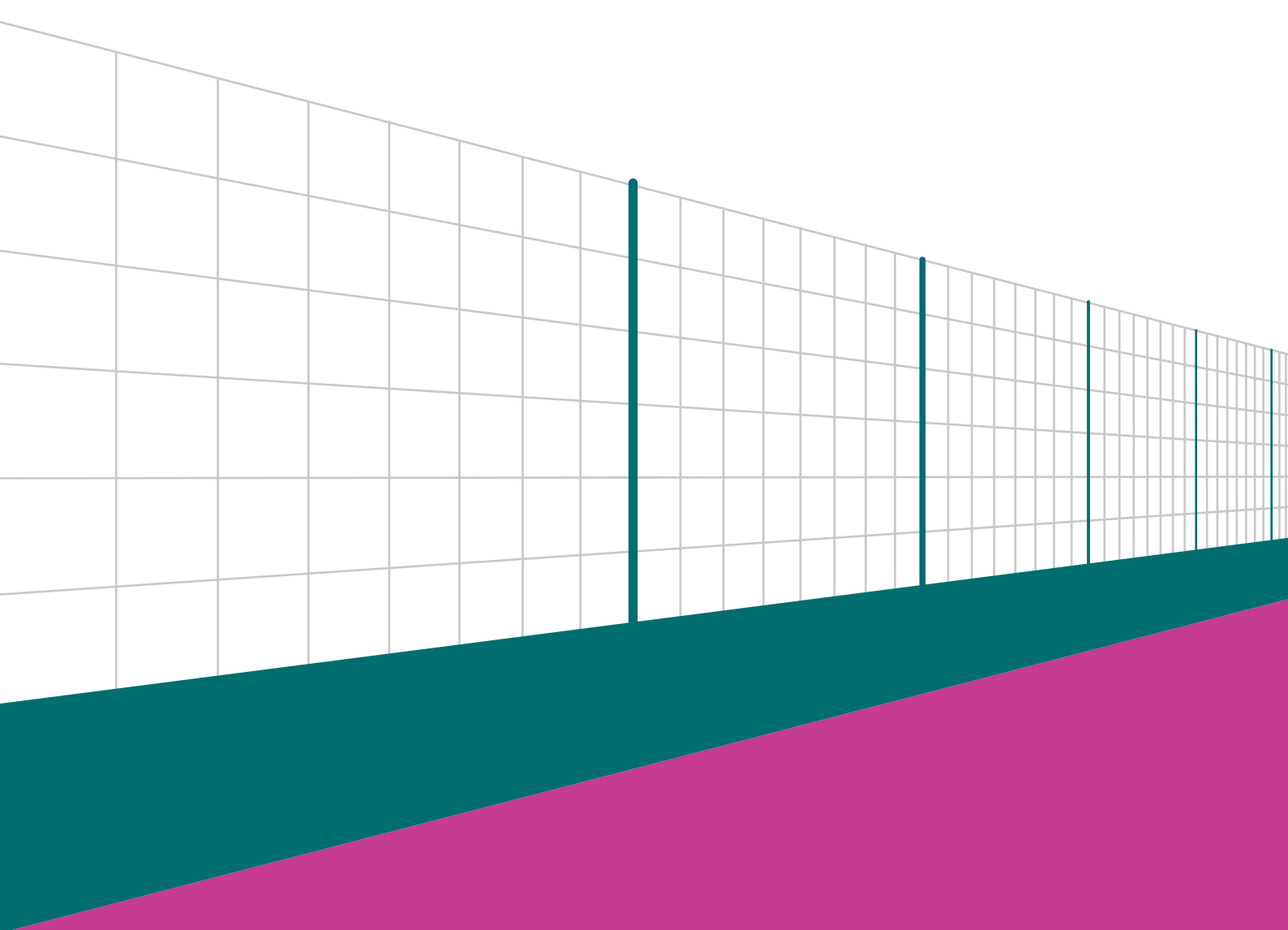


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Edge Protection Federation **Code of Practice 2014**

Edge Protection Federation Code of Practice 2014

A Guide to the Selection and Use of Temporary Edge Protection Systems

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Our thanks also to the Construction Industry Training Board and the Health and Safety Executive for their valued contributions.

This Code of Practice has been produced to provide helpful advice and information to those concerned with edge protection during construction operations, but should not be used as a substitute for supplier guidance or legal advice. It remains the responsibility of the user to carry out risk assessments and follow safe procedures. The Edge Protection Federation accepts no liability in relation to any use or reliance made of any information in this publication.

Edge Protection Federation Code of Practice 2014

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1 Introduction

We have taken the step of revising the EPF Code of Practice due to the need to reflect even more developments in our industry since our first well received publication.

Edge Protection Systems are still a relatively new aspect of the Work at Height industry, yet we are still undergoing relatively fast changes in the methods and products employed. This 2014 version of the EPF CoP includes the very latest changes.

The EPF are consulted by contractors on edge protection solutions proposed by suppliers, and whilst we welcome such approaches, they often leave us concerned at some of the questionable methods being offered into the market.

All of the many different system types now available should still meet the one common standard - BSEN 13374: 2013 (referred to simply as BS EN 13374 from hereon in).

Background

Temporary edge protection is used in construction work, primarily to prevent persons and objects from falling to a lower level from working surfaces (sloped or flat).

In the UK the Work at Height Regulations 2005 govern the requirements for prevention of falls and the hierarchy for solution selection. These Regulations require the selection of collective passive measures such as edge protection in preference to personal measures such as Personal Fall Protection Equipment.

Classes specified within the European Standard BS EN 13374 are used throughout this guidance and reference should be made to this standard. They are intended to cater for the varied requirements appropriate for different uses

Leading Suppliers

This guidance has been written by the leading suppliers and contractors within the industry, working together within the EPF, and is intended to provide guidance on the use of the various alternative product types that provide safe edge protection in a large number of different applications.

It is important to recognise that edge protection performance is dependent on the structure to which it is attached, the method of attachment and consideration of the loads and forces that need to be taken into account.

Importantly, this guidance also advises on the aspects to be considered when selecting the safest method of installation of these products

2 Design and Client Issues

Within this Code of Practice there are a large number of application solutions, with varying products, but a common approach to safety standards. However, it is found that many of these systems can be compromised by circumstances found on sites on a daily basis.

Traditionally, edge protection would have always been by means of tubular scaffolding and, therefore, usually installed by scaffolders. It has now become more common for purpose-designed edge protection systems to be used on many sites, for which more specific training is essential. Tubular guardrails, of varying materials and designs may also increasingly be installed by non-scaffolders.

It is important that clients seek evidence of appropriate training and qualifications for what is clearly one of the more hazardous construction related tasks.

The EPF training programme, which incorporates each of the main proprietary suppliers' products, is an ideal way of providing such evidence.

The EPF course is primarily for installers and is linked with a product specific module of the main proprietary systems used. On its own it would not be sufficient to install edge protection.

Within the Work at Height Regulations there are clearly stated requirements to consider working at height issues so as to minimise the risk of a fall from height of persons and materials (and their consequences) from the very inception of a project, and to properly plan and organise work of this nature. However, on a daily basis, risks are faced which would be greatly reduced if the requirements from the Regulations were followed.

There is an urgent need for designers and contractors to consider the problems posed by a myriad of designs, with insufficient consideration for access and temporary edge protection either prior or subsequent to the building construction. This is a requirement under Regulation 11 of the Construction (Design and Management) Regulations 2007.

Examples of this include steel framed industrial buildings with steel column centres set at 8m and 9m centres, with no intermediate structural supports for edge protection, as many lack rigidity or are made of cold rolled section. Compliance with BS EN 13374 has become very difficult due to the lack of rigid fixing points.

Installation on steel framed buildings is increasingly required to be installed by telescopic boom, to avoid working at height, yet the ground driving conditions are often extremely hazardous at critical times for access as pouring the ground slab is a later priority, and there are many materials obstructions inhibiting the path of MEWPs.

When the guardrail systems are safely bolted or clamped for the duration of the project, the industry is now faced with the increasing problem of component removal once all the cladding elements are in place. The elements are effectively trapped unless removed from lower floor levels by a variety of movable access platforms. The original installation may well have reduced the risk of working at height, but the removal stages could present fresh risks.

These and other issues are highlighted in order to appeal to the industry to assist the suppliers of edge protection systems to reduce the risks of working at height through better organisation, design and planning.

3 Scope

This guidance covers existing best practice for design, selection, safe installation, dismantling, inspection and maintenance of temporary edge protection systems used in both concrete steel and structural timber construction, as well as in many building, and civil engineering applications. This will include potential falls from working areas, e.g. slabs, roofs, lift shafts, pits or voids, plus staircases and similar parts of building structures.

Requirements for scaffold platforms are not covered in this Code of Practice and reference in this area should be made to BSEN 12811: Temporary Works Equipment. Some edge protection with scaffolding components are covered in SG27: 09: Temporary Edge Protection on Open Steelwork, produced by the National Access & Scaffolding Confederation, but this will not cover all applications –those will be catered for through supplier adaptations and proprietary products which include tube and fittings.

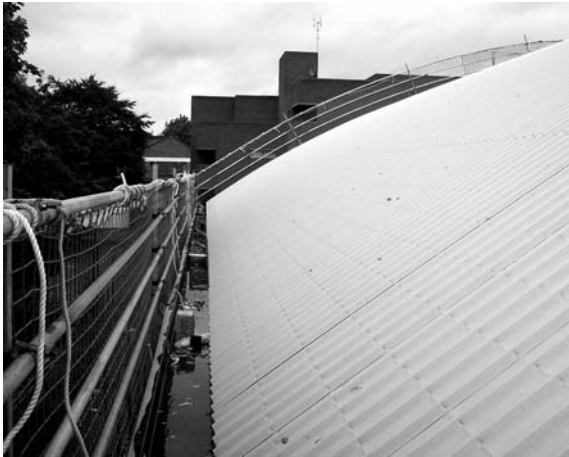
This guidance specifically excludes edge protection to surfaces intended to protect against:

- impact by plant, falling objects or vehicles
- falls into personnel protection fans
- containment of bulk loose material (including snow)
- access by the general public and their protection from falling

Operatives working without an edge protection system designed to BS EN 13374



Typical Edge Protection Systems designed to BS EN 13374



4 Definitions

Anchor sleeve:

component of drilled anchor system which is inserted into concrete and expanded to support heavy duty loads

Beam Bracket:

System socket components on formwork beams which support posts of edge protection systems

Bolted Frame Connection:

component bolted into steel framework of building, either prior to construction, or assembled after initial construction

Cantilever:

a projecting structure, such as a beam, that is supported at one end

Clamps:

system components for the fixing of handrails and guardrails which are clamped horizontally or vertically to structural members

Climbing Screen Systems:

large panel systems, typically for multi-storey applications that give protection for several storeys at once and are lifted in situ by crane or by hydraulic methods

Concrete frame:

building framework constructed primarily of in-situ poured concrete

Containment Systems:

also known as Extended Height or Full Height Protection Systems, that go beyond the minimum standard of BS EN 13374 height and containment specifications

Core Protection Products:

systems or components that are designed specifically for lift shaft and core apertures

Counterweighted Systems:

system components which are not fixed or clamped, but rely on ballast/ counterweights for stability

Debris Containment:

a system designed to prevent debris from falling from the working area

Dynamic Loads:

suddenly applied impact or dynamic loads

Exclusion Zones:

area where access is prevented due to hazardous activity within or above the zoned area

Extended Height:

barrier heights greater than the standard of 1.0m, but not necessarily full height

Falsework:

a temporary structure used to support a permanent structure, or the concrete formwork, until it is self-supporting

Formwork:

the section of temporary works that gives the required shape and support to poured concrete

Free Standing Systems:

systems which are not fixed or clamped

Friction / Compression Posts:

a system that is not anchored or bolted, but relies on friction or compression fixings between the floor and soffit

Full Height Protection:

edge protection installed to fill the entire gap between floor and soffit

Leading Edge:

edges or open edges of buildings / structures where potential fall risks exist

Mesh Barriers:

system protective barriers with mesh infill

Metal Decking:

profiled steel permanent formwork constructed prior to concrete pouring

MEWP's:

Mobile Elevated Work Platforms telescopic booms and scissors lifts

Mobile Anchor:

deadweight / counterweight anchors manufactured to BS EN 795: 2012: Personal Fall Protection Equipment; Anchor Devices; Class E, for the attachment of personal fall protection equipment

Nets:

safety nets compliant to BS EN 1263-1- Safety Nets- safety requirements and test methods

PFPE:

Personal Fall Protection Equipment such as full body harnesses, lanyards, energy absorbers etc.

Posts:

principal vertical supports of edge protection systems to which guardrails, mesh barriers and toeboards may be attached

Slab Edge:

concrete floor edges

Socket Bases:

system base components which are typically anchored into concrete slab

Staircase Systems:

edge protection systems designed and installed using standard or variations of edge protection components on staircases of various materials

Static Loads:

gradually applied horizontal and vertical loads without any impact force

Steel frame:

building constructed primarily of a steel framework

System Classifications:

edge protection Classes as defined within BS EN 13374: 2013

Timber Frame/ Structural Timber Frame System:

Edge protection components designed to suit timber frame applications

Toeboard:

solid horizontal barrier provided level with the working surface specifically to prevent the fall of materials or people

Tubular Handrails:

guardrails constructed from tube and fitting components, and proprietary systems that include other types of guardrails.

5 BS EN 13374: 2013

Temporary Edge Protection Systems.

The Standard for Temporary Edge Protection Systems.

Since its original publication in 2003, this Standard for edge protection has led to the introduction of a significant number of purpose-designed systems for improving edge protection safety.

The Standard was the result of many years of work by specialists from several European countries, including the UK. It has recently been reviewed, 10 years since its inception, and the changes are featured in the following pages.

5.1 Edge Protection Classifications within BS EN 13374: 2013

Edge Protection systems are selected primarily based on the gradient of the surface for which they are to provide protection. The performance requirements for the various Classes are detailed within the Standard BS EN 13374 thus:

Class A

Provides protection to flat surfaces and slopes generally up to 10°. It provides resistance to static loads and is based on the requirements to support a person leaning against, walking beside, and possibly stumbling against the edge protection.

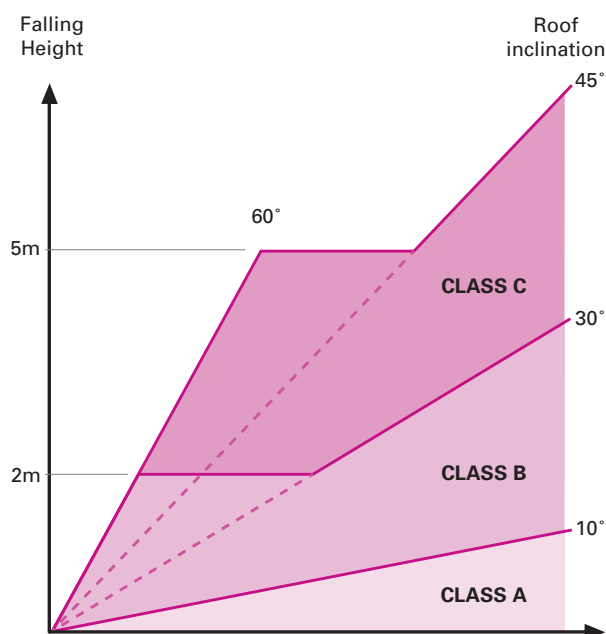
Class B

Provides protection to flat surfaces and slopes generally up to 30°, and to even steeper slopes with short slope lengths. It provides resistance to both static and low dynamic loads and is based on the requirements to support a person leaning against, walking beside, possibly stumbling against, and sliding down a sloping surface towards the edge protection.

