Personal equipment for working at height, Part 4: Selection, use and maintenance

Preface

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee SF-015, Industrial Height Safety Equipment (formerly Industrial Safety Belts and Harnesses), to supersede AS/NZS 1891.~~4:2000. It is one of five Standards in the series *Industrial fall-arrest systems and devices*. The series comprises the following Standards:~~

~~AS/NZS 1891.1, *Personal equipment for work at height, Part 1: Manufacturing requirements for full body combination and lower body harnesses*~~

~~AS/NZS 1891.2, *Industrial fall-arrest systems and devices, Part 2: Horizontal lifeline and rail systems*~~

~~AS/NZS 1891.2 Supp 1, *Industrial fall-arrest systems and devices, Part 2: Horizontal lifeline and rail systems, Supplement 1: Prescribed configurations for horizontal lifelines (Supplement to AS/NZS 1891.2:2001)*~~

~~AS/NZS 1891.3, *Personal equipment for work at height, Part 3: Manufacturing requirements for fall-arrest devices*~~

~~AS/NZS 1891.4~~4:2009, *Industrial fall-arrest systems and devices, Part 4: Selection, use and maintenance*

~~AS. It 1891.5,~~is *one of five Standards in the series Personal equipment for ~~work~~working at height~~, Part 5: Manufacturing requirements for lanyard assemblies and pole straps~~*

~~This Standard incorporates Amendment No~~. ~~1~~A ~~(June 2021). The start and end~~list of ~~changes~~all ~~introduced by the Amendment are indicated~~parts in the ~~text~~AS/NZS ~~by~~ ~~tags~~1891 ~~including~~series can be found in the ~~amendment~~Standards ~~number~~Australia ~~1~~online catalogue.

The objective of ~~Amendment~~this ~~No. 1:2021~~document is to ~~update~~specify ~~referenced~~requirements ~~documents~~and ~~only~~recommendations for the selection, safe use and maintenance of industrial fall-arrest systems and devices.

~~This~~The ~~edition has been prepared with the specific intention of aligning it with the recently published edition of AS/NZS 1891.1.~~

~~Principal~~major changes ~~from~~in ~~the previous~~this edition are as follows:

(a) ~~Removal~~The ~~of "~~document ~~total~~has ~~restraint~~been ~~" from~~restructured ~~the~~to ~~scope~~improve navigation and eliminate duplication of ~~the Standard as equipment provided solely for restraint purposes is not dealt with in the AS/NZS 1891 series of Standards. This Standard recognizes only "restraint technique" which allows for the possibility of a fall and requires the use of fall-arrest rated equipment and anchorages. For clarification purposes a description of "total restraint" is given in Appendix F~~content.

(b) ~~Minimum~~The ~~allowable~~document ~~anchorage~~has ~~strength~~been updated to ~~be~~align ~~12~~with AS/NZS ~~kN~~1891.1, ~~or 15~~AS/NZS ~~kN~~1891.2, ~~depending~~AS ~~on~~ ~~fall~~1891.3, ~~distance~~AS 1891.5, AS/NZS 5532 and AS/NZS ISO 22846.

(c) ~~New~~References ~~terminology~~have ~~for~~been ~~harnesses~~removed from the following documents:

(~~full~~i) ~~or~~AS/NZS ~~lower body)~~4488.2, which has been superseded by AS/NZS ISO 22846.1:2020 and ~~positioning~~AS/NZS ~~of~~ISO ~~fall-arrest attachment~~22846.2:2020; ~~points~~and

(ii) AS 4142.3, which has been withdrawn.

(d) ~~Inclusion~~Additional ~~of~~information ~~twin-tail~~is ~~lanyards~~provided for fall clearance calculations, diversion anchors, chemical fasteners and friction fasteners.

(e) ~~In service~~Scheduled ~~values~~periodic ~~for~~inspection ~~the~~frequencies ~~extension~~have ~~of~~been ~~personal energy absorbers in fall situations~~clarified.

