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ADVISORY COMMITTEE FOR ROOFWORK BEST PRACTICE GUIDE

ACR [CP] 007:2008
Recommended practice for use
of
horizontal safety lines in roofwork

FOREWORD

One of the main causes of deaths and injuries at work each year is falling from height, particularly through or from roofs. To ensure safety during roofwork requires the commitment of all those involved in the procurement process.

Where collective protection is not possible personal protection equipment must be used. Many of these rely on horizontal safety lines fixed, using ‘top fix’ anchors, to the roof sheeting rather than through them to the roof support structure. This has raised concerns about:

- The horizontal safety line and anchor reliability;
- The frequency of inspection;
- The adequacy of testing; and
- Their overall performance

This Best Practice Guide addresses these issues and gives practical advice on what the ACR considers is ‘current best practice’ for the design, installation; commissioning, operation, use and maintenance of horizontal safety lines and single point anchors fixed or supported by ‘top fix’ brackets. It concentrates on profiled roofs. Nevertheless, those engaged in other similar activities would benefit from the advice given, as many of the principles do apply and offer good practice.

The delivery of improvements in the prevention of falls from height will only be achieved with the full involvement of all those with a role to play, i.e. clients, employers, workers, trades unions, trade associations, manufacturers, training providers and others.

I thank those involved for their valued input and the often lively and wide-ranging debate, in producing this guide.

Tony Hutchinson, Chairman of the ACR

CONSTITUTION OF THE TASK GROUP

The following people represented the Associations and Manufacturers invited to the task group:

David Thomas	HSE
Ralph N Bennett	MCRMA
Vince Cranmer	NARM
Mike Luke	CSS Worksafe
James Burns	Horizon Safety Access
Nick Lear	OCS
Nick Hayes	The Access Group
Jim Atwood	Safeline UK Ltd
Tim Bisset	Latchways
Simon Rood	Roodsafe
Peter Davis	Roodsafe
Mike Baldwin	Capital Safety Group
Steve Jervis	Capital Safety Group
Scott Bennett	Dunn & Cowe
Simon Luke	Uniline Safety Systems Ltd
Steve Ball	Kingspan Panels

Lee Davies	CA Group Ltd
Derek Cowe	Dunn and Cowe
Peter Baker	Corus Roof Panels & Profiles
Chris Chapman	BSI

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INTRODUCTION

The Advisory Committee for Roofwork (ACR) was set up in 1998, at the instigation of the Health and Safety Executive (HSE), to consider the safety implications of fragile roof assemblies. It is made up of nominees from trade associations and organizations involved in roofwork that, together with HM Specialist Inspectors, produce documents that provide advice based on sound technical knowledge and many years' collective experience of roof work.

Concerns have been expressed to the ACR about the reliability, adequacy of testing and overall performance of horizontal safety lines (particularly those using 'top fix' anchors) being installed on different roof types.

In response, the ACR convened a Working Group which included representatives of:

- The ACR (including the HSE);
- Safety equipment manufacturers;
- Safety equipment installers; and
- UK representatives on British and European standards committees dealing with relevant product standards and codes of practice

to review and recommend best practice involved in the design, manufacture, installation and use of horizontal safety lines on roofs.

SCOPE

1. This book details what the ACR considers is 'current best practice' for the design, installation; commissioning, operation, use and maintenance of horizontal safety lines and single point anchors, fixed or supported by 'top fix' brackets. (i.e. that are attached to the roof surface but not

fixed directly to the structure underlying the roof surface.)

RESPONSIBILITIES

NOTE: Where a party fulfils more than one role they assume the responsibility for each.

2. The responsibilities of the key parties are as follows:

Client

3. Responsible for

- The adequacy of resources; and,
- Ultimately responsible for approving the decision and justification to select the anchor line installed.

CDM Co-ordinator

4. Responsible for:

- The creation of a Health and Safety File; and
- Including within it an O&M (Operations and Maintenance) Manual related to the anchor line installed.

Architects and Designers

5. Responsible for:

- Providing the Specification(s) that dictate the nature and quality of the roof and line;
- Identifying foreseeable hazards in the building's design and, where possible, eliminating them; and
- Making, and justifying, the decision that a horizontal safety line provides appropriate fall protection and was the right choice for the roof type.

Structural Engineer

6. Responsible for:

- Designing the main structure; and
- Confirming that the roofing assembly is suitable for the fall protection system selected.

Principal Contractor

7. Responsible for:

- Ensuring the quality of installation; and
- Compliance with current standards and industry best practice.

Roofing manufacturer

8. Responsible for:

- Providing a roofing assembly that creates an efficient and effective cover for a structure, which is sufficiently durable to withstand foreseeable weather conditions over its anticipated lifespan; and

- Providing authoritative information and advice to architects and designers on the suitability and reliability of ‘top fix’ fall protection systems when used on their product(s).

Roofing contractor

9. Responsible for:

- Installing the roofing product in accordance with the roof manufacturer’s instructions and guidance.

Anchor device manufacturer / supplier

10. Responsible for:

- Designing and manufacturing fall protection system(s);
- The preparation and issue of all necessary user instructions;
- Ensuring that product(s) meet relevant standards and ‘industry best practice’ and have been independently type-tested against the requirements of relevant standards by a Notified Body;
- Ensuring that product(s) are CE-marked; and that the anchor device (e.g. horizontal safety line or single point anchor) has proved satisfactory when tested in accordance with ACR Publication “Testing of Roof anchors on Roof Systems” and upon each roofing type to which it is intended it will be installed; and
- Selecting, and training, any authorized installers; and for supplying them with products for installation in accordance with its written instructions and guidelines (and, if appropriate, design software).

11. Ultimately, responsible for:

- Ensuring the quality of their products; that they will remain ‘fit for purpose’; and that the calibre of approved installers will ensure that the integrity of systems remains unimpaired;
- Ensuring that a specified fall protection system is suitable for the roof type and purpose for which it is recommended; and that it is sufficiently durable to withstand the rigours of service throughout its foreseeable lifespan;
- Providing recommendations on maintenance requirements; as well as inspection methodology; and
- Providing authoritative information and advice for architects and designers and on the suitability and reliability of their fall protection systems.