Class C

Provides protection to steeply sloping surfaces generally up to 45°, and up to 60° for 5m slopes. It provides resistance to high dynamic loads only and is based on the requirements to contain a person sliding down a steeply sloping surface.

Edge Protection Classifications within BS EN 13374: 2013



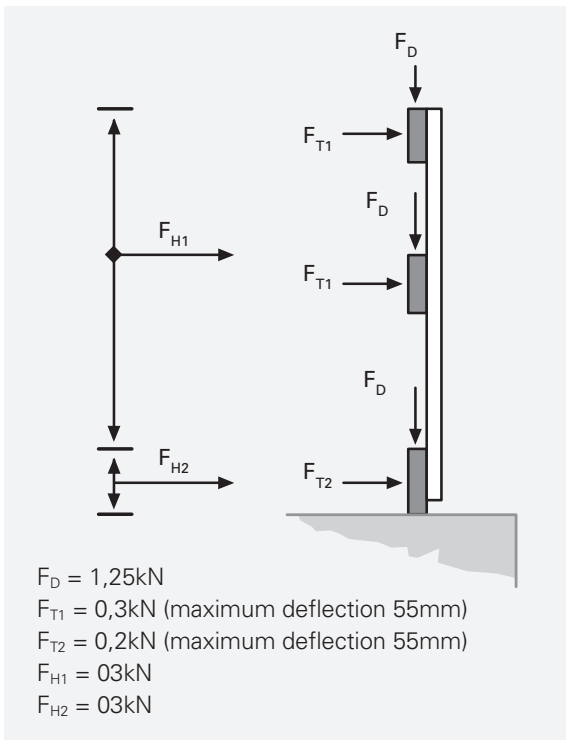
The above graph indicates the normal expected application range for the different classes of edge protection. It appears in an informative annex to BS EN 13374: 2013 and as such, compliance with the graph is not a requirement of the standard.

There is therefore a degree of freedom left to select classes and systems for more shallow slopes than those indicated within the graph, where the specific hazard identification and risk assessment might suggest the use of a Class with a steeper gradient capacity.

Further clarification of the detailed classification requirements can be found within the Standard, BS EN 13374: 2013.

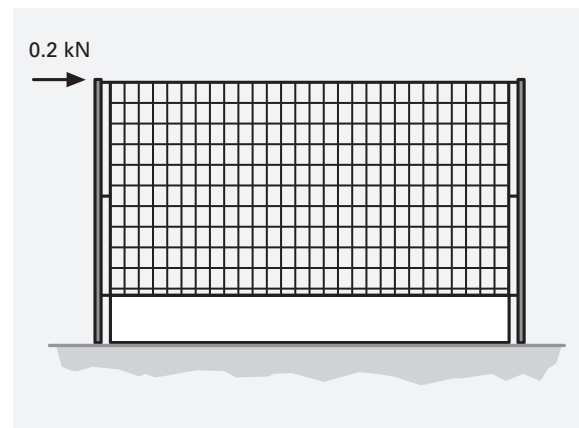
5.2 Loading Requirements for Class A Systems from BS EN 13374: 2013

Extracts from BS EN 13374:



Loads perpendicular, horizontal and vertical, to the system

- F_D Load F_D shall act downwards within an angle of $\pm 100^\circ$ to the face of the edge protection system, anywhere along the top edge of the guardrails and toeboards.
- F_{T1} Force applied to meet deflection requirement (applied to guardrails and posts perpendicular to the edge protection system in the outward direction and downwards parallel to the edge protection system)
- F_{T2} Force applied to meet deflection requirements (applied to toeboards)
- F_{H1} Ultimate Limit State point load force applied to meet strength requirements, and shall act perpendicular to the edge protection system in the outward direction
- F_{H2} Ultimate Limit State point load force applied to toeboard



Loads parallel to the guardrail

The edge protection system and any of its components, except the toeboard, shall be able to withstand a horizontal load of 0,2 kN in its worst position.

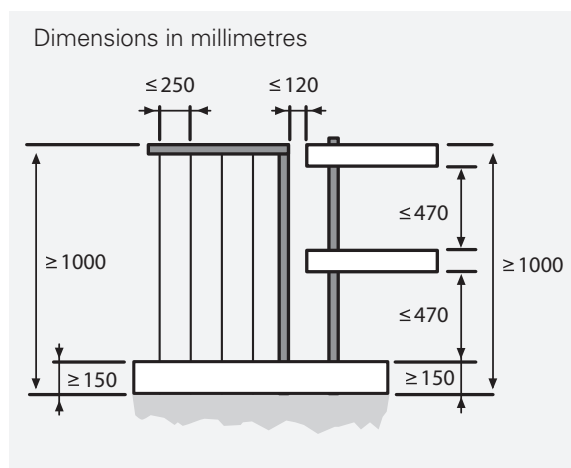
5 BS EN 13374: The Standard for Temporary Edge Protection Systems (Cont)

5.3 Revisions to BSEN 13374: 2013

We highlight below some of the more notable changes in the revision of BS EN 13374, which was published in 2013.

The most significant of these is shown in Section 5.1.1, which refers to the requirement for all components to be designed to avoid accidental removal of any component in any direction during use as extracted below:

Extracts from BS EN 13374:



Dimensional height and spacing of edge protection components

5.1.1 Basic requirements

An edge protection system shall consist of a principal guardrail and either an intermediate guardrail or an intermediate protection. It shall also be possible to attach a toeboard. All components in the system shall be designed to avoid accidental removal or displacement of any component in any direction during use" (BS EN 13374: 2013)

This paragraph is capable of interpretation in different ways, but in our view it may question the current common practice of casting a sleeve (plastic / steel) into the concrete slab and subsequently inserting a vertical tube as the main guardrail post.

As this method, unlike most of the proprietary systems, has no specific locking method to prevent uplift of the Post, it may be considered to be vulnerable to such accidental uplift. Therefore, re-consideration of such designs may be required.

A specific maximum gap of 120mm in the guardrail has also been introduced for the first time. This refers to the horizontal gaps between post / panels longitudinally and the extract from BS EN 13374: 2013 is to the left.

5.1.3 Principal guardrail

The distance between the uppermost part of the principal guardrail and the working surface shall be at least 1000mm measured perpendicular to the working surface... The principal guardrails shall be continuous and any gaps shall be less than 120mm" (BS EN 13374: 2013)

The application of Limit State design methods may also require alternative calculation assessments of some existing systems, although it is not expected to result in any change in the performance of those products.

6 Typical Product Types

With the publication of BS EN 13374 a number of new products and methods were introduced, and innovation continues to be a feature of the industry.

There are several different types, which can be classified as follows:

- mesh Barrier Systems
- net Barrier Systems
- flat Roofing Counterweighted Systems
- climbing Screen Systems
- tubular Guardrail Solutions.

More information on these types is shown in Section 8.0.

The fixing methods for the types of edge protection will vary dependent on the application:

APPLICATIONS	CLASS A	CLASS B	CLASS C	FIXING METHOD
Bridge decks				Drilled Socket / clamped
Concrete frames				Drilled Socket / clamped Compression / friction posts
Steel frames				Bolted / clamped Compression / friction posts
Formwork decks				Clamped
Timber frame				Special
Stairways				Bolted / clamped / inserted
Flat roofs (up to 10°)				Counterweighted / bolted
Sloping surfaces (up to 30°)				Bolted / clamped
Steeply sloping surfaces (over 30°)				Bolted / clamped

7 Design

Class A systems

For flat and sloping surfaces up to 10°. Must resist a horizontal force of 0.3kN anywhere on the top of the Guardrail arrangement, whilst maintaining elastic deflection within 55mm. They must also accept a vertical force of 1.25kN applied as an accidental loading. Type A systems may take their support from clamping, drilled anchors, counterweighted methods, or compression (friction) posts.

Class B systems

Generally for sloping surfaces up to 30°. Must resist the same static loading requirements for Class A, and additionally must pass a low dynamic test using a swing bag. This test applies horizontal impact energy of 0.5kJ to the top rail and 1.1kJ to the lower areas.

Class C systems

For more steeply sloping applications and are required to only resist a high dynamic test using a rolling cylinder. This test applies impact energy of 2.2kJ to the system. The prime consideration is to prevent the person falling, irrespective of the initial damage sustained by the barrier system.

Extracts from BS EN 13374:

Table 1 - overview of design requirements

CLASS	TYPE OF LOAD	
	Static Load	Dynamic Load
Class A	X	--
Class B	X	X
Class C	--	X

7.1 Environmental Factors

Wind

The normal wind velocity pressure within BS EN 13374 is 0.6N/m², which covers most wind conditions in Europe. However, each application should be considered on its own merits and advice should be sought from the supplier on the appropriate factor to apply. Variations will include the physical location, the height of the structure and the duration that the edge protection will stay in place.

BS EN 13374 assumes a wind velocity based on 40m height.

Snow

The effects of snow on certain edge protection products should be considered as potentially adding both static and dynamic loadings. Where there is a build-up of snow, the use of barriers or Class C netting may capture a large drift of snow if in an exposed location. The impact of high winds on such applications, particularly where it is an inclined application, may impose unexpected forces which should be identified as a potential design issue along with the wind.

In addition, there is a general warning about avoiding working on surfaces that may become icy, as there is risk of slips and falls, plus the more worrying effect of a sudden impact onto the protection in the event of a loss of footing.

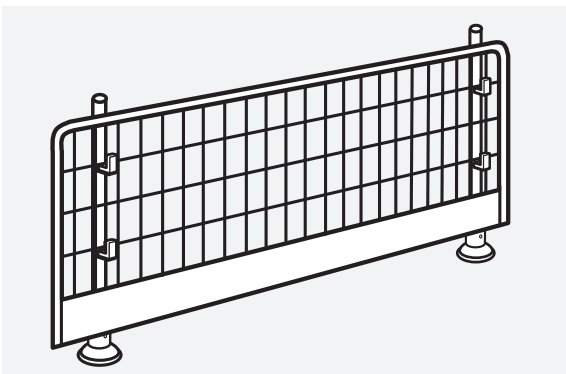
8 Edge Protection Systems and Product Types

Never, in any circumstances, mix the components of different manufacturers, as they may have varying specifications and dimensions, and could result in unsafe conditions. The resultant configuration may not be acknowledged for responsibility by any individual supplier and such installations may not comply with BSEN 13374.

8.1 Mesh Barrier Systems (Classes A & B)

Mesh barrier edge protection systems are fall prevention systems that offer a high level of protection through a full mesh-infilled guardrail and a performance-tested design to BS EN 13374. The mesh infill is typically heavy-duty mesh, and therefore superior to similar products previously used just for materials retention. Toeboards are typically integral to each Panel.

Mesh Barrier assembly



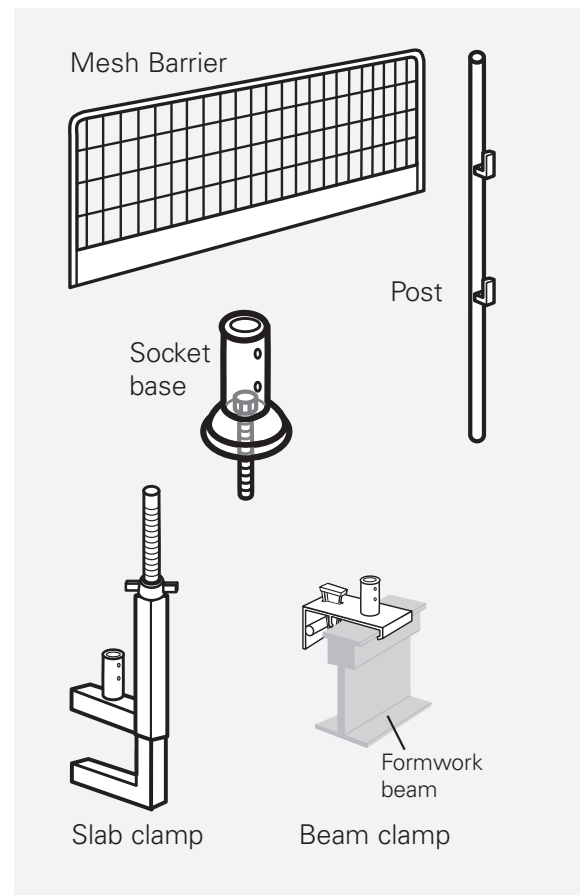
Applications & Surfaces

These types of systems are suitable for use on a wide variety of applications, as there are accessories for fixing to concrete slabs, upstand beams, steel girders, vertical walls, staircases, formwork beams and to many other surfaces including timber. In addition these systems are also used for site pedestrian segregation. In many cases the fixing component is specific for the purpose, however the Mesh Barriers and Posts tend to be used more generally.

Flat Concrete Slabs: Components

- Mesh Barriers
- Vertical Posts
- Socket Bases
- Clamps (to slabs, upstands, etc)
- Beam Brackets.

Typical mesh barrier components for concrete slabs

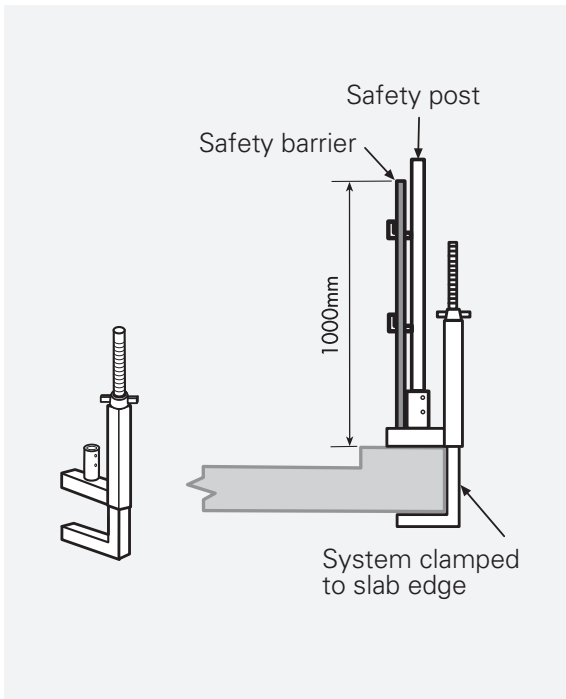


Range of Adjustment: Slab Clamp

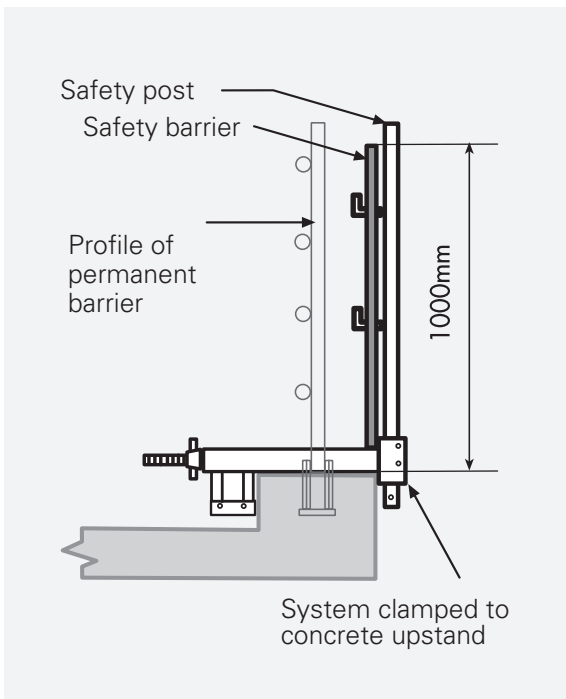
Clamping components will generally adjust within a range of 100 to 600mm, but sizes beyond this may be available for special requirements. Steel joist/ girder clamping components may operate within a smaller range as these are cantilevered applications, and therefore may have to sustain more onerous forces. Clamping components may be capable of being used both horizontally and vertically, (slabs and upstands) with minor adjustments.

