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Guidance Notes for Design and Fixing

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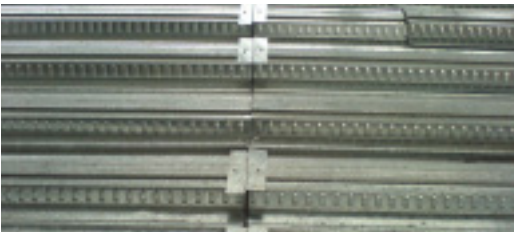


Guidance Notes for Design and Fixing

GOOD PRACTICE: These guidance notes have been developed by RLSD during our many years in the Steel Decking Industry. 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

RLSD's structural decking can be used as permanent shuttering to an in situ 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 codes (principally BS5950: Part 4). A slab design appropriate to the required application can be selected by a suitably qualified person from reference to either RLSD's load/span tables or using Deckspan software, both of which are available free of charge at www.rlsd.com. When decking is used as permanent shuttering only it is the responsibility of the Project Structural Design Engineer to specify all the slab reinforcement necessary to support the permanent loads, ignoring any contribution from the decking profile.

Construction Loading

The RLSD design load/span 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 without consultation with the RLSD Technical Advisory Service. The heaping of concrete during placement should be avoided. In the unpropped condition it is normally the construction stage that governs the allowable spans shown in the tables.

Construction Loading after Initial Concrete Set

The slab strength will generally have been specified by the Project Structural Design Engineer on the basis of 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 back to the Project Structural Design Engineer for assessment.

Permanent Loading

The self weight of the slab has been taken into account in the design process and need not be included in the imposed loads indicated in the load/span 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

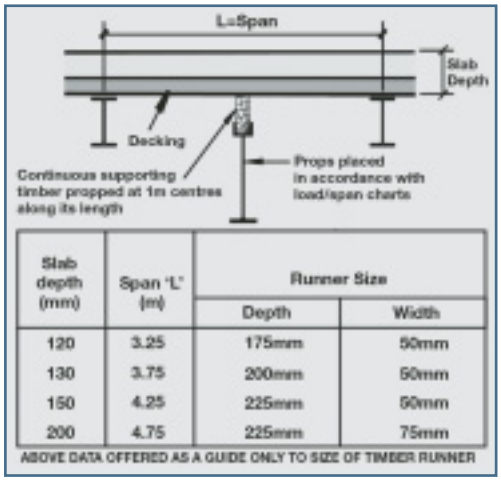
In all circumstances appropriate crack control and distribution reinforcement should be provided within the slab and this can be in the form of a wire-welded mesh or, in certain situations, as synthetic macro fibres. This reinforcement may also be sufficient to provide the necessary fire resistance for the slab and this can be checked by reference to the RLSD tables for the Simplified Fire Design Method, available in literature and on the RLSD website. Where the design criteria are not covered by the simplified tables, then reinforcing bars, positioned in the decking troughs, will be required, the exact quantity being determined using RLSD's Deckspan software or by reference to the Steel Construction Institute publication 056.

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

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.

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 in RLSD's tables or software 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.



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

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 RLSD in the form of span/load tables and Deckspan software and, where provided, 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 so as to ensure zero deflection of the deck at propped points prior to concrete placement. 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 by RLSD's Technical Department, all temporary props to unsupported slab edges are to be fully in place prior to installation of the edge trim or decking. The same condition also applies to internal props meeting the conditions set out in Table 1.

Profile	Span
Holorib	>= 4.0 m
Ribdeck AL	>= 4.0 m
Ribdeck E60	>= 4.0 m
Ribdeck 80	>= 4.5 m

Table 1: Lower Limit for Pre-installation of Temporary Supports.

Temporary supports should remain in place until the concrete has reached a minimum of 70% of its characteristic strength.

Durability

Decking is produced from galvanised steel strip to BS EN 10326 with a standard Z275 coating. When used in a dry and unpolluted environment, such as is the case in the majority of offices, warehouses, hospitals, and schools etc, a design 'life to first maintenance' of 20 - 50 years can be expected. Recent documented research would suggest that the predicted performance is likely to approach the higher end of this range.

Full Lateral Restraint

Guidance on lateral stability of beams can be obtained from SCI publication 093. Positive connection between the composite floor slab and the compression flange of a steel support beam may be achieved using either ENP2 or DAK 16 nails. These nails are capable of resisting lateral forces as required by BS 5950: Part 1, with safe working loads per nail indicated for differing sheet thicknesses in Table 2.