Anchor device installer

12. Responsible for:

- Designing fall protection system(s) and installing them on a roofing assembly in accordance with device manufacturer’s instructions and guidance; and
- Ensuring the quality of installation, as well as compliance with current standards and ‘industry best practice’; and that the specified fall protection system is suitable for the roofing type and purpose for which it is installed.

Note: The device Installer certifies the system and the roof installer certifies the roof.

Building owner, occupier or agent (i.e. person in control of access to a roof and any fall protection system installed on premises)

13. Responsible for:

- Establishing a programme of routine maintenance (and safe system of work) based on the recommendations of the manufacturer, for each fall protection system under their control;
- Devising and implementing a safe system of work that protects effectively all personnel gaining access to a roof; and
- Controlling roof access and verifying that personnel allowed access to the roof are fully familiar with all safety precautions, equipment and necessary safeguards.

Anchor device maintenance service provider

14. Responsible for:

- Inspecting and maintaining fall protection systems according to the manufacturer’s instructions;
- Ensuring that all maintenance personnel are suitable trained, equipped and competent for the tasks they may be expected to perform;
- Adequately supervising the conduct of all work undertaken; and
- Keeping the person in control of the fall protection system properly informed about its condition.

End users

15. Responsible for:

- Making full and proper use of all safety equipment provided;
- Responsible for complying with any ‘site rules’ or procedures (including method statement(s) and manufacturers’ instructions) imposed by the building owner, occupier or agent in respect of roof access and roofwork; and
- Personally, legally responsible for reporting any defects, flaws and / or anomalies that may emerge

during the course of roof access or unsafe roofwork activities.

TERMINOLOGY

16. For the purpose of this Best Practice Guide the following definitions apply:

anchor line

A flexible or rigid line connected at least at one end to a reliable anchor to provide, as part of a personal fall protection system, a means of fall protection or support

horizontal safety line

A line that does not deviate more than 15° from the horizontal plane and forms part of a personal fall protection system

top-fix

A mechanism by which anchors or anchor system components may be securely attached directly to the surface of a roof and only indirectly to the underlying substructure of the roof

NOTE: Access to the underside of the roof is not required.

TYPICAL ROOFING TYPES

17. For the purpose of this Best Practice Guide the following descriptions apply:

Single ply membrane

External roof finish mechanically fixed through insulation layer to sub-structure (metal or timber deck), typically designed with a nominal fall to shed rainwater

NOTE: The roof pitch is usually less than 4 degrees

Standing seam

Traditionally, flat with upstands ('standing seam') to suit width of sheets, in single length external weather sheets (no end laps) allowing for thermal expansion and contraction via halter or clip systems secured to site assembled spacer systems to suit the depth of insulation over a metal liner panel system.

The external weather skin can be supplied in various metallic types, with aluminium and coated steel being the most widely used. Standing seam roofs generally incorporate barrel vault rooflights

NOTE: Standing seam construction is usually specified on roofs less than 4° pitch and curved roofs.

Twin-skin / built-up

Traditionally, trapezoidal ('corrugated') profiled coated steel external weather sheet externally secured to site assembled spacer systems to suit the depth of insulation over a metal liner panel system. Rooflights are normally in plane with this type of roof construction.

NOTE: Twin-skin / built-up construction is usually specified on roof slopes greater than 4°, but can also be curved in certain applications

Composite

Foam or fibre insulated panels, fully bonded to external weather skin and liner panel. Panels are through fixed to the sub-structure. Composite panels can be supplied either with trapezoidal profile or standing seam.

Rooflights can either be in plane or barrel vault dependant upon external profile and roof pitch.

NOTE: Composite construction is usually specified on roof slopes greater than 4°, dependant upon specification/panel design can also be installed on roof pitches as low as 1.5° and shallow curved roofs in certain applications

LEGISLATION AND STANDARDS

Legislation and standards

18. The principal legislation affecting the installation, use, inspection and maintenance of horizontal safety lines.

- Health and Safety at Work etc. Act 1974 (HSWA);
- Management of Health and Safety at Work Regulations 1999 (MHSW);
- Personal Protective Equipment at Work Regulations 1992 (as amended) (PPE);
- Work at Height Regulations 2005 (WAHR); and
- Construction (Design and Management) Regulations 2007 (CDM).

19. In addition to the guidance provided in this section, additional advice / related standards can be found in the references listed in paragraph 134 below.

General principles for selection of work equipment for work at height

20. Guidance on the general principles for the selection of work equipment for work at height can be found in Appendix 1 of the ACR 'Green Book', **ACR (CP) 002: 2005**.

21. A horizontal safety line may be used for either 'work restraint' (i.e. preventing a fall; a personal measure) or 'fall arrest' (i.e. minimising the height and consequences of a fall; a personal measure). See paragraphs 42 and 51 below

Fragile surfaces

22. Guidance on fragile surfaces can be found in the ACR's 'Red Book', **ACR (M) 001: 2005** and 'Orange Book', **ACR (CP) 001: 2003**.

NOTE. Downloadable free of charge from the ACR website – for details see back page

Selecting a roofing contractor

23. Advice on selecting a competent roofing contractor is given in **ACR Information Sheet No. 1**.

NOTE. Downloadable free of charge from the ACR website – for details see back page

Competence

24. A **competent person** is defined as:

a person who can demonstrate that they have sufficient professional or technical training, knowledge, actual experience, and authority to enable them to:

- Carry out their assigned duties at the level of responsibility allocated to them;
- Understand any potential hazards related to the work (or equipment) under consideration; and
- Detect any technical defects or omissions in that work (or equipment), recognise any implications for health and safety caused by those defects or omissions, and be able to specify a remedial action to mitigate those implications.

Note. “authority” here means delegated authority to the individual by his employer to carry out a certain function or duty

25. The ACR ‘Black Book’, **ACR(CP)005: 2006** (Guidance note for competence and general fitness requirements to work on roofs covering inspection, new build, maintenance, repair and refurbishment work) describes the various attributes implied by this definition that enable it to be used to assess those involved in:

- Commissioning roofwork;
- The organisation and planning of roofwork;
- The management of roofwork;
- The supervision of roofwork;
- Working at height;
- Assessing the non fragility of roofs; and
- The inspection of roofs and roofwork.

