.41 (8)	2.73 (8)	2.73 (8)	2.73 (8)
None	120 minutes	125	A193	2.61 (10)	2.60 (12)	2.59 (16)	2.81 (10)	2.81 (12)	2.80 (16)	3.16 (12)	3.14 (16)	3.14 (16)
		130	A193	2.60 (10)	2.60 (12)	2.60 (12)	2.78 (10)	2.77 (12)	2.76 (16)	3.12 (12)	3.12 (16)	3.11 (16)
		140	A193	2.58 (10)	2.58 (10)	2.57 (12)	2.72 (10)	2.71 (12)	2.71 (12)	3.06 (12)	3.06 (12)	3.05 (16)
		150	A252	2.51 (10)	2.51 (10)	2.51 (12)	2.66 (10)	2.66 (10)	2.65 (12)	3.00 (10)	3.00 (12)	2.98 (16)
		160	A252	2.46 (8)	2.46 (10)	2.45 (12)	2.60 (10)	2.60 (10)	2.60 (12)	2.94 (10)	2.94 (12)	2.93 (12)
		170	A252	2.41 (8)	2.41 (10)	2.41 (10)	2.55 (8)	2.55 (10)	2.55 (12)	2.88 (10)	2.88 (12)	2.88 (12)
		180	A393	2.36 (8)	2.35 (10)	2.35 (10)	2.50 (8)	2.50 (10)	2.50 (10)	2.83 (10)	2.83 (10)	2.82 (12)
		190	A393	2.31 (8)	2.31 (8)	2.31 (10)	2.45 (8)	2.45 (10)	2.45 (10)	2.78 (10)	2.78 (10)	2.77 (12)
		200	A393	2.27 (8)	2.27 (8)	2.26 (10)	2.41 (8)	2.41 (8)	2.41 (10)	2.73 (10)	2.73 (10)	2.72 (12)

Double span (m) - Normal weight concrete - Eurocode - Beam width 152mm

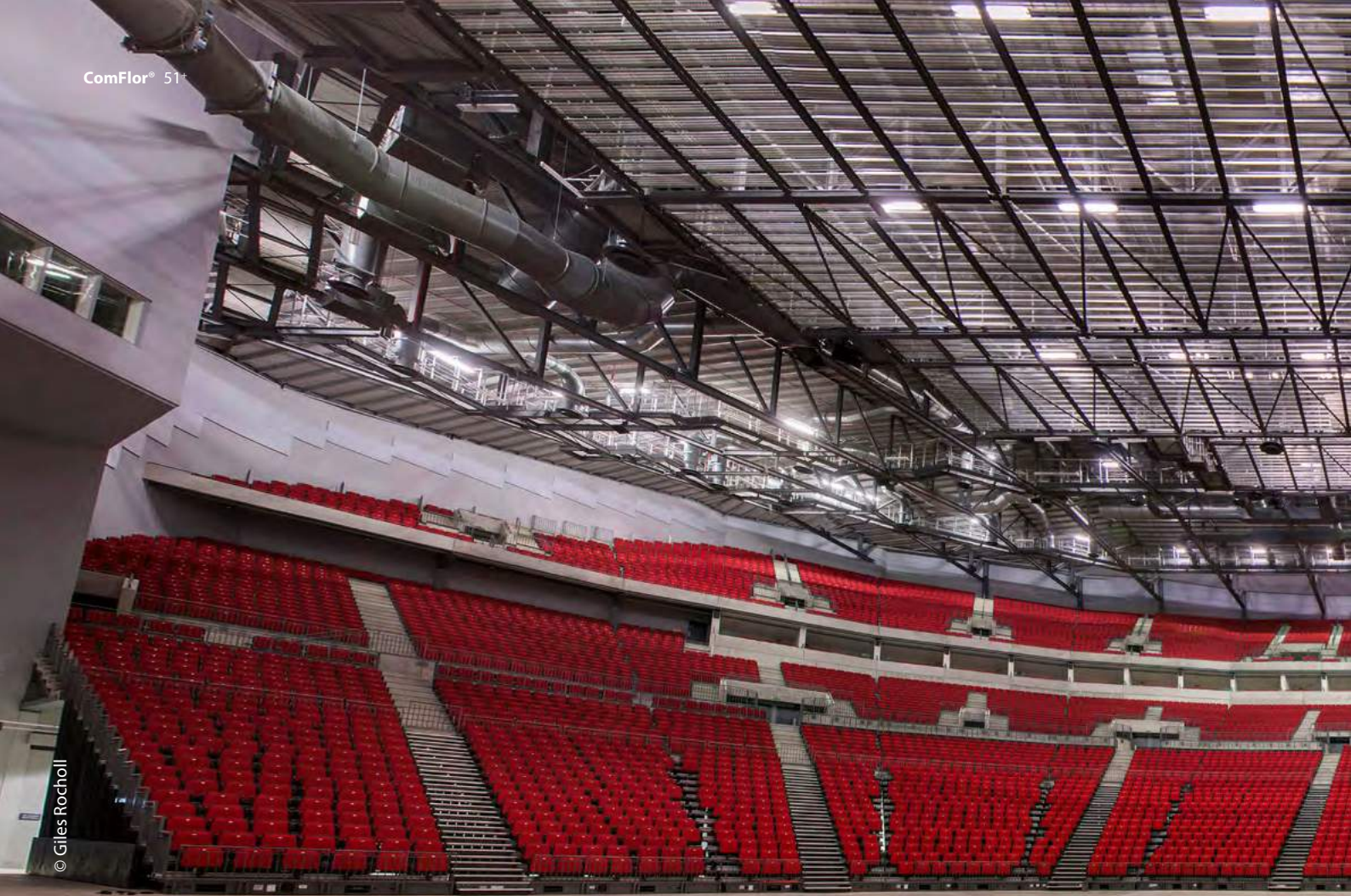


Props	Fire period	Slab depth (mm)	Mesh 0.2% min. reqd.*	Total applied load (kN/m <sup>2</sup> )								
				5.00	7.50	10.00	5.00	7.50	10.00	5.00	7.50	10.00
None	60 minutes			0.90mm			1.00mm			1.20mm		
		101	A142	3.08 (8)	3.08 (8)	3.08 (8)	3.35 (8)	3.35 (8)	3.34 (10)	3.88 (8)	3.87 (10)	3.87 (10)
		110	A142	3.08 (8)	3.08 (8)	3.08 (8)	3.26 (8)	3.26 (8)	3.26 (8)	3.78 (8)	3.78 (8)	3.77 (10)
		120	A142	2.99 (8)	2.99 (8)	2.99 (8)	3.18 (8)	3.18 (8)	3.17 (8)	3.68 (8)	3.68 (8)	3.68 (8)
		130	A193	2.91 (8)	2.91 (8)	2.91 (8)	3.16 (8)	3.16 (8)	3.16 (8)	3.59 (8)	3.59 (8)	3.59 (8)
		140	A193	2.83 (8)	2.83 (8)	2.83 (8)	3.09 (8)	3.09 (8)	3.09 (8)	3.51 (8)	3.50 (8)	3.50 (8)
		150	A252	2.76 (8)	2.76 (8)	2.76 (8)	3.02 (8)	3.02 (8)	3.02 (8)	3.42 (8)	3.42 (8)	3.42 (8)
		160	A252	2.70 (8)	2.70 (8)	2.70 (8)	2.95 (8)	2.95 (8)	2.95 (8)	3.41 (8)	3.41 (8)	3.41 (8)
		170	A252	2.64 (8)	2.64 (8)	2.64 (8)	2.88 (8)	2.88 (8)	2.88 (8)	3.37 (8)	3.37 (8)	3.37 (8)
		180	A393	2.58 (8)	2.58 (8)	2.58 (8)	2.82 (8)	2.82 (8)	2.82 (8)	3.29 (8)	3.29 (8)	3.29 (8)
190	A393	2.53 (8)	2.53 (8)	2.53 (8)	2.76 (8)	2.76 (8)	2.76 (8)	3.23 (8)	3.23 (8)	3.23 (8)		
200	A393	2.48 (8)	2.48 (8)	2.48 (8)	2.71 (8)	2.71 (8)	2.71 (8)	3.17 (8)	3.17 (8)	3.17 (8)		
None	90 minutes	110	A142	3.08 (8)	3.07 (10)	3.07 (10)	3.26 (8)	3.26 (10)	3.25 (12)	3.77 (10)	3.77 (12)	3.75 (16)
		120	A142	2.99 (8)	2.99 (8)	2.99 (10)	3.18 (8)	3.17 (10)	3.17 (10)	3.68 (10)	3.68 (10)	3.67 (12)
		130	A193	2.91 (8)	2.91 (8)	2.90 (10)	3.16 (8)	3.16 (8)	3.16 (10)	3.59 (8)	3.58 (10)	3.58 (12)
		140	A193	2.83 (8)	2.83 (8)	2.83 (8)	3.09 (8)	3.09 (8)	3.09 (10)	3.50 (8)	3.50 (8)	3.50 (10)
		150	A252	2.76 (8)	2.76 (8)	2.76 (8)	3.02 (8)	3.02 (8)	3.02 (8)	3.42 (8)	3.42 (8)	3.42 (10)
		160	A252	2.70 (8)	2.70 (8)	2.70 (8)	2.95 (8)	2.95 (8)	2.95 (8)	3.41 (8)	3.41 (8)	3.41 (10)
		170	A252	2.64 (8)	2.64 (8)	2.64 (8)	2.88 (8)	2.88 (8)	2.88 (8)	3.37 (8)	3.37 (8)	3.37 (8)
		180	A393	2.58 (8)	2.58 (8)	2.58 (8)	2.82 (8)	2.82 (8)	2.82 (8)	3.29 (8)	3.29 (8)	3.29 (8)
		190	A393	2.53 (8)	2.53 (8)	2.53 (8)	2.76 (8)	2.76 (8)	2.76 (8)	3.23 (8)	3.23 (8)	3.23 (8)
		200	A393	2.48 (8)	2.48 (8)	2.48 (8)	2.71 (8)	2.71 (8)	2.71 (8)	3.17 (8)	3.17 (8)	3.17 (8)
None	120 minutes	125	A193	2.94 (10)	2.94 (12)	2.93 (16)	3.15 (12)	3.14 (16)	3.14 (16)	3.62 (12)	3.61 (16)	3.59 (20)
		130	A193	2.90 (10)	2.90 (12)	2.89 (16)	3.15 (12)	3.15 (12)	3.14 (16)	3.58 (12)	3.57 (16)	3.57 (16)
		140	A193	2.83 (8)	2.83 (10)	2.83 (12)	3.09 (10)	3.09 (12)	3.08 (16)	3.50 (12)	3.48 (16)	3.48 (16)
		150	A252	2.76 (8)	2.76 (8)	2.76 (10)	3.02 (8)	3.01 (10)	3.01 (12)	3.42 (10)	3.41 (12)	3.41 (16)
		160	A252	2.70 (8)	2.70 (8)	2.70 (10)	2.95 (8)	2.94 (8)	2.94 (10)	3.41 (8)	3.41 (12)	3.39 (16)
		170	A252	2.64 (8)	2.64 (8)	2.64 (8)	2.88 (8)	2.88 (8)	2.88 (10)	3.37 (8)	3.36 (10)	3.35 (16)
		180	A393	2.58 (8)	2.58 (8)	2.58 (8)	2.82 (8)	2.82 (8)	2.82 (8)	3.29 (8)	3.29 (8)	3.29 (10)
		190	A393	2.53 (8)	2.53 (8)	2.53 (8)	2.76 (8)	2.76 (8)	2.76 (8)	3.23 (8)	3.23 (8)	3.23 (10)
		200	A393	2.48 (8)	2.48 (8)	2.48 (8)	2.71 (8)	2.71 (8)	2.71 (8)	3.17 (8)	3.17 (8)	3.17 (8)

Spans are based on beam centres, with a 152mm flange width and a minimum end bearing of 50mm.

\* In accordance with BS EN 1994-1-1 Clause 9.8.1 (2) - Where the continuous slabs are designed as simply-supported in accordance with 9.4.2 (5), the minimum cross-sectional area of anti-crack mesh reinforcement above the ribs should not be less than 0.2% of the cross-sectional area of concrete above the ribs for unpropped construction.

Figures in brackets represent the diameter of bar required – one bar in each deck trough positioned 25mm above the trough.



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## ComFlor® 51+ Mesh and Deck Fire Method / Propped

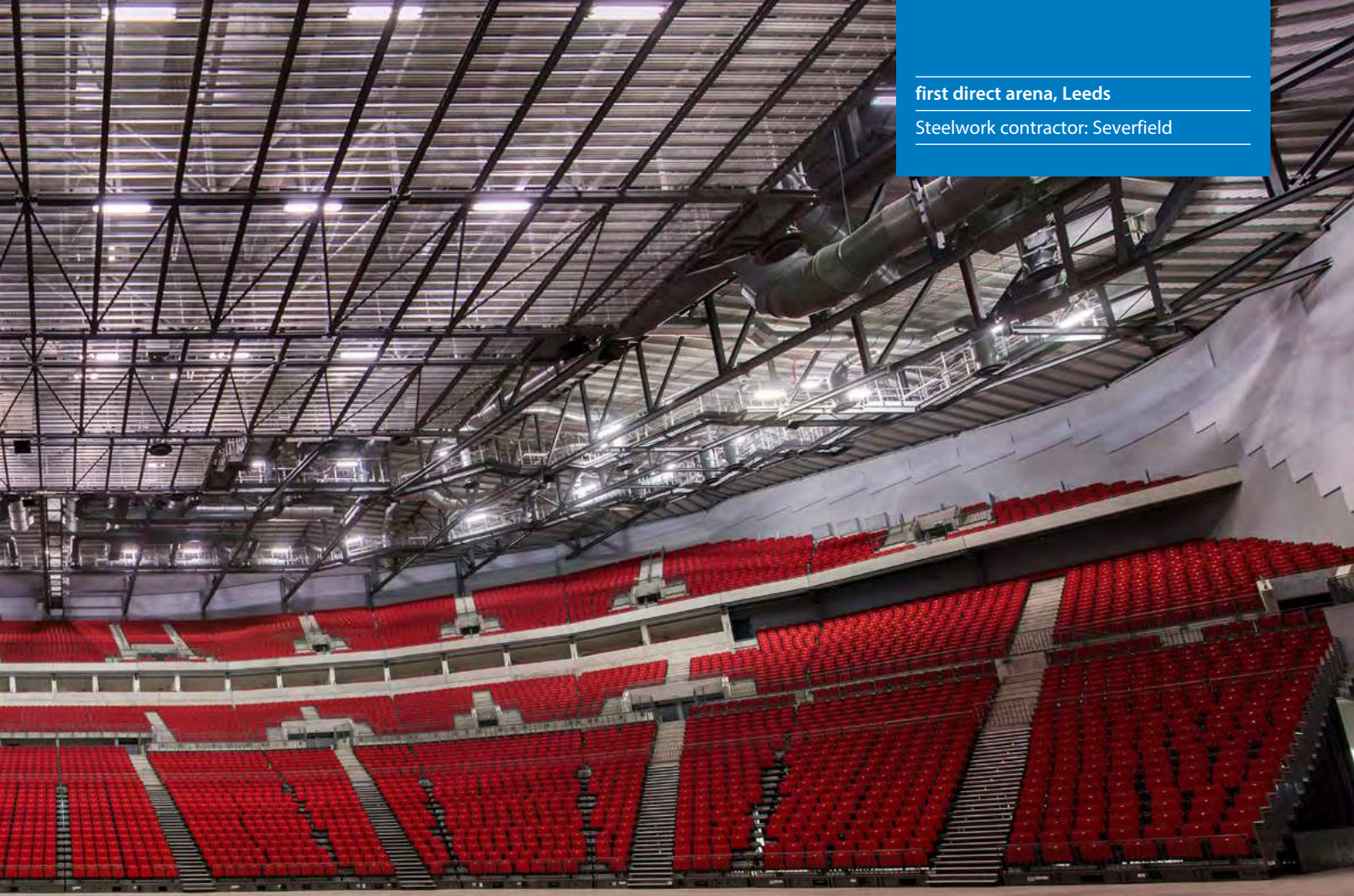
Single Span propped deck, continuous slab (m) - Normal weight concrete - Eurocode - Beam width 152mm  
 (Refer to Technical Department for Double Span propped deck tables.)  
 (Note: Single span deck single span slab is only permitted using Bar Fire Method.)



Props	Fire period	Slab depth (mm)	Mesh 0.4% min.reqd**	Total applied load (kN/m²)								
				5.00	7.50	10.00	5.00	7.50	10.00	5.00	7.50	10.00
1 line	60 minutes			0.90mm			1.00mm			1.20mm		
		101	A252	3.94 (A393)	3.50 (A393)	2.99 (A393)	3.98 (A393)	3.56 (A393)	3.05 (A393)	4.07 (A393)	3.70 (A393)	3.16 (A393)
		110	A252	4.18 (2xA193)	3.88 (2xA252)	3.37 (2xA252)	4.22 (A393)	3.92 (2xA252)	3.42 (2xA252)	4.32 (A393)	4.00 (2xA252)	3.53 (2xA252)
		120	A393	4.43 (2xA252)	4.12 (2xA393)	3.88 (2xA393)	4.48 (2xA252)	4.16 (2xA393)	3.93 (2xA393)	4.58 (2xA193)	4.00 (2xA252)	4.01 (2xA393)
		130	A393	4.68 (2xA252)	4.36 (2xA393)	4.01 (2xA393)	4.73 (2xA252)	4.41 (2xA393)	4.06 (2xA393)	4.84 (2xA252)	4.51 (2xA393)	4.16 (2xA393)
		140	A393	4.93 (2xA252)	4.60 (2xA393)	4.09 (2xA393)	4.98 (2xA252)	4.65 (2xA393)	4.16 (2xA393)	5.09 (2xA252)	4.75 (2xA393)	4.26 (2xA393)
		150	2xA252	5.16 (2xA252)	4.81 (2xA393)	4.19 (2xA393)	5.22 (2xA252)	4.87 (2xA393)	4.25 (2xA393)	5.32 (2xA393)	4.99 (2xA393)	4.36 (2xA393)
		160	2xA252	5.35 (2xA252)	5.03 (2xA393)	4.55 (2xA393)	5.45 (2xA252)	5.11 (2xA393)	4.57 (2xA393)	5.56 (2xA393)	5.23 (2xA393)	4.60 (2xA393)
		170	2xA252	5.23 (2xA252)	5.17 (2xA393)	4.90 (2xA393)	5.61 (2xA393)	5.26 (2xA393)	4.96 (2xA393)	5.80 (2xA393)	5.45 (2xA393)	4.99 (2xA393)
		180	2xA393	5.11 (2xA393)	5.11 (2xA393)	4.99 (2xA393)	5.58 (2xA393)	5.40 (2xA393)	5.05 (2xA393)	5.95 (2xA393)	5.60 (2xA393)	5.17 (2xA393)
190	2xA393	5.01 (2xA393)	5.01 (2xA393)	5.01 (2xA393)	5.47 (2xA393)	5.47 (2xA393)	5.14 (2xA393)	6.09 (2xA393)	5.74 (2xA393)	5.26 (2xA393)		
200	2xA393	4.91 (2xA393)	4.91 (2xA393)	4.91 (2xA393)	5.36 (2xA393)	5.36 (2xA393)	5.22 (2xA393)	6.21 (2xA393)	5.87 (2xA393)	5.35 (2xA393)		
1 line	90 minutes	110	A252	3.67 (2xA252)	3.19 (2xA252)	2.75 (2xA252)	3.73 (2xA252)	3.24 (2xA252)	2.79 (2xA252)	3.83 (2xA252)	3.33 (2xA252)	2.87 (2xA252)
		120	A393	4.42 (2xA393)	3.94 (2xA393)	3.39 (2xA393)	4.47 (2xA393)	3.97 (2xA393)	3.43 (2xA393)	4.56 (2xA393)	4.05 (2xA393)	3.49 (2xA393)
		130	A393	4.67 (2xA393)	4.16 (2xA393)	3.60 (2xA393)	4.72 (2xA393)	4.20 (2xA393)	3.63 (2xA393)	4.82 (2xA393)	4.27 (2xA393)	3.70 (2xA393)
		140	A393	4.79 (2xA393)	4.22 (2xA393)	3.67 (2xA393)	4.83 (2xA393)	4.27 (2xA393)	3.70 (2xA393)	4.93 (2xA393)	4.35 (2xA393)	3.77 (2xA393)
		150	2xA252	4.84 (2xA393)	4.28 (2xA393)	3.73 (2xA393)	4.88 (2xA393)	4.33 (2xA393)	3.77 (2xA393)	4.98 (2xA393)	4.41 (2xA393)	3.84 (2xA393)
		160	2xA252	4.86 (2xA393)	4.32 (2xA393)	3.78 (2xA393)	4.92 (2xA393)	4.37 (2xA393)	3.82 (2xA393)	5.02 (2xA393)	4.46 (2xA393)	3.89 (2xA393)
		170	2xA252	4.91 (2xA393)	4.38 (2xA393)	3.83 (2xA393)	4.96 (2xA393)	4.42 (2xA393)	3.88 (2xA393)	5.07 (2xA393)	4.52 (2xA393)	3.96 (2xA393)
		180	2xA393	5.11 (2xA393)	4.62 (2xA393)	4.06 (2xA393)	5.17 (2xA393)	4.63 (2xA393)	4.07 (2xA393)	5.21 (2xA393)	4.66 (2xA393)	4.09 (2xA393)
190	2xA393	5.01 (2xA393)	5.01 (2xA393)	4.43 (2xA393)	5.47 (2xA393)	5.03 (2xA393)	4.43 (2xA393)	5.61 (2xA393)	5.04 (2xA393)	4.44 (2xA393)		
200	2xA393	4.91 (2xA393)	4.91 (2xA393)	4.76 (2xA393)	5.36 (2xA393)	5.36 (2xA393)	4.80 (2xA393)	6.08 (2xA393)	5.48 (2xA393)	4.85 (2xA393)		
1 line	120 minutes	125	A393	4.25 (2xA393)	3.72 (2xA393)	3.22 (2xA393)	4.29 (2xA393)	3.76 (2xA393)	3.25 (2xA393)	4.37 (2xA393)	3.82 (2xA393)	3.30 (2xA393)
		130	A393	4.40 (2xA393)	3.86 (2xA393)	3.34 (2xA393)	4.44 (2xA393)	3.90 (2xA393)	3.37 (2xA393)	4.51 (2xA393)	3.96 (2xA393)	3.43 (2xA393)
		140	A393	4.60 (2xA393)	4.06 (2xA393)	3.52 (2xA393)	4.64 (2xA393)	4.09 (2xA393)	3.55 (2xA393)	4.72 (2xA393)	4.16 (2xA393)	3.61 (2xA393)
		150	2xA252	4.64 (2xA393)	4.11 (2xA393)	3.58 (2xA393)	4.68 (2xA393)	4.15 (2xA393)	3.61 (2xA393)	4.76 (2xA393)	4.21 (2xA393)	3.67 (2xA393)
		160	2xA252	4.68 (2xA393)	4.16 (2xA393)	3.64 (2xA393)	4.73 (2xA393)	4.20 (2xA393)	3.67 (2xA393)	4.81 (2xA393)	4.27 (2xA393)	3.73 (2xA393)
		170	2xA252	4.70 (2xA393)	4.19 (2xA393)	3.67 (2xA393)	4.74 (2xA393)	4.23 (2xA393)	3.70 (2xA393)	4.83 (2xA393)	4.30 (2xA393)	3.77 (2xA393)
		180	2xA393	4.72 (2xA393)	4.22 (2xA393)	3.71 (2xA393)	4.77 (2xA393)	4.26 (2xA393)	3.75 (2xA393)	4.86 (2xA393)	4.34 (2xA393)	3.82 (2xA393)
		190	2xA393	4.84 (2xA393)	4.34 (2xA393)	3.83 (2xA393)	4.86 (2xA393)	4.36 (2xA393)	3.84 (2xA393)	4.90 (2xA393)	4.39 (2xA393)	3.87 (2xA393)
200	2xA393	4.91 (2xA393)	4.68 (2xA393)	4.14 (2xA393)	5.21 (2xA393)	4.69 (2xA393)	4.14 (2xA393)	5.22 (2xA393)	4.70 (2xA393)	4.15 (2xA393)		

Spans are based on beam centres, with a 152mm flange width and a minimum end bearing of 50mm.

\*\* In accordance with BS EN 1994-1-1 Clause 9.8.1 (2) - Where the continuous slabs are designed as simply-supported in accordance with 9.4.2 (5), the minimum cross-sectional area of anti-crack mesh reinforcement above the ribs should not be less than 0.4% of the cross-sectional area of concrete above the ribs for propped construction. In order to maximise the FIRE LIMIT STATE spans, increased mesh sizing is required as specified in the above Mesh and Deck Fire Method tables.



## ComFlor® 51+ / Bar Fire Method / Propped

Single Span Propped deck, continuous slab (m) - Normal weight concrete - Eurocode - Beam width 152mm  
 (Refer to Technical Department for Double Span propped deck tables.)  
 (Note: Single span deck single span slab is only permitted using Bar Fire Method.)



Props	Fire period	Slab depth (mm)	Mesh 0.4% min.req.**	Total applied load (kN/m²)										
				5.00	7.50	10.00	5.00	7.50	10.00	5.00	7.50	10.00		
1 line	60 minutes	101	A252	4.03 (25)	3.75 (25)	3.56 (32)	4.05 (32)	3.79 (32)	3.58 (32)	4.10 (32)	3.84 (32)	3.63 (32)		
		110	A252	4.34 (32)	4.06 (32)	3.84 (32)	4.35 (32)	4.07 (32)	3.86 (32)	4.40 (32)	4.12 (32)	3.90 (32)		
		120	A393	4.66 (32)	4.37 (32)	4.15 (32)	4.68 (32)	4.39 (32)	4.17 (32)	4.72 (32)	4.44 (32)	4.21 (32)		
		130	A393	4.98 (32)	4.68 (32)	4.45 (32)	5.00 (32)	4.70 (32)	4.47 (32)	5.04 (32)	4.75 (32)	4.51 (32)		
		140	A393	5.29 (32)	4.99 (32)	4.74 (32)	5.31 (32)	5.01 (32)	4.76 (32)	5.36 (32)	5.05 (32)	4.80 (32)		
		150	2xA252	5.41 (20)	5.28 (32)	5.03 (32)	5.61 (32)	5.30 (32)	5.05 (32)	5.66 (32)	5.34 (32)	5.09 (32)		
		160	2xA252	5.34 (8)	5.29 (20)	5.20 (25)	5.74 (25)	5.59 (32)	5.33 (32)	5.96 (32)	5.63 (32)	5.37 (32)		
		170	2xA252	5.22 (8)	5.22 (10)	5.20 (16)	5.71 (8)	5.65 (20)	5.56 (32)	6.25 (32)	5.92 (32)	5.54 (25)		
		180	2xA393	5.10 (8)	5.10 (8)	5.09 (12)	5.57 (8)	5.57 (10)	5.54 (16)	6.37 (25)	6.20 (32)	5.80 (25)		
		190	2xA393	5.00 (8)	5.00 (8)	4.99 (12)	5.46 (8)	5.46 (8)	5.45 (12)	6.34 (12)	6.24 (20)	6.07 (25)		
		200	2xA393	4.90 (8)	4.90 (8)	4.90 (8)	5.35 (8)	5.35 (8)	5.34 (12)	6.20 (8)	6.16 (16)	6.13 (20)		
1 line	90 minutes	110	A252	4.34 (32)	4.06 (32)	3.84 (32)	4.35 (32)	4.07 (32)	3.86 (32)	4.40 (32)	4.12 (32)	3.90 (32)		
		120	A393	4.66 (32)	4.37 (32)	4.15 (32)	4.68 (32)	4.39 (32)	4.17 (32)	4.72 (32)	4.44 (32)	4.21 (32)		
		130	A393	4.98 (32)	4.68 (32)	4.45 (32)	5.00 (32)	4.70 (32)	4.47 (32)	5.04 (32)	4.75 (32)	4.51 (32)		
		140	A393	5.29 (32)	4.99 (32)	4.74 (32)	5.31 (32)	5.01 (32)	4.76 (32)	5.36 (32)	5.05 (32)	4.80 (32)		
		150	2xA252	5.41 (20)	5.28 (32)	5.03 (32)	5.61 (32)	5.30 (32)	5.05 (32)	5.66 (32)	5.34 (32)	5.09 (32)		
		160	2xA252	5.33 (12)	5.29 (20)	5.20 (25)	5.74 (25)	5.59 (32)	5.33 (32)	5.96 (32)	5.63 (32)	5.37 (32)		
		170	2xA252	5.21 (12)	5.20 (16)	5.18 (20)	5.68 (16)	5.65 (20)	5.56 (32)	6.25 (32)	5.92 (32)	5.65 (32)		
		180	2xA393	5.09 (10)	5.09 (12)	5.07 (16)	5.56 (12)	5.54 (16)	5.54 (16)	6.36 (25)	6.20 (32)	5.92 (32)		
		190	2xA393	5.00 (8)	5.00 (10)	4.97 (16)	5.45 (10)	5.43 (16)	5.43 (16)	6.30 (16)	6.24 (20)	6.12 (32)		
				200	2xA393	4.90 (8)	4.90 (10)	4.89 (12)	5.35 (10)	5.33 (16)	5.33 (16)	6.16 (16)	6.16 (16)	6.13 (20)
1 line	120 minutes	125	A393	4.82 (32)	4.48 (25)	4.30 (32)	4.84 (32)	4.55 (32)	4.32 (32)	4.89 (32)	4.59 (32)	4.36 (32)		
		130	A393	4.98 (32)	4.68 (32)	4.45 (32)	5.00 (32)	4.70 (32)	4.47 (32)	5.04 (32)	4.75 (32)	4.51 (32)		
		140	A393	5.29 (32)	4.99 (32)	4.74 (32)	5.31 (32)	5.01 (32)	4.76 (32)	5.36 (32)	5.05 (32)	4.80 (32)		
		150	2xA252	5.41 (20)	5.28 (32)	5.03 (32)	5.61 (32)	5.30 (32)	5.05 (32)	5.66 (32)	5.34 (32)	5.01 (32)		
		160	2xA252	5.29 (20)	5.26 (25)	5.20 (25)	5.74 (25)	5.59 (32)	5.33 (32)	5.96 (32)	5.63 (32)	5.37 (32)		
		170	2xA252	5.18 (20)	5.18 (20)	5.15 (25)	5.65 (20)	5.62 (25)	5.56 (32)	6.25 (32)	5.92 (32)	5.65 (32)		
		180	2xA393	5.08 (16)	5.06 (20)	5.03 (25)	5.52 (20)	5.52 (20)	5.49 (25)	6.37 (25)	6.20 (32)	5.92 (32)		
		190	2xA393	4.98 (16)	4.96 (20)	4.96 (20)	5.41 (20)	5.41 (20)	5.39 (25)	6.22 (25)	6.21 (25)	6.12 (32)		
				200	2xA393	4.89 (12)	4.87 (16)	4.86 (20)	5.33 (16)	5.31 (20)	5.28 (25)	6.13 (20)	6.08 (25)	6.08 (25)

Spans are based on beam centres, with a 152mm flange width and a minimum end bearing of 50mm.

\*\* In accordance with BS EN 1994-1-1 Clause 9.8.1 (2) - Where the continuous slabs are designed as simply-supported in accordance with 9.4.2 (5), the minimum cross-sectional area of anti-crack mesh reinforcement above the ribs should not be less than 0.4% of the cross-sectional area of concrete above the ribs for propped construction.

Figures in brackets represent the diameter of bar required – one bar in each deck trough positioned 25mm above the trough.

# ComFlor® 60

The most successful new generation combined trapezoidal and re-entrant 60mm profile

**ComFlor® 60 was the first of the new generation round shouldered 60mm profiles and is still the one to beat.** This design is exceptionally resistant to compressive buckling, resulting in superior span capability compared to traditional decks. The combined trapezoidal and re-entrant profile provides the benefits of easy service hanging, good shear interaction and long spans together with low concrete and steel usage. Shear studs are placed centrally in the troughs to ensure beneficial placement and the profile is 600mm cover as recommended by Health and Safety guidelines. ComFlor® 60 can be supplied with pre-closed ends.

#### Long span and versatile

The combined trapezoidal and re-entrant profile provides the benefits of easy service hanging, good shear interaction and long spans.

#### Colorcoat FD®

ComFlor® 60 is available with Colorcoat FD® pre-finished soffit, to give a bright attractive finish where a ceiling is not used.

#### Low concrete and steel usage

A low volume of concrete is needed reducing weight and steel requirement.

#### Central stud placement

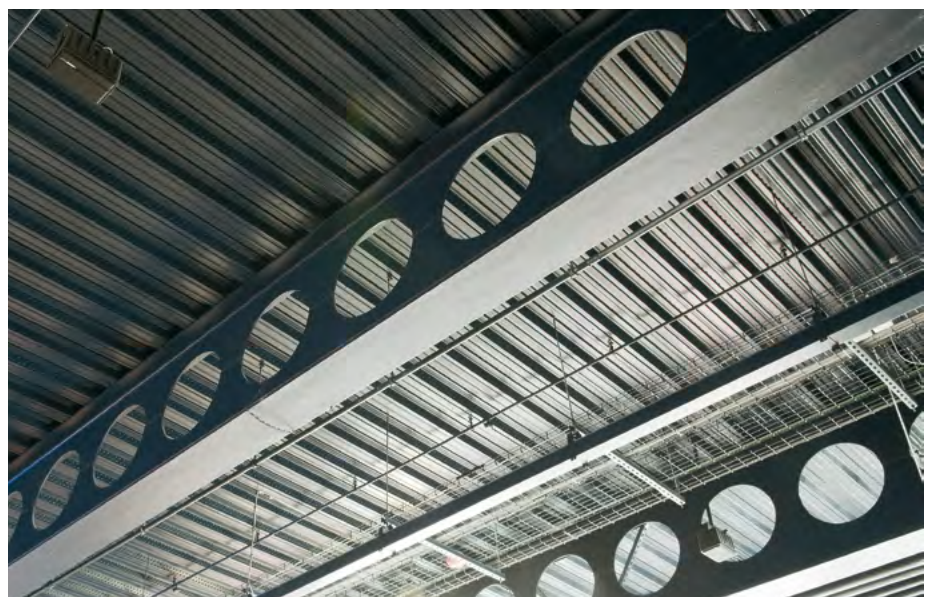
Shear studs are placed centrally in the troughs to ensure beneficial placement.

#### Closed ends

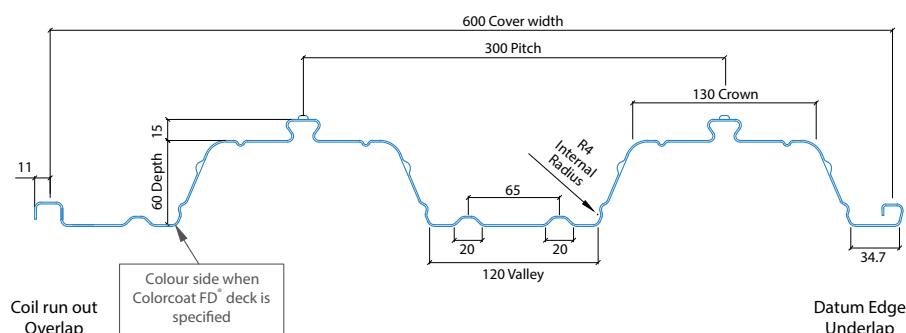
Applied in the factory to close off the profile, particularly suitable for pre-studded beams.

#### Better for Health and Safety

The profile is 600mm cover as recommended by Health and Safety guidelines to allow a lighter weight sheet which reduces strain on installation operatives.



# Design information



## ComFlor® 60 Composite slab - volume and weight (EC values)

Slab depth (mm)	Concrete volume (m <sup>3</sup> /m <sup>2</sup> )	Weight of concrete (kN/m <sup>2</sup> )			
		Normal weight concrete		Lightweight concrete	
		Wet	Dry	Wet	Dry
110	0.078	–	–	1.57	1.49
120	0.088	2.21	2.12	1.77	1.68
130	0.098	2.46	2.36	1.97	1.87
140	0.108	2.71	2.60	2.17	2.06
150	0.118	2.96	2.84	2.37	2.25
160	0.128	3.21	3.08	2.57	2.44
170	0.138	3.46	3.32	2.77	2.63
180	0.148	3.71	3.56	2.97	2.82
190	0.158	3.96	3.80	3.17	3.01
200	0.168	4.21	4.04	3.37	3.20
210	0.178	4.46	4.28	3.57	3.39
220	0.188	4.71	4.52	3.77	3.58
250	0.218	5.46	5.24	4.37	4.15

### Notes

- Deck and beam deflection (ie, ponding) is not included in the table.
- Deck and mesh weight is not included in the weight of concrete figures.
- Eurocode density of concrete is taken as:

Normal weight (wet)	25kN/m <sup>3</sup>
Normal weight (dry)	24kN/m <sup>3</sup>
Lightweight (wet)	20kN/m <sup>3</sup>
Lightweight (dry)	19kN/m <sup>3</sup>

## ComFlor® 60 (S350) Section properties (per metre width)

Nominal thickness (mm)	Design thickness (mm)	Cross section area (mm <sup>2</sup> /m)	Profile weight (kN/m <sup>2</sup> )	Height to neutral axis (mm)	Moment of inertia (cm <sup>4</sup> /m)		Ultimate moment capacity (kNm/m)	
					Sagging	Hogging	Sagging	Hogging
0.90	0.86	1276	0.10	33.70	92.77	86.13	9.30	7.50
1.00	0.96	1424	0.11	33.75	106.15	97.95	11.27	9.36
1.20	1.16	1721	0.14	33.85	132.91	121.60	15.21	13.07

Section properties in the above table conform to BS 5950 and Eurocode

### Design Notes:

#### Deck material

Tata Steel Galvalite®, hot dip zinc coated steel to BS EN 10346 S350GD+Z275, with guaranteed minimum proof strength of 350N/mm<sup>2</sup> and zinc coating of total mass 275g/m<sup>2</sup> (including both sides). This is sufficient for internal floors in a non-aggressive environment, which satisfies the requirement in Clause 4.2 BS EN 1994-1-1 - the exposed surfaces of the steel decking shall be adequately protected to resist the particular atmospheric conditions. A zinc coating, if specified, should conform to the requirements of BS EN 10346. The specification may be varied, depending on service conditions.

#### Anti-crack mesh

As a minimum requirement where the control of crack width is of no interest, BS EN 1994-1-1, 9.8.1(2) recommends that, where continuous slabs are designed as simply-supported in accordance with BS EN 1994-1-1, 9.4.2(5), the cross-sectional area of

the anti-crack reinforcement above the ribs should be not less than 0.2% of the cross-sectional area of the concrete above the ribs for unpropped construction, and 0.4% of this cross-sectional area for propped construction. The mesh specified in the quick reference Eurocode tables, complies with this clause.

Where forklift truck (or other similar concentrated loading) is expected, 0.5% minimum percentage reinforcement should be used over the supports and the previous stated percentages elsewhere to control cracking. For further information refer to SCI AD 150.

In accordance with Steel Construction Institute (SCI) P300 'Composite Slabs and Beams Using Steel Decking: Best Practice for Design and Construction, a nominal cover of 25mm is stated for an exposure level XC1, for all concrete cylinder strengths for both normal (C25/30 to C40/50) and lightweight concrete (LC25/28 to LC32/35). This nominal cover of 25mm is the minimum cover of 15mm plus a fixing tolerance of 10mm.

#### Supporting beam width

For all ComFlor® 60 load/span tables, the width of the support beam used is assumed to be 152mm.

#### Fire design

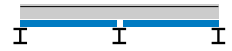
The capacity of a composite slab with nominal anti-crack mesh in fire is calculated in accordance with Steel Construction Institute NCCI PN005 'Fire resistance design of composite slab'. Two fire-design methods can be used in the ComFlor® 9 software, namely 'Mesh and Deck Fire Method' or 'Bar Fire Method'. For further details of the performance of composite slabs with nominal anti-crack mesh in fire, please contact the technical team.

#### Technical services

The Technical Department at Tata Steel offers a comprehensive advisory service on the design of composite flooring, which is available to all specifiers and users. Should queries arise which are not covered by this literature or by the ComFlor® 9 software, please contact us.

## ComFlor® 60 / Mesh and Deck Fire Method/ Unpropped

Single span deck continuous slab (m) - Normal weight concrete - Eurocode - Beam width 152mm  
 (Note: Single span deck single span slab is only permitted using Bar Fire Method.)