Deck Thickness (mm)	ENP2 Shear (kN)	DAK 16 Shear (kN)
0.8	2.3	0.8
0.9	2.7	0.8
1.0	3.0	0.8
1.1	3.5	0.8
1.2	4.0	0.8

Table 2: Safe Working Load per Nail

As examples, values for lateral restraint with 0.9mm thickness decking are:

a) with nails at 333mm centres at sheet ends
ENP2 = 8.10 kN/m DAK 16 = 2.40 kN/m

b) with nails at 666mm centres at intermediate support
ENP2 = 4.05 kN/m DAK 16 = 1.20 kN/m

Diaphragm Action

Guidance on diaphragm action of steel decking during construction can be obtained from the SCI Advice Note AD175 (1995) and by reference to BS 5950: Part 9.

Composite Beams

Guidance on the design of composite beams is given in BS5950: Part 3: Section 3.1. Within the design there is a requirement for the provision of transfer of horizontal shear forces between the steel beam and the concrete slab. This is commonly achieved with the use of headed shear studs welded through the decking panels to the underlying beam top flange.

The Project Structural Design Engineer should ensure that sufficient studs can be welded within the confines of the metal decking troughs to achieve the required degree of shear connection. In particular it is important to avoid the specification of beams with top flanges that are too thin and/or too narrow to accept off-centre welded studs. (Refer to Shear Studs section for further guidance - page 8).

Perimeter Beams

If perimeter beams, and beams adjacent to internal slab openings, are to be designed as composite 'L' beams, then the edge of the slab should extend a minimum distance of 6 times the stud diameter beyond the beam centreline. In most cases this will equate to a minimum distance of 114mm. If this condition is satisfied but does not exceed 300mm, then reinforcement should be specified in the form of 'U' bars detailed below the heads of the studs. If the edge distance exceeds 300mm, then the composite beam may be designed as an internal beam (albeit with reduced effective composite flange width) and reinforcement added as required to satisfy longitudinal shear transmission rules.

Transverse Reinforcement

The concrete flange of a composite beam is subjected to splitting forces and these may be resisted in part by contributions from the concrete, decking, top mesh and any additional steel bars crossing the beam perpendicular to the span direction. Any contribution from the decking should only be considered where the decking spans onto the beam and is either continuous across or is securely anchored to it with through deck welded shear studs. The decking contribution should be ignored where it spans parallel to the composite beam being considered. Any shortfall in transverse shear resistance is normally compensated for by the design and inclusion of additional reinforcement bars.

Shear Studs

Shear studs are manufactured from low carbon steel with minimum values of yield point of 350 N/mm^2, ultimate tensile strength 450 N/mm^2, 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 tabulated in BS 5950:Part 3:Section 3.1. 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 BS5950:Part 3:Section 3.1 for reduction factor formulae.

Reference Literature

- MCRMA Technical Paper 13 / SCI Publication P300: Composite Slabs and Beams Using Steel Decking: Best Practice for Design and Construction.
- BCSA Publication 37/04: Code of Practice for Metal Decking and Stud Welding.
- BS 5950: Structural Use of Steelwork in Building.

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.

Deck	Width (mm)	Height (mm)
Holorib	680	525
Ribdeck E60	1020	175
Ribdeck AL	910	200
Ribdeck 80	620	350

Table 3: Approximate Maximum Sizes of Bundles

Bundle length will depend on decking panel lengths. Export/shipped bundles may differ – please ask for details.

Lengths of decking manufactured in accordance with RLSD layout drawings or customer schedules are normally consolidated into compact, banded bundles as shown in Table 3. These bundles may weigh up to 2 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. Table 4 gives the mass per linear metre (kg/m) of each profile and gauge to assist in the calculation of individual bundle weights.

Deck	Gauge of Steel			
	0.9	1.0	1.1	1.2
Holorib	8.0	8.9	9.8	10.6
Ribdeck E60	9.3	10.3	11.3	12.4
Ribdeck AL	8.7	9.6	10.6	11.5
Ribdeck 80	6.8	7.5	8.3	9.0

Table 4: Mass of Deck Panels (kg/m)

The maximum sheet length on a particular 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 RLSD layout drawings, with a bundle label identifying the product, the site, and a schedule reference code. To further aid identification, each panel of decking has its gauge and yield stress stamped in the base of the trough on the overlap return side of the sheet and each bundle has a paint splash colour identification code on one side as shown in table 5.

Steel Yield Stress	Gauge of Steel (mm)			
	0.9	1.0	1.1	1.2
S350	BLUE/ BLACK	YELLOW/ BLACK	ORANGE/ BLACK	RED/ BLACK

Table 5: Colour Coding for Deck Bundles

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 the appropriate set out point. Care must be taken to avoid local overloading of the structure.

INSTALLATION

Except in situations where fixing is contracted to RLSD, it is the customer who is responsible for the safe execution of the works.
All users, installers and persons working in the proximity of the decking should be made familiar with the recommendations in this section.