NOTE. Downloadable free of charge from the ACR website – for details see back page

26. This document now extends the ACR ‘Black Book’ attributes by giving further implied attributes that, for the following additional parties, determine competence:

Manufacturers and suppliers

27. The manufacturer / supplier of a horizontal safety line or anchor system should be able to demonstrate that they:

- a) Have an understanding of the principles of fall protection;
- b) Can explain to a lay person where and how their products fit within the WAHR fall protection hierarchy;
- c) Can work to a quality management system;
- d) Can manufacture and test a product to a relevant appropriate Standard(s);
- e) Can predict, and explain to a lay person, the performance of their product(s) in different configurations;

- f) Can explain to a lay person their product information, e.g. advantages and limitations, cost-benefits;
- g) Can prepare site-specific installation specification(s) and drawing(s), including connection details, sealant details, etc.
- h) Can train, or will have arrangements to provide training to, their recommended installers in all aspects of their products; and
- i) Can explain in detail to a ‘lay person’ details of, and reasons for, the inspection and maintenance requirements for their products.

28. In addition, they should:

- a) Be able to interpret and explain the meaning of their product test data; and
- b) Have arrangements for issuing a certificate of installation.

Installer

29. The installer of a horizontal safety line or anchor system should be able to demonstrate that they:

- a) Are competent to work at height on a roof (see ‘Black Book’, Paragraph 3);
- b) Have an understanding of the principles of fall protection;
- c) Have product knowledge and can state any restrictions and limitations relating to the systems that they are installing;
- d) Have experience and understanding of horizontal safety line or anchor system design; and
- e) Have undergone, and attained, a suitable level of training in installation.

Inspection and maintenance

30. Those undertaking the inspection and maintenance of horizontal safety lines or anchor systems should be able to demonstrate that they:

- f) Are competent to work at height on a roof (see ‘Black Book’ Paragraph 3);
- g) Have an understanding of the principles of fall protection;
- h) Have product knowledge and can state any restrictions and limitations of the system they are inspecting or maintaining;
- i) Have experience and understanding of horizontal safety line or anchor system design;
- j) Can identify, assess and explain the significance of defects, and be able to state the appropriate corrective action to be taken;
- k) Have the authority to initiate any corrective action, as well as the necessary skills and resources to do so;
- l) Have received product updates on the system they are inspecting or maintaining;

- m) Have undergone, and attained, a suitable level of training for inspection and maintenance on the system they are dealing with; and
- n) Can produce acceptable inspection and maintenance records.

CONCEPTS

General

31. A roof creates a high risk “working environment”.
32. Many problems however can be resolved on the drawing board ‘at the stroke of a pen’ as opposed to the ‘retro-fitting’ of ad-hoc solutions later when the realities of building maintenance have become apparent.
33. It is implicit that a compatible structure, roof system and necessary safeguard(s) are essential features of roof designed to be safe, e.g. perimeter parapets of adequate height to provide fall prevention, low maintenance, non-fragile roofing assemblies which have lengthy guarantee periods.
34. Such features should always be chosen over the provision of personal protection, such as horizontal safety lines as they create an “existing place of work” – the highest level in the WAHR hierarchy of fall protection (apart from avoiding work at height altogether).
35. **However, where the use of horizontal safety lines on roofs cannot be avoided the ACR recommends that the following guidelines should be adopted:**

General Notes on all systems

36. Customers / clients should be encouraged to understand that, according to standard risk assessment criteria, if personal fall protection systems have to be used then a work restraint system must be the preferred option; where this is not the case, use of a fall arrest system should be clearly justifiable; and this may only be considered as a last resort.
37. No one should work at any time on the roof unless they have been suitably trained and instructed in use of their personal fall protection equipment in conjunction with the system or anchor point; understand the necessary precautions to be taken and any limitations that apply; and are fully familiar with the nature and extent of the work to be done. This is a requirement of competence detailed in the black book
38. Once commissioned, the operation and use of an anchor system must be properly supervised and sensible control measures applied. The unauthorized use, operation, maintenance or repair of any anchor system should be strictly prohibited.
39. A permit-to-work system (in addition to any other control measures) supported by appropriate house rules should be applied for personnel access, anchor line operation and work activity on roofs.
40. There should be clear method statements for the conduct of all readily foreseeable work to be undertaken

on the roof whilst using the system. Any new work or irregularity should be subject to risk assessment and additional control measures implemented when necessary

41. No matter which of the following systems is chosen, there are some common themes that should be present in these types of safety products.
- a) They should have been tested to appropriate class of anchor as outlined in BS EN795
- b) They should be CE Marked
- c) They should be made of such suitable materials as to resist corrosion and the environment in which they are installed
- d) They should not have been tampered with or have had their form altered in any way
- e) Where cable systems are used a performance simulation should be provided to ensure loads in the system are controlled to within tolerable levels for the roof structure and workers and that in the event of a fall there is sufficient ground clearance to arrest the worker or workers safely
- f) Where cable systems are used they should terminate on an independent anchor
- g) Systems and all anchors should have a label or tag indicating that it is within its test period and stipulating its limitations of use, conformance with EN795, manufacturers details and the CE mark
- h) Where there is more than one system on a roof, it is necessary to use a twin legged fall arrest shock absorbing lanyard to detach and attach in safety to transfer between them, so that the user is always connected to the anchorage.

NOTE: Systems that are installed too far apart to permit safe access in this way have not been safely designed.

NOTE: The system manufacturers instructions for use and the operating instructions should always cover this issue and should always be consulted.

Work Restraint:

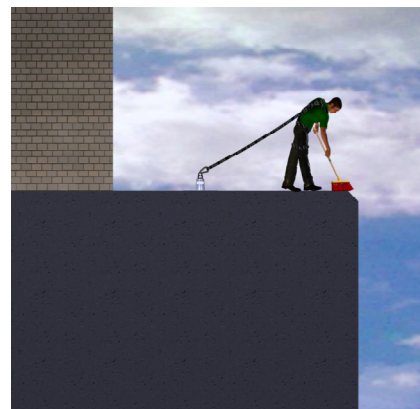


Fig1 – A work restraint system

42. **A work restraint system (as shown in figure1 above) is intended to prevent access, egress and work,**

to those areas that present a risk of falling from height.

