

**METAL
DECKING**

ASSOCIATION

THE UKMDA APPROVED CODE OF PRACTICE FOR THE INSTALLATION OF METAL DECKING AND THRU DECK STUD WELDING



SETTING THE PROFILE FOR EXCELLENCE

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1. INTRODUCTION

1.1 The UKMDA

The UK Metal Decking Association was created in 2015 to recognise Metal Decking and Stud Welding as separate industries which require their own special requirements. Made up of Suppliers, Installers, Manufacturers, Trainers and Associates, the UKMDA has established itself as the lead trade body representing the interests of these industries.

Through the publication of guidance, such as this document, the UKMDA aim to ensure the construction sector is aware of the requirements of these industries and how they should be appropriately considered and managed. The guidance is also intended to help the principal contractor, designers and clients involved in all aspects of the industries, from planning to completion, carry out their specific tasks with consideration to the latest CDM Regulations 2015 in all aspects of the process.

Through the creation and development of training and qualifications, the UKMDA intend to ensure the workforce is fully competent to safely and effectively carry out their specific job without creating any unnecessary hazards to themselves, their colleagues or other personnel. Qualification of the workforce ensures that the metal decking and stud welding has been carried out to the highest of standards, giving peace of mind that the job has been carried out correctly.

1.2 The UKMDA Audit

Prior to any company wishing to join UKMDA, the trade association for the Metal Decking and Stud Welding Industry, the company will undergo a "Membership Audit" prior to being approved and 12 months following admission to membership. All existing UKMDA members will undergo a full audit every 24 months, with a desktop audit in the interim years.

The ongoing audit processes are designed to provide information to the UKMDA Board that their members remain committed to achieving the high standards for which they had demonstrated previously.

In addition to the Construction Design & Management Regulations 2015 the UKMDA Audit will identify UKMDA Minimum Standards in addition to financial, quality, environmental and UKMDA Best Practice audit questions, therefore making this audit all encompassing.

UKMDA Commitment

UKMDA state that "Membership is a 'must' for all those involved in the Metal Decking and Studwelding Industry, with many Clients and Principal Contractors insisting on UKMDA membership as part of their pre-qualification process".

The UKMDA Board believes as a minimum all members will meet its legal obligation and the Audit Process will be used to assist individual members to strive for excellence.

Declaration

To ensure that the audit is a true reflection of the members being audited, UKMDA Advocates that:

1. No member shall use their findings to promote their business over that of another UKMDA Member
2. The audit findings and any follow up correspondence will only be viewed by the UKMDA Board
3. UKMDA will not disclose the audit findings or any other member or to third party organisations i.e. Clients / Principal Contractors

1.3 Aims of the UKMDA Code of Practice

Ultimately, the UKMDA want to increase the safety of all those involved with or working around metal decking and stud welding, ensuring that projects are completed safely but still in a timely fashion. This Approved Code of Practice is intended to increase the knowledge of contractors as to the process of carrying out this work, selecting and managing competent suppliers / installers and their workforce and being aware of the needs of the supplier / installers.

It is also intended that this Code of Practice will help keep those working with or around metal decking and stud welding safe through all stages of the work. These dangers are varied, and include the risk of falling from height, the hazards associated with and the long-term health effects of working with the equipment used and the management of material through all aspects of the project.

1.4 Regulations, Acts and Legislation

At all stages of a project involving metal decking and stud welding, the following regulations must be considered. This list is not exhaustive.

- Health and Safety at Work etc. Act 1974
- Management of Health and Safety at Work Regulations 1999
- Construction (Design and Management) Regulations 2015
- The Work at Height Regulations 2005
- Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1995

Health and Safety at Work etc. Act 1974

This is the primary piece of health and safety legislation in the UK, covering all aspects of work. Through this legislation, a duty is placed upon all employers “to ensure, so far as is reasonably practicable, the health, safety and welfare at work” of all their employees.

The Act requires the safe use, handling and storage of dangerous substances and adequate welfare provisions for persons at work. Especially applicable to the metal decking and stud welding industries, the Act also requires the maintenance of safe access and egress to the workplace, adequate training of staff to ensure health and safety and the safe operation and maintenance of the working environment, plant and systems.

Employers must keep and revise a written record of their health and safety policy, consulting with employees on such policies when employing five or more persons. This is however a requirement of all UKMDA Members irrespective of their size and is ensured by the thorough audit that has been developed.

Employees have an obligation to work safely at all times, in accordance with their training and the instructions given to them, reducing the likelihood of any health and safety issues. In the event of an incident, the employee must notify their employer / the person responsible for health and safety of any serious or immediate danger to health and safety or any shortcoming in the health and safety arrangements.

Management of Health and Safety at Work Regulations 1999

This regulation places a duty on employers assess and manage risks to their employees and others arising from their work activities. All work activities must be assessed, not just those at height.

By assessing the work activities at all stages of a project, the employer must ensure the health and safety of the workplace at all times. This includes arrangements for emergencies, the conveyance of information and instruction, adequate training for

employers and in the case of metal decking and stud welding, health surveillance.

Construction (Design and Management) 2015

The Construction (Design and Management) Regulations 2015 (CDM 2015) cover the management of health, safety and welfare when carrying out construction projects in the United Kingdom. CDM2015 regulations will be applicable to the vast majority of tasks undertaken by UKMDA member companies.

CDM2015 is a large and detailed subject with an established variety of support and further reading available from many sources. A good starting point for further advice and guidance is the HSE publication L153. The purpose of CDM2015 is to secure a safe construction project from start to finish but it is not the only regulation applicable on a construction site.

The key elements of CDM are:

- Managing the risks by applying the general principles of prevention
- Appointing the right people and organisations at the right time
- Making sure everyone has the information, instruction, training and supervision they need to carry out their jobs in a way that secures health and safety
- Duty holders co-operating and communicating with each other and co-ordinating their work and consulting workers and engaging with them to promote and develop effective measures to secure health, safety and welfare.

Designers and Principal Contractors should engage with UKMDA companies as early as is practicable to ensure adequate time for effective design, planning and construction. To ensure success, it is important that throughout all stages of construction, relevant information is freely shared between all duty holders as construction sites may require unforeseen alteration to plan to maintain safe working conditions.

An example of change that is common and problematic for UKMDA member companies is for the planning by others of edge protection at working levels. Very often the plan only caters for edge protection at an installed steelwork level and does not consider finished floor levels or how the installation will be undertaken or will progress or obstruction.

After the completion of works, UKMDA companies should also ensure that all relevant project information (including installation drawings) is submitted to the Principal Contractor for submission into The Health and Safety File.

The Work at Height Regulations 2005

The main purpose of these Regulations is to prevent death and injury caused by a fall from height and must be considered during all metal decking and stud welding activities. It applies to all employers involved with these industries and any person controlling work at height and makes it a requirement of these employers / controllers to ensure that after assessing the risks involved, any work at height activity must be properly planned, supervised and carried out by competent people.

The Work at Height Regulations mean that employees have general legal duties to take reasonable care of themselves and others who may be affected by their actions, and to co-operate with their employer to enable their health and safety duties and requirements to be complied with.

Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1995

Commonly referred to as RIDDOR, these regulations require certain serious workplace accidents, occupational diseases and specified dangerous occurrences (near misses) to be reported by employers, the self-employed and people in control of premises. These reports can be submitted to the Incident Contact Centre or online via the HSE's RIDDOR report webpage.

1.5 Glossary of Terms

Closure / End Caps: a pre-formed steel sheet, designed to close up gaps between decking sheets to prevent the loss of concrete through the ends of a decking profile. Profiled expanded polythene filler blocks or bungs may be used.

Decking bundle: a number of individual decking sheets secured together for placement onto the structure by preceding trades in accordance with decking working drawings.

Decking sheet: an individual panel of decking.

Decking Operations: any operations involved with metal decking.

Edge trim: a pressed steel formwork which is secured to the structure and restrained back to the decking, designed to restrain wet concrete at the edge of a slab.

Exclusion zone: the metal decking working area as well as above and below that area which, by means of demarcation and / or physical barrier, prevents other trades from

entering an area of danger. This area may not always be the immediate area beneath the place of work and may be extended in any direction if required.

Fixing Tools: Fixing tools can be either gas or cartridge (low velocity powder actuated), used to fix the decking and edge trims to the steelwork / masonry.

Flashing: see "Closure".

Multiple span: decking that spans over three or more supports (as opposed to "Single span").

Shot Firing: the operation of the fixing tool.

Single span: decking that spans between only two supports (as opposed to "Multiple span").

Pack: see "Decking Bundle".

Thru-Deck Stud Welding: a welded shear connector / stud that is welded through the metal decking to the steelwork below, providing a vertical element which, once the concrete has been poured, creates a composite connection between the steelwork and the concrete slab.

Welded Shear Connector / Stud: Concrete anchor stud generally fixed to structural metal beams and piles for composite action in a structure.