Installation Service

RLSD provides the UK's most experienced and professional installation service. Operating throughout the country, installing decking on projects ranging from 10m^2 to over 100,000m^2, RLSD can provide fully-trained construction teams backed by expert safety, construction and technical departments. The company also boasts externally-accredited management systems for health, safety and the environment to OHSAS 18001 and ISO 14001.

Health and Safety

Decking is manufactured to ISO 9001 from high yield steel coated with zinc and may be covered with a 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 RLSD decking.

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 (incl. Brick and Block)
50mm	70mm	70mm

Table 6: Minimum Bearing Requirements for Decking

Decking MUST be suitably secured to avoid excessive deflection or dislodgement during construction. The fixings should be placed at 333mm maximum spacing at panel ends and 667mm 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 ENP 2 can be used with the DX 750 cartridge 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 DAK 16 can be used with the DX A40 or A41 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.

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 in the Ribdeck range be 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.

Ribdeck E60	Ribdeck 80	Ribdeck AL
1.0 m	1.5 m	1.0 m

Table 7: Maximum Spacing of Seam Stitch Screws

Note: The guidance given here applies to the shallow deck range of profiles supplied by RLSD. Separate guidance should be sought on the safe installation of deep deck profile SD225.

Cartridge Tools

Hilti cartridge tools are commonly used to install ENP 2 and DAK 16 nails. No external power source is required. These tools should be used only by suitably-trained personnel in accordance with manufacturer's instructions. When detailing steelwork for the support of metal decking sheets, consideration should be given to the physical dimensions of the cartridge tool, which must be held perpendicular to the fixing surface and will experience a re-coil effect on firing.

The nails are suitable for fastening decking and edge trim to structural steelwork up to 630 R_m N/mm^2 and a minimum thickness of 6mm. Technical advice on the use of these tools can be obtained from Hilti Technical Advisory Service, Manchester (Freephone 0800 886 100, e-mail gbsales@hilti.com, web www.hilti.com).

Alternative tools and fixings can be obtained from Spit (tel: 0141 764 2700, e-mail support@itwspit.co.uk, web www.itwspit.co.uk).

Site Testing

Once nails have been installed, the effectiveness of the fixing can be determined by comparing appearance of the installed nail with guidance diagrams and other information in the manufacturer's literature.

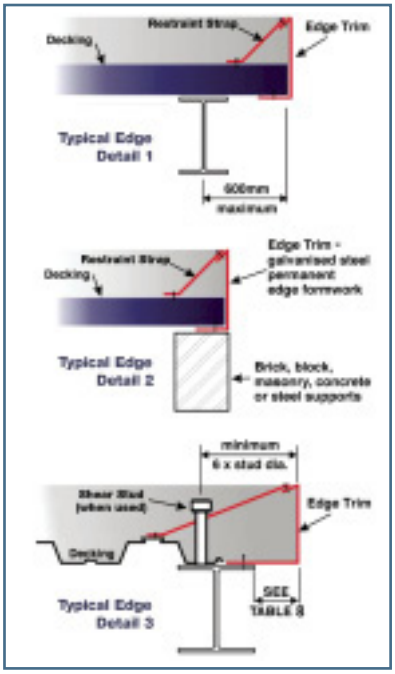
Edge Trim

Galvanised steel edge trim is not a structural component. It is used only as permanent formwork to retain the wet concrete slabs, avoiding the need for timber shuttering. It is normally supplied in 3m lengths but may be in 2.5m lengths if obtained directly from our stock depots. Thicknesses, or gauges, are usually 1.0mm or 1.2mm, but can be up to 2mm when needed. Edge trim is supplied complete with restraint strapping in standard 1.2m lengths to be cut to suit on site. Fixing screws are only provided when RLSD is carrying out installation.

Edge trim can be secured to the end of a decking sheet using self-tapping screws (see detail 1) or to the main support structure using the same fixings as used for securing the decking (details 2 & 3). Fixings to the top flange are normally made at each end of the edge trim sheet and at maximum 600mm centres along its length.

Edge trim is delivered to site in straight lengths and is cut to suit on site. To approximate a curve, the edge trim can be cut on site to form a facetted face and the frequency of fixings may need to be increased accordingly.

Restraint straps are used to control the outward deflection of the edge trim under pressure from the wet concrete and should generally be installed at no more than 600mm centres and at an angle no steeper than 45°. Restraint straps will normally be provided in 1.0 mm gauge but this may be increased where additional rigidity is demanded.



WARNING: Steel decking is a structural element of the construction and should always be installed by a competent contractor to avoid adverse effects on following trades. As a minimum requirement, valid CSCS cards for steel decking and/or stud welding should be held by all workers involved in the installation of these products.