(f) ~~Lower~~The ~~body~~hierarchy ~~harness use restricted to limited free~~of fall-protection ~~and~~system ~~restrained~~has ~~fall~~been clarified.

(g) ~~Updated~~Training and competency requirements ~~for~~have ~~operator~~been replaced with a training requirements clause and ~~assessment~~an informative appendix "Recommended training outcomes". Roles and responsibilities have been removed.

(h) ~~The~~Recommendations ~~term "suspension trauma" has~~have been ~~changed to "suspension intolerance (trauma)".~~

~~(i) A belt or waist strap alone in lieu of a harness is no longer permitted~~included for ~~any~~leading ~~of~~edge ~~the~~and ~~applications~~tie ~~in~~back ~~this~~lanyard ~~Standard to protect against a potential fall~~assemblies.

The ~~term~~terms "normative" and "informative" ~~has been~~are used in ~~this Standard~~Standards to define the application of the ~~appendix~~appendices to which ~~it~~they ~~applies~~apply. ~~An~~A "normative" appendix is an integral part of a Standard, whereas an "informative" appendix is only for information and guidance.

~~Statements expressed in mandatory terms in footnotes to figures are deemed to be requirements of this Standard.~~

1 Scope and general

1.1 Scope

This ~~Standard~~document specifies requirements and ~~sets out~~ recommendations for the selection, safe use and maintenance of industrial fall-arrest systems and devices. ~~based~~It ~~on~~includes the ~~use of safety harnesses, horizontal life lines and rails, fall-arrest devices, and associated lanyards, connectors, anchorages and fittings, as follows:~~following:

(a) ~~*Selection* Requirements and recommendations for determining the types of components of the system that would be appropriate to the envisaged usage~~Harnesses.

(b) ~~*Safe use* Requirements and recommendations relating to the safe practices to be followed in the use of components and assemblies~~Lanyards.

(c) ~~*Maintenance*~~Pole ~~-~~straps.

(d) ~~Requirements~~Connectors.

(e) ~~and~~Anchors.

(f) ~~recommendations~~Fall-arrest ~~for~~devices.

(g) ~~inspection,~~Horizontal ~~storage,~~lifelines.

(h) ~~servicing~~Horizontal ~~and~~rail ~~cleaning practices~~systems.

~~NOTE~~

Personal ~~This~~protective ~~Standard~~equipment ~~provides~~designed ~~guidance~~exclusively for the ~~selection~~following ~~of equipment and safe use procedures for some but not necessarily all forms of height protection or all of the circumstances under which such equipment and procedures are used.~~

~~The selection and safe use of equipment used in total restraint or rope access~~purposes is not covered by this ~~Standard~~document:

(i) Total restraint equipment.

NOTE 1 Total restraint equipment means non-adjustable equipment that will prevent a user reaching a fall zone. For more information, see Appendix A.

(ii) Rescue operations.

(iii) Emergency services.

(iv) Recreational activities.

(v) Theatrical flying.

NOTE 2 Equipment conforming to referenced Standards in this document may be appropriate for the purposes listed in (~~see~~i) to (v).

This document excludes the following:

(A) Topics covered in AS/NZS ISO 22846 Parts 1 and 2.

(B) Performance requirements for ~~selection~~height safety equipment.

NOTE 3 Performance requirements for height safety equipment are specified in AS/NZS 1891. Parts 1, 2 and ~~safe~~3, ~~use~~AS ~~of~~ ~~rope~~1891.5 ~~access~~and AS/NZS 5532.

NOTE 4 Conformance to this document for height and safety equipment~~)~~ cannot be claimed.