Props	Fire period	Slab depth (mm)	Mesh 0.2% min.reqd*	Total applied load (kN/m <sup>2</sup> )								
				0.90mm			1.00mm			1.20mm		
				5.00	7.50	10.00	5.00	7.50	10.00	5.00	7.50	10.00
None	60 minutes	120***	A142	3.50 (A142)	3.09 (A193)	2.51 (A193)	3.68 (A193)	3.09 (A193)	2.55 (A193)	3.94 (A193)	3.18 (A193)	2.64 (A193)
		130	A142	3.41 (A142)	3.40 (A252)	3.39 (A393)	3.59 (A142)	3.58 (A252)	3.56 (A393)	3.84 (A142)	3.82 (A393)	3.81 (2xA252)
		140	A193	3.32 (A193)	3.32 (A193)	3.30 (A393)	3.50 (A193)	3.50 (A193)	3.48 (A393)	3.74 (A193)	3.74 (A252)	3.73 (A393)
		150	A193	3.24 (A193)	3.24 (A193)	3.23 (A252)	3.42 (A193)	3.42 (A193)	3.40 (A393)	3.66 (A193)	3.66 (A193)	3.65 (A393)
		160	A252	3.16 (A252)	3.16 (A252)	3.16 (A252)	3.34 (A252)	3.34 (A252)	3.34 (A252)	3.58 (A252)	3.58 (A252)	3.57 (A252)
		170	A252	3.09 (A252)	3.09 (A252)	3.09 (A252)	3.27 (A252)	3.27 (A252)	3.27 (A252)	3.51 (A252)	3.51 (A252)	3.51 (A252)
		180	A252	3.03 (A252)	3.03 (A252)	3.03 (A252)	3.21 (A252)	3.21 (A252)	3.21 (A252)	3.44 (A252)	3.44 (A252)	3.44 (A252)
		190	A393	2.96 (A393)	2.96 (A393)	2.96 (A393)	3.15 (A393)	3.15 (A393)	3.15 (A393)	3.37 (A393)	3.37 (A393)	3.37 (A393)
		200	A393	2.90 (A393)	2.90 (A393)	2.90 (A393)	3.10 (A393)	3.10 (A393)	3.10 (A393)	3.32 (A393)	3.32 (A393)	3.32 (A393)
None	90 minutes	130	A142	3.40 (A252)	3.39 (A393)	3.38 (2xA252)	3.58 (A252)	3.57 (A393)	3.32 (2xA252)	3.83 (A252)	3.82 (A393)	3.19 (2xA252)
		140	A193	3.32 (A193)	3.30 (A393)	3.30 (2xA252)	3.50 (A193)	3.48 (A393)	3.48 (2xA252)	3.74 (A252)	3.73 (A393)	3.72 (2xA252)
		150	A193	3.24 (A193)	3.23 (A252)	3.23 (A393)	3.42 (A193)	3.40 (A393)	3.40 (2xA252)	3.66 (A193)	3.65 (A393)	3.64 (2xA252)
		160	A252	3.16 (A252)	3.16 (A252)	3.15 (A393)	3.34 (A252)	3.34 (A252)	3.33 (A393)	3.58 (A252)	3.57 (A393)	3.56 (2xA252)
		170	A252	3.09 (A252)	3.09 (A252)	3.09 (A252)	3.27 (A252)	3.27 (A252)	3.27 (A252)	3.51 (A252)	3.51 (A252)	3.50 (A393)
		180	A252	3.03 (A252)	3.03 (A252)	3.03 (A252)	3.21 (A252)	3.21 (A252)	3.21 (A252)	3.44 (A252)	3.44 (A252)	3.44 (A252)
		190	A393	2.96 (A393)	2.96 (A393)	2.96 (A393)	3.15 (A393)	3.15 (A393)	3.15 (A393)	3.37 (A393)	3.37 (A393)	3.37 (A393)
		200	A393	2.90 (A393)	2.90 (A393)	2.90 (A393)	3.10 (A393)	3.10 (A393)	3.10 (A393)	3.32 (A393)	3.32 (A393)	3.32 (A393)
None	120 minutes	140	A193	3.31 (A252)	3.30 (A393)	3.28 (2xA393)	3.49 (A252)	3.48 (A393)	3.46 (2xA393)	3.73 (A393)	3.72 (2xA252)	3.70 (2xA393)
		150	A193	3.24 (A193)	3.23 (A393)	3.22 (2xA252)	3.41 (A252)	3.40 (A393)	3.40 (2xA252)	3.65 (A252)	3.65 (A393)	3.62 (2xA393)
		160	A252	3.16 (A252)	3.16 (A252)	3.15 (A393)	3.34 (A252)	3.34 (A252)	3.33 (2xA252)	3.58 (A252)	3.57 (A393)	3.56 (2xA252)
		170	A252	3.09 (A252)	3.09 (A252)	3.09 (A252)	3.27 (A252)	3.27 (A252)	3.27 (A393)	3.51 (A252)	3.51 (A252)	3.50 (A393)
		180	A252	3.03 (A252)	3.03 (A252)	3.03 (A252)	3.21 (A252)	3.21 (A252)	3.21 (A252)	3.44 (A252)	3.44 (A252)	3.43 (A393)
		190	A393	2.96 (A393)	2.96 (A393)	2.96 (A393)	3.15 (A393)	3.15 (A393)	3.15 (A393)	3.37 (A393)	3.37 (A393)	3.37 (A393)
		200	A393	2.90 (A393)	2.90 (A393)	2.90 (A393)	3.10 (A393)	3.10 (A393)	3.10 (A393)	3.32 (A393)	3.32 (A393)	3.32 (A393)

Double span (m) - Normal weight concrete - Eurocode - Beam width 152mm



Props	Fire period	Slab depth (mm)	Mesh 0.2% min.reqd*	Total applied load (kN/m <sup>2</sup> )								
				0.90mm			1.00mm			1.20mm		
				5.00	7.50	10.00	5.00	7.50	10.00	5.00	7.50	10.00
None	60 minutes	120***	A142	3.47 (A193)	2.92 (A193)	2.46 (A193)	3.52 (A193)	2.96 (A193)	2.50 (A193)	3.62 (A193)	3.06 (A193)	2.59 (A193)
		130	A142	3.64 (A193)	3.62 (A393)	3.51 (2xA252)	3.93 (A252)	3.90 (A393)	3.51 (2xA252)	4.65 (A393)	4.38 (2xA252)	3.53 (2xA252)
		140	A193	3.50 (A193)	3.49 (A252)	3.47 (2xA252)	3.80 (A193)	3.78 (A393)	3.75 (2xA393)	4.50 (A393)	4.49 (2xA252)	4.24 (2xA393)
		150	A193	3.37 (A193)	3.37 (A193)	3.35 (A393)	3.75 (A193)	3.74 (A252)	3.73 (2xA252)	4.38 (A252)	4.37 (A393)	4.33 (2xA393)
		160	A252	3.24 (A252)	3.24 (A252)	3.24 (A252)	3.69 (A252)	3.69 (A252)	3.68 (A393)	4.26 (A252)	4.25 (A393)	4.21 (2xA393)
		170	A252	3.13 (A252)	3.13 (A252)	3.13 (A252)	3.57 (A252)	3.57 (A252)	3.56 (A393)	4.14 (A252)	4.14 (A252)	4.12 (2xA252)
		180	A252	3.03 (A252)	3.03 (A252)	3.03 (A252)	3.45 (A252)	3.45 (A252)	3.45 (A252)	4.03 (A252)	4.03 (A252)	4.02 (A393)
		190	A393	2.93 (A393)	2.93 (A393)	2.93 (A393)	3.34 (A393)	3.34 (A393)	3.34 (A393)	3.92 (A393)	3.92 (A393)	3.92 (A393)
		200	A393	2.85 (A393)	2.85 (A393)	2.85 (A393)	3.25 (A393)	3.25 (A393)	3.25 (A393)	3.89 (A393)	3.89 (A393)	3.89 (A393)
None	90 minutes	130	A142	3.62 (A393)	3.61 (2xA252)	2.97 (2xA252)	3.92 (A393)	3.65 (2xA252)	2.99 (2xA252)	4.64 (2xA252)	3.64 (2xA252)	3.01 (2xA252)
		140	A193	3.49 (A252)	3.37 (A393)	3.44 (2xA393)	3.78 (A393)	3.77 (2xA252)	3.75 (2xA393)	4.49 (2xA252)	4.47 (2xA393)	4.16 (2xA393)
		150	A193	3.37 (A193)	3.36 (A252)	3.33 (2xA252)	3.74 (A252)	3.73 (2xA252)	3.71 (2xA393)	4.37 (A393)	4.33 (2xA393)	4.33 (2xA393)
		160	A252	3.24 (A252)	3.24 (A252)	3.23 (A393)	3.69 (A252)	3.68 (A393)	3.64 (2xA393)	4.25 (A393)	4.24 (2xA252)	4.21 (2xA393)
		170	A252	3.13 (A252)	3.13 (A252)	3.12 (A393)	3.57 (A252)	3.57 (A252)	3.56 (A393)	4.14 (A252)	4.13 (A393)	4.10 (2xA393)
		180	A252	3.03 (A252)	3.03 (A252)	3.03 (A252)	3.45 (A252)	3.45 (A252)	3.44 (A393)	4.03 (A252)	4.02 (A393)	4.01 (2xA252)
		190	A393	2.93 (A393)	2.93 (A393)	2.93 (A393)	3.34 (A393)	3.34 (A393)	3.34 (A393)	3.92 (A393)	3.92 (A393)	3.92 (A393)
		200	A393	2.85 (A393)	2.85 (A393)	2.85 (A393)	3.25 (A393)	3.25 (A393)	3.25 (A393)	3.89 (A393)	3.89 (A393)	3.89 (A393)
None	120 minutes	140	A193	3.48 (A393)	3.47 (2xA252)	3.44 (2xA393)	3.78 (A393)	3.75 (2xA393)	3.52 (2xA393)	4.49 (2xA252)	4.47 (2xA393)	3.48 (2xA393)
		150	A193	3.37 (A193)	3.27 (A393)	3.31 (2xA393)	3.73 (A393)	3.73 (2xA252)	3.71 (2xA393)	4.36 (2xA252)	4.33 (2xA393)	3.95 (2xA393)
		160	A252	3.24 (A252)	3.24 (A252)	3.22 (2xA252)	3.69 (A252)	3.67 (2xA252)	3.64 (2xA393)	4.23 (A393)	4.21 (2xA393)	4.21 (2xA393)
		170	A252	3.13 (A252)	3.13 (A252)	3.12 (A393)	3.57 (A252)	3.53 (A393)	3.52 (2xA393)	4.13 (A393)	4.12 (2xA252)	4.10 (2xA393)
		180	A252	3.03 (A252)	3.03 (A252)	3.03 (A393)	3.45 (A252)	3.45 (A252)	3.44 (A393)	4.03 (A252)	4.02 (A393)	3.99 (2xA393)
		190	A393	2.93 (A393)	2.93 (A393)	2.93 (A393)	3.34 (A393)	3.34 (A393)	3.34 (A393)	3.92 (A393)	3.92 (A393)	3.91 (2xA252)
		200	A393	2.85 (A393)	2.85 (A393)	2.85 (A393)	3.25 (A393)	3.25 (A393)	3.25 (A393)	3.89 (A393)	3.89 (A393)	3.85 (A393)

Spans are based on beam centres, with a 152mm flange width and a minimum end bearing of 50mm.

\* In accordance with BS EN 1994-1-1 Clause 9.8.1 (2) - Where the continuous slabs are designed as simply-supported in accordance with 9.4.2 (5), the minimum cross-sectional area of anti-crack mesh reinforcement above the ribs should not be less than 0.2% of the cross-sectional area of concrete above the ribs for unpropped construction. In order to maximise the FIRE LIMIT STATE spans, increased mesh sizing is required as specified in the above tables.

\*\*\* All mesh covers for all profile types and slab depths are taken as 30mm. However, due to mesh size restriction, the ComFlor® 60 120mm slab depth requires a mesh cover depth of 25mm.

## ComFlor® 60 / Bar Fire Method / Unproped

Single span deck, single span slab (m) - Normal weight concrete - Eurocode - Beam width 152mm



Props	Fire period	Slab depth (mm)	Mesh 0.2% min. reqd.*	Total applied load (kN/m <sup>2</sup> )								
				0.90mm			1.00mm			1.20mm		
				5.00	7.50	10.00	5.00	7.50	10.00	5.00	7.50	10.00
None	60 minutes	120	A142	3.49 (10)	3.49 (12)	3.48 (16)	3.68 (10)	3.67 (12)	3.60 (16)	3.93 (12)	3.93 (12)	3.61 (12)
		130	A142	3.40 (10)	3.40 (10)	3.39 (12)	3.58 (10)	3.57 (12)	3.56 (16)	3.83 (10)	3.82 (10)	3.81 (16)
		140	A193	3.31 (10)	3.31 (10)	3.31 (12)	3.49 (10)	3.49 (10)	3.48 (12)	3.73 (10)	3.73 (12)	3.72 (16)
		150	A193	3.23 (8)	3.23 (10)	3.23 (12)	3.41 (10)	3.41 (10)	3.41 (12)	3.65 (10)	3.65 (12)	3.65 (12)
		160	A252	3.15 (8)	3.15 (10)	3.15 (10)	3.34 (8)	3.33 (10)	3.33 (12)	3.57 (10)	3.57 (10)	3.57 (12)
		170	A252	3.09 (8)	3.08 (10)	3.08 (10)	3.27 (8)	3.27 (10)	3.27 (10)	3.50 (10)	3.50 (10)	3.50 (12)
		180	A252	3.02 (8)	3.02 (8)	3.02 (10)	3.21 (8)	3.21 (10)	3.21 (10)	3.44 (8)	3.44 (10)	3.43 (12)
		190	A393	2.96 (8)	2.96 (8)	2.96 (10)	3.15 (8)	3.14 (10)	3.14 (10)	3.37 (8)	3.37 (10)	3.37 (10)
		200	A393	2.90 (8)	2.90 (8)	2.90 (10)	3.09 (8)	3.09 (8)	3.09 (10)	3.32 (8)	3.31 (10)	3.31 (10)
None	90 minutes	130	A142	3.39 (16)	3.39 (16)	3.37 (20)	3.56 (16)	3.56 (16)	3.55 (16)	3.81 (16)	3.81 (16)	3.80 (20)
		140	A193	3.31 (12)	3.30 (16)	3.30 (16)	3.48 (16)	3.48 (16)	3.46 (16)	3.72 (16)	3.72 (16)	3.71 (20)
		150	A193	3.23 (12)	3.22 (16)	3.22 (16)	3.41 (12)	3.40 (16)	3.40 (16)	3.64 (16)	3.64 (16)	3.63 (20)
		160	A252	3.15 (12)	3.15 (12)	3.14 (16)	3.33 (12)	3.32 (16)	3.32 (16)	3.57 (12)	3.56 (16)	3.56 (16)
		170	A252	3.08 (12)	3.08 (12)	3.08 (16)	3.26 (12)	3.26 (16)	3.26 (16)	3.50 (12)	3.49 (16)	3.49 (16)
		180	A252	3.02 (10)	3.02 (12)	3.01 (16)	3.20 (12)	3.20 (12)	3.20 (16)	3.43 (12)	3.43 (16)	3.43 (16)
		190	A393	2.96 (10)	2.95 (12)	2.95 (16)	3.14 (12)	3.14 (12)	3.14 (16)	3.37 (12)	3.36 (16)	3.36 (16)
		200	A393	2.90 (10)	2.90 (12)	2.90 (12)	3.09 (10)	3.09 (12)	3.08 (16)	3.31 (12)	3.31 (12)	3.31 (16)
None	120 minutes	140	A193	3.27 (25)	3.27 (25)	3.25 (32)	3.45 (25)	3.45 (25)	3.42 (32)	3.69 (25)	3.66 (32)	3.66 (32)
		150	A193	3.21 (20)	3.20 (25)	3.17 (32)	3.37 (25)	3.37 (25)	3.35 (32)	3.61 (25)	3.58 (32)	3.58 (32)
		160	A252	3.13 (20)	3.12 (25)	3.12 (25)	3.31 (20)	3.30 (25)	3.28 (32)	3.54 (25)	3.54 (25)	3.51 (32)
		170	A252	3.07 (20)	3.06 (25)	3.06 (25)	3.25 (20)	3.24 (25)	3.24 (25)	3.47 (25)	3.47 (25)	3.44 (32)
		180	A252	3.00 (20)	3.00 (20)	2.99 (25)	3.19 (20)	3.18 (25)	3.18 (25)	3.42 (20)	3.41 (25)	3.38 (32)
		190	A393	2.94 (20)	2.94 (20)	2.93 (25)	3.13 (20)	3.12 (25)	3.12 (25)	3.35 (20)	3.34 (25)	3.34 (25)
		200	A393	2.89 (20)	2.89 (20)	2.88 (25)	3.08 (20)	3.08 (20)	3.07 (25)	3.30 (20)	3.29 (25)	3.29 (25)

Double span (m) - Normal weight concrete - Eurocode - Beam width 152mm



Props	Fire period	Slab depth (mm)	Mesh 0.2% min. reqd.*	Total applied load (kN/m <sup>2</sup> )								
				0.90mm			1.00mm			1.20mm		
				5.00	7.50	10.00	5.00	7.50	10.00	5.00	7.50	10.00
None	60 minutes	120	A142	3.68 (10)	3.67 (12)	3.64 (16)	4.07 (12)	4.07 (12)	3.70 (16)	4.70 (12)	4.62 (25)	3.70 (16)
		130	A142	3.63 (10)	3.63 (10)	3.62 (12)	3.93 (10)	3.92 (12)	3.91 (16)	4.65 (12)	4.62 (16)	3.99 (16)
		140	A193	3.49 (8)	3.48 (10)	3.48 (12)	3.79 (10)	3.79 (10)	3.78 (12)	4.50 (12)	4.50 (12)	4.25 (16)
		150	A193	3.36 (8)	3.36 (8)	3.35 (10)	3.74 (8)	3.74 (10)	3.74 (12)	4.38 (10)	4.37 (12)	4.36 (16)
		160	A252	3.24 (8)	3.24 (8)	3.23 (10)	3.68 (8)	3.68 (10)	3.67 (12)	4.25 (10)	4.24 (10)	4.23 (12)
		170	A252	3.13 (8)	3.13 (8)	3.13 (8)	3.56 (8)	3.56 (8)	3.56 (10)	4.13 (8)	4.13 (10)	4.12 (12)
		180	A252	3.03 (8)	3.03 (8)	3.03 (8)	3.45 (8)	3.45 (8)	3.45 (10)	4.02 (8)	4.02 (10)	4.02 (12)
		190	A393	2.93 (8)	2.93 (8)	2.93 (8)	3.34 (8)	3.34 (8)	3.34 (8)	3.91 (8)	3.91 (8)	3.91 (10)
		200	A393	2.85 (8)	2.85 (8)	2.85 (8)	3.24 (8)	3.24 (8)	3.24 (8)	3.88 (8)	3.88 (8)	3.88 (10)
None	90 minutes	130	A142	3.61 (16)	3.61 (16)	3.59 (20)	3.91 (16)	3.91 (16)	3.89 (20)	4.64 (16)	4.62 (20)	3.97 (20)
		140	A193	3.48 (12)	3.46 (16)	3.46 (16)	3.77 (16)	3.77 (16)	3.75 (20)	4.49 (16)	4.47 (20)	4.24 (20)
		150	A193	3.35 (10)	3.34 (16)	3.34 (16)	3.74 (12)	3.73 (16)	3.72 (20)	4.36 (16)	4.34 (20)	4.34 (20)
		160	A252	3.24 (8)	3.23 (10)	3.21 (16)	3.68 (10)	3.66 (16)	3.66 (16)	4.23 (16)	4.23 (16)	4.21 (20)
		170	A252	3.13 (8)	3.12 (10)	3.12 (12)	3.56 (10)	3.55 (12)	3.54 (16)	4.12 (12)	4.11 (16)	4.10 (20)
		180	A252	3.03 (8)	3.03 (8)	3.03 (10)	3.45 (8)	3.45 (10)	3.44 (12)	4.01 (10)	4.01 (16)	4.01 (16)
		190	A393	2.93 (8)	2.93 (8)	2.93 (8)	3.34 (8)	3.34 (8)	3.33 (10)	3.91 (8)	3.91 (10)	3.89 (16)
200	A393	2.85 (8)	2.85 (8)	2.85 (8)	3.24 (8)	3.24 (8)	3.24 (10)	3.88 (8)	3.88 (10)	3.88 (12)		
None	120 minutes	140	A193	3.42 (25)	3.42 (25)	3.37 (32)	3.73 (25)	3.69 (32)	3.69 (32)	4.39 (32)	4.39 (32)	3.76 (32)
		150	A193	3.32 (20)	3.29 (25)	3.25 (32)	3.70 (25)	3.67 (32)	3.67 (32)	4.27 (32)	4.27 (32)	3.97 (32)
		160	A252	3.21 (16)	3.20 (20)	3.18 (25)	3.64 (20)	3.62 (25)	3.57 (32)	4.19 (25)	4.15 (32)	4.15 (32)
		170	A252	3.12 (12)	3.11 (16)	3.10 (20)	3.54 (16)	3.52 (20)	3.46 (32)	4.08 (20)	4.04 (32)	4.04 (32)
		180	A252	3.02 (12)	3.01 (16)	3.00 (20)	3.43 (16)	3.42 (20)	3.39 (25)	3.99 (20)	3.97 (25)	3.93 (32)
		190	A393	2.93 (8)	2.93 (10)	2.91 (16)	3.33 (10)	3.32 (16)	3.31 (20)	3.89 (16)	3.88 (20)	3.86 (25)
		200	A393	2.85 (8)	2.85 (8)	2.84 (12)	3.24 (8)	3.23 (12)	3.22 (16)	3.87 (16)	3.87 (20)	3.85 (25)

Spans are based on beam centres, with a 152mm flange width and a minimum end bearing of 50mm.

\* In accordance with BS EN 1994-1-1 Clause 9.8.1 (2) - Where the continuous slabs are designed as simply-supported in accordance with 9.4.2 (5), the minimum cross-sectional area of anti-crack mesh reinforcement above the ribs should not be less than 0.2% of the cross-sectional area of concrete above the ribs for unproped construction.

Figures in brackets represent the diameter of bar required – one bar in each deck trough positioned 25mm above the trough.

## ComFlor® 60 Mesh and Deck Fire Method / Propped

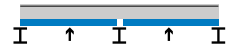
Single Span propped deck, continuous slab (m) - Normal weight concrete - Eurocode - Beam width 152mm  
 (Refer to Technical Department for Double Span propped deck tables.)  
 (Note: Single span deck single span slab is only permitted using Bar Fire Method.)



Props	Fire period	Slab depth (mm)	Mesh 0.4% min. reqd.**	Total applied load (kN/m²)								
				5.00	7.50	10.00	5.00	7.50	10.00	5.00	7.50	10.00
1 line	60 minutes	120***	A252	0.90mm			1.00mm			1.20mm		
		130	A393	3.93 (A393)	3.39 (A393)	3.09 (A393)	3.93 (A393)	3.39 (A393)	3.10 (A393)	3.95 (A393)	3.41 (A393)	3.12 (A393)
		140	A393	4.27 (2xA252)	3.75 (2xA252)	3.21 (2xA252)	4.33 (2xA252)	3.79 (2xA252)	3.25 (2xA252)	4.45 (2xA252)	3.87 (2xA252)	3.32 (2xA252)
		150	A393	4.48 (2xA393)	4.17 (2xA393)	3.78 (2xA393)	4.55 (2xA393)	4.23 (2xA393)	3.81 (2xA393)	4.67 (2xA393)	4.34 (2xA393)	3.87 (2xA393)
		160	2xA252	4.72 (2xA252)	4.39 (2xA393)	3.84 (2xA393)	4.79 (2xA252)	4.45 (2xA393)	3.87 (2xA393)	4.89 (2xA393)	4.55 (2xA393)	3.93 (2xA393)
		170	2xA252	4.94 (2xA252)	4.61 (2xA393)	4.00 (2xA393)	5.01 (2xA252)	4.63 (2xA393)	4.01 (2xA393)	5.13 (2xA252)	4.65 (2xA393)	4.03 (2xA393)
		180	2xA252	4.83 (2xA252)	4.78 (2xA393)	4.42 (2xA393)	5.22 (2xA252)	4.88 (2xA393)	4.42 (2xA393)	5.35 (2xA252)	5.00 (2xA393)	4.42 (2xA393)
		190	2xA252	4.67 (2xA252)	4.67 (2xA252)	4.64 (2xA393)	5.33 (2xA393)	5.01 (2xA393)	4.77 (2xA393)	5.56 (2xA393)	5.20 (2xA393)	4.84 (2xA393)
		200	2xA393	4.50 (2xA393)	4.50 (2xA393)	4.50 (2xA393)	5.16 (2xA393)	5.14 (2xA393)	4.85 (2xA393)	5.68 (2xA393)	5.33 (2xA393)	4.92 (2xA393)
1 line	90 minutes	130	A393	3.80 (2xA252)	3.29 (2xA252)	2.83 (2xA393)	3.83 (2xA252)	3.32 (2xA252)	2.85 (2xA252)	3.90 (2xA252)	3.38 (2xA252)	2.90 (2xA252)
		140	A393	4.48 (2xA393)	4.03 (2xA393)	3.47 (2xA393)	4.55 (2xA393)	4.06 (2xA393)	3.49 (2xA393)	4.67 (2xA393)	4.10 (2xA393)	3.53 (2xA393)
		150	A393	4.68 (2xA393)	4.10 (2xA393)	3.55 (2xA393)	4.71 (2xA393)	4.14 (2xA393)	3.57 (2xA393)	4.77 (2xA393)	4.19 (2xA393)	3.61 (2xA393)
		160	2xA252	4.73 (2xA393)	4.16 (2xA393)	3.61 (2xA393)	4.76 (2xA393)	4.19 (2xA393)	3.63 (2xA393)	4.82 (2xA393)	4.24 (2xA393)	3.68 (2xA393)
		170	2xA252	4.81 (2xA252)	4.21 (2xA393)	3.66 (2xA393)	4.80 (2xA393)	4.24 (2xA393)	3.69 (2xA393)	4.86 (2xA393)	4.29 (2xA393)	3.73 (2xA393)
		180	2xA252	4.67 (2xA252)	4.51 (2xA393)	3.94 (2xA393)	5.09 (2xA393)	4.51 (2xA393)	3.94 (2xA393)	5.10 (2xA393)	4.52 (2xA393)	3.94 (2xA393)
		190	2xA393	4.50 (2xA393)	4.50 (2xA393)	4.31 (2xA393)	5.16 (2xA393)	4.93 (2xA393)	4.31 (2xA393)	5.55 (2xA393)	4.94 (2xA393)	4.32 (2xA393)
200	2xA393	4.36 (2xA393)	4.36 (2xA393)	4.36 (2xA393)	5.01 (2xA393)	5.01 (2xA393)	4.68 (2xA393)	5.81 (2xA393)	5.33 (2xA393)	4.68 (2xA393)		
1 line	120 minutes	140	A393	4.23 (2xA393)	3.69 (2xA393)	3.18 (2xA393)	4.25 (2xA393)	3.71 (2xA393)	3.20 (2xA393)	4.29 (2xA393)	3.75 (2xA393)	3.23 (2xA393)
		150	A393	4.46 (2xA393)	3.90 (2xA393)	3.37 (2xA393)	4.48 (2xA393)	3.92 (2xA393)	3.39 (2xA393)	4.52 (2xA393)	3.96 (2xA393)	3.42 (2xA393)
		160	2xA252	4.54 (2xA393)	4.00 (2xA393)	3.47 (2xA393)	4.57 (2xA393)	4.02 (2xA393)	3.48 (2xA393)	4.61 (2xA393)	4.05 (2xA393)	3.52 (2xA393)
		170	2xA252	4.59 (2xA393)	4.05 (2xA393)	3.52 (2xA393)	4.61 (2xA393)	4.07 (2xA393)	3.54 (2xA393)	4.65 (2xA393)	4.11 (2xA393)	3.58 (2xA393)
		180	2xA252	4.67 (2xA252)	4.14 (2xA393)	3.62 (2xA393)	4.68 (2xA393)	4.15 (2xA393)	3.62 (2xA393)	4.70 (2xA393)	4.17 (2xA393)	3.63 (2xA393)
		190	2xA393	4.50 (2xA393)	4.48 (2xA393)	3.92 (2xA393)	5.03 (2xA393)	4.47 (2xA393)	3.91 (2xA393)	5.03 (2xA393)	4.47 (2xA393)	3.91 (2xA393)
200	2xA393	4.36 (2xA393)	4.36 (2xA393)	4.24 (2xA393)	5.01 (2xA393)	4.83 (2xA393)	4.24 (2xA393)	5.42 (2xA393)	4.84 (2xA393)	4.24 (2xA393)		

## ComFlor® 60 Bar Fire Method / Propped

Single Span propped deck, continuous slab (m) - Normal weight concrete - Eurocode - Beam width 152mm  
 (Refer to Technical Department for Double Span propped deck tables.)  
 (Note: Single span deck single span slab is only permitted using Bar Fire Method.)



Props	Fire period	Slab depth (mm)	Mesh 0.4% min. reqd.**	Total applied load (kN/m²)								
				5.00	7.50	10.00	5.00	7.50	10.00	5.00	7.50	10.00
1 line	60 minutes	120***	A252	0.90mm			1.00mm			1.20mm		
		130	A393	4.48 (32)	4.16 (32)	3.69 (20)	4.51 (32)	4.19 (32)	3.69 (16)	4.57 (32)	4.24 (32)	3.69 (16)
		140	A393	4.77 (32)	4.44 (32)	4.02 (25)	4.80 (32)	4.47 (32)	4.01 (25)	4.86 (32)	4.52 (32)	4.02 (25)
		150	A393	5.06 (32)	4.72 (32)	4.32 (25)	5.09 (32)	4.75 (32)	4.34 (25)	5.14 (32)	4.80 (32)	4.33 (25)
		160	2xA252	5.10 (25)	4.99 (32)	4.63 (32)	5.36 (32)	5.02 (32)	4.62 (32)	5.42 (32)	5.07 (32)	4.64 (25)
		170	2xA252	4.98 (10)	4.94 (20)	4.85 (32)	5.57 (32)	5.27 (32)	4.92 (32)	5.68 (32)	5.33 (32)	4.90 (25)
		180	2xA252	4.81 (10)	4.81 (12)	4.79 (16)	5.48 (20)	5.38 (32)	5.21 (32)	5.95 (32)	5.58 (32)	5.20 (32)
		190	2xA252	4.66 (8)	4.65 (10)	4.63 (16)	5.34 (10)	5.32 (16)	5.27 (25)	6.20 (32)	5.84 (32)	5.48 (32)
		200	2xA393	4.49 (8)	4.49 (8)	4.48 (10)	5.15 (8)	5.15 (10)	5.13 (16)	6.28 (32)	6.08 (32)	5.73 (32)
1 line	90 minutes	130	A393	4.35 (8)	4.35 (8)	4.35 (10)	5.00 (8)	5.00 (10)	4.99 (12)	6.19 (20)	6.14 (25)	6.01 (32)
		140	A393	4.77 (32)	4.44 (32)	4.02 (25)	4.80 (32)	4.47 (32)	4.01 (25)	4.86 (32)	4.52 (32)	4.00 (25)
		150	A393	5.06 (32)	4.72 (32)	4.32 (25)	5.09 (32)	4.75 (32)	4.34 (25)	5.14 (32)	4.80 (32)	4.33 (25)
		160	2xA252	5.10 (25)	4.99 (32)	4.63 (32)	5.36 (32)	5.02 (32)	4.62 (32)	5.42 (32)	5.07 (32)	4.64 (25)
		170	2xA252	4.94 (20)	4.94 (20)	4.85 (32)	5.57 (32)	5.27 (32)	4.92 (32)	5.68 (32)	5.33 (32)	4.90 (25)
		180	2xA252	4.79 (16)	4.77 (20)	4.74 (25)	5.48 (20)	5.38 (32)	5.21 (32)	5.95 (32)	5.58 (32)	5.20 (32)
		190	2xA252	4.65 (12)	4.63 (16)	4.62 (20)	5.30 (20)	5.30 (20)	5.27 (25)	6.20 (32)	5.84 (32)	5.48 (32)
200	2xA393	4.48 (10)	4.47 (16)	4.45 (20)	5.13 (16)	5.11 (20)	5.08 (25)	6.28 (32)	6.08 (32)	5.73 (32)		
1 line	120 minutes	140	2xA393	4.35 (10)	4.35 (12)	4.33 (16)	4.99 (12)	4.98 (16)	4.96 (20)	6.19 (20)	6.14 (25)	6.01 (32)
		140	A393	4.78 (32)	4.18 (32)	3.61 (32)	4.78 (32)	4.18 (32)	3.61 (32)	4.77 (32)	4.18 (32)	3.61 (32)
		150	A393	4.94 (32)	4.34 (32)	3.76 (32)	4.94 (32)	4.34 (32)	3.76 (32)	4.94 (32)	4.34 (32)	3.76 (32)
		160	2xA252	4.85 (32)	4.46 (32)	3.87 (32)	5.05 (32)	4.46 (32)	3.87 (32)	5.05 (32)	4.45 (32)	3.87 (32)
		170	2xA252	4.69 (32)	4.61 (32)	4.01 (32)	5.20 (32)	4.60 (32)	4.01 (32)	5.19 (32)	4.60 (32)	4.01 (32)
		180	2xA252	4.59 (25)	4.54 (32)	4.16 (32)	5.21 (32)	4.75 (32)	4.15 (32)	5.34 (32)	4.75 (32)	4.15 (32)
190	2xA393	4.45 (20)	4.42 (25)	4.27 (32)	5.03 (32)	4.87 (32)	4.27 (32)	5.45 (32)	4.87 (32)	4.27 (32)		
200	2xA393	4.32 (20)	4.30 (25)	4.26 (32)	4.93 (25)	4.89 (32)	4.41 (32)	5.60 (32)	5.01 (32)	4.41 (32)		

Spans are based on beam centres, with a 152mm flange width and a minimum end bearing of 50mm.

\*\* In accordance with BS EN 1994-1-1 Clause 9.8.1 (2) - Where the continuous slabs are designed as simply-supported in accordance with 9.4.2 (5), the minimum cross-sectional area of anti-crack mesh reinforcement above the ribs should not be less than 0.4% of the cross-sectional area of concrete above the ribs for propped construction. In order to maximise the FIRE LIMIT STATE spans, increased mesh sizing is required as specified in the above as specified in the the above Mesh and Deck Fire Method tables.

\*\*\* All mesh covers for all profile types and slab depths are taken as 30mm. However, due to mesh size restriction, the ComFlor® 60 120mm slab depth requires a mesh cover depth of 25mm. Figures in brackets represent the diameter of bar required – one bar in each deck trough positioned 25mm above the trough.

**Consett Academy and Leisure Centre,  
County Durham**

Steelwork contractor:  
Harry Marsh (Engineers) Ltd

Decking installer: MSW UK Ltd



# ComFlor® 80

Combined 80mm deep round shouldered trapezoidal combined composite profile with long span capability

ComFlor® 80 is the big sister to ComFlor® 60 with the same round shoulder combined profile technology applied to an 80mm deep trapezoidal shape to give big spans. The use of this profile allows a designer to reduce still further the number of secondary beams in a building to give a cleaner lower cost structure. It allows central stud placement to ensure effective composite beam design and is 600mm cover to give lighter weight sheets in accordance with Health and Safety guidelines.

#### Versatile

Combined profile allows easy service attachment, with trapezoidal spanning ability.

#### Reduced number of secondary beams

The use of this profile allows a designer to reduce still further the number of secondary beams in a building to give a cleaner lower cost structure.

#### Low concrete and steel usage

A low volume of concrete is needed reducing weight and steel requirement.

#### Colorcoat FD®

ComFlor® 80 is available with Colorcoat FD® pre-finished soffit, to give a bright attractive finish where a ceiling is not used.

#### Central stud placement

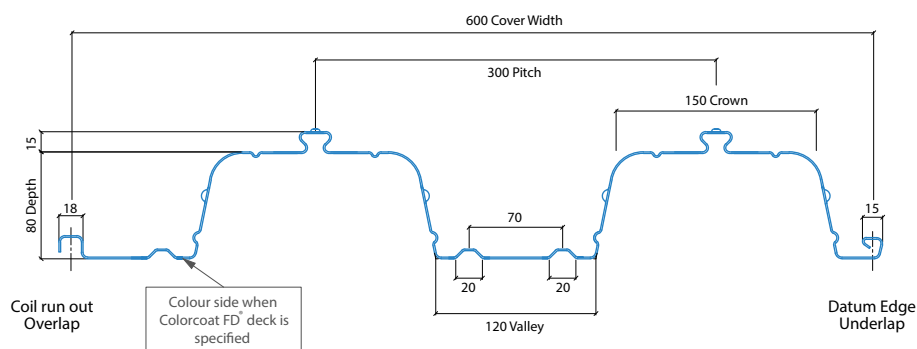
Shear studs are placed centrally in the troughs to ensure beneficial placement.

#### Better for Health and Safety

The profile is 600mm cover as recommended by Health and Safety guidelines to allow a lighter weight sheet which reduce strain on installation operatives.



# Design information



## ComFlor® 80 Composite slab - volume and weight (EC values)

Slab depth (mm)	Concrete volume (m <sup>3</sup> /m <sup>2</sup> )	Weight of concrete (kN/m <sup>2</sup> )			
		Normal weight concrete		Lightweight concrete	
		Wet	Dry	Wet	Dry
130	0.085	–	–	1.70	1.62
140	0.095	2.38	2.28	1.90	1.81
150	0.105	2.63	2.52	2.10	2.00
160	0.115	2.88	2.76	2.30	2.19
170	0.125	3.13	3.00	2.50	2.38
180	0.135	3.38	3.24	2.70	2.57
190	0.145	3.63	3.48	2.90	2.76
200	0.155	3.88	3.72	3.10	2.95
210	0.165	4.13	3.96	3.30	3.14
220	0.175	4.38	4.20	3.50	3.33
230	0.185	4.63	4.44	3.70	3.52
240	0.195	4.88	4.68	3.90	3.71
250	0.205	5.13	4.92	4.10	3.90

## ComFlor® 80 (S350) Section properties (per metre width)

Nominal thickness (mm)	Design thickness (mm)	Cross section area (mm <sup>2</sup> /m)	Profile weight (kN/m <sup>2</sup> )	Height to neutral axis (mm)	Moment of inertia (cm <sup>4</sup> /m)		Ultimate moment capacity (kNm/m)	
					Sagging	Hogging	Sagging	Hogging
0.90	0.86	1382	0.11	44.86	165.42	156.17	10.76	8.68
1.00	0.96	1542	0.12	44.90	181.32	171.83	13.34	10.65
1.20	1.16	1864	0.15	45.01	213.13	203.16	18.49	14.59

Section properties in the above table conform to BS 5950 and Eurocode

### Design Notes:

#### Deck material

Tata Steel Galvatite®, hot dip zinc coated steel to BS EN 10346 S350GD+Z275, with guaranteed minimum proof strength of 350N/mm<sup>2</sup> and zinc coating of total mass 275g/m<sup>2</sup> (including both sides). This is sufficient for internal floors in a non-aggressive environment, which satisfies the requirement in Clause 4.2 BS EN 1994-1-1 - the exposed surfaces of the steel decking shall be adequately protected to resist the particular atmospheric conditions. A zinc coating, if specified, should conform to the requirements of BS EN 10346. The specification may be varied, depending on service conditions.

#### Anti-crack mesh

As a minimum requirement where the control of crack width is of no interest, BS EN 1994-1-1, 9.8.1(2) recommends that, where continuous slabs are designed as simply-supported in accordance with BS EN 1994-1-1, 9.4.2(5), the cross-sectional area of the

anti-crack reinforcement above the ribs should be not less than 0.2% of the cross-sectional area of the concrete above the ribs for unpropped construction, and 0.4% of this cross-sectional area for propped construction. The mesh specified in the quick reference Eurocode tables, complies with this clause.

Where forklift truck (or other similar concentrated loading) is expected, 0.5% minimum percentage reinforcement should be used over the supports and the previous stated percentages elsewhere to control cracking. For further information refer to SCI AD 150.

In accordance with Steel Construction Institute (SCI) P300 'Composite Slabs and Beams Using Steel Decking: Best Practice for Design and Construction, a nominal cover of 25mm is stated for an exposure level XC1, for all concrete cylinder strengths for both normal (C25/30 to C40/50) and lightweight concrete (LC25/28 to LC32/35). This nominal cover of 25mm is the minimum cover of 15mm plus a fixing tolerance of 10mm.

### Notes

- Deck and beam deflection (ie, ponding) is not included in the table.
- Deck and mesh weight is not included in the weight of concrete figures.
- Eurocode density of concrete is taken as:

Normal weight (wet)	25kN/m <sup>3</sup>
Normal weight (dry)	24kN/m <sup>3</sup>
Lightweight (wet)	20kN/m <sup>3</sup>
Lightweight (dry)	19kN/m <sup>3</sup>

### Supporting beam width

For all ComFlor® 80 load/span tables, the width of the support beam used is assumed to be 152mm.

### Fire design

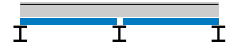
The capacity of a composite slab with nominal anti-crack mesh in fire is calculated in accordance with Steel Construction Institute NCCI PN005 'Fire resistance design of composite slab'. Two fire-design methods can be used in the ComFlor® 9 software, namely 'Mesh and Deck Fire Method' or 'Bar Fire Method'. For further details of the performance of composite slabs with nominal anti-crack mesh in fire, please contact the technical team.

### Technical services

The Technical Department at Tata Steel offers a comprehensive advisory service on the design of composite flooring, which is available to all specifiers and users. Should queries arise which are not covered by this literature or by the ComFlor® 9 software, please contact us.

## ComFlor® 80 / Mesh and Deck Fire Method / Unproped

Single span deck continuous slab (m) - Normal weight concrete - Eurocode - Beam width 152mm  
 (Note: Single span deck single span slab is only permitted using Bar Fire Method.)