8 Edge Protection Systems and Product Types (Cont)

Slab Camp arrangement



Upright Beam Slab Clamp arrangement

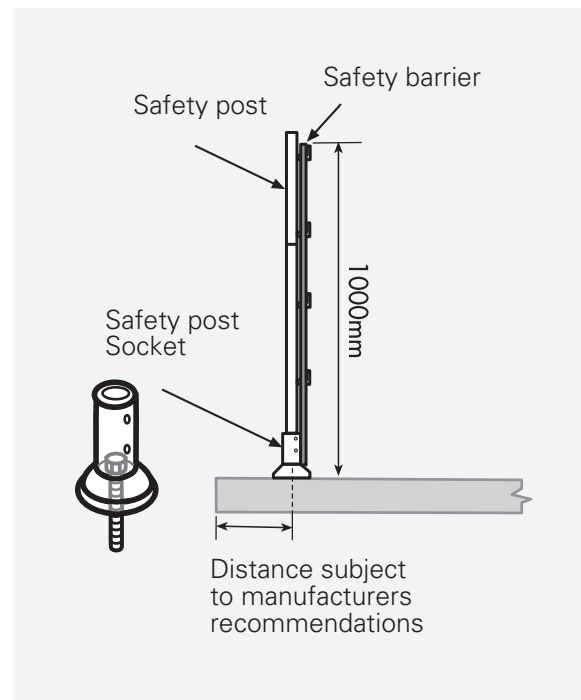


Anchor Loadings: Socket Bases

Typical socket base situations may impose a tensile load on the anchor of approximately 6kN, and a shear load of at least 0.3kN for a 1m long post. For longer post applications, the supplier will provide information and guidance. It is extremely important that anchors are selected, positioned and set, strictly in accordance with the manufacturer's instructions.

Components from different suppliers/manufacturers should not be mixed (see section 8.0) as they may not be compatible and may be of differing specifications.

Socket Base assembly



8.2 Edge Protection for Industrial Steel Frame Buildings

Edge protection for steel frame buildings has usually been problematical for the installation task, as there is no flat concrete slab to work from until the flooring has been laid. It is important that protection is in place at the earliest stage. Equipment is available which can be clamped, bolted or welded to the horizontal steelwork. The fixing of these components can be done beforehand on structural elements prior to installation or by the use of a suitable MEWP to avoid operatives working in more exposed conditions.

Installation and Removal by MEWP

Increasingly, installation in conjunction with MEWPs has become more favoured, although new safety procedures and techniques need to become established. The removal of the installed components at a later stage is also a matter that requires close attention to avoid other access risks from working at height during the internal fit-out stage.

Installation by Trained Operatives

The installation of tubular type equipment for industrial steel frame applications has in the past been the province of scaffolders, but there are now methods combined with netting, hybrid combinations of varying tubular members and proprietary components. These may often now be installed by trained operatives who are not scaffolders, so clients do need to reassure themselves that a suitable training process has been undertaken.

Structural Integrity

Edge protection on steel framed industrial buildings often relies on the vertical columns for its support, and these have in recent years become more and more widely spaced as the design of the other elements have been optimised. The other components of the building may lack the structural integrity to support the forces arising from BS EN 13374.

In considering the building structure, it is likely that hot rolled sections will have sufficient strength but cold rolled sections should be carefully considered. Where other building components are employed e.g. purlins, it is important to determine that their strength and deflection characteristics will enable the guardrail components to comply with BS EN 13374.

Over spans of 7, 8 or even 9 metres, it may be difficult to meet the deflection requirements of Class A systems without specially designed building or product solutions, due to the lack of adequate strength of structural members. This may be a matter for the permanent works designer to consider under the CDM Regulations.

Tube and fitting components combined with aluminium scaffold beams and netting which are regularly used over these longer spans may not at times meet the requirements of BS EN 13374, and furthermore may not provide a reasonable level of guardrail rigidity in order to protect and give reassurance to the users. These should be the subject of design assessments, calculations and / or testing.

Steel scaffold tube and aluminium trussed scaffold beams will have different properties and should be considered separately for BS EN 13374 compliance.

8 Edge Protection Systems and Product Types (Cont)

It is important to be aware that Class B also **has** to meet the Class A (eg 'Flat') static load requirements of the Standard, and specific test or calculation evidence may be appropriate.

Class B solutions apply to applications up to 30 degrees of inclination. Such systems must meet Class A fall protection requirements e.g. 55mm deflection The hierarchy requirements of the WAH Regulations must be remembered, and fall protection should take precedence over fall arrest methods.

FASET (Fall Arrest Safety Equipment Training) have made the following statement about the attachment of safety nets to aluminium beam guardrails, as on their website it states:

“Safety nets must never be attached to handrails unless they have been designed to take a minimum 6kN load at 45 degrees to the vertical.”

Examples of poor practice



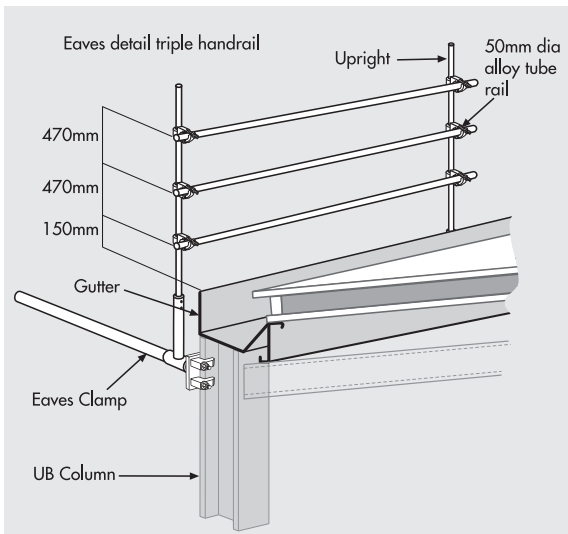
The guardrail above has been joined in a poor manner, which could result in a weakness and movement which would not comply with the BS EN 13374.



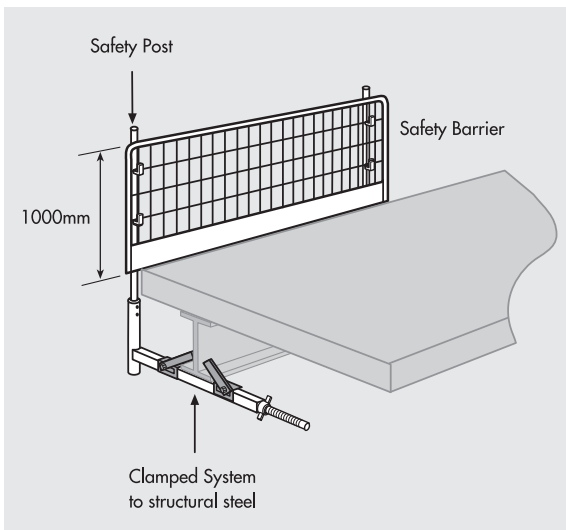
The guardrail above is on a Class A application, and safety netting will not meet the static loading requirements of BS EN 13374. The Work at Height Regulations also require a maximum gap of 470mm between guardrails, which this would fail to comply with.

Typical Examples of Steel Frame Edge Protection

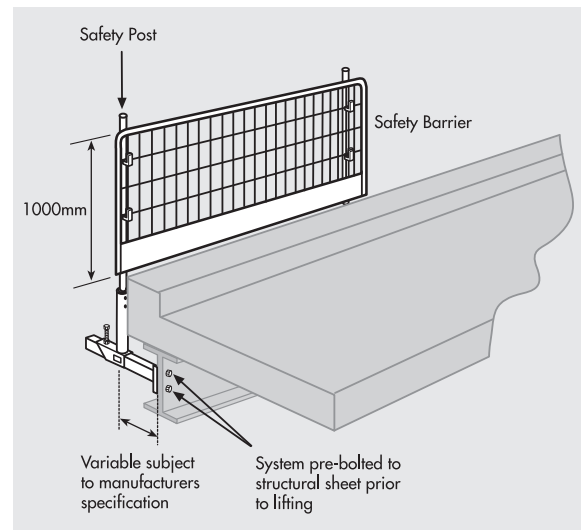
Connecting to vertical steel columns



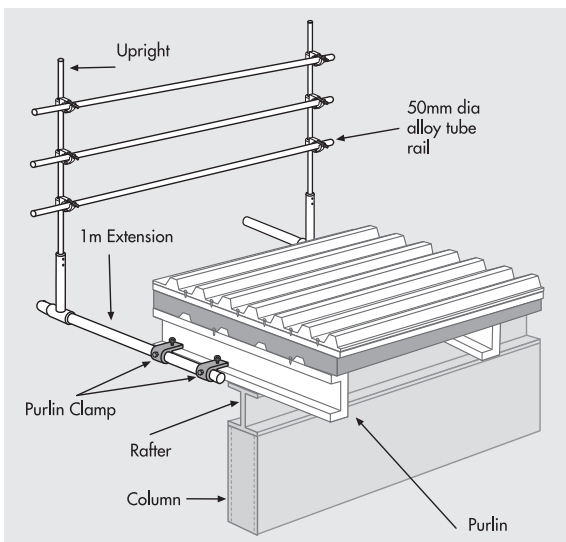
Clamping to horizontal beams



Bolting to horizontal beams



Purlin clamps



8 Edge Protection Systems and Product Types (Cont)

8.3 Extended Height Containment

The term 'Containment' refers to the containing of both persons and materials from falling out of the leading edge. This does not include Climbing Screen Systems. Clients need to clearly state their requirements, which may be beyond BS EN 13374, and may sometimes be more difficult to achieve except as a specially designed solution.

These applications are now covered beyond BS EN 13374 by the EPF document which is based on earlier Combisafe design guidance titled "Containment Systems for Extended Height Edge Protection".

Such configurations or systems will typically fill the edge protection space including and above 1.0m, at varying heights up to the soffit. These arrangements are different from standard BS EN 13374 installations due to the increased forces (mainly wind loadings) that result.

A variety of different mesh apertures or the use of debris netting may be applied to these applications, which require careful engineering assessment. The use of solid monarflex sheeting should be treated with particular caution, as these will impose significant wind loadings and should only be used if a competent Temporary Works Designer or equivalent has approved of the installation of such materials.

The securing of these applications will vary from product to product, and include base anchors, soffit anchors, and friction / compression posts. Special panels have been developed in some cases to ease the increased manual handling risks and risks arising from higher wind loadings.

Applications

The typical applications encountered will be where there is an increased hazard affecting pedestrian traffic, for high rise / multi-storey buildings, and generally where a safety policy applies to a client / contractor / project.

Loadings

The loading capability of the specific installation should be determined by consultation with the Supplier.

Design Issues

In the EPF guidance document 'Containment Systems for Extended Height Edge Protection' it is proposed that the area between floor and soffit should be defined as three different areas that can be covered with different types of containment systems. These are:

- from floor to minimum 1m above floor
- from 1m to 2m above floor, assuming that personnel remain standing on the floor
- from 2m to soffit. This area is normally only covered when work has to be done to columns or work on the soffit.

In addition, containment porosity may vary with each application, and may be defined by the size of a theoretical sphere that would be retained. The degree of porosity can range from as little as 5mm up to 250mm in size.

The performance expectation of the containment system should be based on the assessment of the likelihood of persons falling from above floor level, and / or the nature of the materials to be contained.

Wind loadings should be based on BS EN 13374 and individually assessed for the location and specific containment protection employed.

Typical example of full height edge protection

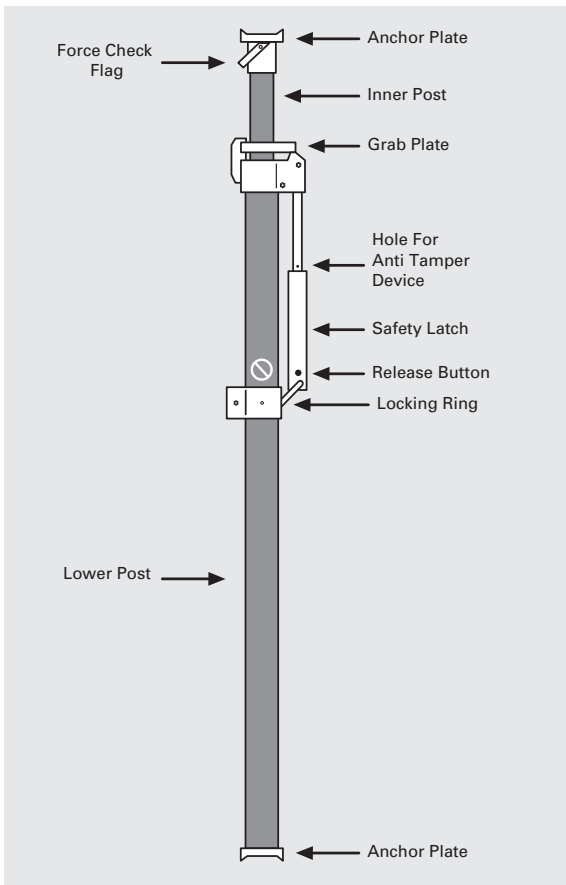


8.4 Compression / Friction Posts

These components are used to provide similar edge protection to the anchored or bolted methods described elsewhere in this document, but employing a different, faster, fixing principle. They are mainly applied to concrete frame applications, but fixing to some steel frames can also be provided.

Friction post systems fix between concrete floors and soffits without anchors to provide a more rapid installation process. The key element within this type of product is the design and operation of the post, which is located and locked securely into position from a standing position using compression between floor and soffit e.g. via a lever concept or other method.

Panels are secured to the posts when in its locked position and visual methods should identify the fact that it is secure. Either single height or multiple height panels may be installed with this method or alternatively a lower panel with additional soft netting to the soffit.



Specification

Friction Posts should be tested to BS EN 13374.

Application

Principally concrete frame projects within concrete floors, but also some steel frames.

Loadings

Vertical and horizontal loadings must comply with BS EN 13374.

Applications

Friction Post systems are generally limited to concrete frame applications with level floors where the post can be adequately secured and restrained within pre-cured floor levels. Some Friction Posts can also be used steel to steel.

