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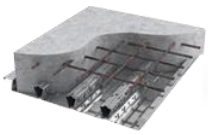
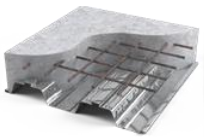
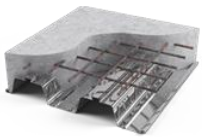
GOOD PRACTICE: These guidance notes have been developed by RSD. Whilst every effort has been made to ensure that they are comprehensive, we would refer you to the BCSA publication No 37/04 – BCSA Code of Practice for Metal Decking and Stud Welding – for further guidance. These notes should also be read in conjunction with the prevailing national design guidance and health and safety legislation.

DESIGN

General

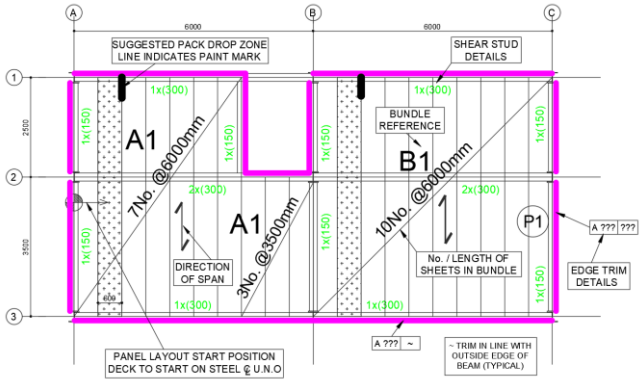
RSD decking can be used as permanent shuttering to an insitu concrete topping, or as both shuttering and tensile reinforcement to form what is referred to as a composite floor slab.

Composite floor slabs form the most frequent application, and these are designed to the currently applicable design code BS5950: Part 4.

When decking is used as permanent shuttering only, it is the responsibility of the Project Structural Design Engineers to specify all the slab reinforcement necessary to support the permanent loads, ignoring any contribution from the decking profile.

RSD provide full working drawings for the steel deck locations to assist offload and landing of packs.

RSD will be releasing a unique software package that enables engineers to design the frame and decking interaction for composite slabs.



Formwork / Composite Decking

Form decking serves as a permanent formwork for a reinforced concrete slab, until the slab can support itself and its live load.

Composite decking serves as a tensile reinforcement for the concrete slab to which it is bonded with embossed rib pattern. Composite action between the concrete slab and the floor beams or joists can be achieved by welding shear studs through the decking to the supporting beam below.

Construction Loading

The design span/load tables generally make allowance for a temporary construction live load of 1.5kN/m² in addition to the wet weight of concrete. This should not be exceeded with consent of RSD's Engineer.

The heaping of concrete during placement should be avoided. In propping condition, it is normally the construction stage that governs the allowable spans shown in the tables.

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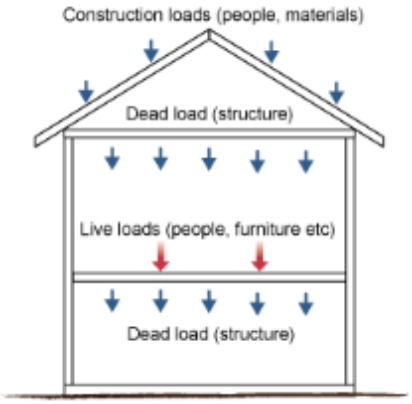
Construction Loading after Concrete Set

The slab strength will generally have been specified by the Project Structural Design Engineer based on support of long-term loads consistent with the building's intended use.

In the temporary condition, construction loads from plant used for erecting steelwork or from materials stored for following trades may constitute a more onerous design condition and should be referred to the Project Structural Design Engineer for assessment.

Permanent Loadings

The self-weight of the slab has been considered in the design process and need not be included in the imposed loads indicated in the span/load tables.



The Project Structural Design Engineer should sum all predominantly uniform applied live, partition, finishes and loads when reading from these tables. Any walls other than lightweight partitions should be considered separately as either line or concentrated loads, and specific calculations should be made to check the adequacy of the selected slab to support them.

Reinforcement Mesh

In all circumstances appropriate crack control and distribution reinforcement should be provided within the slab and this can be in the form of a wire-welded mesh or, in certain situations, as macro fibres.