Cantilevered Deck and Trim

Special consideration should be given to cantilevers. Guidance is given here on the use of both decking and edge trim as cantilevered shuttering. It is the responsibility of the Project Structural Design Engineer to assess whether any additional reinforcement is required to enable the finished floor slab to carry the design imposed loads.

In the direction of span of the decking sheets, a maximum cantilever distance of 600mm is recommended. This limit is based on health & safety considerations and is not affected by the gauge or profile of decking, or the depth of concrete to be poured. It is important that the back span of the decking sheet is securely anchored at no more than the recommended maximum spacing for end and intermediate supports respectively. Unsupported side cantilevers of decking are NOT permitted in any circumstances.

Edge trim cantilevers are measured from the toe of the beam flange. The maximum cantilever length permitted varies with concrete depth to be poured and with gauge of edge trim. When cantilevering edge trim to the distances shown in Table 8, the maximum spacing of the restraint straps and fixings to the beam top flange should follow the guidelines given previously for non-cantilevered edge trim.

Overall Slab Depth	Deck End	Deck Side	Edge Trim		
	From Beam Centreline		From Toe of Beam		
	Any Gauge		1.0	1.2	2.0
130	600	0	105	120	180
150	600	0	100	115	175
175	600	0	n/a	110	165
200	600	0	n/a	105	160
250	600	0	n/a	n/a	150

Table 8: Maximum Cantilever Distances

For conditions outside of the scope of Table 8, permanent supports or temporary propping may be required. Please refer to the RLSD Technical Department for further guidance.

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

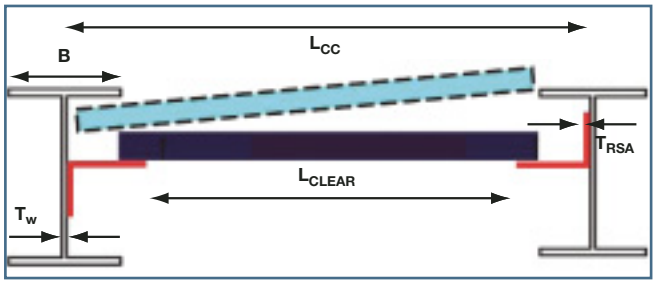
L_{CLEAR} is the clear distance between toes of shelf angles

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

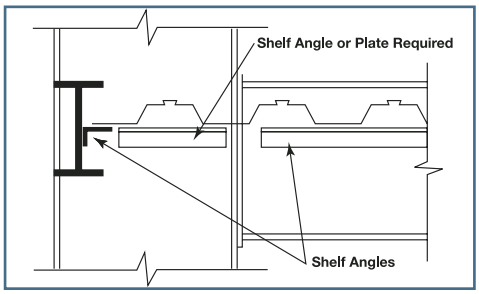
T_{RSA} is the thickness of the vertical leg of the shelf angle



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 50 mm 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.

Decking Around Columns

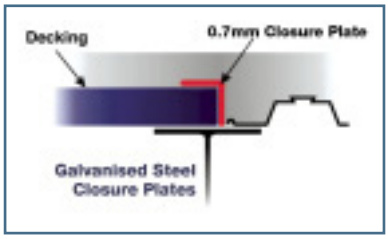
Decking should be cut on site to fit into the webs of columns that penetrate the floor plate. Where there are no beams available as supports, and where column penetrations exceed 250mm in width, the steel frame supplier should provide additional support (such as welded on angle brackets) in the web of the column.



Decking Support Details at a Column Web

Minimising Concrete Loss

Wherever possible, decking sheets are butt jointed with ribs lined through. Gaps up to 5mm in width can be tolerated without significant leakage of concrete over the top flange of the beams. Gaps greater than 5mm should be sealed using a method such as adhesive tape or expanding foam. At the building perimeter the decking should either continue out to butt up against the edge trim or be sealed using a 0.7mm gauge galvanised steel closure plate or preformed polystyrene inserts.

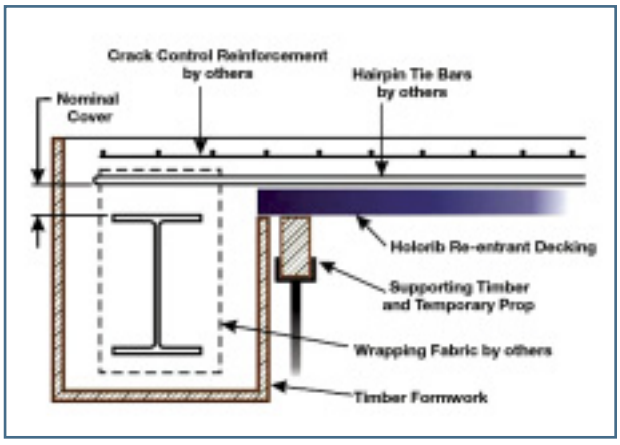


For the treatment of side lap joints of decking refer to the earlier section on seam stitching requirements. Where the decking changes direction of span it may be necessary to stitch the edge of the last sheet to the supporting beam and seal off the ends of the perpendicularly-spanning sheets with closure plates or preformed polystyrene inserts.