~~1.2 Objective and principles~~

~~The objective of this Standard is to provide users of fall-arrest systems and devices with requirements and recommendations relating to their selection, use and maintenance. (See also Clause 1.6, which indicates where fall-arrest systems are placed within the hierarchy of control of fall protection).~~

~~The principles on which these requirements and recommendations are based, are summarized as follows:~~

~~(a) Any person at risk of a potentially injury producing fall shall be secured by equipment that is rated for fall arrest.~~

~~(b) A person suffering a fall when secured by a fall-arrest system shall –~~

~~(i) be subjected to an arresting force not exceeding 6 kN;~~

~~(ii) be wearing equipment that distributes fall-arrest forces over the body in a way that will minimize the possibility of injury;~~

~~(iii) be connected to a system which avoids the user reaching ground or striking any other obstacle that will cause injury, and maintains the user in a suitable post fall-arrest attitude for rescue purposes; and~~

~~(iv) be wearing a harness with at least a front fall-arrest rated attachment point, which may assist in rescue and which is designed to avoid or reduce the likelihood of suspension intolerance (trauma).~~

NOTE This does not preclude the use of other permitted fall arrest rated attachment points.

1.3 Referenced documents

The following documents are referred to in this Standard:

NOTE Excludes some documents listed in the informative bibliography at Appendix B.

AS 1319, *Safety signs for the occupational environment*

AS 1353.2, *Flat synthetic webbing slings, Part 2: Care and use*

AS 1418, *Cranes, hoists and winches (series)*

AS 1657, *Fixed platforms, walkways, stairways and ladders–Design, construction and installation*

AS 1666.2, *Wire rope slings, Part 2: Care and use*

AS 1891.5, *Personal equipment for work at height, Part 5: Manufacturing requirements for lanyard assemblies and pole straps*

AS 2550, *Cranes, hoists and winches–Safe use (series)*

AS 4142.1, *Fibre ropes, Part 1: Care and safe usage*

AS 4497.2, *Roundslings–Synthetic fibre, Part 2: Care and use*

AS/NZS 1891.1, *Personal equipment for work at height, Part 1: Manufacturing requirements for full body combination and lower body harnesses*

AS/NZS 1831.2 Supp 1, *Personal equipment for work at height, Part 2: Horizontal lifeline and rail systems Supplement 1: Prescribed configurations for horizontal lifelines (Supplement to AS/NZS 1891.2:2001)*

AS/NZS 1891.2, *Industrial fall-arrest systems and devices, Part 2: Horizontal lifeline and rail systems*

AS/NZS 1891.3, *Personal equipment for work at height, Part 3: Manufacturing requirements for fall-arrest devices*

AS/NZS 3931, *Risk analysis of technological systems–Application guide*

AS/NZS 5532, *Manufacturing requirements for single-point anchor device used for harness-based work at height*

AS/NZS ISO 22846, *Personal equipment for protection against falls – Rope access systems*

AS/NZS ISO 22846.1, *Personal equipment for protection against falls – Rope access systems, Part 1: Fundamental principles for a system of work*

AS/NZS ISO 22846.2, *Personal equipment for protection against falls – Rope access systems, Part 2: Code of practice*

1.2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document:

NOTE Documents for informative purposes are listed in the Bibliography.

AS/NZS 1891.1, *Personal equipment for work at height, Part 1: Manufacturing requirements for full body combination and lower body harnesses*

AS/NZS 1891.2, *Industrial fall-arrest systems and devices, Part 2: Horizontal lifeline and rail systems*

AS 1891.3, *Personal equipment for work at height, Part 3: Manufacturing requirements for fall-arrest devices*

AS 1891.5, *Personal equipment for work at height, Part 5: Manufacturing requirements for lanyard assemblies and pole straps*

AS/NZS 5532, *Manufacturing requirements for single-point anchor device used for harness-based work at height*

BS EN 362, *Personal protective equipment against falls from a height – Connectors*

1.43 Terms and definitions

ForUnless thedefined purpose of this Standardbelow, the terms and definitions given in AS/NZS 1891, Parts .1, AS/NZS 1891.2, AS 1891.5, and 3AS/NZS and these below,5532 apply to this document.

1.43.1
anchorage slinganchor
aitem sling designedconnected to be placed around a structural element to form an anchorage, and to which the connecting system is attached

Note 1 to entry: These items can include single point anchors or horizontal systems.