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/mm2, and have a cover of at least three diameters.

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) 325 (30 Cover)	335 (25 Cover) 300 (30 Cover)	320 (25 Cover) 290 (30 Cover)

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

Decking can only contribute to the transverse shear reinforcement for the distribution of longitudinal shear forces in composite beams when it is spanning perpendicular to the beam. In addition, it should either be continuous across

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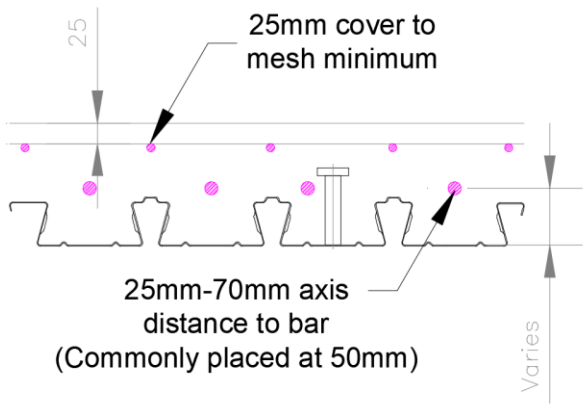
the beam, or the beam flange be wide enough to allow effective anchorage of the deck using shear studs welded in a staggered pattern.

Bar Reinforcement

Additional reinforcement may also be required to comply with building or other regulations and it is the customer's responsibility to ensure that the necessary design checks and approvals have been granted.



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.

Deflection

Decking will deflect under the weight of wet concrete as it is placed. The design process takes account of this deflection and limits it in accordance with the relevant code of practice. The additional weight of concrete due to this deflection is factored into this and all subsequent calculations.

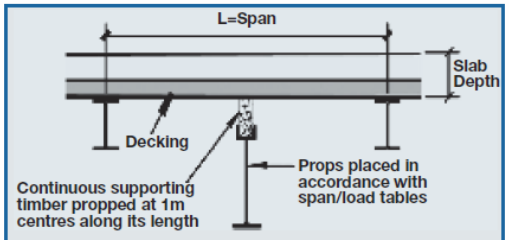
No account is taken for any deflection of the supporting steel frame. Those responsible for the placement of the concrete should be made aware of all expected deflections when assessing concrete volumes and finishing techniques.

Temporary Support

Temporary support may sometimes be necessary to sustain the dead weight of wet concrete and any other construction loads.

General guidance is provided by RSD on project specific installation layout drawings and design calculations. The Project Structural Design Engineer may also specify temporary propping in situations where tighter control on deflections is deemed necessary.

The design and safe installation of temporary supports, including any bracing necessary, is the responsibility of the Project Structural Design Engineer. There should be continuous sole and header plates across the full width of every propped bay and the system should be installed to ensure zero deflection of the deck at propped points prior to concrete placement.



Slab depth (mm)	Span 'L' (m)	Runner Size	
		Depth	Width
120	3.25	175mm	50mm
130	3.75	200mm	50mm
150	4.25	225mm	50mm
200	4.75	225mm	75mm

ABOVE DATA OFFERED AS A GUIDE ONLY TO SIZE OF TIMBER RUNNER

Lower Limit for Pre-installation of Temporary Supports. Temporary supports should remain in

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place until the concrete has reached a minimum of 70% of its characteristic strength.

The header plate should offer a wide area of support so as not to locally compromise the structural integrity or the appearance of the decking. Except where specifically advised, all temporary props to unsupported slab edges are to be fully in place prior to installation of the edge trim or decking.

Shear Studs

Shear studs are manufactured from low carbon steel with minimum values of yield point of 350 N/mm2, ultimate tensile strength 450 N/mm2, and elongation 15%.

The studs should be headed and for through deck welding they should be specified with a shank diameter of 19mm. Studs should protrude a minimum of 35mm above the shoulder of the decking profile and the covering of concrete over the head of the stud should be a minimum of 15mm.
The shear capacity of headed studs embedded in solid concrete is calculated in accordance with BS EN 1994-1-1 cl. 6.6. In composite slabs the studs may be affected by the proximity of the webs of the steel decking sheet and their capacity may be reduced. Refer to BS EN 1994-1-1 cl. 6.6 for reduction factor formulae.