Props	Fire period	Slab depth (mm)	Mesh 0.2% min.reqd*	Total applied load (kN/m²)								
				5.00	7.50	10.00	5.00	7.50	10.00	5.00	7.50	10.00
None	60 minutes	140***	A142	0.90mm			1.00mm			1.20mm		
		150	A142	3.71 (A193)	3.69 (A393)	3.29 (A393)	4.07 (A252)	4.06 (A393)	3.29 (A393)	4.34 (A252)	4.15 (A393)	3.31 (A393)
		160	A193	3.61 (A142)	3.60 (A252)	3.59 (2xA252)	3.96 (A193)	3.95 (A393)	3.94 (2xA252)	4.26 (A193)	4.25 (A393)	3.96 (2xA252)
		170	A193	3.51 (A193)	3.51 (A193)	3.50 (A393)	3.86 (A193)	3.86 (A252)	3.84 (2xA252)	4.18 (A193)	4.17 (A393)	4.17 (2xA252)
		180	A252	3.50 (A193)	3.50 (A193)	3.49 (A393)	3.77 (A193)	3.77 (A193)	3.76 (A393)	4.11 (A193)	4.11 (A252)	4.10 (2xA252)
		190	A252	3.45 (A252)	3.45 (A252)	3.45 (A252)	3.68 (A252)	3.68 (A252)	3.68 (A393)	4.04 (A252)	4.04 (A252)	4.04 (A393)
		200	A252	3.37 (A252)	3.37 (A252)	3.37 (A252)	3.60 (A252)	3.60 (A252)	3.60 (A252)	3.99 (A252)	3.99 (A252)	3.98 (A393)
None	90 minutes	150	A142	3.29 (A252)	3.29 (A252)	3.29 (A252)	3.53 (A252)	3.53 (A252)	3.53 (A252)	3.92 (A252)	3.92 (A252)	3.92 (A252)
		160	A193	3.59 (A393)	3.59 (2xA252)	2.89 (2xA252)	3.95 (A393)	3.65 (2xA252)	2.92 (2xA252)	4.25 (A393)	3.61 (2xA252)	2.97 (2xA252)
		170	A193	3.51 (A193)	3.50 (A393)	3.48 (2xA393)	3.85 (A393)	3.84 (2xA252)	3.83 (2xA393)	4.17 (A393)	4.17 (2xA252)	4.15 (2xA393)
		180	A193	3.50 (A193)	3.49 (A252)	3.48 (2xA252)	3.77 (A252)	3.76 (A393)	3.74 (2xA393)	4.10 (A393)	4.10 (2xA252)	4.08 (2xA393)
		190	A252	3.45 (A252)	3.45 (A252)	3.44 (A393)	3.68 (A252)	3.68 (A252)	3.67 (2xA252)	4.04 (A252)	4.04 (A393)	4.02 (2xA393)
		190	A252	3.37 (A252)	3.37 (A252)	3.36 (A393)	3.60 (A252)	3.60 (A252)	3.60 (A393)	3.99 (A252)	3.98 (A393)	3.98 (2xA252)
		200	A252	3.29 (A252)	3.29 (A252)	3.29 (A252)	3.53 (A252)	3.53 (A252)	3.52 (A393)	3.92 (A252)	3.92 (A252)	3.91 (A393)
None	120 minutes	160	A193	3.50 (A393)	3.48 (2xA393)	3.35 (2xA393)	3.85 (A393)	3.83 (2xA393)	3.34 (2xA393)	4.17 (2xA252)	4.15 (2xA393)	3.34 (2xA393)
		170	A193	3.50 (A193)	3.48 (2xA252)	3.47 (2xA393)	3.76 (A393)	3.75 (2xA252)	3.74 (2xA393)	4.10 (A393)	4.09 (2xA393)	4.08 (2xA393)
		180	A252	3.45 (A252)	3.45 (A252)	3.42 (2xA393)	3.68 (A252)	3.68 (A393)	3.66 (2xA393)	4.04 (A393)	4.03 (A252)	4.02 (2xA393)
		190	A252	3.37 (A252)	3.37 (A252)	3.36 (A393)	3.60 (A252)	3.60 (A252)	3.59 (2xA252)	3.99 (A252)	3.98 (A393)	3.96 (2xA393)
		200	A252	3.29 (A252)	3.29 (A252)	3.29 (A393)	3.53 (A252)	3.53 (A252)	3.52 (A393)	3.92 (A252)	3.92 (A252)	3.89 (2xA393)

Double span (m) - Normal weight concrete - Eurocode - Beam width 152mm



Props	Fire period	Slab depth (mm)	Mesh 0.2% min.reqd*	Total applied load (kN/m²)								
				5.00	7.50	10.00	5.00	7.50	10.00	5.00	7.50	10.00
None	60 minutes	140***	A142	0.90mm			1.00mm			1.20mm		
		150	A142	3.71 (A193)	3.69 (A393)	3.28 (A393)	4.19 (A393)	3.83 (A393)	3.28 (A393)	4.46 (A393)	3.85 (A393)	3.29 (A393)
		160	A193	3.56 (A142)	3.54 (A252)	3.47 (2xA252)	4.03 (A252)	4.02 (A393)	3.50 (2xA252)	4.64 (A393)	4.32 (2xA252)	3.57 (2xA252)
		170	A193	3.41 (A193)	3.41 (A193)	3.39 (A393)	3.88 (A193)	3.86 (A393)	3.82 (2xA393)	4.59 (A393)	4.57 (2xA393)	4.38 (2xA393)
		180	A193	3.28 (A193)	3.28 (A193)	3.27 (A252)	3.73 (A193)	3.73 (A252)	3.71 (A393)	4.54 (A252)	4.53 (A393)	4.48 (2xA393)
		190	A252	3.16 (A252)	3.16 (A252)	3.16 (A252)	3.59 (A252)	3.59 (A252)	3.58 (A393)	4.39 (A252)	4.38 (A393)	4.34 (2xA393)
		200	A252	3.05 (A252)	3.05 (A252)	3.05 (A252)	3.47 (A252)	3.47 (A252)	3.47 (A252)	4.25 (A252)	4.24 (A393)	4.23 (2xA252)
None	90 minutes	150	A142	2.95 (A252)	2.95 (A252)	2.95 (A252)	3.36 (A252)	3.36 (A252)	3.36 (A252)	4.12 (A252)	4.12 (A252)	4.11 (A393)
		160	A193	3.53 (A393)	3.31 (2xA252)	2.80 (2xA252)	3.96 (2xA252)	3.34 (2xA252)	2.83 (2xA252)	4.02 (2xA252)	3.41 (2xA252)	2.89 (2xA252)
		170	A193	3.41 (A193)	3.38 (2xA252)	3.35 (2xA393)	3.86 (A393)	3.82 (2xA393)	3.59 (2xA393)	4.57 (2xA393)	4.43 (2xA393)	3.62 (2xA393)
		180	A193	3.28 (A193)	3.27 (A252)	3.24 (2xA252)	3.73 (A193)	3.71 (A393)	3.68 (2xA393)	4.51 (2xA252)	4.48 (2xA393)	3.92 (2xA393)
		190	A252	3.16 (A252)	3.16 (A252)	3.15 (A393)	3.59 (A252)	3.59 (A252)	3.58 (A393)	4.38 (A393)	4.34 (2xA393)	4.08 (2xA393)
		190	A252	3.05 (A252)	3.05 (A252)	3.05 (A252)	3.47 (A252)	3.47 (A252)	3.46 (A393)	4.25 (A252)	4.24 (A393)	4.20 (2xA393)
		200	A252	2.95 (A252)	2.95 (A252)	2.95 (A252)	3.36 (A252)	3.36 (A252)	3.35 (A393)	4.12 (A252)	4.10 (A393)	4.07 (2xA393)
None	120 minutes	160	A193	3.40 (A252)	3.35 (2xA393)	3.12 (2xA393)	3.82 (2xA393)	3.75 (2xA393)	3.14 (2xA393)	4.54 (2xA393)	3.77 (2xA393)	3.17 (2xA393)
		170	A193	3.28 (A193)	3.27 (A252)	3.23 (2xA393)	3.73 (A252)	3.68 (2xA393)	3.46 (2xA393)	4.48 (2xA393)	4.21 (2xA393)	3.48 (2xA393)
		180	A252	3.16 (A252)	3.16 (A252)	3.15 (A393)	3.59 (A252)	3.58 (A393)	3.55 (2xA393)	4.36 (2xA252)	4.34 (2xA393)	3.76 (2xA393)
		190	A252	3.05 (A252)	3.05 (A252)	3.04 (A393)	3.47 (A252)	3.47 (A252)	3.46 (A393)	4.24 (A393)	4.20 (2xA393)	3.92 (2xA393)
		200	A252	2.95 (A252)	2.95 (A252)	2.95 (A252)	3.36 (A252)	3.36 (A252)	3.35 (A393)	4.12 (A252)	4.11 (A393)	4.04 (2xA393)

Spans are based on beam centres, with a 152mm flange width and a minimum end bearing of 50mm.

\* In accordance with BS EN 1994-1-1 Clause 9.8.1 (2) - Where the continuous slabs are designed as simply-supported in accordance with 9.4.2 (5), the minimum cross-sectional area of anti-crack mesh reinforcement above the ribs should not be less than 0.2% of the cross-sectional area of concrete above the ribs for unproped construction. In order to maximise the FIRE LIMIT STATE spans, increased mesh sizing is required as specified in the above Mesh and Deck Fire Method tables.

\*\*\* All mesh covers for all profile types and slab depths are taken as 30mm. However, due to mesh size restriction, the ComFlor® 80 140mm slab depth requires a mesh cover depth of 25mm.

## ComFlor® 80 / Bar Fire Method / Unpropped

Single span deck, single span slab (m) - Normal weight concrete - Eurocode - Beam width 152mm

(Note: Single span deck with single span slab is only permitted using Bar Fire Method.)



Props	Fire period	Slab depth (mm)	Mesh 0.2% min. reqd.*	Total applied load (kN/m <sup>2</sup> )								
				5.00	7.50	10.00	5.00	7.50	10.00	5.00	7.50	10.00
None	60 minutes	140	A142	0.90mm			1.00mm			1.20mm		
		150	A142	3.70 (10)	3.70 (12)	3.69 (16)	4.07 (10)	4.06 (12)	3.91 (16)	4.33 (12)	4.32 (16)	3.92 (16)
		160	A193	3.60 (10)	3.60 (10)	3.60 (12)	3.96 (10)	3.95 (12)	3.94 (16)	4.25 (12)	4.25 (12)	4.19 (16)
		170	A193	3.51 (10)	3.51 (10)	3.50 (12)	3.86 (10)	3.85 (12)	3.85 (12)	4.17 (10)	4.17 (12)	4.16 (16)
		180	A252	3.49 (10)	3.49 (10)	3.49 (12)	3.76 (10)	3.76 (10)	3.76 (12)	4.10 (10)	4.10 (12)	4.10 (16)
		190	A252	3.45 (8)	3.44 (10)	3.44 (12)	3.68 (10)	3.68 (10)	3.67 (12)	4.04 (10)	4.04 (12)	4.04 (12)
None	90 minutes	150	A252	3.36 (8)	3.36 (10)	3.36 (10)	3.60 (10)	3.60 (10)	3.59 (12)	3.98 (10)	3.98 (12)	3.98 (12)
		200	A252	3.29 (8)	3.29 (10)	3.29 (10)	3.53 (8)	3.52 (10)	3.52 (12)	3.91 (10)	3.91 (10)	3.91 (12)
		150	A142	3.59 (16)	3.59 (16)	3.58 (20)	3.94 (16)	3.94 (16)	3.93 (20)	4.24 (16)	4.23 (20)	4.18 (20)
		160	A193	3.50 (12)	3.49 (16)	3.49 (16)	3.84 (16)	3.84 (16)	3.83 (20)	4.16 (16)	4.16 (16)	4.15 (20)
		170	A193	3.49 (12)	3.48 (16)	3.48 (16)	3.75 (16)	3.75 (16)	3.75 (16)	4.10 (16)	4.10 (16)	4.09 (20)
		180	A252	3.44 (12)	3.43 (16)	3.43 (16)	3.67 (12)	3.67 (12)	3.67 (16)	4.03 (16)	4.03 (16)	4.02 (20)
None	120 minutes	190	A252	3.36 (12)	3.35 (16)	3.35 (16)	3.59 (12)	3.59 (16)	3.59 (16)	3.97 (16)	3.97 (16)	3.96 (20)
		200	A252	3.28 (12)	3.28 (12)	3.28 (16)	3.52 (12)	3.51 (16)	3.51 (16)	3.90 (16)	3.90 (16)	3.90 (16)
		160	A193	3.47 (25)	3.47 (25)	3.45 (32)	3.81 (25)	3.78 (32)	3.78 (32)	4.14 (25)	4.11 (32)	4.09 (32)
		170	A193	3.46 (25)	3.46 (25)	3.44 (32)	3.73 (25)	3.73 (25)	3.70 (32)	4.07 (25)	4.05 (32)	4.05 (32)
		180	A252	3.42 (20)	3.41 (25)	3.38 (32)	3.64 (25)	3.64 (25)	3.61 (32)	4.01 (25)	3.99 (32)	3.99 (32)
		190	A252	3.34 (20)	3.33 (25)	3.33 (25)	3.56 (25)	3.56 (25)	3.54 (32)	3.95 (25)	3.92 (32)	3.92 (32)
200	A252	3.27 (20)	3.25 (25)	3.25 (25)	3.51 (20)	3.49 (25)	3.47 (32)	3.88 (25)	3.88 (25)	3.86 (32)		

Double span (m) - Normal weight concrete - Eurocode - Beam width 152mm



Props	Fire period	Slab depth (mm)	Mesh 0.2% min. reqd.*	Total applied load (kN/m <sup>2</sup> )								
				5.00	7.50	10.00	5.00	7.50	10.00	5.00	7.50	10.00
None	60 minutes	140	A142	0.90mm			1.00mm			1.20mm		
		150	A142	3.70 (10)	3.70 (10)	3.69 (12)	4.21 (10)	4.20 (12)	4.03 (16)	4.82 (12)	4.80 (16)	4.01 (16)
		160	A193	3.55 (8)	3.54 (10)	3.54 (12)	4.03 (10)	4.02 (12)	4.01 (16)	4.65 (12)	4.63 (16)	4.34 (16)
		170	A193	3.40 (8)	3.40 (8)	3.40 (10)	3.87 (8)	3.86 (10)	3.86 (12)	4.60 (10)	4.59 (12)	4.58 (16)
		180	A252	3.27 (8)	3.27 (8)	3.27 (10)	3.72 (8)	3.72 (10)	3.71 (12)	4.53 (10)	4.53 (12)	4.51 (16)
		190	A252	3.15 (8)	3.15 (8)	3.15 (8)	3.59 (8)	3.59 (8)	3.58 (10)	4.38 (8)	4.38 (10)	4.37 (12)
None	90 minutes	200	A252	3.04 (8)	3.04 (8)	3.04 (8)	3.47 (8)	3.47 (8)	3.46 (10)	4.24 (8)	4.24 (10)	4.23 (12)
		150	A252	2.95 (8)	2.95 (8)	2.95 (8)	3.36 (8)	3.36 (8)	3.36 (8)	4.11 (8)	4.11 (10)	4.10 (12)
		150	A142	3.54 (12)	3.52 (16)	3.52 (16)	4.01 (16)	4.01 (16)	3.99 (20)	4.63 (16)	4.61 (20)	4.33 (20)
		160	A193	3.40 (10)	3.38 (16)	3.38 (16)	3.85 (12)	3.84 (16)	3.82 (20)	4.58 (16)	4.57 (20)	4.57 (20)
		170	A193	3.27 (8)	3.27 (10)	3.25 (16)	3.72 (10)	3.70 (16)	3.70 (16)	4.51 (16)	4.49 (20)	4.49 (20)
		180	A252	3.15 (8)	3.15 (10)	3.14 (12)	3.58 (10)	3.58 (12)	3.57 (16)	4.36 (16)	4.36 (16)	4.34 (20)
None	120 minutes	190	A252	3.04 (8)	3.04 (8)	3.04 (10)	3.47 (8)	3.46 (10)	3.46 (12)	4.23 (12)	4.22 (16)	4.20 (20)
		200	A252	2.95 (8)	2.95 (8)	2.94 (10)	3.36 (8)	3.35 (10)	3.35 (12)	4.11 (10)	4.10 (12)	4.09 (16)
		160	A193	3.36 (20)	3.33 (25)	3.28 (32)	3.79 (25)	3.74 (32)	3.74 (32)	4.52 (32)	4.52 (32)	4.01 (32)
		170	A193	3.25 (16)	3.21 (25)	3.21 (25)	3.65 (25)	3.65 (25)	3.61 (32)	4.41 (25)	4.40 (32)	4.15 (32)
		180	A252	3.14 (12)	3.13 (16)	3.11 (20)	3.57 (16)	3.55 (20)	3.48 (32)	4.31 (25)	4.26 (32)	4.26 (32)
		190	A252	3.04 (10)	3.03 (16)	3.01 (20)	3.45 (16)	3.43 (20)	3.41 (25)	4.20 (20)	4.13 (32)	4.13 (32)
200	A252	2.94 (10)	2.94 (12)	2.93 (16)	3.35 (12)	3.34 (16)	3.33 (20)	4.07 (20)	4.05 (25)	4.00 (32)		

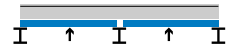
Spans are based on beam centres, with a 152mm flange width and a minimum end bearing of 50mm.

\* In accordance with BS EN 1994-1-1 Clause 9.8.1 (2) - Where the continuous slabs are designed as simply-supported in accordance with 9.4.2 (5), the minimum cross-sectional area of anti-crack mesh reinforcement above the ribs should not be less than 0.2% of the cross-sectional area of concrete above the ribs for unpropped construction.

Figures in brackets represent the diameter of bar required – one bar in each deck trough positioned 25mm above the trough.

## ComFlor® 80 / Mesh and Deck Fire Method / Propped

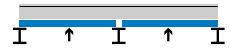
Single Span propped deck, continuous slab (m) - Normal weight concrete - Eurocode - Beam width 152mm.  
 (Note: Single span deck single span slab is only permitted using Bar Fire Method.)



Props	Fire period	Slab depth (mm)	Mesh 0.4% min. reqd.**	Total applied load (kN/m <sup>2</sup> )								
				5.00	7.50	10.00	5.00	7.50	10.00	5.00	7.50	10.00
				0.90mm			1.00mm			1.20mm		
1 line	60 minutes	140***	A252	4.43 (A393)	3.83 (A393)	3.28 (A393)	4.44 (A393)	3.84 (A393)	3.29 (A393)	4.43 (A393)	3.84 (A393)	3.29 (A393)
		150	A393	4.61 (A393)	4.01 (A393)	3.45 (A393)	4.64 (A393)	4.03 (A393)	3.46 (A393)	4.63 (A393)	4.03 (A393)	3.46 (A393)
		160	A393	4.93 (2xA393)	4.46 (2xA393)	3.85 (2xA393)	4.99 (2xA393)	4.51 (2xA393)	3.89 (2xA393)	5.11 (2xA393)	4.58 (2xA393)	3.96 (2xA393)
		170	A393	4.97 (2xA252)	4.56 (2xA252)	3.94 (2xA393)	5.20 (2xA252)	4.60 (2xA393)	3.98 (2xA393)	5.32 (2xA393)	4.68 (2xA393)	4.05 (2xA393)
		180	2xA252	4.79 (2xA252)	4.76 (2xA393)	4.23 (2xA393)	5.37 (2xA252)	4.88 (2xA393)	4.24 (2xA393)	5.53 (2xA393)	4.90 (2xA393)	4.25 (2xA393)
		190	2xA252	4.62 (2xA252)	4.62 (2xA252)	4.59 (2xA393)	5.32 (2xA252)	5.12 (2xA393)	4.59 (2xA393)	5.68 (2xA393)	5.28 (2xA393)	4.60 (2xA393)
1 line	90 minutes	150	A393	3.66 (2xA252)	3.19 (2xA252)	2.74 (2xA252)	3.70 (2xA252)	3.22 (2xA252)	2.77 (2xA252)	3.79 (2xA252)	3.30 (2xA252)	2.84 (2xA252)
		160	A393	4.44 (2xA393)	3.89 (2xA393)	3.35 (2xA393)	4.48 (2xA393)	3.92 (2xA393)	3.38 (2xA393)	4.55 (2xA393)	3.98 (2xA393)	3.43 (2xA393)
		170	A393	4.67 (2xA393)	4.10 (2xA393)	3.55 (2xA393)	4.71 (2xA393)	4.13 (2xA393)	3.58 (2xA393)	4.77 (2xA393)	4.19 (2xA393)	3.63 (2xA393)
		180	2xA252	4.75 (2xA393)	4.09 (2xA393)	3.64 (2xA393)	4.79 (2xA393)	4.22 (2xA393)	3.66 (2xA393)	4.85 (2xA393)	4.28 (2xA393)	3.72 (2xA393)
		190	2xA252	4.62 (2xA252)	4.25 (2xA393)	3.70 (2xA393)	4.84 (2xA393)	4.28 (2xA393)	3.73 (2xA393)	4.91 (2xA393)	4.35 (2xA393)	3.79 (2xA393)
1 line	120 minutes	160	A393	3.98 (2xA393)	3.48 (2xA393)	3.01 (2xA393)	4.01 (2xA393)	3.51 (2xA393)	3.03 (2xA393)	4.07 (2xA393)	3.56 (2xA393)	3.07 (2xA393)
		170	A393	4.27 (2xA393)	3.75 (2xA393)	3.25 (2xA393)	4.30 (2xA393)	3.77 (2xA393)	3.27 (2xA393)	4.35 (2xA393)	3.82 (2xA393)	3.31 (2xA393)
		180	2xA252	4.49 (2xA393)	3.96 (2xA393)	3.44 (2xA393)	4.52 (2xA393)	3.98 (2xA393)	3.46 (2xA393)	4.57 (2xA393)	4.03 (2xA393)	3.50 (2xA393)
		190	2xA252	4.59 (2xA393)	4.05 (2xA393)	3.53 (2xA393)	4.61 (2xA393)	4.08 (2xA393)	3.55 (2xA393)	4.66 (2xA393)	4.12 (2xA393)	3.59 (2xA393)
		200	2xA252	4.47 (2xA252)	4.47 (2xA252)	3.97 (2xA252)	5.14 (2xA252)	4.58 (2xA252)	4.00 (2xA252)	5.23 (2xA252)	4.64 (2xA252)	4.05 (2xA252)

## ComFlor® 80 / Bar Fire Method / Propped

Single Span propped deck, continuous slab (m) - Normal weight concrete - Eurocode - Beam width 152mm.  
 (Note: Single span deck single span slab is only permitted using Bar Fire Method.)



Props	Fire period	Slab depth (mm)	Mesh 0.4% min. reqd.**	Total applied load (kN/m <sup>2</sup> )								
				5.00	7.50	10.00	5.00	7.50	10.00	5.00	7.50	10.00
				0.90mm			1.00mm			1.20mm		
1 line	60 minutes	140***	A252	5.17 (32)	4.80 (32)	4.02 (16)	5.19 (32)	4.82 (32)	4.02 (16)	5.24 (32)	4.86 (32)	4.01 (16)
		150	A393	5.25 (25)	5.06 (32)	4.35 (16)	5.45 (32)	5.08 (32)	4.34 (16)	5.50 (32)	5.12 (32)	4.33 (16)
		160	A393	5.15 (16)	5.08 (25)	4.65 (20)	5.72 (32)	5.34 (32)	4.65 (20)	5.76 (32)	5.38 (32)	4.64 (16)
		170	A393	4.97 (10)	4.95 (16)	4.92 (32)	5.62 (20)	5.56 (32)	4.95 (20)	6.02 (32)	5.63 (32)	4.94 (20)
		180	2xA252	4.78 (8)	4.77 (10)	4.75 (16)	5.49 (12)	5.45 (20)	5.22 (25)	6.26 (32)	5.87 (32)	5.23 (20)
		190	2xA252	4.61 (8)	4.61 (10)	4.59 (16)	5.30 (10)	5.28 (16)	5.27 (16)	6.45 (32)	6.12 (32)	5.49 (25)
1 line	90 minutes	150	A393	5.25 (25)	5.06 (32)	4.32 (25)	5.45 (32)	5.08 (32)	4.31 (25)	5.50 (32)	5.12 (32)	4.30 (25)
		160	A393	5.12 (20)	5.08 (25)	4.64 (25)	5.72 (32)	5.34 (32)	4.63 (25)	5.76 (32)	5.38 (32)	4.62 (25)
		170	A393	4.93 (20)	4.92 (20)	4.89 (25)	5.63 (25)	5.56 (32)	4.94 (25)	6.02 (32)	5.63 (32)	4.92 (25)
		180	2xA252	4.75 (16)	4.73 (20)	4.70 (25)	5.45 (20)	5.41 (25)	5.22 (25)	6.26 (32)	5.87 (32)	5.21 (25)
		190	2xA252	4.60 (12)	4.57 (20)	4.57 (20)	5.26 (20)	5.26 (20)	5.22 (25)	6.45 (32)	6.12 (32)	5.49 (25)
1 line	120 minutes	160	A393	5.02 (32)	4.51 (32)	3.90 (32)	5.14 (32)	4.51 (32)	3.90 (32)	5.15 (32)	4.50 (32)	3.90 (32)
		170	A393	4.83 (32)	4.65 (32)	4.03 (32)	5.28 (32)	4.65 (32)	4.03 (32)	5.29 (32)	4.64 (32)	4.03 (32)
		180	2xA252	4.64 (32)	4.64 (32)	4.13 (32)	5.35 (32)	4.74 (32)	4.13 (32)	5.38 (32)	4.74 (32)	4.12 (32)
		190	2xA252	4.49 (32)	4.49 (32)	4.25 (32)	5.17 (32)	4.87 (32)	4.25 (32)	5.51 (32)	4.86 (32)	4.25 (32)
		200	2xA252	4.42 (20)	4.34 (32)	4.34 (32)	5.00 (32)	4.99 (32)	4.37 (32)	5.63 (32)	4.99 (32)	4.37 (32)

Spans are based on beam centres, with a 152mm flange width and a minimum end bearing of 50mm.

\*\* In accordance with BS EN 1994-1-1 Clause 9.8.1 (2) - Where the continuous slabs are designed as simply-supported in accordance with 9.4.2 (5), the minimum cross-sectional area of anti-crack mesh reinforcement above the ribs should not be less than 0.4% of the cross-sectional area of concrete above the ribs for propped construction. In order to maximise the FIRE LIMIT STATE spans, increased mesh sizing is required as specified in the above Mesh and Deck Fire Method tables.

\*\*\* All mesh covers for all profile types and slab depths are taken as 30mm. However, due to mesh size restriction, the ComFlor® 80 140mm slab depth requires a mesh cover depth of 25mm

Figures in brackets represent the diameter of bar required – one bar in each deck trough positioned 25mm above the trough.



Bloomberg Place, London

Steelwork contractor: William Hare

Decking installer: Prodeck-Fixing Ltd

# ComFlor® 100

Strong long span composite profile for non-composite beams

ComFlor® 100 is a strong long span profile that reduces or eliminates temporary propping whether used on steel, concrete or masonry supports. It provides a composite floor slab and is suitable for use with concrete beams or non-composite steel beams. The profile is fully nestable giving low transport and handling costs and provides fast slab installation.

#### Long span strength

Long span strength reduces or eliminates temporary propping.

#### Nestable

The simple trapezoidal shape neatly nests one profile into another, allowing more square metres per bundle.

#### Fast laying

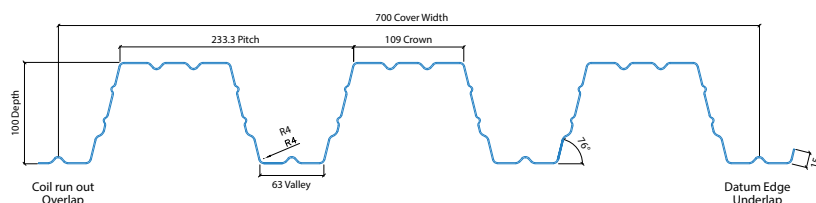
As simple to install as a roof deck, the concrete can soon be poured.

#### Efficient for export

Maximises the square meterage in each container.



# Design information



## ComFlor® 100 Composite slab - volume and weight (BS values)

Slab depth (mm)	Concrete volume (m <sup>3</sup> /m <sup>2</sup> )	Weight of concrete (kN/m <sup>2</sup> )			
		Normal weight concrete		Lightweight concrete	
		Wet	Dry	Wet	Dry
150	0.090	–	–	1.69	1.60
160	0.100	2.37	2.32	1.87	1.77
170	0.110	2.60	2.55	2.06	1.95
180	0.120	2.84	2.78	2.25	2.13
190	0.130	3.07	3.01	2.43	2.30
200	0.140	3.31	3.24	2.62	2.48
210	0.150	3.54	3.47	2.80	2.66
220	0.160	3.78	3.70	2.99	2.83
230	0.170	4.01	3.93	3.18	3.01
250	0.190	4.48	4.39	3.55	3.36

## Notes

- Deck and beam deflection (ie, ponding) is not included in the table.
- Deck and mesh weight is not included in the weight of concrete figures.
- British Standard density of concrete is taken as:

Normal weight (wet)	2400kg/m <sup>3</sup>
Normal weight (dry)	2350kg/m <sup>3</sup>
Lightweight (wet)	1900kg/m <sup>3</sup>
Lightweight (dry)	1800kg/m <sup>3</sup>

## ComFlor® 100 (S280) Section properties (per metre width)

Nominal thickness (mm)	Design thickness (mm)	Cross section area (mm <sup>2</sup> /m)	Profile weight (kN/m <sup>2</sup> )	Height to neutral axis (mm)	Moment of inertia (cm <sup>4</sup> /m)		Ultimate moment capacity (kNm/m)	
					Sagging	Hogging	Sagging	Hogging
0.90	0.86	1511	0.12	58.00	225.77	–	11.26	11.20
1.20	1.16	2022	0.16	58.00	298.00	–	12.40	18.64

Section properties in the above table conform to BS 5950

## Design Notes:

### Deck material

Tata Steel Galvalite®, hot dip zinc coated steel to BS EN 10346 S280GD+Z275, with guaranteed minimum proof strength of 280N/mm<sup>2</sup> and zinc coating of total mass 275g/m<sup>2</sup> (including both sides). This is sufficient for internal floors in a non-aggressive environment, which satisfies the requirement in Clause 4.2 BS EN 1994-1-1 - the exposed surfaces of the steel decking shall be adequately protected to resist the particular atmospheric conditions. A zinc coating, if specified, should conform to the requirements of BS EN 10346. The specification may be varied, depending on service conditions.

### Anti-crack mesh

As a minimum requirement where the control of crack width is of no interest, BS EN 1994-1-1, 9.8.1(2) recommends that, where continuous slabs are designed as simply-supported in accordance with BS EN 1994-1-1, 9.4.2(5), the cross-sectional area of the

anti-crack reinforcement above the ribs should be not less than 0.2% of the cross-sectional area of the concrete above the ribs for unpropped construction, and 0.4% of this cross-sectional area for propped construction. The mesh specified in the quick reference Eurocode tables, complies with this clause.

Where forklift truck (or other similar concentrated loading) is expected, 0.5% minimum percentage reinforcement should be used over the supports and the previous stated percentages elsewhere to control cracking. For further information refer to SCI AD 150.

In accordance with Steel Construction Institute (SCI) P300 'Composite Slabs and Beams Using Steel Decking: Best Practice for Design and Construction, a nominal cover of 25mm is stated for an exposure level XC1, for all concrete cylinder strengths for both normal (C25/30 to C40/50) and lightweight concrete (LC25/28 to LC32/35). This nominal cover of 25mm is the minimum cover of 15mm plus a fixing tolerance of 10mm.

### Supporting beam width

For all ComFlor® 100 load/span tables, the width of the support beam used is assumed to be 152mm.

### Fire design

The capacity of a composite slab with nominal anti-crack mesh in fire is calculated in accordance with Steel Construction Institute NCCI PN005 'Fire resistance design of composite slab'. Two fire-design methods can be used in the ComFlor® 9 software, namely 'Mesh and Deck Fire Method' or 'Bar Fire Method'. For further details of the performance of composite slabs with nominal anti-crack mesh in fire, please contact the technical team.

### Technical services

The Technical Department at Tata Steel offers a comprehensive advisory service on the design of composite flooring, which is available to all specifiers and users. Should queries arise which are not covered by this literature or by the ComFlor® 9 software, please contact us.

## ComFlor® 100 / Bar Fire Method / Unpropped

Single span slab (m) - Normal weight concrete - British Standard - Beam width 152mm.

(Note: A single span deck will require trough bar reinforcement whether the concrete slab is single or continuous span, using Bar Fire Method.)



Props	Fire period	Slab depth (mm)	Mesh 0.1% min. reqd.	Total applied load (kN/m <sup>2</sup> )					
				5.00	7.50	10.00	5.00	7.50	10.00
				0.90mm			1.20mm		
None	60 minutes	170	A142	3.85 (10)	3.85 (10)	3.85 (12)	4.03 (10)	4.03 (10)	4.02 (12)
		180	A142	3.76 (8)	3.75 (10)	3.75 (10)	3.92 (10)	3.92 (10)	3.92 (12)
		190	A142	3.66 (8)	3.66 (10)	3.66 (10)	3.83 (8)	3.83 (10)	3.83 (10)
		200	A142	3.58 (8)	3.57 (10)	3.57 (10)	3.74 (8)	3.74 (10)	3.74 (10)
		250	A193	3.23 (8)	3.23 (8)	3.23 (8)	3.38 (8)	3.38 (8)	3.38 (8)
None	90 minutes	180	A142	3.75 (10)	3.75 (12)	3.73 (16)	3.92 (12)	3.92 (12)	3.90 (16)
		190	A142	3.66 (10)	3.66 (12)	3.66 (12)	3.83 (10)	3.82 (12)	3.81 (16)
		200	A142	3.57 (10)	3.57 (12)	3.57 (12)	3.74 (10)	3.73 (12)	3.73 (12)
		250	A193	3.23 (8)	3.22 (10)	3.22 (10)	3.38 (8)	3.37 (10)	3.37 (10)
None	120 minutes	190	A142	3.66 (12)	3.64 (16)	3.64 (16)	3.82 (12)	3.81 (16)	3.81 (16)
		200	A142	3.57 (12)	3.56 (16)	3.56 (16)	3.73 (12)	3.72 (16)	3.72 (16)
		250	A193	3.22 (10)	3.22 (12)	3.22 (12)	3.37 (10)	3.37 (12)	3.36 (12)

Double span (m) - Normal weight concrete - British Standard - Beam width 152mm.

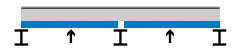


Props	Fire period	Slab depth (mm)	Mesh 0.1% min. reqd.	Total applied load (kN/m <sup>2</sup> )					
				5.00	7.50	10.00	5.00	7.50	10.00
				0.90mm			1.20mm		
None	60 minutes	170	A142	4.01 (10)	4.01 (10)	4.00 (12)	4.59 (10)	4.58 (12)	4.56 (16)
		180	A142	3.86 (10)	3.86 (10)	3.85 (12)	4.47 (10)	4.46 (12)	4.46 (12)
		190	A142	3.73 (8)	3.73 (10)	3.73 (10)	4.36 (10)	4.36 (12)	4.36 (12)
		200	A142	3.60 (8)	3.60 (10)	3.60 (10)	4.27 (10)	4.27 (10)	4.26 (12)
		250	A193	3.10 (8)	3.10 (8)	3.10 (8)	3.86 (8)	3.85 (10)	3.85 (10)
None	90 minutes	180	A142	3.85 (12)	3.85 (12)	3.83 (16)	4.46 (12)	4.45 (16)	4.45 (16)
		190	A142	3.73 (10)	3.72 (12)	3.70 (16)	4.36 (12)	4.34 (16)	4.34 (16)
		200	A142	3.60 (10)	3.59 (12)	3.59 (12)	4.26 (12)	4.25 (16)	4.25 (16)
		250	A193	3.10 (8)	3.10 (10)	3.10 (10)	3.85 (10)	3.85 (12)	3.85 (12)
None	120 minutes	190	A142	3.72 (12)	3.70 (16)	3.70 (16)	4.34 (16)	4.34 (16)	4.33 (20)
		200	A142	3.59 (12)	3.58 (16)	3.58 (16)	4.25 (16)	4.25 (16)	4.23 (20)
		250	A193	3.10 (10)	3.09 (12)	3.09 (12)	3.85 (12)	3.84 (16)	3.84 (16)

## ComFlor® 100 / Bar Fire Method / Propped

Propped deck, single or continuous slab (m) - Normal weight concrete - British Standard - Beam width 152mm.

(Note: For Simple Mesh and Deck Fire Method load/span tables, please refer to the Technical Department.)



Props	Fire period	Slab depth (mm)	Mesh 0.1% min. reqd.	Total applied load (kN/m <sup>2</sup> )					
				5.00	7.50	10.00	5.00	7.50	10.00
				0.90mm			1.20mm		
1 line	60 minutes	170	A142	6.30 (32)	5.84 (32)	5.24 (25)	6.52 (32)	5.98 (32)	5.36 (25)
		180	A142	6.19 (25)	6.05 (32)	5.44 (25)	6.80 (32)	6.28 (32)	5.76 (32)
		190	A142	6.04 (16)	5.97 (25)	5.63 (25)	7.02 (32)	6.54 (32)	6.15 (32)
		200	A142	5.87 (16)	5.83 (20)	5.81 (20)	7.18 (32)	6.71 (32)	6.41 (32)
		250	A193	5.06 (10)	5.04 (16)	5.04 (16)	6.98 (16)	6.90 (25)	6.90 (25)
1 line	90 minutes	180	A142	6.19 (25)	6.05 (32)	5.44 (25)	6.80 (32)	6.28 (32)	5.76 (32)
		190	A142	6.03 (20)	5.97 (25)	5.63 (25)	7.02 (32)	6.54 (32)	6.15 (32)
		200	A142	5.86 (16)	5.83 (20)	5.81 (20)	7.18 (32)	6.71 (32)	6.41 (32)
		250	A193	5.04 (16)	5.04 (16)	5.04 (16)	6.95 (20)	6.90 (25)	6.90 (25)
1 line	120 minutes	190	A142	6.03 (20)	5.97 (25)	5.63 (25)	7.02 (32)	6.54 (32)	6.15 (32)
		200	A142	5.83 (20)	5.78 (25)	5.77 (25)	7.18 (32)	6.71 (32)	6.41 (32)
		250	A193	5.04 (16)	5.01 (20)	5.01 (20)	6.90 (25)	6.90 (25)	6.80 (32)

Figures in brackets represent the diameter of bar required – one bar in each deck trough positioned 25mm above the trough.



Schiphol Airport, Amsterdam

Fabricator and decking contractor :  
Voortman Steel Construction

Supply and design:  
Dutch Engineering r.i. B.V.

# ComFlor® 210

The original deep ultra long span composite profile introduced for the first Slimflor® systems

ComFlor® 210 is the original deep composite profile introduced for the first Slimflor® systems with wider lower flange steel beams that allow the deck to land on the bottom not the top flange. The profile is very efficient, the cross stiffener technology and deep profile shape provides a very efficient metal deck and composite slab, with a low usage of concrete. Although it is especially suited to bear on the extended lower flange of a steel beam, it can also be used on the top flange of a non-composite steel or concrete beam. The nestable profile shape gives low transport and handling costs.

#### Efficient

Cross stiffener technology and deep profile shape provides a very efficient metal deck and composite slab giving low usage of steel and concrete.

#### Versatile

Especially suited to bear on the extended lower flange of a steel beam, can also be used on the top flange.

#### Nestable

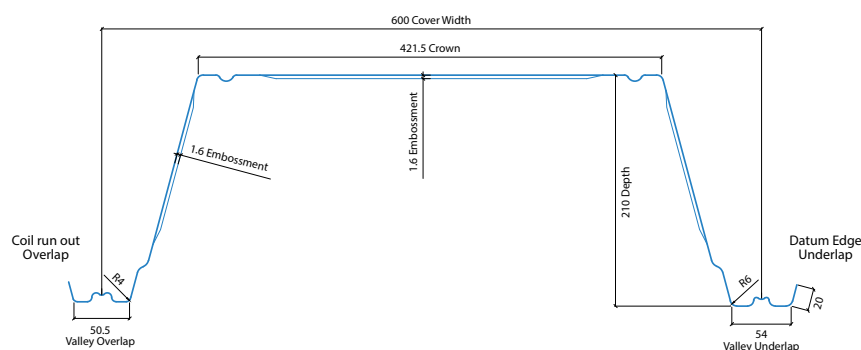
The simple trapezoidal shape neatly nests one profile into another, allowing more square metres per bundle.

#### Efficient for export

Maximises the square meterage in each container.



# Design information



## ComFlor® 210 Composite slab - volume and weight (BS values)

Slab depth (mm)	Concrete volume (m <sup>3</sup> /m <sup>2</sup> )	Weight of concrete (kN/m <sup>2</sup> )			
		Normal weight concrete		Lightweight concrete	
		Wet	Dry	Wet	Dry
260	0.091	–	–	1.70	1.61
270	0.101	2.38	2.33	1.89	1.79
280	0.111	2.62	2.56	2.07	1.96
290	0.121	2.85	2.79	2.26	2.14
300	0.131	3.09	3.03	2.45	2.32
305	0.136	3.21	3.14	2.54	2.41
310	0.141	3.33	3.26	2.63	2.49
330	0.161	3.80	3.72	3.01	2.85
350	0.181	4.27	4.18	3.38	3.20
375	0.206	4.86	4.76	3.85	3.64
400	0.231	5.44	5.33	4.31	4.08
500	0.331	7.80	7.64	6.17	5.85

## Notes

- Deck and beam deflection (ie, ponding) is not included in the table.
- Deck and mesh weight is not included in the weight of concrete figures.
- British Standard density of concrete is taken as:

Normal weight (wet) 2400kg/m<sup>3</sup>

Normal weight (dry) 2350kg/m<sup>3</sup>

Lightweight (wet) 1900kg/m<sup>3</sup>

Lightweight (dry) 1800kg/m<sup>3</sup>

## ComFlor® 210 (S350) Section properties (per metre width)

Nominal thickness (mm)	Design thickness (mm)	Cross section area (mm <sup>2</sup> /m)	Profile weight (kN/m <sup>2</sup> )	Height to neutral axis (mm)	Moment of inertia (cm <sup>4</sup> /m)		Ultimate moment capacity (kNm/m)	
					Sagging	Hogging	Sagging	Hogging
1.25	1.21	2009	0.16	95.00	816.00	–	23.20	23.20

Section properties in the above table conform to BS 5950

## Design Notes:

### Deck material

Tata Steel Galvatite®, hot dip zinc coated steel to BS EN 10346 S350GD+Z275, with guaranteed minimum proof strength of 350N/mm<sup>2</sup> and zinc coating of total mass 275g/m<sup>2</sup> (including both sides). This is sufficient for internal floors in a non-aggressive environment, which satisfies the requirement in Clause 4.2 BS EN 1994-1-1 - the exposed surfaces of the steel decking shall be adequately protected to resist the particular atmospheric conditions. A zinc coating, if specified, should conform to the requirements of BS EN 10346. The specification may be varied, depending on service conditions.

### Anti-crack mesh

As a minimum requirement where the control of crack width is of no interest, BS EN 1994-1-1, 9.8.1(2) recommends that, where continuous slabs are designed as simply-supported in accordance with BS EN 1994-1-1, 9.4.2(5), the cross-sectional area of the anti-crack reinforcement above the ribs should be

not less than 0.2% of the cross-sectional area of the concrete above the ribs for unpropped construction, and 0.4% of this cross-sectional area for propped construction. The mesh specified in the quick reference Eurocode tables, complies with this clause.

Where forklift truck (or other similar concentrated loading) is expected, 0.5% minimum percentage reinforcement should be used over the supports and the previous stated percentages elsewhere to control cracking. For further information refer to SCI AD 150.