1.43.2
anchorage
structure to which an anchor is attached

1.3.3
can
indicates the possibility of an option

1.3.4

chemical fastener

structural fixing held in the anchorage by a curing adhesive

1.3.5

competent person

~~a~ person who has acquired, through education, training, qualification or experience or a combination of ~~training~~these, ~~qualification and experience, acquired~~the knowledge and ~~skills~~skill enabling that person to ~~correctly~~ perform ~~a specified~~the task required

1.~~4~~3.~~3~~6

~~engineer~~connecting system

~~a person who is eligible for Corporate Membership~~part of the ~~Institution~~fall-protection system that connects the harness to the anchor

1.3.7

diversion anchor

anchor used to change the direction of ~~Engineers Australia or~~ the ~~Institution~~user's ~~of~~connecting ~~Professional~~system ~~Engineers,~~without ~~New Zealand and who has appropriate experience and competence to assess the integrity of~~making a ~~building~~fixed ~~or structure and anchorage points~~connection

1.~~4~~3.~~4~~8

fall-arrest device

~~a~ self-locking device ~~meeting~~with ~~the requirements of AS/NZS 1891.3 whose~~a function ~~is~~ to arrest a fall

1.~~4~~3.~~5~~9

fall-~~arrest~~protection system

~~an~ assembly of interconnected components comprising ~~a~~an ~~harness~~anchor connected to ~~an~~a ~~anchorage~~harness ~~point~~via ~~or~~a ~~anchorage~~connecting system

1.3.10

fall ~~either~~clearance

shortest ~~directly~~distance ~~or~~from ~~by~~the ~~means~~anchor to the ground/object that can be struck during a fall

1.3.11

fixed connection

attachment of a ~~lanyard~~connecting system to an anchor that does not allow the connecting system to change length or ~~pole~~to ~~strap~~pass freely through the anchor

1.3.12

free fall

unimpeded downward movement under the influence of gravity

1.3.13

friction fastener

structural fixing held in the anchorage by applying a mechanical force to or cutting a detail in a pre-drilled hole

1.3.14

harness

device to support a user's body and which is attached to the connecting system

1.3.15

horizontal lifeline

HLL

horizontal flexible line connecting two or more anchors

1.3.16

horizontal rail system

HRS

horizontal rigid rail connecting two or more anchors

1.3.17

lanyard assembly

assembly of a line, of either fixed or adjustable length, and ~~whose~~components ~~purpose~~which will enable a connection between a harness and an anchorage, the intent of which is to ~~arrest a fall in accordance with~~limit the ~~principles~~deceleration ~~and requirements of this Standard~~

~~1.4.6~~

~~free fall, free fall-arrest~~

~~a fall or~~during the arrest of a fall

1.3.18

limited free fall

fall where the fall distance before the fall-arrest system begins to take any ~~loading,~~load is ~~in~~less ~~excess~~than 600 mm vertically

1.3.19

may

indicates the existence of ~~600~~an ~option

1.3.20

professional ~~mm~~engineer

person ~~either~~who ~~vertically~~is:

(a) ~~or~~If ~~on~~legislation is applicable – a ~~slope~~registered ~~on~~professional ~~which~~engineer ~~it~~in the relevant discipline who has appropriate experience and competence in the relevant field

(b) If legislation is not ~~possible~~applicable –

(i) a Corporate Member of the Institution of Engineers, Australia; or

(ii) eligible to ~~walk~~become ~~without~~a Corporate Member of the ~~assistance~~Institution of ~~a~~Engineers, ~~handrail or hand line~~

~~**1.4.7**~~
~~**harness**~~
~~a full-body or lower-body harness as described in this Standard (see Clause 4.1.2~~Australia, and ~~Clause~~has ~~4.1.3~~)

~~**1.4.8**~~
~~**height**~~**appropriate** ~~**safety**~~**experience** ~~**equipment**~~**and** ~~**inspector**~~
~~a person who is competent~~competence in the ~~skills~~relevant ~~needed to detect faults in height safety equipment and to determine remedial action~~field

1.~~4~~3.~~9~~
~~**height safety manager**~~
~~a person who is competent in the selection, design, manufacture or installation of height safety systems or equipment, or the development of control measures or work practices~~