DELIVERY

Delivery, Transportation and Access

Loads are normally delivered by articulated vehicles of approximately 16 metres in length and with maximum gross weights of up to 36 tonnes. Decking will normally be delivered in full loads. Suitable access to and from unloading points on sites must be provided and maintained by the client.

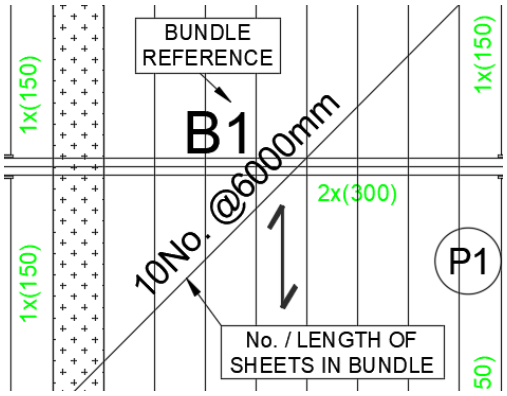
Delivery vehicles have a maximum unloading time of 2 hours. Unless otherwise agreed in writing before delivery, offloading and lifting to level and position is the responsibility of the customer.

Lengths of decking manufactured in accordance with RSD layout drawings or customer schedules are normally consolidated into compact, banded bundles. These bundles may weigh up to 1.5 tonnes and cover an effective area up to 100 square metres when laid, depending on the profile, gauge and length of the panels being delivered.

The maximum sheet length on a project could be governed by one or more of the following: manual handling limitations, support configuration, transportation and access for loading deck bundles onto the steel frame.

Identification

Where appropriate, bundles will be marked to correspond with RSD layout drawings, with a bundle label identifying the product, the site, and a schedule reference code (see extract below).



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Lifting and Storage

The customer should arrange for bundles to be lifted using two double wrapped chains, with care taken to avoid excessive pressure across the sheets. Careless use of the slings can cause panels to buckle. Under no circumstances should the bundles or sheets be removed from delivery vehicles by tipping, barring or similar means.

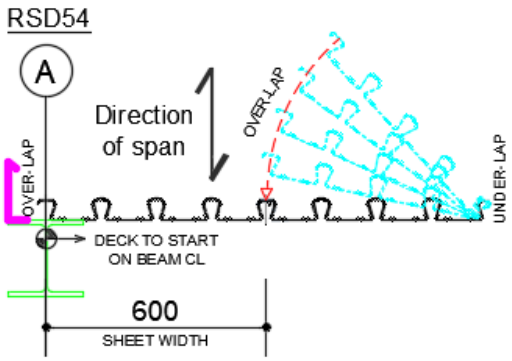
Bundles should be lifted directly from the delivery vehicle and placed on the building framework at the correct level and in positions appropriate for installation. Generally, one bundle of decking will be positioned in each steelwork bay. The sides of the bundles are identified with paint splashes and these marked sides must all face away from the appropriate set out point. Care must be taken to avoid local overloading of the structure.

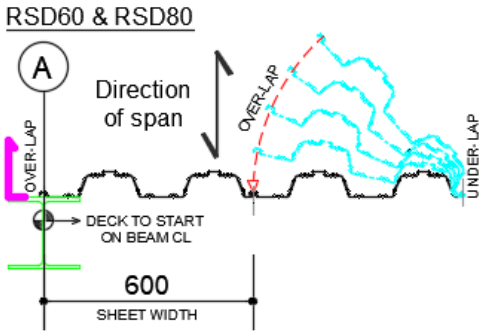
INSTALLATION

Installation Service

RSD are fully equipped with experienced and professional installation teams backed up by our Construction/Design Departments. Operating throughout the country, installing decking on all shapes and sizes of projects.

RSD are also externally-accredited to ISO 14001 management systems for health, safety and the environment. The sheets will have sharp edges and corners. COSHH data sheets are available for all hazards/activities associated with the handling and fixing of RSD decking.





Health & Safety

Decking is manufactured to ISO 9001 from high yield steel coated with zinc and may be covered with soluble protective lubricant which does not adversely affect performance. The sheets will have sharp edges and corners. COSHH data sheets are available for all hazards/activities associated with the handling and fixing of RSD decking.