In accordance with Steel Construction Institute (SCI) P300 'Composite Slabs and Beams Using Steel Decking: Best Practice for Design and Construction, a nominal cover of 25mm is stated for an exposure level XC1, for all concrete cylinder strengths for both normal (C25/30 to C40/50) and lightweight concrete (LC25/28 to LC32/35). This nominal cover of 25mm is the minimum cover of 15mm plus a fixing tolerance of 10mm.

### Supporting beam width

For deep decks, an Asymmetric Slimflor® Beam (ASB) is assumed, with a bottom flange width of 285mm, and a

minimum support bearing width of 50mm.

### Fire design

The capacity of a composite slab with nominal anti-crack mesh in fire is calculated in accordance with Steel Construction Institute NCCI PN005 'Fire resistance design of composite slab'. The fire-design method used in the ComFlor® 9 software for deep decks is specified as 'Bar Fire Method', whereby a single reinforcement bar must be placed in the trough of the composite deck. For further details of the performance of composite slabs with nominal anti-crack mesh in fire, please contact the technical team.

### Technical services

The Technical Department at Tata Steel offers a comprehensive advisory service on the design of composite flooring, which is available to all specifiers and users. Should queries arise which are not covered by this literature or by the ComFlor® 9 software, please contact us.

## ComFlor® 210 / Bar Fire Method / Unpropped

Single span deck, single or continuous slab (m) - Normal weight concrete - British Standard - Beam width 400mm.  
Profile span type within ComFlor® 9 - Simple.



Props	Fire period	Slab depth (mm)	Mesh 0.1% min.reqd.	Total applied load (kN/m <sup>2</sup> )		
				5.00	7.50	10.00
None	60 minutes			1.25mm		
		280	A142	5.65 (16)	5.64 (20)	5.64 (20)
		290	A142	5.52 (16)	5.51 (20)	5.51 (20)
		300	A142	5.40 (16)	5.39 (20)	5.39 (20)
		310	A142	5.29 (16)	5.29 (16)	5.28 (20)
		320	A193	5.18 (16)	5.18 (16)	5.17 (20)
		330	A193	5.08 (16)	5.08 (16)	5.07 (20)
		340	A193	4.99 (16)	4.99 (16)	4.99 (16)
		350	A193	4.90 (16)	4.90 (16)	4.90 (16)
		375	A252	4.71 (12)	4.70 (16)	4.70 (16)
		400	A252	4.53 (12)	4.53 (16)	4.53 (16)
None	90 minutes	290	A142	5.51 (20)	5.51 (20)	5.50 (25)
		300	A142	5.39 (20)	5.39 (20)	5.38 (25)
		310	A142	5.28 (20)	5.28 (20)	5.27 (25)
		320	A193	5.18 (16)	5.17 (20)	5.17 (20)
		330	A193	5.08 (16)	5.07 (20)	5.07 (20)
		340	A193	4.99 (16)	4.98 (20)	4.98 (20)
		350	A193	4.90 (16)	4.90 (20)	4.90 (20)
		375	A252	4.70 (16)	4.70 (16)	4.70 (20)
		400	A252	4.53 (16)	4.53 (16)	4.53 (16)
None	120 minutes	300	A142	5.39 (20)	5.38 (25)	5.36 (32)
		310	A142	5.28 (20)	5.27 (25)	5.27 (25)
		320	A193	5.17 (20)	5.16 (25)	5.16 (25)
		330	A193	5.07 (20)	5.06 (25)	5.06 (25)
		340	A193	4.98 (20)	4.98 (20)	4.97 (25)
		350	A193	4.90 (20)	4.90 (20)	4.89 (25)
		375	A252	4.70 (16)	4.70 (20)	4.70 (20)
		400	A252	4.53 (16)	4.52 (20)	4.52 (20)

## ComFlor® 210 / Bar Fire Method / Propped

Single span deck, single or continuous slab (m) - Normal weight concrete - British Standard - Beam width 400mm.  
Profile span type within ComFlor® 9 - Simple.



Props	Fire period	Slab depth (mm)	Mesh 0.1% min.reqd.	Total applied load (kN/m <sup>2</sup> )		
				5.00	7.50	10.00
1 Line	60 minutes			1.25mm		
		280	A142	7.47 (25)	7.24 (32)	6.49 (25)
		290	A142	7.20 (20)	7.11 (32)	6.62 (25)
		300	A142	6.93 (20)	6.88 (25)	6.74 (25)
		310	A142	6.67 (20)	6.67 (20)	6.64 (25)
		320	A193	6.43 (20)	6.42 (20)	6.40 (25)
		330	A193	6.22 (16)	6.21 (20)	6.20 (20)
		340	A193	6.03 (16)	6.01 (20)	6.01 (20)
		350	A193	5.84 (16)	5.83 (20)	5.82 (20)
		375	A252	5.42 (16)	5.41 (16)	5.41 (20)
		400	A252	5.06 (16)	5.06 (16)	5.06 (16)
1 Line	90 minutes	290	A142	7.17 (25)	7.11 (32)	6.61 (32)
		300	A142	6.90 (25)	6.90 (25)	6.73 (32)
		310	A142	6.64 (25)	6.64 (25)	6.60 (32)
		320	A193	6.43 (20)	6.40 (25)	6.40 (25)
		330	A193	6.21 (20)	6.19 (25)	6.19 (25)
		340	A193	6.01 (20)	5.99 (25)	5.99 (25)
		350	A193	5.83 (20)	5.83 (20)	5.81 (25)
		375	A252	5.42 (16)	5.41 (20)	5.41 (20)
		400	A252	5.06 (16)	5.06 (16)	5.05 (20)
1 Line	120 minutes	300	A142	6.84 (32)	6.84 (32)	6.71 (32)
		310	A142	6.64 (25)	6.60 (32)	6.60 (32)
		320	A193	6.40 (25)	6.36 (32)	6.36 (32)
		330	A193	6.19 (25)	6.18 (25)	6.15 (32)
		340	A193	5.99 (25)	5.99 (25)	5.95 (32)
		350	A193	5.83 (20)	5.81 (25)	5.81 (25)
		375	A252	5.41 (20)	5.39 (25)	5.39 (25)
		400	A252	5.05 (20)	5.05 (20)	5.05 (20)

Spans are based on beam centres, with a 400mm bottom flange width and a minimum end bearing of 50mm.

Figures in brackets represent the diameter of bar required - one bar at each deck trough. - one bar in each deck trough positioned 70mm above the trough.

**Stadskantoor, Rotterdam**

Fabricator: CSM Structures

Decking installer: Kempen Cladding

Supply and design:

Dutch Engineering r.i. B.V.



# ComFlor® 225

High performance deep deck specifically designed for Slimdek® and all other integrated steel beam systems

**ComFlor® 225 is a high performance combined deep deck specifically designed for Slimdek® and all other integrated steel beam systems.** These systems provide a reduced overall floor height with fewer steel beams, a counter intuitive result for such a deep profile. The inclusion of a re-entrant allows for easy service attachment and services can be concealed within the large profile void. The optimised profile design gives superb span capability combined with composite performance with a very small concrete usage.

### **Provides all the benefits of Slimdek® type systems**

ComFlor® 225 used with integrated beams gives a reduced floor height, low vibrations, big open areas and a 6 metre unpropped span.

### **Superb span capability combined with composite performance**

The optimised profile design gives superb span capability combined with composite performance with a very small concrete usage.

### **Easy service attachment and integration**

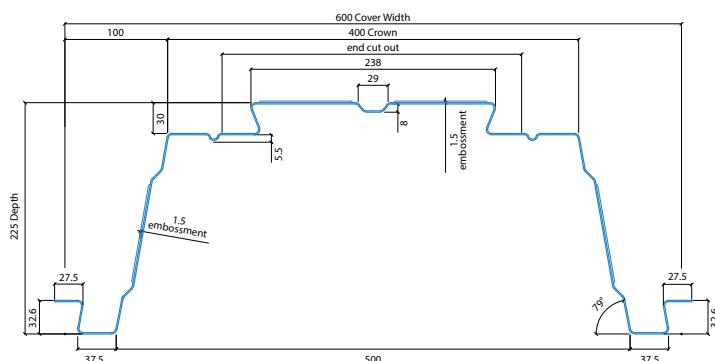
The inclusion of a re-entrant allows for easy service attachment and services can be concealed within the large profile void.

### **Provides reduced overall floor height with fewer steel beams**

This enables an extra floor every eight floors, within the same building height.



# Design information



## ComFlor® 225 Composite slab - volume and weight (EC values)

Slab depth (mm)	Concrete volume (m <sup>3</sup> /m <sup>2</sup> )	Weight of concrete (kN/m <sup>2</sup> )			
		Normal weight concrete		Lightweight concrete	
		Wet	Dry	Wet	Dry
275	0.115	–	–	2.31	2.19
285	0.125	3.13	3.01	2.51	2.38
290	0.130	3.26	3.13	2.61	2.47
295	0.135	3.38	3.25	2.71	2.57
300	0.140	3.51	3.37	2.81	2.66
310	0.150	3.76	3.61	3.01	2.85
320	0.160	4.01	3.85	3.21	3.04
330	0.170	4.26	4.09	3.41	3.23
340	0.180	4.51	4.33	3.61	3.42
350	0.190	4.76	4.57	3.81	3.61
360	0.200	5.01	4.81	4.01	3.80
370	0.210	5.26	5.05	4.21	3.99
380	0.220	5.51	5.29	4.41	4.18
390	0.230	5.76	5.53	4.61	4.37
400	0.240	6.01	5.77	4.81	4.56
500	0.340	8.51	8.17	6.81	6.46

## ComFlor® 225 (S350) Section properties (per metre width)

Nominal thickness (mm)	Design thickness (mm)	Cross section area (mm <sup>2</sup> /m)	Profile weight (kN/m <sup>2</sup> )	Height to neutral axis (mm)	Moment of inertia (cm <sup>4</sup> /m)		Ultimate moment capacity (kNm/m)	
					Sagging	Hogging	Sagging	Hogging
1.25	1.21	2108	0.17	134.48	1089.80	1056.87	31.66	23.58

Section properties in the above table conform to BS 5950 and Eurocode

### Design Notes:

#### Deck material

Tata Steel Galvatite®, hot dip zinc coated steel to BS EN 10346 S350GD+Z275, with guaranteed minimum proof strength of 350N/mm<sup>2</sup> and zinc coating of total mass 275g/m<sup>2</sup> (including both sides). This is sufficient for internal floors in a non-aggressive environment, which satisfies the requirement in Clause 4.2 BS EN 1994-1-1 - the exposed surfaces of the steel decking shall be adequately protected to resist the particular atmospheric conditions. A zinc coating, if specified, should conform to the requirements of BS EN 10346. The specification may be varied, depending on service conditions.

#### Anti-crack mesh

As a minimum requirement where the control of crack width is of no interest, BS EN 1994-1-1, 9.8.1(2) recommends that, where continuous slabs are designed as simply-supported in accordance with BS EN 1994-1-1, 9.4.2(5), the cross-sectional area of

the anti-crack reinforcement above the ribs should be not less than 0.2% of the cross-sectional area of the concrete above the ribs for unpropped construction, and 0.4% of this cross-sectional area for propped construction. The mesh specified in the quick reference Eurocode tables, complies with this clause.

Where forklift truck (or other similar concentrated loading) is expected, 0.5% minimum percentage reinforcement should be used over the supports and the previous stated percentages elsewhere to control cracking. For further information refer to SCI AD 150.

In accordance with Steel Construction Institute (SCI) P300 'Composite Slabs and Beams Using Steel Decking: Best Practice for Design and Construction, a nominal cover of 25mm is stated for an exposure level XC1, for all concrete cylinder strengths for both normal (C25/30 to C40/50) and lightweight concrete (LC25/28 to LC32/35). This nominal cover of 25mm is the minimum cover of 15mm plus a fixing tolerance of 10mm.

### Notes

- Deck and beam deflection (ie, ponding) is not included in the table.
- Deck and mesh weight is not included in the weight of concrete figures.
- Eurocode density of concrete is taken as:

Normal weight (wet) 25kN/m<sup>3</sup>

Normal weight (dry) 24kN/m<sup>3</sup>

Lightweight (wet) 20kN/m<sup>3</sup>

Lightweight (dry) 19kN/m<sup>3</sup>

### Fire design

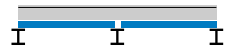
The capacity of a composite slab with nominal anti-crack mesh in fire is calculated in accordance with Steel Construction Institute NCCI PN005 'Fire resistance design of composite slab'. The fire-design method used in the ComFlor® 9 software for deep decks is specified as 'Bar Fire Method', whereby a single reinforcement bar must be placed in the trough of the composite deck. For further details of the performance of composite slabs with nominal anti-crack mesh in fire, please contact the technical team.

### Technical services

The Technical Department at Tata Steel offers a comprehensive advisory service on the design of composite flooring, which is available to all specifiers and users. Should queries arise which are not covered by this literature or by the ComFlor® 9 software, please contact us.

## ComFlor® 225 / Bar Fire Method / Unpropped

Single span deck, single or continuous slab (m) - Normal weight concrete - Eurocode



Props	Fire period	Slab depth (mm)	Beam width (mm)	Mesh 0.2% min. reqd.	Bar axis (mm)	Total applied load (kN/m <sup>2</sup> )		
						5.00	7.50	10.00
						1.25mm		
None	60 minutes	295	400	A142	70	6.00 (16)	5.99 (20)	5.99 (20)
		300	400	A193	70	5.93 (16)	5.92 (20)	5.92 (20)
		310	400	A193	70	5.82 (16)	5.82 (16)	5.81 (20)
		320	400	A193	70	5.73 (16)	5.73 (16)	5.73 (20)
		330	400	A252	70	5.65 (16)	5.65 (16)	5.65 (20)
		340	400	A252	70	5.58 (16)	5.58 (16)	5.58 (20)
		350	400	A252	70	5.51 (16)	5.51 (16)	5.51 (20)
		375	400	A393	70	5.28 (16)	5.28 (16)	5.28 (16)
		400	400	A393	70	5.07 (12)	5.06 (16)	5.06 (16)
None	90 minutes	305	400	A193	90	5.86 (20)	5.86 (20)	5.85 (25)
		310	400	A193	90	5.82 (16)	5.81 (20)	5.80 (25)
		320	400	A193	90	5.73 (16)	5.73 (20)	5.72 (25)
		330	400	A252	90	5.65 (16)	5.65 (20)	5.65 (20)
		340	400	A252	90	5.58 (16)	5.58 (20)	5.58 (20)
		350	400	A252	90	5.51 (16)	5.51 (20)	5.51 (20)
		375	400	A393	90	5.28 (16)	5.28 (16)	5.27 (20)
		400	400	A393	90	5.06 (16)	5.06 (16)	5.06 (20)
None	120 minutes	315	400	A193	120	5.77 (20)	5.77 (20)	5.76 (25)
		320	400	A193	120	5.73 (20)	5.73 (20)	5.72 (25)
		330	400	A252	120	5.65 (20)	5.65 (20)	5.64 (25)
		340	400	A252	120	5.58 (16)	5.58 (20)	5.57 (25)
		350	400	A252	120	5.51 (16)	5.51 (20)	5.51 (20)
		375	400	A393	120	5.28 (16)	5.27 (20)	5.27 (20)
		400	400	A393	120	5.06 (16)	5.06 (16)	5.06 (20)

## ComFlor® 225 / Bar Fire Method / Propped

Single span deck, single or continuous slab (m) - Normal weight concrete - Eurocode



Props	Fire period	Slab depth (mm)	Beam width (mm)	Mesh 0.4% min. reqd.	Bar axis (mm)	Total applied load (kN/m <sup>2</sup> )		
						5.00	7.50	10.00
						1.25mm		
1 line	60 minutes	295	400	A142	70	8.01 (32)	7.49 (32)	7.02 (32)
		300	400	A193	70	8.05 (32)	7.53 (32)	7.04 (32)
		310	400	A193	70	8.13 (32)	7.63 (32)	7.11 (25)
		320	400	A193	70	8.21 (32)	7.73 (32)	7.16 (25)
		330	400	A252	70	8.29 (32)	7.82 (32)	7.20 (25)
		340	400	A252	70	8.37 (32)	7.91 (32)	7.22 (25)
		350	400	A252	70	8.45 (32)	8.00 (32)	7.23 (25)
		375	400	A393	70	8.32 (32)	8.21 (32)	7.23 (25)
		400	400	A393	70	7.83 (20)	7.82 (25)	7.23 (25)
1 line	90 minutes	305	400	A193	90	7.90 (32)	7.41 (32)	7.07 (32)
		310	400	A193	90	7.94 (32)	7.46 (32)	7.09 (32)
		320	400	A193	90	8.03 (32)	7.56 (32)	7.14 (32)
		330	400	A252	90	8.11 (32)	7.65 (32)	7.18 (32)
		340	400	A252	90	8.20 (32)	7.75 (32)	7.22 (25)
		350	400	A252	90	8.28 (32)	7.84 (32)	7.23 (25)
		375	400	A393	90	8.32 (32)	8.06 (32)	7.23 (25)
		400	400	A393	90	7.82 (25)	7.82 (25)	7.23 (25)
1 line	120 minutes	315	400	A193	120	7.73 (32)	7.26 (32)	7.05 (32)
		320	400	A193	120	7.77 (32)	7.31 (32)	7.13 (32)
		330	400	A252	120	7.86 (32)	7.41 (32)	7.18 (32)
		340	400	A252	120	7.95 (32)	7.51 (32)	7.20 (32)
		350	400	A252	120	8.04 (32)	7.61 (32)	7.21 (32)
		375	400	A393	120	8.25 (32)	7.84 (32)	7.21 (32)
		400	400	A393	120	7.82 (25)	7.80 (25)	7.23 (25)

Spans are based on beam centres, with a 400mm bottom flange width and a minimum end bearing of 50mm.

Bar axis is 70, 90 and 120mm for fire resistance periods of 60, 90 and 120 minutes respectively.

Figures in brackets represent the diameter of bar required – one bar in each deck trough positioned 70mm above the trough.

In accordance with BS EN 1994-1-1 Clause 9.8.1(2) - Where the continuous slabs are design as simply-supported in accordance with 9.4.2 (5), the minimum cross-sectional area of anti-crack mesh reinforcement above the ribs should not be less than 0.2% of the cross sectional area of concrete above the ribs for unpropped construction , and 0.4% for propped construction.



The Exchange, Colworth Science Park  
Steelwork contractor:  
H Young Structures Ltd  
Decking installer:  
Composite Profiles UK Ltd





## **ComFlor® 46, 51+, 60, 80 and 100**

Design, construction and sitework information

# Composite floor decks - Design information

## ComFlor®

Composite floor decking design is generally dictated by the construction stage condition, the load and span required for service and the fire resistance required for the slab. The deck design is also influenced by the composite beam design.

## BIM (Building Information Modelling)

Technical details and drawings relating to ComFlor products are available in BIM ready format and may all be accessed from our website, [www.tatasteelconstruction.com](http://www.tatasteelconstruction.com) by following the relevant links.

## Design parameters

- **Fire rating** – dictates minimum slab depth.
- **Concrete type** – also dictates minimum slab depth and influences unpropped deck span.
- **Deck span** – (unpropped) usually dictates general beam spacing.
- **Slab span** – (propped deck) dictates maximum beam spacing.

## Two stage design

All Composite Floors must be considered in two stages.

- **Wet concrete and construction load**
  - carried by deck alone.
- **Cured concrete**
  - carried by composite slab.

## General design aims

Generally designers prefer to reduce the requirement to provide temporary propping and so the span and slab depth required governs the deck selection. Fire requirements usually dictate slab depth. For most applications, the imposed load on the slab will not limit the design.

## Quick reference and full design

The combination of this manual and ComFlor® 9 software makes both quick reference and full design easy. Indicative design may be carried out from the printed tables, however the software greatly increases the scope available to the design engineer and allows the engineer to print a full set of calculations, which can be used for submission to a Local Authority.

## Concrete choice

Both normal weight concrete and lightweight concrete are used in composite slabs, but in the Eurocodes these are now referred to, as normal concrete (NC) and lightweight aggregate concrete (LWAC) respectively. Normal concrete is made using dense aggregates from natural sources. Lightweight aggregate concrete contains artificially produced aggregates such as expanded pulverized fuel ash pellets. The cement and water contents are higher in lightweight concrete because of the absorption of water by the aggregate. Within ComFlor® 9 for normal concrete, the concrete strength class can be chosen among: C20/25, C25/30, C30/37, C35/45, C40/50 and C45/55. For lightweight concrete, the concrete class can be chosen among: LC25/28, LC30/33, LC35/38, LC40/44, LC45/50 and LC50/55.

Lightweight concrete is commonly used because the obvious advantage of (typically) 25% weight saving can provide economic benefit for the overall design of the structure and its foundations. However, this must be balanced against the effect of a reduced modulus of elasticity, which leads to greater deflections and to lower stud resistances. Lightweight concrete also has better fire insulating qualities than normal concrete, and so thinner slabs may be possible when the 'fire condition' governs the slab design. Unfortunately, lightweight concrete is not always readily obtainable in all areas of the UK. Also, it may not be appropriate if it is to be used in trafficked areas; to achieve a good wearing surface, the finishing process must cover the particles of lightweight coarse aggregate with an adequate, well-trowelled dense surface mortar layer. It also has poorer sound insulation properties than normal concrete.

Ordinary Portland cement is an energy-intensive product, which can and should be replaced by alternatives as far as practical. Commonly available cement replacements are ground granulated blast furnace (GGBS) slag.

and pulverized fuel ash (PFA). Up to 50% replacement is practical with GGBS; rather less with PFA. The designer should consider the effect of such substitution on the strength gain of the concrete and any negative effect this may have on the structure, for example in determining creep effects.

In most building structures, it will not be necessary or cost-effective to specify concrete stronger than C30/37. No structural advantage will be obtained with stronger classes, and in practice the durability of C25/30 is adequate for the internal environment of most composite floors. Class C30/37 may be preferred if a more severe risk of carbonation induced corrosion is anticipated, or if the slab is to be a wearing surface.

## Shrinkage and creep

Shrinkage in concrete occurs during curing (autogenous shrinkage) and as the concrete dries out (drying shrinkage). In accordance with BS EN 1994-1-1, 3.1(4), the effects of autogenous shrinkage may be neglected when determining stresses and deflections. However, the strains due to drying shrinkage are more significant and will need to be considered in structural calculations when the span to depth ratio is greater than 20. Concrete can also develop significant time dependant strains due to creep effects, which need to be considered in composite construction.

## Composite deck durability

In accordance with BS EN 1994-1-1, 4.2, the exposed surfaces of the steel decking shall be adequately protected to resist the particular atmospheric conditions. A Zinc coating, if specified, should conform to the requirements of BS EN 10346. A Zinc coating of total mass 275g/m<sup>2</sup> (including both sides) is sufficient for internal floors in a non-aggressive environment, but the specification may be varied depending on service conditions.

# Composite floor decks - Design information

## Mesh laps in accordance with BS EN 1992-1-1, 8.7.5

Fabric reference	Bar Size (mm)	Minimum lap length (mm) for concrete class		
		C25/30	LC28/35	C30/37 & LC30/33
A142	6	195	180	175
A193	7	230	210	200
A252	8	260	240	230
A393	10	360 (25 Cover)	335 (25 Cover)	320 (25 Cover)
		325 (30 Cover)	300 (30 Cover)	290 (30 Cover)

### Anti-crack mesh

Composite floors are normally designed as simply supported slabs with the profiled sheet itself usually providing the necessary structural reinforcement in the slab. Although in heavily loaded floors, additional bottom reinforcement is sometimes used. Normally only light top reinforcement is provided

As a minimum requirement where the control of crack width is of no interest, BS EN 1994-1-1, 9.8.1(2) recommends that where continuous slabs are designed as simply-supported in accordance with BS EN 1994-1-1, 9.4.2(5), the cross-sectional area of the anti-crack reinforcement above the ribs should be not less than 0.2% of the cross-sectional area of the concrete above the ribs for unpropped construction, and 0.4% of this cross-sectional area for propped construction. The mesh specified in the quick reference Eurocode tables, complies with this clause.

Strictly, this reinforcement is not required at mid-span, but in practice it takes form of blanket coverage of mesh. It applies equally to composite slabs and to composite beams. The reinforcement in the beam design as simply supported should extend over a length of 0.25L each side of the internal support, where L is the length of the relevant span.

Typically, sheets of mesh reinforcement are 4.8 m by 2.4 m. They must be lapped to achieve continuity of the reinforcement. Lap lengths for mesh reinforcement can be calculated using methods given in BE EN 1992-1-1, 8.7.5. The 'mesh laps' table shows the calculated lap lengths for typical wire size and concrete grades, based on the nominal yield strength of 500 N/mm<sup>2</sup>, and have a cover of at least three diameters.

### Forklift trucks

Where forklift truck (or other similar concentrated loading) is expected, 0.5% minimum percentage reinforcement should be used over the supports and the previous stated percentages elsewhere to control cracking. For further information refer to SCI AD 150.

### Exposed floors

In most applications, it is not required to satisfy 'crack width control' criteria where the floor is covered. If however, the floor is not covered, then designers should be aware that there are certain cases where crack width control is essential.

Composite floors are usually covered by finishes, flooring or a computer floor, and because cracking is not visible, light top reinforcement is adequate. However where the composite slab is to be left uncovered, e.g. for power trowelled floor finishes, cracking, particularly over the beams, may not be adequately controlled by the light mesh usually provided, or by FibreFlor alone. The cracking has no structural significance, but the appearance of it, and the possibility of the crack edge breakdown under traffic may be perceived as a problem. In this case, refer to Concrete Society publication, 'Cracking In Composite Concrete/Corrugated Metal Decking Floors Slabs' which provides valid mesh sizing and detailing for specific crack width control. Where forklifts are to be used also refer to Steel Construction Institute advisory note 'AD 150, Composite Floors - Wheel Loads From Forklifts'. Both publications are available from our Technical Advisory Desk.

Control of cracking in accordance with BS EN 1994-1-1, 9.8.1(1) requires that the crack width in hogging moment regions of continuous slabs should be checked in accordance with BS EN 1992-1-1, 7.3. This concerns limiting crack widths to a maximum crack width limit  $w_{max}$  of 0.30mm as specified in Table NA.4 of the UK National Annex to BS EN 1992-1-1. In the absence of specific requirements (e.g. water tightness), it may be assumed that limiting the calculated crack widths to 0.30mm, under quasi-permanent combinations of loads, will generally be satisfactory for composite floors in buildings with respect to appearance and durability. For crack control, sufficient reinforcement is detailed to distribute tensile strains in such a way that many fine cracks form, rather than single large cracks.

However, if control of crack width is of interest, a specified minimum amount of anti-crack mesh is required to control cracking in areas where tension is expected in the hogging moment regions. Unless a more accurate method is used in accordance with BS EN 1992-1-1, 7.3.2, the minimum reinforcement for composite slabs required for crack control width can be calculated in accordance with BS EN 1994-1-1, 7.4.2. This is based on the mean value of tensile strength of the concrete effective at the time when cracks may first be expected to appear. When the age of concrete at cracking cannot be established with confidence as being less than 28 days, a minimum tensile strength of 3.0N/mm<sup>2</sup> may be adopted, which equates to a minimum reinforcement area of 0.43% in accordance with the relevant clause. This reinforcement should extend over the negative moment region, which may be taken as 15% of the span measured either side of the edge of the support. The amount of reinforcement should be distributed transversely by restricting the maximum bar spacing to 200mm. The cover to the top of the slab should be a maximum of 25mm, or as required for durability.

Further details are provided in the Concrete Society publication, 'Cracking In Composite Concrete/Corrugated Metal Decking Floors Slabs'.

# Composite floor decks - Design information

## Minimum/Maximum Anti-Crack Mesh Cover

The concrete cover is the distance between the surface of the reinforcement closest to the nearest concrete surface and the nearest concrete surface. In accordance with BS EN 1992-1-1, 4.4.1.2, minimum concrete cover  $c_{min}$ , shall be provided in order to ensure the safe transmission of bond forces, the protection of the steel against corrosion and adequate fire resistance. Fire cover is not an issue as the anti-crack mesh is positioned in the upper 'cooler' portion of the slab whereas fire would be exposed to the slab underside.

The greater value for  $c_{min}$  satisfying the requirements for both bond and environmental conditions shall use the larger of the following:

- Minimum cover due to bond requirement  $c_{min,b}$
- Minimum cover due to environmental conditions  $c_{min,dur}$  plus the additive safety element  $c_{dur,y}$
- 10mm

The minimum cover due to bond requirement is the bar diameter. The minimum cover due to environmental conditions is based on exposure and structural classes. Structural classes are determined in accordance with BS EN 1990 Clause 2.3, Table 2.1. It is based on the design working life category, ranging from a minimum 10 years for S1, and up to 100 years for S5. The recommended structural class for a design working life of 50 years is S4.

For internal floors in a watertight heated building, with dry conditions would be class XC1 in accordance with BS EN 1992-1-1, Table 4.1. Therefore the minimum cover for a XC1 S4 classification is 15mm, and that a nominal cover as described as the minimum cover plus a fixing tolerance of 10mm would give a minimum of 25mm. However, in practice, nominal covers less than 30mm with light mesh fabrics are not recommended owing to the practical difficulty in supporting the mesh in the correct location.

For lightweight aggregate concrete, the same indicative exposure classes can be used as for normal density concrete, but that the minimum concrete cover shall be increased by 5mm.

In accordance with SCI P300 'Composite Slabs and Beams Using Steel Decking: Best Practice for Design and Construction, a nominal cover of 25mm is stated for an exposure level XC1, for all concrete cylinder strengths for both normal (C25/30 to C40/50) and lightweight concrete (LC25/28 to LC32/35). This nominal cover of 25mm is the minimum cover plus a fixing tolerance of 10mm.

In practice, we recommend a nominal top cover of 30mm for mesh and is set as default in the ComFlor® 9 composite slab design software. However when improved crack control is required in the hogging regions for exposed slabs a 25mm maximum cover is recommended, as noted in the paragraph above, which will require much tighter site control of mesh position.

## Bar reinforcement

The axis distance of bar reinforcement defines the distance from the bottom of the ribs to the centre of the bar, which has a minimum value of 25mm, and a maximum value of the profile height. Where used, bar reinforcement is placed at one bar per profile trough.

For ComFlor® 225 to both BS and EC, the bar axis for fire resistance periods of 60, 90 and 120 minutes are 70, 90 and 120mm respectively.

## Transverse reinforcement

Longitudinal transverse reinforcement in composite beams are designed in accordance with BS EN 1994-1-1, 6.6.6.4. The longitudinal shear resistance of the concrete slab must be checked to ensure that the force from the shear connectors can be transferred into the slab without splitting the concrete. This requires the provision of transverse reinforcement (perpendicular to the beam centre-line). It is usually found that mesh or fibre reinforcement is sufficient for the design of secondary beams, where the decking ribs run perpendicular to the beam. For beams where the ribs run parallel to the beam such as primary beams, additional bar reinforcement is likely to be required. Potential shear planes through the slab lie on either side of the supporting beam. The shear resistance per unit length of the shear plane

along the beam is a function of concrete strength and the amount of reinforcement provided. For edge beams, 'U' bars should be used. The decking may also act as part of the transverse reinforcement to contribute to the longitudinal shear resistance.

Decking that is continuous and transverse to the beam will contribute to the transverse reinforcement. Decking that is transverse to the beam but discontinuous over the top flange may still contribute to the transverse reinforcement, provided it is fixed to the beam by shear studs welded through the steel sheeting. The contribution to the transverse reinforcement then becomes a function of the design bearing resistance of the shear stud welded through the decking. The contribution of the decking should always be neglected where it is not properly anchored at discontinuities, or where the decking ribs run parallel to the beam. Studs fixed in a single line at a butt joint in the decking do not provide sufficient anchorage for the decking to contribute to the transverse reinforcement. Primary beams must generally rely on supplementary rebar and mesh. Any contribution from parallel decking is neglected, even if the studs are welded through the sheet, because side laps are likely to occur within the width of the effective concrete flange, causing a discontinuity in the decking resistance. Side lap fasteners do not provide meaningful resistance to longitudinal shear. Even without joints, a parallel deck cannot be considered to provide the transverse tensile resistance. If the mesh and decking do not provide the resistance required, additional transverse rebar must be provided. Further guidance on transverse reinforcement can be found in SCI P359, AD 192 and AD 266.

# Composite floor decks - Design information

## Modular ratio

The modular ratio defines the ratio of the elastic modulus of steel to concrete, as modified for creep and shrinkage in the concrete as necessary. In the absence of more precise information, the EC modular ratios for normal and lightweight concrete are 10 and 15 respectively.

## Bearing requirements

The bearing length is the longitudinal length of decking or slab in direct contact with the support. In each case, this length should be sufficient to satisfy the following relevant criterion. For decking, it should be sufficient to avoid excessive rib deformations, or web failure, near the supports during construction. For the slab, it should be sufficient to achieve the required load carrying capacity of the composite slab in service.

In accordance with BS EN 1994-1-1, 9.2.3(1), the bearing length shall be such that damage to the slab and the bearing is avoided; that fastening of the deck to the bearing can be achieved without damage to the bearing and that collapse cannot occur as a result of accidental displacement during construction.

The recommended bearing lengths and support details differ depending upon the support material (steel, concrete, etc), and they are different for end and continuous supports.

Bearing lengths in accordance with BS EN 1994-1-1, 9.2.3(2) should not be less than the following limiting values:

- Composite slabs bearing on steel or concrete supports should have a minimum end bearing length of 75mm for the slab, and minimum end bearing of 50mm for the decking. For continuous decking, the minimum overall bearing width should be 75mm.
- Composite slabs bearing on materials other than steel or concrete should have a minimum end bearing length of 100mm for the slab, and minimum end bearing of 70mm for the decking. For continuous decking, the minimum overall bearing width should be 100mm.

## Fire design

BS EN 1994-1-2, 2.1.2 defines the failure criteria for nominal fire exposure under three headings, namely load bearing capacity (R), integrity (E), and insulation (I). A structural element must maintain adequate load bearing capacity for the required period in fire conditions and, if it is also a separating element, then insulation and integrity criteria must also be fulfilled. Composite floor slabs are often designed to be separating elements and must therefore behave adequately in accordance with each of these performance criteria.

The structural resistance of composite slabs in fire conditions can be determined from the design methods given in BS EN 1994-1-2. Fire design for composite slabs may be based on the plastic moment resistance of the slab, allowing for continuity over the supports in accordance with BS EN 1994-1-2, 4.3.1, provided that rotational capacity can be assured. Unlike design at room temperature, the decking provides considerably less tensile resistance, whereby additional trough bottom bar reinforcement in the slab becomes the principle reinforcement. BS EN 1994-1-2 expects reinforcing bars to be placed in the ribs of the slab, but test evidence in the UK shows that adequate performance can also be achieved using mesh reinforcement without bottom bars, provided that the slab is continuous over at least one support.

BS EN 1994-1-2 refers to its Annex D for calculation of the insulation and load bearing capacity. However, the use of Annex D is not recommended by the UK National Annex, to BS EN 1994-1-2. Alternative guidance is provided by the non-contradictory complementary information (NCCI) document PN005c-GB published by the Steel Construction Institute. This document provides guidance on calculating suitable design temperatures to be used in the calculation of plastic moment resistance to BS EN 1994-1-2, 4.3.1, and also on how the insulation criterion may be satisfied. The insulation requirements will be met provided that the minimum thickness of concrete is not less than the specified in NCCI PN005c-GB Table 3.1 and Table 3.2 for composite slabs comprising of trapezoidal and re-entrant profile sheeting respectively.

Within ComFlor® 9, two fire design methods exist. The capacity of the composite slab in fire may be calculated using either 'Mesh and Deck Method' or 'Bar Method'. Both methods are based on the NCCI principles. The 'Mesh and Deck Method' will be the most economic as no bottom bar reinforcement is required in the troughs of the deck. The resultant tensile resistance and corresponding moment capacity is provided by a single or double layer of standard anti-crack mesh in addition with the reduced strength of the 'heated' deck. If further fire resistance is required then reinforcement bar in each deck troughs is required in the 'Bar Method'. This method does not use deck and mesh contribution. When trough reinforcement is introduced, then the mesh will often be above the neutral axis and make no contribution to the plastic moment capacity. At current, there is no method for the combined contribution of deck and trough reinforcement.

Load/span tables for both 'Mesh and Deck Method' and 'Bar Method' and provided in this brochure. Within the 'Mesh and Deck Method' load/span tables, the minimum amount of mesh required for fire resistance is provided in brackets in each cell. This is usually greater than the minimum mesh required for cracking control.

Within the 'Bar Method' load/span tables, the minimum amount of trough reinforcement required for fire resistance is provided in brackets in each cell. Minimum mesh required is for cracking control only.

## CE Marking

All ComFlor® composite decks are CE marked in accordance with BS EN 1090. Declaration of Performance (DOP) specifications can be found on our website.

# Composite floor decks - Design information

## End anchorage from shear studs

End-anchorage from shear studs may be considered in ComFlor® 9, however the input only allows for ONE stud per trough. Note that a maximum of two studs per trough is permitted for the composite beam design – for an edge beam only one stud will be adjacent to the edge of the sheet, and for an internal beam only one stud will be anchored in the discontinuous sheet.

## Construction stage deflection limits

At the construction stage, there is an important link between the leveling technique used in construction, the deflection of the bare steel and the consequent volume and weight of the concrete. It may be necessary to limit the deflection of the decking to limit the effects of ponding of concrete during construction and the increase in dead weight as a result. According to BS EN 1994-1-1, 9.3.2(2), if the central deflection of the decking is greater than a tenth of the slab thickness, ponding should be considered. BS EN 1994-1-1, 9.6(2) states that the deflection of the decking under its own weight plus the weight of wet concrete, excluding the construction load, should not exceed the limits provided in the UK National Annex 1994-1-1, NA.2.15.

Where additional loads due to ponding of wet concrete are ignored when determining the loading, a more onerous deflection limit is used to check the decking at serviceability. In these cases, the mid-span deflection should be limited to the lesser of:

- Effective span/180 and 20mm.

Where additional loads due to ponding of wet concrete are included, the mid-span deflection should be limited to the lesser of:

- Effective span/130 and 30mm.

It is recommended that the prop width should not be less than 100mm. We are not required to account for beam deflection in composite floor deck design, however if the slab is laser leveled, beam deflection may be significant to the load on the deck, the load on the beam and the dead load on the frame. Therefore, if laser leveling is to be used, design slab depth should be significantly more than the nominal slab depth, to account for it when calculating deflections and loads, but not when calculating strength.

## Vibration

The dynamic sensitivity of composite slabs is not normally critical, because they are relatively stiff compared with the beams, although the dynamics of the whole floor should be considered. To ensure that the walking activities will be outside the range, which could cause resonant or close-to-resonant excitation of the fundamental mode of vibration of the floor, no floor structure should have a fundamental frequency less than 3Hz. Similarly, no single element i.e. the composite slab within the floor structure should have a frequency less than 3Hz. Floors that may be subject to rhythmic group activities should not normally be designed to have a natural frequency less than 5Hz. Therefore in the absence of more appropriate information, the natural frequency of the composite slab should not exceed 5Hz for normal office, industrial or domestic usage. Conversely, for dance floor type applications or for floors supporting sensitive machinery, the limit may need to be set higher. On this basis the ComFlor® 9 design software has a default natural frequency limit of 5Hz.

The dynamic sensitivity of the composite slab within ComFlor® 9 is checked in accordance with the Steel Construction Institute publication P076: Design guide on the vibration of floors. The natural frequency is calculated using the self-weight of the slab, superimposed dead load, and 10% of the characteristic imposed loads, representing the permanent loads and the floor.

For design to the Eurocodes, the loads considered for the vibration check are increased using the psi-factor for imposed loads (typically 0.5). The natural frequency limit may be reduced to 4Hz, because of this higher load, used in the calculation.

To determine the vibration response of sensitive floors with improved accuracy, calculation methods are given in SCI publication P354 “Design of Floors for Vibration: A New Approach”. This enables designers to compare the response with the acceptance levels in BS 6472 and ISO 10137 for building designs and in the NHS performance standard for hospitals, HTM 2045.

The relevant Eurocode requirements regarding vibration are given in:

1. BS EN 1990, 3.4(3) – The verification of serviceability limit state should be based on criteria concerning vibrations that cause discomfort to people, or that limit the functional effectiveness of the structure.
2. BS EN 1990, A1.4.2 - Stiffness criteria may be expressed in terms for vertical deflections and for vibrations.
3. BS EN 1990, A1.4.4 – The natural frequency of vibrations of the structure or structural member should be kept above appropriate values.
4. BS EN 1993-1-1, 7.2.3 (1)B – With reference to EN 1990 Annex A1.4.4, the vibrations of structures on which the public can walk should be limited to avoid significant discomfort to users, and limits should be specified for each project and agreed with the client. The National annex may specify limits for vibrations of floors.
5. BS EN 1993-1-1 National Annex, NA.2.25 – Reference should be made to specialist literature as appropriate. For floor vibrations see NA.4. Reference is made to NCCI: Vibrations SN036a-EN-EU.
6. BS EN 1994-1-1, 7.3.2(1) - The dynamic properties of floor beams should satisfy the criteria in BS EN 1990, A1.4.4.

# Composite floor decks - Design information

## Loads and load arrangement

### Construction loads on profiled steel decking (SCI AD 346)

#### Construction loads applied during the casting of concrete

The construction loads ( $Q_c$ ) during the casting of concrete are covered in BS EN 1991-1-6 Clause 4.11.2.

The diagram implies that the load within the working area would be no greater than the outside working area, unless the slab weight exceeds  $7.5 \text{ kN/m}^2$ , which is much greater than in normal composite decks. This further implies that there would be no allowance for heaping of concrete in the working area. SCI considers that the omission of an allowance for heaped concrete is unwise, and may not have been intended. Consequently, SCI recommends the following construction loads during casting of concrete for a composite slab:

1.  $0.75 \text{ kN/m}^2$  generally
2. An additional of 10% of the slab weight or  $0.75 \text{ kN/m}^2$ , whichever is greater, over a  $3 \text{ m} \times 3 \text{ m}$  working area. This area should be treated as a moveable patch load that should be applied to cause maximum effect.