~~**1.4.10**~~
~~**height safety operator**~~
~~a person who is able to perform harness based work at heights under the direct supervision of a height safety supervisor~~

~~**1.4.11**~~
~~**height safety supervisor**~~
~~a person who is competent in the skills needed to perform harness based work at heights, to supervise other operators including those at entry level and to participate in first response rescue~~

~~**1.4.12**~~
~~**limited free fall, limited free fall-arrest**~~
~~a fall or the arrest of a fall occurring under the conditions described in Clause 1.4.6 except that under reasonably foreseeable circumstances the fall distance will not exceed 600 mm~~

~~**1.4.13**~~**21**
restrained fall~~**, restrained fall-arrest**~~
~~a fall or the arrest of a~~ fall where ~~the~~downward ~~person suffering the fall~~motion is ~~partially restrained by a pole strap~~impeded

1.~~4~~3.~~14~~22
restraint technique
~~control~~technique ~~on~~whereby ~~a person's movement by use~~components of a fall-~~arrest~~protection system~~, which entails connection to an anchorage using an adjustable lanyard or other adjustable component that~~ can be adjusted ~~for length as necessary~~ to ~~physically~~ prevent ~~the~~a ~~person~~user from reaching a ~~position~~fall ~~at~~hazard

1.3.23
shall
indicates ~~which~~that ~~there~~a statement is mandatory

1.3.24
short circuit
misuse that prevents an energy absorber from functioning properly

1.3.25
should
indicates a ~~risk~~recommendation

1.3.26
strop
extension to an anchor

1.3.27
total restraint
system that prevents a user reaching a fall hazard

Note 1 to entry: The selection and use of total restraint equipment is not covered in this document. See Appendix A for more details.

1.3.28
work positioning
technique that enables a ~~free~~person to work supported in tension or ~~limited~~suspension ~~free~~in such a way that a fall from height is prevented or restricted

~~1.5 Performance requirements~~

~~This Standard does not include product performance requirements for height safety equipment. Compliance to this Standard of any such equipment cannot be claimed.~~

~~Performance requirements with which items of equipment dealt within this Standard shall comply are specified in AS/NZS 1891, Parts 1, 2 and 3, and AS 1891.5.~~

1.6 Hierarchy of control

Users of fall arrest systems need to be aware as to where these systems are placed in the hierarchy of control of fall protection, so that an assessment can be made as to whether the highest practicable level of protection is being applied in a particular case. Figures 1.1 and 1.2 illustrate this hierarchy of control.

Selection of appropriate equipment shall be based on an identification of potential fall hazards associated with the work type and an assessment of the risk of a fall, either free, limited free or restrained (as defined, see Clause 1.4).

Relevant legislation may impose obligations to provide safe systems of work on those responsible for people working at heights. An appropriate means of discharging these obligations is to conduct hazard identification and safety risk assessment with reference to the hierarchy of control of risks. This Standard provides guidance on the selection of equipment and safe use procedures for some but not necessarily all forms of height protection. Guidance on risk analysis can be found in AS/NZS 3931.