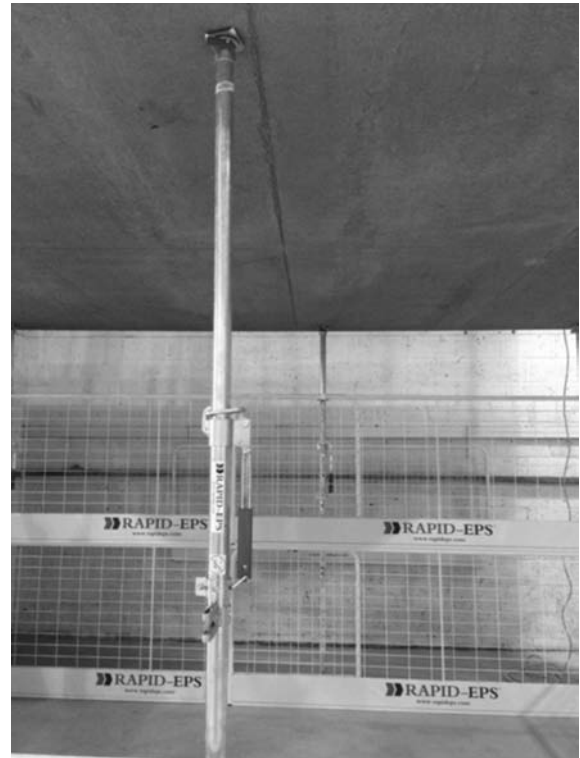
8 Edge Protection Systems and Product Types (Cont)

Safety issues

Installation of these systems will often be necessary on a leading edge, and therefore adequate PFPE from a firm anchoring point will be required for safe fixing of components. It is recommended that the operative should work out from one direction and wherever possible work behind a pre-installed section.

As the Posts are not physically anchored or bolted like other edge protection products, care should be taken to ensure that the locking action is securely in place to prevent movement. In certain situations it may be advisable that these posts are anchored at the base, for example, tall floor to soffit heights, or where wind loading is likely to be increased such as when using debris netting.

The weight of components should be as light and easy to secure as possible to limit any possibility of falls of persons or materials and for ease of installation at the leading edge. Exclusion zones should be applied during installation.



Design Issues

Temporary works designers must satisfy themselves of the capability of the slab to sustain the force imposed on them by the operation of the securing mechanism.

8.5 Staircase Edge Protection

Safe access and egress by staircases within construction projects has been traditionally protected by tubular components or by limited guardrailing methods. The industries development of either specific clamping devices or through the inclusion of cast-in sockets at staircase production stage has greatly improved the quality and safety of such methods.

Specification

In order to apply edge protection system panels to staircases, in most cases, a series of specially profiled panels have been developed by suppliers. These products will allow for the variations in staircase rise and going dimensions, and provide a smooth, snag-free termination to each flight.

Application

Concrete, timber and steel staircases.

Loadings

Staircase protection panels and posts should comply with BS EN 13374.

Limitations

The fixing to some designs of concrete stairs may be restricted by the specific details of the method chosen, the availability of sockets, and the width may be restricted with some methods, so each application should be considered on an individual basis with suppliers.

Safety Issues

As with the installation of all EP systems, the installation on staircases may present fall risks, in which case fall protection for the installers will be required. In some cases now the edge protection is pre-installed and can then be craned into position.



8 Edge Protection Systems and Product Types (Cont)

8.6 Excavation Protection

There is a need to prevent falls into trenches and excavations as there is to prevent falls from structures and other leading edges. The fixings and type of protection differ from standard floor slabs and steel beams as they are required to secure onto steel trench sheeting and steel sheet piling members. In other respects they may be similar in form and performance to other Class A BS EN 13374 products.



8.7 Free Standing Systems (Class A)

Free standing weighted edge protection systems are designed to comply with the Class A requirements of BS EN 13374 but are based on different supporting principles to fixed mesh barrier systems.

These systems derive their support from weighted components fixed to lever arms connected in turn to barrier frames positioned at, or near the edge of the building

Examples of Free Standing Systems



Applications and Surfaces

Flat roofs are defined as having slopes of 10° or less, but may have a variety of surfaces, including concrete, roofing felt, bitumen, solar coatings or similar.

Free standing edge protection systems may be installed to provide protection for inspection, access to plant, or for maintenance, or new roof covering work.

This type of system is not generally suitable for profiled industrial roofs, although special adaptations may be available. In addition, some types of surface may present particular problems e.g. pebbles, granular loose materials, and those that lack frictional resistance. Wet or icy conditions are particular hazards, and some Class A tests attempt to simulate wet surfaces.

The test requirements in the 2013 version of BS EN 13374 require manufacturers to conduct them at the maximum inclination and on typical base materials, both wet and dry, and without an upstand.

Applications will vary considerably, by virtue of:

- Edge upstands / parapets
- Roof falls
- Gutters
- Rooftop Plant
- Different Levels
- Roof access
- Shape.



Design Features

The weighted systems all have one important feature in common: they avoid penetrating the roof surface in order to resist movement. This avoids the likelihood of roof leakage. The barrier designs have elements which allow them to fit any rectangular shape. Curves can also be catered for in some instances.

Components

- Frames
- Horizontal Linking tubes
- Weights
- Tubular lever arms
- Bases
- Toeboards

The amount of ballast may vary from product to product, but would typically be in the 20 to 50kg range. The length of lever arms will also vary. The ballast material used should be solid, (ie not sand or water) and be capable of being positively secured against displacement.

When roof covering is taking place, edge protection can interfere with production, therefore in most cases the weights can be temporarily removed. It is very important to closely follow the manufacturer's instructions concerning the removal of weights to prevent compromising the system's ability to perform safely. In some cases the counterweights have arms that can be lifted to raise the weight clear of the surface.

The moving of ballast weights has manual handling Regulations implications, so the movement of them should be minimised.

Proprietary handrail fixings may be incorporated into projects in order to add flexibility to systems.

Performance

These product types should satisfy the requirements of Class A, to BS EN 13374, however due to the need to resist dynamic loads, they are unlikely to satisfy Classes B or C.

Wind

These systems are generally designed to be freestanding and capable of resisting moderate wind loadings (eg 40 to 50mph) but the wind profile will be adversely affected when toeboards are incorporated. A toeboard would be a legal requirement for maintenance tasks or new work, but for long term use they have been known to be omitted if not a working area. In some instances a wind calculation report may be required to demonstrate the performance of the system. Additional ballast or additional fixings may then be required.

Proximity

The free standing edge protection systems may be employed at the leading edge of the roof, as a visual barrier, or walkway arrangements between roof plant. The safe distance from the roof edge will vary from product to product, and advice should be sought from suppliers to determine whether they recommend a safe minimum distance from the roof edge.

8 Edge Protection Systems and Product Types (Cont)

8.8 Tubular Guardrail Solutions (Class A)

Edge protection using standard tube and fittings or proprietary tubular type systems components are not standard scaffolding applications and require more specific application consideration.

These methods/ systems comprise of two basic types

1. Purpose-designed tubular components of varying dimensions and / or varying fixing components. Proprietary methods that have been calculated and tested.
2. Purpose-designed traditional scaffold tube and fittings applied to edge protection. Calculations / testing is still required under the WAH Regulations.

Installations using these methods may be based on a specific supplier / contractor, who needs to be able to verify their particular proposition.

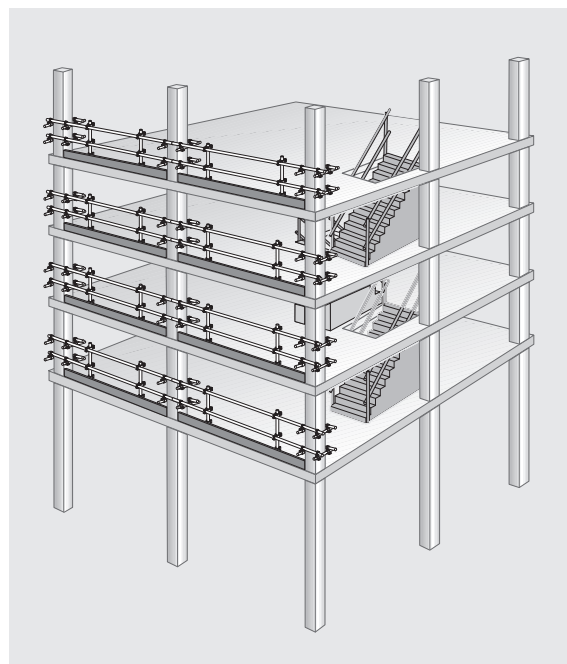
For some tubular scaffolding materials in edge protection, we recommend that guidance is also sought from the NASC document SG27:09- Temporary Edge Protection on Open Steelwork, which covers a number of issues arising from the installation of traditional tube and fitting guardrails.

Proprietary edge protection systems and purpose-designed equipment, in conjunction with tubular components will not be covered in the NASC documents, and the contractor / supplier will have their own specifications.

Traditional Scaffold Tube and Fittings: Components

Scaffold tube and fittings are the traditional components for constructing slab edge protection. Short length tubes are used for the support posts, ties, and bracing members whilst tubes up to 6.4m in length are used for the handrails. The tubes are connected together by means of fittings, and the support posts may include a base plate. The toeboard is normally a 3.9m scaffold board which should be fixed to the support post by means of a toeboard clip. If used as a free standing edge protection system, concrete blocks may be required to stabilise this arrangement, although many free-standing tubular guardrails are employed primarily as a visual barrier only (e.g. on flat roofs)

Example of a Tubular Scaffolding application



Applications and Surfaces

Whilst virtually all of the purpose-designed edge protection systems will meet the performance requirements of BS EN 13374, the situation with tubular guardrails and traditional scaffolding components requires confirmation. The reason for this is that, whilst systems are modular, and usually at pre-determined centres, tubular guardrail posts are variable in location.

On concrete frames, individual socket bases are often used in conjunction with tubular scaffolding to reduce the need for clamping steel tubes to the slab edge. If this is not part of a recognised proprietary system, evidence of their capability should be sought.

Importantly, the revision to BS EN 13374 Standard requires a resistance to accidental loadings (see below), that will be challenging for this method.

Extract from BS EN 13374: 2013

**“ 5.1.1 Basic requirements
An edge protection system shall consist of a principal guardrail and either an intermediate guardrail or an intermediate protection. It shall also be possible to attach a toeboard. All components in the system shall be designed to avoid accidental removal or displacement of any component in any direction during use.”**

(BS EN 13374: 2013).

Tube and fitting guardrails can be suitable for many edge protection requirements, and their performance to Class A can readily be shown by calculation or testing. This would be a requirement under the Work at Height Regulations.

Design Features - Tube & Fittings

Tube and fitting components are flexible and are capable of adaptation to virtually any shape. The slip loads of 6.1kN or 9.1kN per fitting (Class A or Class B) in accordance with BS EN 74: 2005 need to be accommodated.

Traditional free standing systems in an 'A' type frame arrangement are recommended to be designated only as a visual barrier and set back from the edge. This type of arrangement is not considered to be adequate for fall prevention at an edge.

Containment nets and sheets are frequently used to infill the guardrail and increase the level of containment. However the increased wind load must be considered and accommodated within the calculated design.

Lightweight steel mesh panels (brickguards) can be used to contain materials, however these need to be closely controlled as they are easily moved out of position. A toeboard is used to further contain small items, and is normally a scaffold board fitted on edge.

Components

- Scaffold Tubes (typically various set lengths)
- Scaffold Fittings (fixed, swivelling, and various specials for particular applications)
- Scaffold Boards (used as toe boards)
- Base Plates

8 Edge Protection Systems and Product Types (Cont)

8.9 Edge Protection Methods for Steel Frames

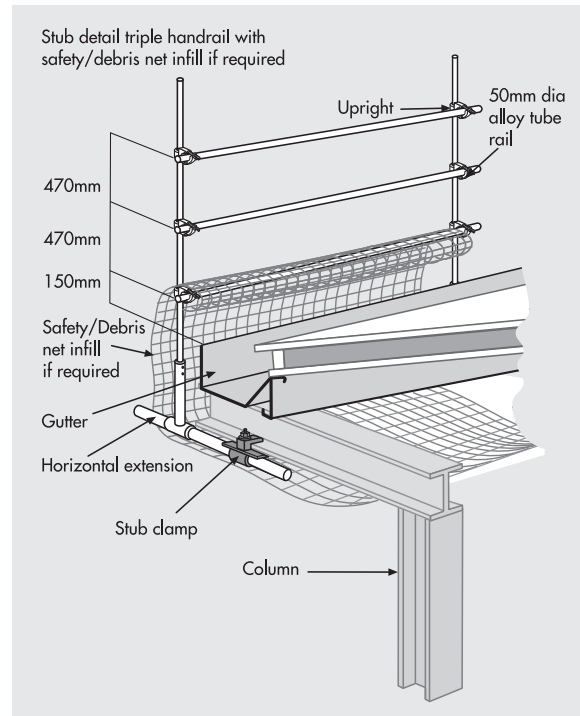
Purpose designed clamp on systems for edge protection to profiled steel roofs

Purpose designed clamp on systems must meet the criteria laid out in BS EN 13374. They are specifically designed for clamping to steelwork sections usually at full height roof level but can also be used at intermediate floor levels.

They would normally incorporate aluminium or steel tube / lattice beams to form a guardrail that must comply with the dimensions specified in the WAH Regulations.

Safety nets and / or debris nets can be attached to the system to give additional protection for roof workers and to prevent objects falling from the roof but the system must be tested for this purpose.

If the netting is to be used for fall arrest purposes, safety netting which is compliant to BS E 1263-2: 2002 must be specified. Debris netting should be assessed for wind loading on the guardrail structure.



Wind Forces

Wherever mesh, sheets, or infill's are installed, it is important to assess the impact on wind forces, as these could add considerably to wind pressures that need to be resisted.

Wind pressure is based on a structure with a maximum height of 40m in accordance with criteria set out in BS EN 13374.

Where wind is shown to be the governing force the supplier should supply calculations to show the system is capable of withstanding the loads generated.

8.10 Edge Protection Methods for Timber Frames

It is now possible to apply the BS EN 13374 standard of edge protection to structural timber frame applications. With application-specific fixings, special adaptation plates, and standard mesh barrier components, the same quality of protection can be provided for a number of applications. Ground pre-fixing is also achievable, and desirable, to minimise work at height risks.



8.11 Falls from Vehicles

This application is not commonly associated with the edge protection industry, but it is directly relevant to the EPF market sector.

The need for loading, unloading and maintenance of vehicles, where no alternative safer methods exist, may give rise to falls from 1.3m up to 4m or more. A fall from a typical height vehicle bed (eg 1.8m) can result in a serious injury. According to the HSE, 75% of falls occur during loading and unloading.

Falls from vehicles are now a more important safety issue as the high number of incidents were recognised by the HSE and became a focus of interest and a major campaign topic. The HSE website contains valuable advice on this subject.

The potential for falls from vehicles has now begun to be addressed in a large variety of ways:

- Avoidance of mounting vehicles by load planning and improved vehicle selection e.g. mechanical handling.
- On site drive-in gantries
- Bolted guardrail systems
- Chain-link and similar flexible systems
- Adaption of proprietary edge protection systems
- Special components for perimeter edge platforms
- Large vehicle soft landing bags
- Counterweighted 'hangman' systems (tested to BS EN 795: 2012 Class B)
- Fall arrest / PFPE fixings solutions

A number of these, as collective methods to prevent falls, come under the auspices of BS EN 13374: 2013.