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Fall Arrest

It is recommended that appropriate fall arrest systems are used. Generally, safety netting is advised for steel-framed structures; air bags or similar for other structures. Details of the appropriate fall arrest system, together with a risk assessment covering the safety system installation method, should be included in the detailed installation method statement prepared by the decking installer prior to commencement of work.

Fixing and Securing

Prior to the commencement of installation of the decking the supporting structure must be in a sound and stable condition.
Steelwork must be adequately restrained and support for the decking must be provided around columns, splices, openings and other penetrations. Brickwork, blockwork and concrete supports must be adequately cured.

Steelwork	Concrete	Other Materials (Inc. Block)
50mm	70mm	70mm

Decking MUST be suitably secured to avoid excessive deflection or dislodgement during construction. The fixings should be placed at 300mm maximum spacing at panel ends and 600mm maximum spacing on intermediate supports.

No pedestrian access to the installed decking should be permitted until it has been securely fixed to the supporting structure and access is recommended to be limited to essential construction personnel once installation is complete.

In the case of a steel support structure, low power powder-actuated fastenings such as Hilti X-ENP-19 L15 can be used with the DX 76 fastening tool to make this connection. In situations where shear studs are subsequently to be welded through the decking, a lighter gauge nail such as Hilti X-DAK 16 can be used with the DX 460 or DX 36 cartridge tools at the discretion of the Project Structural Design Engineer.

Alternatives to Hilti nails are available through companies such as Spit, or decking can be secured to steelwork using self-tapping screws. Decking may be secured to brickwork, blockwork and concrete supports provided that the top surface is flat and level and that the top course of bricks or blocks are of solid construction.
Special masonry fixings, such as the Hilti HPS-1 Hammer Screw and Hilti X-SW Soft Washer Fastener can be considered, but in all instances, it is recommended that the decking installer refers to the fixing manufacturer's recommendations for the system to be used.

Refer to Hilti data sheet DS 699 Issue No. 02

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Decking may be cut on site to accommodate notching around obstructions such as columns, but this may affect the design of the sheet and its spanning capability. In such situations special consideration should be given as to the adequacy and completeness of bearings and to the spanning capability of cut sheets, adjacent sheets and the finished floor slab.

A petrol-driven disc cutter is the preferred method for cutting deck sheets and edge trim on site. It is recommended that all profiles are seam-stitched at regular intervals along their length using self-tapping screws. Care should be taken to ensure that the seam stitch screws effectively penetrate and engage with the under-lapping deck sheet.

Decking on Shelf Angles

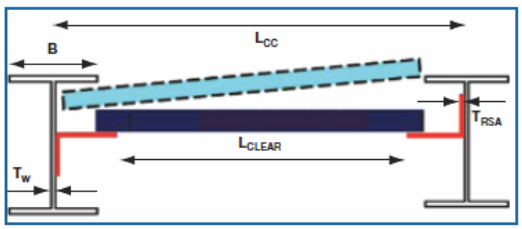
Where decking is required to be supported on shelf angles, the following checks are made to ensure it is physically possible to place panels of sufficient length to achieve 50mm minimum end bearings. Similar arrangements are necessary where the decking panels sit on the bottom flanges of steelwork.

$L_{MIN} = L_{CLEAR} + 2 \times 50mm$

$L_{MAX} = L_{CC} - B / 2 - T_w / 2 - 20mm$ [- T_{RSA} if angle leg upwards]

Where:

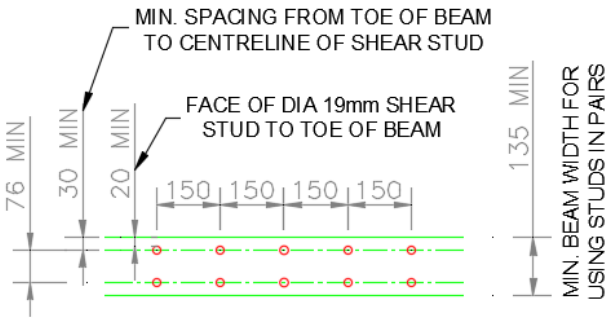
L_{MIN} is the minimum allowable sheet length
L_{MAX} is the maximum allowable sheet length
L_{CLEAR} is the clear distance between toes of shelf angles
L_{CC} is the centre to centre spacing of the beams
B is the smaller of the two flange widths
T_w is the web thickness of the other beam
T_{RSA} is the thickness of the vertical leg of the shelf angle



The shelf angles are structural supports and the Project Structural Design Engineer should ensure that they are fit for purpose. In addition, it is important that the angles project a minimum of 50mm beyond the top flange of the steel beam to enable a cartridge tool or similar to be used to secure the decking to the supporting structure.