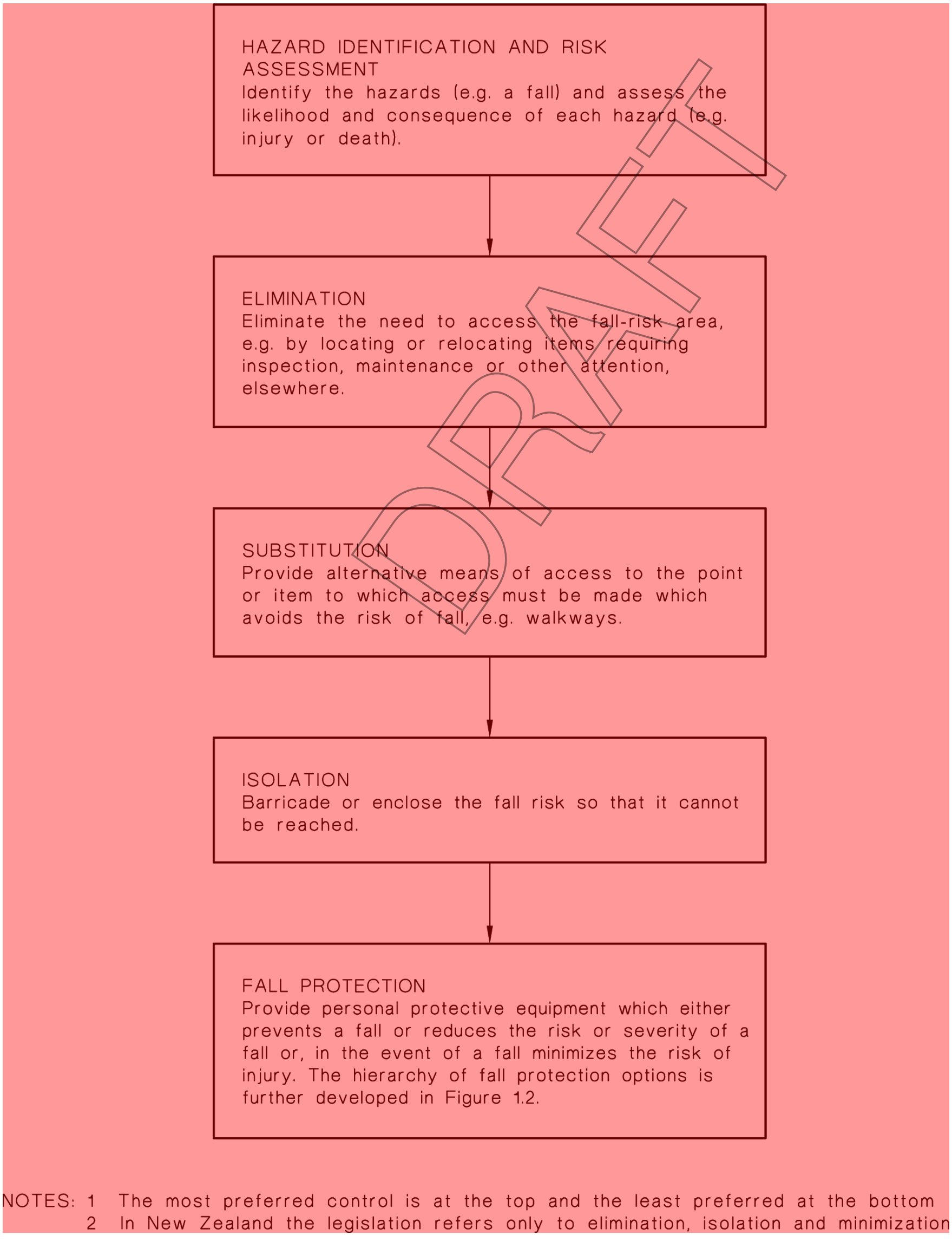
