IRATA International code of practice for industrial rope access

Part 3: Informative annexes

Annex F: Safety considerations when installing or placing anchor devices for use in rope access

September 2013

Contents

The first edition of Annex F was published in August 2011.
This edition was published in March 2013.

Amendments issued since publication in March 2013

Amd. No	Date	Text affected
1	2013-Sep-01	Front cover: *September 2013* replaces *2013 edition*. This page: change of IRATA address and telephone number. Date in footer updated. All the changes are classed as editorial.

Published by:

IRATA International
First Floor, Unit 3
Eurogate Business Park
Ashford
Kent
TN24 8XW
England

Tel: +44 (0)1233 754600

www.irata.org

ISBN: 978-0-9544993-5-8

Annex F (informative)
Safety considerations when installing or placing anchor devices for use in rope access

Introduction

Annex F gives advice and other information that could be relevant to users of rope access methods and is one of a number of informative annexes in Part 3 of this code of practice. This informative annex should be read in conjunction with other parts of this code of practice, should not be used in isolation and is not intended to be exhaustive. For further advice, readers should refer to relevant specialist publications**.**

F.1 General

NOTE An explanation of various terms relating to anchors is provided in Part 1 via definitions and the accompanying Figure 1.1 in that part.

F.1.1 There are many different types of anchor device. These generally fall into two broad categories: those that are installed into the structure or natural feature (*installed anchor devices*), e.g. eyebolts fixed to concrete, brick, block-work or steel beams; anchor rails; paired anchors; ground anchors, and those that are placed without installation into the structure or natural feature (*placed anchor devices*), e.g. tripods; scaffold hooks; deadweight anchors; counterweight anchors; anchor slings; beam clamps.

F.1.2 The installation or placement of anchor devices should only be carried out from a safe place, i.e. a place arranged so that there is no risk of a fall from a height, and where there is a safe means of access and egress.

F.1.3 When deciding where anchor devices are to be installed or placed, account should be taken of the envisaged work to be carried out from them, e.g. that the point where a descent starts is directly above the intended place of work.

F.1.4 Anchor devices should be installed or placed in such a way that they can only be loaded in the directions intended by the manufacturer. Where this is difficult to achieve, special marking on or close to the anchor device which points out the limitations of loading might suffice. All aspects of installation, placement and use should follow the manufacturer's instructions.

F.1.5 Anchor devices should be positioned so that attached anchor lines avoid contact with any hazardous surface, e.g. edges; abrasive or hot surfaces. If it is not possible or reasonably practicable to position the anchor devices in this way, the anchor lines should be appropriately protected against such hazardous surfaces, e.g. by the use of edge protectors or anchor line protectors (see **Part 2, 2.11.3**). This is essential for the safety of the user.

F.1.6 Permanently installed and permanently placed rope access anchor systems should be provided with information relating to the installation or placement and with user instructions, see **F.4** for guidance. These anchor systems should be subjected to appropriate inspection and, where appropriate, testing procedures, which should be recorded.

F.1.7 Anchor devices, or any component or element of them, should not be modified from the condition in which they were supplied without the manufacturer's written approval. This is because a modification might affect the performance of the anchor device and could also cause it to fall outside the manufacturer's specification.

F.1.8 There is a responsibility on the installer (for installed anchor devices) or the person who placed the anchor (for placed anchor devices, if not temporary) to carry out detailed inspections or to have detailed inspections carried out for them by a competent person at regular intervals, which should be at least every six months. In addition, the user should carry out visual, tactile and, where appropriate, function checks on the anchor devices before each use. The checks and inspections

should cover signs of wear, corrosion, cracking or other defects and should include both the anchor device itself and the surrounding area.

F.1.9 It is recommended that structures or natural features to be used for installation or placement of anchor devices are assessed by an engineer, unless it is clear to a competent person that the structure or natural feature is adequately stable and strong. An example of where an engineer might not be required is where an anchor sling of the correct capacity is secured around a solid permanent structure such as a plant room or large steel beam. If any doubt exists about the adequacy of the structure or natural feature, an engineer should make the assessment. The engineer should certify in writing that all combinations of loads in a worst-case situation can be safely withstood by the proposed structure or natural feature, bearing in mind that dynamic loads, e.g. under fall-arrest conditions, can be considerably higher than the static or quasi-static loads imposed by the rope access technician during normal rope access activities.

F.1.10 The installation or placement of anchor devices should take account of recommendations in **Part 2, 2.7.9, 2.11.1** and **2.11.2** that the working line and the safety line should each be attached to its own independent anchor point. It should be noted that the anchor devices do not need to be of the same type: for example, the working line could be attached to an appropriately selected and installed eyebolt, while the safety line could be attached to an anchor sling placed around an appropriate steel beam. It is recommended that each anchor line is connected to both anchors for added security and arranged so that the load on each anchor line is shared equally between the two anchors. Account should be taken of the angles created between the anchor lines and the potential loads to the anchor devices: see **Part 2, Figure 2.4**.

F.1.11 Some anchor devices are designed to deform at low loads to absorb energy. Before such anchor devices are used, confirmation should be obtained from the manufacturer that they are suitable for rope access use, including rescue. This is because intentionally deformable anchor devices are usually designed for a single fall arrest load and the continual low loading experienced in normal rope access activities could cause premature deformation and affect the energy-absorbing function.

F.1.12 To protect the user against injury while transporting and assembling anchor devices, e.g. deadweight anchors; counterweight anchors; tripods, the size and mass of the anchor device or its component parts should be easily manageable and should take into account the requirements of local legislation and/or guidelines relating to manual handling.

F.2 Installed anchor devices

WARNING! Anchor devices should only be installed by competent persons, who should be trained in the installation of each type of anchor device to be installed and for each type of base material into which they are to be installed. An IRATA rope access qualification at any level is not sufficient to assure competency to install or test anchor devices, or to carry out a detailed inspection of them. It should not be assumed that a Level 3 or other IRATA rope access technician is competent to install or inspect eyebolts or other specialist anchor systems.

F.2.1 General

F.2.1.1 **F.2** gives advice to consider when installing anchor devices for use in rope access. However, this advice does not replace proper training. Neither does it replace the need for a thorough understanding of and adherence to the information supplied by the manufacturer of the anchor devices or his authorized representative.

F.2.1.2 Installation in this annex means the preparation of the structural material to which the anchor device is to be fitted (which is called the base material), e.g. by drilling a hole through steelwork or into concrete, rock, block-work, brickwork or other suitable materials; the fixing of the structural anchor to the base material, when such a structural anchor is to be fitted; and the attachment of the anchor device to the base material, either directly, e.g. into steelwork, or indirectly, e.g. via a structural anchor.

F.2.1.3 Wherever anchor devices are to be installed, it is essential to ensure that the structure and base materials are of an appropriate type and have sufficient strength, quality, thickness and stability for the anchor device selected to withstand the loads that could be applied, e.g. in the event of a fall. This applies especially to brickwork, block-work or a combination of both. The installation of anchor devices should be such that they do not impair the integrity of the structure or natural feature.

F.2.1.4 Installations should normally only be carried out in base materials intended by the manufacturer of the anchor device. The manufacturer should have carried out type tests of the anchor device installed in the base materials recommended. If no such type tests have been carried out or if there is no list of permitted base materials, it is recommended that trial tests are carried out as described in **F.2.1.7**.

F.2.1.5 Fixings, e.g. bolts, recommended by the manufacturer of the anchor device for each type of base material as used in the type tests should be used. However, if alternative fixings are considered, their specification and performance should be checked to ensure they are at least as suitable as those originally specified and their suitability should be confirmed by the manufacturer of the anchor device.

F.2.1.6 It should be noted that an installer who deviates from the installation instructions provided by the manufacturer and does not have authorisation from the manufacturer to do so (e.g. uses unapproved resins, non-type-tested substrates, alternative fixings or other components) takes on the rôle and responsibilities of the manufacturer for that aspect of the installation.