SHEAR STUDS

Shear studs are normally welded through the decking to the top flange of the steel beam. To avoid burn through of the beam flange the studs should be welded directly above the web (on the beam centreline) or the flange should have a minimum thickness of 0.4 times the shank diameter (0.4 d = 7.6mm generally). It is preferable to limit the number of studs to a maximum of 2 per trough, wherever possible. As the number of studs increases beyond this limit, the decking becomes more susceptible to localised heat warping and weld splatter can interfere with subsequent welds.



PLAN VIEW ON BEAM WITH SHEAR STUDS IN PAIRS

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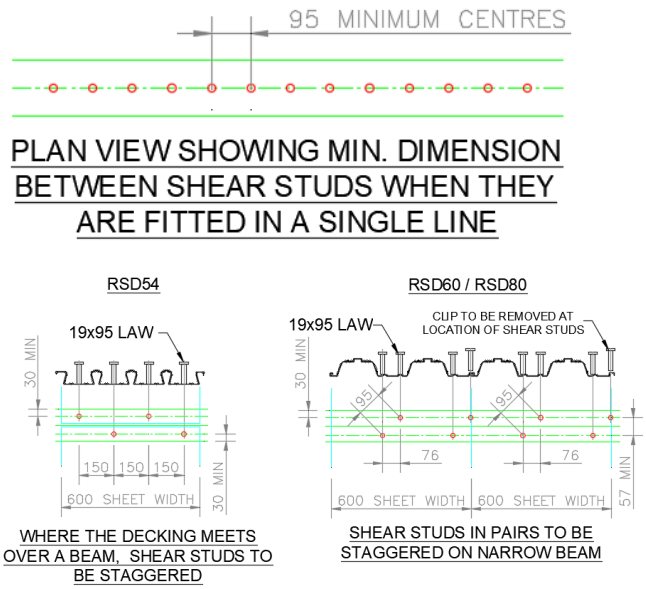


An alternative to welded shear studs is the Hilti X-HVB shear connector. These connectors are 'L' shaped galvanised steel sections that are secured to the steel beam flange using the Hilti DX 76 powder actuated tool. The mechanical properties of the HVB connectors are different to those of welded studs and a substitution should not be made without the consent of the Project Structural Design Engineer.

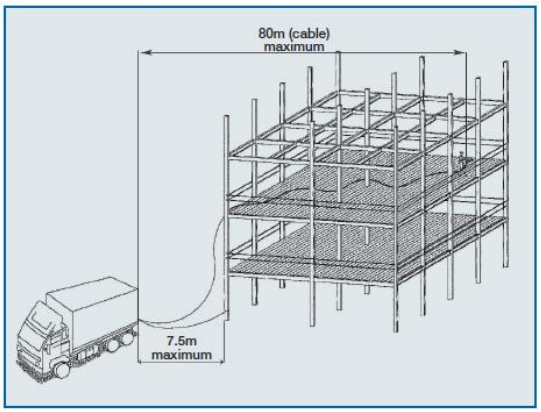
A greater number of X-HVB connectors are needed to provide the same degree of shear connection as when using welded studs, and particular attention should be paid to the space available for placing these within the confines of a steel decking profile.

Preparation of Steel Flanges

Any impurities present at the welding interface will lead to a decrease in weld quality. RSD's profiles are formed from steel with a Z275 galvanised coating and the through deck welding process can be successfully applied to this material provided that the top flange of the steel beam is not primed, painted or galvanised and is also free from dirt, grease and loose rust. Light rusting that occurs after shot blasting is acceptable. In the welding zone, the decking should fit closely against the beam top flange, a condition that can generally be assured by the installer at the time of welding.