Concrete Encased Perimeter Steel Beams

Concrete encasement may be specified as part of the fire resistant design of perimeter steel members. The preferred method of construction is for concrete encasement to be carried out off site prior to erection of the steel frame. If the encasement only extends to the top of the steel beam, then metal decking installation can proceed as normal.

In situations where pre-encasement is not practical, the following solution is offered for Holorib floor slabs only. The Holorib decking should be fitted to the perimeter steel beams as normal to provide a working platform and then cut back to the line of the shuttering once it has been installed around the beam. The Project Structural Design Engineer should check that the shuttering system has been designed to support the decking and subsequent weight of wet concrete, and if not, to specify the inclusion of an adequate temporary propping system as indicated in the diagram.



A sufficient quantity of hairpin tie bars, as determined by the Project Structural Design Engineer, should be positioned in each trough of the Holorib decking prior to placement of the concrete.

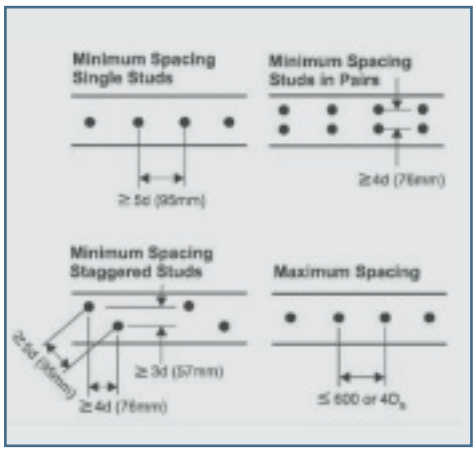
SHEAR STUDS

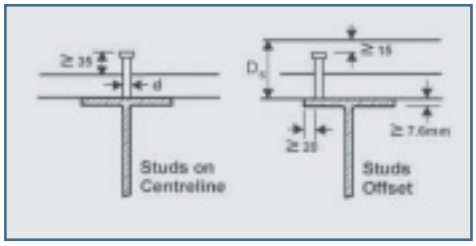
Shear studs are normally welded through the decking to the top flange of the steel beam. To avoid burn through of the beam flange the studs should be welded directly above the web (on the beam centreline) or the flange should have a minimum thickness of 0.4 times the shank diameter (0.4 d = 7.6mm generally). 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.

An alternative to welded shear studs is the Hilti HVB shear connector. These connectors are 'L' shaped galvanised steel sections that are secured to the steel beam flange using the Hilti DX750 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 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. Guidance and assistance on the application of the HVB system is available from Hilti (tel: 0800 886100).

Spacing of Shear Studs

In order to maintain effective shear connection, both maximum and minimum spacings are defined for the studs. The maximum longitudinal spacing is defined to prevent localised vertical separation of the slab from the beam. Minimum spacings are defined to ensure that each stud is adequately embedded in concrete and that concentrations of compressive force do not occur as a result of overlapping zones of influence around adjacent studs.





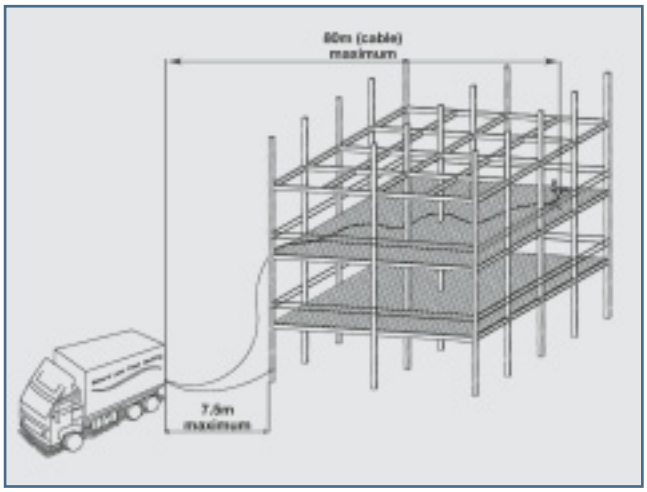
The studs should not be welded closer than 20mm clear distance from the edge of the top flange

Preparation of Steel Flanges

Any impurities present at the welding interface will lead to a decrease in weld quality. RLSD 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

Where RLSD is carrying out installation, access to within 7.5m of the structural steel frame will be required for a chassis mounted mobile generator unit. This unit consists of a 200 KVA diesel generator and welding convertor housed in the rear of a vehicle which is 7m long, 2.6m wide and 3.5m high. From this position stud welding can be carried out at a radius of up to 80m.