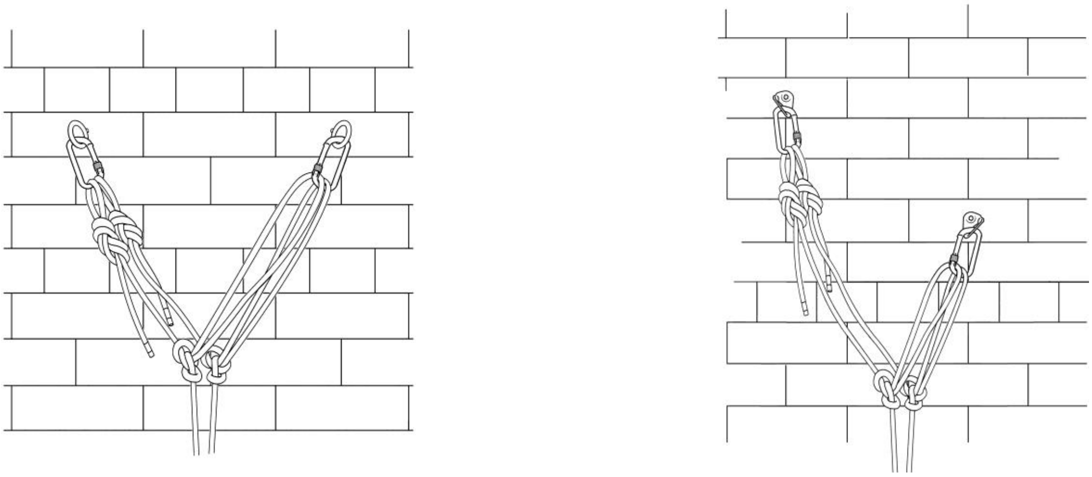
F.2.1.7 Where the installation is intended to be made into a base material which was not included in the type tests or which was included in the type tests but whose actual strength is unknown (which could be less than that of the material in which the type tests were carried out), e.g. old brickwork, it is recommended that a series of three trial static strength tests be carried out to prove the reliability of the base material (sometimes known as substrate tests). The trial static strength tests should be carried out on samples of the anchor device installed as recommended by the manufacturer of the anchor device in a sample of the base material that is representative of the base material to which it is intended to install the anchor devices for the rope access work in hand. If these static strength tests are to be carried out on site, they should be well away from this work area. The static test load to be applied to the anchor device should be (15 +1/0) kN for (3 +0,25/0) min in the intended direction of use, e.g. in shear. The load should be applied gradually, i.e. as slowly as is practicable. Trial static strength tests for ground anchors should follow a different procedure, see **F.2.4**.

NOTE 1 The trial static strength tests are not the same as the proof load tests carried out during a detailed inspection, which have a different test method and a recommended test load of 6 kN.

NOTE 2 The strength of concrete in existing structures is rarely known but can generally be safely assumed to be greater than 30N/mm². Trial tests are therefore not needed in concrete structures if the type test was carried out in a sample of no more than 30N/mm². Trial tests may be justified if the condition of the concrete has deteriorated sufficiently to suggest its strength may be lower than that of the test sample.

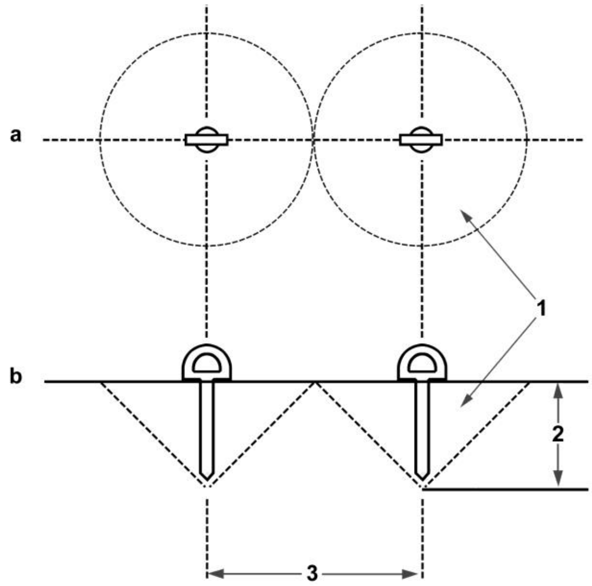
F.2.1.8 Holes for anchor devices to be installed in concrete, masonry or rock should be drilled strictly in accordance with the information supplied by the anchor device manufacturer, particularly in respect of depth and diameter, and thoroughly cleaned, e.g. by brushing and blowing or vacuuming, to remove any dust. Thorough cleaning is essential to ensure a good grip by the anchor device. It is also essential that the recommended embedment depth of fixings is never reduced. If an obstruction during drilling prevents this, the location of the fixings should be moved. An obstruction such as a reinforcing bar may be drilled through with the permission of a responsible engineer.

F.2.1.9 Anchors for rope access are used in pairs (see **Part 2, 2.11.1 and 2.11.2**). When anchor devices are installed in concrete, rock, block-work or brickwork, it is essential that they are spaced apart correctly. This information should be provided by the manufacturer.



a) on horizontal centreline b) offset

Figure F.1 — Examples of minimum spacing between anchor devices set in non-adjacent masonry units



Key

a Upper drawing: plan view
b Lower drawing: side elevation
1 Areas of potential failure
2 Embedment depth
3 Minimum anchor spacing equal to or more than twice embedment depth

Figure F.2 — Example of minimum spacing between anchor devices set in concrete to protect the cone of potential failure around each

F.2.1.10 In masonry, the anchor devices should not be installed in the same or adjacent masonry units. See **Figure F.1** for examples of minimum spacing. Anchor devices may be installed on a horizontal, diagonal or even vertical centreline. Where mortar joints are visible, the minimum spacing would be 350 mm and where the joints are not visible, the minimum spacing would be 500 mm.

F.2.1.11 In materials such as rock or concrete, there is a need to protect the cone of potential failure around each anchor device. This cone is usually considered to have a maximum radius equal to the depth of the installed anchor, including any structural anchor, and thus affects the minimum spacing between the anchor devices: see **Figure F.2**. Attention is drawn to the need to take account of the effect of increased Y angles if the spacing between anchor devices is wide: see **Part 2, 2.11.2** and **Part 2, Figure 2.4**.

F.2.1.12 Other factors that need to be addressed when deciding upon the spacings include:

a) the strength and nature of the base material;

b) the ability to share the load equally between the anchors.

F.2.1.13 Installed anchor devices that are intended to be removed from the structure or natural feature during inspection should be inspected, taking account of the advice given in **Part 2, 2.7.9, 2.10** and **2.11.2**. Where any safety critical part of anchor devices (e.g. fixings) are covered during or after installation, e.g. by roofing materials, the visible parts should be inspected as recommended by the manufacturer and, at a period not exceeding ten years, the coverings should be removed and the anchor device should be inspected.

F.2.1.14 For installed anchor devices that cannot be removed for detailed inspection at the recommended regular intervals, e.g. 6 months, the installer should provide information on the life expectancy of the anchor devices to the building owner, together with instructions to take the anchor devices out of service as soon as the life expectancy date has been reached.

F.2.2 Anchor rails and other rigid horizontal anchor lines

F.2.2.1 Anchor rails provide variable anchor points on a horizontal plane and are useful where a number of descents or ascents are required from the same plane, e.g. for maintenance to columns and rows of windows on the side of a building. They typically comprise appropriate metal tubing and brackets, which are usually fitted permanently to the structure. See **Figure F.3** for an example of an anchor rail.

F.2.2.2 Attachment to an anchor rail is typically made by the use of two anchor slings passed around the anchor rail, each linked with an appropriate connector, to which the working line and the safety line are independently connected. Some anchor rails are fitted with travellers (mobile anchor points) to which the working line and safety line are independently connected.

F.2.2.3 Anchor rails are a type of rigid horizontal anchor line. When attached correctly to a structure or natural feature, horizontal anchor lines (both rigid and flexible) can be considered to be a type of anchor device (which uses a mobile anchor point or points). If a type of rigid horizontal anchor line other than an anchor rail is chosen for use and it does not conform to a recognized standard, it is recommended that the testing, installation and use generally follow the same recommendations as those outlined in **F.2.2.4** to **F.2.2.7**.

NOTE Flexible horizontal anchor lines are to be covered in the first revision of Annex L, Other harness-based work at height access methods, which is due to be published in the summer of 2013.