#### Allowance for the weight of wet concrete and reinforcement

The densities and self-weight of construction materials are given in BS EN 1991-1-1, and the data is informative. However, SCI believe that the increase in density of concrete due to the reinforcement of  $1 \text{ kN/m}^3$  given in BS EN 1991-1-1, Annex A, Table A.1 is appropriate for reinforced concrete but not for composite floors, which have only a relatively light mesh. It is also noted that the weight of wet concrete is to be treated as a variable action. For composite slabs then, SCI recommends the following loads for the weight of concrete and reinforcement:

1.  $24 \text{ kN/m}^3$  for dry normal concrete and  $19 \text{ kN/m}^3$  for dry lightweight aggregate concrete.
2.  $25 \text{ kN/m}^3$  for wet normal concrete and  $20 \text{ kN/m}^3$  for wet lightweight aggregate concrete.
3. The weight of the reinforcement for the specified mesh; the value should thus be determined on a case-by-case basis.
4. The self weight of the wet concrete is treated as a variable action for the construction condition.
5. The self weight of the reinforcement is treated as a permanent action.

#### Lateral restraint and diaphragm action in construction phase

Once it is fixed down, ComFlor® steel decking will provide temporary lateral restraint to stabilise the beams and/or diaphragm action to stabilise the building as a whole before the concrete is cured. After curing the composite slab provides this function.

The SCI publication P360 - Stability of steel beams and columns, section 3.12 explains the lateral restraint design check, when deck is running perpendicular to the beam (deck parallel to the beam does not offer lateral restraint). Diaphragm action may be checked using the methodology in the SCI advisory desk document AD 175 - Diaphragm action of steel decking during construction.

## Acoustic detailing for steel construction (SCI P372)

Acoustic performance of composite floors is covered in SCI P372. The construction details of floors and walls of a building is the key to its acoustic performance i.e. the transmission of sound from one part of the building to another. The purpose of this publication is to describe the composite floor and wall construction that can be used in steel-framed buildings to achieve levels of acoustic performance demanded by current regulations. The expected acoustic performance of composite floor decks, have been derived by using a combination of published literature and results from on-site acoustic testing. This publication updates and extends the guidance given in previous SCI publications P128, P320, P321, P322 and P336. However, P321 and P322, entitled "Acoustic Performance of Slimdek" and "Acoustic Performance of Composite Floors" for standard decks, covers the acoustic design in greater detail. Both publications highlight the requirements of Part E of the building regulations and then show how the acoustic requirements can be achieved with various forms of composite floor construction, such as screed, platform, raft or cradle floor. Indicative acoustic performance ratings for both airborne sound insulation and impact sound transmission are provided for each type of construction, which achieve the performance requirements demanded by the current building regulations.

#### Acoustic Performance Prediction Tool for Separating Floors

<http://bcstools.steel-sci.org/Acoustics/>

Disclaimer. The values predicted by this tool should only be used for scheme design purposes to give an indication of performance.

# Composite floor decks - Design information

## Openings

Openings can be accommodated readily in composite slabs, by boxing out prior to pouring concrete and cutting out the deck after concrete has cured (see sitework section on page 65). The design of openings depends on their size:

### Small

Openings up to 300mm square - do not normally require additional reinforcement.

### Medium

Openings between 300mm and 700mm square - normally require additional reinforcement to be placed in the slab. This is also the case if the openings are placed close together.

### Large

Openings greater than 700mm square - should be trimmed with additional permanent steelwork back to the support beams.

### Opening rules

Where  $W$  = width of opening across the span of the deck.

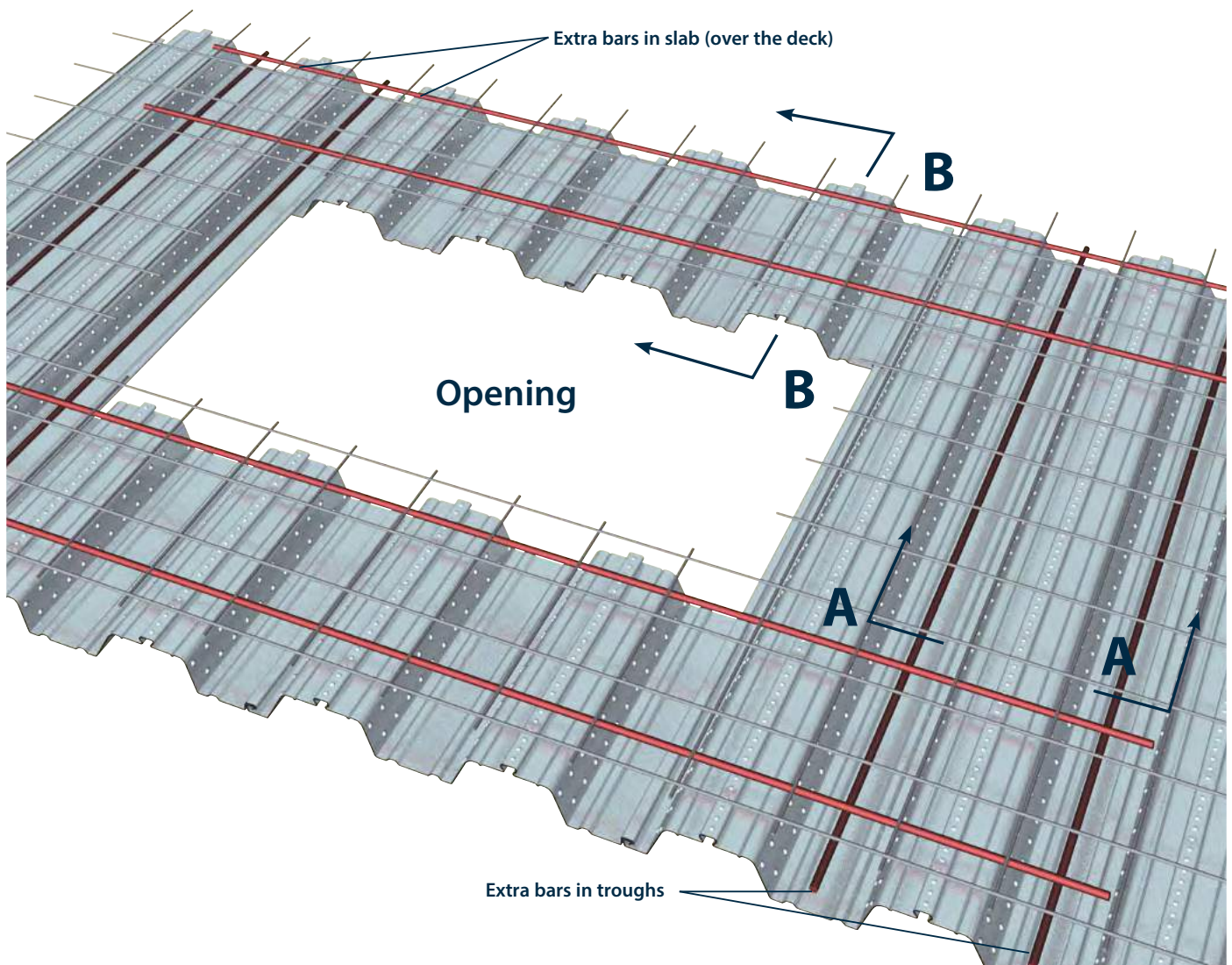
1. The distance between the opening and unsupported edge must be greater than 500mm or  $W$ , whichever is the greater.
2. Openings must not be closer together than  $1.5W$  (of the largest opening) or 300mm, whichever is the greater. If they are closer they must be considered as one opening.

3. Not more than 1/4 width of any bay is to be removed by openings.

4. Not more than 1/4 width of deck span is to be removed by openings.

Where these rules are not satisfied, the openings must be fully trimmed with support steelwork.

If the opening falls within the usual effective breadth of concrete flange of any composite beams (typically span/8 each side of the beam centre line), the beam resistance should be checked assuming an appropriately reduced effective breadth of slab.



Reinforcement around opening

# Composite floor decks - Design information

## Slab design around openings

It may be assumed that an effective system of 'beam strips' span the perimeter of the opening. The effective breadth of the beam strips should be taken as  $d_o/2$ , where  $d_o$  is the width of the opening in the direction transverse to the decking ribs. Only the concrete above the ribs is effective.

The transverse beam strips are assumed to be simply supported, and span a distance of  $1.5 d_o$ . The longitudinal beam strips are designed to resist the load from the transverse beam strips, in addition to their own proportion of the loading.

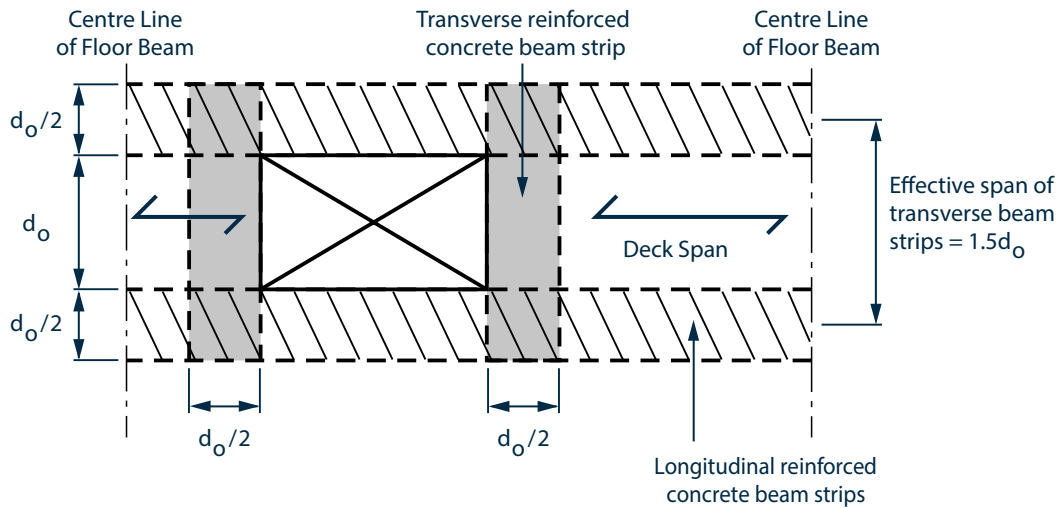
## Reinforcement

Extra reinforcement is provided within the 'beam strips' to suit the applied loading. This reinforcement often takes the form of bars placed in the troughs of the decking.

Additional transverse or diagonal bars may be used to improve load transfer around the opening.

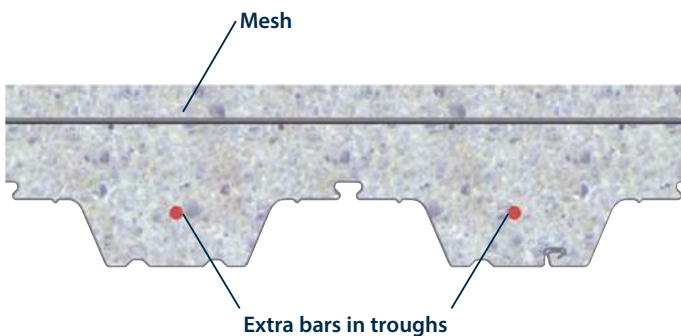
## Further Guidance

Further guidance on forming openings in composite slabs, see SCI P300 'Composite slabs and beams using steel decking. Best practice for design and construction'.

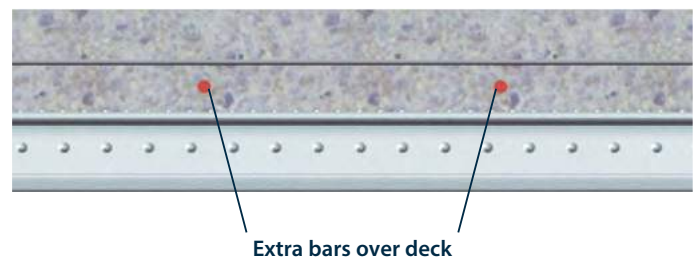


Load paths and beam strips around medium to large openings

## Section A-A



## Section B-B



# Composite floor decks - Design information

## Design of shear studs

### Composite beam design

Savings in beam weight of up to 50% can be achieved when the composite slab is effectively anchored to the steel beam. The slab will then act as a compression flange to the beam. The methods of connection between slab and beam is generally by means of through deck welding of 19mm diameter shear studs of varying height, which are fixed to the beam after the decking has been laid.

### Shear stud design resistance

The design rules for determining the resistance of headed studs used as shear connectors with profiled steel decking are given in BS EN 1994-1-1 Clause 6.6.4. Rules for sheeting spanning parallel to the supporting beam are given in BS EN 1994-1-1 Clause 6.6.4.1, while 6.6.4.2 covers decking transverse to the supporting beam. The resistance of a headed stud within the decking trough is determined by multiplying the design resistance for a headed stud connector in a solid concrete slab by a reduction factor  $k$ .

Shear connectors should be spaced along the beam in accordance with an appropriate longitudinal shear force distribution. Consideration must also be given to the need to prevent separation between the steel and concrete. To prevent uplift, the shear connector should have a tensile resistance equal to at least a tenth of its shear resistance; headed shear studs can satisfy this requirement. When ductile shear connectors are used, the studs may be spaced uniformly along the beam, which simplifies the design.

### Shear stud design reduction

The reduction factor  $k$  as shown in the table below can be applied to the appropriate profile where the following criteria are met:

- The studs are placed in profile ribs with a height  $h_p$  not greater than 85mm.
- The average trough width  $b_s$  is not less than  $h_p$ .
- For through deck welding, the diameter of the studs is not greater than 20mm.

### Shear stud specification

The most common type of shear connection used in composite beams in buildings is the 19mm diameter headed shear stud. This is the only diameter of shear stud that can be practically used for through-deck welding.

BS EN ISO 13918 gives the specifications for welded studs. The length of the stud after welding will depend on the initial stud length and the method of welding used. For design, it is the finished length of the stud after welding,  $h_{sc}$ , that is used to calculate stud resistance. The height of a shear stud should not extend less than  $2d$  above the deck rib, where  $d$  is the diameter of the stud shank.

The minimum width of the troughs that are to be filled with concrete should not be less than 50mm. The commonly available lengths of through-deck shear studs in the UK are 100 and 130mm, which results in as-welded heights after weld of 95 and 125mm. The 19mm x 100mm (95mm length after weld) studs are used with ComFlor® 46, ComFlor® 51+ and ComFlor® 60. 19mm x 130mm (125mm length after weld) studs are used with ComFlor® 80.

### Stud spacing

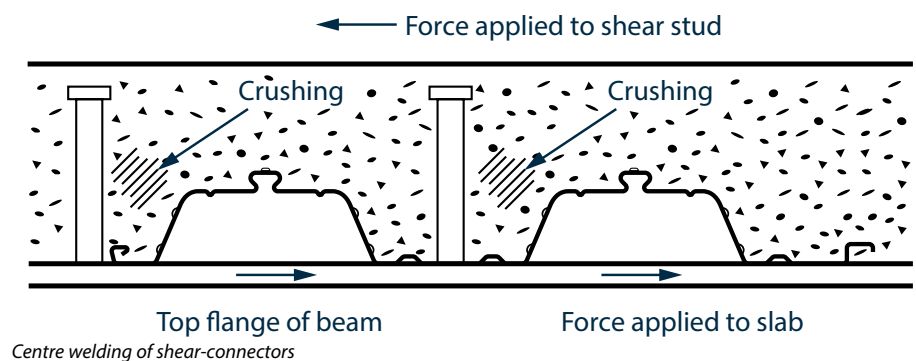
In accordance with BS EN 1994-1-1 Clause 6.6.5.6, the minimum distance  $e_o$  between the edge of a connector and the edge of the beam flange to which it is welded should not be less than 20mm. In accordance with BS EN 1994-1-1 Clause 6.6.5.7, the spacing of studs in the direction of shear force should not be less than  $5d$ , whereas the spacing in the direction transverse to the shear force should not be less than  $4d$ , where  $d$  is the diameter of the stud shank.

### Mesh positioning and K factor modification (NCCI PN001a-GB)

Current practice, using modern trapezoidal decks, is to provide only a single layer of mesh and the position of that mesh does not comply with the requirement in BS EN 1994-1-1, 6.6.5.1 that there should be a clear distance of at least 30mm above it and below the underside of the head of the stud. However, although not explicitly stated in BS EN 1994-1-1, it is believed that that detailing requirement should only be applied to solid slabs. Indeed, its reference to 'lower reinforcement' is meaningless for a composite slab, which usually has only a single layer of mesh. Between 2006 and 2008 further experimental work was conducted on beam tests and push tests using typical modern trapezoidal decks and a single layer of mesh reinforcement above and below the stud head. Design values were determined for 19mm diameter headed stud connectors with an as-welded height not less than 95mm. As a result of the experimental work, modification factors  $k_{mod}$  which can be applied to the design resistance values given by BS EN 1994-1-1 have been derived for this situation; the modification factors may be applied to the values given by BS EN 1994-1-1 as an alternative to the modification of the partial safety factors that is permitted by the UK National Annex. This work is presented in the SCI publication 'NCCI: Resistance of headed stud shear connectors in transverse sheeting NCCI PN001a-GB'.

### BS EN 1994-1-1 Reduction Factor $k$

	Ribs perpendicular (transverse) to beam		Ribs parallel to beam
	1 stud/rib	2 studs/rib	
ComFlor® 46 & ComFlor® 51+ - 1mm or less	0.85	0.70	1.00
ComFlor® 60 - 1mm or less	0.85	0.70	0.85
ComFlor® 46 & ComFlor® 51+ - greater than 1mm	1.00	0.80	1.00
ComFlor® 60 - greater than 1mm	1.00	0.70	0.85
ComFlor® 80	0.66	0.47	0.57



# Composite floor decks - Design information

The design shear resistance of headed stud connectors in trapezoidal decking with ribs transverse to the beam may be calculated in accordance with BS EN 1994-1-1, 6.6.4.2, provided that the resistance value given by BS EN 1994-1-1, Equation 6.19 i.e. the resistance of the concrete, is multiplied by a reduction factor to take into account the shape of the concrete surrounding the shear stud. Depending on whether the anti-crack mesh is positioned above or below the head of the shear stud, the shear stud capacity within the deck trough is then further multiplied by the relevant  $k_{mod}$  given in the table below. For these modified shear stud design resistances, the mesh position need not comply with BS EN 1994-1-1, Clause 6.6.5.1, provided certain conditions are satisfied as given in the NCCI PN001a-GB document.

## Minimum degree of shear connection for composite beams

The number of studs required on a range of beams may be reduced by referring to SCI publication P405 – Minimum degree of shear connection rules for UK construction to Eurocode 4. This publication presents design resistances for shear studs when used in the presence of modern forms of decking. It includes rules for the minimum number of studs that are needed on a range of beams to satisfy the minimum degree of shear connection. In many cases this minimum is lower than would be required by EN 1994-1-1 (and indeed BS 5950-3.1 prior to its amendment in 2010).

Consideration is given in P405 to steel grade, beam span, and asymmetry as in 1994-1-1, but further variables included are: propped or unpropped beams, composite deck type and orientation, level of loading and beam utilisation. These rules can allow a lower degree of shear connection which results in the need for fewer shear studs. Further detailed information and design tables can be found on our website at the link:

[Minimum degree of shear connection for ComFlor® on composite beams.](#)

## Provision of 'appropriate anchorage' to profiled sheeting (NCCI PN003a-GB)

BS EN 1994-1-1 allows shear stud resistances to be calculated for decking parallel to the supporting beam whether the deck is continuous or not. However, if the deck is not continuous and is not appropriately anchored to the beam, then the reinforcement should satisfy BS EN 6.6.5.4. This involves dimensional restrictions and rebar bent into the trough, which is impractical. It is therefore all but obligatory to provide appropriate anchorage, and means to achieve this is given in NCCI PN003a-GB.

## Suitability of decks

Shear studs cannot be placed on profile stiffeners, however with ComFlor® 51+, 60 and 80 the position of the stiffeners and side lap allows central placement of studs.

**N.B. ComFlor® 100 is not suitable for use with shear connectors.**

## Non-welded shear connectors

Hilti shear connectors may be used. Refer to Hilti for further information.

## Design guide

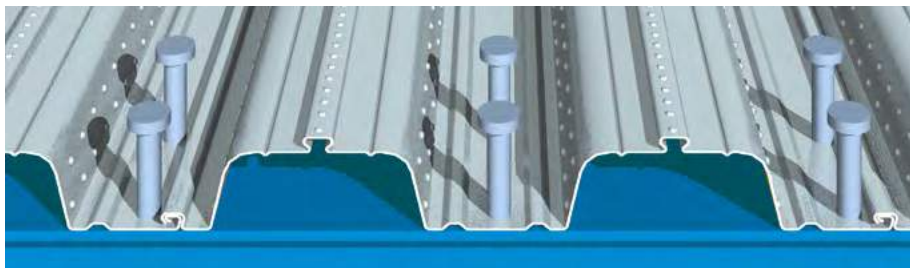
The Steel Construction Institute/Metal Cladding & Roofing Manufacturers Association P300 'Composite Slabs and Beams using Steel Decking: Best Practice for Design and Construction' is recommended by Tata Steel for further reference.

Shear connection detailing is also covered in Section 4.4 of SCI Publication P359 'Composite Design of Steel Frames Buildings – In accordance with Eurocodes and the UK National Annexes'.

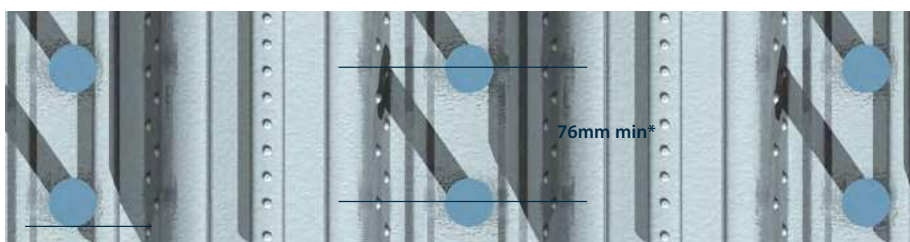
## Factor to apply to solid slab design shear resistance values derived from BS EN 1994-1-1, 6.6.3.1 Equation (6.19) using partial safety factor of 1.25

Stud No. per trough	Position of Mesh	$k_{mod}$
1	Above the heads of the studs	1.00
1	At least 10mm below the heads of the studs	1.00
2	Above the heads of the studs	0.70
2	At least 10mm below the heads of the studs	0.90

**Note:** Positioning the mesh below the heads may have practical implications i.e. crack and/or fire control.



CENTRAL STUDS

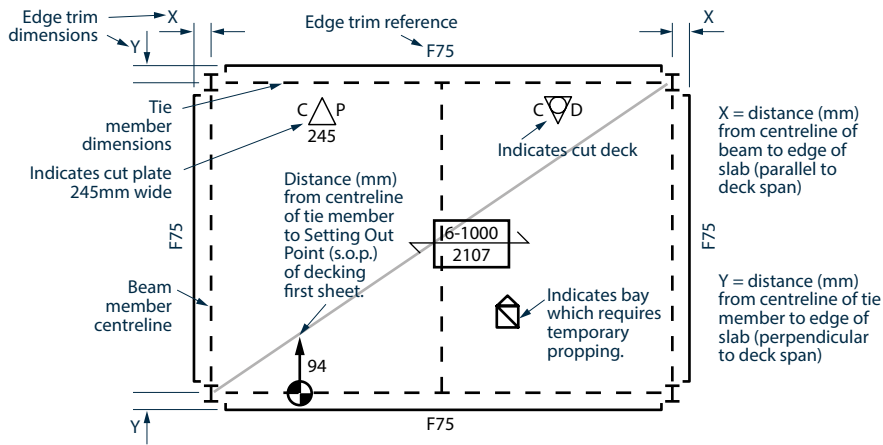


↑ 20mm min., edge of stud to edge of beam

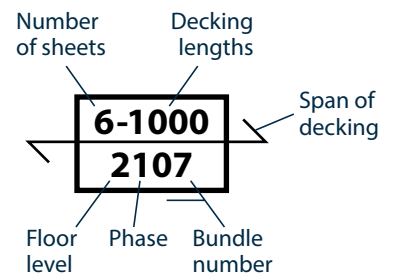
\*76mm = 4d for 19mm studs

# Composite floor decks - Construction details

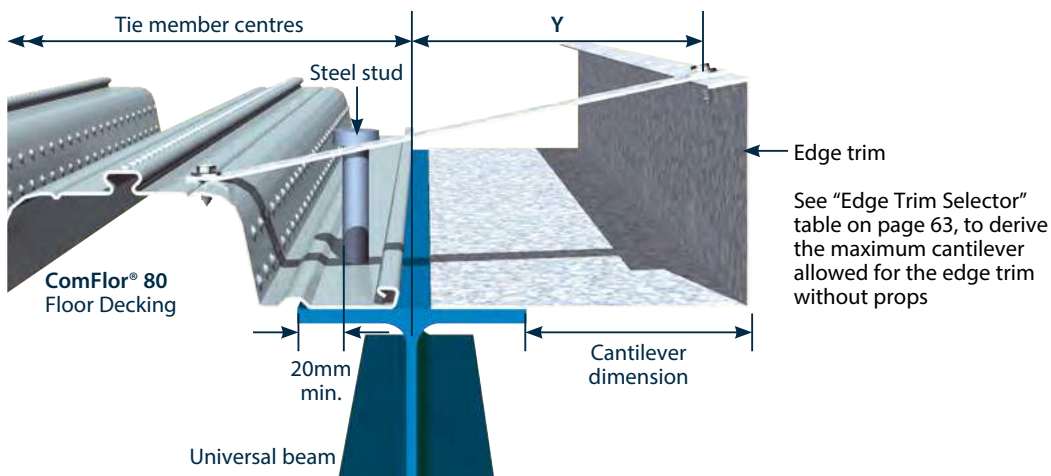
Plan view of typical floor layout



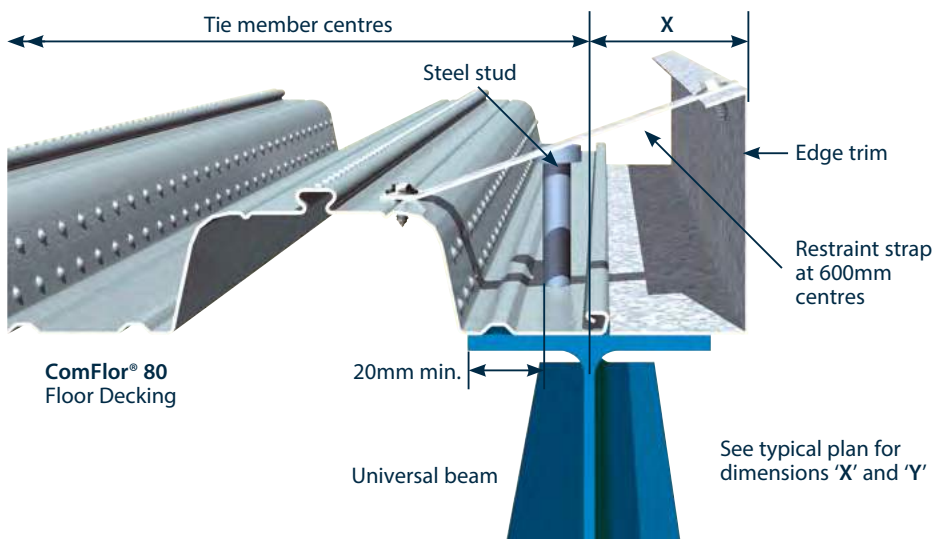
Deck notation



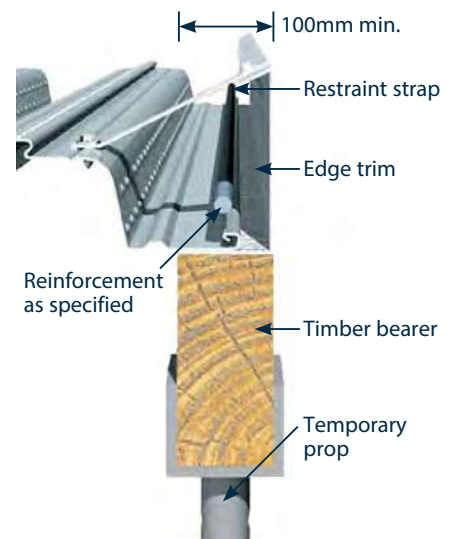
Typical side detail



Typical side detail

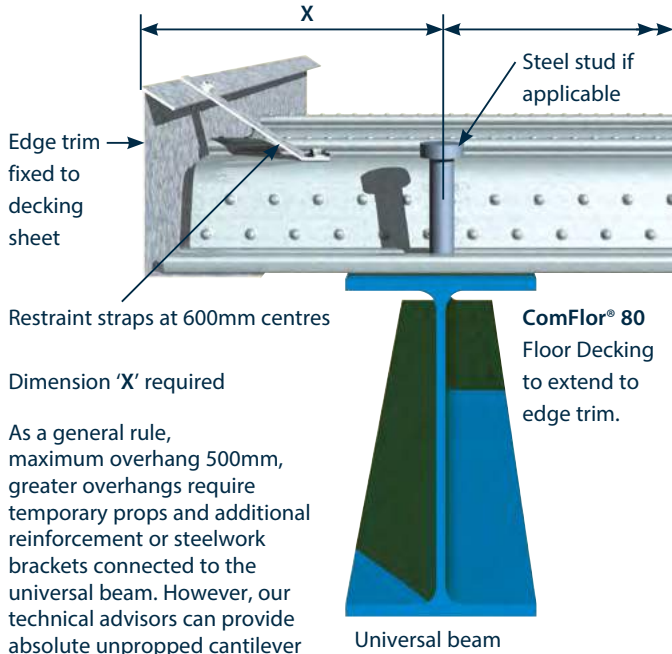


Unsupported edge detail



# Composite floor decks - Construction details

## Typical end overhang

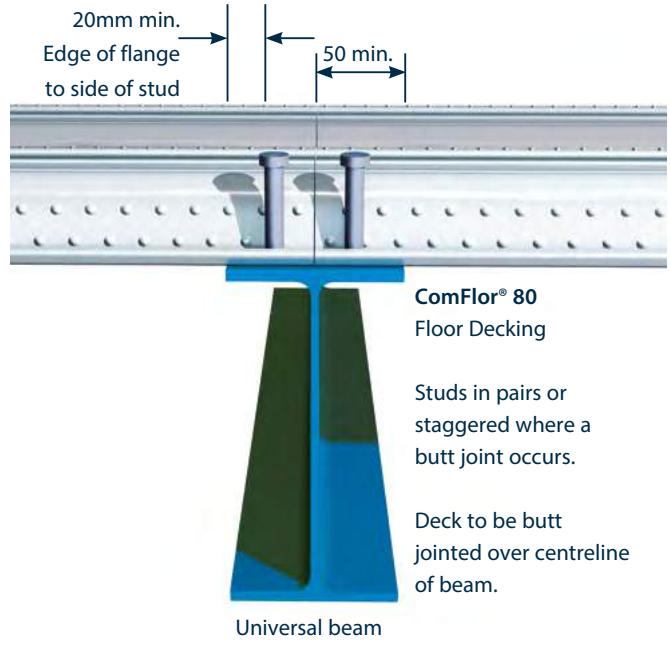


Restraint straps at 600mm centres

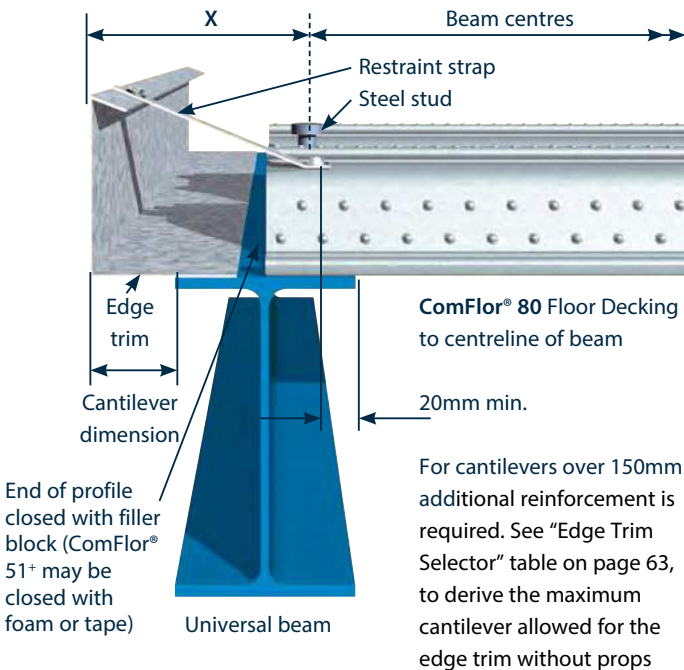
Dimension 'X' required

As a general rule, maximum overhang 500mm, greater overhangs require temporary props and additional reinforcement or steelwork brackets connected to the universal beam. However, our technical advisors can provide absolute unpropped cantilever lengths and also steel tensile slab reinforcement requirements based on the relevant deck and slab specification.

## Butt joint



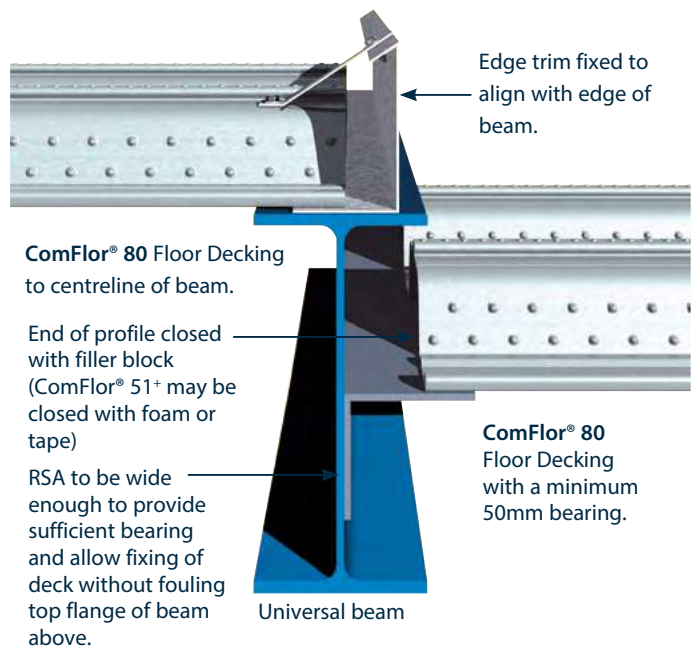
## End detail



End of profile closed with filler block (ComFlor® 51+ may be closed with foam or tape)

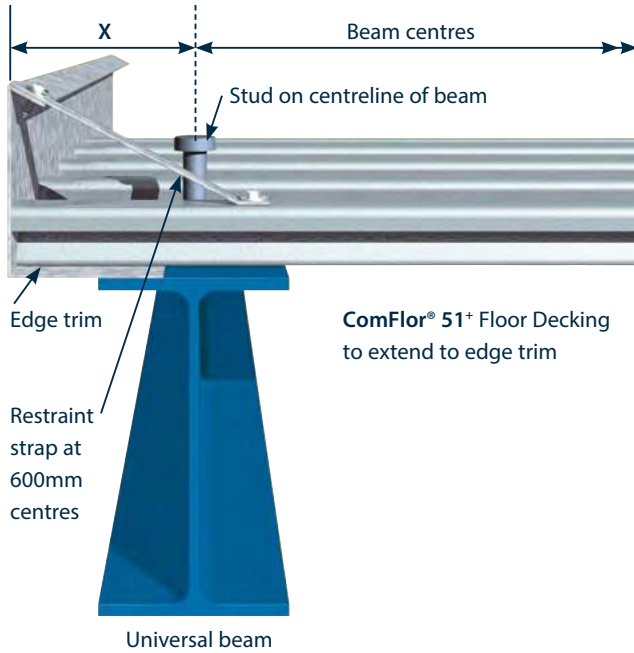
For cantilevers over 150mm additional reinforcement is required. See "Edge Trim Selector" table on page 63, to derive the maximum cantilever allowed for the edge trim without props

## Step in floor

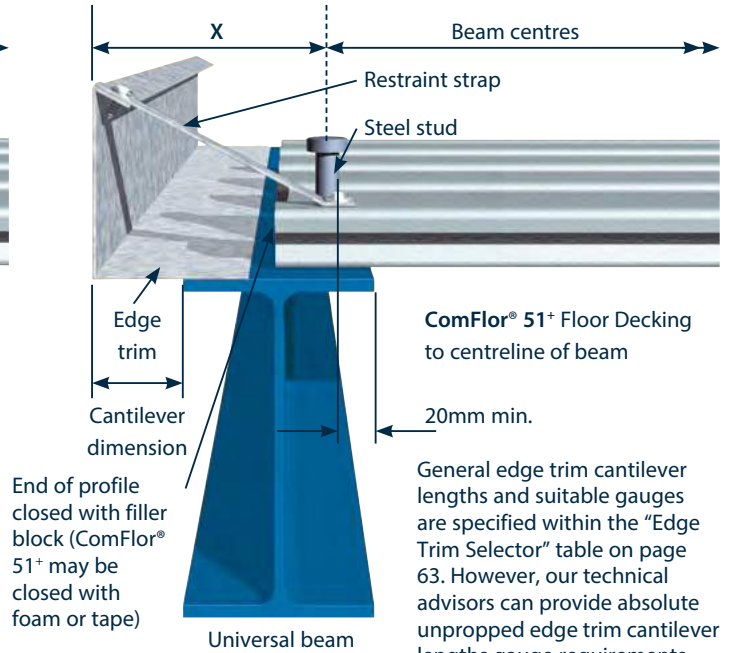


# Composite floor decks - Construction details

End detail alternative 1

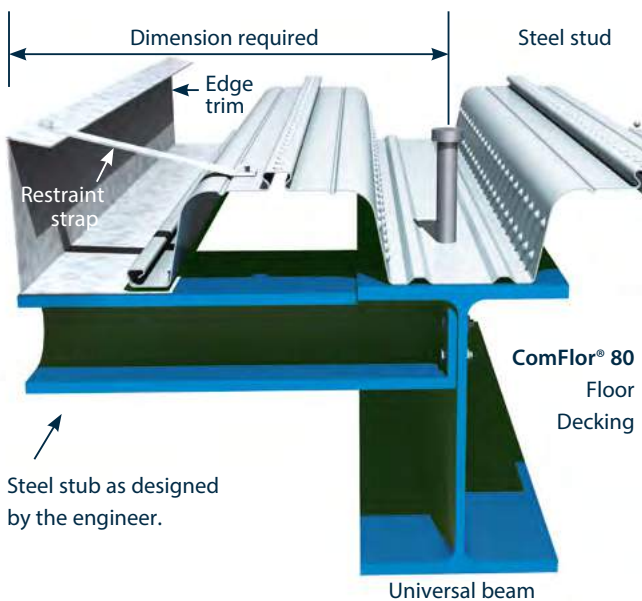


End detail alternative 2

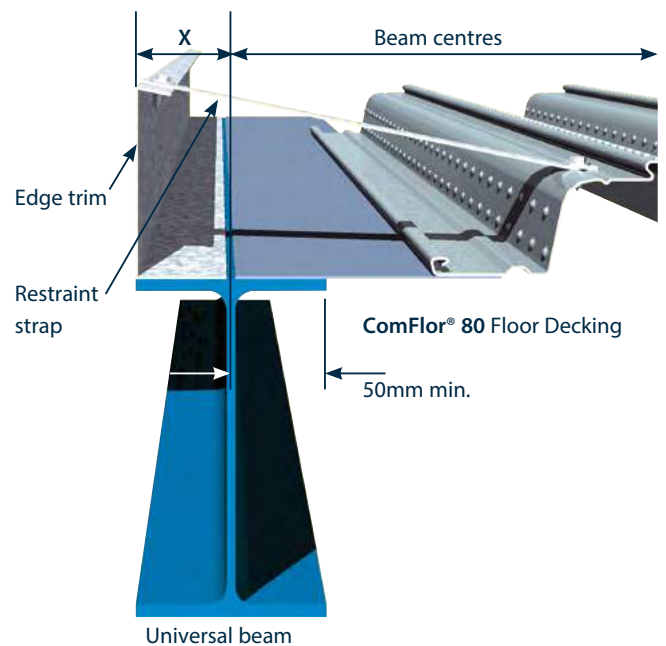


General edge trim cantilever lengths and suitable gauges are specified within the "Edge Trim Selector" table on page 63. However, our technical advisors can provide absolute unpropped edge trim cantilever lengths gauge requirements based on the relevant deck and slab specification. For cantilevers over 150mm additional reinforcement is required. See "Edge Trim Selector" table on page 63, to derive the maximum cantilever allowed for the edge trim without props.