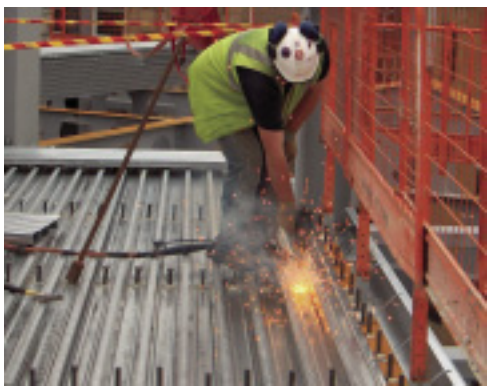
Where access for the welding rig to within 7.5m of the frame is restricted, a steel section may be welded to the frame and extended to a position from which the 7.5m access rule may be applied. This steel section should, as a minimum, be a steel plate measuring 100 x 10mm.

Larger multi-storey projects are often welded using mains power. This provides a quiet, clean and environmentally-friendly option. 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.

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. 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.

Installation and Testing

Welded shear studs should be installed and tested in accordance with BS5950:Part 3:Section 3.1, the recommendations of the manufacturers of the welding equipment and studs, and the project specific design and layout. On projects where RLSD have installed the studs, any testing in addition to this should be carried out prior to the demobilisation of personnel and equipment to avoid any additional charges for return visits.



PRIOR TO PLACEMENT OF CONCRETE

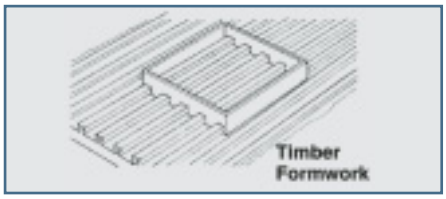
Forming Openings

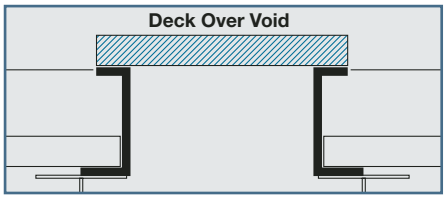
The following guidelines are offered for forming openings in a slab. It is the responsibility of the Project Structural Design Engineer to ensure the slab will be adequate to support the design imposed loads after the formation of any openings. RLSD's responsibilities exclude the design, supply or installation 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 250mm 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 250mm 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 affected.

Cleaning the Decking

It is recommended that any debris on the decking be removed by the contractor after all reinforcement has been positioned and openings boxed out and immediately prior to concreting. Slight surface grease or oil residue from the decking manufacturing process does not affect the design bond strength between decking and concrete and therefore need not be removed. Any residual ceramic ferrule fragments left over after breaking them away from the welded shear studs can be left distributed over the decking surface and lost within the concrete pour.

CONCRETE PLACEMENT

Temporary Props

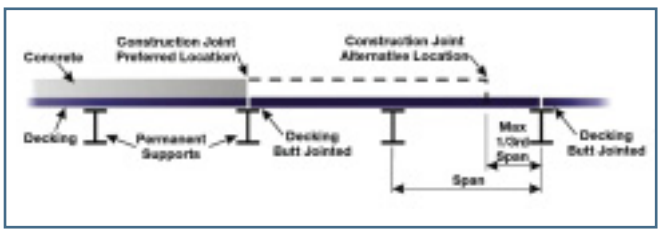
Immediately prior to concrete placement, it is recommended that checks are made to ensure that temporary propping is installed:

a) where indicated on RLSD drawings if supplied under the contract;
b) where shown to be required on RLSD standard load/span tables;
c) where indicated on project specific design calculations.

Care should be taken not to over-jack these props whilst ensuring that the prop header is in continuous and level contact with the deck soffit. The propping system should extend to the full width of the bay and be left in place for a minimum of 14 days after the concrete has been placed to ensure that sufficient shear bond resistance is developed.

Construction Joints

Continuous concrete pours in excess of 1,000m^2 can be achieved on composite floor slabs. If the limits of the pour do not coincide with permanent slab edges, a construction joint should be formed. The construction joint should wherever possible be positioned over permanent supports at the ends of decking panels, not over intermediate supports which would result in only one span of a multiple span sheet receiving concrete.
Where it is not possible to have the construction joint at a sheet end, it should be positioned such that no more than 1/3 of the final span is left unconcreted.