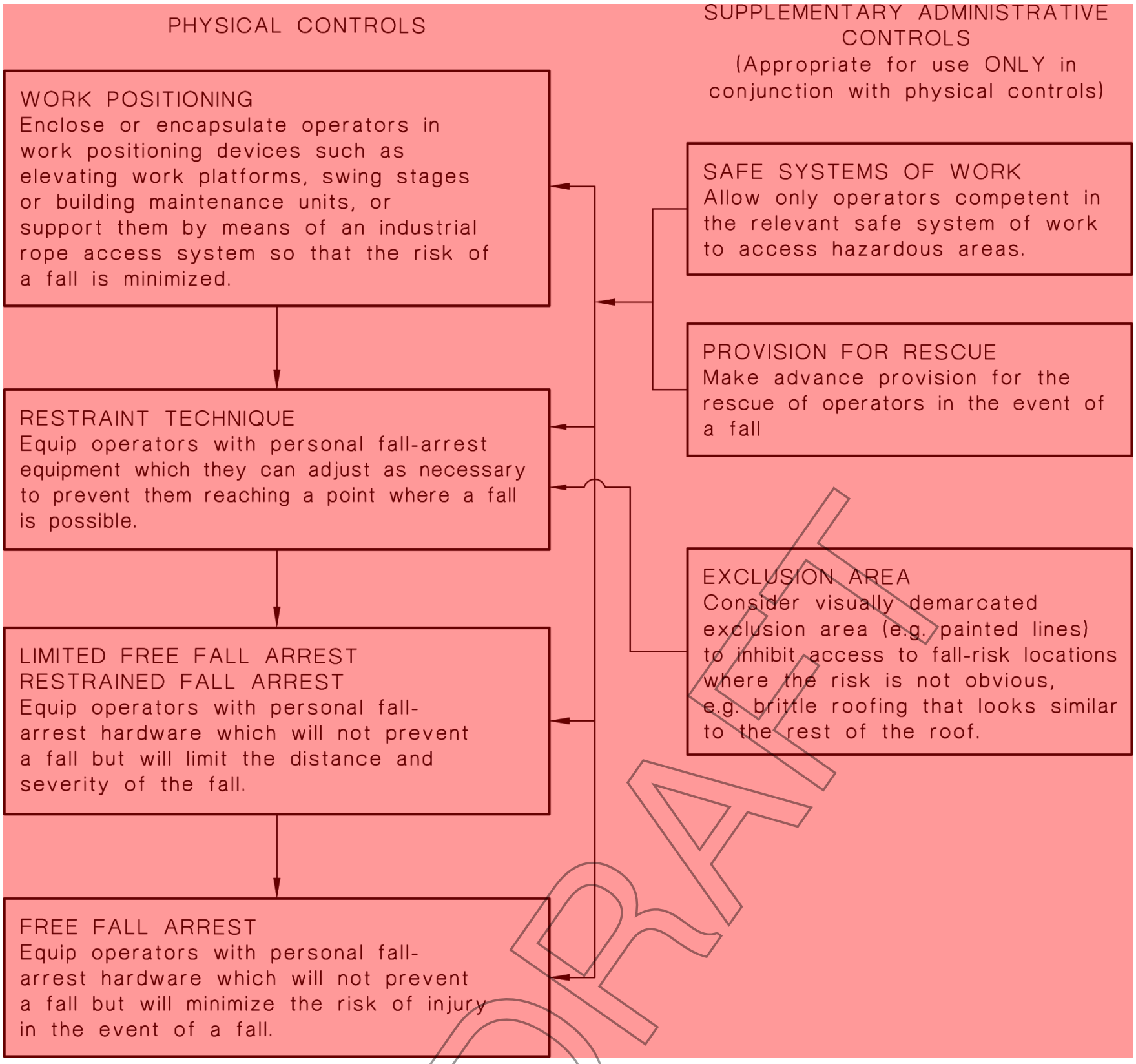