43. It should normally be considered as the preferred option for a roof installation where personal protection measures are being provided.

Note: This is consistent with the spirit of The Work at Height Regulations 2005; and the principle of 'risk avoidance'.

44. There should be designated safe means of access and egress for every access point to / from the anchor system. Defined routes, arrangements and restrictions on movement should be formally recommended upon installation of the system; updated and amended as necessary over time; supported by house rules; and strictly controlled (by lock and key, or equivalent measure).
45. The maximum number of users that the system is designed to accommodate should be manifestly clear to everyone concerned with work on the roof; and a working party that exceeds that number should be prohibited.
46. A work restraint system **MUST** be installed so that the position of the anchor when combined with the users connector, lanyard and safety harness, prevents the user from gaining access to the fall hazard. It is recommended that a work restraint system should **NOT** be installed less than 2 m from any roof edge, surface opening, fragile roof light or surface, or similar hazard.
47. It is recommended that operatives required to access the roof and make use of the anchor system should be suitably equipped with a full body harness and energy absorbing lanyard recommended (or approved) by the anchor system manufacturer; together with an anchor line traveller.
48. Operatives should be trained and instructed to undertake access, egress and work activity on the in-board side of the horizontal safety line (i.e. away from and perceivable hazard) whenever possible.
49. If operatives are in an area recognised as a safe zone, i.e. with no risk of fall at all, then they are not required to remain clipped on.
50. It is only when a fall risk is evident and requires a protective measure that work restraint or fall arrest is required and therefore the only time they are required to be attached, but it may be good practice to remain clipped on to avoid confusion.

Fall Arrest:

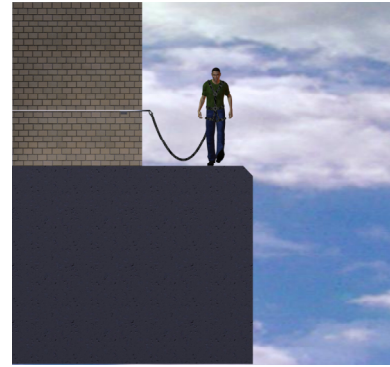


Fig 2 – A fall arrest system

51. A fall arrest system (as shown in figure2) is intended to allow access, egress and work, to those areas that present a risk of falling from height.
52. With the exception of the 2 m limit for edges such as fragile surfaces, open spaces, roof lights, roof edges, fall hazards and access ladders, all of the above recommendations for work restraint systems should be applied to fall arrest systems.
53. The selection, design and installation of a fall arrest system should be clearly justifiable; and the reasoning behind it should be recorded via a formal risk assessment process.
54. Access routes defined by the horizontal safety line should be designed to minimize exposure to risk(s) as should house rules for the workplace and method statements for work content.
55. The fall envelope(s) associated with a fall arrest system in high risk areas of exposure should be carefully assessed and untenable risks addressed by appropriate control measures e.g. anchor line positioning, use of bespoke lanyards or other practical means.
56. It is essential that adequate free space is always available within every fall envelope to enable a fall to be arrested before the user hits the ground or other obstacle that could cause injury.

NOTE: Endusers/clients are reminded that when using a fall arrest system a 'rescue plan' should be in place which details procedures which will ensure that any fallen person can be rescued within a short period of time.(e.g. approximately 10 mins).

NOTE: Reliance should not be placed on the Emergency Services to perform such rescues

TYPICAL ANCHOR DEVICES AND COMPONENTS

Description & Characteristics

57. The following is a list of 'top fix' anchorages that are available for use on a roof for the attachment of PPE designed to provide protection whilst working at height:

Single Point Anchor

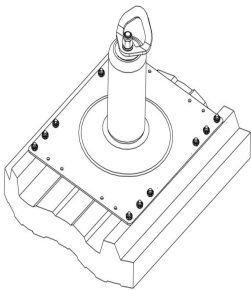


Fig 3- detail of a single point anchor

58. A top fix single point anchor (as shown in Fig 3) is intended for the attachment of one user; and every device of this type installed on a roof should be clearly marked 'for one user only'.

Horizontal safety lines:

59. A horizontal safety line system comprises a tensioned anchor line or rigid rail (see fig 4 & 5 below) that spans an entire access route and / or work area and onto which can be fitted a traveller capable of sliding along the line to provide a mobile anchor

Cable Horizontal safety line System

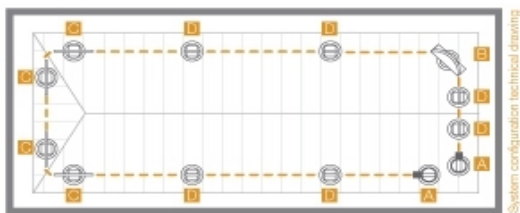


Fig 4-plan view of cable horizontal safety line system

Rigid Rail System

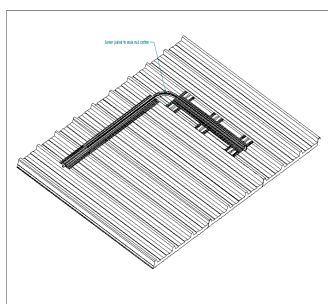


Fig 5 detail of a rigid rail system

60. The traveller has means of connecting other personal fall protection equipment, for example an energy absorbing lanyard that can be attached to the user's harness.

61. The traveller is specially designed to pass over the intermediate support brackets of the cable without disconnection. It is essential therefore that only the manufacturer's designated traveller should be used. Once installed the anchor system provides a continuous means

of fall protection along its entire length without need for repeated connection, disconnection and reconnection of energy absorbing lanyards.

62. In-line energy absorbers may often be installed at the end anchors of the horizontal safety line, or at intermediate line supports. This is to ensure that under all foreseeable circumstances, for example a fall by multiple users, the loads on the anchor system will remain within design limits.