F.2.2.4 In the absence of any recognized standards for anchor rails, it is recommended that anchor rails are designed by a competent engineer. In addition, it is recommended that a static strength type test is carried out and that anchor rails (including any travellers, where travellers are intended to be used) are able to withstand a minimum static load of (15 +1/0) kN for (3 +0,25/0) min when the load is applied gradually, i.e. as slowly as is practicable, at:

a) an extremity anchor;

b) an intermediate anchor if one is fitted;

c) the centre of the largest span;

d) the centre of any span containing a joint in the anchor rail;

e) the end of any cantilevered section.

NOTE A span is considered to be the distance between:

a) extremity anchors (i.e. anchors at the ends of an anchor rail), where there is no intervening intermediate anchor;

b) an extremity anchor and an intermediate anchor;

c) two intermediate anchors.

F.2.2.5 The type test should be carried out on a sample of the anchor rail installed as recommended by the manufacturer of the anchor rail in a sample of the base material that is representative of the base material to which it is intended to install the anchor rail for the rope access work in hand. If the type test is to be carried out on site, it should be well away from this work area. The static test load to be applied to the anchor rail should be in the intended direction of use, e.g. in shear.

F.2.2.6 The static strength test described in **F.2.2.4** and **F.2.2.5** should be applied to the anchor rail via an anchor sling fitted to the anchor rail or, if the anchor rail system is intended to incorporate a traveller, via a traveller fitted to the anchor rail. During the test, yielding is acceptable but should take into account any necessary clearance distances required to avoid contact by the rope access technician with the ground or structure, should a fall occur.

F.2.2.7 Normally, only one rope access technician should be attached to any one span of the anchor rail at any one time. When establishing the static strength of an anchor rail, the possibility of use by more than one person per span should be taken into consideration and the strength increased accordingly. Advice on what the increase should be is not given in this annex because opinions vary between different countries, their authorities and their standards bodies. Consideration should also be given to extra loads that may be imposed during rescue.

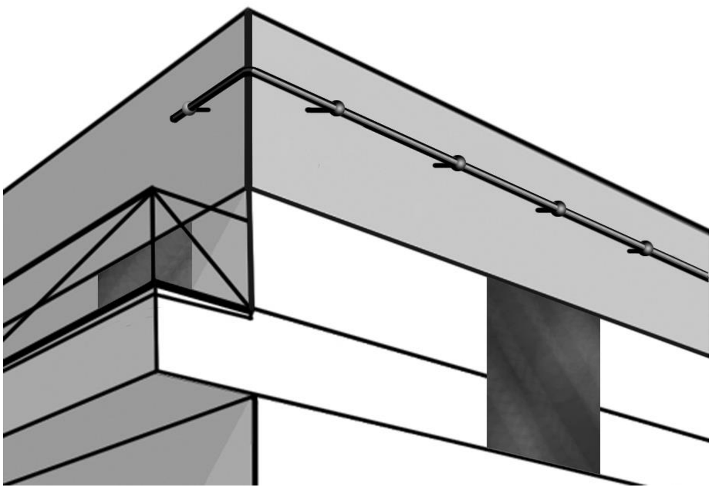


Figure F.3 — Example of an anchor rail

F.2.3 Paired anchor devices

F.2.3.1 A paired anchor device consists of two anchor points mounted on a single base and includes the elements (fixings) used to fix the paired anchor device to the base material. The base element of a paired anchor device is that part to which the anchor points are attached and which is used to attach the paired anchor device to the base material.

F.2.3.2 There are several types of paired anchor device, see **Figure F.4**, with potential for more designs. A typical design is one where the base element of the paired anchor device is of a box type construction, with appropriate proprietary eyebolts attached to provide the anchor points. A typical application of paired anchor devices is installation to a flat roof structure made of concrete. The base element of the paired anchor device is usually partially or completely covered by roofing membranes or coatings after installation.

F.2.3.3 Paired anchor devices may sometimes be fitted to walls or other inclined structures. It is recommended that they are not installed or used in brick constructions, either solid or cavity, or constructions of lightweight, thermal or hollow block-work, as the structure is unlikely to be able to withstand potential loads, especially fall arrest loads, which could be imposed as a result of foreseeable misuse. In any case, for this type of construction, other anchor options, e.g. multiple independent anchor devices, are likely to be more suitable than paired anchor devices. For other base materials, such as constructions of dense aggregate concrete blocks and other masonry constructions, the manufacturer should be consulted.

F.2.3.4 Paired anchor devices may be used for personal fall protection purposes other than rope access. They should be designed, tested, selected and installed such that they also cater for fall arrest. Markings on the paired anchor device should indicate the uses permitted by the manufacturer.

F.2.3.5 To avoid unwanted galvanic corrosion, all metal parts of the paired anchor device that could come into contact with each other should be of the same material. However, sometimes this is not possible or at least very difficult to achieve. If the various parts of the paired anchor device are manufactured from different metals, e.g. the anchor devices are made from stainless steel and the base element is made from galvanised carbon steel, it is essential they are isolated from each other at the time of installation (including within thread engagement areas). Any holes through which an anchor device is attached to the base element of the paired anchor device should be sealed to prevent the ingress of water.

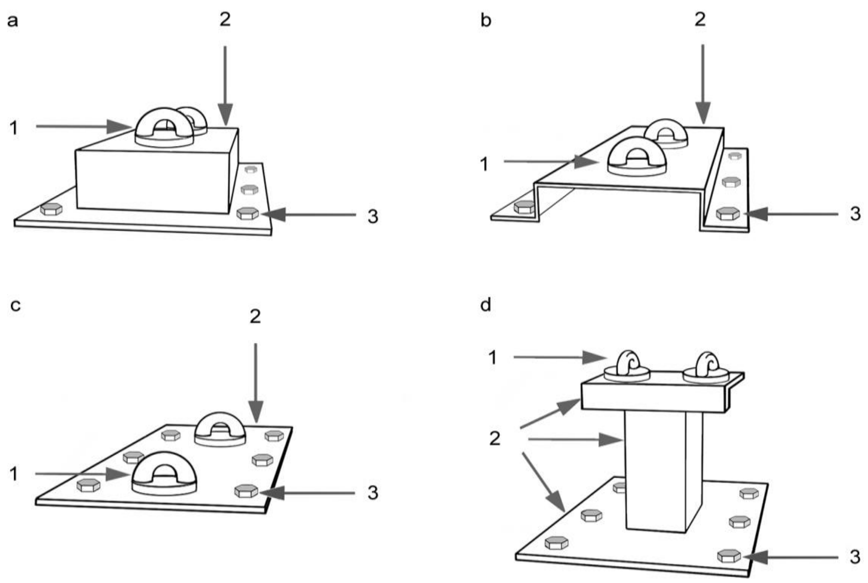
F.2.3.6 Unless otherwise specified by the manufacturer of the paired anchor device, all the fixing holes provided should be used when fixing the paired anchor device to the base material.

F.2.3.7 Where as part of the installation it is intended to cover the base element of the paired anchor device with some form of waterproof membrane or coating, this should be done in such a way that there can be no ingress of water and in accordance with the information provided by the manufacturer.

F.2.3.8 The pre-use check and inspection of paired anchor devices should follow the advice provided by the manufacturer and that given in **Part 2, 2.10**. Where paired anchor devices are intended to be removable, they should be removed during the detailed inspection. When paired anchor devices are partially covered by roofing materials such as waterproof membranes or coatings, it becomes difficult or impossible to carry out a full inspection, e.g. including the base plate and the fixings. In this case, the paired anchor devices may be considered as not being intended to be removable. However, there is a need at some stage to carry out an inspection of the whole paired anchor device. This is known as a complete inspection.

F.2.3.9 Where paired anchor devices are not intended to be removed at the time of detailed inspection, then at intervals not exceeding ten years they should undergo a complete inspection. A sample of 5% per discrete site, chosen at random, with a minimum of at least two whole paired anchor devices, should be exposed by removing any coverings or coatings. Future samples for removal should be different from previous samples. The fixings should then be undone, their specification checked against the manufacturer’s specification and the paired anchor device removed

for examination. The paired anchor device (including the fixings) should be disassembled as far as possible (e.g. if anchor points are removable, they should be removed) and the component parts examined for wear, corrosion, damage, deformation, degradation of plating or welds or any other defect. Any item showing any defect should be withdrawn from service and the sample rate doubled (i.e. a total of 10% or at least four paired anchor devices). Should any further defects be found, all the remaining paired anchor devices should be subjected to a complete examination.