1.6 Sequencing

Before commencing works, the principal contractor / decking client should coordinate and liaise with the decking contractor at an early stage so that safe working methods and practices on site can be evaluated and thorough planning can take place with adequate time for changes allowed. Giving adequate time to the planning stages will allow for the following to be considered:

- Evaluation of all hazards and access requirements throughout all stages of the works

- Assessment of hazards that cannot be removed or reduced during the design process and planning for the management of these hazards
- Communication between the client and the contractor
- Programmes of works to be established and evaluated, considering the impacts to other works and individuals as well as situations which cannot be controlled and may occur during the works
- The appointment of suitably competent and experienced management at all levels
- Ensuring that sufficient details have been provided to the contractor, such as detailed up to date drawings of the structure
- Ensuring that sufficient details have been provided to the client, such as decking, trim and shear stud layout drawings
- The correct materials and components can be ordered and manufactured in line with the relevant British Standards and manufacturer's recommendations and can be delivered to site in the required order
- Ensuring all site operatives, whether employed or sub-contracted are suitably trained in the works that they will be carrying out
- Ensuring that all equipment being used throughout the works are suitable for the job and have been tested and inspected as required including evidence
- Position of access



Figure 1. Example of suitable edge protection as a result of early consideration

Access

Access positions should be coordinated with the construction drawings so that, having accessed the working area, the decking bundles are available to the operatives immediately

without the need for traversing steelwork. When planning the positioning of an access provision, it should be remembered that the laying out of materials and the installation of any fall protection / prevention systems are not restricted. It is the responsibility of the Principal Contractor to ensure that suitable and sufficient access and egress is provided which will require early engagement with the Metal Decking / Stud Welding Contractor.

When planning operatives' access to the working level, the aim should be to provide immediate access to the decking bundles. When this is not possible, consideration must be given to the operatives' safe access to the working positions.

There are two preferred methods of access to the working level:

- Permanent staircase
- Temporary stair towers

In circumstances where a permanent staircase or temporary stair tower is not possible, other access methods should be considered and a suitable risk assessment and method statement must be prepared.

By providing work level access adjacent to the decking packs, the operatives are able to create a safe working platform as they lay the sheets out, thus there should be no need for walking boards / stagings. Personal secondary fall prevention / protection (such as running lines and harnesses) is not required as safety netting and edge protection must always be in position prior to the metal decking operations commencing. In addition, the inclusion of walking boards and personal fall protection creates additional health and safety risks which can be avoided.

Access by Mobile Elevated Working Platforms (MEWPs) is not suitable as it does not provide a safe means of egress in the event of an incident and does not allow for access by the emergency services.

Fall Prevention / Protection

Prior to metal decking / stud welding works commencing, suitable and sufficient fall prevention and protection must be installed for the safety of all workers. Each type of fall prevention / protection must be considered in accordance with the Work at Height Regulations. When evaluating the suitability of different fall prevention / protection systems, it should be remembered that collective and passive systems rather than personal and active systems should be used where possible

Edge Protection is a necessary collective and passive system and must be installed to all perimeter edges and internal voids on all floors to prevent a fall from height occurring. The method of installation and the possible need for adjustment during Metal Decking / Stud Welding works must be considered at the planning stages.

Whenever possible, edge protection should be installed to the steelwork at ground level before it is lifted and secured in place. This eliminates the need to work at height and allows for increased access to the system.

If not adequately planned, the position of edge protection systems on the steelwork can create additional work at height risks for the Metal Deckers / Stud Welders. If placed on the outer edge of the steelwork, Metal Deckers are often able to install the edge trims without needing to lean through the guardrails or adjust the installed system. It is however often necessary to adjust edge protection systems to allow for the edge trim and / or studs to be installed, requiring additional personal and active fall prevention measures to be considered. Edge protection is often installed to the finished floor level (following concrete pouring) but this often leads to excessive gaps between the working level and the edge protection guardrail / infill. To reduce the gap to less than 470mm, as required by BS EN 13374, an additional guardrail can be installed close to finished floor level and the edge trim put in place as soon as possible to act as a toeboard and prevent items and persons falling to ground level. Once the floor is cast, a permanent toeboard can then be installed for follow-on trades.

It may be more appropriate to close out internal voids completely by the use of fixed decking which is then cut out following concrete pouring to re-instate the void. This practice prevents items and persons from falling to the working level below, but the areas must be clearly marked to show their location.

Safety Netting is commonly used during Metal Decking operations as a collective and passive method of fall protection. Minimal recorded injuries have been reported as a result of falls into safety nets as they are rigged as close as practicable to the working level, usually resulting in a maximum fall of 500mm. It should be remembered that the introduction of additional personal active fall protection measures are not required and may cause additional health and safety risks. Further guidance on Safety Netting and other collective and passive fall protection methods can be found in the UKMDA Technical Guidance Bulletin 01 – *The Advantage of Safety Nets When Installing Metal Decking*.

The Fall Arrest Safety Equipment Training's "Three C's of Safety Netting" are:

- Compliant Product Nets manufactured to BS EN 1263-1
- Comprehensive Maintenance
- Competent Riggers and certified to BS EN 1263-2 and BS 8411

Safety Netting must be considered within the sequence of work and adequate clearance distances beneath the nets maintained, as advised in FASET's Technical Bulletin 26 – *Clearance Distances Beneath Safety Nets*.

Safety netting must also be completely removed prior to any stud welding operations above.

Information regarding the installation of safety netting, appropriate attachments, training etc. should be sought from the FASET website, www.faset.org.uk.

In some circumstances, such as when Metal Decking is being installed to a masonry structure, it may not be possible to use safety netting. In these cases, soft landing systems such as air bags and bean bags should be considered. Although effective, there are disadvantages to their use, such as potentially increased fall heights, the speed of installation, issues at perimeters adjacent to the handrail and handling issues. For these reasons, safety netting is the more favourable option when possible.



Figure 2. An example of a situation where safety netting cannot be used as a collective fall protection measure, so a soft landing system has been used instead

Metal Decking

1. Suitable access and fall prevention / protection measures put in place to allow for

efficient and safe working.

2. Decking packs delivered to site to suit the steel erection programme, thus causing minimal storage issues and site hazards. Up to date construction drawings are essential at this stage to ensure that the decking packs are loaded out as required, allowing immediate access to them by the operatives.
3. Installation of the metal decking and edge trims, as per Section 7 of this UKMDA Approved Code of Practice.
4. Waste removed in a safe manner, as identified by risk assessment and method statements.
5. Collective fall prevention / protection measures removed.
6. Area handed over to the site's appointed person.

Stud Welding

1. Plant positioned as identified by the risk assessments and method statements.
2. Shear connectors hoisted to the working level
3. Safety nets removed from below the deck to be welded
4. Installation of the studs, as per Section 8 of this UKMDA Approved Code of Practice.
5. Waste removed in a safe manner, as identified by risk assessment and method statements.
6. Area handed over to the site's appointed person.

1.7 Profile Types and Function

Different metal decking profiles are used depending on the building design. There are three main types of deck design used in the UK market, as listed below:

1. Trapezoidal deck
2. Re-entrant
3. Slim deck

During the construction phase, the metal decking must support the weight of the wet concrete, the concreting operatives and their equipment.



Figure 3. A completed section of Metal Decking and Stud Welding

1.8 Training and Qualifications

It is important that all operatives working within the Metal Decking / Stud Welding sequence of works are suitably trained and competent. This should be ensured from the very start of the planning stages by all parties involved.

Operatives

It must be ensured that all operatives are competent to carry out all works that they are involved with. Detailed below are some common training requirements for operatives:

- UKMDA Core Training OR training in individual categories as below:
 - Manual Handling
 - Abrasive Wheels
 - HAVS
 - Cartridge Tools
 - Work at Height
 - Basic PPE (including harness awareness and daily inspection)
 - Hot Works / Fire Awareness
- Health and Safety Awareness training

Studwelders should also have completed training in:

- Stud welding

- Fire Prevention Safety

If the operatives employed to undertake the Metal Decking / Stud Welding are also to complete the required Safety Netting works, they must hold a CSCS Blue Skilled Worker FASET Safety Net Rigger card or hold a CSCS Red Trainee FASET Safety Net Rigger card and be working under the supervision of a CSCS Blue Skilled Worker FASET Safety Net Rigger card holder. They will also require MEWP Training for category 3a and / or 3b.

If work positioning to install the nets using ropes or beam gliders is required, the FASET Specialist Rigger endorsement is required on their Blue Skilled Worker Card.

Before commencing works, all operatives should be inducted onto the site and briefed as to the programme of works by the contractor. The induction provided should reflect the Method Statements and Risk Assessments previously completed and should be evidenced by the way of signatures from each operative. Site inductions are commonly held by the Principal Contractor and run through any site specifics and hazards.

As works progress, it may be necessary for the contractor to complete toolbox talks with the operatives to run through key points to do with the next phase of work. These may include any changes made to the programme of works, any new or adjusted method statements, highlight any poor practice / safety issues which have been identified or refresh the operatives on the safe use / inspection of work equipment.

Supervisors

In addition to the operatives' qualifications, a supervisor must hold a valid CITB Site Supervisor Safety Training Scheme (SSSTS) certificate. This two-day course introduces Site Supervisors to their legal responsibilities regarding health, safety, welfare and environmental issues.

A supervisor also needs to hold a current Emergency First Aid at Work certificate as a minimum.

Managers

Site / Construction managers need to hold a valid CITB Site Managers Safety Training Scheme (SMSTS) certificate. This five-day course introduces managers to their responsibilities for planning, organising, monitoring, controlling and administering groups of staff.

In addition to the SMSTS qualification, managers must possess a CSCS Black Manager

card or AQP (Academically Qualified Person) White card. To achieve this, managers should have achieved a Construction related Degree / HNC / HND or NVQ / SVQ Level 6 or 7 in the relevant construction management level qualification to gain this card.

Although managers don't need the same qualifications as the operatives, they must be able to demonstrate an understanding of the works being undertaken. To demonstrate this, attendance at a Safety Nets for Managers course (previously Safety Net Inspectors course) shows a level of competence for Safety Netting and the IPAF MEWPS for Manager's course covers what managers need to know about using MEWPs on site, from planning the job and completing a risk assessment, to selecting the right equipment and mitigating all possible risks

2. DESIGN CONSIDERATIONS

2.1 CDM

The Construction (Design and Management) Regulations 2015 focus on improving the health and safety of all involved within industry and are very important when planning the sequence of build. The regulations require the work to be appropriately planned, taking into consideration all trades and work activities being undertaken at a given time, enabling the risks to be managed as well as ensuring suitably trained and experienced operatives are available.