Placing and Compacting

Care should be taken when concreting in extremes of temperature. If the air temperature falls below 4°C, then the concrete should be discharged from the mixer at a temperature of no lower than 10°C and be protected from frost and maintained at no lower than 5°C for 72 hours after placement. In hot weather the concrete temperature when deposited should not exceed 32°C and measures should be taken to prevent drying out of the surface before any curing protection can be applied.

Where possible the concrete should be pumped or discharged from a skip in a controlled manner over an intermediate beam of a multiple span sheet and spread evenly into the adjacent spans. For single span slabs and in situations where the concrete must be discharged directly on to the span, care should be taken not to allow the concrete to fall from a height exceeding 1.0m nor for heaping to a depth significantly in excess of the design slab depth. Work should progress transversely across each bay in a direction such that the lap joints are approached from the side of the overlapping sheet.

If the workability of the concrete is too low, then it will not be possible to achieve full compaction and an acceptable finish. Advice should be obtained from the concrete supplier on any measures to be taken to recover the workability of the mix. Under no circumstances should water be added to the concrete after it has left the batching plant.

The concrete should be compacted using a power driven beam or plate vibrator. Immersion vibrators should not be used. Care should be taken to avoid over-vibration as this could cause segregation of the mix, leakage through deck joints, and surface laitance.

Curing

Concrete should be protected from the harmful effects of sun, wind, cold and rain during the first stage of hardening. The protection should be applied as soon as possible after placing the concrete and be designed to prevent surface drying for a minimum of 7 days. No concrete should be disturbed for at least 24 hours after placing.

COMPOSITE FLOOR SLAB

Loading of the composite floor slab to its full design load should only take place once the concrete has reached its target strength. Early loading of the slab can have detrimental effects on the long-term strength and load-bearing capacity of the structure. The use of the floor slab for storage of materials or as a working platform for further erection of the structure should only be attempted with the prior approval of the Project Structural Design Engineer.

Soffit Fixings

The Holorib and Ribdeck ranges of steel decking allow the suspension of lightweight services and fixtures from removable wedge-shaped fixings. It is important that the correct wedge fixing and decking are paired together and that the wedges are not inserted into lap joints. Table 9 shows the options available, together with the safe static working load that can be suspended from each fixing when attached to a fully cured composite floor slab.

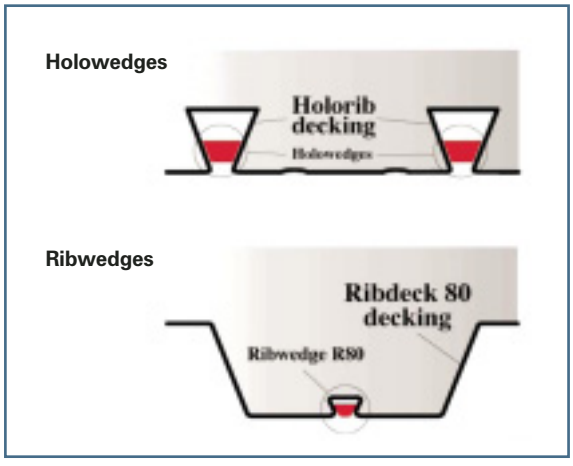
Profile	Wedge Type	Thread Size (mm)	Safe Static Working Load (kg)
Holorib	Holowedge	4 6, 8, 10	150 200
Ribdeck E60	Alphawedge Uni-Deck BN1Z	6, 8, 10 6, 8, 10	100 150
Ribdeck 80	Ribwedge R80 Alphawedge Uni-Deck BN1Z	6 6, 8, 10 6, 8, 10	100 100 150
Ribdeck AL	Alphawedge Uni-Deck BN1Z	6, 8, 10 6, 8, 10	100 150

Table 9: Safe Static Working Loads

The wedges are designed to act as vertical anchors only and should not be used as nuts. To avoid local overloading of the floor slab the wedges should not be closely grouped, a nominal 600 mm grid being recommended as a minimum. Design advice for closer groupings should be obtained from the project structural design engineer or from RLSD Technical Department. Dynamic loads should NOT be supported by wedge fixings. Proprietary anchors can be embedded in the slab and used as directed by the manufacturer and where approved by the Project Structural Design Engineer.

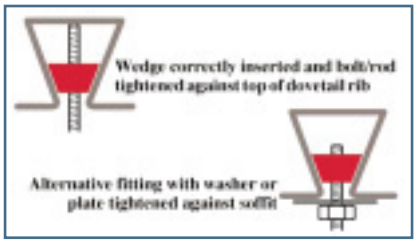
Holowedge and Ribwedge R80

The Holowedge and Ribwedge R80 suspension fixings are available from RLSD. They are designed for use with all gauges of decking and are formed in mild steel grade EN1A, electrolytic zinc plated and bright passivated to BS EN 12329/12330. To help identify that the Holowedges and Ribwedge R80s have been supplied by RLSD and are the correct size and shape to carry the loads indicated in Table 9, they are uniquely embossed as illustrated.