Key

a Box paired anchor device
b Saddle paired anchor device
c Flat plate paired anchor device
d Pedestal paired anchor device

1 Anchor point
2 Base element
3 Fixing

Figure F.4 — Examples of paired anchor devices

F.2.4 Ground anchors

F.2.4.1 Ground anchors are driven or otherwise embedded into the base material, i.e. the ground, to which anchor lines are connected either directly or indirectly. They are generally used in situations where there are no other viable anchor alternatives.

F.2.4.2 There is a variety of types of ground anchor. However, the guidance in this annex is limited to the type where metal stakes, typically made from steel or aluminium alloy, are driven into the ground and linked together with a connecting line.

F.2.4.3 A ground anchor comprises the number of elements (ground anchor elements) inserted into the ground required to provide a reliable anchor of sufficient strength when the ground anchor elements are linked together.

F.2.4.4 Ground anchors should always consist of more than one ground anchor element – usually, there are several – which should be linked together in such a way that the load is shared, see **Figure F.5**. When loaded, each inserted ground anchor element should to be in equal tension with the others to maximize the load-bearing ability of the combination of them. The angle at which a connecting line or an attached anchor line emanates from the leading ground anchor element could

influence this load sharing detrimentally by applying unequal loading, so care should be taken to keep connecting lines and anchor lines in the correct orientation.

F.2.4.5 Prior to installation, checks should be made to ensure the ground into which the ground anchors are to be installed does not contain any services, e.g. gas pipes, sewer pipes, drainage pipes, electricity cables, that are located where they could be damaged by the ground anchors.

F.2.4.6 It is essential that each ground anchor element is strong enough for its intended task and has an adequate safety margin. Therefore, it is recommended that each ground anchor element should be capable of withstanding a static load of 15 kN for 3 min when tested in shear with the element fixed in an appropriate way in a suitable test rig. The static load should be applied gradually, i.e. as slowly as is practicable, at the attachment points or positions on the ground anchor element intended for the attachment of the anchor line or connecting line, as recommended by the manufacturer of the ground anchor element.

F.2.4.7 The integrity of any installed ground anchor relies heavily on the resistance provided by the ground into which it is installed, which can vary from installation area to installation area or even within one installation area. Correct installation also relies greatly on the skills and experience of the installer and on a good risk assessment.

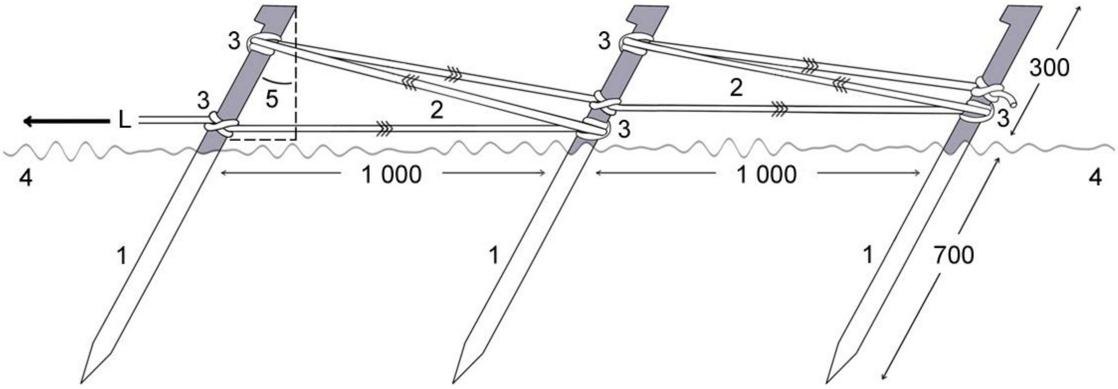
F.2.4.8 It is recommended that the resistance provided and reliability of any area of ground used in the installation of ground anchors is proven. This can be achieved by carrying out trial static strength tests. These static strength tests should be carried out near but not at each worksite in an area that is representative of the ground in which it is intended to install the ground anchors for the rope access work in hand.

F.2.4.9 An effective test method is to install one ground anchor element into the ground at the recommended backward leaning angle (see **F.2.4.11**) and then apply a load at the intended point of attachment for the anchor line in the intended direction of use. The load should be applied gradually, i.e. as slowly as is practicable. Record the peak load (up to a maximum of 15 kN for 3 min) at which it is pulled from the inserted angle to become vertical, or at which any part of a ground anchor breaks or fails in another way before reaching a vertical position. Then, divide that peak load into the minimum static strength required, which is 15 kN per single user. This gives an approximate number of ground anchor elements needed to be installed. As a precaution, at least one more ground anchor element should be added to the group.

F.2.4.10 For greater confidence, the static strength test can be carried out on the full configuration of ground anchor elements (i.e. the ground anchor), which both on test and in use should always be linked together in such a way that the load is shared by all of them. The ground anchor should be tested in accordance with its intended configuration in use, in an area that is representative of the ground where it is intended to install the ground anchors for the rope access work in hand but, to avoid any possibility of weakening the ground, not at the worksite itself. The test should be considered to have failed if any ground anchor element moves from the inserted angle to become vertical, or if any part of a ground anchor breaks or fails in another way before reaching a vertical position.

F.2.4.11 Tests have shown that a reliable ground anchor configuration can be achieved if the ground anchor elements are placed in line behind each other, about 1 m apart, in such a way that the loading during use follows that line. However, other configurations may be appropriate. The preferred length for ground anchors is 1 m and they should be installed into the ground by two thirds of their length at a backwards leaning angle from vertical of between 10° and 15°, see **Figure F.5**.

F.2.4.12 The cross section of the metal stake used as a ground anchor element can affect its holding power in the ground. For example, in tests, the average strength for a 35 mm diameter round bar across various ground types was approximately 4 kN. The round bar version was outperformed by a ground anchor element made from 40 mm T section and 50 mm right-angled section by around 35% and 45% respectively. Employers should establish for themselves their preferred profile, e.g. by testing.

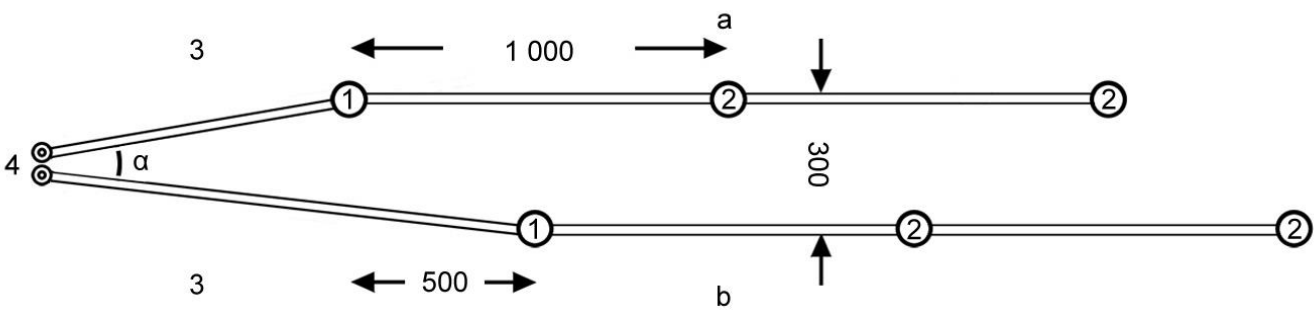


Dimensions are in mm and are approximate

Key

1 Ground anchor element
2 Connecting line (arrows show direction of fitting to ground anchor elements)
3 Clove hitch
4 Ground level
5 Angle of insertion of ground anchor element into ground (10° to 15° off vertical)
L Load

Figure F.5 — Example of length, depth, spacing and angles of installation of ground anchor elements



Dimensions are in mm and are approximate

Key

a Ground anchor a with 3 ground anchor elements
b Ground anchor b with 3 ground anchor elements offset from those in a
1 Leading ground anchor element
2 Ground anchor element
3 Connecting line
4 Connecting line terminations
α Shallow included angle to help equalise loading on ground anchor elements

Figure F.6 — Example layout for two ground anchors and connecting lines

F.2.4.13 A key factor in establishing a safe ground anchor configuration is the way in which the ground anchors are linked together, see **F.2.4.4**, which should be such that the load is shared as equally as possible by all the ground anchor elements from which the ground anchor is comprised. An example of one proven method is shown in **Figure F.5**. In this example, a connecting line, e.g. a length of 11 mm diameter low stretch kernmantel rope, is linked without slack to both the top and bottom of the part of the ground anchor element protruding from the ground, using clove hitches. This is terminated in a loop, e.g. by a figure of eight knot, to which an anchor line may be connected via an appropriate connector. An alternative is to terminate the connecting line at the leading ground anchor element and then to connect the anchor line directly to this leading ground anchor element.