2.2 Edge Protection

All perimeter edges, and internal voids require edge protection which complies with BS EN 13374: 2013 where practicable. Early consideration as to the attachment of these systems to the building structure and how components of the edge protection system may interfere with the metal decking / concrete pouring works is essential. For example, the toeboard of an edge protection system may cause interference to the metal decking works and consideration as to how the system may need to be adjusted throughout the works by a trained operative should be given in the early stages.

Where it is identified at the planning / sequencing stage that it will not be possible to install a system which is compliant to BS EN 13374: 2013, additional safety measures must be considered to prevent the fall of any person or objects from the working level. This may be through the use of the metal decking edge trims taking on the role of the edge protection toeboard prior to the concrete being poured and the edge protection being adjusted by a competent person if required.

2.3 Access Provision

When planning works, careful consideration must be given to the safe access to each floor and work area. Access to level is normally achieved by one of the following methods:

Use of Existing Permanent Stairs

These are usually within the foot print of the building, have pre-existing, permanent hand rails and are the safest method of access.

Permanent Staircases with Temporary Hand Rail

These stair cases which are still in construction phase can be made up of pre-cast or metal stairs that are being placed within a new build. As they have been designed in conjunction with the floors, they usually match the floor heights and therefore provide a very good way of accessing the work area. One consideration for this method of access is to always ensure that temporary hand rails are put in place before use as the building envelope is often still open and edge protection or hand rails may not be in place at this stage of the build.

Mechanical Hoist

Quite often on high rise buildings, a mechanical hoist will have been installed. This is a suitable form of access to level for stud welders once the floors have been decked. This technique is not suitable for gaining access to a netted floor to start decking.

Stair Towers

Proprietary Stair Towers are often used to gain access to the floors and can be designed and installed to the requirement of each site. They must always be planned and often a temporary works design will need to be submitted by the contractor employed to install the access. Stair Towers need to be regularly inspected; at least every 7 days or after severe weather etc. There will need to be some consideration for the pack positioning as often the access point will not be known prior to the decking being designed.

Gated Ladders

Ladders should be the last resort in gaining access to a floor height. They must always be fixed at the top of the ladder and a working gate in place to prevent people being able to walk off the phased or perimeter edge. This is the least preferred option and should be avoided so far as practicable. This method does not allow site operatives to carry tools required for the fixing of decking up and down form level.

Unsuitable Methods

MEWPS are not deemed a suitable means to access and egress floors. They are a working platform and not a hoist.

Decking packs must never be stacked on top of each other when loaded onto the building and must always have a minimum bearing at each end of at least 50mm on steel work and 75mm on concrete or blockwork.

Where decking sheets are single spans it is good practice to oversize the bottom sheet by 100mm to ensure that there is plenty of bearing surface, as shown in Figure 6.

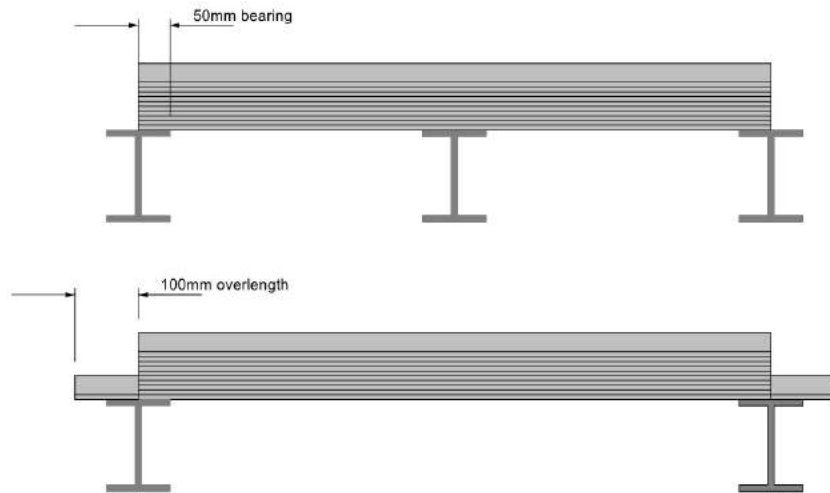


Figure 6. Correct loading out of decking packs.



Figure 7. An example of poor practice when laying out decking packs.

Pack placements must be planned so that the first sheet is directly adjacent to the access point. This should be considered at the design stage of the decking.



Figure 8. An example of good practice when laying out decking packs.

2.5 Sealing of Decking Joints and Gaps

Although the layout of decking sheets will be designed so that they butt along the centre of the supporting steelwork, gaps of up to 5mm are commonly accepted. Gaps in excess of 5mm will require sealing so as to avoid grout loss, but gaps smaller than 5mm will be sealed by the aggregate within the concrete when poured.

Designers should be aware that some grout loss is often inevitable as the metal decking sheets when laid do not create a watertight seal.

It is important to avoid the use of a poker when laying the concrete as they can cause the joints of the metal decking to vibrate, thus increasing the amount of grout loss. In place of a poker, a vibrating beam should be used.

2.6 Decking as an Exposed Soffit

It is important to note that decking is a structural component of a building and is not designed or installed to be visible once the building has been built. Should the soffits be exposed, additional considerations may need to be required and included for when estimating the contract to ensure an aesthetic finish is achieved.

2.7 CE Marking

Metal Decking contractors dealing in the Supply & Installation of Metal Decking & ancillary components are required to prove that they achieve CE marking in accordance with BS EN 1090-1: 2009+A1: 2011 *Execution of steel structures and aluminium structures – Requirements for conformity assessment of structural components* for the design and procurement of composite steel floor decking up to Execution Class 3.

From 1st July 2013 all construction products covered by a harmonised standard must be CE marked and from the 1st July 2014 it is a mandatory legal requirement that fabricated structural steelwork delivered to site is CE marked by an approved fabricator. Composite steel floor decking and Thru Deck welded shear studs are a major structural component of all steel framed structures, covered by the scope of BS EN 1090 *Execution of steel*

structures and aluminium structures, but because they are installed and welded on site they fall outside the Factory Production Control (FPC) requirements of BS EN 1090-1.

As such, decking contractors are not required to be CE marked for the onsite installation of the metal floor deck and welding of shear connectors however they must still comply with the requirements of BS EN 1090 Parts 1 & 2, which includes the design and procurement stages of the construction process

BS EN 1090-2 also contains detailed technical requirements for the welding and inspection of shear studs. Any Metal Decking contractor dealing in the supply and welding of Shear Studs plus the ancillary components to go with these are to ensure that they have fully compliant welding procedures in place.

Clients, designers and main contractors are now legally obliged to ensure that all the structural steel components meet the requirements of BS EN 1090. This includes composite steel floor decking and welded shear studs as well as the structural steel frame.

2.8 Painting of Beams

It is important that prior consideration is given to the quality of the weld as thru deck shear stud weld contains contamination. This contamination is known and has been tested to prove its suitability.

The top flanges of steel work must be free from any further contaminants as this introduces a further unknown element in to the weld that will affect the quality of the weld and the suitability of the shear stud in that position.



Figure 9. Steelwork with the uppermost surface free from paint and other contaminants so as not to reduce the quality of the weld

Contaminates that must be considered when thru deck shear stud welding are as follows:

- **Paint.** The entire top flange should be free from paint of any sort including weldable primers.
- **Grease.** All grease must be removed from the top flanges of the steel prior to being erected. The grease may not be visible until the steel is being worked on, however the possibility should be planned and managed by the steel fabricators.
- **Excessive corrosion.** It is accepted that there will be elements of corrosion on the top flange of the steel work, but care should be taken to avoid excessive levels.
- **Water.** Moisture on the top of the flanges will affect the porosity of the weld. Additional care should be taken around butt joints and end of bays

Scorching on the underside of the steel works is inevitable and cannot be avoided.

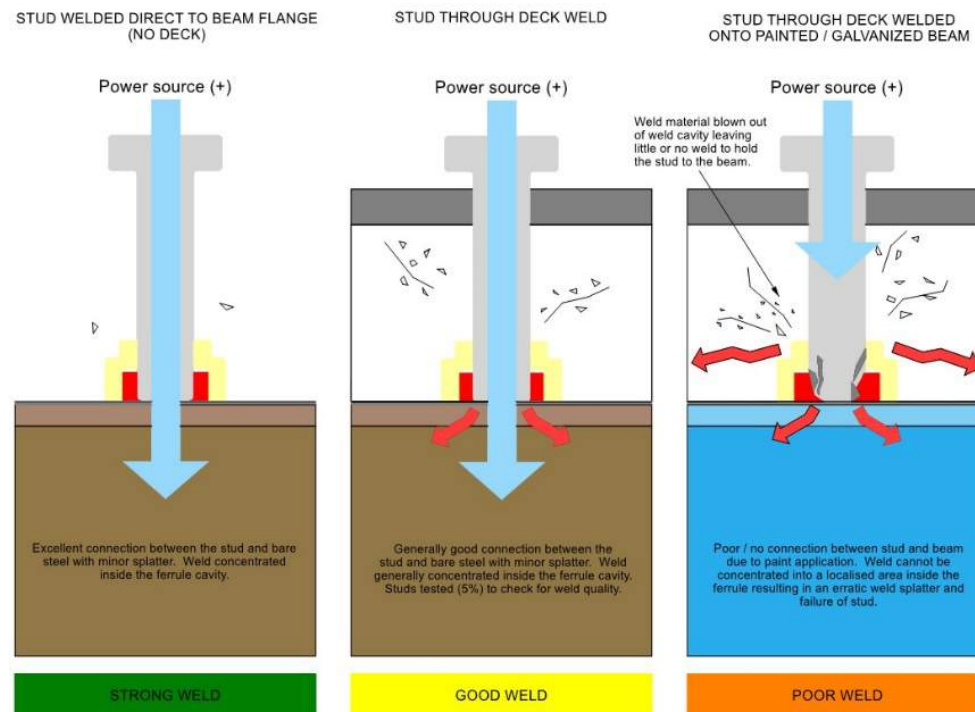


Figure 10. An illustration showing the need for the upper most surface of the steel to be unpainted and free of contaminants

2.9 Site Logistics

The designer / planner must consider suitable and sufficient access to the site during all phases of the works. Once on site, sufficient areas must be designated for the off-loading of plant and materials in a suitable location to allow for lifting / hoisting into position. It is common for the steelwork contractor to undertake this work as they usually have the correct craneage and other necessary equipment as well as qualified and competent supervisors and operatives on site.