63. Some systems are combined with single point anchors to create "radial points" (see figure 6 below) giving controlled access to specific areas which would otherwise be difficult to reach

Radial Point

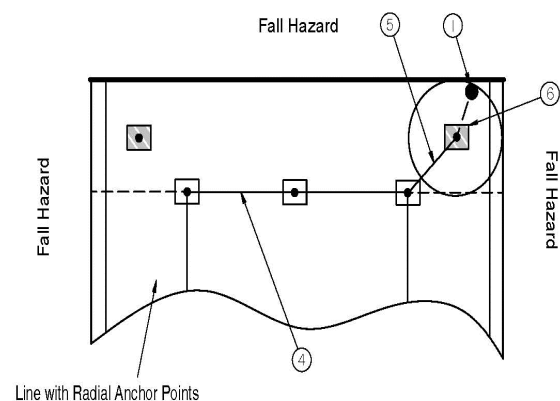


Fig 6 – plan view of radial point operation

GENERAL INFORMATION ABOUT COMMON FIXING METHODS

64. There are generally four different methods currently employed for top fixing anchorages to roofing structures. These are:

- Rivets / Screws** – used commonly on roof structures such as Composite Panels and Built Up Roof Systems utilising metal profiled outer sheets
- Clamps** – used commonly on standing seam and some clip fix roof systems
- Toggle Clamps** – used commonly on flat roofing systems of a built up style where the substrate is a profiled metal deck or plywood
- Chemical Anchors** – used commonly on flat roofing systems of a built up style where the substrate is concrete

65. The following sections describes each type of system / anchor and its limitations for use:-

66. There should be designated safe means of access to and egress from each system / anchor.

67. Defined routes, arrangements and restrictions on movement should be formally recommended upon installation of the device; updated and amended as necessary over time; supported by house rules; and

strictly controlled (by lock and key, or equivalent measure).

Single Point Anchor (see Fig 3)

68. A top fix single point anchor bracket installed on a roof should have the capacity to arrest a fall.
69. A single point anchor allows the attachment of **one** user, unless specifically stated on the product that it is suitable for the attachment of more than one person. The user should only attach to the anchor point with a connector hook that meets the requirements of EN362, but should firstly satisfy them that no-restrictions on the type of connector hook have been stipulated by the manufacturer in the user instruction manual.
70. The connecting fall arrest device connected to a single point anchor should be of an appropriate length, determined by the amount of access required and the work to be carried out, to restrict the movement of the user to a zone where the risk of a fall is removed completely, or the fall distance is minimised where it cannot be removed..

Note: Ideally, the anchor should only be used with a short lanyard for access in the localised area.

71. If the anchor is not approved as a 'fall arrest anchor' it is imperative that the user does not allow themselves to be exposed to a risk of falling. Refer to the user instruction manual and building maintenance file to establish any limitations for use, such as the type of fall arrester that can be used with the anchor.
72. If a user were to fall, the anchor should arrest the fall and the users PPE will restrict the force on the user and the anchor to a maximum of 6kN.

Cable Horizontal Safety Line System (see Fig 4)

73. Horizontal safety lines provide more comprehensive protection for personnel working at height, covering larger areas and providing continuous protection whilst the user is generally able to carry out their work with both hands free.
74. Systems are supported at intervals determined by the manufacturer by using intermediate anchorages, allowing a system to cover 100's of metres. They can also make changes in direction using corner anchorages, which in many systems can accommodate a range of angles and changes in the contour of the building to which they are attached.
75. Generally, cables should not exit components of the system at angles exceeding 15 degrees.
76. As well as being used as a fall arrest system, working to decelerate a worker or workers if they fall, horizontal safety lines can also be used as work restraint systems, preventing workers from entering an area of greater risk. They are not intended for use as work-positioning systems on steeply pitched roofs or as a system for performing tasks requiring suspension
77. Users should attach to the system using the recommended mobile attachment device prescribed by

the manufacturer. Where systems use intermediate brackets, which is extremely common, the mobile attachment point will enable the worker to pass the brackets with relative ease and more importantly, without the need to detach themselves from the horizontal safety line.

78. Some systems can be used with only a connector hook that meets the requirements of EN362. This is the case only when the intermediate brackets permit the use of such a connector without the user needing to detach them from the system.

Rigid Rail Systems (see Fig 5)

79. Rail systems provide a similar level of comprehensive protection for personnel working at height, as that provided by horizontal safety line systems, but with increased levels of user safety in certain circumstances.
80. Users are able to remain attached at all times and conduct work with both hands free, but unlike a cable based fall protection system, the rail systems do not deflect under dynamic load and so less ground clearance is required to arrest a fall and the load transferred to the structure is also significantly less.
81. On roofs, rail systems need to be supported more frequently and generally take the form of a continuous base plate with an integral profiled rail that an attachment carriage can move freely along. Some roof mounted rail systems can also navigate changes in direction and the contours of the roof structure.
82. Unlike a cable safety system, a rail system can be used as a work-positioning system on a steeply pitched roof and some are also rated for suspension access work, this will be entirely dependent on the specific rail system. Some will not be approved for suspension work therefore it is recommended that the user always checks with the manufacturer for guidance and instruction.
83. Rail systems are typically fixed to the roof structure using a series of rivets, screws or clamps.

Radial Point (See Fig 6)

NOTE: Sometimes referred to as an 'anti-pendulum posts'.

84. Radial points and anti-pendulum posts are generally used to increase access to the corners of a roof or to reduce or eliminate the risk of a pendulum fall from the gable end of a roof structure.
85. They can be used either with a fixed length lanyard or with a longer rope and work-positioning device such as a rope grab. In the latter case, the rope should be clipped in to a karabiner hook, which should ideally be made captive on the anchor. All users should receive specialised training where this is the work method employed.
86. Where anti-pendulum anchors are used with longer ropes, it is the intention that forces generated in a fall are transferred to main safety anchorage.
87. There is currently no standard in place for testing radial / anti-pendulum posts, so when one is encountered

on a roof, it is likely there will be no markings on the anchor.