Cantilever with stub bracket

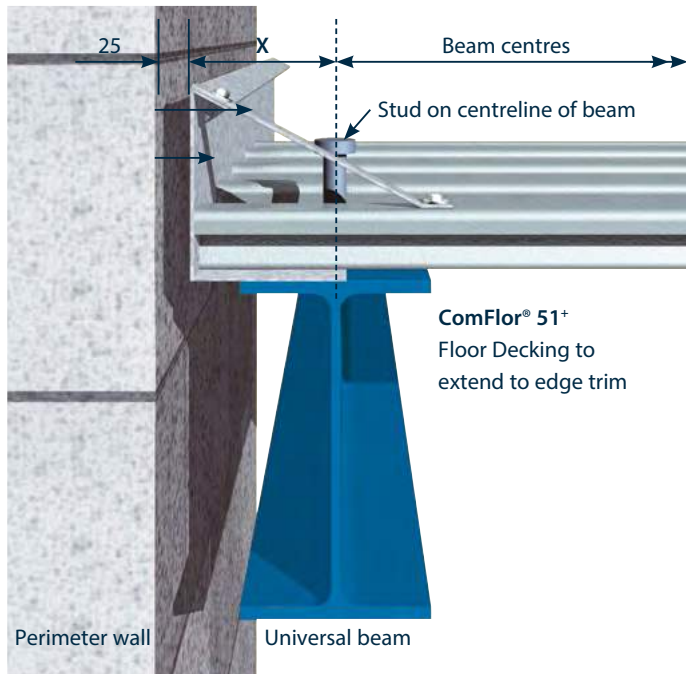


Typical edge with plate

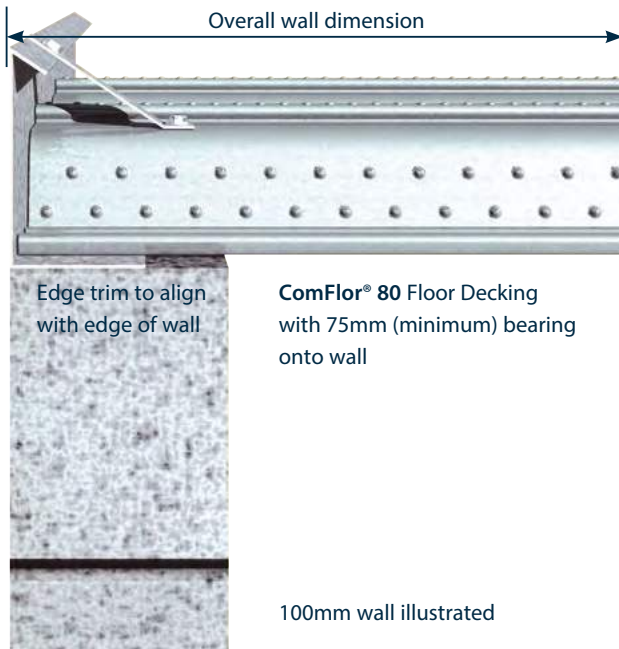


# Composite floor decks - Construction details

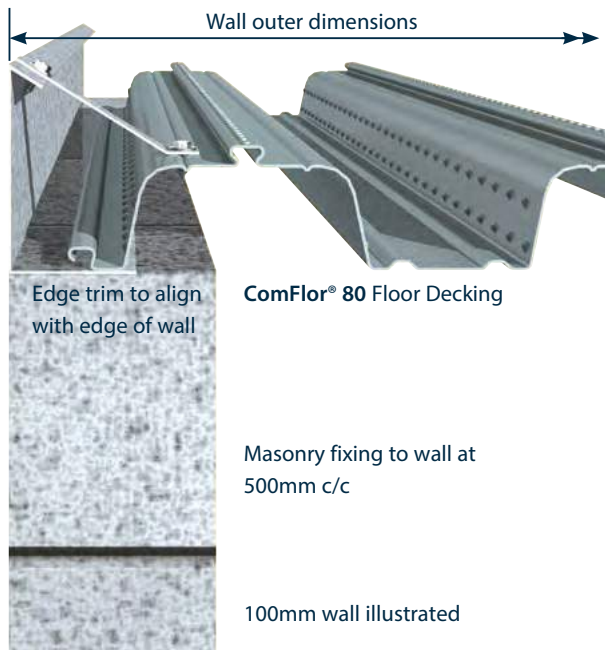
Beam at perimeter wall



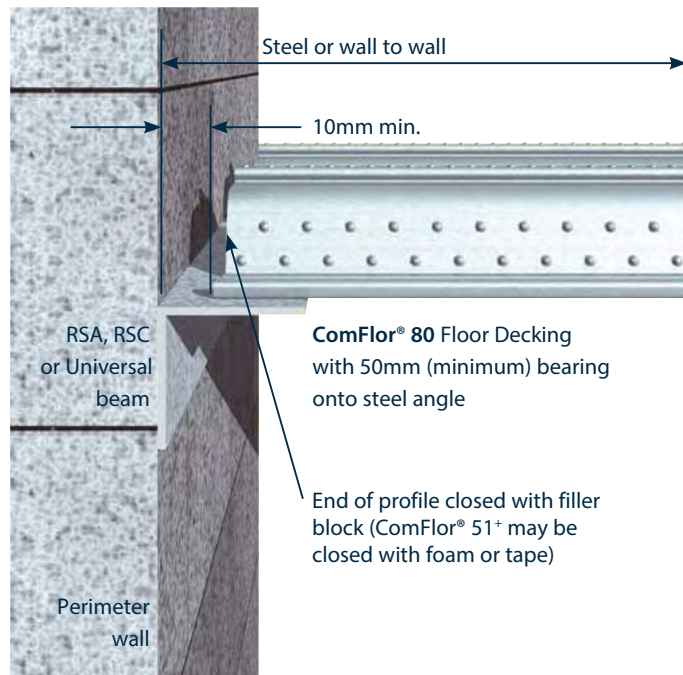
Typical wall end detail



Typical wall side detail

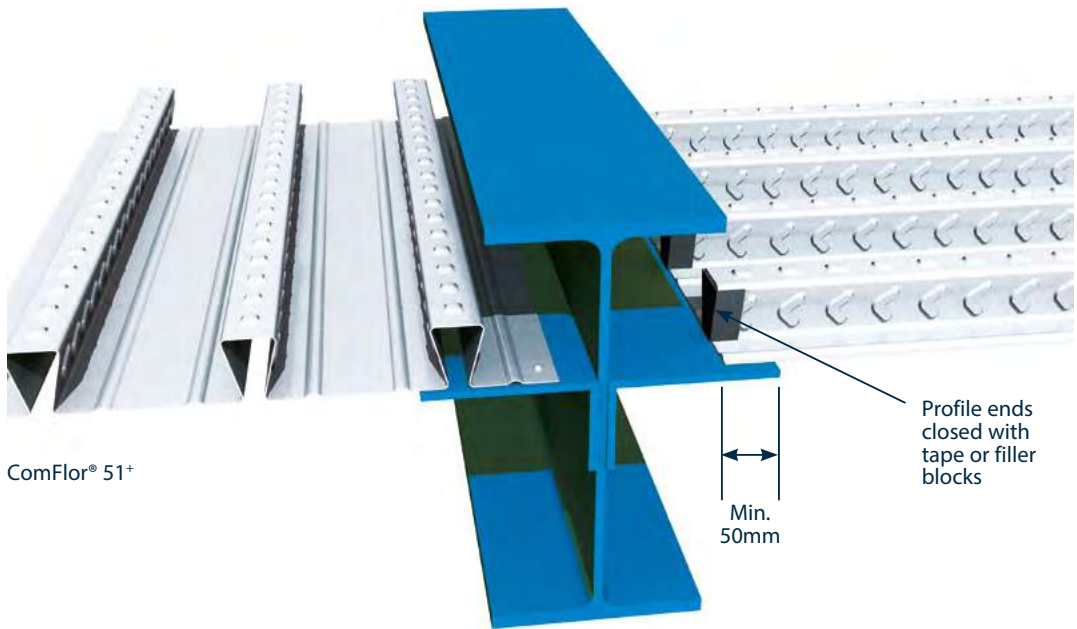


Deck inside of wall detail

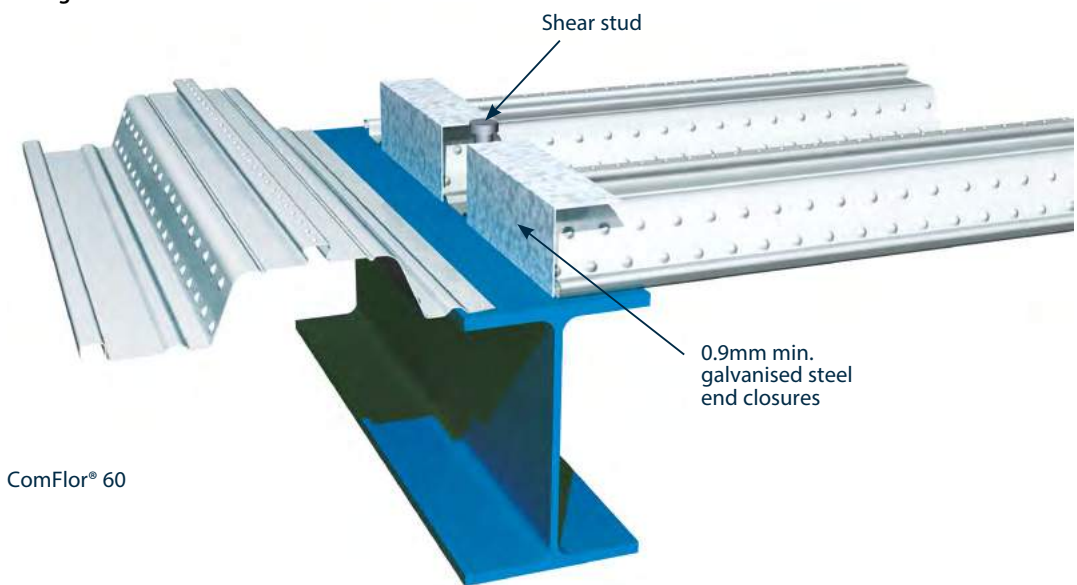


# Composite floor decks - Construction details

## Change of direction with ledger angle



## Change of direction



# Composite floor decks - Construction details

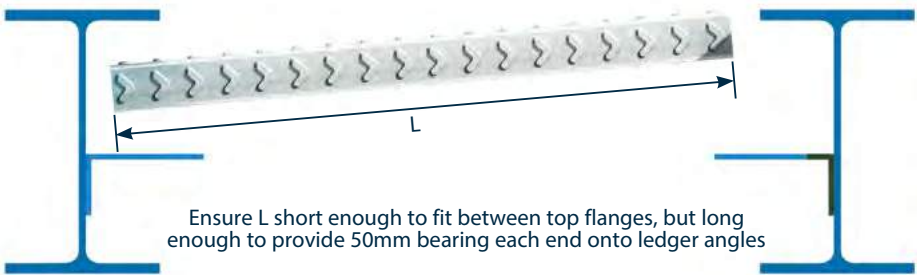
## Connection to structural wall

ComFlor® 80



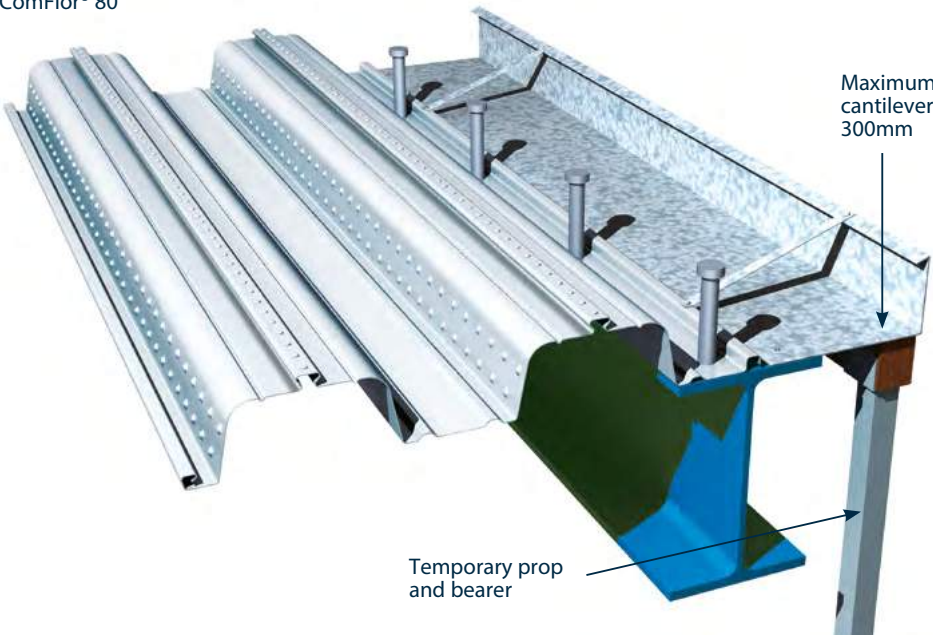
## Installation of deck onto ledger angle

ComFlor® 51+



## Propped edge trim

ComFlor® 80



# Composite floor decks - Sitework

## Deck fixing

Immediately after laying, the deck must be fixed through its trough to the top of the supporting structure. Powder actuated pins or self-drilling screws are used. Side lap fixings are required at 1000mm centres for all profiles.

The 'Fixing information for composite floor decking' table shows the number of fixings required for all composite ComFlor® decking, with or without shear studs.

## Wind loading

\* Where temporary fixings, such as X-DAK, are used, wind loading should be checked, especially on exposed sites.

## Telephone numbers of fixings suppliers

EJOT	0113 247 0880
Erico	0118 958 8386
Hilti	0800 886 100
SFS	0113 208 5500
Spit	0800 731 4924

## Filler blocks

Profiled foam fillers to close profiles are available from Paulamar 0141 776 2588.

Dense rockwool profile fillers for fire and acoustic stopping may be sourced from AIM 01342 893 381.

## Side Lap taping for ComFlor® 51+

Side lap taping is recommended if a watertight seal is required.

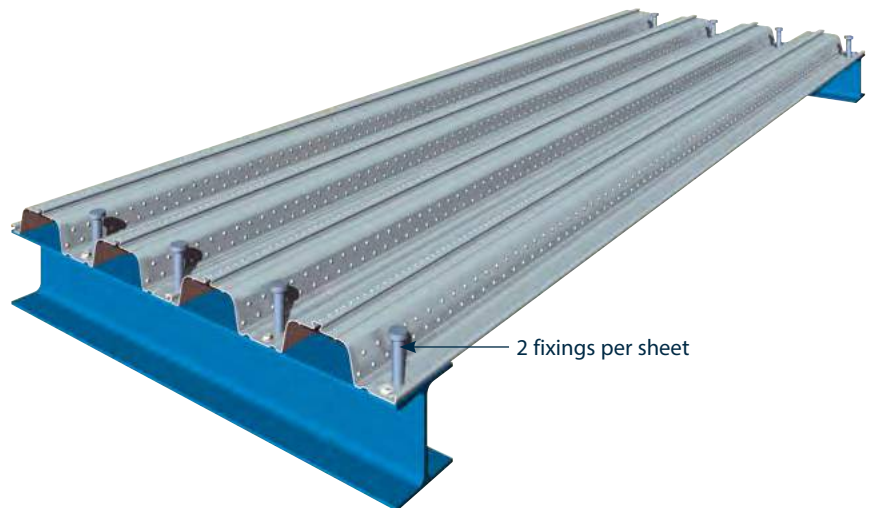
## Fixing information for composite floor decking

<b>To steel</b>	Heavy duty powder actuated fixings - Hilti X-ENP-19 L15 nail/ Spit SBR14 or equivalent. For temporary fixing (i.e. where weld through shear studs are to be used) - Hilti XU-15.* Self-drilling screws. To steel up to 11mm thick - SFS SD14 - 5.5 x 32/EJOT HS 38, Hilti S-MD 55Z, 5x40 or equivalent. To steel up to 17mm thick SFS TDC-T-6.3 x 38 or equivalent.
<b>To masonry or concrete</b>	Pre-drill hole - use self tapping fixing suitable for masonry/ concrete - SFS - TI-6,3x32/EJOT 4H32, Hilti S-MP 52Z 6,3x38 or equivalent.
<b>To side laps or closures etc.</b>	Self-drilling stitching screw typically SFS SL2 or 3 range (will depend on deck thickness)/EJOT SF25, Hilti S-MS 01Z 4,8x19 or equivalent.

## Fixing spacings

	ComFlor® 46 & ComFlor® 100	ComFlor® 51+, ComFlor® 60 & ComFlor® 80
<b>End fixing</b>	3 per sheet (2 per sheet when using shear studs)	2 per sheet
<b>Intermediate supports</b>	2 per sheet (1 per sheet when using shear studs)	1 per sheet
<b>Side laps (for all profiles)</b>		1 fixing at 1000mm c/c
<b>Side fixing onto support (for all profiles)</b>		1 fixing at 600mm c/c

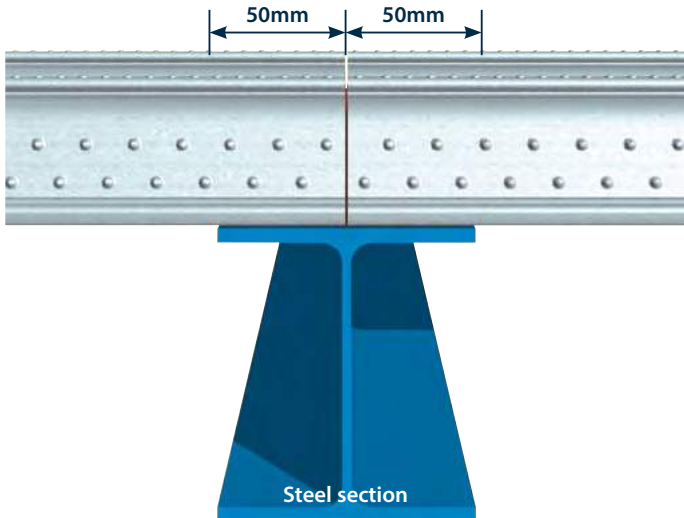
## Deck fixing on ComFlor® 80



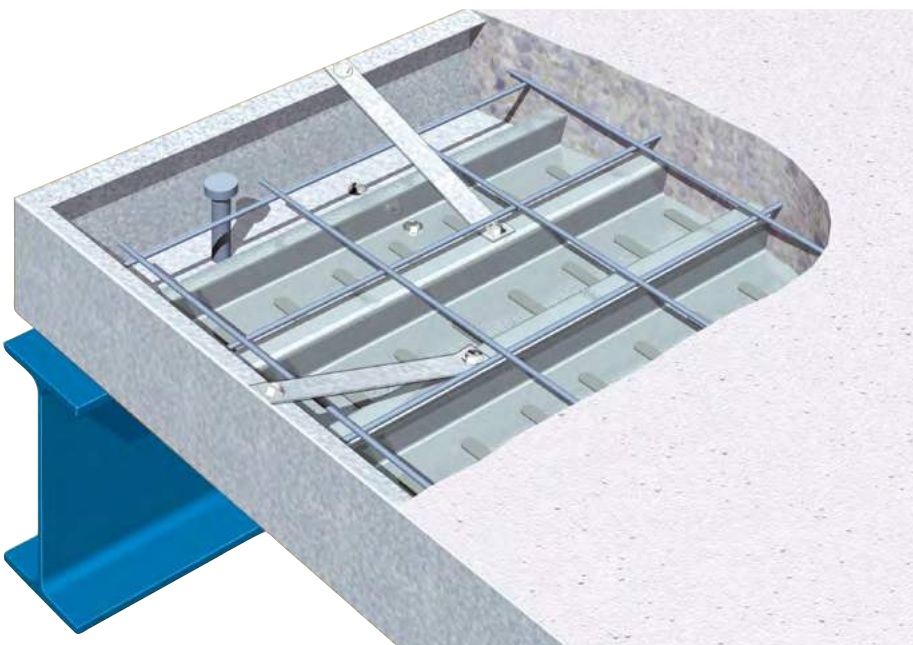
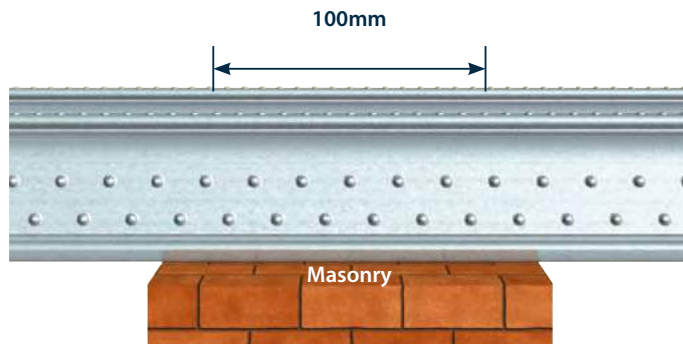
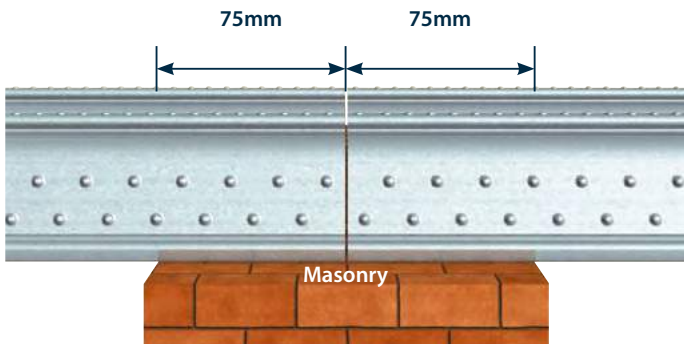
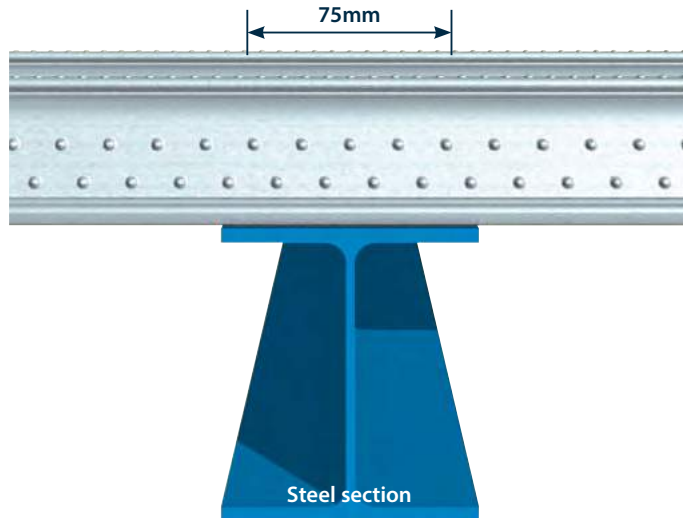
# Composite floor decks - Sitework

## Bearing requirements

End bearing and shared bearing (minimum)



Continuous bearing (minimum)



## Edge trim

This is used to retain the wet concrete to the correct level at the decking perimeters. It is fixed to the supports in the same manner as the deck and the top is restrained by straps at 600mm centres, which are fixed to the top of the deck profile, by steel pop rivets or self-drilling screws. Each strap is 25mm wide, and is fixed at each end with a stitching screw as shown in the adjacent figure. Edge trim and restraint straps are supplied by Tata Steel.

## Edge trim selector

Edge trim depth	Maximum cantilever (mm)			
	Galv. steel edge trim thickness (mm)			
	0.9	1.2	1.6	2.0
130	100	125	160	195
150	50	115	150	185
200	x	100	130	160
250	x	50	100	135
300	x	x	50	100
350	x	x	x	50

x - not recommended

# Composite floor decks - Sitework

## Shear connectors

Most commonly used shear connectors are 19mm diameter headed studs, which are welded to the support beam through the deck, a process carried out by specialist stud welding contractors.

Site conditions must be suitable for welding and bend tests carried out as appropriate. The spacing and position of the shear connectors is important and must be defined by the design engineer on the deck set out drawings.

**Stud Spacing:** In accordance with BS EN 1994-1-1 Clause 6.6.5.6, the minimum distance  $e_0$  between the edge of a connector and the edge of the beam flange to which it is welded should not be less than 20mm. In accordance with BS EN 1994-1-1 Clause 6.6.5.7, the spacing of studs in the direction of shear force should not be less than  $5d$ , whereas the spacing in the direction transverse to the shear force should not be less than  $4d$ , where  $d$  is the diameter of the stud shank. See page 54.

Further guidance on shear studs for designers and installers may be found in The Steel Construction Institution publications: P300 Composite Slabs and Beams Using Steel Decking: Best Practice for Design and Construction, P055 Design of Composite Slabs and Beams with Steel Decking, P359 Composite design of steel framed buildings in accordance with Eurocodes and the UK National Annexes, BCSA: Code of Practice for Metal Decking and Stud Welding.

## Mesh placement

With regard to mesh placement, please refer to 'Minimum/Maximum Anti-crack Mesh Cover' within the 'Composite Floor Decks Design information' section on page 47.

## Casting concrete

Before the concrete is poured, the decking must be cleared of all dirt and grease, which could adversely influence the performance of the hardened slab. The oil left on the decking from the roll forming process does not have to be removed. Concrete should be poured evenly, working in the direction of span. Care should be taken to avoid heaping of concrete in any area during the casting sequence. Construction and day joints should occur over a support beam, preferably also at a deck joint.

## Ceilings and services hanger systems

The dovetail shaped re-entrant rib on ComFlor® 51+ and the 15mm high raised mini-dovetail re-entrant stiffener on ComFlor® 60 and ComFlor® 80 profiles allow for the quick and easy suspension of ceiling and services, using either of the two following suspension systems.



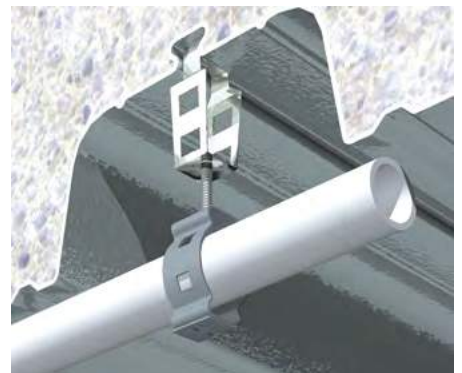
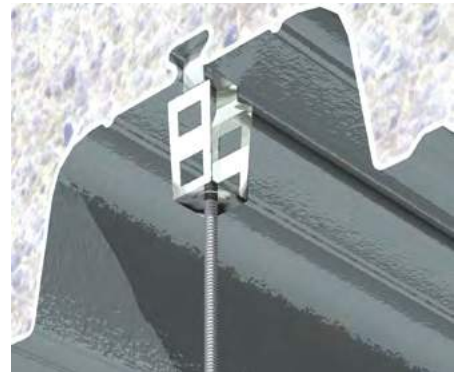
### (a) Threaded wedge nut fixings

Wedges are dovetail shaped steel blocks, which are threaded to take metric bolts or threaded rods. The wedge nut hanger system is installed after the concrete of the composite slab has been poured and is hardened.

### Installation

For installation of the system, wedge nuts are inserted into the raised re-entrants of the profile before being rotated 90 degrees, after which the dovetail shaped wedge nuts will lock into the dovetail re-entrants under vertical loading. Finally, the bolts or threaded rods are finger tightened up to the roof of the re-entrants and mechanically tightened.

### (b) GTD-clip hanger fixings



GTD-clip hanger fixings are cold-formed thin steel hangers with circular openings in the soffit to take metric bolts, threaded rods or further pipe clamp hangers. The system is installed after the composite slab has been poured and the concrete is sufficiently hardened.

### Installation

To install the GTD-clips, the two dovetail shaped ends are compressed by hand and inserted into the dovetail re-entrant of the profile, before being rotated 90 degrees. After releasing the two ends the clip will snap into position and is tightly connected. Finally, bolts, threaded rods or pipe clamps are connected into the soffit opening of the GTD-clip.

### Load bearing capacities

System	Thread size	Maximum static working load (Kg)
Wedge Nut	4	Refer to Technical Dept.
	6	
	8	
GTD - Clip	6	90
	8	90
	10	90
GTD - Clip and pipe clamp	N/A	45

A minimum safety factor of 4 has been applied to the safe working load capacities.

# Composite floor decks - Sitework

## Openings

Openings greater than 300mm must be designed by the engineer, with extra reinforcement placed around the opening. Openings up to 700mm can be accommodated readily in composite slabs, by boxing out prior to pouring concrete and cutting out the deck after concrete has cured. Larger openings require support trimming steel, which must be installed prior to the decking. The decking is cut away immediately and the opening edges are then treated like any other perimeter with edge trim.

## Further Guidance

Further guidance on forming openings in composite slabs, see SCI P300 'Composite slabs and beams using steel decking. Best practice for design and construction'.

**NOTE: Do not cut the opening in the steel deck prior to concreting, or before the concrete has cured.**

## Temporary supports

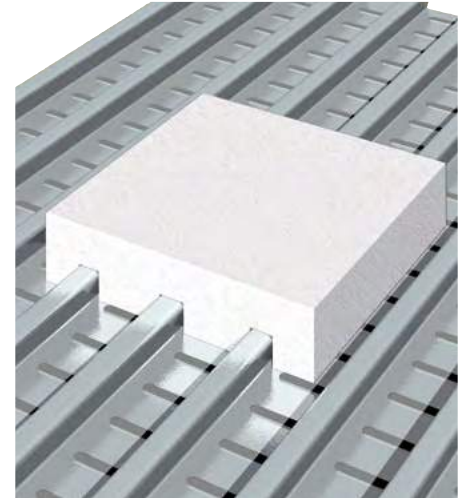
The safe design and installation of temporary props is the responsibility of the main contractor or designated sub-contractor. Where temporary supports are required by the design, these must provide continuous support to the profiled sheeting. Spreader beams (timbers) are used, supported by temporary props at one metre centres.

## Temporary support using an 'Acrow' type prop



Timber shutter

- [a] The timbers and props must be of adequate strength and construction
- [b] The temporary supports are placed at midspan or at other suitable centres if more supports per span are required. Please contact our Technical Advisory Desk.
- [c] The spreader beams or timbers are to provide a minimum bearing width of 100mm. The spreaders must not deflect more than 10mm and should be placed narrow edge up, see diagram.
- [d] The propping structure is not to be removed until the concrete has reached at least 70% of its characteristic strength.



Dense polystyrene block

The horizontal bearer timbers must be at least 100mm wide and should be propped at no more than 1 m centres. Sometimes the specification may call for 150mm wide bearers, as determined by the structural engineer or concreting contractor. Props should be stable without relying on friction with the deck for lateral stability. The end props in a row should be self supporting, and braced to the internal props.

## Temporary props

Timber bearer guide all to be min. 100mm wide	
Slab depth (mm)	Bearer depth (mm)
up to 120	150
130 - 160	200
170 - 200	250

## Percussive drilling

Percussive drilling into composite concrete slabs is not recommended, however small scale rotary hammer drills are considered to be satisfactory.





## **ComFlor® 210 and 225**

Design, construction and sitework information

## Deep composite floor decks - Design information

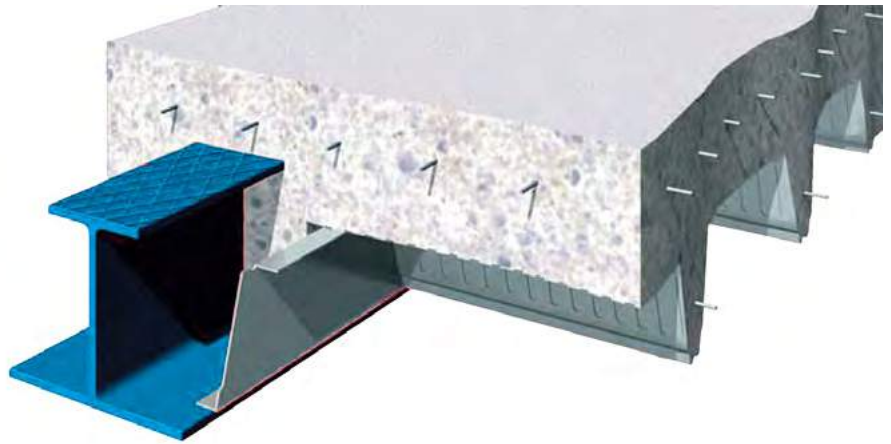
Deep composite floor decks usually bear onto the bottom flange of asymmetric support beams with the lower flange wider than the upper, on the principles of the Slimdek® system. The beam and the deck are consequently integrated into the floor slab resulting in a very shallow structural floor.

### Deep composite floor decks

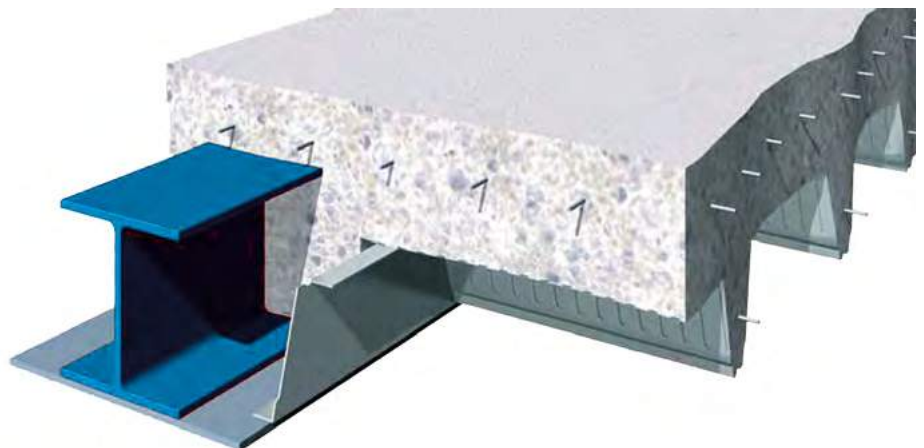
Our deep composite floor decks will be used in one of these applications:

1. An integrated system where the ComFlor® deep deck bears onto a wider bottom flange beam. As illustrated here with the original Tata Steel Slimdek® or Slimflor® systems.
2. Long span composite concrete/steel floor deck on the top flange of non-composite steel beams.
3. Long span composite concrete/steel floor deck in concrete frame or on masonry walls.

The design considerations relating to the decking are similar for all these applications.



Asymmetric Slimflor® beam (ASB), which is a hot rolled section with a narrower top flange than bottom flange.



Slimflor® fabricated beam (SFB), which is a Universal Column section with a wide flange plate welded to its underside.



Rectangular hollow Slimflor® beam (RHSFB), which is a rectangular hollow section with a flange plate welded to its lower face (generally used for edge beams).

# Deep composite floor decks - Design information

## Design procedure

There are two distinct stages for which the elements of the integrated beam and floor slab system must be designed. The first is the construction stage, during which the beams and decking support the loads as non-composite sections. During the second stage the decking and concrete act together to form composite slabs, as do (generally) the ASBs and slab. SFBs and RHSFBs will act compositely if shear studs have been provided.

### The key design points are:

- Consideration of the required spans will allow the depth of the beams to be determined.
- Consideration of the required fire resistance will allow the depth of slab to be determined, as a function of the cover required for the beams and the decking.

Having established these scheme design parameters, detailed design of the beams and slab can be undertaken. With an integrated beam and slab system the slab depth is the same as the overall structural floor depth and can be as little as 280mm, as can be seen from our load/span tables in this manual. However the needs of the beams employed must also be considered in giving the beams adequate cover and connection to the concrete if required.

## Integrated beam design

This is carried out by the supplier of the wider lower flange beam system, compatible with ComFlor® 210 and ComFlor® 225. Please contact our technical department for details.

Further detailed design information is available in The Steel Construction Institute publications: P300 Composite Slabs and Beams Using Steel Decking: Best Practice for Design and Construction, P055 Design of Composite Slabs and Beams with Steel Decking and SCI P359: Composite design of steel framed buildings in accordance with Eurocodes and the UK National Annexes.

## Decking design

In addition to considering the self-weight of the slab, the design of the deep decking should take into account temporary construction loads.

## Construction loads applied during the casting of concrete

The construction loads ( $Q_c$ ) during the casting of concrete are covered in BS EN 1991-1-6 Clause 4.11.2.

The diagram implies that the load within the working area would be no greater than the outside working area, unless the slab weight exceeds  $7.5\text{kN/m}^2$ , which is much greater than in normal composite decks. This further implies that there would be no allowance for heaping of concrete in the working area. SCI considers that the omission of an allowance for heaped concrete is unwise, and may not have been intended. Consequently, SCI recommends the following construction loads during casting of concrete for a composite slab:

1.  $0.75\text{kN/m}^2$  generally
2. An additional of 10% of the slab weight or  $0.75\text{kN/m}^2$ , whichever is greater, over a  $3\text{m} \times 3\text{m}$  working area. This area should be treated as a moveable patch load that should be applied to cause maximum effect.

## Temporary propping (when required)

The spacing of temporary props is governed by the ability of the decking to resist combined bending and web-crushing in the hogging (negative) moment regions over the lines of props. It is recommended that the spacing between the props should be relatively close, so that local loads do not cause damage to the decking (2.5m to 3.5m spacing depending on the slab weight). A 100mm wide timber bearer should be used to distribute the load at these points.

## End bearing

The end bearing of the sheets should be specified as 50mm. The flange widths are such that this bearing can be achieved, whilst still allowing the sheets to be dropped vertically into position (i.e. without having to 'thread' them between the top and bottom flanges).

## CE Marking

All ComFlor® composite decks are CE marked in accordance with BS EN 1090. Declaration of Performance (DOP) specifications can be found on our website.

# Deep composite floor decks - Design information

## Slab design

The design of composite slabs using deep decking differs from that for standard decking in the following ways:

Placing bar reinforcement in the troughs of the decking increases the ultimate load resistance of the slab. The benefit of these bars is considered in both the 'normal' and fire conditions.

The slab depth may need to be chosen not only to satisfy the structural durability and fire resistance requirements of the slab itself, but also to provide appropriate cover over ASB or Slimflor® beams.

The reinforcing bars in the troughs of the decking provide additional tensile area to that provided by the decking, and thus enhance the bending resistance of the composite slab.

Bar diameters range from 8mm to 32mm, depending on the span and fire resistance requirements.

Straight bars may be used to achieve 60 minutes fire resistance (provided that shear

stresses are low). In other cases, L bars should be used to provide sufficient end anchorage in fire conditions.

## Cracking

It is normal for some cracking to occur in the slab over the beams. These cracks run parallel with the beams and are not detrimental to the structural behaviour of the slab. They may be controlled by mesh reinforcement provided across the tops of the beams. Guidance on the detailing of reinforcement to control cracking may be found in the Tata Steel Slimdek® manual.

Additional reinforcement may be required to fulfil the following roles:

- Transverse reinforcement adjacent to shear connectors.
- U-bars at composite edge beams.
- Additional crack control reinforcements
- Strengthening around openings.
- Strengthening at positions of concentrated loads.

## Fire resistance

One of the principal considerations governing the choice of slab depth is the required fire resistance period. Minimum depths are given above as a function of the concrete type and fire resistance required and are based on insulation requirements.

## Concrete thickness above deck

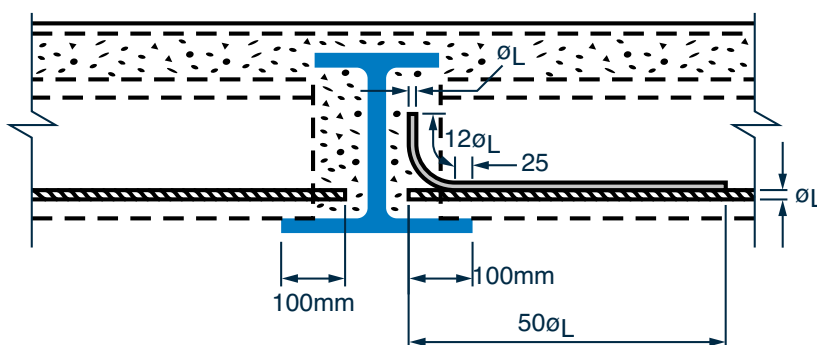
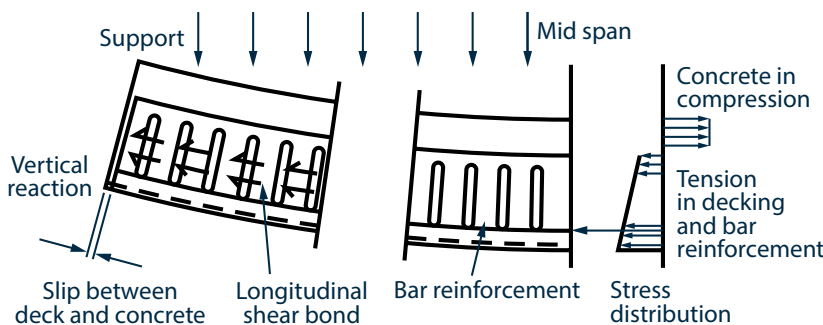
Fire resistance	NWC	LWC
60 min	70mm	60mm
90 min	80mm	70mm
120 min	95mm	80mm

The bar fire method: The capacity assessment in fire is based on a single or double layer of standard mesh at the top and one bar in each concrete rib. For ComFlor® 210 or ComFlor® 225 decking, the bar is placed at an axis distance, dependent on the fire resistance period. The axis distance must not be less than 70mm. To maximise fire resistance capacity the axis distance needs to be 70, 90 and 120mm (from the soffit of the deck) for 60, 90 and 120 mins. fire resistance, respectively. However where fire resistance is not the limiting factor it may be more effective for the axis distance to be at the minimum.

## Anti-crack mesh

As a minimum requirement where the control of crack width is of no interest, BS EN 1994-1-1, 9.8.1(2) recommends that where continuous slabs are designed as simply-supported in accordance with BS EN 1994-1-1, 9.4.2(5), the cross-sectional area of the anti-crack reinforcement above the ribs should be not less than 0.2% of the cross-sectional area of the concrete above the ribs for unpropped construction, and 0.4% of this cross-sectional area for propped construction. The mesh shown in these quick reference tables, complies with this clause.

Strictly, this reinforcement is not required at mid-span, but in practice it takes form of blanket coverage of mesh. It applies equally to composite slabs and to composite beams. The reinforcement in the beam design as simply supported should extend over a length of 0.25L each side of the internal support, where L is the length of the relevant span.



## Vibration

The dynamic sensitivity of the composite slab within ComFlor® 9 is checked in accordance with the Steel Construction Institute publication P076: Design guide on the vibration of floors. The natural frequency is calculated using the self-weight of the slab, superimposed dead load, and 10% of the characteristic imposed loads, representing the permanent loads and the floor.

For design to the Eurocodes, the loads considered for the vibration check are increased using the psi-factor for imposed loads (typically 0.5). The natural frequency limit may be reduced to 4Hz, because of this higher load, used in the calculation.

To determine the vibration response of sensitive floors with improved accuracy, calculation methods are given in SCI publication P354 "Design of Floors for Vibration: A New Approach". This enables designers to compare the response with the acceptance levels in BS 6472 and ISO 10137 for building designs and in the NHS performance standard for hospitals, HTM 2045.

In the absence of more appropriate information, the natural frequency of the composite slab should not exceed 5Hz for normal office, industrial or domestic usage. For designs using ComFlor® 225 or ComFlor® 210 decking, this limit may be reduced to 4Hz if the design has been carried out on the assumption of simple supports at the ends. Conversely, for dance floor type applications or for floors supporting sensitive machinery, the limit may need to be set higher.

## Partial continuity for deep decking

Regarding British Standard design only, the following partial continuity applies. This condition does not apply to Eurocode design.

Tests have shown that the ComFlor® 225 or ComFlor® 210 composite slabs supported on a steel beam and provided with adequately detailed continuity mesh reinforcement over the steel beam support exhibits a degree of continuity at the support. The beneficial effect of partial continuity at the supports may be taken into account by specifying CONTINUOUS in the Span Type field. When this option is specified, the following assumptions are made by the design software;

- a 20% reduction in the deflections of the composite slab at the normal design stage.
- a 30% reduction in the deflections when assessing the natural frequency of the slab. This is justified by the lower stress levels during vibration.