It is advisable that the delivery and off-loading / hoisting of metal decking materials and plant / equipment is coordinated with the build of the structure so that the need to operate through the steelwork is avoided and site storage is minimized.

2.10 Power Requirements

Power may be required on site for varying activities. The installation of metal decking usually requires 110 Volt power, provided either from the mains or an on-site generator. Occasionally, charging stations may be required for battery operated tools which usually require 240 Volt power and should be in a site cabin or designated charging station.

Plasma cutting may require a larger power supply and Stud Welding requires a 415 Volt 3-Phase power supply.

3. PRE-START CONSIDERATIONS

3.1 Deliveries

It is common for metal decking sheets to be supplied in bundles of 18, secured using metal banding and weighing circa 1.2 tonnes, but it is possible to receive bundles of 24, weighing up to 2.5 tonnes. Shear studs are delivered in metal containers.

It is important that adequate access is allowed for deliveries and that the lorries making the deliveries can access the required area of the site to be safely unloaded.

Decking sheets are delivered pre-cut to the site-specific requirement, thus avoiding the need for additional propping and on-site cutting. It is important that the decking bundle labels are cross referenced with the loading out drawings using the unique reference numbers provided. It is common for decking bundles to be marked with spray paint along one common side which indicates which way around they should be unloaded in the designated area on the steelwork. The spray line should face the direction of the setting out point as indicated in the loading out drawings. Observing these simple indicators greatly decreases the amount of manual handling required and the dangers associated with working at height.

As well as materials, deliveries of plant / generators will also be necessary.

3.2 Steel Frame Requirements

Prior to any works commencing on the steel frame, it is important that it has been handed over to the netting and decking teams. The steel fabricators / erectors have a duty to hand over their work and demonstrate that it is completed and safe for follow on trades to access the frame in the same way that safety nets must be handed over before working above them. The following points should be covered in a steel work hand over:

- Plumbed, lined and grouted
- Frame handed over prior to commencement
- Top flange unpainted
- Perimeter, phase and void edge protection is completed and installed to BS EN 13374: 2013



Figure 11. A good example of well-planned laying out of decking packs on unpainted steelwork.

3.3 Collective Fall Arrest Measures

As discussed in Section 1.5, thorough consideration must be given to the use of collective passive fall protection / prevention measures. Collective measures provide protection for a number of operatives at the same time and by using passive measures, no reliance upon the operative to correctly use PPE is required.

The use of safety nets in isolation is advised by the UKMDA for most circumstances. The nets are rigged as close as possible to the steelwork, minimising the fall height and therefore the possibility of injury whilst providing protection for a number of operatives at once. Additional personal fall protection measures are not required when safety nets are

utilised as this may increase the health and safety risks if used.

Consideration must be given as to how the steelwork is to be accessed for the installation of safety netting and whether work at height can be minimised by the use of remote attachment devices. The method of attachment must be considered to ensure that it does not hinder the securing of the metal decking sheets. Such as net / lion claw and gripper clamps.

Section 1.5 of this Code of Practice also discussed the necessity of edge protection through all stages of metal decking operations. The possibility of installing edge protection to the steelwork at ground level and then hoisted in place must be considered at an early stage to further reduce the need for working at height.

Prior to the installation of an edge protection system, the required distance beneath it and the steelwork to allow for the installation of the metal decking sheets must be carefully considered. Space is required to allow for the sheets to be placed underneath the edge protection and safely secured without the need to lean through / over the system. This does however cause issues with regards to the provision of fall prevention systems for the operatives during the installation of the metal decking.



Figure 12. Installation of safety netting using a MEWP.

3.4 Personal Fall Protection Measures

Personal fall protection measures are not often necessary due to the preferred use of collective and passive measures. They can cause additional health and safety risks if used without due consideration.

It is often necessary for edge protection systems to be installed or adjusted so that they

allow for the installation of the metal decking below the bottom of the edge protection panel / bottom guardrail / toeboard. When the systems have been adjusted to allow for this, an excessive gap will be left between the edge protection system and working level and consideration must be given to how the operatives will safely work at this time without the risk of falling through the gap. Personal fall protection measures are often the solution during this period of work and the edge protection system should be reset as soon as possible to close up the gap produced.

3.5 Hoisting of Shear Studs

In order to keep the manual handling of shear connectors to a minimum, provision to lift shear studs to the appropriate area is required. Mechanical means must be provided to ensure safe placement of the stud barrels on to the laid deck prior to upper levels being laid otherwise access will be compromised. Generally, the barrels contain 700 shears with a gross weight of 200kg maximum (Std 19dia x 95 LAW). A Certified lifting frame is considered the most appropriate method. The Barrels should not be dropped onto the decking but landed onto a suitable landing frame spanning the beams.



Figure 13. A barrel lifting frame for the placement of Shear Studs on the working level.

3.6 Waste Removal

The scrap created during Metal Decking works has sharp edges and points and must be dealt with using extreme care. Careful consideration must be given as to how the scrap will be removed from the working level once the Metal Decking has been completed.

Metal Decking and Stud Welding contractors do not undertake lifting works as it falls outside of the industry experience and skills. Removal must therefore be considered at an early stage to ensure that safe removal can be completed.

Further information can be found in Section 9 of this Code of Practice.

3.7 Exclusion Zones

Exclusion zones should be set up beneath any area where the installation of collective fall prevention / protection systems, Metal Decking or Stud Welding is taking place. Physical demarcation must be in place, which may comprise of tape, ratchet straps, barriers, signs etc. as appropriate.

It is important to remember that no works should be taking place in the area above the working level either due to the risk of falling objects. Any overhead works should be separated by two fully completed levels of metal decking or one fully completed concrete slab which has cured for a minimum of 7 days.

3.8 Permit to Work

Hot-Work Permits

Hot works permits are required for any operation



Figure 14. An example of the creation of an exclusion zone using ratchet straps and signage.

involving open flames or operations that produce heat and / or sparks. The permit must be prepared by a competent person and must describe the work taking place as well as the location. It must note the precautions to be taken including having the correct fire extinguisher accessible during the hot-works.

Operatives must fully understand the permit before signing it and must work within the parameters of the permit at all times.

The hot-works must cease at least 30 mins before the end of the shift unless otherwise stated, with the operative remaining in the area for at least 15 mins following completion of work to ensure there is no hot spot residue.

The permit must be signed off by the operator and an authorised site manager. An inspection of the work area covered by the permit must be carried out by the site management or fire warden after the permit has been signed off following completion of the hot works.

Other permits to consider:

In some situations, we will be required to operate under additional permits some of these have been listed below:

- General permit to work
- Ladder permit
- Working at height permit
- Confined spaces

3.9 Protection of Other Workers

Whilst Metal Decking and Stud Welding works are taking place, the protection of other workers around the work area must be taken into consideration. The immediate area above and below



Figure 15. The use of fire blankets to protect other trades and the public.

must have an exclusion zone (see Section 3.7) to protect other workers from harm.

Even with an exclusion zone directly below the works, objects can still fall outside this zone at the perimeters. Metal Decking and Stud Welding operations require all tools to be tethered when working within 3m of the perimeter (see Section 3.10) to prevent them from falling from the working area and injuring those below.

When Stud Welding at or near perimeters or voids, fire / welding blankets can be used to stop the weld dross from splattering over the edge of the building and falling to the ground. The method used is to attach a fire / welding blanket to the edge protection handrail at the perimeter of the building and pulling it into the floor below. The sparks hit the blankets and extinguish themselves in the exclusion zone. The blankets are used in small sections around the perimeter, being moved as works commence around the welded area.



Figure 16. The use of fire blankets to protect other trades and the public.

As explained in Section 4.2, Metal Decking works are very noisy and hearing protection is mandatory for all workers involved in the task. Other workers on site need to be protected from the effects of high noise levels by way of larger exclusion zones or by the site offering hearing protection to all those working in areas where the noise levels exceed 80dB. Protection can be given to the workers by offering ear plugs at the start of the day or by having noise protection stations around site.

Fumes created by Stud Welding plant, Stud Welding operations, petrol disc cutters and petrol blowers will become hazardous in enclosed working environments. When working in these environments, the fumes can gather and cause both operators and other workers' respiratory problems. It is crucial that the fumes are extracted away from the work area and

this must be planned prior to decking / stud welding teams commencing works. Where building envelopes have not been completed it is accepted that natural ventilation is suitable to remove welding and petrol fumes.

3.10 Tethering

When working at height it is important to ensure that not only the operatives are safe from falling but that people at ground level are safe from falling objects. To mitigate against falling objects, tools must be tethered when working within 3m of the perimeter of any building.