8 Edge Protection Systems and Product Types (Cont)

Specification

Whilst there are a large number of alternatives, the majority should meet the requirements of a BS EN 13374 Class A system. The deflection requirements in particular seem to be overlooked by some of the proposed solutions, which can be very unsatisfactory.

Application

HGV vehicles, articulated or rigid, trailers, curtain sided, vans, excavators, etc. Loading, unloading, electrical connections, repairs, air hose connections.

Limitations and Design Issues

The difficulty for these applications is that the vehicle designs are so varied due to lack of standardisation of trailer bed design, including the rake (the steel section which runs along the sides of the trailer bed) and the cross and longitudinal beams providing the structure under the floor.

Therefore there are likely to remain a large number of potential solutions to provide protection for falls from vehicles.

Safety

The WAH hierarchy should be remembered when determining the preferred method of fall prevention, as avoidance and collective fall protection should take precedence over personal fall arrest solutions.



NB: also refer to the BCSA Guide to Work at Height during the Loading and Unloading of Steelwork



Fall Arrest Option

9 Climbing Screen Protection Systems

Screens are large edge protection panels that typically give protection over several stories at the same time, providing protection for workers at casting, erecting and striking levels as well as follow on trades. They require considerable design input, and remain a hybrid edge protection solution as they go well beyond the scope of BS EN 13374.

Application

The most typical applications are for multi-storey, high-rise projects. Developments with lower heights of about 7-8 storeys have also been successfully managed.

Future Standard

At present there is no specific British or EN Standard that specifically applies to Climbing Screens, as they are a recent development. Designers may apply BSEN 12811, BS EN 13374 and/ or TG20 or other Euro codes. Every application is designed individually, and applied to different proprietary systems. In the EPF's view there is a need for a new Standard to be developed, and the Edge Protection Federation has invited the specialist suppliers to formulate a new Code of Practice under our banner, as we feel a closer affinity to such products.

Specification

The screens are usually manufactured out of substantial steel sections, varying from supplier to supplier, and can be faced with steel mesh, perforated steel sheets or solid ply sheets. The screen panels themselves are connected to vertical tracks that are supported by means of proprietary needles that are anchored to the cured slabs. Tracks and panels can be lifted by crane, electric chain hoists or if required hydraulically.

Screens can also be designed to incorporate working platforms for post tensioning operations.

Screens are almost certainly the ultimate in edge protection for concrete frame high rise structures, creating an environment that instils such levels of confidence in the work force that productivity can be enhanced.

Design and Weight

Each project will be individually designed and configured.

Screen panel sizes are designed to suit maximum crane capacity, relevant wind loadings and the number of levels requiring protection. A typical overall panel size would be in the region of 4.8m wide by 11.5m high and this would normally give protection to 3½ floors in height.

The self-weight of a panel this size would be in the region of 2.5 tonnes with working platforms and 1.9 tonnes without platforms, but some may be even heavier.

Panels are usually designed to go around the full perimeter of the building. To enable safe lifting, gaps of approximately 100mm are left between panels but these are closed off by means of vertical flexible rubber "skirts" that do not interfere with the lifting operations. Gaps between the edge of the concrete slab and screen panel are closed by means of plywood flaps.

Needle supports are anchored to the cured slab by means of proprietary anchors or through ties with removable anchor cones. The load on the anchors will depend on the screen design, and care should be taken to ensure the slab is not overloaded.

With solid screen panels extra care needs to be taken in the design stages due to the wind load acting on a solid surface. Mesh and perforated sheeting will offer less resistance to wind, but these loads should be taken into consideration by the temporary works designer when designing the screen layout.

Screens can be partially assembled off site and assembly then completed on site. The width of load being transported and number of panels per truck needs to be taken into consideration if this method is adopted.

9 Climbing Screen Protection Systems (Cont)

Loadings

As stated above, the applied loads will depend on the screen design, but may also comply with BSEN13374 or BS EN 12811 / TG20 . Wind loadings will be assessed for the specific location.

Safety

Screens provide a high level of safety and security, as they screen the full floor height, and for some subsequent lifts above. The fixings are substantial, and movement takes place within the protected area. When the programmed screened areas move on to the next level, other more conventional types of edge protection may be installed for other stages of the contract, and this should be undertaken within the screened area wherever practical.

Screen suppliers should provide a site specific Method Statement and Risk Assessment as well as a Safety Checklist that will allow for the safe assembly and installation of the screen system being used.

In order to minimise the risk of falls of materials, gaps may be largely sealed by rubber gaskets/ skirts, as movement of the units may require a degree of tolerance that could otherwise make it difficult to eliminate gaps.

In order to reduce some of the tasks and risks involved with assembling the large Screens on site, they may be fabricated off-site, transported to the location and craned straight into position. The width of the load being transported and the number of panels per lorry needs to be taken into consideration if this method is adopted.

Typical Installation Guidance: Climbing Screens

- Consult the design drawings
- During assembly and dismantling of system, operatives must wear the appropriate PPE at all times
- Needles are anchored to the slab once the concrete has acquired sufficient strength to carry imposed loads

- Screens may be erected in a suitable assembly area on site or off site for part pre-assembled delivery
- Due to the self-weight of components, provision should be made for mechanical handling during on site or off site assembly. This would also apply when dismantling a system at the completion of the project
- Only suitably trained personnel should be used for screen assembly and dismantling
- The lifting sequence must be carefully planned and carried out in accordance with the supplier's instructions. Care must be taken to ensure screen weights are within the lifting capacity of the crane
- LOLER regulations apply during all lifting operations.
- At all times, the user must follow the suppliers Method Statement for the safe use of the system

Examples of Climbing Screen protection Systems



10 Net Barrier Systems (Classes B & C)

Net Barrier Systems are fall arrest systems made using BS EN 1263 energy absorbing safety nets, to combine fall prevention and a high degree of containment. They comprise of a safety net spanning between intermediate support posts that can be set at significant support centres. They have specific corner assemblies and access routes into the protected area.

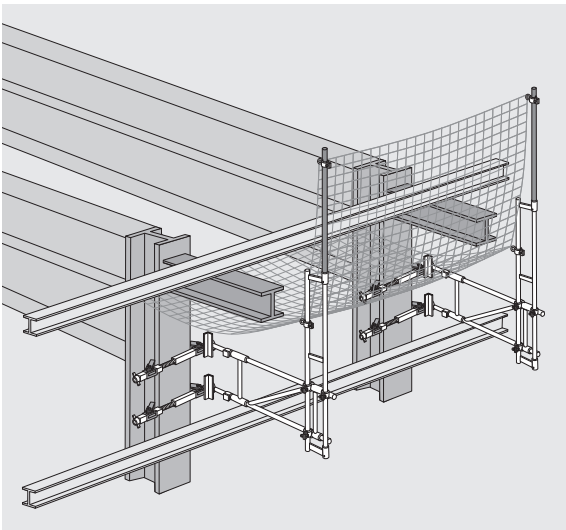
If net barrier systems and ladder beams are to be used on roofs where a supporting guardrail is required along with full fall protection, this should be assessed by the Temporary Works Designer in view of the potential loadings on the structure.

Applications and surfaces

Net barrier systems are typically used with steep or curving roofs as well as large bay sized industrial roofs, where the ability to meet the static test deflection criteria of Class A and B is complicated by the bay size.

Net Barrier Systems are also used extensively in stadia building and in other applications .

Example of a net barrier system



Design Features - Net Barrier Systems

Net barrier systems are typically Class C systems with no requirement to satisfy the static test within BS EN 13374. The test does, however, require a minimum deflection criterion to be achieved in order that the system absorbs the applied dynamic loading.

They are formed using a safety net, sometimes supported on a top rope or cable, to provide an energy absorbing edge protection system for steep slopes. Systems

can be designed to combine the edge protection with an eaves overhang fall arrest solution, linking into the building or the internal under-slung safety nets. Nets should generally not be supported by guardrails

They are typically set at a high level relative to the working surface, to ensure full containment in spite of their flexibility in the event of a high dynamic fall. In view of their high level, access points need to be made through the net to provide access to the working area.

The intermediate support arrangements normally secure to the primary structure at bay centres, and have a high degree of adjustability to accommodate various eave and verge details. The corner arrangements take much of the impact load, and so are stiffened with bracing etc.

Components

- Safety Net (combining overhang)
- Top rope / cable
- Intermediate support arrangement
- Corner arrangement
- Access point

Performance

Large bay sizes can be accommodated, with intermediate supports up to 10m apart. Eave and verge overhang limits will depend on the structure, the system chosen, and its method of attachment to the building. As the overhang increases, the attachment point can move from the column to other suitable secondary anchor points.

Wind loading is an important performance and capacity issue, which also affects the maximum intermediate support spacing. This can have a bearing on the maximum height at which the system may be used, and can also limit the use of fine mesh overlays for a higher level of small material containment.

11 Installation Guidance

11.1 Safe Systems of Work

All edge protection activities, in common with most other construction activities, should be undertaken in accordance with a safe system of work. A safe system of work is a formal procedure that results from a systematic examination of a task to identify all of the hazards and assess the consequent risks. It is a means of ensuring that wherever possible hazards are eliminated or otherwise minimised by the application of appropriate control measures.

It has been estimated that at least a quarter of all accidents at work involve failures in systems of work. Therefore it is essential that the entire process of edge protection erection and dismantling, including all peripheral activities such as storage and material handling, is covered by a comprehensive system of work.

Use of Site Facilities / Main Client Duties

In order to safely install edge protection systems there are a number of areas that installers will benefit from the support and co-operation of the main contractor. It is in these areas that there is a need to clearly communicate the aspects of site activity that will aid the safe, speedy installation and removal of such systems.

Points for consideration are:

- Involvement with the design team to minimise the need for special components to overcome building obstructions. Facilitate pre-drilling of steelwork for ground based assembly
- Formation of well compacted surfaces and roadways
- Operators of MEWPs to be suitable trained and familiar with the equipment they are to be using
- Co-ordination of crane lifts
- Exclusion zones to be established during installation
- Weekly inspection regime
- No interference with installed components, except by suitably trained and nominated persons
- Access to building frame to facilitate dismantling, which may require scaffolding, mobile towers or MEWPs
- Storage during stage by stage dismantling to avoid loss of or damage to equipment

Risk Assessments

In the development of safe systems of work, the decision process should be led by hazard identification and the assessment of associated risks which, if they cannot be eliminated, must then be effectively controlled.

Significant hazards relating to edge protection include:

- Falls from height
- Falling materials
- Manual handling
- Inadequate working space
- Inadequate access to height
- Lifting and lowering of loads
- Plant and machinery operator competence
- Structural integrity
- Ground conditions
- Access methods

11.2 Typical Method Statement Issues

The following items identify many of the issues that typically are required to be considered during the installation and removal of edge protection.

Site Induction

All personnel working on or visiting the site on a regular basis should report to the main contractor to attend a site induction. This induction should be held on first day of operating on site.

Site Labour

All operatives are required to be competent in the erection and dismantling of edge protection systems, and familiar with site procedures. All operatives should carry evidence of competence to install the system concerned, evidence to use any access or lifting equipment, and general site safety awareness by way of a CSCS card or similar.

Accidents

Any accident, however slight, to be reported immediately to the main site agent and entered into the site accident book. If the accident or injury falls within the requirements of RIDDOR regulations, it shall be reported.

Access requirements / Site Conditions

Suitable roadways and access routes are to be provided and maintained to allow transport to gain access from the public highway to the working area. The ground conditions within the working area shall be established and maintained in a suitable condition to support the access (e.g. MEWP's) and lifting equipment.

Working Areas

Once the start point and gridline have been determined, the main contractors shall ensure that no other personnel work either under or in fall risk areas. These areas should be monitored closely by the main contractor and adjusted to suit progress.

Where work is being undertaken that may cause materials to fall onto persons passing below, adequate means of isolating the areas below the work activity must be installed.

Planning

Detailed planning of the work can alleviate the need to work at height, through pre-installation of systems. Examples are indicated later within this guidance.

When working on the edge, installers may need to wear a safety harness. When the method of work requires the specification of a harness, both the lanyard and the attachment point must be included within the method statement. Consideration should also be given to the need for a rescue plan and the necessary equipment required, as well as adequate and appropriate training in the equipment being used.

Competence

Having established a safety system of work, only those competent to carry out the work should be employed, and they should follow the method statement.

Adjustment / Temporary Removal

If the system needs to be temporarily removed to allow other work to be undertaken, the unprotected area should be immediately secured by other compensatory methods, and the system should be re-instated as soon as practical by those competent to reinstate it.

Setting Out

The system should be set out in accordance with the system supplier's instructions, and in accordance with the relevant Class requirements from within the standard BS EN 13374. The minimum height requirements of 1m and the maximum gaps required by the relevant Class should all be satisfied.

Handover

On completion of an area, the installer should complete a handover certificate and leave a copy with the main contractor's site agent. Following handover the installed system will require a daily inspection by the user who should be familiar with the equipment and the inspection required.

11 Installation Guidance (Cont)

Installation Options

This table indicates the most common installation options by type:

	Concrete Frame	Steel Frame	Timber Frame	Sloping Roof	Flat Roof
Drilled anchors	Yes	Yes	No	No	Yes
Cast-in anchors	Yes	No	No	No	No
Clamps	Yes	Yes	No	Yes	Yes
Formwork Beams	Yes	No	No	No	No
Vertical Surfaces	Yes	Yes	No	Yes	No
MEWPS	Yes	Yes	No	Yes	No
Column secured	Yes	Yes	No	Yes	No
Free Standing	Yes	No	No	No	Yes
Bolted	Yes	No	Yes	No	No

The materials being used must always be checked for damage with damaged items being replaced immediately. The same system must always be used and system components must not be mixed and matched, as all systems have different specifications. Edge protection systems should not be adapted or altered in any way, other than by a competent person, and in line with the manufacturer's approval.

Edge protection systems are not designed for the attachment of fall arrest devices, nor are they designed to provide support to building materials.

Ensure type or class of edge protection meets the specifications that are required on site for the specific applications.

Edge Protection Systems should not be adapted or altered in any way, other than by a competent person, and in line with the manufacturer's approval.

GAPS

In general, gaps in edge protection should be kept to a minimum. Below the protective barriers, toeboards or debris nets, the gaps should be no more than 20mm. If there are practical limitations e.g. profiled surfaces it should be as close as practicable to 20mm, to capture loose materials from sliding underneath. Side gaps in the edge protection should be sufficiently small (120mm) that a person cannot fall through.

11.3 Installation Guidance: Concrete Frames

Drilled Anchors

The selection of a suitable anchor will be dependent on both the system being installed, and on the base material available. The system supplier can advise on suitable anchors and can confirm the load imparted to the anchor with the various socket bases and configurations.

The strength, thickness, age, and type of concrete all have a bearing on performance, as do the edge distance, depth of embedment, and the proximity to other fixings. In all cases the anchor manufacturer's instructions must be closely followed to achieve the desired capacity.