DESIGN CRITERIA

Requirements for Horizontal safety Lines on roofs

88. A horizontal safety line system installed on a roof should provide secure means of permanent attachment for a minimum of two individuals, each wearing a full body harness and interconnecting shock absorbing lanyard and / or attachment device, when access is necessary or work is to be undertaken. Even when intended for work restraint purposes a horizontal safety line installed on a roof should normally have the capacity to arrest falls.
89. The minimum capacity of the horizontal safety line system may need to be increased (to more than 2 individuals) if use of the system is integral to any proposed rescue plan(s).
90. In exceptional circumstances, a 'work restraint' horizontal safety line or single point anchor without the capacity to arrest a fall may be installed, where
- The risk of a fall occurring is inconceivable; and
 - The justification is supported by a formal risk assessment recorded in the site's health and safety file; and
 - Control measures are in place which preclude the risk of any person using the system who is not fully aware of the nature of the system and its limitations; and,
 - The risk of misuse or abuse of the system is considered negligible.
91. Every horizontal safety line system should be designed, in principle, to avoid the risk of a fall occurring (by controlling routes for access and egress); prevent the risk of a fall (by restricting access to safe areas); have the capacity to arrest a fall should it occur (by providing a secure anchorage); and limit the risk of injury (by ensuring adequate clearances and careful assessment of the fall envelope).
92. The horizontal safety line system should be engineered to ensure that the force experienced by the victim(s) of a fall does not exceed 6kN; and the resultant energy of the fall (or falls) is distributed in such a way that the forces endured by the top fix anchor roof fixings will not prove critical to either to the anchor, the anchor fixings, the surface of the roof, or the sub-structure of the roof.
93. A safety factor of at least 2 should be adopted for all roof horizontal safety line systems and should be based on the maximum design force / strength limit of the structure.
94. Horizontal safety lines should meet the requirements of BS EN 795 class C and rail systems to EN 795 Class D taking into account other published guidelines such as BS 7883:2005 and BS 8437:2005.
95. In addition, the ACR considers that sample anchor devices to be installed on metal deck roof and supported by top-fix brackets should be tested in accordance with the recommendations of ACR Publication "Testing of Roof Anchors on Roof Systems", to ensure that in the foreseeable circumstances of a fall, the fixings of the anchorage system, the roof surface and the roof's support structure remain secure and intact; and that the overall performance of the safety system is adequate as the current design and testing codes do not address this aspect.
96. A horizontal safety line meeting the above design criteria that has been tested and proved to operate successfully with a particular roof type may be designed using a computer software package based on the key parameters established for, or derived from testing of that horizontal safety line and roof type combination. However the design of a horizontal safety line system by use of theoretical calculations alone (i.e. without validation of the results by testing) is **NOT** recommended.

Requirements for Anchor Device Components

97. Every single point anchor and radial anchor should meet the requirements for a class A2 anchor specified in EN795: 1997; and in addition have a static strength of at least 12kN (providing a safety factor of 2).
98. Top fix end anchors, corner and intermediate anchors should meet the requirements of EN 795:1997 for a class C system and in addition be tested according to the test methods recommended in this guideline.
99. As there is currently no standard in place for testing radial / anti-pendulum posts, in order to ensure that the anchor is fit for purpose, it is recommended that this type of anchor when installed is, as a minimum, marked for its intended purpose of use. Ideally it should be a single point anchor tested to EN795 class A2 anchorage devices and is therefore capable of arresting a users fall

INSTALLATION

Preparation

100. The installation of every fall protection anchor, or anchor system, should be undertaken with a clear understanding that it:
- Will involve work at a critically hazardous location at height;
 - Will constitute 'construction work' as defined within CDM & WAHR regulation); and
 - Should be expected to provide adequate safeguard for the life of the building or structure to which it is attached, subject to a properly designed regular maintenance programme.
101. Preparations for the installation of a system should normally include:
- a) A pre-site survey by the installer;

- b) A check by the system installer with the system manufacturer in conjunction with the roofing installer to ensure the components of the fall protection system and materials of the roof structure are compatible, the above checks should also be discussed with the specifier / designer;
- c) Agreement with the client / designer, Horizontal safety line manufacturer and installer) of the proposed layout for the fall protection system that ensures safe access to the entry point;
- d) A clear mutual understanding about the nature and extent of the work to be undertaken between / designer, Horizontal safety line manufacturer and installer
- e) Agreement over safe routes for access / egress on the worksite, and to / from the roof between / designer, Horizontal safety line manufacturer and installer;
- f) Arrangements with main contractor and installer whereby materials can be raised to the roof mechanically; and,
- g) Advance provision for the storage of materials, components and equipment on site, that is formally agreed between main contractor and installer.

Actual Installation

102. The installation of a fall protection system should always:
- a) Be pre-planned, properly risk assessed, subject to formal method statements and have provision made for rescue;
 - b) Involve only trained and competent operatives and be subject to a strict level of discipline and supervision;
 - c) Use a permit-to-work system; and, arrival and departure to / from the site should be subject to a formal logging protocol agreed with the site manager; and
 - d) Ensures that every anchor point, or anchor line system is installed in accordance with the manufacturers instructions
103. **Installation of fall protection systems on roofs MUST NOT involve:**
- a) The application of low level fixings along an open edge, low level fixings are those at foot level where a fall would mean that the user would 'deck out' due to deflection in a cable. An example of this would be perimeter systems that allow the user to come into a fall risk. Work restraint systems set further back with correct PPE should be used;
 - b) The mixing of components from different manufactures in one system means that a completely new system has been created, which has therefore not been subjected to EN795 tests and has no certification. Compatibility of components and performance of the systems cannot be proved.
 - c) Employment of untrained operatives – except when under training and subject to strict supervision.

104. The environment in which single point anchors or horizontal safety line systems are installed should be assessed upon installation of the equipment and recorded for use to determine the frequency of inspection. Any recommendation(s) in this respect should also be recorded.