Figure 17. Examples of tool tethers.

All tools should be tethered using suitably load tested tool tethers. When installing trim at the perimeter of any building it is important that the trim is also tethered. Due to the weight of trims, they should not be tethered to the operatives but to the handrail standards / vertical posts.



Figure 18. Tool tethers in use during the installation of Metal Decking.

3.11 Inclement Weather

Consideration must be given as to how the weather conditions on a site may affect Metal Decking and Stud Welding operations.

High winds create a significant risk of materials being blown about and possibly off the edge of the building. High winds can also affect lifting operations as suspended loads may swing.

Stud welding must also be considered when winds are high as weld splatter will carry in the wind. Consideration must also be given to fire blankets as these will act as a sail, they must be removed if weather is forecast to change.

The risk of slipping can be greatly increased in wet or freezing conditions meaning that day to day scheduling may need to be altered as the weather changes. Wet and freezing conditions can also adversely affect the stud welding operations.

Weather conditions should be assessed throughout the works and appropriate re-scheduling allowed for.

3.12 Site Inductions

Site inductions are a necessary part of all jobs and give the operatives information on the job in hand as well as site specific considerations, such as site policies, welfare facilities etc. It is also an opportunity for site supervisors to make operatives aware of any site hazards.

The Metal Decking / Stud Welding contractor will need to organise these inductions in line with the Principal Contractor's instructions. The Method Statements and programme of works should be fully explained as well as all site specific procedures.

Toolbox Talks should be delivered to operatives throughout the programme of works to ensure that they are familiar with every aspect of work during each stage, are aware to any changes to the method statements or site hazards etc.

Operatives should sign a document confirming that they have attended and understood the induction and all subsequent toolbox talks.

3.13 Method Statements and Risk Assessments

As part of the process of providing a safe system of work to its employees, Metal Decking / Stud Welding contractors should prepare and communicate method statements which cover all work activities. They should be used to record all significant hazards and communicate these to the workforce. Method statements should also be used to identify what work equipment is required for specific tasks so it can be ensured they are available and the operatives trained to use them.

Method statements need to be clear to the operatives and may include simple sketches where necessary. They do not need to be long documents, but their size depends on the job in hand.

It is advised that as a minimum, method statements should include:

- Site details
- References to any site / job specific documentation or drawings
- Description of works
- Management / safety organisation / contacts
- Risk assessments and controls

- Materials to be used
- Training requirements
- Plant and equipment to be used
- Safety system requirements
- Sequence of works
- Temporary works
- PPE
- Access arrangements
- Manual handling requirements
- Housekeeping
- Noise and vibration considerations
- Traffic management
- Protection of others
- Health and Welfare arrangements
- Rescue procedures
- Site logistics

4. WELFARE & WORKING ENVIRONMENT

4.1 Welfare Requirements

It is the responsibility of the Principal Contractor to provide the correct welfare facilities as required by the CDM Regulations.

4.2 Noise

The noise level produced by nearly all Metal Decking and Thru Deck Stud Welding operations requires by law the use of hearing protection. The law requires employers to assess and identify measures to eliminate or reduce risks from exposure to noise so that employees hearing can be protected.

Where identified by risk assessment, employers should ensure that:

- Hearing protection is provided and used
- Any other controls are properly used
- Information, training and health surveillance is provided
- Protection and controls provided are reviewed if anything changes which affects the noise levels / exposure

Prolonged exposure to noise produced by Metal Decking / Stud Welding could result in serious and permanent hearing damage or loss. Tinnitus could also result if adequate protection / controls are not in place.

Typical noise levels experienced at a 1m distance from two common Metal Decking / Stud Welding operations are:

- Cutting metal decking using petrol cut off saw – 105dB(A)
- Shot firing using gas-actuated tool – 114dB(A)

Hearing protection must be available to workers experiencing noise levels above 85dB(A). For this reason, the UKMDA highly recommends that Metal Decking and Stud Welding operatives wear hearing protection at all time during work activities.

It should also be remembered that other trades working in the vicinity may be exposed to high levels of noise and this should also be evaluated.

4.3 Hand Arm Vibration Syndrome (HAVS)

Hand tools used during Metal Decking and Stud Welding operations, such as grinders, petrol driven disc cutters, cut off saws, blowers and hand drills can transmit a mechanical vibration to operatives. This vibration can also be transferred to the operative by holding on to materials being worked on by vibrating tools.

Regular and frequent exposure to vibrating tools can lead to Hand-Arm Vibration Syndrome (HAVS) or Vibration White Finger (VWF) / Carpel Tunnel Syndrome (CTS).

HAVS is commonly noticed by a whitening of the finger which is worse during cold or damp conditions. It can result in the need for long-term treatment due to the loss of dexterity experienced. Tingling and numbness can also be experienced in the fingers which may result in an inability to carry out work tasks. As well as these symptoms, CTS sufferers may experience pain and weakness in the hands.

Every hand-held tool has a different vibration magnitude level, although manufacturers attempt to reduce this as much as possible. Whenever possible, machinery with a low vibration magnitude level should be used.

Following the introduction of The Control of Vibration at Work Regulations in 2005, employers must assess and identify measures to eliminate or reduce risks from exposure to hand-arm vibration. The Regulations include an Exposure Action Value (EAV) and an Exposure Limit Value (ELV) which is based upon a combination of the vibration at the grip points on the equipment and the time spent gripping it, resulting in the following limits:

- A daily EAV of 2.5m/s^2 A(8), resulting 100 HSE Exposure Points which is identified as a clear risk which requires management
- A daily ELV of 5m/s^2 A(8), resulting 400 HSE Exposure Points which is identified as a high risk above which employees should not be exposed.

Through past monitoring within the Metal Decking industry, it has been proven that the accumulation of most decking activities involves around or above the EAV value for each operative during an 8-hour work period. This identifies a clear need for continued health

surveillance monitoring and for exposure to be mitigated by tool selection, limiting the tool use time and sharing the potentially harmful operations between workers.

Damaged or old equipment may be hazardous to the user's health even when used for short periods of time.

4.4 Personal Protective Equipment (PPE)

The following list gives the minimum requirement for PPE when Metal Decking or Stud Welding. Risk Assessments may identify additional PPE requirements which should be dealt with on a case by case basis.

- Hard Hat
 - *BS EN 397: 2012+A1: 2012 – Industrial Safety Helmets.*
- Ear Protection
 - *BS EN 352 – Hearing Protectors*
- Eye Protection
 - *BS EN 166: 2002 – Personal eye protection. Specifications. Minimum Class B for Metal Decking.*
- Hi Visibility Vest
 - *BS EN 471: 2003+A1: 2007 – High-visibility warning clothing for professional use. Test methods and requirements.*



Figure 19. PPE is use during the installation of Metal Decking.

- Gloves
 - *BS EN 388: 2016 – Protective gloves against mechanical risks. Cut Resistant Grade 5.*
- Safety Boots
 - *BS EN ISO 20345: 2011 – Personal protective equipment. Safety footwear. Lace up boots with mid-sole, ankle and toe protection.*

4.5 Protection of the Public and Other Trades

Although metal decking equipment, materials and waste are routinely secured to the structure, the Principal Contractor should consider what precautions can be taken to avoid any injury to the public, especially when a building is situated close to the perimeter of a site or public areas.

Various methods of securing safety net attachment devices to the border cord of the net are now available which prevent them from falling when the net is dismantled. These methods range from the use of cable ties to the use of manufacturer supplied slips and springs. Consideration to the use of these methods should be given to present the risk of injury due to falling objects.

As detailed in Section 3.6, exclusion zones immediately beneath any safety netting, metal decking or stud welding works must be observed at all times by all site staff and operatives.

4.6 First Aid

Emergency First Aid at Work

The roles and responsibilities of the Emergency First Aider are assessing an incident, recognising signs and symptoms of injury and illness and assisting a casualty who is suffering from injury and illness.

A qualified Emergency First Aider will hold an Emergency First Aid at Work Certificate which is lifed for three years. The HSE stated that to be valid in the workplace, learners must retake the qualification before it expires.

4.7 Safety Net Rescue

A Safety Net Rescue Plan is required for all operations taking place above a Safety Net. The plan should give guidance to operatives to enable them to perform a basic rescue of a colleague. All operatives should have competency in Safety Net Rescue and should be familiar with:

- How a Safety Net works
- How a Safety Net behaves under tension
- Self-Rescue
- Two Person Rescue
- Three Person Rescue
- MEWP Rescue

As well as ensuring that a Safety Net Rescue Plan is in place, employers must ensure that it has been fully understood by all operatives. Suitable and sufficient Rescue Kits should be available at all times. Before executing a rescue, a competent First Aider should be contacted and the emergency services contacted if necessary.

Once a fall into a safety net has occurred, it should be removed from service and replaced.

The UKMDA recognise that each situation will be unique and must be assessed and the operatives made aware of the approved method for each work area. Typical forms of rescue are detailed below.

Self-Rescue

Usually an operative who has fallen into a safety net will recover themselves without assistance as the net will have been rigged as close as possible to the working level. If they are finding it difficult to climb back onto the Metal Decking, they may need their colleague to extend the ladder from their Rescue Kit and place it into the safety net. The faller will then be able to climb out of the net unassisted.

Rescue Using a 2nd Operative from Above

Safety nets are designed to take the weight of up to 3 operatives at any one time. If the faller is having difficulty exiting the safety net, a colleague may extend the ladder from the Rescue Kit. They may then climb down the ladder, into the net, and aid the faller on to the ladder and up to the working level.