F.2.4.14 When the choice at a work site is to use only ground anchors, there should be a minimum of two ground anchors for each rope access system, see **a** and **b** in **Figure F.6**, to provide independent anchor points for the working line and the safety line.

F.2.4.15 Tests have shown that an effective position for the second ground anchor (e.g. **b** in **Figure F.6**) is to install it approximately 300 mm away from and parallel to the first ground anchor (**a** in **Figure F. 6**) and with the second ground anchor elements set approximately 500 mm back from the first ground anchor elements, i.e. so they are offset, e.g. as shown in **Figure F.6**.

F.2.4.16 The included angle created by the connecting lines emanating from each leading ground anchor element should be such that all the ground anchor elements of each ground anchor are loaded as equally as possible.

F.2.4.17 Designs and configurations of ground anchors not covered by this annex should be tested extensively and proved to be reliable before being put into use.

F.3 Placed anchor devices

CAUTION! Anchor devices should only be placed by competent persons, who should have the experience or have been trained in the placement of each type of anchor device they intend to place.

F.3.1 General

F.3 gives advice to consider when placing anchor devices for use in rope access. However, this advice does not replace proper training. Neither does it replace the need for a thorough understanding of and adherence to the information supplied by the manufacturer of the anchor devices or his authorized representative.

F.3.2 Tripods and quadpods

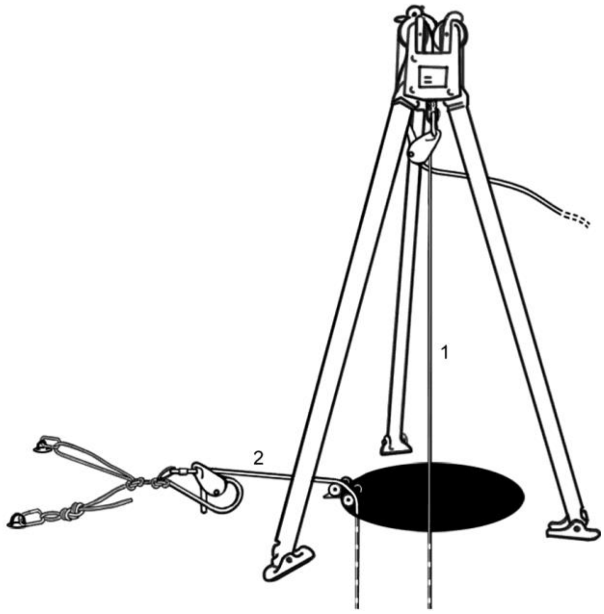
Tripods and quadpods can be used to provide an anchor point for the working line directly above the desired point of access, e.g. above a manhole, see **Figure F.7**. They should be positioned only on stable and even surfaces and placed in such a way that they cannot become accidentally dislodged during use. Tripods and quadpods should be able to withstand a static load of at least 15 kN when tested vertically downwards from the anchor point. This should be confirmed by the manufacturer. Account should be taken of the need for the safety line to be anchored independent of the tripod or quadpod, e.g. as shown in **Figure F.7**.

F.3.3 Deadweight anchors

F.3.3.1 Deadweight anchors are one way of providing anchor points on roofs where no other appropriate anchor points exist. They typically comprise a weighted metal base with an anchor point to which an anchor line may be attached.

F.3.3.2 The performance of a deadweight anchor or combination of deadweight anchors relies primarily on the amount of friction between the deadweight anchor device and the surface upon which it is placed, see **Figure F.8**. If the friction is insufficient, the deadweight anchor could slide out of position when submitted to a load such as that generated in a fall or during repetitive applications of loads such as those applied when descending or ascending the working line.

F.3.3.3 The frictional resistance of any deadweight anchor system should be such that it does not slip when under a load that could be applied while work is being carried out from it, e.g. a fall generating 6 kN, with a safety factor of 2.5, i.e. 15 kN.



Key

1 Working line
2 Safety line

Figure F.7 — Example of a tripod anchor device (in this example with working line and safety line rigged for rescue)

F.3.3.4 After testing and/or a risk assessment, a single deadweight anchor may be used if it is judged that it would have sufficient mass and frictional resistance to the ground to provide an unquestionably reliable anchorage for both the working line and the safety line, and that there are appropriate attachment points for these anchor lines. Where the frictional resistance of one deadweight anchor is insufficient, two or more deadweight anchors may be used. Their frictional resistance should be confirmed as sufficient by testing and/or risk assessment.

F.3.3.5 Where two or more deadweight anchors are used, the working line and the safety line should be connected to all these deadweight anchors. The working line and the safety line should be arranged so that the load is shared equally between the deadweight anchors, to ensure that the minimum load at which they start to slip under load is over 15 kN, see **Figure F.8**.

F.3.3.6 Consideration should be given to any potential rescue scenario, where the weight of two persons might have to be taken into account. This is likely to require the use of an additional deadweight anchor.

F.3.3.7 The reduction of friction and the potential for inadvertent sliding of the deadweight anchor when subjected to a load can be caused in a number of ways:

a) insufficient weight; weights attached incorrectly;

b) insufficient roof surface roughness, e.g. caused by a smooth weather-proofing to the roof;

c) inappropriate type of roof surface e.g. the type of roof ballast used;

d) surface water, e.g. after rain;

e) surface contaminants, e.g. lichen; moss; chemicals;

f) icy conditions, e.g. caused by overnight freezing after rain;

g) the roof angle and pitch, especially on a downward slope.

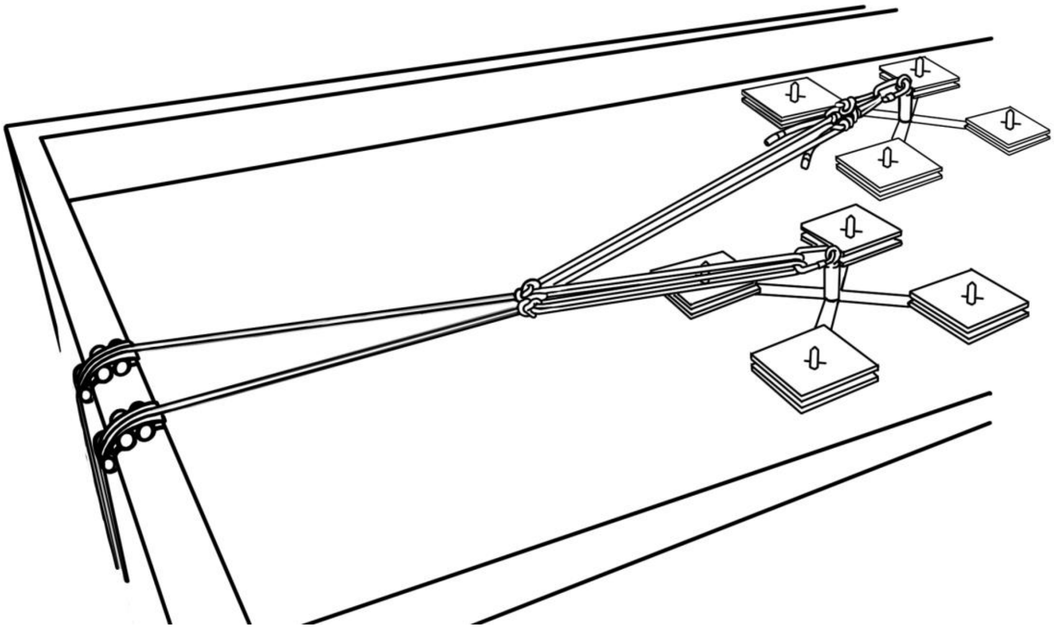


Figure F.8 — Example of two deadweight anchor devices sharing the load

F.3.3.8 A deadweight anchor should be able to withstand a minimum static load of (15 +1/0) kN for (3 +0,25/0) min when tested in the test house with the base fixed and the load applied to the anchor point in the direction(s) intended in use. The load should be applied gradually, i.e. as slowly as is practicable. During the test, yielding is acceptable but should take into account any necessary clearance distances required to avoid contact by the rope access technician with the ground or structure, should a fall occur.