Do not mix base components of different manufacturers, as they may have varying specifications and dimensions. In particular, the stud components, which may be subject to replacement, **must** be to the manufacturer's specification otherwise hazardous conditions could be created.

Anchors

Anchors used in the support of edge protection are frequently heavily loaded, and all key anchorage performance areas need to be carefully considered:

- anchor edge distance
- anchor spacing
- depth of embedment
- the base material itself
- the load on the anchor is influenced by the geometry of the system and the attachments, as well as by the thickness of the slab and application geometry
- Additionally wind loading and combination loading must be considered.

Effective anchorage solutions might include the use of cast in channels or other fixings that are placed for the permanent works, but that can be utilised for the temporary works in supporting the edge protection. Their ability to accommodate the loads imposed by the edge protection system must be confirmed.

Having selected an attachment point on the slab face or wall surface, it is equally important to consider the impact such a location has on the effectiveness of the toe board containment. Panel type systems will frequently lose effective toe board height, within the depth of the slab, or by positioning the attachments down the wall face below the wall top. The EN requirements for minimum toeboard height must be maintained, and equally the need to contain the 20mm sphere must also be considered.

The other consideration in selecting such an attachment position is the overall effective height of the edge protection. The minimum height of 1m in accordance with BS EN 13374) must be maintained at all stages of the construction process. This may result in the need to "top up" the height of the edge protection system post and panels.

11 Installation Guidance (Cont)

Slab Socket Base

When working at an edge, the operative must wear suitable personal fall protection equipment, which has been inspected and for which they are trained to use and should be anchored to a suitable point in the structure in accordance with the safe use of the fall arrest system.

Before installing the anchors, the location for each socket base must be measured and identified. They can then be installed into sufficiently cured concrete slabs.

It is normal practise to install an expanding sleeve type anchor. The hole diameter and depth should be to the manufacturer's instructions.

It is normal practice that the hole is drilled no less than 200mm+/- 50mm in from the slab edge. However at all times reference **must** be made to both the system installation instructions and those of the anchor manufacturer.

The anchor sleeve must sit flush with the slab surface and not above. If the anchor sits proud of the surface, check the hole for debris and depth and then re-locate.

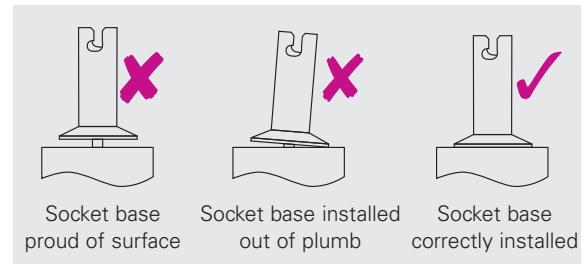
The anchor can then be set using the setting tool and a hammer until solid resistance is encountered. It must be ensured that the thread on the socket base is free from defects and / or damage, at which point the socket base can be threaded into the surface and tightened according to supplier's recommendations.

Socket base centres and edge distances should at all times be set out in accordance with the system manufacturers requirements

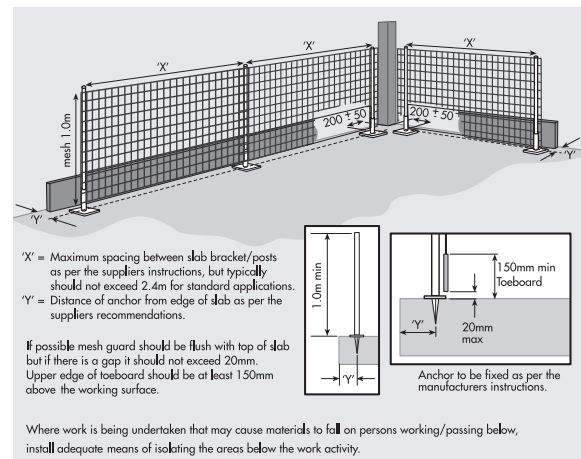
Anchor installation



Socket base installation



Typical spacing and gaps for floor slabs



Vertical Surfaces

Where edge protection systems need to be fastened to vertical surfaces such as slab edges or walls, consideration at the design stage should be given to the type of anchor and its suitability to the loading application. The anchor will be subject to combined loading from both shear and tensile forces resulting from self weight and other superimposed loads as well as moments due to handrail and wind loading. The strength of the surface into which the anchor is fixed is a major consideration and where any doubts exist, the strength should be confirmed by pull out tests or other approved means.

Reference should always be made to the anchor manufacturer.

Gaps between the vertical surface and the handrail / toeboard must be controlled and kept to the minimum as required by BS EN 13374. The installation should be carried out by trained personnel wearing suitable personal fall protection equipment and in turn anchored to a suitable point in the structure in accordance with the safe use of the restraining system. Alternatively MEWP's may be a suitable alternative for access installation.

Cast In Anchors and Cast In Sockets

If proprietary anchors are to be inserted into floors prior to pouring, the manufacturer's recommendation must be closely followed. It is important to properly secure anchors, to prevent movement, and ensure that the resulting anchor is both vertical and flush with the finished slab.

Cast in sockets are mostly used in composite type construction, either with pre-cast units or with metal decking. The setting out and positioning of the sockets must be carefully planned, and must follow the system manufacturer's recommendations. Best practice would include, where possible, the opportunity to pre-install the complete system prior to lifting into position.

It is also important to consider the changes in working surface level, at the various stages of the construction process. The overall height requirements within BS EN 13374 must be maintained, as must the containment limits.

When planning and installing edge protection for pre-cast unit placement, consideration should be given to the location of the anchors for the edge protection relative to the floor layout.

Effect of Concrete Topping

The edge protection may also need to be lifted to maintain its minimum height for the topping pour. The principle being to minimise movement and change to the edge protection, whilst maintaining both height and toe board containment

Clamps

Various clamps and attachments can be effectively used to maximise flexibility and to avoid drilling or penetrating the structural element. Clamp systems, fitted in accordance with the manufacturer's instructions, require more space to provide adequate support, and care must be taken to avoid conflict with other trades such as cladding.

Before installation, the design should be carefully checked to ensure that the structural element will have sufficient strength to accept the loads from the clamps. Where the finish may be sensitive, care should be taken to minimise the impact of the clamp on finishes.

Where possible Clamps should be secured against inadvertent release during the installation process. Use of lanyards or ties should be considered.

The location for each clamp and post should be measured and the approximate depth of the slab determined before adjusting the clamp to within 100mm of this figure depth. The clamp can then be hooked over the slab and positioned to obtain full contact against the edge.

11 Installation Guidance (Cont)

Finally the clamp can be adjusted to fit by turning the handle firmly so it clamps rigidly into place on the slab floor. Test for movement and if necessary, re-tighten.

Formwork Beams

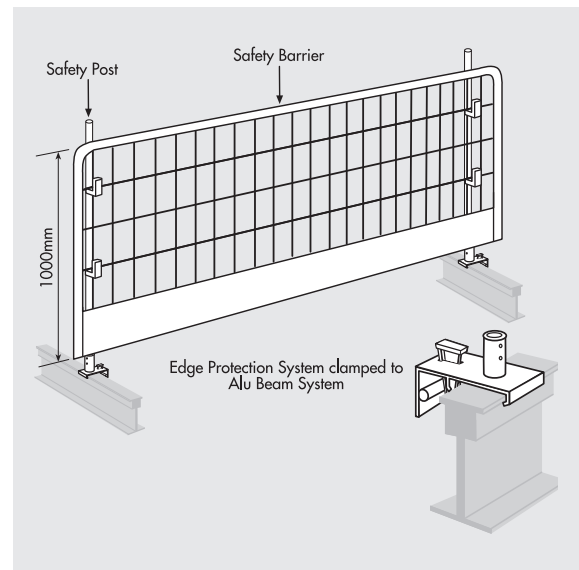
Proprietary brackets are available that lock onto the upper or lower surfaces of aluminium or proprietary timber formwork beams to provide a socket or other means of clamping a vertical handrail post. These brackets can be pre-fixed onto the formwork beams during the initial formwork erection procedure and can remain in place during formwork or table movement thus providing a handrail facility at all stages of the formwork use.

The brackets must be fitted in accordance with the manufacturer's instructions at centres that are adequate to sustain the forces exerted onto the posts, via mesh barriers or handrails, due to wind and handrail loading.

When working at an edge the operative must wear a suitable safety harness and lanyard, which has been inspected and in turn should be anchored to a suitable point in the structure in accordance with the safe use of the restraining system.

Before installation the beams should be inspected for damage or distortion of the web and at the ends. Once it has been checked that the beams are securely fixed to the falsework / formwork structure the brackets can be fixed to the manufacturer's instructions. The centres of the brackets should be at least 150mm in from the end of the beam.

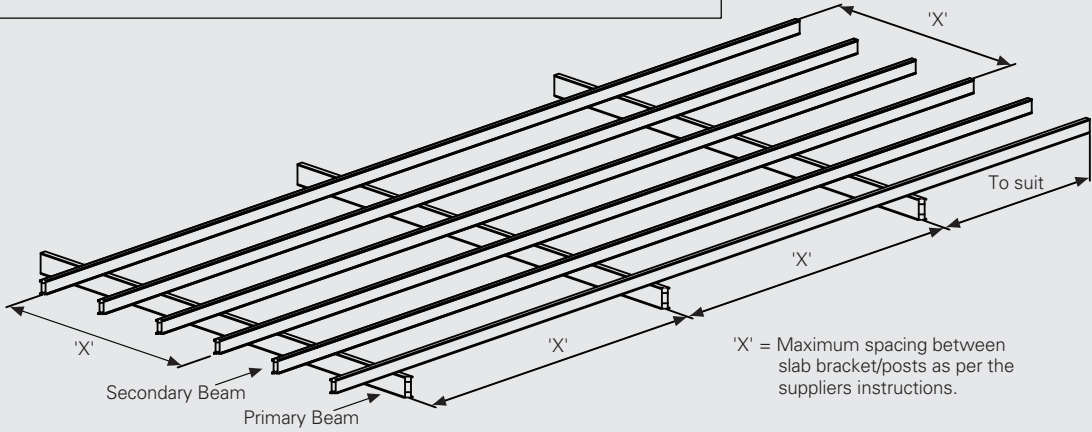
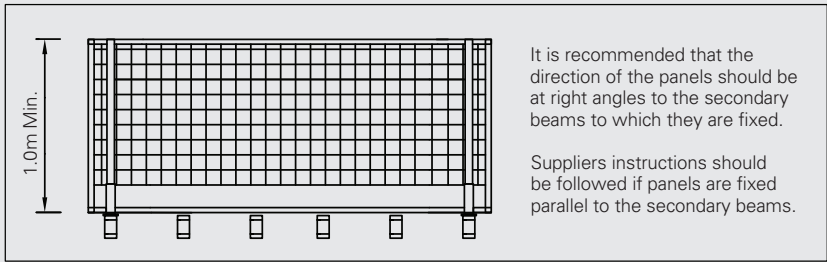
The horizontal spacing of brackets should follow the system manufacturer's recommendations and the brackets should only be fixed to beams that are at right angles to the mesh barrier direction. A supplier may be able to provide a solution to this limitation that is specific to their own products- in which case the guidance must be closely followed, but should not be assumed to apply to any other formwork beams without specific supplier approval.



Cantilevers

Cantilever applications, whilst in common use, need further design considerations with particular regard to stability, loading and deflection criteria both during the initial erection and in the intended final application. Formwork beam brackets can again be utilised on these applications but the deflection on the beams due to the combined loading from concrete and the additional moments from the handrail loading need to be considered by the Temporary Works Designer.

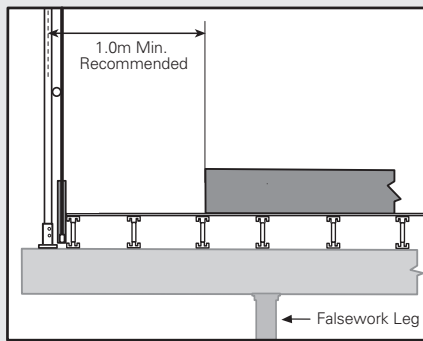
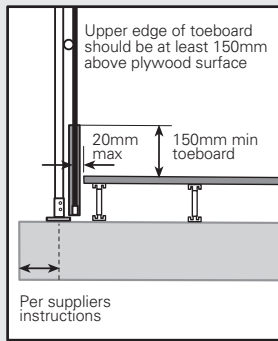
The brackets must be fitted in accordance with the manufacturer's instructions at centres that are adequate to sustain the forces exerted onto the posts, via mesh barriers or handrails, due to wind and handrail loading.



If possible mesh guard should be flush with edge of plywood but if there is a gap it should not exceed 20mm

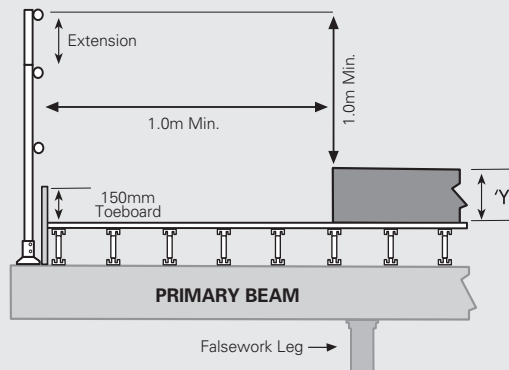
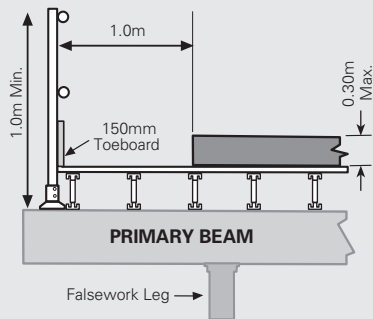
If falsework is erected as a tableform then the formwork beams, plywood and edge protection can be fixed at ground level and lifted complete into position on top of the falsework.

FORMWORK BEAMS - Typical dimensions for spacings and gaps



Where work is being undertaken that may cause materials to fall onto persons working/passing below, then install adequate means of isolating the areas below the work activity.

Class A Edge Protection



SLABS UP TO 0.3m THICK

SLABS OVER 0.3m THICK

The above cantilevers, toeboard heights etc. are required to maintain the integrity of Class A edge protection systems.

On slabs over 0.3m thick the edge protection will have to be extended in height, (1.0m Min. above slab level) in accordance with the manufacturers/suppliers instructions. Extensions are only a visible barrier on slabs over 0.5m. Alternatively the system may have to be designed to suit the requirements of Class B/C Edge Protection.

Wider cantilevers may necessitate the need for extended edge protection on deeper slabs but consideration will have to be given to the falsework/formwork design.