- stresses in the composite slab in fire conditions are derived from a model which assumes full continuity at one end and a simple support at the other (i.e a propped cantilever condition).

## Service attachments

The ComFlor® 225 decking facilitates the fixing of services and suspended ceilings. Hangars can be used to support services running either parallel or perpendicular to the decking span. The new adjustable Lindapter Slimdek® 2 fixing is designed for use with ComFlor® 225 to accommodate variances encountered on site and enable secure suspension of services directly from the underside of the ComFlor® 225 composite floor decking.

Installation of Lindapter Slimdek® 2 is fast and accurate every time and is carried out without specialist tools or skills because the product slots easily into the re-entrant channel and is locked mechanically with a 180° turn of a spanner. Variable drop rod position and lateral adjustability along the re-entrant channel permit unhindered alignment of service runs, whilst the shallow fixing depth enables pipework, ducting, electrical equipment and cable tray to run within the structural floor space. The assembly consists of a main body and a M6, M8 and M10 V-Nut. The Lindapter Slimdek® 2 has a 3:1 factor of safety and a safe working load of 1kN. Alternatively, selfdrilling self-tapping screws may be used to attach hangers to the decking after the concrete has been placed.



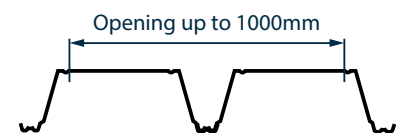
## Openings in the slab

Provision for vertical service openings within the floor slab will necessitate careful design and planning. The following summarises the options that are available to the designer:

Openings up to 300mm x 300mm can be accommodated anywhere in the slab over a crest section of the deck, normally without needing additional reinforcement.

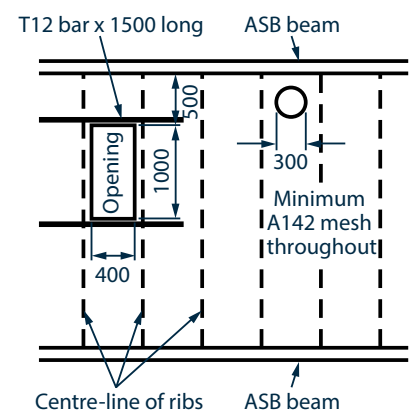
Openings up to 400mm wide x 1000mm long may be taken through the crest of the deep decking. Additional reinforcement, which should be designed in accordance with BS EN 1992-1-1, may be required around the opening.

Openings up to 1000mm wide x 2000mm long may be accommodated by removing one rib (maximum) of the decking, fixing suitable edge trims and providing additional reinforcement to transfer forces from the discontinuous rib. The slab should be designed as a ribbed slab in accordance with BS EN 1992, with decking being used as permanent formwork. Guidance may be found in the Tata Steel Slimdek® manual.



Larger openings will generally require trimming by secondary beams.

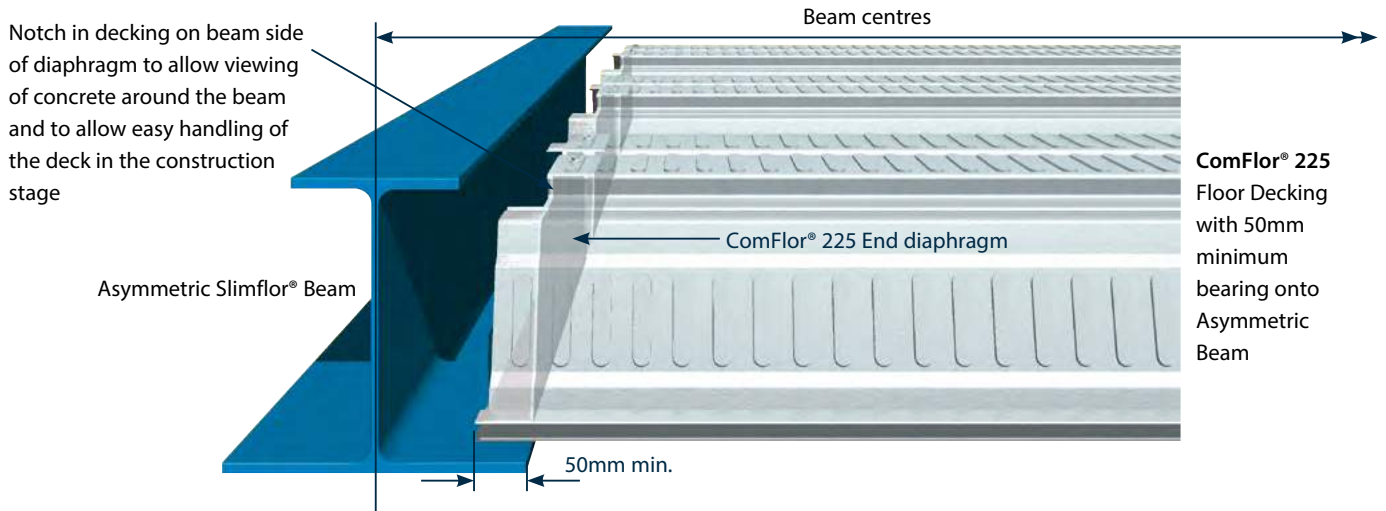
If an opening greater than 300mm x 300mm lies within the effective width of slab adjacent to a beam ( $L/8$ ), the beam should be designed as non-composite. A close grouping of penetrations transverse to the span direction of the decking should be treated as a single large opening.



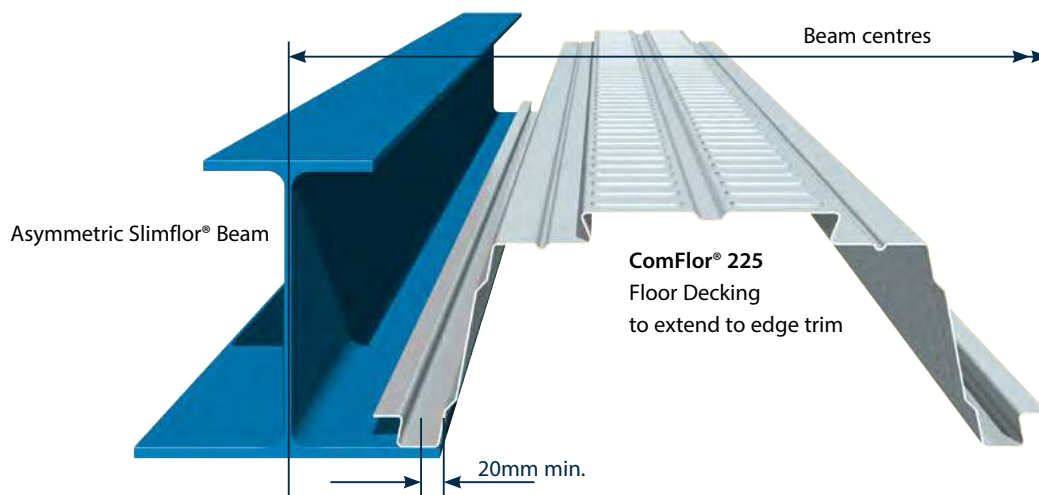
Design of small and medium size openings in the slab.

# Deep composite floor decks - Construction details

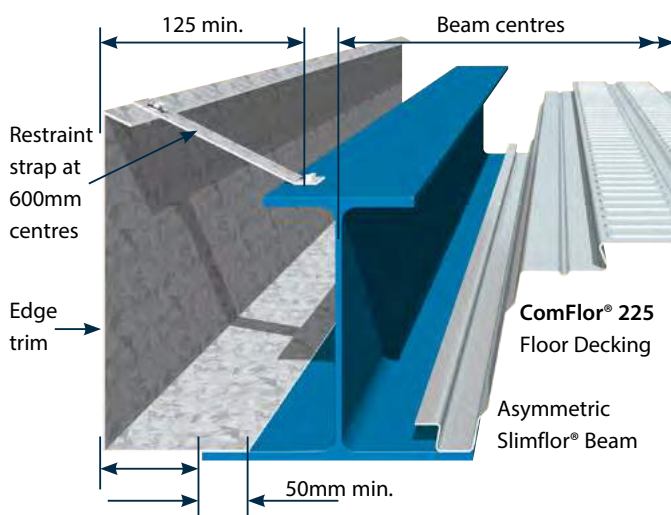
## End fixing onto ASB



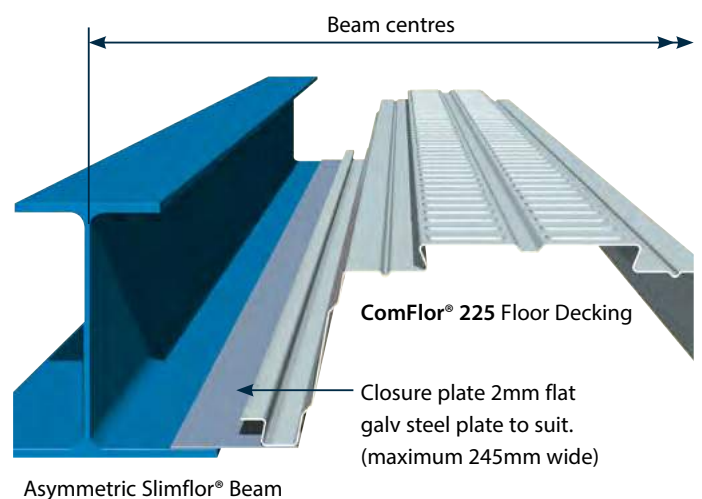
## Side fixing onto ASB



## Perimeter with trim



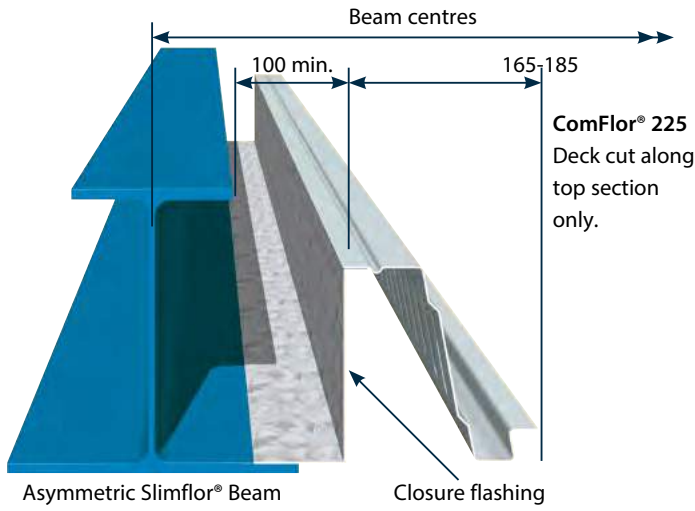
## Cut plates



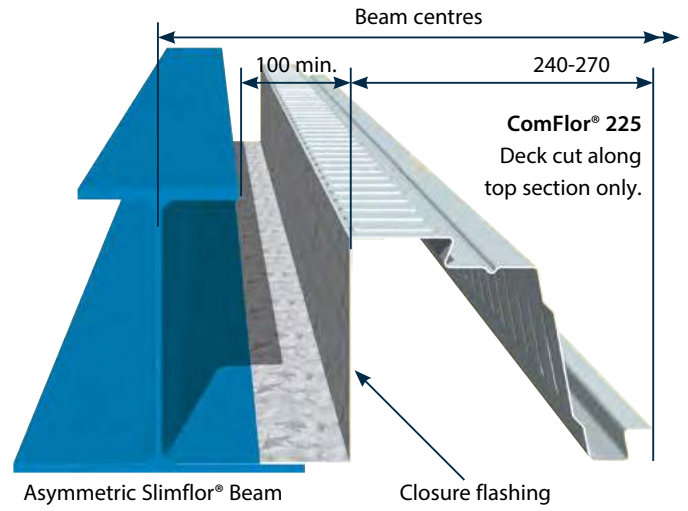
Cantilever  
See table "Edge Trim Selector" table on page 78, to derive the maximum cantilever allowed for the edge trim without props

# Deep composite floor decks - Construction details

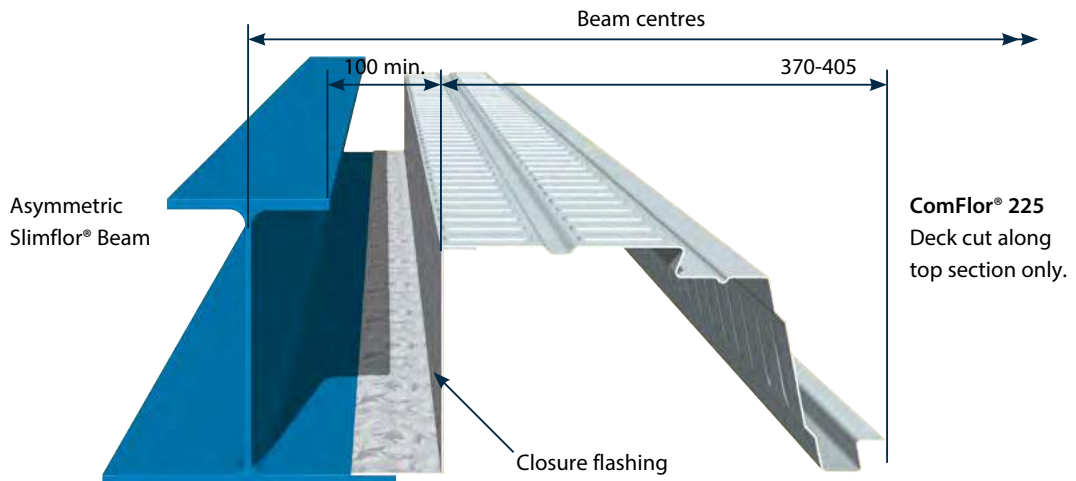
Cut deck - Option 1



Cut deck - Option 2

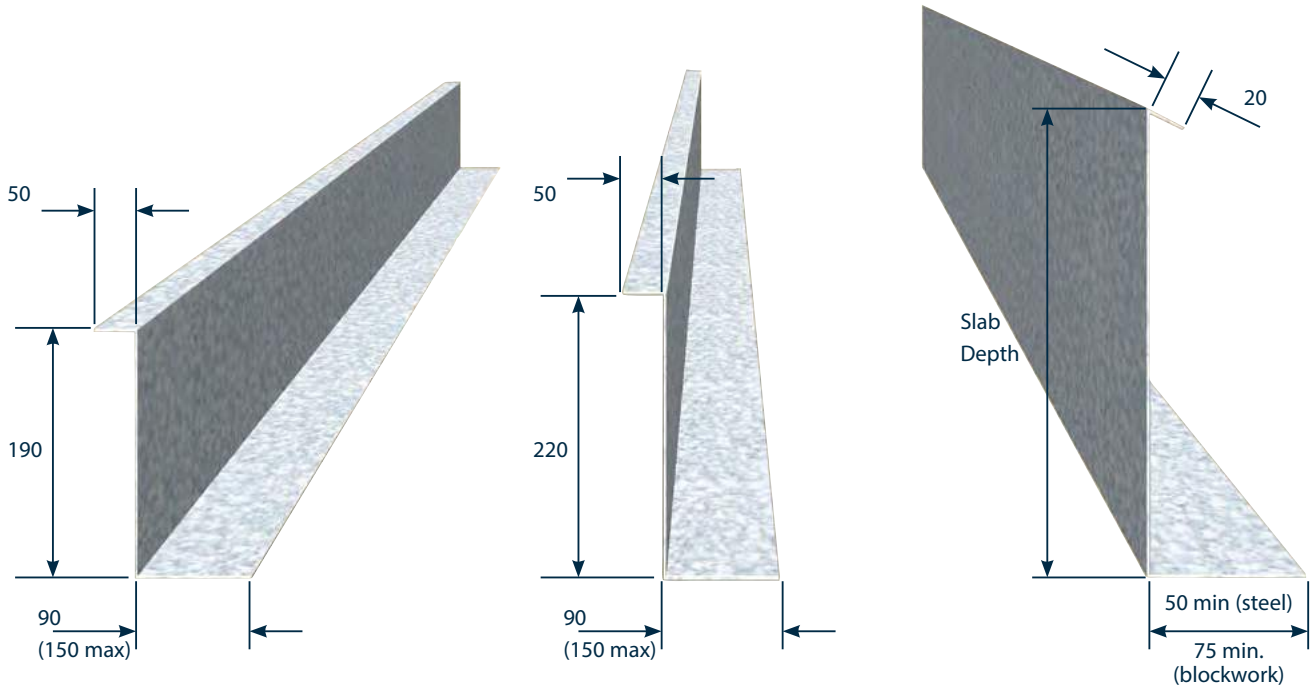


Cut deck - Option 3

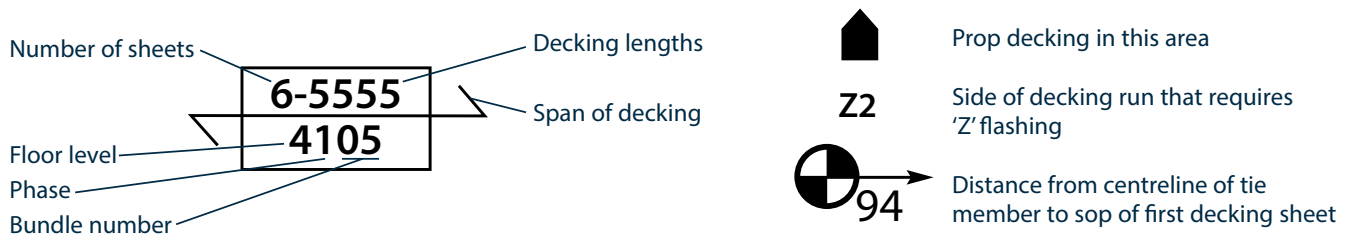


# Deep composite floor decks - Construction details

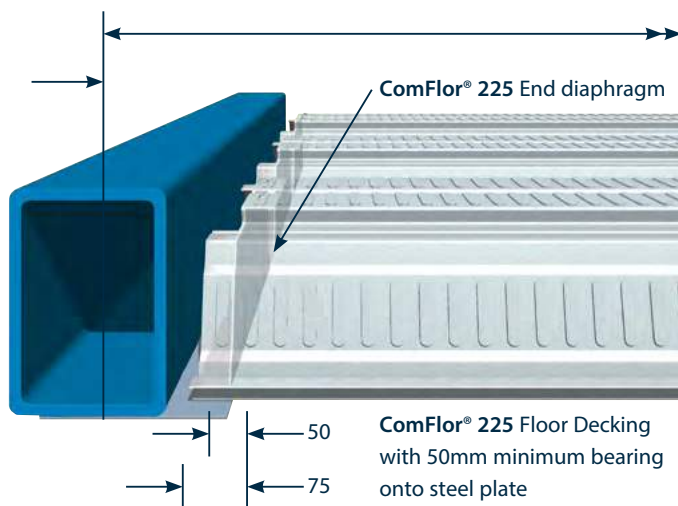
## Steel trims



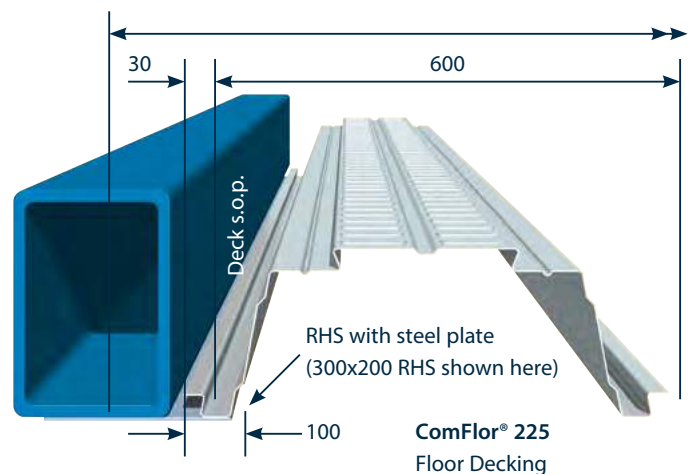
## Notations used on deck layout drawing



## End fixing onto RHS

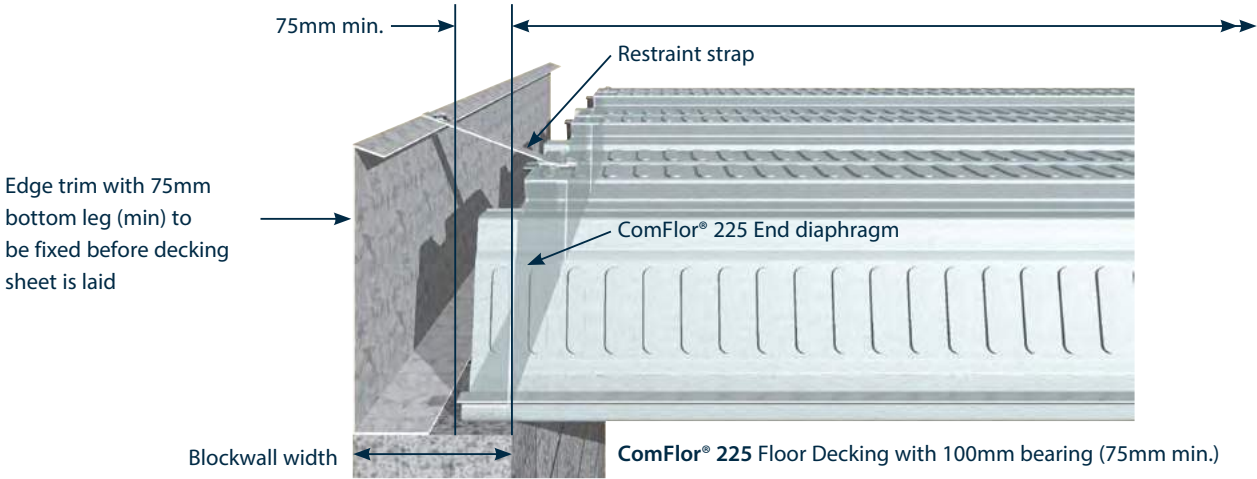


## Side fixing onto RHS

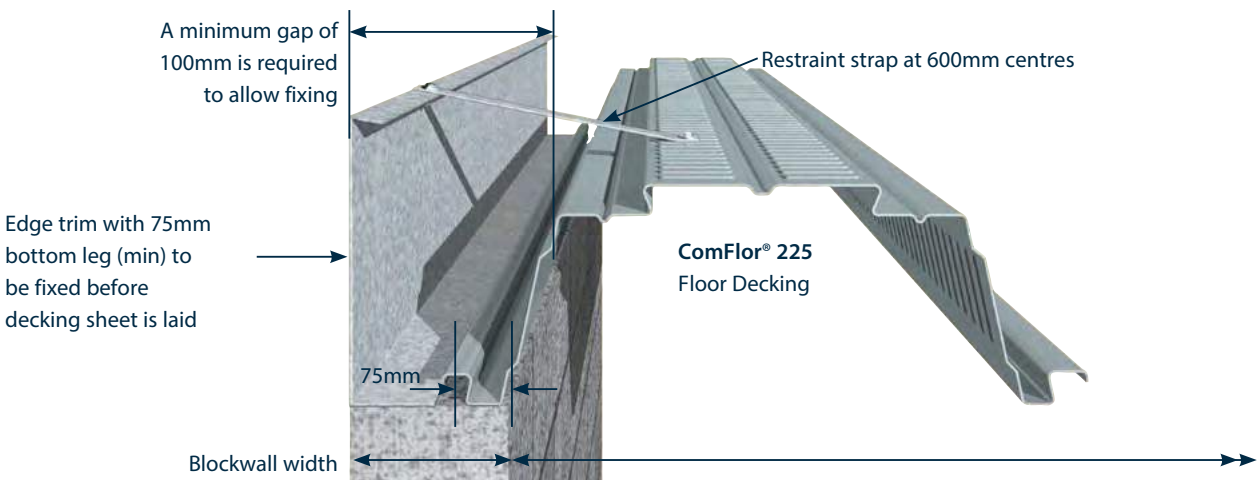


# Deep composite floor decks - Construction details

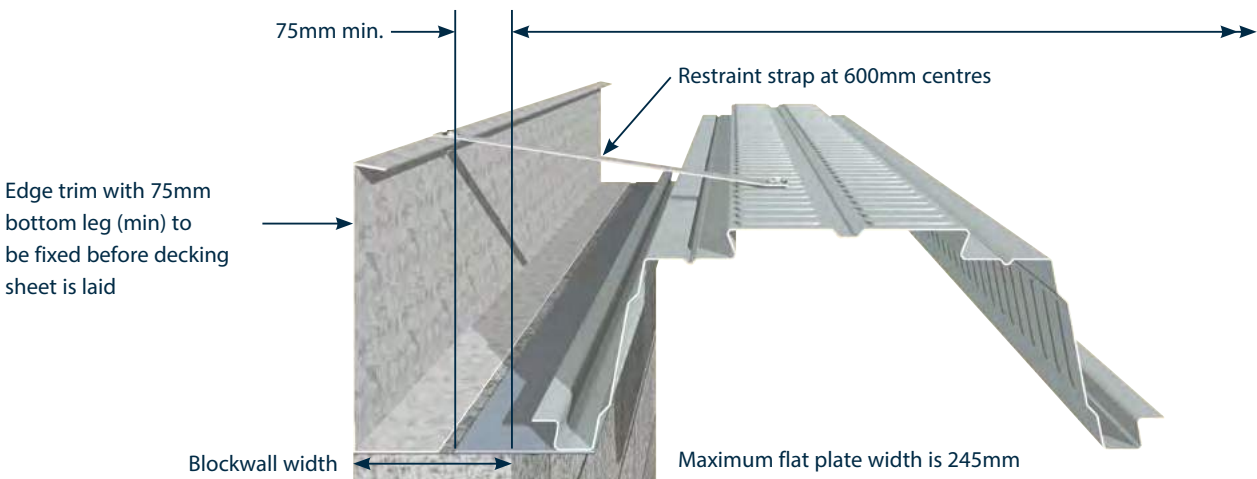
## End fixing onto blockwork



## Side fixing onto blockwork



## Cut plate on blockwork



# Deep composite floor decks - Sitework

## Health and Safety

ComFlor® 225 decking must be installed by contractors approved by Tata Steel, and ComFlor® 210 should only be installed by contractors experienced in fixing long span steel decking.

It is the responsibility of the contractor to provide safe working procedures for the installation of deep decking on any particular project and to provide a risk assessment to the main contractor.

Reference should be made to the BCSA Publication No 44/07 'Guide of Installation of Deep Decking'.

## Installation of deep deckings

The following general guidelines should also be followed to maximise health and safety on site:

1. Diaphragms should where reasonably practicable be fitted from a safe working platform or from below from a MEWP or a platform access system.
2. The side lap on ComFlor® 225 has been modified to allow the sheets to be laid in both directions (rather than the single direction laying as previously). Sheets should now be laid always away from the pack so that operatives are working from a deck platform, considerably reducing the requirement to carry the deck across isolated beam tops.
3. Deck cutting should be carried out as the last operation in each bay. Thus it can be carried out on a safe working platform of previously laid deck.

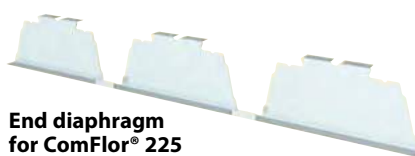
## End diaphragms

Steel end diaphragms, as manufactured by Tata Steel, are essential for both deep deck systems to ensure the structural integrity of the deck. The end diaphragms, are fixed first and are supplied in lengths of 1800mm, to cover three of our deep deck profiles. They are fixed using at least two light duty shotfired pins for each length; in the Slimdek® system the end diaphragms align with the edge of the lower flange of the beam.

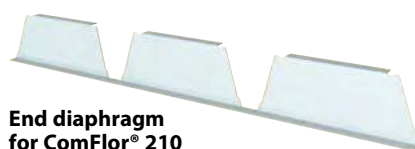
Single diaphragms are available with pre-punched service holes in two types. Type 1 has one 160mm diameter hole; Type 2 has one elongated 160mm diameter hole to make opening 320mm wide x 160mm high.

Unpunched single diaphragms are also available. Where the deep deck lands onto a support at a rake, the single diaphragms are used doubled up, and adjusted on site to take up the extra length required due to the fact that the end of the deck is at a raked angle to the support rather than at right angles.

The concrete that the diaphragms entrap around the Asymmetric Slimflor® Beam, give the beam its fire rating, therefore the diaphragms must be placed strictly according to specification.



End diaphragm for ComFlor® 225



End diaphragm for ComFlor® 210

## Deck fixing

The decking sheets are manually lowered individually onto the beams. In the Slimdek® system, the end bearing of the sheets should be 50mm; the flange widths are such that this can be achieved, whilst still being able to drop the sheets vertically into position (i.e. without having to thread them between the top and bottom flanges).

## Fixing information for deep decking

<b>To steel</b>	Heavy duty powder actuated fixings - Hilti X-ENP-19 L15 nail/ Spit SBR14 or equivalent. For temporary fixing (i.e. where weld through shear studs are to be used) - Hilti XU-15.* Self-drilling screws. To steel up to 11mm thick - SFS SD14 - 5.5 x 32/EJOT HS 38, Hilti S-MD 55Z, 5x40 or equivalent. To steel up to 17mm thick SFS TDC-T-6.3 x 38 or equivalent.
<b>To masonry or concrete</b>	Pre-drill hole - use self tapping fixing suitable for masonry/ concrete - SFS - TI-6,3x32/EJOT 4H32, Hilti S-MP 52Z 6,3x38 or equivalent.
<b>To side laps or closures etc.</b>	Self-drilling stitching screw typically SFS SL2 or 3 range (will depend on deck thickness)/EJOT SF25, Hilti S-MS 01Z 4,8X19 or equivalent.

## Fixing spacings

	ComFlor® 225	ComFlor® 210
<b>End fixing</b>	2 per trough	1 per trough
<b>Side laps</b>	1 fixing through top flat of small dovetail at 500mm c/c	1 fixing with shear clip 350mm c/c
<b>Side fixing onto support</b>	1 fixing at 600mm c/c	1 fixing at 600mm c/c

Once the sheets for the whole bay are in place, they are secured to the beam flanges using heavy duty shot-fired fixings. The required number of main fixings for ComFlor® 225 is two per trough, one on both sides of the centre dovetail section. ComFlor® 210 requires one main fixing per trough.

Where ComFlor® 210 deck is being used with Asymmetric Slimflor® Beams, the top flange of the profile must be notched back by 50mm, so that the concrete can be observed passing between the end diaphragm and the beam to allow concrete to flow into the beam. (ComFlor® 225 is supplied pre-punched).

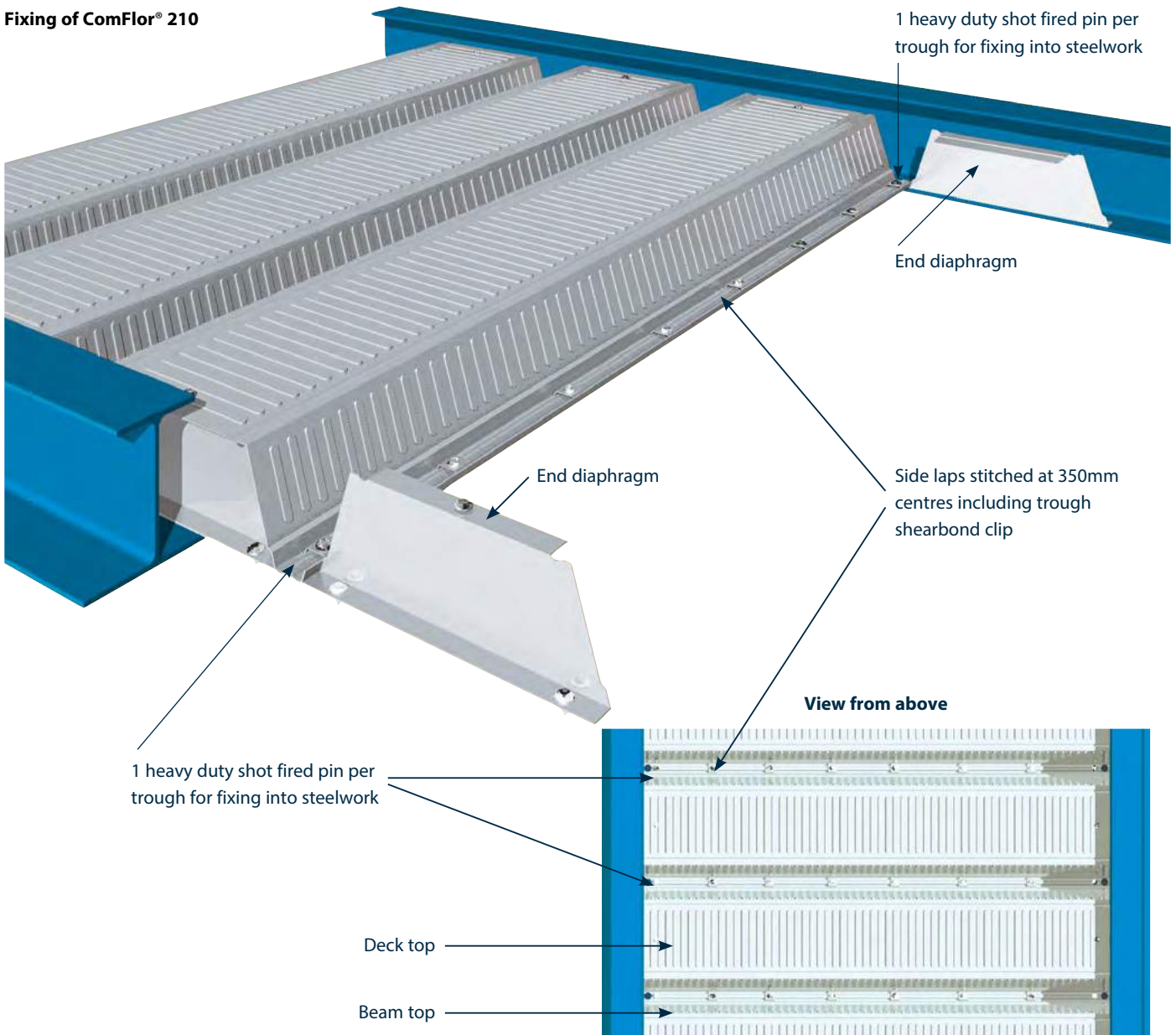
The crown of the deck sheet is fixed to the top of the diaphragms using two self drilling screws for ComFlor® 225, or one self drilling screw for ComFlor® 210.

When fixing to other types of supports such as reinforced concrete, or load bearing walls, 2 suitable fixings must be used in each ComFlor® 225 trough (one per ComFlor® 210 trough), as for the steel supports.

The new symmetrical side lap does not provided a positive engagement, which means that the underlap requires some support during the installation of seam fixings. Methods of achieving this include using a standard Irwin Vise-Grip Locking Welding Clamp (see [www.irwin.com](http://www.irwin.com)), or a simple lever under the underlap.

# Deep composite floor decks - Sitework

## Fixing of ComFlor® 210



### Telephone numbers of fixings suppliers

EJOT	0113 247 0880
Hilti	0800 886 100
Lindapter	0127 452 1444
SFS	0113 208 5500
Spit	0800 731 4924

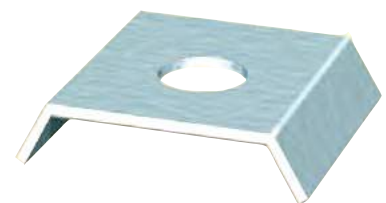
### Side laps

The new side lap on ComFlor® 225 requires stitching at 500mm centres; see further information under Deck Fixing (previous page).

With both profiles, where the first and last sheet lands on a support, the edge of the sheet must be fixed to the support at 600mm centres.

ComFlor® 210 side laps are to be stitched at 350mm centres with 5.50mm diameter self drilling screw, the location is marked by an indentation in the overlap tail. Every side lap fastener must fix and locate a trough shear connector clip into position. The clip is partly responsible for the composite action of the

decking and must not be omitted unless the ComFlor® 210 is being used as formwork only.



**ComFlor® 210 Shear Clip**

# Deep composite floor decks - Sitework

## Edge details

The steelwork must be stable and adequately restrained with support for the deck around columns and openings. The Tata Building Systems deep decking can be easily cut, and fitted, to accommodate columns and other awkward shapes. Where there is no supporting steelwork, brackets fixed to the column will have to be used for local support to the deck.

Light steel edge trim is used to form the edges of the slab and to infill where the 600mm profile of the deck does not align with the parallel supports. Supplied in 3m lengths as standard, and offered in thickness of 1.20mm to 2.00mm, the edge trims are fixed to the perimeter steel beams, using the same shot fired fasteners that secure the deck.

The upper leg is strapped to the crown of the profile, to prevent buckling during the concrete pouring operation.

## Cantilevers

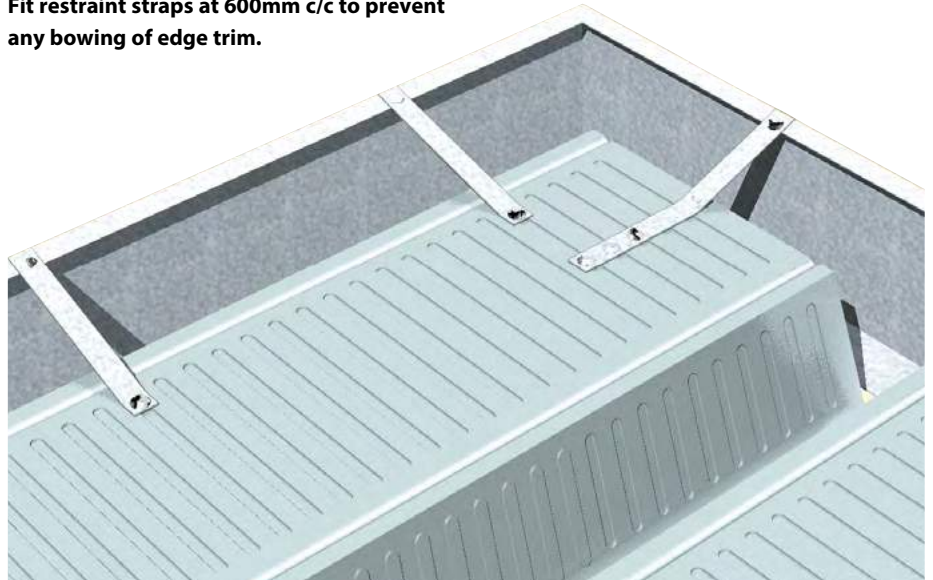
Our deep decks can overhang along their lengths up to 500mm during construction. When Cantilevers are required perpendicular to the span of the profile, stub beams or some similar type of support has to be supplied. In both cases, the Cantilever must be assessed, for the final stage, in accordance with BS EN 1992-1-1 and BS EN 1992-1-2, to determine whether additional reinforcement is required.

## Reinforcement

The decking forms a part of the slab reinforcement, with the remainder being supplied by a bar in each trough of the decking and a mesh placed near to the top of the slab. Reinforcement should be fixed in accordance with the requirements of the structural designer. Normally, circular plastic spacers are used to position the bars 70mm from the base of the trough. This distance can increase to 90 or 120mm (respectively) when 90 or 120 minutes fire resistance are required. There may be additional mesh or bar requirements to fix adjacent to the supports or edge beams, or above beams for crack control purposes.

Any shear studs that are required (to make SFBs or RHSFBs composite) may be welded to these sections during fabrication, because they do not interfere with the decking.

**Fit restraint straps at 600mm c/c to prevent any bowing of edge trim.**



## Edge trims selector

Edge trim depth (mm)	Maximum Cantilever (mm)	
	Galv. steel edge trim thickness (mm)	
270	1.6	2.0
300	100	135
350	50	100
400	x	50
	x	50

x = not recommended.



# Deep composite floor decks - Sitework

## Temporary props

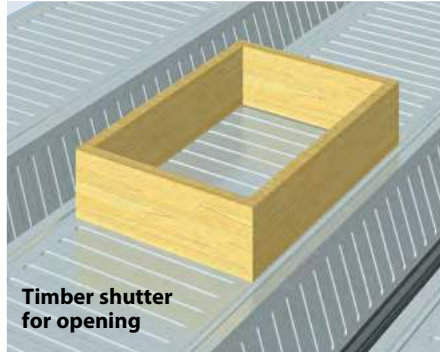
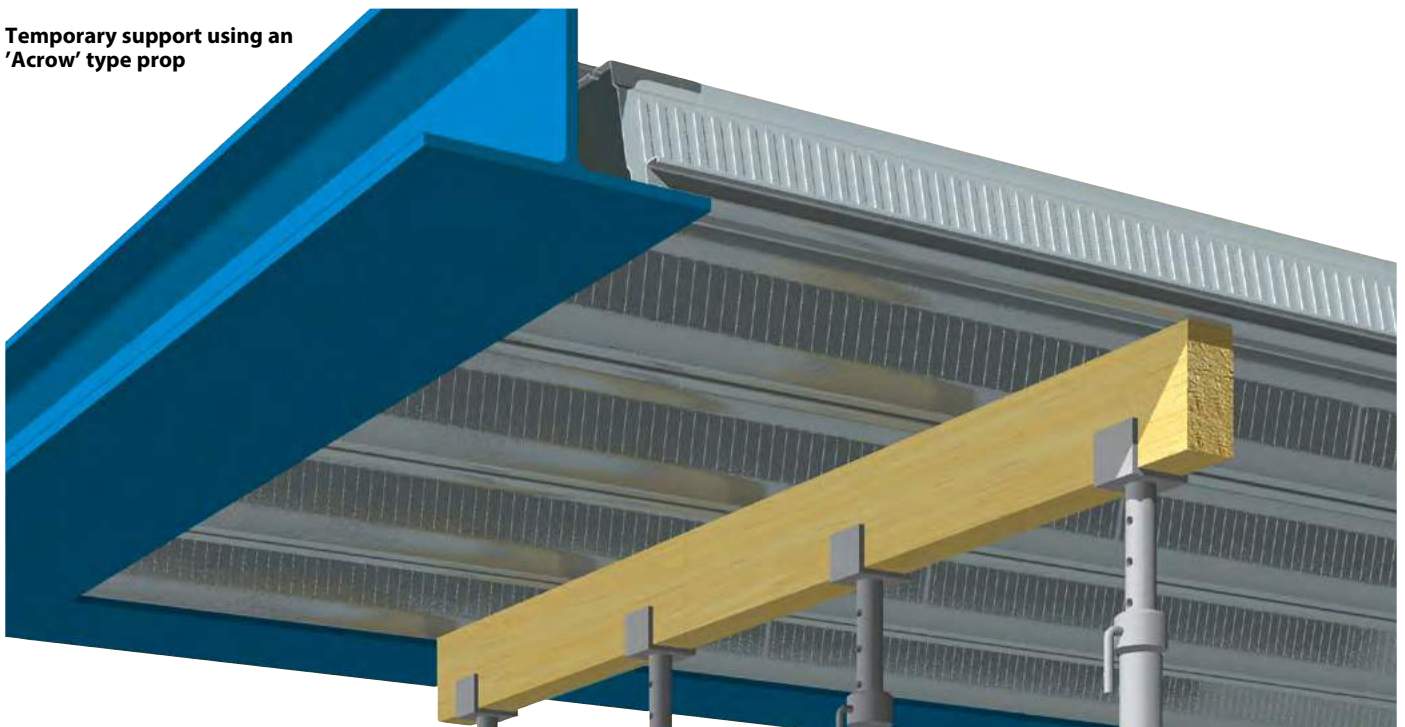
In instances when the design spans exceed the construction stage capacity of the decking, it is necessary to support the weight of the wet concrete and construction loads, by using additional temporary supports.