F.3.3.9 The weights used with deadweight anchors should be made of a material that cannot leak or flow. Sand and/or water bags should not be used. Examples of appropriate materials for counterweights are steel, lead, concrete.

F.3.3.10 The weights should be connected to the deadweight anchor in such a way that prevents them from becoming detached, e.g. by vibration sliding them out of position, and be protected against tampering, e.g. by chaining and locking them. Nevertheless, the weights should always be checked before each use.

F.3.3.11 Other aspects that should be addressed when using deadweight anchors are:

a) strictly follow the manufacturer's guidance;

b) the maximum potential load that could be applied to the deadweight anchor;

c) that there are sufficient weights and that these are correctly positioned on the frame of the deadweight anchor. (An insufficient number of weights and/or incorrectly positioned weights can cause the deadweight anchor to topple under load);

d) that the strength of the roof is sufficient for the weights intended to be applied;

e) that the minimum distance from the edge of the roof to the deadweight anchor is as specified by the manufacturer;

f) that the presence of a parapet or upstand does not impede the functioning of the deadweight anchor device.

F.3.3.12 Deadweight anchors should not be used in freezing conditions or when there is a risk of such conditions. Ice acts as a lubricant and is likely to severely reduce the coefficient of friction between the deadweight anchor and the surface of the roof.

F.3.3.13 Deadweight anchors should not be used on any surface that is more than 5° sloping downwards from the horizontal. There are occasions where deadweight anchors can be placed on an upward slope, e.g. on the non-working side of a roof with a ridge, which would require the deadweight anchor device to travel up the slope if subjected to a load. In this case, the maximum recommended upward angle from the horizontal is 15°.

F.3.3.14 It is recommended that deadweight anchors are backed up if possible, e.g. if there is an appropriate structural element of the building in the vicinity.

F.3.4 Counterweight anchors

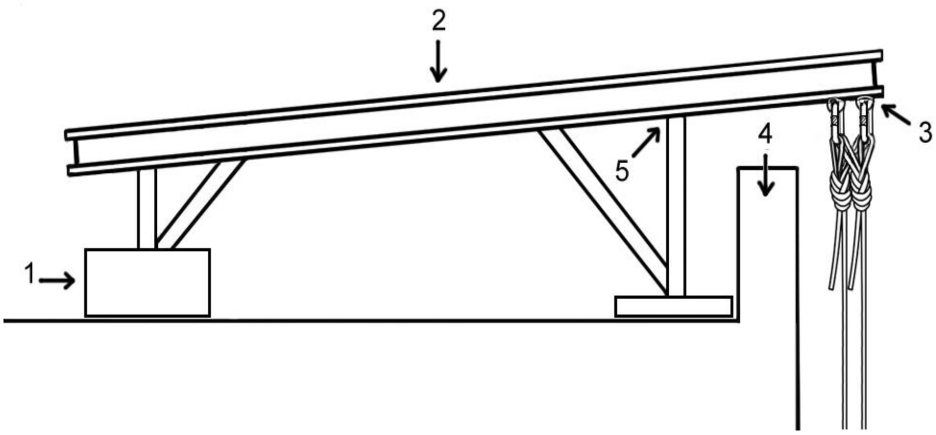
F.3.4.1 Counterweight anchors are another way of providing anchor points on roofs where no other appropriate anchor points exist. They typically comprise a metal base loaded with weights and an attached arm, with a support to provide a pivot point. The arm projects over the edge of the building to provide the descent/ascent take-off point for the rope access technician. The pivot point is the point from which the outer part of the arm becomes unsupported. See **Figure F.9** for an example of a counterweight anchor.

F.3.4.2 After testing and/or a risk assessment, a single counterweight anchor may be used if it is judged that it would have sufficient mass to provide an unquestionably reliable anchorage for both the working line and the safety line, and that there are appropriate attachment points for these anchor lines. Where the mass of one counterweight anchor is insufficient, two or more counterweight anchors may be used. Their mass should be confirmed as sufficient by testing and/or risk assessment.

F.3.4.3 Where two or more counterweight anchors are used, the working line and the safety line should be connected to all these counterweight anchors. The working line and the safety line should be arranged so that the load is shared equally between the counterweight anchors, to ensure that the minimum load at which they start to lift under load is over 15 kN.

F.3.4.4 Consideration should be given to any potential rescue scenario, where the weight of two persons might have to be taken into account. This is likely to require the use of an additional counterweight anchor.

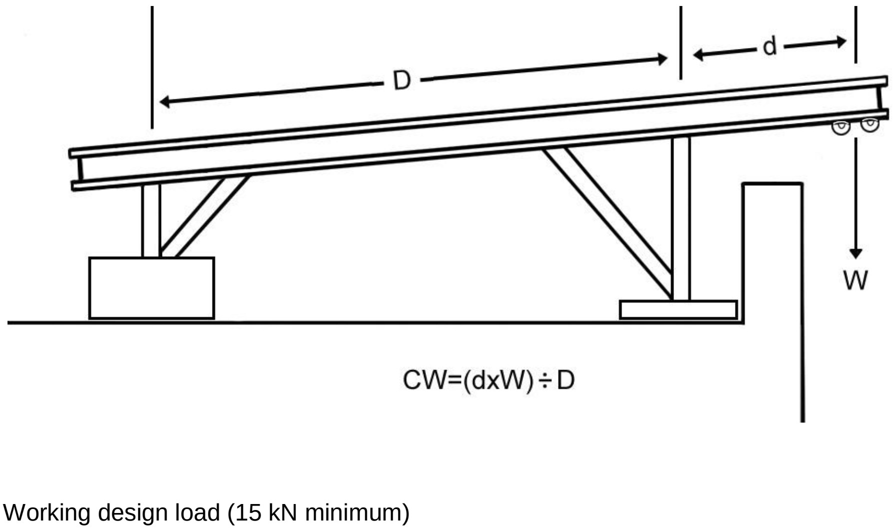
F.3.4.5 The performance of a counterweight anchor relies primarily on the combination of the amount of mass placed at its inner end and, very importantly, the position of the pivot point towards the outer end of the arm, i.e. the end that projects over the edge of the structure. This combination has to be correct to prevent the weighted base from lifting from the surface on which it lies when it comes under load.



Key

1 Counterweight
2 Arm
3 Anchor points
4 Roof parapet
5 Pivot point

Figure F.9 — Example of a single counterweight anchor device being used as an anchor device for two anchor lines



Key

W Working design load (15 kN minimum)
CW Minimum counterweight (mass) required (kg)
d Length of outrigger from front support (mm)
D Dimension from centre of anchor points to centreline of counterweight (mm)

Figure F.10 — Example of a calculation of the counterweight required for a counterweight anchor device

F.3.4.6 It should be noted that counterweight anchors function differently from deadweight anchors. The primary function of the weighted base of a deadweight anchor is to provide enough friction between it and the roof surface to stop it from sliding out of position, not to stop it lifting from the roof surface, which is the primary function of the weighted base of counterweight anchors.

F.3.4.7 Counterweight anchors work on the principle of a lever. The dimension from the pivot point to the outer end of the arm should be kept as short as possible, while the dimension from the pivot point to the counterweights should be as long as possible so that the number and mass of the weights required is kept to a minimum.

F.3.4.8 Users should be aware that the cantilever length of different designs of counterweight anchor varies. This length affects the maximum cantilever capacity and this in turn the suitability for use in rope access.