11 Installation Guidance (Cont)

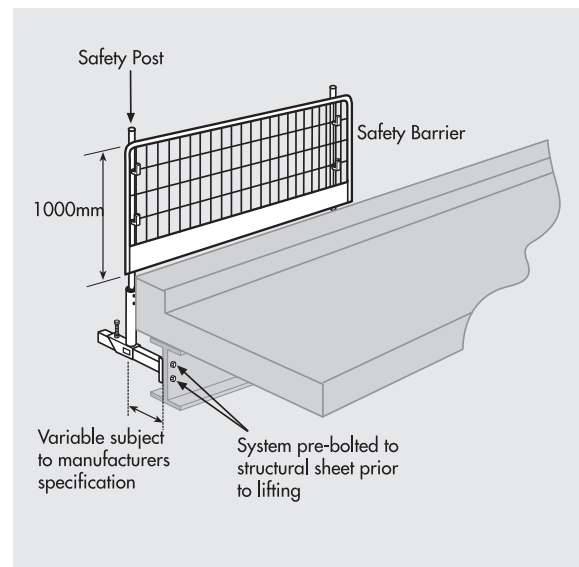
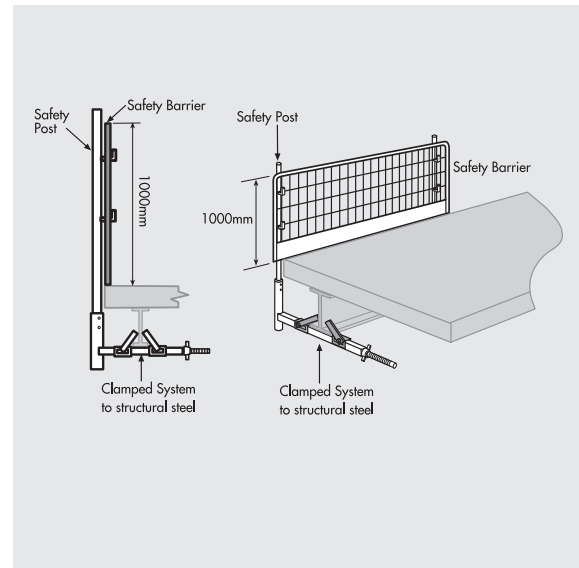
11.4 Installation Guidance: Steel Frames

In accordance with the Work at Height legislation, hierarchal controls must be employed to reduce or preferably eliminate the need to work at height. It is therefore recommended that where site conditions allow, ground level, pre-determined installation of edge protection systems is utilised.

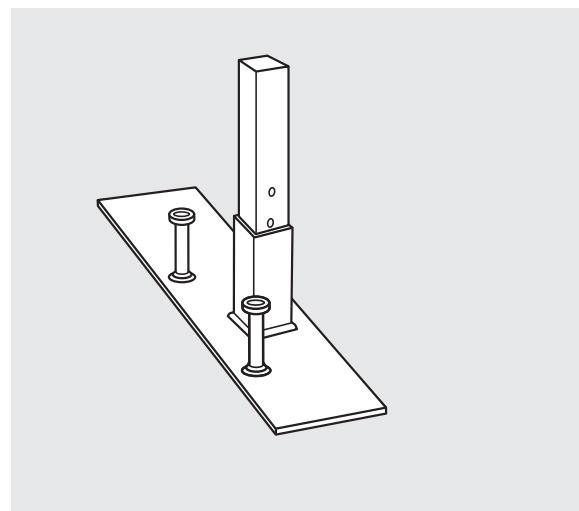
Planning

In order to build the edge protection at ground level, it is important to determine:

- whether clamping or bolting components will be selected
- that the steel sections have the appropriate properties to resist the loads
- if components are to be pre-bolted, the section size will be compatible with the size of the component
- that there is a reliable process for any pre-drilling during manufacture
- the craneage facility will maintain the balance of the beams to avoid rotation
- ensure adequate knowledge of the system has been gained prior to any installations, including fixing operations and component sizes
- prior to any craning or manual handling activity, consideration should be given to identifying each component weight
- all appropriate site risk assessments should be developed and communicated to all relevant parties
- implement the necessary exclusion zones
- where appropriate, netting should be utilised
- for MEWP equipment, the site ground conditions should consist of a suitable hard core surface which has been consolidated and levelled



Sacrificial socket



Weather

Consideration should be given to weather conditions that could have an adverse effect on the craning and installation of the edge protection. (Refer to the BCSA guide, erecting steel in windy conditions)

Pre-attaching systems to steelwork:

The steel sections should be checked to ensure that the pre-drilled holes are to the correct spacings before securely fixing the components to the manufacturer's instructions. All components to be lifted in a MEWP must have a reliable securing method to ensure that they cannot accidentally be dislodged during lifting or during fixing operations.

Positional (i.e. vertical) adjustments can be made prior to attachment to the steel frame.

Ensuring that minimum gaps would be left between the final working surface levels and the underside of the barriers, removing where possible the need to re-position the system at a later stage.

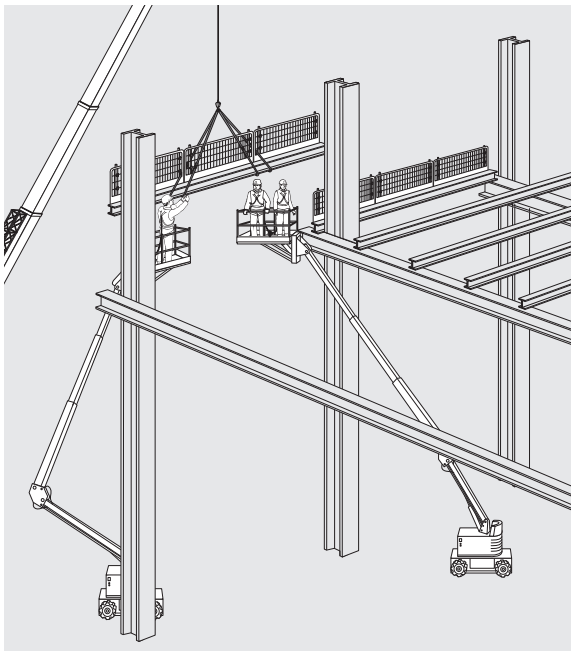
Ensure that component positioning will preclude the need for operatives to lean through the edge protection.

Measures should be taken to ensure the necessary working clearances are provided for the fixing of edge trims etc. before the guardrail posts are inserted and the mesh panels attached according to the manufacturers' instructions. Finally it should be checked that the guardrail height meets regulatory requirements.

11 Installation Guidance (Cont)

Cantilevers

MEWP's can be used for access to install edge protection systems in a large range of applications. They can be used to install tubular guardrail solutions or other separate component systems when all the work is carried out at height as well as completing a mesh barrier type system that has been partly installed to the structural elements prior to lifting. They are also most commonly used to install net barrier systems, where the intermediate support points are typically installed on the column heads and then the safety netting is strung between the supports to complete the system.



General guidance

- MEWP's should not be used other than by suitably trained and competent operatives, who can produce evidence of their competence and training
- when working within a boom type MEWP, the operative should wear a full body harness together with a fall restraint lanyard, of such a length that the user cannot climb up or out of the basket whilst attached to the anchorage point. Alternatively, comply with the manufacturers requirements.

- the ground conditions within the whole working area should be established and maintained in a suitable condition to support the MEWP and any lifting equipment required. Specific attention is frequently required around the building perimeter.
- care must be taken to ensure that the combined weight of the operative, the tools, and any equipment at no time exceeds the capacity of the MEWP being used
- long or large components may require the specification of alternative MEWP's or the use of lifting equipment
- the area around and below the MEWP should be access restricted to limit the hazard of falling materials and tools
- all hand tools and other accessories should be secured against falling, as they present a hazard to those passing below

Installing clamping components from a MEWP

It should be ensured that the steel sections are suitable for the edge protection system being installed and the capacity of the MEWP relative to weight of individual components checked. All components to be lifted in a MEWP must have a reliable securing method to ensure that they cannot accidentally be dislodged during lifting or during fixing operations.

Before starting installation, a rescue plan should be produced to recover operatives in the event of a fall, trapping etc.

The clamping components should be positioned and rigidly secured at the recommended spacings before inserting the guardrail posts in the correct position. The mesh panels should then be installed following the manufacturer's instructions, ensuring that the guardrail height meets regulatory requirements.

Crane Slinging Edge Protection Systems

Slinging and positioning of the steel beam, complete with the edge protection should be carried out with consideration given to the possible rotation and imbalance of the load.

Measures should be taken to ensure the edge protection itself is secured to the steel frame components during lifting.

Securing the load to the primary lifting device by means of secondary chains and ties is suggested, as is following existing best practice with regard to positive connection lifting.

Tubular Guardrail Solutions on steelwork

If tubular guardrails are to be installed by traversing the steelwork, there are particular issues, as this can be a particularly hazardous operation.

We recommend the procedures outlines in the NASC document SG27:09- Temporary Edge Protection on Open Steelwork.

Installing tubular guardrails from mobile elevating work platforms

Great care and site specific prior approval must be sought to lift and handle very long tubes (up to 6.4m) from a boom type MEWP basket.

Handling materials such as this must be the subject of a specific risk assessment that ensures that they can be safely lifted without risk of dislodgement or of overloading the platform.

There must be a means of ensuring that the tubes remain secure throughout the operation. Suitable measures to prevent the tubes rolling during manoeuvring of the MEWP should be adopted, such as feeding the tube through the basket guardrails. However, the basket guardrails may not be suitable for vertical loading without additional measures. Temporary clips or open fittings can be used at the standards, to partially support the tubes, whilst sliding into position and connecting.

Lighter materials than steel should be considered, such as aluminium, to ease manual handling issues. Maintaining a clear area below the operations is of increasing importance as the risk of falling materials increases with the component size.

Greater care is needed in the control of the MEWP, as the long tube components extend the basket width substantially and present impact hazards over a large area. Consideration should be given to accessing steelwork for fixings, as some of the bolt fixings may be in difficult positions to ensure adequately torqued fittings.

Over-reaching and climbing out of the platform must be avoided and consideration should be given to the prevailing weather conditions, which may affect the stability of the platform and equipment.

Mesh Barrier Type Solutions

Lifting and handling mesh barrier panels within a MEWP can present concerns due to the weight and size of the panels. Early consideration should be given to barrier component weights prior to selection of a MEWP.

Site specific prior approval must be sought to lift and handle mesh barrier panels, and methods of safely, temporarily securing or restraining the barrier panels should be considered.

Net Barrier System Installing

Pre-assembly or part pre-assembly of the components will reduce work at height and ease the use of a MEWP.

The net barrier is installed longitudinally under tension and normally fitted into the fall arrest netting system within the building, having previously installed the corner elements, and the intermediate supports. This requires a larger and more rapidly changing exclusion zone to be established below the work area, and also renders the installation even more sensitive to ground conditions.

Suitably trained and competent installers should always be used, who should strictly follow the system manufacturers guidance. In most cases they will also need to be FASET (Fall Arrest Safety Equipment Training) qualified safety net riggers. FASET best practice should be followed at all times.

11 Installation Guidance (Cont)

11.5 Free Standing Systems Installation

Free standing systems are typically used in flat roof applications, or where the inclination is no greater than 10 degrees, and there is reluctance to drill into the fabric of the roof. These systems can also be used to protect voids, lift shafts and stairwells where it may be more difficult to support from elements of the building structure. Where roofing membranes are being laid, facilities may exist for adapting systems to achieve clear unobstructed areas.

Installation Guidance: Free Standing Systems

When working at the edge,- the operative must wear a suitable safety harness which has been inspected and in turn should be anchored to a suitable point in the structure in accordance with the safe use of the restraining system.

The amount of material required should be estimated and a plan produced for the position of the guardrail, together with any ballast positions and point loads on the roof should be considered before transporting the material onto it.

At least two people will be required to build this type of system

Once on the roof surface, the material should be laid out in approximately the right position, away from the edge. The components should be connected together and moved to the distance from the edge specified by the supplier. Once in place, the toeboards should be attached.

11.6 Mobile Anchor and Fixed Anchor Systems

Where it is not possible to confidently prevent a fall, it is a requirement of the WAH Regulations to mitigate the consequences of a fall, and this will require the use of a harness- based system attached to a suitable anchor point. In the absence of suitable support from the building structure, a mobile anchor can offer such support.

Whatever method is used, the BS 8437: 2005 (+A1 2012) Code of Practice for selection, use and maintenance of personal fall protection systems should be referred to. This document covers restraint systems, rigid horizontal / vertical anchor lines, work positioning systems and other fall arrest equipment. The specification and hazards of such systems are covered in detail. It should also be read in conjunction with BS 7883: 2005 *Code of practice for the design, selection, installation, use and maintenance of anchor devices conforming to BS EN 795*

BS 8437: 2005+A1: 2012 *Code of Practice for selection, use and maintenance of personal fall protection systems and equipment for use in the workplace*
BS 7883:2005 *Code of practice for the design, selection, installation, use and maintenance of anchor devices conforming to BS EN 795*

Mobile Anchors

Such systems will generally comprise of a central framework with the facility of attaching dedicated weights sufficient to resist the impact and weight of a person whilst falling. The framework will feature a load-tested attachment point for an inertia / fixed length / restraint fall arrest safety block. The line should be restricted in length for most applications to avoid the danger of any pendulum effect. *The safety block should only be used if it has been approved for this purpose by the supplier, and it should be provided with suitable protection or sheathing devices to prevent the risk of severing or critical damage on roof edges in the event of a fall.*

- the mobile anchor should have been tested to EN795
- it is important that all mobile anchor systems are installed and used no closer than 2 metres from the leading edge in order to have sufficient clearance to operate in the event of a fall.
- check that the surface is capable of bearing the deadweight of the anchor and that the friction resistance is suitable.
- do not use in icy or wet conditions.
- assembled and used in accordance with manufacturer's instructions
- many systems are designed to accept only one person- check the capability
- counterweights should be moved with regard to Manual Handling requirements
- employ internal lifts or mechanical handling where possible.
- the harness line should be of a maximum length of 5 metres
- attach counterweights to central framework and check that all items are secure.
- clip karabiner hook to central eyebolt.

Performance

Systems tested to BSEN 795 Class B or E, and should have the capability of resisting a dead force of 100kg dropping vertically through 2.5 metres. This should result in a mass weight in the region of 250 to 350kg for most systems.

Components

Central Anchor Frame
Counterweights
Safety line and harness.

11.7 Tubular Guardrail Solutions

Installation Guidance: Tubular Guardrails

Detailed guidance for the erection, alteration and dismantling of tubular scaffolding, including guardrails, can be found in the NASC technical guidance document TG20, but for proprietary tubular methods, seek the suppliers guidance information.

The following suggestions should be read in conjunction with that guidance.

- when working at an edge the operative must wear a suitable safety harness and lanyard, which has been inspected and in turn should be anchored to a suitable point in the structure in accordance with the safe use of the restraining system.
- tubular guardrail solutions should only be designed and installed by competent and suitably experienced persons
- steel tubes should be cut square and clean, free from bends, distortion, splits or corrosion.

Tubular Scaffolding

- all fixings should be made to an appropriate structure capable of sustaining the forces required. The NASC recommends the use of Class B right angle / double couplers and connections between the needles and the steelwork is made using Girder Clamps fitted to both flanges of the steelwork.
- all tubes should be connected with load-bearing couplers and scaffold fittings should be tested to BS EN 74 (Couplers, spigot pins and baseplates for use in falsework and scaffolds. Part 1)
- sleeve Couplers should be used for horizontal tubing
- maximum spacing for supporting posts to be set to achieve the performance requirements for the relevant Class of protection within BS EN 13374
- toeboards provided should be capable of sustaining the horizontal forces specified in BS EN 13374.