Stud Installation Equipment

The preferred method for welding shear studs is through the use of mains power. The supply should be 3 phase with 415 V / 150 A per phase. The welding convertor, measuring 0.5m cubed and weighing 0.5 tonne, is connected to this supply through a watertight 150 amp plug and socket.



Where access for the welding rig to within 7.5m of the frame is restricted, a steel section may be welded to the frame and extended to a position from which the 7.5m access rule may be applied. This steel section should, as a minimum, be a steel plate measuring 100 x 10mm.

In situations where access for the mobile rig is restricted and mains power is not available, a static generator can be provided. This 200 KVA generator is housed in a unit measuring 3m long, 2m wide and 2m high and with a gross weight of 5 tonnes.

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This unit will emit diesel fumes when in operation and should be positioned on the structure in a well-ventilated area which is verified as suitable for this purpose by the Project Structural Design Engineer. Consideration should also be given to the method of safely re-fuelling the unit and to the safe storage of fuel in a bunded diesel bowser on the site.

PRIOR TO CONCRETE PLACEMENT

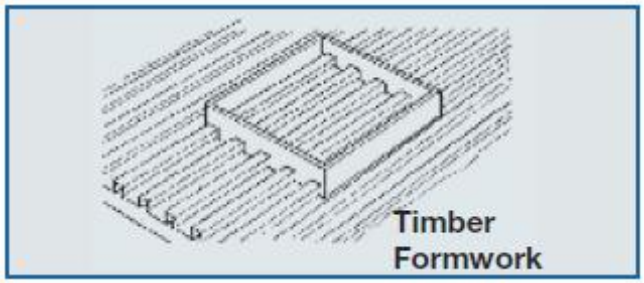
Forming Openings

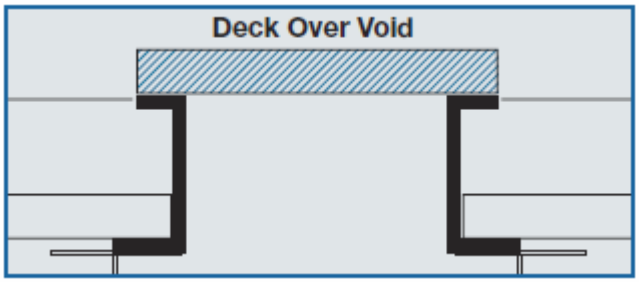
The following guidelines are offered for forming openings in a slab. It is the responsibility of the Project Structural Design Engineer to ensure the slab will be adequate to support the design imposed loads after the formation of any openings.

RSD's responsibilities exclude the design, supply or installation of any framing or reinforcement and the boxing out of decking to form openings. Openings can be classified in terms of the width measured perpendicular to the span of the decking:

1) Up to 300mm wide – No special treatment is required. The opening should be boxed out and the decking only cut out using a reciprocating saw or nibbler when the slab has cured.
2) Between 300mm and 700mm wide – The opening should be formed as above but additional reinforcement bars should be designed and added as necessary to spread the load laterally around the opening, supplement the slab strength immediately parallel to the opening, and control crack widths at corners.
3) Over 700mm wide – Structural trimming steel should be added to the framing arrangement before the decking is installed.

Health and Safety note: Due consideration should be given to the means of providing protection against falls and accidental passage through of materials at whatever stage openings are formed in the slab. One method that can be used is to provide a temporary cover to the opening using unconcreted decking secured to a special edge trim.





The three size categories, outlined here, relate to isolated openings. If openings are grouped such that a gap of less than 1.5 times the width of the largest opening exists between them, then consideration should be given to the combined width.

REFERENCES – HEALTH & SAFETY

British Standards compliant

The following instructions are designed to help composite flooring contractors.

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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.

Eurocode 3 and 4

10. EC3 ENV 1993 - 1 - 3: 2001 Design of steel structures. Supplementary rules for cold formed thin gauge members and sheeting.
11. EC4 ENV 1994 - 1 - 1: 1994 Design of Composite steel and concrete structures. General rules for building.
12. EC4 ENV 1994 - 1 - 2: 2001 Design of composite steel and concrete structures. Structural fire design.
13. SCI - P - 076: Design guide on the vibration of floors. SCI in association with CIRIA (1989).