F.3.4.9 It is critically important that the pivot point of a counterweight anchor is established accurately. A small inaccuracy, say 50 mm, can make a large difference to the number of counterweights required. This is particularly so where the counterweight has a short arm or where the arm projects substantially beyond the pivot point. **Figure F.10** shows how to calculate the minimum counterweight required.

F.3.4.10 Counterweight anchors are typically adapted for rope access from the swing stage (suspended platform) industry. Unless a counterweight anchor has been designed specifically for rope access, it is strongly recommended that an engineering assessment is made as to its suitability, bearing in mind that a load in a fall could be higher than that in normal swing stage use.

F.3.4.11 The counterweight anchor should be able to withstand a minimum static load of (15 +1/0) kN for (3 +0,25/0) min without any permanent deformation or any movement of the counterweights from the surface on which they rest, when tested at the anchor point at the outer end of the arm, with the load applied gradually, i.e. as slowly as is practicable.

F.3.4.12 Counterweights should be made of a material that cannot leak or flow. Sand and/or water bags should not be used. Examples of appropriate materials for counterweights are steel; lead; concrete.

F.3.4.13 The counterweights should be connected to the arm in such a way that prevents them from becoming detached, e.g. by vibration sliding them out of position, and be protected against tampering, e.g. by chaining and locking them. Nevertheless, the counterweights should always be checked before each use.

F.3.4.14 The arm should always be set up to be either horizontal or with a slight slope to the rear. Steep sloping of the arm should be avoided.

F.3.4.15 The arm may be supported on purpose-made frames or on a built up scaffold frame. It is essential that the frame is designed for the loads to be imposed, which may be very high at the front, and also so that stability of the arm is ensured, including when the counterweights are fitted.

F.3.4.16 The arm should only be rested on a parapet if it can be verified that the parapet is strong enough and stable enough to support the load, including any lateral load. This may require the services of an appropriate engineer. As many parapets are rendered, it may be necessary to verify that the substructure is satisfactory, particularly in the case of brickwork, or even pre-cast concrete where it may be strong enough in itself, but not attached well enough to the building to be stable. It should be noted that some parapets look solid but are made from materials inappropriate for use in the counterweight anchor system, e.g. plastic foam; timber framing; loose bricks.

F.3.4.17 It is recommended that counterweight anchors are backed up if possible, e.g. if there is an appropriate structural element of the building in the vicinity.

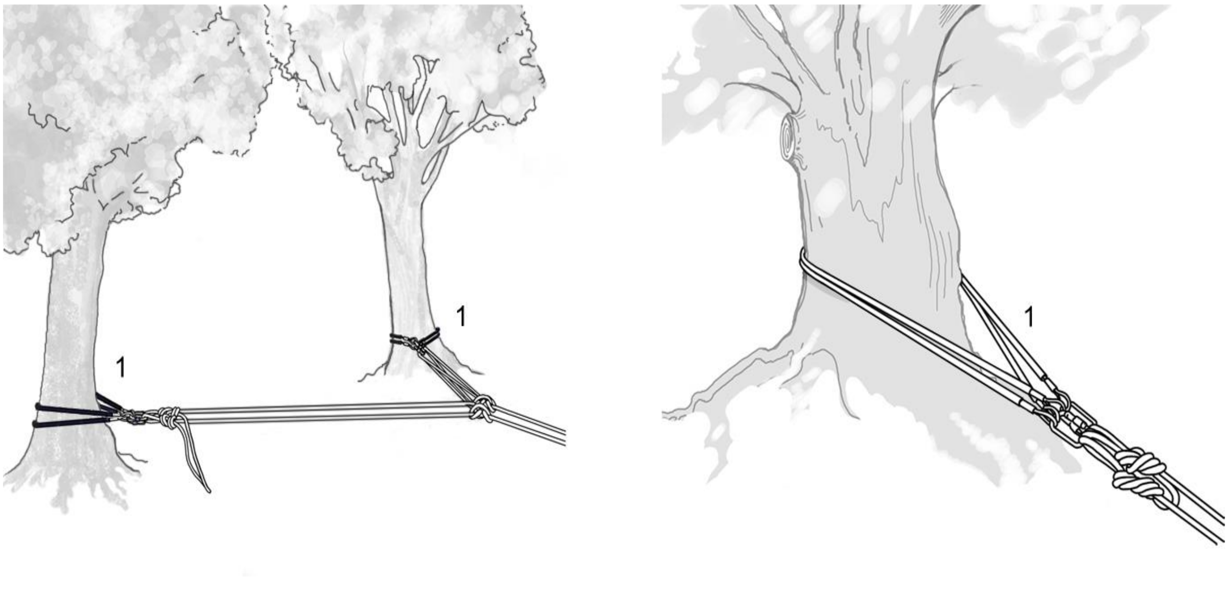
F.3.4.18 Rescue should only be carried out by lowering or lifting the casualty, i.e. the counterweight anchor should not be called upon to support the mass of two persons or more, unless this has been addressed at the design and assembly stage, e.g. see **F.3.3.8**.

F.3.5 Natural anchors (e.g. trees, rock)

F.3.5.1 There is no simple formula for assessing the strength of natural anchors. Use of these types of anchor relies on the experience of users and, sometimes, assessment by an engineer and/or other specialists. The selection of suitable natural anchors, such as trees, see **Figure F.11**, or rock features, e.g. spikes or bollards, see **Figure F.12**, for the placement of anchor slings requires a large amount of judgement, particularly in terms of their stability.

F.3.5.2 Trees differ in their ability to withstand loads applied to their trunk or branches by species, size and time of year. Attention should be paid not only to the integrity of the trunk or branch to which attachment of the anchor sling is intended, but also to the integrity of the root system. Trunk or branch breakage or splitting, dead trunk or branches, rot and fungal growth, excessive insect activity and disturbance of the root system may all be indicators that the tree is not suitable for anchorage use. Anchor slings are best placed so that they cause as little leverage as possible, e.g. at the base of the trunk or close to the trunk if attached to a branch. Advice may be sought from specialist arborists.

F.3.5.3 Rock features to be used as anchors should normally be part of the bedrock and should not exhibit any signs of fracturing or other defect that could cause their failure. Large boulders could be used if a risk assessment indicates sufficient integrity. The area at the back of a rock feature where any load would be applied by the anchor sling should have such characteristics that the anchor sling would not roll off it or be cut or badly abraded when in use, either during normal rope access activities or in the event of a fall. Sharp edges should be avoided or at least protected against. Dependent upon the precise use intended, consideration should be given to the possibility that the anchor sling might be inadvertently lifted off the rock feature during any upwards movement.



a) Two small trees

b) One large tree

Key

1 Two anchor slings, each with its own connector

Figure F.11 — Examples of trees being used as anchorages

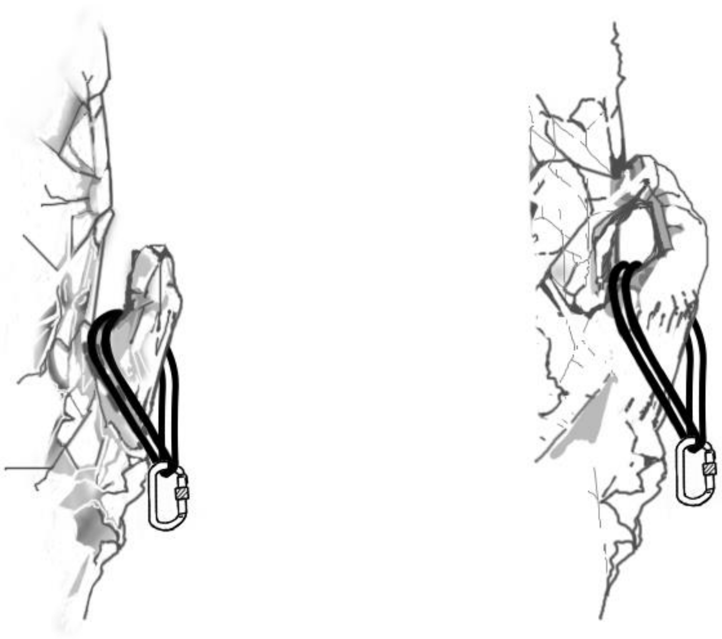


Figure F.12 — Examples of rock features being used as anchorages

F.3.6 Vehicles and mobile site machinery

F.3.6.1 Vehicles and mobile site machinery of various types can make effective anchors. Only reference to vehicles is made in the advice that follows but this advice may also be applied to any mobile site machinery considered for use as an anchor.