Rescue from Below

When appropriate, a stretcher / board should be brought up to the casualty from below the net and positioned underneath the casualty. The casualty should be secured to the stretcher / board and a hole should then be cut in the net around the casualty and stretcher / board. The casualty should then be lowered to a safe area for further emergency assistance.

You then need to exclude access from this area until the net has been reinstated/ replaced.

5. MANUFACTURE & DELIVERY

5.1 CE Marking

See Section 2.7.

5.2 Traceability

It should be possible to trace the source of origin for all materials if required.

5.3 On Site Requirements for Unloading

Access to site needs to be provided by the Principal Contractor. Suitable means of access and egress must be ensured allowing access to articulated vehicles. These vehicles can be up to 13.5m long and up to 40 tonne gross weight. Ground conditions must be ensured prior to any unloading commencing.

5.4 Site Restrictions / Parking Vehicle Restrictions

Site restrictions will be set out by the Principal Contractor, these include site access and egress, pedestrian walking route and access to and from the workplace. Prior to commencement on site the Principal Contractor will have arranged vehicle parking. Due to heavy site traffic and/or space available, offsite parking may be the only option. This should be discussed during the site visits and during site induction with operatives.

5.5 Safe Unloading

It is the Principal Contractors duty of care to ensure the safe unloading on site. All pedestrian routes are to be fenced off to separate pedestrians from vehicle movements. A safe parking area should be provided for the unloading of materials such as decking, edge trim and stud barrels to steelwork. This must be monitored daily by the Principal Contractor.



Figure 20. An example of the plant required to lift materials on to complex buildings.

6. PACK LOCATION

6.1 Drawings

Decking packs should always be placed on the steel work in accordance with the decking drawing. Pack positions are usually highlighted with some form of hatching, as shown in Figure 4.

It is important that the orientation of the decking packs detailed on the drawings is observed. Decking packs will be delivered with a sprayed line on one side of the pack to indicate which way round the pack should be positioned. Please always check with the decking contractor as to how the sprayed lines correspond with the orientation shown on the drawings, as shown in Figure 5.

6.2 Direction of Lay

The orientation of decking packs is very important. Decking packs will be delivered with a sprayed line on one side of the pack and checks must be made with the decking contractor to see how this line corresponds with the drawing. For an example of Deck Reference Symbols, see Section 2.4.



Figure 21. Metal Decking packs loaded on to the steel according to the layout drawing.

6.3 Manual Handling Considerations

It is important to carefully follow the decking drawing to reduce Manual Handling as much as practicable. When installing metal sheets, the weights of the sheet lengths should be included within the site risk assessments.

7. INSTALLATION OF METAL DECKING

7.1 Methodology

After the steelwork is handed over to the decking contractor, the netting will need to be put in place in order for the decking installation to commence. Work should be planned allowing the area directly below and above the installation area to be zoned off. Areas should have physical barriers and clear visible signs to show other contractors that this area is closed due to decking installation above. The installation will then commence from a gridline or start point.

Laying Deck Sheets

When decking commences operatives will use the access (fixed or temporary stairs) provided by the Principal Contractor adjacent to set out point. Deckers will then cut the banding on the decking bundles. The first sheet will be laid as to create a working platform in order to lay the rest of the pack from. When the decking sheets are all in position and lapped together they will then be fixed to the steel using approved fixing method such as shot fired fixings. This will fix the deck to the steel. Lap joints are screwed together with a Tek screw gun at specified centres.

When full floors cannot be completed, for example when the building is split into different phases, best practice would be the erection of temporary phased edge protection. In some instances, a safety net can be extended beyond the leading edge to give an additional 3 metres of Fall Arrest, however unauthorised access onto the work area must be controlled. The Principal Contractor should be made aware of the pyramid effect that will occur when phased edge protection is not in place which has a detrimental effect as it reduces the available floor area as you go up the building.

The Principal Contractor must make arrangements to protect all voids and small openings prior to safety netting or metal decking works taking place. These can be protected using edge protection or boarding out.

When safety netting is being used this provides the primary method of fall arrest so there will be no requirement for running lines. The safety net provides the best measure of fall arrest as the safety net will have been installed to the underside of the steel directly beneath the deck thus reducing the height of any potential falls.

Cutting Methods

Decking sheets should be detailed to reduce the amount of cutting time, in most cases decking will only have to be cut out around columns or raking the sheets down in order for the studs to be welded to the steel beams. On site cutting will be conducted using a petrol saw as this is the most common and practical way in the decking industry. Only in areas where a petrol saw cannot be used an angle grinder or plasma cutter will then be used to cut decking sheets.



Figure 22. An example of on-site cutting during the installation of Metal Decking.

Forming Voids and Openings

When trimmer steels are installed decking will have to be cut to suit the size of the voids. Dimensions will be indicated on the approved decking drawings. If no trimmer steel is installed then decking will cover the void which will then be boxed out by others prior to the concrete pour and will only be cut out once the concrete has cured.

Fixings

The fixing of decking sheets should be installed in accordance to the manufacturer's recommendations. This will include the primary fixings at the end of the sheets and secondary fixings at the intermediate beams. All fixing of decking to steelwork will be

carried out by cartridge or gas fixing tools fired into the deck as this provides a safe method of fixing down the decking. All operators should be fully trained on the use of all fixing tools.

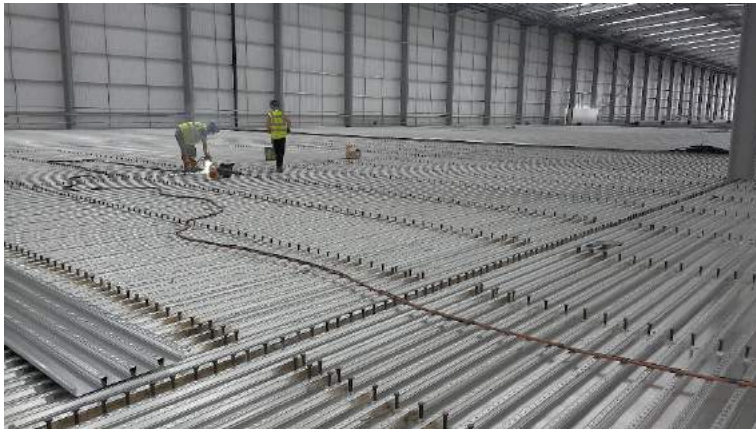


Figure 23. Metal Decking towards the end of the Stud Welding process.

If shot fired tools are not permitted then the fixing of the decking can be carried out by using self-tapping screws however this method is time consuming and has an effect on the installation programme, particularly if the steel has over a 10mm deep flange. Over time the ergonomic affect this has on an operative can lead to difficulties as the operative will be bent over for most of the working period. HAVS is also a consideration with this method. Therefore, the designer and steelwork contractor should always approve of the COT's/Gas operated guns where possible.

Sealing and Finishing

The decking sheets are designed in a way to butt together at the centre line of beam gaps. If the butt joint is over 5mm it will generally be sealed using expanding foam to minimise the concrete seeping through.



Figure 24. Metal decking once the edge trims and end caps have been installed.



Figure 25. Expanding foam used to seal up gaps in the Metal Decking greater than 5mm.

Any gaps larger than 5mm, for example around columns where decking has had to be notched around will require patching to seal it off and then the use of expanding foam to finish. If support is needed around the columns, then this is provided by the Steelwork Contractor within the fabrication process.

House keeping

All waste such as decking offs cut should have been removed from the area and placed in the relevant recycling receptacle which is usually provided by the principal contractor.

It is important to note that decking off cuts should never be manual handled down stairs as this greatly increases the risks of cuts and serious abrasions.

All lifts from level will need to be planned.

Handover

On completion of decking and edge trim a handover or completion certificate will be completed by the decking supervisor confirming that all fixing, sealing of the decking and edge trim will have been installed in accordance with the working drawing. A walkover will then be undertaken by the Principal Contractor to check the work has been installed as per the Decking Contractors drawing. Only then can this be signed off ready for studwelding to commence.

8. THRU DECK STUD WELDING

8.1 Methodology

Thru Deck stud welding involves welding shear studs through the decking and onto the top flanges of the beam. This is all done with a stud welding gun with welding cables connected to a power converter (rectifier) which in turn is connected to a static generator or power source supplied on site by the Principal Contractor.

Thru Deck Stud welding uses semi-automatic drawn arch stud welding plant the current and duration of the weld is set by the operatives in line with the company procedure and training. It is important that the top flange of any steelwork is clean of paint, primer, excessive rust and dirt.

Once the trigger is applied on the welding gun this starts the weld cycle, melting both the stud, deck and parent material. Once the set time has been reached the stud is then plunged in to the molten pool completing the weld. A ceramic ferrule is used at the base of the stud to contain the weld. This process is then repeated until all the studs have been installed.

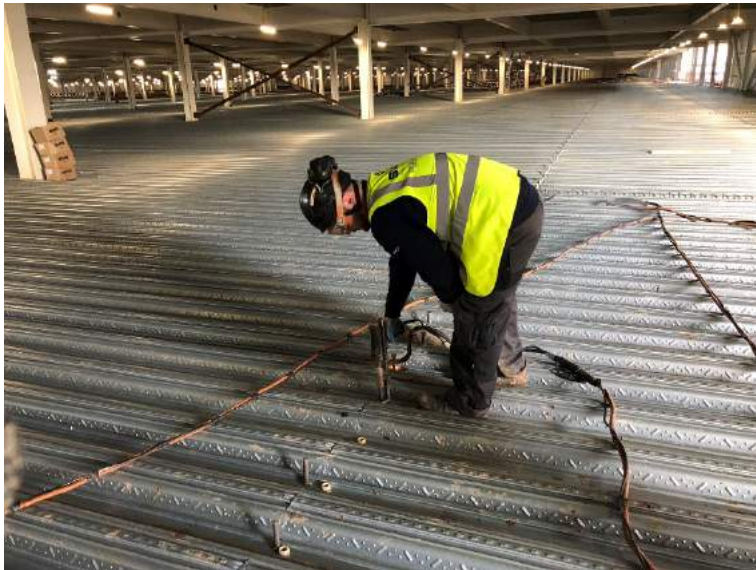


Figure 26. Stud Welding in progress.