For spans in excess of 7.5m, the temporary props should be in place and suitably braced, prior to the installation of the decking. The supports should offer a continuous bearing of at least 100mm width to the underside of the deck. Where temporary supports are used it is important that: The timbers and supports are of adequate strength.

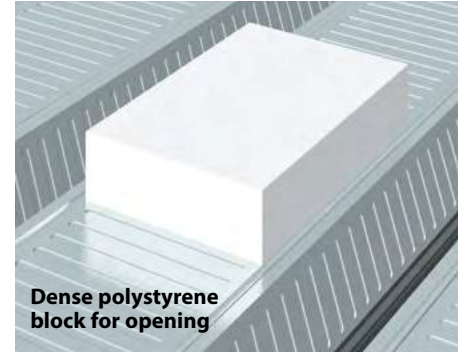
The props are placed at mid-span, or at third span, as required. The propping structure is not to be removed until the concrete has achieved 75% of its design strength. The horizontal bearer timbers must be at least 100mm wide and should be propped at no more than 1m centres. Sometimes the specification may call for 150mm wide bearers.

Props should be stable without relying on friction with the deck for lateral stability. The end props in a row should be self supporting, and braced to the internal props.

## Temporary support using an 'Acrow' type prop



**Timber shutter for opening**



**Dense polystyrene block for opening**

## Penetrations

Openings should be made through the wide crown of the profile. The openings should be boxed out prior to the pouring of the concrete, and the metal of the deck only cut once the concrete has achieved 75% of its design strength.

## Casting concrete

All grease, dirt and debris which could have an adverse effect upon the performance of the cured slab, must be cleared before the application of the concrete can commence. The deck may have some lubricant from the roll forming process on its surface. This does not have to be removed. Care should be taken

during the application of the concrete, to avoid heaping, and the close working of unnecessarily large number of operatives.

## Unsupported edges

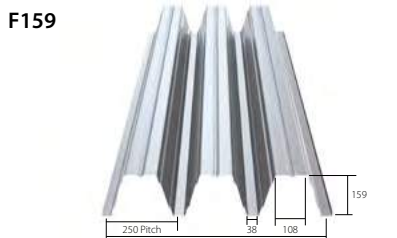
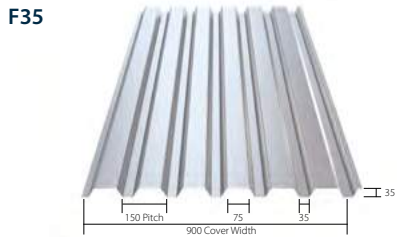
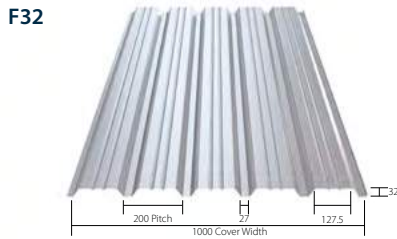
All unsupported edges must be propped, and may require additional reinforcement.

## Temporary props

Timber bearer guide (deep decks) All to be min. 100mm wide	
Slab depth (mm)	Bearer depth (mm)
280	150
320	200
360	250

# ComFlor® formwork

## Permanent non-composite formwork profiles



We manufacture a range of profiles from 32mm to 210mm depths which are used as permanent formwork.

Permanent formwork remains in situ for the life of the building but, unlike composite flooring profiles, it does not act as reinforcement in the concrete slab.

### Advantages

- The steel decking supports the wet concrete and construction loads.
- Temporary propping is eliminated and steel lost formwork is left in situ which gives fast, easy construction.
- The concrete slab requires full structural bar or mesh reinforcement.
- The wide range of Tata Steel formwork profiles ensure the optimum solution is available.

### Concrete volume (m<sup>3</sup>/m<sup>2</sup>)

Profile	Total slab depth (mm)											
F32	82	90	100	110	120	130	140	150	200	250	300	350
	0.058	0.066	0.076	0.086	0.096	0.106	0.116	0.126	0.176	0.226	0.276	0.326
F35	85	90	100	110	120	130	140	150	200	250	300	350
	0.063	0.068	0.078	0.088	0.098	0.108	0.118	0.128	0.178	0.228	0.278	0.328
F46		96	100	110	120	130	140	150	200	250	300	350
		0.069	0.073	0.083	0.093	0.103	0.113	0.123	0.173	0.223	0.273	0.323
F60				110	120	130	140	150	200	250	300	350
				0.076	0.086	0.096	0.106	0.116	0.166	0.216	0.266	0.316
F100								150	200	250	300	350
								0.092	0.142	0.192	0.242	0.292
F159									209	250	300	350
									0.107	0.148	0.198	0.248
F210										260	300	350
										0.092	0.132	0.182

### Weight of wet normal concrete (kN/m<sup>2</sup>)

Profile	Total slab depth (mm)											
F32	82	90	100	110	120	130	140	150	200	250	300	350
	1.46	1.66	1.91	2.16	2.41	2.66	2.91	3.16	4.41	5.66	6.91	8.16
F35	85	90	100	110	120	130	140	150	200	250	300	350
	1.57	1.69	1.94	2.19	2.44	2.69	2.94	3.19	4.44	5.69	6.94	8.19
F46		96	100	110	120	130	140	150	200	250	300	350
		1.73	1.83	2.08	2.33	2.58	2.83	3.08	4.33	5.58	6.83	8.08
F60				110	120	130	140	150	200	250	300	350
				1.91	2.16	2.41	2.66	2.91	4.16	5.41	6.66	7.91
F100								150	200	250	300	350
								2.92	3.54	4.79	6.04	7.29
F159									209	250	300	350
									2.67	3.70	4.95	6.20
F210										260	300	350
										2.30	3.30	4.55

## Maximum span (m) for single span

Profile	Steel Thickness (mm)	Profile Weight (kN/m <sup>2</sup> )	Total slab depth (mm)												
			82	90	100	110	120	130	140	150	200	250	300	350	
F32	0.7	0.07	1.77	1.72	1.66	1.61	1.56	1.52	1.48	1.44	1.29	1.11	0.96	0.85	
	0.9	0.08	2.05	2.00	1.94	1.88	1.82	1.77	1.73	1.69	1.52	1.41	1.31	1.23	
	1.2	0.11	2.40	2.33	2.25	2.18	2.12	2.06	2.01	1.97	1.80	1.67	1.58	1.50	
F35	0.7	0.07	1.89	1.86	1.79	1.74	1.69	1.64	1.60	1.56	1.40	1.29	1.20	1.12	
	0.9	0.09	2.20	2.17	2.10	2.04	1.98	1.93	1.88	1.84	1.66	1.53	1.43	1.34	
	1.2	0.12	2.65	2.61	2.52	2.44	2.38	2.32	2.26	2.22	2.02	1.86	1.73	1.63	
F46	0.7	0.07		2.08	2.03	1.90	1.78	1.68	1.59	1.51	1.21	1.02	0.88	0.78	
	0.9	0.09		2.62	2.59	2.51	2.44	2.42	2.36	2.30	1.93	1.62	1.39	1.22	
	1.2	0.12		3.16	3.12	3.03	2.95	2.87	2.80	2.73	2.46	2.26	2.10	1.97	
F60	0.7	0.08				1.10	1.20	1.30	1.40	1.50	2.00	2.50	3.00	3.50	
	0.9	0.11				2.30	2.15	2.03	1.91	1.81	1.44	1.20	1.03	0.90	
	1.2	0.14				3.67	3.56	3.46	3.37	3.29	2.95	2.71	2.51	2.36	
F100	0.7	0.09									1.50	2.00	2.50	3.00	3.50
	0.9	0.12									2.08	1.59	1.29	1.09	0.94
	1.2	0.16									4.62	4.07	3.75	3.40	2.93
F159	1.25	0.19									2.09	2.50	3.00	3.50	
											5.71	4.96	4.19	3.51	
F210	1.25	0.15										2.60	3.00	3.50	
												5.85	5.19	4.62	

## Maximum span (m) for double span

Profile	Steel Thickness (mm)	Profile Weight (kN/m <sup>2</sup> )	Total slab depth (mm)												
			82	90	100	110	120	130	140	150	200	250	300	350	
F32	0.7	0.07	1.89	1.82	1.74	1.60	1.54	1.49	1.45	1.41	1.24	1.12	1.02	0.95	
	0.9	0.08	2.30	2.22	2.13	2.05	1.98	1.91	1.85	1.79	1.53	1.38	1.27	1.18	
	1.2	0.11	2.59	2.55	2.48	2.39	2.31	2.24	2.18	2.12	1.88	1.70	1.53	1.43	
F35	0.7	0.07	2.15	2.12	2.04	1.98	1.92	1.87	1.82	1.77	1.54	1.39	1.27	1.18	
	0.9	0.09	2.54	2.53	2.46	2.38	2.31	2.24	2.18	2.13	1.91	1.75	1.58	1.47	
	1.2	0.12	3.08	3.03	2.93	2.85	2.77	2.74	2.68	2.62	2.34	2.14	1.97	1.83	
F46	0.7	0.07		2.38	2.31	2.16	2.03	1.91	1.81	1.72	1.38	1.15	1.00	0.88	
	0.9	0.09		3.06	3.02	2.89	2.78	2.67	2.58	2.49	2.14	1.84	1.58	1.39	
	1.2	0.12		3.66	3.60	3.45	3.32	3.24	3.19	3.08	2.67	2.39	2.16	1.99	
F60	0.7	0.08				1.10	1.20	1.30	1.40	1.50	2.00	2.50	3.00	3.50	
	0.9	0.11				2.63	2.46	2.32	2.18	2.07	1.63	1.36	1.17	1.02	
	1.2	0.14				4.26	4.10	3.96	3.83	3.78	3.26	2.89	2.62	2.40	
F100	0.7	0.09									1.50	2.00	2.50	3.00	3.50
	0.9	0.12									2.39	1.82	1.47	1.24	1.07
	1.2	0.16									5.16	4.47	3.88	3.44	3.12
F159	1.25	0.19									2.09	2.50	3.00	3.50	
											5.97	5.16	4.46	3.97	

# ComFlor® 60 with closed ends

## Precision crimped closed ends

Our ComFlor® 60 composite floor profile is available with engineered closed ends.

Produced on line during the profile forming operation, closed ends are optional.

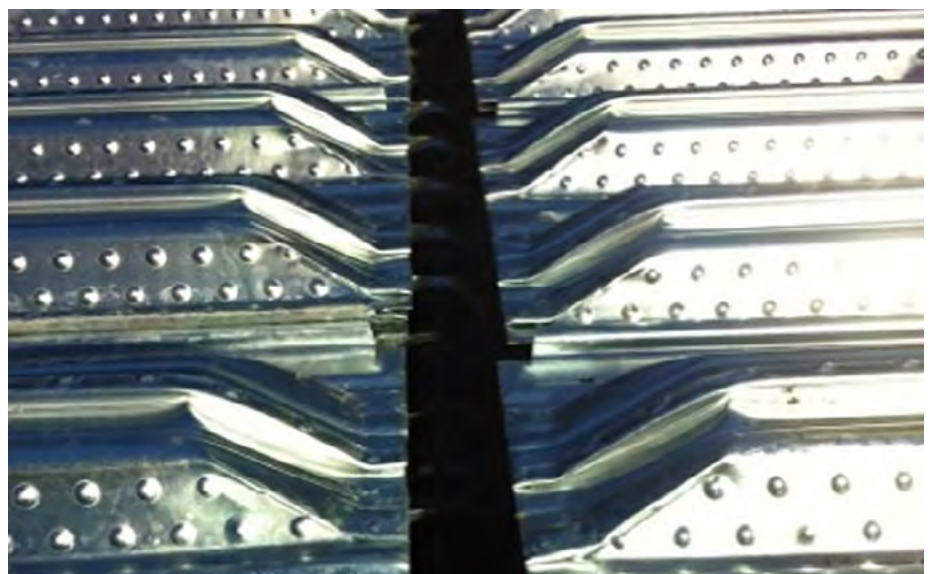
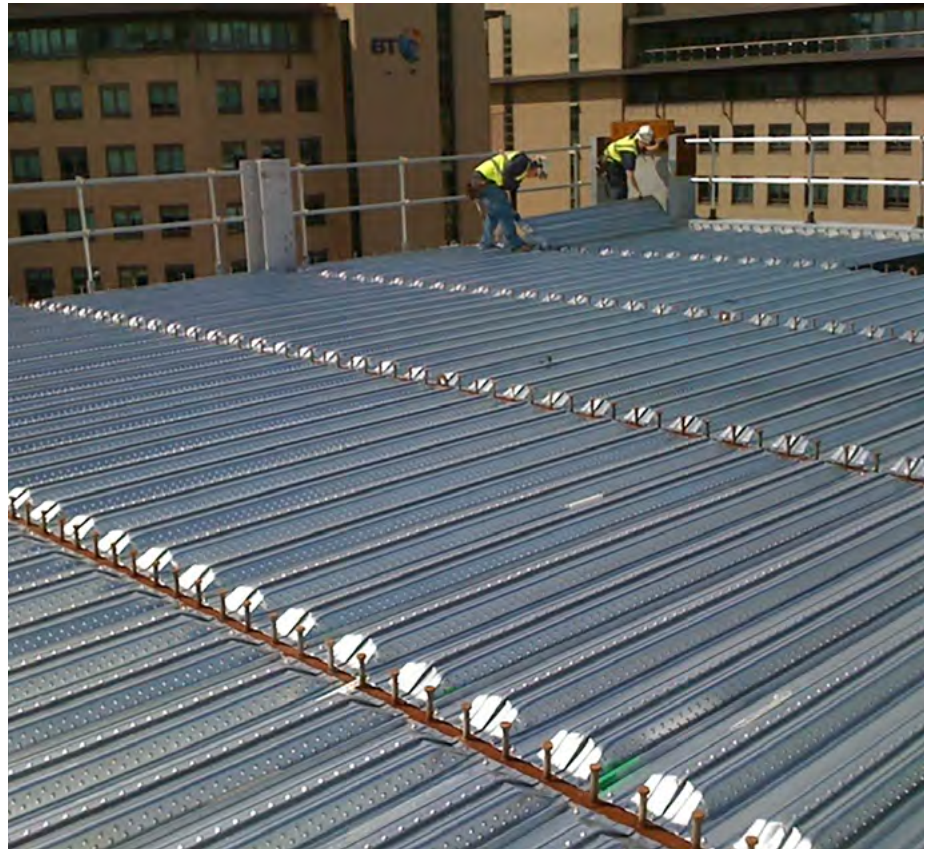
ComFlor® 60 provides excellent acoustic performance and fire protection, and the closed ends eliminate any requirement for filler blocks.

### Closed ends with Colorcoat FD®:

- Uniquely, closed ends can be used in combination with Colorcoat FD® coating to the soffit, providing an extremely neat coloured finish where the deck sits over the beam.

### Closed end benefits:

- Quicker simplified installation on-site, due to elimination of filler blocks.
- Very easy to install on pre-studded beams. No end caps required and no need to worry about relative stud and deck position.
- Cost savings on labour and materials. Closed ends are produced off-site which reduces the requirements for hot work on-site; pre-studded beams require no end caps, removes requirement for on-site stud welding, allows post galvanised beams.
- Precision crimped closed ends give a more aesthetic finish.
- Closed ends prevent and control the loss of concrete.
- Suitable for all forms of construction, particularly ideal for single span projects.
- Enhanced acoustic and fire performance.
- Optimum shear stud performance. Closed ends leave sufficient concrete around the studs to eliminate reduction factors and the position of the stud in relation to the deck troughs is not important.



# ComFlor® Active

## Thermally active flooring

**As the drive to deliver sustainable buildings intensifies, innovative products which reduce the environmental impact of a building are coming to the fore.**

ComFlor® Active exemplifies this new approach. It facilitates truly sustainable control of room temperature in new buildings without heavy reliance on carbon intensive fuels.

It permits circulation of cool or warm water through a network of waterpipes embedded into the concrete to thermally activate the floor. This method provides highly effective cooling for office buildings and similar heating benefits in residential structures.

In both cases, the low temperature differential between the room temperature and the circulated water allows the use of low carbon

technologies, rather than traditional carbon intensive heaters or chillers, to supply water at the required temperature.

The low water temperature also reduces heat losses from the intermediate pipework and increases the system's overall efficiency. Thermally activated traditional concrete slab floors provide a high comfort level, reduce the need for radiators and provide a self-regulating, energy efficient system offering cooling and heating in a single package.

ComFlor® Active offers all these advantages, with some key extra features. Benefits include a large radiant surface to maximise output and optional Colorcoat FD® 25 and Colorcoat FD® 170 pre-finished steel to further improve performance and offer an aesthetically appealing finish.



# ComFlor® with Colorcoat FD®

## Pre-finished composite floor deck

### Colorcoat FD®

Colorcoat FD® pre-finished steel is ideal when the exposed ComFlor® soffit is used as a feature of the building's interior, such as in car parks, avant garde offices or schools, especially when using ComFlor® Active. It is available in two different coatings, both applied over the galvanised substrate to EN 10346:2015.

**Colorcoat FD® 170** pre-finished steel is a tough satin embossed plastisol coating 170 microns thick with an aesthetic guarantee of up to 25 years and a design life of 50 years. It provides significant additional protection to exposed soffits in both internal and external environments, with project specific guarantees available for both inland and coastal applications.

**Colorcoat FD® 25** pre-finished steel is a 25 micron polyester coating that also offers additional protection to the exposed soffit. Intended for use in internal environments, it is available with a paint adhesion and colour fade project specific guarantee of up to 10 years.



### Colorcoat FD® pre-finished steel features:

- Good formability and durability in exterior applications.
- Exposed side available in white as standard for optimum reflectivity. Other colours are available on request.
- Reverse side pre-treatment compatible with concrete.

### Use of Colorcoat FD®

Through deck welded shear studs cannot be used with Colorcoat FD® 25 or Colorcoat FD® 170, however various alternative fixing options are available, such as pre-welded studs.



## Colorcoat FD® 25 Mechanical properties

Grade	Yield Strength ReH (N/mm <sup>2</sup> )	Tensile strength Rm (N/mm <sup>2</sup> )	Elongation A <sub>Bo</sub> (%)
S350	350 (min)	420 (min)	16 (min)
S320	320 (min)	390 (min)	17 (min)
S280	280 (min)	360 (min)	18 (min)

All steel grades are available with a gauge of 0.9mm to 1.2mm in standard coil widths of 890 mm to 1300 mm

### Notes:

1. Values are based on test pieces taken in the longitudinal direction.
2. Tensile values relate to test pieces cross sections without Zinc coating.
3. The index of elongation indicates the original gauge length used, expressed in millimetres, e.g. A80 indicates an 80mm gauge length.
4. S280GD+Z, S320GD+Z and S350GD+Z are manufactured according to BS EN 10346:2015.
5. Following the paint process there is virtually no age hardening of the substrate.
6. Gauge tolerances are normal or special as per BS EN 10143:2006. For other tolerances please contact Tata Steel.

## Typical properties

Colorcoat FD® 25		Test standard	
Nominal organic coating thickness	(µm)*	25	EN 13523-1
Specular gloss (60°) Standard colours	(%)	25-45	EN 13523-2
Scratch resistance Standard colours	(g)	> 2500	EN 13523-12
Abrasion resistance (Taber, 250 rev, 1 kg) Standard colours	(mg)	< 40	EN 13523-16
Flexibility:			
Minimum bend radius	(T)	3 (16°)	EN 13523-7
Reverse impact	(J)	16	EN 13523-5
Adhesion (cross hatch)	(%)	100	EN 13523-6
Corrosion resistance:			
Salt spray	(h)	500	EN 13523-8
Humidity	(h)	1000	EN 13523-25
UV resistance category		Good	EN 13523-10
Reaction to fire		Class A1	EN 13501

\*µm = microns

### General notes

The figures in this table are typical properties and do not constitute a specification. These figures relate to the painted surface. Colorcoat FD® 25 meets the requirements of Class 0 of the Building Regulations for England and Wales 2006.

## Guarantee period Colorcoat FD® 25

Colorcoat FD® 25 is available with a paint adhesion and colour fade project specific guarantee of up to 10 years depending upon exact project details.

### Note

Not recommended for use in marine environments up to 2km from the coast.

## Colorcoat FD® 170 Mechanical properties

Grade	Yield Strength ReH (N/mm <sup>2</sup> )	Tensile strength Rm (N/mm <sup>2</sup> )	Elongation A <sub>Bo</sub> (%)
S350	350 (min)	420 (min)	16 (min)

All steel grades are available with a gauge of 0.9mm to 1.2mm in standard coil widths of 890mm to 964mm

### Notes:

1. Values are based on test pieces taken in the longitudinal direction.
2. Tensile values relate to test pieces cross sections without Zinc coating.
3. The index of elongation indicates the original gauge length used, expressed in millimetres, e.g. A80 indicates an 80mm gauge length.
4. S350GD+Z is manufactured according to BS EN 10346:2015.
5. Following the paint process there is virtually no age hardening of the substrate.
6. Gauge tolerances are normal or specials per BS EN 10143:2006. For other tolerances please contact Tata Steel.

## Typical properties

Colorcoat FD® 170		Test standard	
Nominal organic coating thickness	(µm)*	170	EN 13523-1
Specular gloss (60°) Standard colours	(%)	20-40	EN 13523-2
Scratch resistance Standard colours	(g)	> 3000	EN 13523-12
Flexibility:			
Minimum bend radius	(T)	0 (16°)	EN 13523-7
Reverse impact	(J)	≥ 18	EN 13523-5
Adhesion (cross hatch)	(%)	100	EN 13523-6
Corrosion resistance:			
Salt spray	(h)	1000	EN 13523-8
Humidity	(h)	1000	EN 13523-25
UV resistance category		Ruv 4	EN 13523-10
Max continuous operating temp	°C	60	Tata Steel
Reaction to fire		Class C S33-d0	EN 13501

\*µm = microns

### General notes

The figures in this table are typical properties and do not constitute a specification. These figures relate to the painted surface. Colorcoat FD® 170 meets the requirements of Class 0 of the Building Regulations for England and Wales 2006.

## Guarantee period Colorcoat FD® 170

Colorcoat FD® 170 is available with a paint adhesion and colour fade project specific guarantee of up to 25 years for inland applications and up to 15 years for coastal environments, depending on exact project details.

### Note

Coastal applies to buildings within 1km of any coast.

# ComFlor® 9 software

## Download instructions

The comprehensive ComFlor® 9 software for the design of composite floor slabs is freely available, to all professionals who register, at: <http://rpuws.steel-sci.org/Software/Comflor/ComFlorReleaseHistory.htm>

## Use of the design program

All the variables start with a default value, however check or input new variables in all three input datasheets, namely structure, loading and design. When satisfied click analyse to run the calculations which are then shown in the results sheet. Job details may be entered for a formal printout.

It is not necessary to put in shear connectors (shear studs) for the composite slab design (shear connectors are used primarily for the benefit of the beam not the slab). However if shear connectors are to be used, then the design software allows end anchorage to be accounted for which in some cases will improve the load capacity of the composite slab.

Before accepting a particular design as satisfactory, it is highly advisable to print out the calculations and check that all the input parameters are correct.

## Design criteria and methods

The design program has been produced by the Steel Construction Institute on behalf of Tata Steel UK Limited.

## Help function on disk

The Help function on the design program contains all the detailed information that is used to produce the calculations.

## Professional support

Tata Steel maintains a friendly technical advisory desk, which is freely available to all consulting engineers and contractors to assist in composite flooring design issues.

The ComFlor® technical hotline is available on **01244 892199**.



The Wallbrook Building, City of London  
Steelwork contractor and decking installer: William Hare

# Sustainability

We are committed to making the products society needs and to making them in the safest and most responsible way possible.

Sustainability is at the very heart of what we do. As one of the world's leading steel producers, we manage our operations responsibly and operate a programme of continuous improvement in our systems and processes to ensure that they meet, and wherever possible exceed, the standards set by regulators.

We work together with our customers to design more sustainable products that contribute to solutions that are lighter, last longer and use fewer resources to produce.

## Our steel goes into the world's most sustainable buildings

As proud members of ULCOS (Ultra-Low CO<sub>2</sub> Steelmaking Partnership) which has the stated goal of developing technologies capable of reducing the CO<sub>2</sub> emissions of steel production by 50% by 2050, and as host to its leading pilot project, Hisarna, Tata Steel will continue to invest in research & development in the search for ways to reduce CO<sub>2</sub> emissions through breakthrough technology.

Our innovative products are also crucial for a lower CO<sub>2</sub>, more resource efficient world, ranging from lighter vehicles to making regular buildings their own 'power stations' - we will continue to investment in such product innovation. We have also

demonstrated strong sustainability credentials through our responsible sourcing programme which has achieved BES 6001 certification across nine of our European sites. We plan to certify a further eight sites to BES 6001 by 2017.

As well as looking to the future, we provide unrivalled support to our customers on all issues relating to sustainable construction in steel through a network of in-house technical experts in conjunction with organisations such as The UK Green Building Council, The BCSA, and The Steel Construction Institute (SCI), as well as working together with academic experts such as Oxford Brookes University and our supply chains



"We take our responsibility as a sustainable steel producer very seriously and have taken a leading role in reducing CO<sub>2</sub> emissions across the steel industry."

Tata Steel's Shotton site – now with 25% less CO<sub>2</sub> emissions than in 2005.

# ComFlor® in construction

## CPD Seminars

As the voice of authority for the structural steel market, Tata Steel extends its knowledge and expertise to CPD seminars.

The ComFlor® in Construction CPD seminar provides an invaluable insight into the use of composite floor decks. It addresses the key issues to be considered when specifying a structural composite floor:

- **Spanning**
- **Concrete usage**
- **Health and Safety implications**
- **Acoustics**

### It also looks at:

- ComFlor® Active
- ComFlor® with fibres in Construction
- Impact on building lifecycle costs
- Sustainability and environmental impact
- Case study examples

### Duration

45 minutes

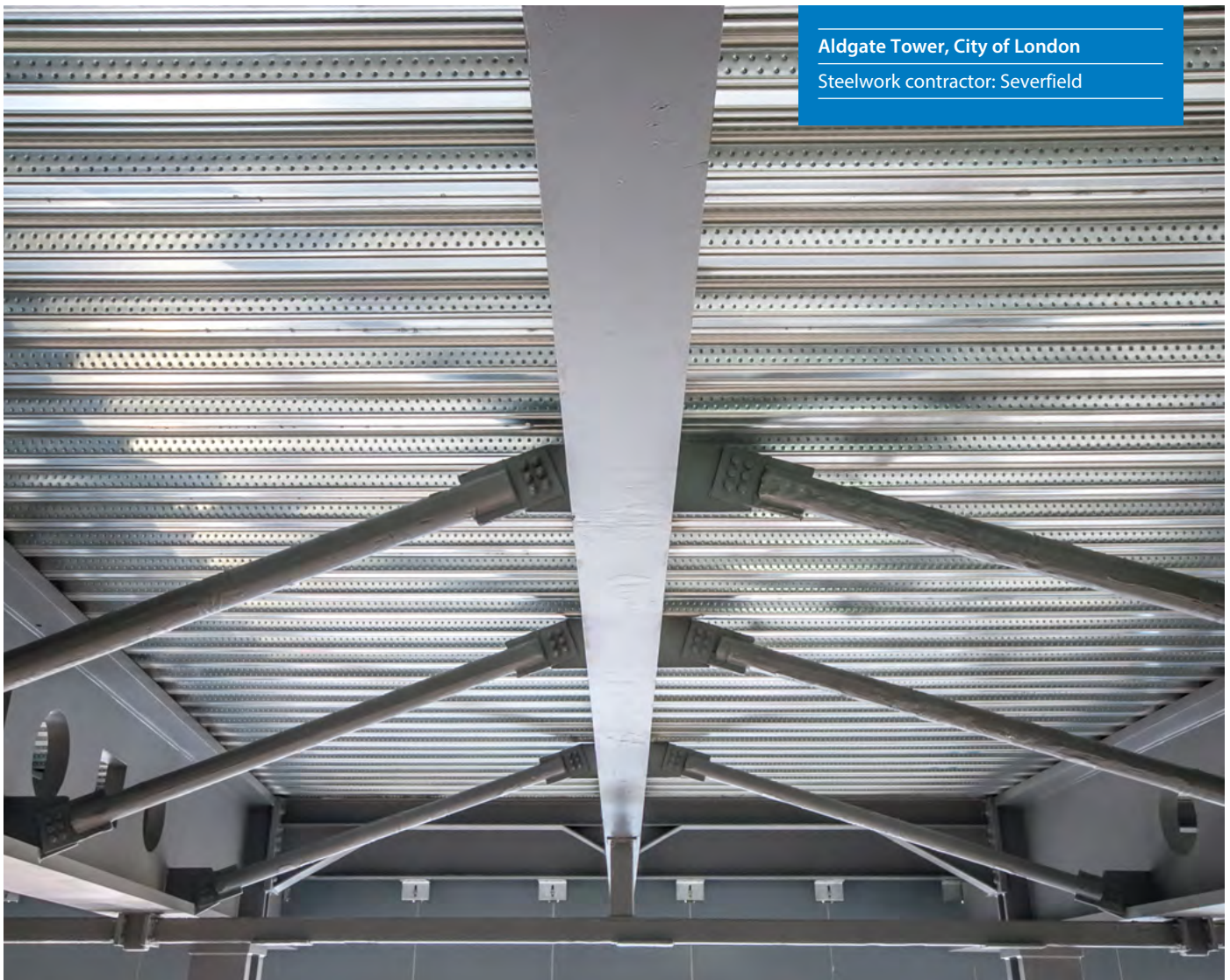
### Also available:

Technical Support · Literature ·  
Material Samples · ComFlor® 9 Software demo

### RoofDek CPD seminar

You may also be interested in our Roof deck in construction CPD which provides an insight into the comprehensive range of structural roof decking products that we offer, ranging from 32mm to 210mm deep.

To request a ComFlor® in Construction CPD visit [www.tatasteelconstruction.com](http://www.tatasteelconstruction.com)



# Transport & Handling

**For general information on Transport, Handling and Storage, refer to the relevant Tata Steel leaflet.**

## Receiving & checking

Composite floor decking is packed into bundles of up to 24 sheets and the sheets are secured with nylon banding. Each bundle may be up to 950mm wide (the overall width of a single sheet) by 750mm deep, and may weigh up to 2.5 tonnes, depending on sheet length (average weight is about 1.5 tonnes). Loads are normally delivered by articulated lorries approximately 16m long with a maximum gross weight of up to 40 tonnes, and a turning circle of approximately 19m. The main contractor should ensure that there is suitable access and appropriate standing and off-loading areas.

Each bundle has an identification tag. The information on each tag should be checked by operatives from the decking contractor (or, if they are not on site, the main contractor) immediately upon arrival. In particular, the stated sheet thickness should be checked against the requirement specified on the contract drawings, and a visual inspection should be made to ensure that there is no damage.

## Storage

The decking should be installed as soon as possible upon delivery on-site. If the decking is not for immediate use, it should be stored on the steel frame to avoid damage from site traffic.

It should also be noted that to avoid the risk of condensation the decking should be stored in a location that minimises fluctuation in both temperature and humidity. For further guidance, please contact us.

## Lifting bundles

Bundles should be lifted from the lorry. Bundles should never be off-loaded by tipping, dragging, dropping or other improvised means.

Care is needed when lifting the decking bundles; protected chain slings are recommended. Unprotected slings can damage the bundle during lifting; when synthetic slings are used there is a risk of the severing them on the edges of the decking sheets.

If timber packers are used, they should be secured to the bundle before lifting so that when the slings are released they do not fall to the ground (with potentially disastrous results). Steel bundles must never be lifted using the nylon banding.

## Positioning the decking

Support steelwork should be prepared to receive the decking before lifting the bundles onto it. The top surface of the underlying beams should be reasonably clean. When thru-deck welding of shear studs is specified, the tops of the flanges should be free of paint or galvanising.

The identification tags should be used to ensure that bundles are positioned on the frame at the correct floor level, and in the nominated bay shown on the deck layout drawing. Bundles should be positioned such that the interlocking side laps are on the same side. This will enable the decking to be laid progressively without the need to turn the sheets. The bundles should also be positioned in the correct span orientation, and not at 90° to it. Care should be taken to ensure bundles are not upside down, particularly with trapezoidal profiles. The embossments should be oriented so that they project upwards.

## Placement of decking

The breaking open of bundles and installation of decking should only begin if all the sheets can be positioned and secured. This will require sufficient time and suitable weather. The decking layout drawing should also be checked to ensure that any temporary supports that need to be in position prior to deck laying are in place.

Access for installation will normally be achieved using ladders connected to the steel frame. Once they have started laying out the sheets, the erectors will create their own working platform by securely fixing the decking as they progress.

The laying of sheets should begin at the locations indicated on the decking layout drawings. These would normally be at the corner of the building at each level; to reduce the number of 'leading edges', i.e. unprotected edges, where the decking is being laid. When the bundles have been

properly positioned, as noted above, there should be no need to turn the sheets manually, and there should be no doubt which way up the sheet should be fixed. Individual sheets should be slid into place and, where possible, fixed to the steelwork before moving onto the next sheet.

This will minimise the risk of an accident occurring as a result of movement of a sheet when it is being used as a platform. (However, for setting-out purposes, it may be necessary to lay out an entire bay using a minimum number of temporary fixings before fully securing the sheets later).

Sheets should be positioned to provide a minimum bearing of 50mm on the steel support beams. The ends of adjacent sheets should be butted together. A gap of up to 5mm is generally considered not to allow excessive seepage, but, if necessary, the ends of the sheets may be taped together. When end gaps are greater than 5mm, it is normally sufficient to seal them with an expanding foam filler. The longitudinal edges should be overlapped, to minimise concrete seepage.

## Cutting sheets

Where necessary, sheets may be cut using a grinder or a nibbler. However, field cutting should be kept to a minimum and should only be necessary where a column or other obstruction interrupts the decking. Gaps adjacent to the webs of columns should be filled in with off-cuts or thin strips of steel. Decking sheets shown as continuous on the decking layout drawing should never be cut into more than one length. Also, sheets should never be severed at the location of a temporary support, and the decking should never be fastened to a temporary support.

As the work progresses, unwanted scraps and off-cuts should be disposed of in a skip placed alongside the appropriate level of working. The skip should be positioned carefully over a support beam to avoid overloading the decking. If a skip is not available, scraps should be gathered for collection by the main contractor as soon as is possible. Partially used bundles should be secured, to avoid individual sheets moving in strong winds.

# Health & Safety

## Health & Safety

### Handling hazards

Zinc coated steel decking should be handled with care; it may be delivered with soluble protective layer of oil, which can cause contamination to lacerated skin. Decking will have sharp edges and corners. Adequate gloves and protective clothing should be worn when handling decking.

### Eye hazards

Eye protectors conforming to the specification in BS 2092:1987 should always be worn, when breaking the strapping around bundles because the sudden release of tension creates a risk to eyes.

Particles of metal also create eye hazards when cutting steel, and eye protection should be worn, during this activity.

### Noise hazards

Noise may be hazardous whilst handling or cutting decking, shot firing, etc, adequate ear defenders should be worn.

### Respiratory hazards

Fumes containing oxides of iron and zinc are produced during welding or flame cutting and if inhaled these may cause metal fume fever; this is a short-lasting condition with symptoms similar to those of influenza. In conditions of exposure to such hazards, the use of respiratory equipment is recommended.

### Explosives and fumes

When using shot fired fixings explosives and fumes may create a hazard.

### Occupational exposure limits

Limits for iron and zinc oxides are  $5\text{g}/\text{m}^3$  (8 hours TWA) and  $10\text{mg}/\text{m}^3$  (10 minutes TWA). (OE recommendation)

### Summary of protective measures

Wear adequate gloves and protective clothing and safety goggles.

Ensure adequate ventilation and use personal protective equipment.

Follow instructions for safe handling, use, disposal and control of cartridges issued by equipment supplier.

Ensure adequate ventilation and / or use personal respiratory protective equipment. Use appropriate ear defenders or earplugs.

### Installation of deep decks

Please contact the ComFlor® Technical Hotline for special health and safety considerations regarding installation of deep decks.

### General safety points

Follow the good practice outlined here and in SCI publications.

- Always fix deck securely before using as a working platform.
- Steel end diaphragms, as manufactured by Tata Steel Panels and Profiles, are essential for both deep deck systems to ensure the structural integrity of the deck.
- Rigorously employ all personal safety measures such as hard hats, protective clothing.
- Rigorously employ all site safety measures such as safety lines, edge protection, properly tied ladders.
- **Don't** leave any unfixed decking sheets.
- **Don't** heap concrete or drop from any height.
- **Don't** put heavy loads on unprotected deck.
- **Don't** place props on uncured concrete.
- **Don't** cut holes/voids in the deck prior to concreting.

# ComFlor® reference

## Design standards

### Eurocode Standards

The design guidance given in this brochure, are in accordance with the following Standards:

#### Basics of structural design

1. BS EN 1990 Eurocode 0: Basis of Structural Design.

#### Actions on structures

2. BS EN 1991-1-1 Eurocode 1: Actions on structures. Part 1-1: General actions – Densities, self-weight, imposed loads for buildings.

#### Concrete

3. BS EN 1992-1-1 Eurocode 2: Design of concrete structures. Part 1-1: General rules and rules for buildings.

#### Profiled steel deck

4. BS EN 1993-1-3 Eurocode 3: Design of steel structures. Part 1-3: General rules – Supplementary rules for cold-formed members and sheeting.

#### Composite floor slab and composite beams

5. BS EN 1994-1-1 Eurocode 4: Design of Composite steel and concrete structures. Part 1-1: General rules and rules for buildings.

#### Fire resistance

6. BS EN 1994-1-2 Eurocode 4: Design of Composite steel and concrete structures. Part 1-2: General rules – Structural fire design.

#### Reinforcement

7. BS EN 10080: Steel for the reinforcement of concrete. Weldable reinforcing steel. General.

#### Shear Stud Specification

8. BS EN ISO 13918: Welding – Studs and ceramic ferrules for arc stud welding.

#### Steel Substrate Specification

9. BS EN 10346: Continuously hot-dip coated steel flat products – Technical delivery conditions.
10. BS EN 10143: Continuously hot-dip coated steel flat products – Tolerances on dimension and shape.

#### Supplementary SCI Publications

11. SCI P056: The fire resistance of composite floors with steel decking.
12. SCI P076: Design guide on the vibration of floors.
13. SCI P262: Durability of light steel framing.
14. SCI P300: Composite slabs and beams using steel decking – Best practice for design and construction (Revised Edition).
15. SCI P321: Acoustic performance of Slimdek®.

16. SCI P322: Acoustic performance of composite floors.

17. SCI P354: Design of floors for vibration – A new approach.

18. SCI P359: Composite design of steel framed buildings – In accordance with Eurocode and the UK National Annexes.

19. SCI P367: Construction loading for composite slabs.

20. SCI P372: Acoustic detailing for steel construction.

21. SCI AD 150: Wheel loads from forklifts.

22. SCI AD 192: Transverse reinforcement of in composite T-beams.

23. SCI AD 266: Shear Connection in composite beams.

24. SCI AD 343: Position of reinforcing mesh relative to stud shear connectors.

25. SCI AD 346: Design actions during concreting for beams and decking in composite floors.

26. SCI NCCI PN001a-GB – Resistance of headed stud shear connectors in transverse sheeting.

27. SCI NCCI PN003a-GB – Provision of 'appropriate anchorage' to profiled sheeting.

28. SCI NCCI PN005a-GB – Fire resistance design of composite slabs.

29. SCI NCCI SN036a-EN-Eu – Vibrations.

#### Supplementary Concrete Advisory Publications

30. Concrete Advisory Service ADS 14: Cracking in composite concrete/corrugated metal decking floor slabs.

#### Supplementary British Construction Steelwork Association (BCSA) Publications

31. BCSA Publication No 44/07 – Guide to the installation of Deep Decking.

### British Standards

The design guidance given in this brochure and on the attached software complies, where relevant, with the following Standards.

#### Composite floor deck

1. BS 5950: Part 4 1994. Structural use of steelwork in building: Code of practice for design of composite slabs with profiled steel sheeting.

#### Composite steel beams

2. BS 5950: Part 3: 1990. Design in composite construction: Section 3.1: 1990. Code of practice for design of simple and continuous composite beams.

#### Profiled steel deck

3. BS 5950: Part 6 1995. Structural use of steelwork in building: Code of practice for design of light gauge profiled steel sheeting.

#### Fire resistance

4. BS 5950: Part 8 2003. Structural use of steelwork in building: Code of practice for fire resistant design.

#### Concrete

5. BS 8110: Part 1: 1997 Structural use of concrete: Code of practice for design and construction.
6. BS 8110: Part 2: 1985 Structural use of concrete: Code of practice for special circumstances.

#### Reinforcement

7. BS 4483: 2005 Specification for steel fabric for the reinforcement of concrete.
8. BS 4449: 2005 Specification for carbon steel bars for the reinforcement of concrete.
9. BS 4482: 2005 Steel wire for the reinforcement of concrete products specification.

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