Health and Safety

Handling Hazards

Handle Zinc coated steel decking with care as it may be delivered with soluble protective layer of oil which can cause contamination to lacerated skin. You should also wear adequate protective gloves and clothing when handling decking as it will have sharp edges and corners.

Eye Hazards

Always wear eye protectors conforming to the specification in BS 2092:1987 when breaking the strapping around bundles as the sudden release of tension creates can be very hazardous. You should also wear eye protection when cutting steel as flying particles of metal can also be very dangerous.

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Noise Hazards

Make sure you wear adequate ear defenders when handling or cutting decking and shot firing as the noise levels can be hazardous.

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

Take extra care when using shot fired fixings as explosives and fumes can create hazards.

Occupational Exposure Limits

Limits for iron and zinc oxides are 5g/m> (8 hours TWA) and 10mg/m< (10 minutes TWA). (OE recommendation)

Summary of Protective Measures

Make sure that you wear adequate protective gloves and clothing and safety goggles. Ensure adequate ventilation and use personal protective equipment. Follow the 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.

General Safety Points

Make sure you follow the good practice outlined here and in SCI publications:

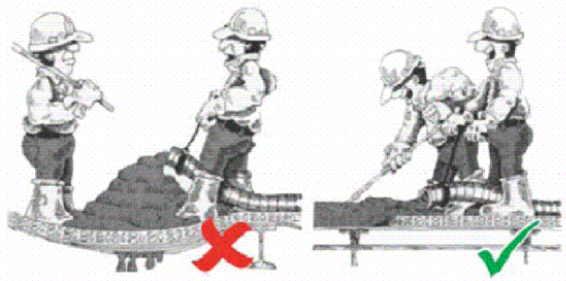
- Always fix deck securely before using as a working platform.
- Always employ personal safety measures such as hard hats and protective clothing.
- Always employ all site safety measures such as safety nets, edge protection, and properly tied ladders.
- **Don't** leave any unfixed decking sheets.
- **Don't** cut holes/voids in the deck before concreting.
- **Don't** place props on uncured concrete.
- **Don't** put heavy loads on unprotected deck.
- **Don't** heap concrete or drop from any height.

HEALTH & SAFETY (CDM) - Concreting:

The metal decking design and temporary propping requirements are based on the slab depth indicated. Therefore, concrete **MUST** be poured to constant thickness and **NOT** datum, unless noted otherwise.

All concreting should follow best practice outlined in SCI Publication P300 and Concrete Society Technical Report No. 75 – Composite Concrete Slabs using Steel Decking.

The Outlet pipe should be moved frequently and carefully so that heaping is minimized. No more than 4 workmen should be present around the pipe outlet during pumping.



Concrete should be first placed over the supports, followed by mid-span regions. Concrete should not be dropped from the outlet pipe onto the floor decking.

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JUST A FEW REASONS WHY TO USE COMPOSITE FLOORING FROM RSD

Sustainability benefits of composite floor construction

Composite flooring systems offer clients and designers several benefits which address the social, environmental and economic dimensions of sustainable construction.

Speed of construction

Composite flooring systems facilitate fast track construction; up to 400m2 of decking can be installed by one team in a day! Speed, simplicity of design and affinity for steel-framed buildings make composite floors the system of choice where time, and hence speed of construction, are key drivers. Steel decking can be ordered from us and delivered to order, efficiently stacked on lorries that can carry many square metres of decking in a single load.

Rapid construction minimises plant hire costs, cranage. The use of the decking as a safe working platform during construction, speeds up the work of others and follow-on trades and offers logistical benefits on congested sites. The minimal steel reinforcement required can be fixed quickly and large areas of floor poured using pumped concrete.

By shortening the construction programme, the impacts on neighbours and the public within the vicinity of the construction site, such as noise, dust and traffic congestion are minimised.

Resource efficiency Composite flooring systems are structurally efficient, thereby minimising the resources used in constructing the building (particularly concrete) and reducing the waste generated when it is necessary to deconstruct it. Less concrete means fewer site deliveries and less localised traffic congestion.

Composite floor systems are stiffer, stronger and lighter than many other floor systems. This means that the weight and size of the primary structure and the foundations can often be reduced again minimising resource consumption and end-of-life waste generation.