Ceramic ferrules are used at the base of the stud and acts as a shutter to contain the weld. The ferrule also acts as a shield in order to prevent any other trades or members of the public seeing the welding arc. This removes the requirement for welding screens. Once this stud is welded the ferrule is broken away, so the stud weld can be inspected. The ferrule is then left and forms part of the concrete aggregate.

8.2 Installation and Parking of Plant

Mobile Welding Plant

Parking of plant should be considered and an area designated by the Principal Contractor. In some cases, the mobile generator may be housed within a Rigid HGV Lorry measuring approximately 6.20metres length, 2.49metre width and with a weight of up to 17tonnes. To obtain suitable earth it needs to have a suitable hard standing and be within 7.5metres of the steel frame to get the best results from the welding equipment. Welding cables can run up to a maximum of 80metres from the studwelding rig.

Static Generator

A static generator may be considered for larger city centre sites where mains power is not available. These generators, combined with a welding rectifier will take out the need of a mobile welding rig where access or room is not an option. These generators weigh approximately 5 tonnes and measure 3 metres long by 2 metres wide and 2 metres high. These generators emit diesel fumes, so consideration should be taken into account as to where it is stationed. Never cover the unit as this would trap fumes so it always needs to be set up in a well-ventilated area.

Mains Power

A mains power supply is the most environmentally friendly source of power and is again suitable for large high-rise building sites where a dedicated 150 Amp, 3-phase, 415-volt mains supply is available. The stud welding rectifier is plugged into the mains and welding can begin. This takes out the need for power from a diesel generator which may have environmental and lifting considerations. The rectifiers can be taken anywhere in the workplace via a goods lift within the building.

Permits

The stud welding process creates a great deal of molten weld splatter both above and below the area of works therefore suitable control measures must be implemented.

All aspects should be taken into consideration i.e. windows, nearby parked vehicles and flammable or combustible materials under or adjacent to the work area. There should be an exclusion zone put up with clear visible signs stating hot works being undertaken. The Principal Contractor should ensure this has been fully implemented in the Method of Works (Method statement or Risk Assessment).

The studwelding contractor should provide specialist fire safety equipment to reduce fire risks such as a fire extinguisher, fire retardant sheets etc.

Once the Principal Contractor has checked the method statements, risk assessments and the work area and the hot works permit has been signed by the Principal Contractor then studwelding can begin.

Start-Up Procedure

Prior to commencing Stud Welding a minimum of ten test studs should be welded. These will then be bent over 30° with a stud bending bar, manually in the direction of the span of the beam towards the nearest column. If the stud cracks and the weld breaks, then the weld has failed, and a replacement stud should be welded adjacent to the failed stud. The test procedure will be repeated until the weld meets requirements. The tested studs are left bent in-situ as evidence of the test procedure.

The Start-Up Procedure should be completed every time the welding equipment is relocated and at the start of every shift and the tested studs should be detailed on the handover certificate.

After welding is complete, every stud will have the ferrule broken away, a visual inspection carried out to ensure that there is a 360° weld around the stud collar and a ring test carried out using a 2kg hammer. A minimum of 2 studs or 5% of studs per beam (whichever is the greater) will then be subjected to bend testing by placing a stud bending bar over the stud and bending it 15° towards the nearest end of beam. If no fracture occurs, then the stud is considered to be meet the requirements and should be left bent. If any studs fail, then a re-weld will be implemented, and it will be retested.

Welding Conditions / Environment

Thru Deck studwelding should not be carried out in adverse weather or when water cannot be kept away from the studs. In areas where ventilation cannot be achieved then the risk assessment should be implemented to aid operatives. This should include suitable

protective measures such as exhaust ventilation, air blowers or suitable respiratory protection for the studwelding operatives.

Loading Out and Laying of Mesh

The loading of materials onto decking prior to concreting should be avoided if possible but this cannot always be achieved. The best possible practice for this is to land any mesh and reinforcing bar only when decking and studwelding has been completed.

When loading use the following recommendation:

1. Typical deck can support distributed loads of 3-4kn/m²
2. Place loads over or close to supporting beams
3. Use timber distributed over a number of ribs
4. Never load on single span sheets
5. Decking should never be point loaded
6. If sheets become damaged they will need to be replaced

Beam Specification

Minimum bearing on steel beams for the decking is 50mm and 75mm on concrete or blockwork.

Production & Test

Throughout the studwelding process systematic tests should be undertaken.

The ferrule will be broken away and a visual inspection will then be implemented to ensure that there is a 360° weld around the stud collar. This will then be subjected a ring test using a hammer. Finally, bend testing will be undertaken by placing a stud bending bar over the stud and bending it 15° towards the nearest end of beam. If no fracture occurs, then the stud is considered to be meet regulations and left bent. If any studs fail, then a re-weld will be implemented and then retested

Ferrule Removal

After studwelding is complete and all studs have been tested, all the ferrules will need to be taken off from around the studs. The ferrules mostly break away after the studs have been ring tested. The ferrules, once broken away, remain on the deck as they are not concentrated in one area, they will form part of the aggregate. However, if the client insists on the removal then it can be done (usually at an additional cost) with a handheld blower. They are then collected and taken from the decking to the recycling receptacle provided.

Sometimes this process will not be done as ferrules can be used as concrete aggregate.

Handover

Once the ferrules have been removed and the bend / ring tests completed, the Contractor will issue a Handover Certificate to the Principal Contractor. Once the Principal Contractor has checked the work, the Handover Certificate will be accepted and signed by both parties prior to the Contractor leaving the working area.

Scorching

It is accepted that where a contract requires a stud to be welded to the top flanges of the steel, the underside of the top flange will show signs of the weld being made. This is especially evident where the top flanges are less than 12mm thick.

Where there is intumescent paint, this may blister due to the heat produced in the stud welding process however unless the coating has cracked this is deemed as fit for purpose.

All paint touch ups are deemed the responsibility of the steel work contractor as this should have been considered in the designing phase.



Figure 27. Scorching is to be expected following Stud Welding.

9. WASTE / HOUSEKEEPING

It must be remembered that the scrap produced from Metal Decking and Stud Welding can be sharp and early consideration regarding its removal must be given.

Typically, scrap consists of:

- Decking pack straps
- Off cuts of decking sheets
- Trim and flashing off cuts
- Stud barrels

9.1 Hierarchy

The hierarchy of controls for dealing with scrap are as follows:

1. Elimination

All decking sheets with an angled profile are cut away from site, prior to delivery, thus reducing (but not eliminating) the scrap produced. This can be expensive to undertake due to the increased work at the manufacturing stage.

2. Lift a skip to level

Place the scrap in a certified lifting skip or skip with a lifting cradle that has been placed on the working level and is removed when full.

3. Hoisting

Place the scrap in a suitable materials hoist which is then lowered to the ground at the end of each shift.

4. Skip lifted to edge protection

A suitable skip or container can be lifted to the top of the perimeter edge protection and scrap is placed into the skip / container before being lowered back to ground level.

5. Palletising

If none of the other options are suitable, scrap should be neatly bundled on and strapped to a pallet near the perimeter of the building to be lifted down by follow on trades when lifting their materials.

In all cases, when scrap is left on the working level, it must be strapped back to the laid decking to prevent it from blowing off the building.

Under no circumstances should scrap be manually handled down stairs or ladder as this creates a vastly increased risk of deep cuts and lacerations to the operative and others. This method of scrap removal is unsuitable on all sites.

The practice of “bombing” (throwing the scrap from the level to the ground below in an uncontrolled manner) is completely unacceptable due to the high risk of injury to other trades and the general public.

Rubble chutes should not be used as they are not designed for long and sharp scrap objects which may snag and block them.

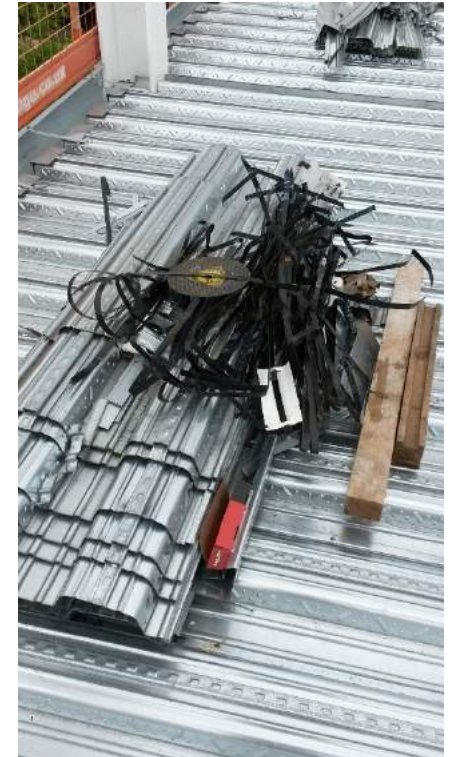


Figure 28. Scrap material collected and bundled ready to be removed from the working level.

9.2 Cartridge Removal

Due to the makeup of a direct fastening tools cartridge, the disposal guidelines from the manufacturers must be followed strictly. Typically, the industry uses two manufactures; Hilti and Spit. They both have different types of cartridge that are disposed of in different ways.