11 Installation Guidance (Cont)

Dismantling of Edge Protection System

Sequence of Work

- ensure adequate knowledge of the system has been gained prior to any dismantling operations and implement controls appropriate with the Work At Height legislation
- edge protection systems must not be removed prior to installation of permanent means of protection, and without the explicit permission of the main contractor
- prior to any manual handling activity, consideration should be given to identifying each component weight
- early consideration should be given to the possible restricted access for plant and machinery necessary for the dismantling operation
- ground conditions should be made safe and suitable for any machinery to operate
- the dismantling procedures and sequence should be in line with the supplier's recommendations
- the intention should be stated e.g. the purpose will be to dismantle the temporary guardrail at the eaves position and guardrail at the gable position of the steel framed structure
- the grid line start point is to be determined on site prior to dismantling

Movement of Edge Protection Equipment

- when manually handling tubes, operatives are to be aware of other operatives working around the site and equally when manoeuvring MEWP's with tubes loaded they are also to be aware of any operatives that may move into the erection / dismantling area and will stop work immediately until the area is cleared
- ensure edge protection components are neatly and safely stored in readiness for site removal

Dismantling of bolted edge protection on steel framed buildings

Consideration should be given at an early planning stage to the issue of removal at the advanced stage of construction. Components can otherwise become less accessible. If components do become locked into less accessible positions it may become necessary to use access platforms, where practicable, to eliminate the undesirable risks of working at height.

12 Safety Requirements

Listed below are the major pieces of Health and Safety legislation that apply to the use of edge protection systems:

- The Work at Height Regulations 2005
- The Health and Safety at Work Etc Act 1974 (HASWA)
- The Management of Health and Safety at Work Regulations (MHSWR)
- The Lifting Operations and Lifting Equipment Regulations (LOLER)
- The Provision and Use of Work Equipment Regulations (PUWER)
- The Manual Handling Operations Regulations
- The Construction (Design and Management) Regulations (CDM) 2007 and revisions
- Construction Health and Safety at Work Regulations (modified by WAH regulations)

Industry Guidance

BS5975 Code of Practice for temporary works procedures and the permissible stress design of falsework

Includes procedures for the management and control of temporary works procedures on sites

13 Hierarchy of Hazard Management

All edge protection activities, in common with most other construction activities, should only be undertaken when using a safe system of work. A safe system of work is a formal procedure that results from a systematic examination of a task to identify all of the hazards and assess the consequent risks. It is a means of ensuring that wherever possible hazards are eliminated or otherwise minimised by the application of appropriate control measures.

It has been estimated that at least a quarter of all accidents at work involve failures in systems of work. Therefore it is essential that the entire process of edge protection erection and dismantling, including all peripheral activities such as storage and material handling, is covered by a comprehensive safe system of work.

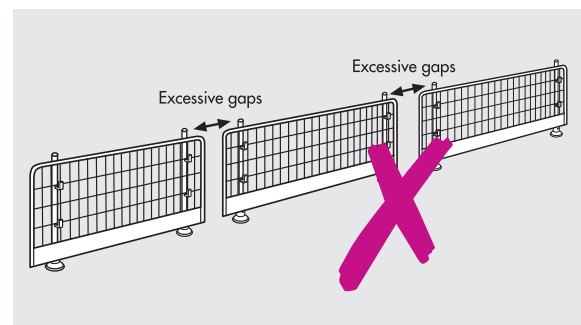
Hazard Identification

In the development of safe systems of work, the decision process should aim to identify all hazards associated with the planned activity and, if they cannot be eliminated, identify ways in which they can be effectively controlled to an acceptable level of risk.

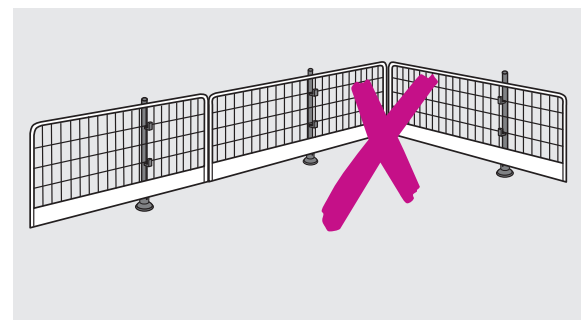
Significant hazards relating to edge protection include:

- falls from height
- lifting & lowering of loads
- manual handling
- trapping
- inadequate working space
- structural instability
- inadequate access to height
- plant and machinery

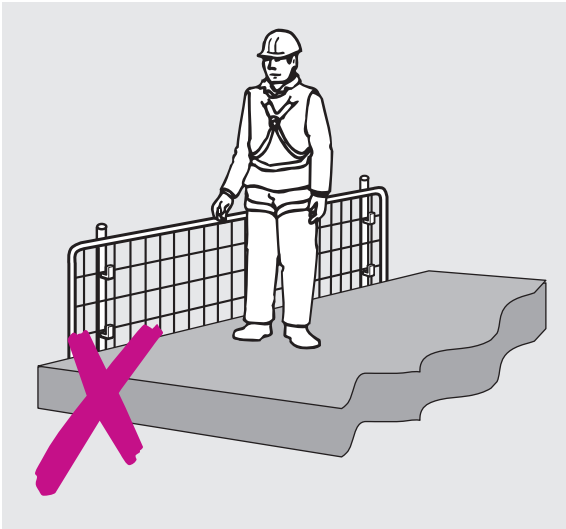
Excessive gaps



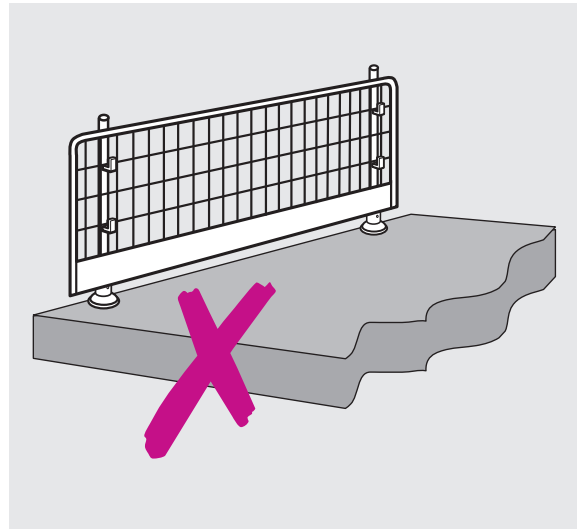
Inadequate Support



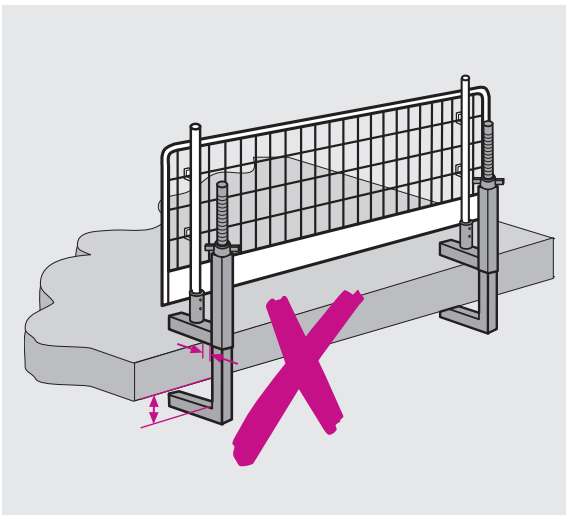
Edge Protection too Low



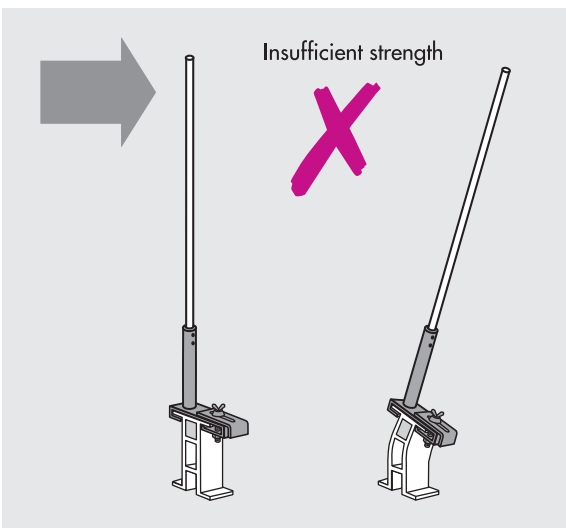
Too close to the Edge



Inadequate support



Wrong Orientation



One of the most common hazards encountered whilst installing edge protection on formwork decks is that of working at height, with recent research suggesting that falls from height alone accounting for over 45% of all site fatalities. In accordance with the Work at Height Regulations, wherever reasonably practicable, work at height should be avoided.

Risk assessments should be commenced at planning / design stage and be refined throughout the scheme and detailed design process. It is at concept stage that designers can be most effective in eliminating or reducing hazards. This is because as the design progresses, hazards get locked into the design and become harder to design out.

Hazards which cannot be avoided must be controlled. The HSE promotes a structured approach to risk control which it refers to as a 'hierarchical system'. The aim is to promote control measures on the basis of 'most effective first'. It is based on the clear principles that:

- prevention is better than protection
- collective Passive protection (protecting all personnel and not requiring actions by the individual) is better than active personal protection (requiring individual action)
- as a last resort, care must be taken to mitigate the consequences of any accident

13 Hierarchy of Hazard Management (Cont)

Hierarchy of Control Measures

This is expanded in the Management of Health and Safety at Work Regulations 1999 as follows:

- 1) avoid risks
- 2) evaluate the risks that cannot be avoided
- 3) combat the risks at source
- 4) adapt the work to the individual
- 5) adapt to technological progress
- 6) replace the dangerous by the non or less dangerous

- 7) develop a coherent overall prevention policy
- 8) give collective protective measures priority over individual protective measures
- 9) give appropriate instructions to employees.

This is presented within the following matrix showing four levels of control measure / equipment associated with work at height. At every level, collective measures should be considered ahead of personal ones.

Type of work equipment	Collective Protection Measures	Personal Protection Measures
Work equipment that prevents a fall	Guard-rails; scaffolding; mobile towers; multi-user MEWPs; Edge protection	
		Work restraint systems Single user MEWPs Fall factor 0
Work equipment that minimises height and consequences of fall	Nets at high level Soft landing systems (close under work surface)	
		Personal fall protection equipment Fall factor 1 Fall factor 2
Work equipment that minimises consequences of fall	Soft landing systems Nets at low level (<6m below surface)	
		Life jackets Inflating air suits Injury reduction systems
Work equipment that does neither	Hop-ups; platforms	Ladders; step-ladders

↑ Most effective

↓ Least effective

Fig 1.0 Hierarchy of control measures

Note - In all cases collective protection measures have priority over personal protection measures

Regulations Summary

The Work at Height Regulations

These Regulations have been made to prevent deaths and injuries caused by falls from work at height. They consolidate and replace all earlier regulations about working at height. The overriding principle is that everything reasonably practicable should be done to prevent anyone from being injured by falling from height.

The Regulations require duty holders to ensure that:

- all work at height is properly planned and organised
- those involved in work at height are trained and competent
- any person involved in Work at Height, including organisation, planning, purchasing, shall be competent
- the risks from work at height are assessed and appropriate work equipment is selected and used
- the risks from fragile surfaces are properly controlled
- equipment for work at height is properly inspected and maintained.

Duty holders include employers, the self employed and anyone who controls the way work at height is undertaken.

The Health and Safety of Work Act 1974 (HSWA)

This Act is the major piece of health and safety legislation in Great Britain. It applies to every type of work situation. The act sets out general duties for the health and safety of those involved in work, including employers, employees, the self employed, suppliers of work equipment and those who control work premises. Section 6 covers the requirement to provide adequate information.

The main general duties are contained in sections 2 -7 of the Act. Section 15 provides the Secretary of State with extensive powers to make delegated legislation which contain more specific responsibilities such as The Management of Health and Safety at Work Regulations.

The Management of Health and Safety at Work Regulations (MHSWR)

The Regulations place broad general duties on employers and employees in all non domestic work activities. They aim to improve health and safety management and make more explicit what is required of employers under the HSWA.

The Regulations, which aim to encourage a systematic and organised approach to health and safety, overlap with several other regulations such as the CDM Regulations.

The broad requirements of the MHSWR on employers are:

- to undertake an assessment of the risks to Health and Safety of their employees and to other persons affected by their undertaking
- to make appropriate arrangements for implementing any preventive or protective measures identified in the risk assessment
- to undertake health surveillance as appropriate regarding the risks to employee's Health and Safety identified in the assessment
- to appoint one or more competent persons to assist in undertaking the above measures
- to provide relevant information to their employees.

13 Hierarchy of Hazard Management (Cont)

The Lifting Operations and Lifting Equipment Regulations (LOLER)

The Regulations aim to reduce risks to people's health and safety from lifting equipment provided for use at work.

The Regulations require that lifting equipment provided for use at work is:

- strong and stable enough for the particular use and marked to indicate safe working loads
- positioned and installed to minimise any risks
- used safely, i.e. the work is planned, organised and performed by competent people
- subject to ongoing thorough examination and where appropriate, inspection by competent people

Lifting equipment includes any equipment used at work for lifting and lowering loads including lifting accessories.

The Provision and Use of Work Equipment Regulations (PUWER)

Under these Regulations work equipment, which includes machinery, appliances, apparatus, tools, component assemblies and in some cases, complete plant, must:

- be suitable for its intended task and area of operation
- be well maintained
- conform to certain EC requirements

When work equipment poses a specific risk, only designated, trained persons may use or maintain it. Employees must receive adequate information, instruction and training on how to safely use the equipment. They must also understand the risks and necessary control measures associated with their work.

The Manual Handling Operations Regulations

The regulations, aimed at reducing the risk of injury from manual handling, establish a hierarchy of measures to be followed:

- avoid hazardous manual handling operations so far as is reasonably practicable. This may be done by redesigning the task to avoid moving the load or by automating or mechanising the process
- make a suitable and sufficient assessment of any hazardous manual handling operations that cannot be avoided
- reduce the risk of injury from those operations so far as is reasonably practicable. Where possible, mechanical assistance should be provided, for example, a trolley or hoist. Where this is not reasonably practicable then changes to the task, the load and the working environment should be explored

The assessment referred to above should consider:

- the load to be manually lifted
- the task i.e. twisting bending etc.
- the environment where the activity is being carried out

Employers must provide employees with information about the nature of the load to be lifted and employees should make full use of any work equipment provided by the employer.

The Construction (Design and Management) Regulations (CDM)

The construction industry covers a wide range of activities, hazards, materials, techniques employment patterns and contractual arrangements. The Regulations are based on the premise that good management of construction progress from concept through to completion is essential if health and safety standards are to improve.

The Regulations require the systematic health and safety management of projects. Hazards must be identified and eliminated where possible, and the remaining risks reduced and controlled. This approach reduces risks during construction work and throughout the life cycle of a structure (including eventual demolition).

In summary the Regulations require:

- a realistic project programme with adequate time allowed for planning, preparation and the work itself
- early appointment of key people
- competent duty holders with sufficient resources to meet their legal duties
- provision of health and safety information from the start of the design phase, through construction and maintenance to eventual demolition, so that everyone can discharge their duties effectively
- co-operation between duty holders
- effort and resources proportionate to the risk and complexity of the project to be applied to managing Health and Safety issues

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