Pre-use handover Inspections

105. A single point anchor, or horizontal safety line system, must not be used until a detailed inspection has been carried out (as part of the handover process) to confirm that the condition of the equipment is satisfactory and that it operates correctly. This should include all single point anchors and / or the entire horizontal safety line system.
106. Checks by the horizontal safety line and roof installer together with the client should aim to ensure that:
- a) The roof surface upon which the Horizontal safety line system is installed is undamaged and it is not contaminated by oil, grease or any other alien substance;
 - b) The re-test date for a 'thorough examination' has not passed;
 - c) Anchors, energy absorbers and tensioning units are intact;
 - d) Swaged terminals at the end of any line or cable do not show signs of slippage (there should be a method to check whether any slippage has occurred since installation.
 - e) Any horizontal safety line is correctly tensioned (according to the manufacturers instructions);
 - f) The line or cable does not show visible wear amounting to a reduction in the cross sectional area to any strands of the cable at any point. Check for signs of corrosion on any part of the horizontal safety line since installation.
 - g) Bolts and fixings remain tight and locknuts are secure;
 - h) Warning signs are visible at each access point and at each end of the line indicate that the system is only for the attachment of fall protection equipment and the maximum number of users permitted to attach to the system at any one time;
 - i) The attachment device to be used is correct for the line or cable and is free from any defect and / or debris which might interfere with its operation;
 - j) When appropriate, a lanyard is securely connected to the attachment device by means of suitable connector (e.g. BS EN 362).
107. When there is any doubt about the conditions of a system it should not be accepted for operation. Use of the system should be prohibited until it can be demonstrated that deficiencies have been rectified and it is fit for service.

SYSTEM USAGE CHECKS

Pre-Use Checks

108. On every occasion of use, a single point anchor or horizontal safety line system should be subject to pre-use checks to confirm that the condition of the equipment is satisfactory and that it operates correctly.
109. Use of any anchor, or anchor system, should be prohibited unless checks have been carried out according to the guidance provided by the manufacturer and shown to be satisfactory in respect of at least the following essential items.
- Operatives in the working party are all equipped with personal protective equipment that is compatible with the anchor, or anchor system;
 - The number in the working party does not exceed the capacity of the anchor, or anchor system;
 - The structure to which the anchor or anchor system is fixed is in sound condition;
 - The anchor, or anchor system, is in good repair securely fixed to the structure and the anchor line is properly tensioned;
 - There is clear indication that the anchor or anchor system has been subject to a detailed inspection within the period specified for the installation; and,
 - Every connector and / or attachment device is correct for the anchor or anchor system concerned and operates satisfactorily.
 - The system does not show signs of having arrested a fall;
110. Equipment must prove satisfactory in respect of each item above before it is considered satisfactory for use.

Detailed Inspections

111. Any single point anchor or horizontal safety line system should be regarded as fall protection equipment.
112. The detailed examination of such systems, see below, will however invariably involve “work at height” activities
113. The ACR note that most manufacturers refer to BS EN365:2004 (which covers instructions and marking of all types of fall protection equipment) requires that a manufacturer’s instructions regarding periodic examinations include a:
- “...recommendation in regard to the frequency of periodic examinations, taking account of such factors as legislation, equipment type, frequency of use, and environmental conditions. The recommendation shall include a statement to the effect that the periodic examination frequency shall be at least every 12 months....”*
114. If any single point anchor or horizontal safety line system is actually used very infrequently (i.e. frequencies of less than once a year) this recommendation appears to

conflict with the requirements of the Work at Height Regulations 2005 regarding avoidance of work at height.

Explanatory Note: In order to comply with BS EN 365:2004 (a harmonised standard) to obtain a certificate of conformity, manufacturers of single point anchor or horizontal safety line systems will have no option but to recommend a minimum examination period of “at least every 12 months”, regardless of actual levels of usage.

115. The ACR fully supports, and actively promotes, the concept of avoiding “unnecessary” work at height.
116. Therefore where any single point anchor or horizontal safety line system is used frequently (i.e. at least once every year or more frequently) the ACR agrees that a detailed examination period of “*at LEAST every 12 months, or more frequently if required due to the local environment or level of usage*”, is appropriate.
117. However, where the single point anchor or horizontal safety line system is used very infrequently (i.e. less than once every year), the ACR suggests that there is no need for a 12 monthly examination but that the horizontal safety line system must be examined prior to use, unless it has been examined within the last twelve months, **subject to the following overriding proviso: -**
- Such an examination scheme SHOULD be agreed with the manufacturer of the system involved and REGARDLESS of the circumstances, a single point anchor or horizontal safety line system SHOULD NEVER BE USED if an examination, in accordance with this ACR document, has NOT been carried out within the twelve months period immediately preceding the date of it’s use.**
118. All detailed examinations should be done in accordance with BS7883 period examinations, any manufacturer’s instructions and with this ACR document by a competent person authorised by the manufacturer.
119. Failure to comply with the criteria below should require the horizontal safety line system to be removed from service and deemed unfit for use until remedial work is carried out by the manufacturer of the system or an authorised representative of the manufacturer.
120. A thorough examination should include all items from the interim inspection above, and in addition:
- Check for any signs of corrosion on the anchor system and its fixings and examine the surface of all components in detail. Dismantling the system is recommended;
 - Remove the protective covers and check for corrosion, build up of dirt, dust, foreign objects;
 - Ensure all nuts, bolts, fasteners are present and correct, and the torque is correct to the manufacturers recommendations;
 - Test all swaged connections according to the manufacturer’s recommendations;
 - All labels and markings are visible and in accordance with the requirements of EN365;

- f) That instructions for use / user manuals are available, complete and current;
- g) The manufacturers design program software should be available to the inspector examining a system to confirm that the system was installed properly, i.e. spans, extremity brackets, corners, energy absorber rating;

NOTE: The latest version of the design calculation software obtained from the manufacturer should always be used.

- h) Pull Tests must be carried out on chemical anchors; and,
- i) New test dates must be added to all relevant signage.

NOTE: Single point attachments and anti-pendulum posts should be included in the inspection process.

- j) Checks should be undertaken to ensure that fall distances below roof lights or at the perimeter of the roof have not been reduced by alterations to the height of internal or external racking, or (for example) the introduction of new protrusions from the vertical face of the building or structure, additional buildings, plant, storage equipment etc; by the opening of windows; or by vehicular or pedestrian traffic;

MAINTENANCE

Interim Inspections

121. Requirements for the interim inspection of single point anchors and horizontal safety line systems are described in detail in BS 7883:2005 clause 12.
122. Other aspects of inspection and testing are covered in section 11 of the code of practice (and paragraph 111 above of this document), and marking in section 13.
123. It is recommended that an individual carrying out interim inspection of a single point anchor device or horizontal safety line system should be thoroughly familiar with the equipment, the type of installations (and its fixings) and **all** the requirements of BS 7883:2005.