F.3.6.2 After testing and/or a risk assessment, a single vehicle may be used as the anchor if it is judged that it would have sufficient mass and frictional resistance to the ground to provide an unquestionably reliable anchorage for both the working line and the safety line, and that there are appropriate attachment points for these anchor lines. Where the frictional resistance of one vehicle anchor is insufficient, two or more vehicle anchors may be used. Their frictional resistance should be confirmed as sufficient by testing and/or risk assessment. The working line and the safety line should be arranged so that the load is shared equally between the vehicles.

F.3.6.3 When selecting attachment points, care should be taken to ensure no damage to the vehicle could occur, particularly to safety critical parts, e.g. hydraulic brake pipes, electrical cables.

F.3.6.4 The surface upon which a vehicle is to stand during use as an anchor device should provide sufficient friction to avoid movement (sliding) of the vehicle should a load be applied such as that which could be applied during a fall, plus a safety factor of 2.5. It is recommended that this is checked before use by employing a load cell and a method of applying a pulling load, to confirm that there is no slippage under a minimum static load of (15 +1/0) kN for (3 +0,25/0) min when the load is applied gradually, i.e. as slowly as is practicable.

F.3.6.5 There should be no possibility that the vehicle engines could be started or that the vehicle(s) could be moved, e.g. by being pushed or by being impacted by another vehicle. Correct isolation of the vehicle(s) should be ensured. Wheel chocking may be necessary. Barricading should be provided to make the vehicle(s) part of an exclusion zone. Signs warning of the dangers of unauthorized movement should be considered. A sentry may be required.

F.3.6.6 Vehicles should never be used to tension an access system.

F.3.7 Anchor connectors (e.g. scaffold hooks)

F.3.7.1 When a connector is attached directly to the structure (as opposed to being attached to an anchor device), the connector effectively becomes an anchor device. See **Part 2, 2.7.4** for advice on connectors.

F.3.7.2 When attaching any connector directly to the structure, great care should be taken during placement to avoid the possibility of a sideways loading should the connector be subjected to a load, e.g. the weight of a person or the force generated in a fall. This can happen when a connector is attached to an upright on the structure, e.g. a vertical scaffold pole or diagonal latticework on a mast. Connectors are weak when loaded sideways.

F.3.7.3 It is important that an appropriate type of connector is selected when the intention is to connect directly to a structure. An example is a scaffold hook, which is a special but common kind of anchor connector with a large gate to enable attachment to wide diameter bars and tubes such as scaffolding poles, and has a shape to accommodate these.

F.3.8 Anchor slings

Anchor slings may be used where there are no suitable anchors to which the anchor lines can be attached directly (see **Part 2**, **2.7.8.3, 2.11.2.11** and **2.11.2.13** to **2.11.2.15** for further information). See Figure **F.13**. Other examples of their use are given in Figures **F.11** and F.**12**.

F.3.9 Beam clamps

F.3.9.1 Beam clamps can be useful in providing moveable anchor points on horizontal I-beams. Beam clamps and the I-beams to which they are to be attached should all be of sufficient strength for the planned work. It may require the services of a qualified engineer to ascertain this.

F.3.9.2 When the choice at a work site is to use only beam clamps as anchors, there should be a minimum of two beam clamps for each rope access system to provide independent anchor points for the working line and the safety line.

F.3.9.3 Beam clamps should be securely clamped to the I-beam before use.

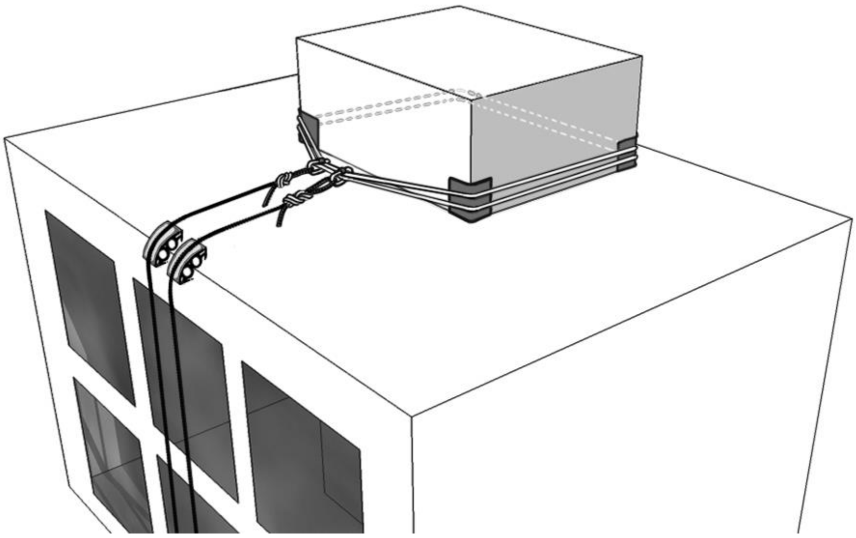


Figure F.13 — Example of the use of anchor slings

F.4 Guidance on documentation to be supplied for permanently installed anchor devices

F.4.1 This guidance covers only permanently installed anchor devices. Permanent in this context means anchor devices that are intended to remain in place and to be re-used as and when required, e.g. not intended to be for a single, temporary use. Placed anchor devices are not covered in this guidance because they are not normally placed permanently. If they are placed permanently, the principles in this guidance should be able to be applied.

F.4.2 The documentation produced after an installation of anchor devices is an essential part of a safe anchor system. For the client, it should provide evidence that the installation has been carried out properly. For the user, it should enable an appropriate and safe use of the anchor system. In addition, the documentation should provide sufficient information for it to be used as the basis for future periodic detailed inspections of the anchor devices. Bearing in mind that the fixings of many anchor devices are not visible or accessible, having accurate, detailed information for use in inspections is of the utmost importance.

F.4.3 Permanently installed rope access anchor systems should be provided with user instructions, which should include a load rating, diagrams showing rigging examples, inspection procedures and, where appropriate, testing procedures.

F.4.4 Once the installation of the anchor devices is completed, copies of the installation documentation should be given to the client. This documentation should be kept on site and be readily available for users and for use in subsequent periodic detailed inspections of the anchor devices.

F.4.5 The installation documentation should contain at least the following information:

a) the address and exact location of the installation of the anchor devices;

b) client details, e.g. name; address; contact person; phone number; email address;

c) installation company details, e.g. name; address; phone number; email address;

d) the name and address of the person in charge of the installation of the anchor devices;

e) details of the building material into which the anchor devices were installed, e.g. concrete ceiling; concrete column; reinforced concrete; concrete strength; minimum thickness;

f) details of the anchor devices installed, e.g. manufacturer; type; model; serial number;

g) details of any fixing device, e.g. manufacturer; type; model; serial number;

h) fixing details, e.g. drill hole diameter; drill hole depth; method of forming hole (such as hammer/rotary drill) torque applied (torque control); drill hole clearing method; fitted wet or dry; minimum edge distances; minimum axial spacings; permissible tensile load; permissible shear load.

F.4.6 It is recommended that a schematic installation plan is prepared, which shows relevant information for both users and inspectors. This could be attached to the structure in a place where it is visible or available for all relevant persons.

F.4.7 As part of the schematic plan, it is recommended that each anchor point and its location are identified. This could be by a photograph or photographs of the anchor devices, which have been allocated numbers. This numbering could then be incorporated into the inspection (and test) protocols.

F.4.8 There should be a signed declaration by the person in charge of the installation of the anchor devices at least that the anchor devices were:

a) installed in accordance with the manufacturer’s installation instructions;

b) installed in accordance with the installation plan;

c) fixed to the specified base material (substrate);

d) fixed as specified, e.g. the correct number of bolts; the correct materials; the correct position; the correct location;

e) commissioned in accordance with the information supplied by the manufacturer, e.g. checks and tests;

f) supplied with information detailing the installation, e.g. photographs of the various stages of installation, especially when fixings (e.g. bolts) and the underlying substrate are not visible after completing the installation.