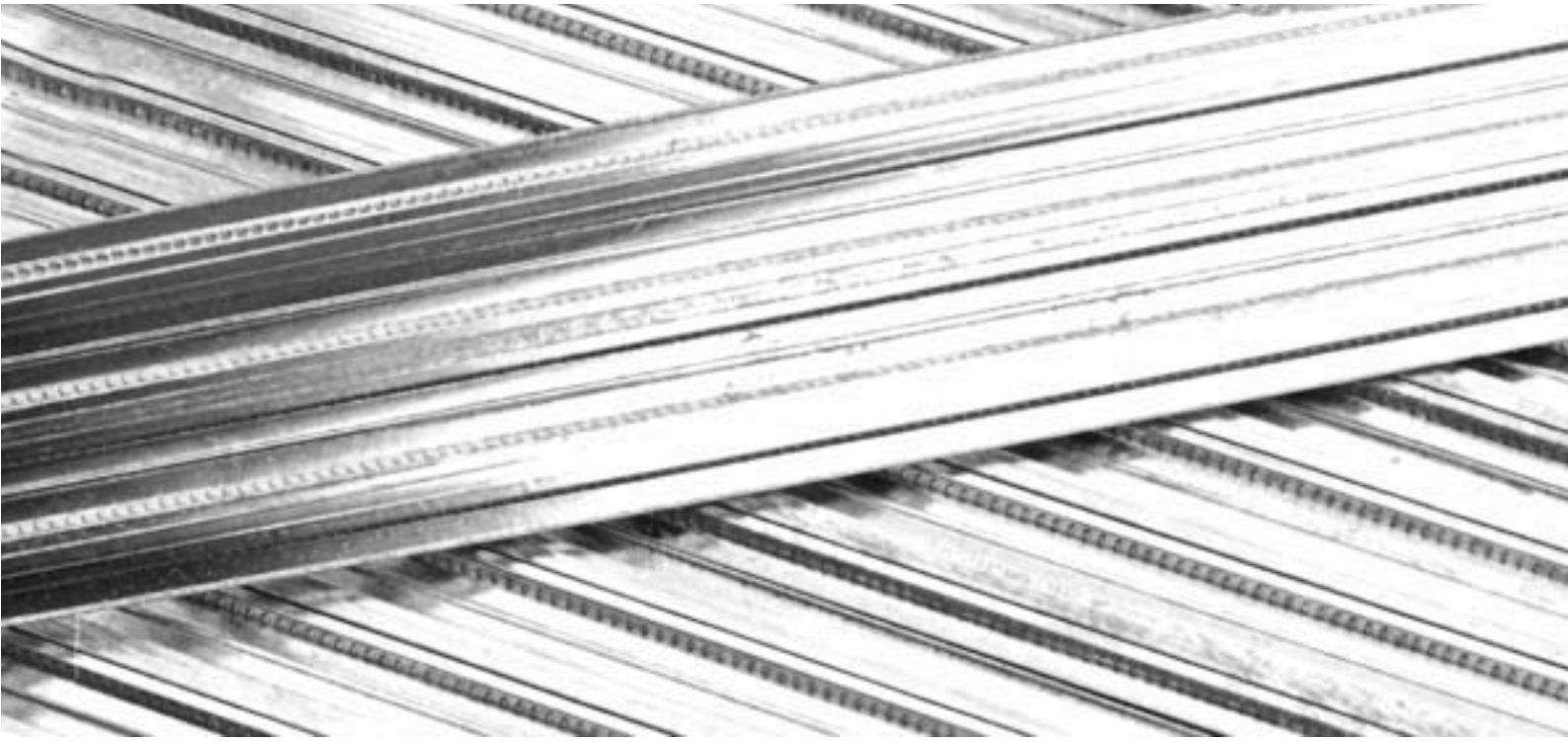
Installation Procedure:

1) Ensure that the correct wedge is selected.
2) Thread wedge onto the required bolt or rod.
3) Insert wedge in to dovetail rib from below and rotate through 90° so that the sloped faces of the wedge bear on the decking ribs.
4) The bolt or rod should then be finger tightened up to the roof of the dovetail or to a washer set against the soffit of the decking.
5) Use mechanical tightening to finish.



Alphawedge

The Alphawedge suspension fixing is available from Lindapter International Ltd (tel: 01274 521444). It is designed for use with all gauges of Ribdeck E60, Ribdeck 80 and Ribdeck AL. Guidance on the use of Alphawedge fixings is available from Lindapter International Ltd.



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