Hilti cartridges are to be thrown away as household or factory waste if the strip is completely discharged. If the strip has one or more charges unfired the cartridge must be disposed of as hazardous waste. Local authority regulations must be observed for disposal.

Spit disc cartridges must be disposed of as waste metal if completely discharged. Discs with in-tact charges remaining must only be disposed of by a specialist licensed contractor.

10. TOOLS & EQUIPMENT

10.1 Commonly Used Equipment (Metal Decking)

Cutting Tools

- i) Disc Cutters: petrol driven 305mm diameter disc cutters with abrasive blades are used on the majority of contracts to cut the deck, trim and closure. 110v electric disc cutters are sometimes used on sites where fuel saws are prohibited or where exhaust fumes could be an issue. Angle grinders (230mm) can also be used however due to the machines configuration and the small size of the cutting disc they are not very practicable. Operatives using this equipment must carry out a suitable abrasive wheel awareness course.

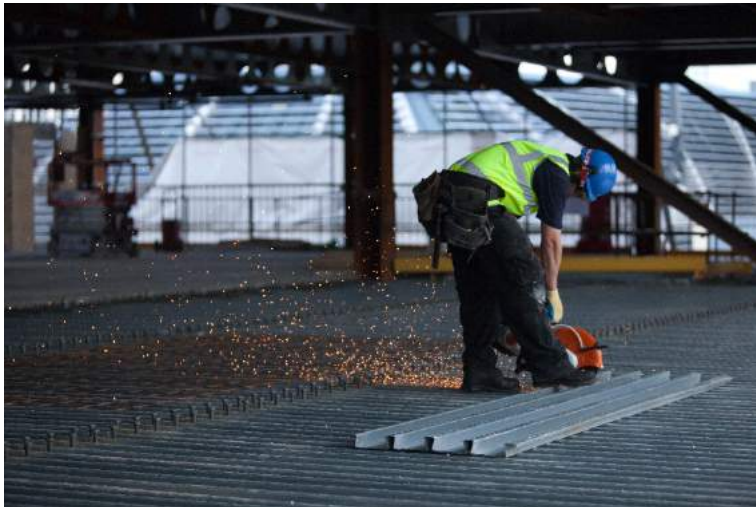


Figure 29. On-site cutting of a Metal Decking sheet.

- ii) Plasma Cutter: since 2003 it has become more common to use plasma cutters on large inner-city sites where noise is an issue as they are significantly quieter than disc cutters. A suitable power supply, the weight and mobility and the difficulties of working in wet weather are considerations that need to be taken into account before using this method.

Cartridge Tools

- a) Cartridge Tools: these are the most efficient and cost-effective method for fastening down the decking materials. They come with a range of nails to accommodate steel, concrete and masonry.
 - i) Powder actuated: Fastening tool that uses a powder charge to drive nails through the decking material and secure it to the base material. There are a number of these products on the market including the Hilti DX460 / DX76 and the Spit P370 / P560.
 - ii) Gas actuated: the ignition of flammable gas actuates the fastening tool. Hilti GX120 & GX - 3 and Spit Pulsa 800P are two such tools.

Screw Fastening Tools

- a) Screw Fastening Tools: Screw guns are used to carry out the side lap stitching with self-tapping screws and connecting the restraint straps to edge trim. Improvements in the battery life of cordless screw guns have seen them supersede 110v screws guns in most cases. Screws guns are also used to install decking on contracts where heavy duty self-tapping screws are specified in place of powder actuated fixings.

Drills

Masonry drills are used when installing deck and trim on block work and concrete. Holes are drilled through the deck panels / trim and block work / concrete then expansion fixings are used to hold the material in place.

Percussion drills are occasionally used to pre-drill heavy section steel work when self-tapping screws are used to install the decking materials.

110V Generator

110 volt generators: in some cases, a petrol or diesel generator will be required on sites where there is no mains power. A 2.5kva generator is sufficient for 110-volt screw guns. Where an electric disc cutter or plasma cutter is to be used then a larger generator will be required.

Foam Dispenser

Foam Dispenser: these are used to apply expandable foam to fill gaps in the decking and trim.

10.2 Commonly Used Equipment (Stud Welding)

Welding Set

Often called a Rectifier or Converter, this equipment enables the welding current and welding times to be adjusted to suit the various stud sizes and applications (i.e. straight to steel, through deck, sheet piles, etc).

Welding Guns

These have inter-changeable chucks, ferrule grips and adjustable legs to accommodate the various types and sizes of studs.

Welding / Gun Control Cables

These come in 10m, 15 & 20m lengths and are fitted with plugs and sockets to connect them together.

Earth Cable

This cable is around 7.5 metres long, one end plugs into the welding set and the other end is fitted with a clamp. It is connected to the base metal (usually a steel column, sheet pile, etc.).

Generator

Generators are required to supply sufficient power to run the welding control unit.

- i) Mobile welding lorries (stud rig) carry all the equipment on them including the large generator. Consideration has to be given as to where the lorry will be parked on site as it needs to be located around 7.5 metres from the steel frame.
- ii) Static generators are used where there is no space for a mobile rig to park. It should be noted that this equipment can weigh up to 7 tonnes in weight.

Petrol Blower

These are used to remove any rain water that has accumulated on the decking prior to installing the studs.

Bending Bar

This tool fits over the head of the stud and is used to carry out the bend testing.

Lifting Stillage / Barrel Lift

These have been designed to lift the studs up to level with the use of a crane.

10.3 Tool Tethering

Tool Tethering is carried out to prevent tools and / or other equipment falling from height which could lead to injury to persons or damage to property.

It involves connecting a tool or other equipment to an anchor or fixed point by means of a lanyard or tether and has been explained in detail in Section 3.10.

11. COMPLETION

11.1 Handover

Upon the completion of an area of work, a signed Handover Certificate must be issued by the Metal Decking / Stud Welding contractor to the Principal Contractor.

If possible, Metal Decking which has not yet had the concrete poured on it should not be loaded. This cannot always be avoided however, but consideration as to the weight of materials being loaded onto it and where it is loaded in relation to the supporting steelwork.

It is important that the Metal Decking is not loaded until it and the Stud Welding are completed and handed over.

The slab contractor will need to be assured that the metal decking is ready for the pour, suitable edge protection is in place which allows for access to the edge of the pour, appropriate propping has been installed and that safe access / egress has been provided.

11.2 Temporary Propping

Ideally, temporary propping will not be necessary due to the profile and thickness of the decking. If this cannot be achieved and additional secondary beams cannot be included in the building design, temporary propping may be necessary and must be considered where concrete will be poured over single span decks as they run the risk of the slab cracking, especially over the primary and secondary beams. If temporary propping is required, the Principal Contractor must ensure that the temporary works design has been approved.

As composite slabs rarely have the required strength to prop the level above, it is usually necessary to prop through several floors or to ground level. If the slabs below have not been concreted, it is necessary to use packing so as to avoid crushing the decking ribs. Temporary propping can have a significant impact on other trades working on the floors below and has the potential to create differing deflections on the decking between the temporary props and the beams.

It is important to ensure that spreader beams are continuous and support the decking across the full width of the pay to avoid localised loading. Temporary props are typically placed at the centre of a span or at the third of a span (two props per span) and should not

be placed at centres greater than 1m, however specific details will be described in the designed temporary works scheme

It is important to ensure that Temporary Props are in place, levelled and braced prior to the deck being laid and must not be removed until the concrete has achieved at least 75% of its design strength.

11.3 Day Joints

In most cases, day joints, otherwise known as construction joints, should not be included in a design as this could put restrictions on the method and sequence of the contractor's work. However, the contractor does need to be made aware of where day joints can be placed. Day joints are required where the pour boundary does not match with a permanent edge. In the case of an unexpected pause in the concrete pour, suitable materials should be available on site to create emergency joints.

Day joints should ideally be close to butt joints in the decking and to one side of the line of shear connectors so as to ensure concrete surrounds the studs. If the day joint cannot be made close to a butt joint, no more than one third of the decking span from a butt joint should be left unpoured. This will avoid excessive deflection that would occur if the weight of the concrete was not kept fairly equal either side of intermediate support beams. Figure 30 demonstrates this.

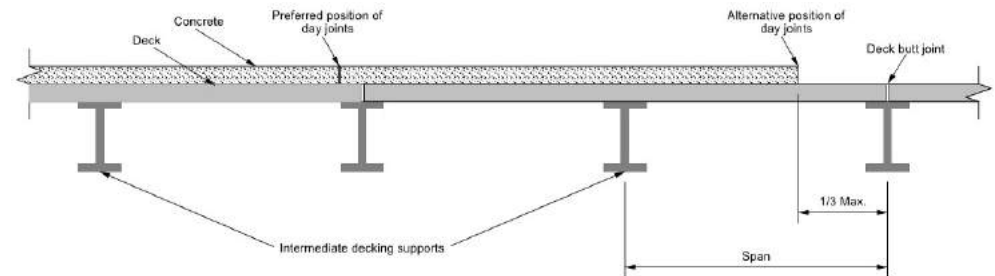


Figure 30. Illustration of the correct placement of day joints.

11.4 Concrete Placement

As previously noted, checks should be made to ensure that suitable edge protection is in place at all perimeter edges and internal voids which allows for access to the edge of the slab during the pour.

Damage to the decking should be avoided by the use of a concrete pump and spreader boards, with the concrete not being dropped from more than 1m above the decking. Care should be taken not to overload the decking in any one place and for this reason, it is recommended that no more than four operatives are working at the discharge of the concrete pump. The concrete should also be placed over the supports followed by the mid span regions.



Figure 31. Concrete placement following the installation of Metal Decking.

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