NOTE: It is the responsibility of the employing organization providing such inspection services to ensure that this is the case.

124. Inspections should be carried out by a competent person. Inspections should take into account the guidance and instructions issued by the manufacturer of the equipment concerned.
125. Such guidance should follow the recommendations of BS 7883 and be noted by the installer in documentation handed over to the client upon completion of an installation [BS 7883:2005 clause 13.1.1]. This information should be requested from the client / building owner before any examination is undertaken and any deficiency in this respect should be recorded in the examination report.
126. The environment recorded at the time of installation of the equipment should be used as an indicator for the frequency with which 'interim' and detailed inspections are required. Any recommendation(s) recorded in this respect should also be followed.

REPAIRS

127. **When a single point anchor or horizontal safety line system has arrested a fall it must be taken out of service**, and the manufacturer of the system or an authorised representative of the manufacturer of the equipment, contacted immediately for advice and guidance on any necessary remedial measures to be undertaken **before** the system is re-commissioned.
128. Repair or maintenance of an anchor system should only be carried out by competent personnel employed by the manufacturer of the equipment or by an authorised representative of the manufacturer.
129. Only genuine, new replacement components should be used for all repairs.
130. Only the special tools or equipment i.e. swaging tools etc, specified or approved by the manufacturer concerned should be used during repair or maintenance of an anchor system.
131. Any component considered to have failed due to a manufacturing or design flaw should always be sent to the manufacturer of the anchor system for inspection.
132. Damaged components that are not returned to the manufacturer must be disposed of in a controlled manner to ensure they cannot inadvertently be put back into service.
133. Any cleaning of an anchor system, or any component of an anchor system, should only be carried out according to the manufacturer's instructions.

REFERENCES

134. In addition to the information provided in this book, additional advice concerning:
- a) The technical requirements relating to aspects of single point anchors, horizontal safety lines and personal fall protection can be found in the following publications:
- BS 7883: 2005, Code of practice for the design, selection, installation, use and maintenance of anchor devices conforming to BS EN 795;
 - BS EN 795: 1997, Protection against falls from a height – Anchor devices – Requirements and testing;
 - BS 8437: 2005, Code of practice for selection, use and maintenance of personal fall protection systems and equipment for use in the workplace; and
 - BS 7985: 2002, Code of practice for the use of rope access methods for industrial purposes.
- b) Competence & Training for Work at Height
- The Advisory Committee for Work at Height Training (ACWAHT) – and others – used the definition of 'competent person' in their 'Work at Height Awareness Syllabus' (drafted to support

the development of BS 8454). See Website:
<http://www.acwaht.org.uk>

- BS 8454:2006 Delivery of training for work at height and rescue.

This document can be downloaded free of charge from the ACR website at

<http://www.roofworkadvice.info>

British Constructional Steel Association [BCSA]

4 Whitehall Court
Westminster
London
SW1A 2ES
Tel: 020 7839 8566
www.steelconstruction.org
Contact: Mr P Walker

British Safety Industry Federation, Height Safety Group [BSIF,HSG]

93 Bowen Court
St. Asaph Business Park
St. Asaph
Clwyd
LL17 0JE
Tel: 01745 5856000
www.bsif.co.uk
Contact: Mr G Hook

Concrete Tile Manufacturers Association [CTMA]

60 Charles Street
Leicester
Leicestershire
Tel: 0116 253 6161
www.britishprecast.org
Contact: Mr C Nessfield

Engineered Panels in Construction [EPIC]

29 High Street
Ewell
Surrey
KT17 1SB
Tel: 020 8786 3619
www.epic.uk.com
Contact: Mr. P Trew

Fall Arrest Safety Equipment Training [FASET]

Carthusian Court
12, Carthusian Street,
London
EC1M 6EZ
Tel: 020 7397 8128
e-mail: enquires@faset.org.uk
Contact: Mr S Kennefick

Fibre Cement Manufacturers' Association [FCMA]

5A The Maltings,
Stowupland Road,
Stowmarket,
Suffolk,
IP14 5AG
Tel: 01449 676053
e-mail: fcma@ghyllhouse.co.uk
Contact: Mr A M Hutchinson

Flat Roofing Alliance [FRA]

Fields House,
Gower Road,
Haywards Heath,
West Sussex,
RH16 4PL
Tel: 01444 440027
e-mail info@fra.org.uk
Contact: Mr P Franklin

Metal Cladding & Roofing Manufacturers Association [MCRMA]

18, Mere Farm Road,
Prenton,
Birkenhead,
Merseyside,
CH43 9TT
Tel: 0151 652 3846
Email: mcrma@compuserve.com
Contact: Mr C Dyer

National Association of Rooflight Manufacturers [NARM]

43 Clare Croft,
Middleton
Milton Keynes,
MK10 9HD
Tel: 01908 692325
e-mail: admin@narm.org.uk
Contact: Lorraine Cookham

National Federation of Roofing Contractors

Roofing House,
31Worship St
London,
EC2A 2DY
Tel: 020 7638 7663
e-mail: info@nfre.co.uk
Contact: The Technical Officer

Rural Industrial Design and Building Association [RIDBA]

5A The Maltings,
Stowupland Road,
Stowmarket,
Suffolk,
IP14 5AG
Tel: 01449 676049
e-mail: secretary@ridba.org.uk
Contact: Mr A M Hutchinson

Single Ply Roofing Association [SPRA]

The Building Centre
26 Store Street
London
WC1E 7BT
0115 914 4445
www.spra.co.uk
Contact: Clive Johnson

Work at Height Safety Association [WAHSA]

3 Sherwood Road
Aston Fields Industrial Estate
Bromsgrove
Worcestershire
B60 3DU
Tel: 01527 577665
www.wahsa.org.uk
Contact: Mr M Griffiths

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