Figure 1.1 – Hierarchy of control of risks for people working at heights



~~Figure 1.2 – Hierarchy of fall-arrest options~~

2 General requirements for selection and safe use

~~2.1 System and equipment selection~~

~~2.1.1 General~~

~~This Section gives general requirements and recommendations applicable to all forms of fall-arrest systems including restraint technique. It should be read in conjunction with the relevant Sections 3, 4, 5 or 6 relating to the specific items of equipment covered in those Sections.~~

~~It is important that investigations be conducted before purchase of any fall-arrest equipment in order to identify the aspects of use that need to be catered for to enable the best system or equipment for the task to be selected. The investigation should include a risk assessment of any special hazards such as those covered in Clause 2.1.4 and Clause 2.1.5, likely to be encountered during the use of the equipment. Factors needing initial consideration include but are not necessarily restricted to, the following:~~

~~(a) Work type, e.g.~~

~~(i) pole work;~~

~~(ii) work from a high fixed platform;~~

~~(iii) ladder work;~~

~~(iv) confined space work;~~

~~(v) working on a slope, e.g. roof work;~~

~~(vi) work requiring horizontal restraint only; and~~

(vii) work from elevating work platforms, building maintenance units and suspended scaffolding.

(b) Potential for a fall and fall severity, e.g.—

(i) free fall, including restraint technique that could result in a free fall;

(ii) limited free fall, including restraint technique that could result in a limited free fall;

(iii) restrained fall.

The characteristics of various situations, equipment and anchorage requirements are specified in Table 2.1. Typical situations are illustrated in Figure 2.1.

(c) Task mobility requirements, e.g. degree of lateral and vertical movement needed to perform the task while connected to the system.

(d) Constraints on fall distances and clearances, both vertical and lateral (see also Section 7 and Clause 2.2.2).

The selection of a single piece of equipment or assembly, which will cover all of the work types and other operational variables encountered by each user or at least any one set of work situations on a particular job, should be considered.

2.1.2 Effects on wearer

Regardless of the type of system to which the wearer is connected, if there is a likelihood of a free fall greater than 600 mm, a full-body harness shall be worn.

Fall-arrest systems shall be selected and assembled so that in the event of a fall the maximum force transmitted to the wearer's harness is 6 kN.

In the selection of equipment for any particular task, care should be taken to ensure that the equipment gives the wearer, as far as is compatible with safety, the maximum degree of comfort, freedom of movement and, in the event of a fall, the greatest possible security against injury—

(a) from impact with the ground or other objects below the wearer, or with the surrounding structures;

(b) from the harness as a result of the arrested fall; or

(c) from falling out of a harness.

Equipment should be tried on by potential users and checked for comfort and freedom of movement when working. Trials should include users being suspended in the harness, taking care that during such trial the possible onset of suspension intolerance (trauma), see Clause 2.1.6, is allowed for.

Equipment that may be worn by persons at risk of falls of various levels of severity is described in Clause4.1 and Clause 4.2, and tabulated in Table 4.1.

Table 2.1 – Characteristics of various restraint/fall situations

Restraint/fall situation	System description	Equipment and anchorage requirements (minimum) (see Notes 1 and 4)	Typical application
Restraint technique	A combination of anchorage placement and lanyard length adjustment which will not physically permit the operator to reach a fall risk position (see Note 2) unless the lanyard is incorrectly adjusted.	Fall arrest rated equipment as follows: Where any possible fall will only be a limited free fall (<600 mm), a lower body harness and anchorage with ultimate strength 12 kN. All other cases, a full body harness and anchorage with ultimate strength 15 kN.	Any situation where access to the work can be achieved entirely on a working surface with secure footing and without exposure to a fall provided that the equipment is correctly adjusted.
Restrained fall only	A pole strap of length which will permit only a restrained fall when working on a pole	Full body or lower body harness and pole strap.	Working on a pole where no free fall is possible.
Limited free fall	A combination of anchorage placement and lanyard length which will permit only a limited free fall (<600 mm).	Full body or lower body harness. Lanyard or fall arrest device that will limit free fall to 600 mm max. (See Note 2). 12 kN ultimate strength anchorage or equivalent horizontal lifeline or rail.	Any situation where the use of either a short lanyard or a fall arrest device (or both where applicable) will limit any free fall to 600 mm. May also be applicable to rope access systems, see AS/NZS ISO 22846 Parts 1 and 2.
Free fall	Any suitable fall arrest system.	Full body harness. Lanyard or fall arrest device which will limit free fall to 2 m max. (see Note 2). 15 kN ultimate strength anchorage or equivalent horizontal lifeline or rail.	Any situation in which a free fall greater than 600 mm is possible.
Total restraint	A system where no fall is possible	Not specified in the AS/NZS 1891 Series of Standards (see Note 3).	See Appendix F.

NOTE 1 Fall protection work practices not in accordance with this Standard, in particular, the use of non-complying personal equipment (e.g. lanyards without specified energy absorbing properties), may create fall arrest forces which will exceed the anchorage strengths specified in the Table.

NOTE 2 See also Section 8.

NOTE 3 While no equipment is specified, fall arrest rated equipment can be used.

NOTE 4 "Ultimate strength" means that the anchorage may yield at the stated load but must not fail.

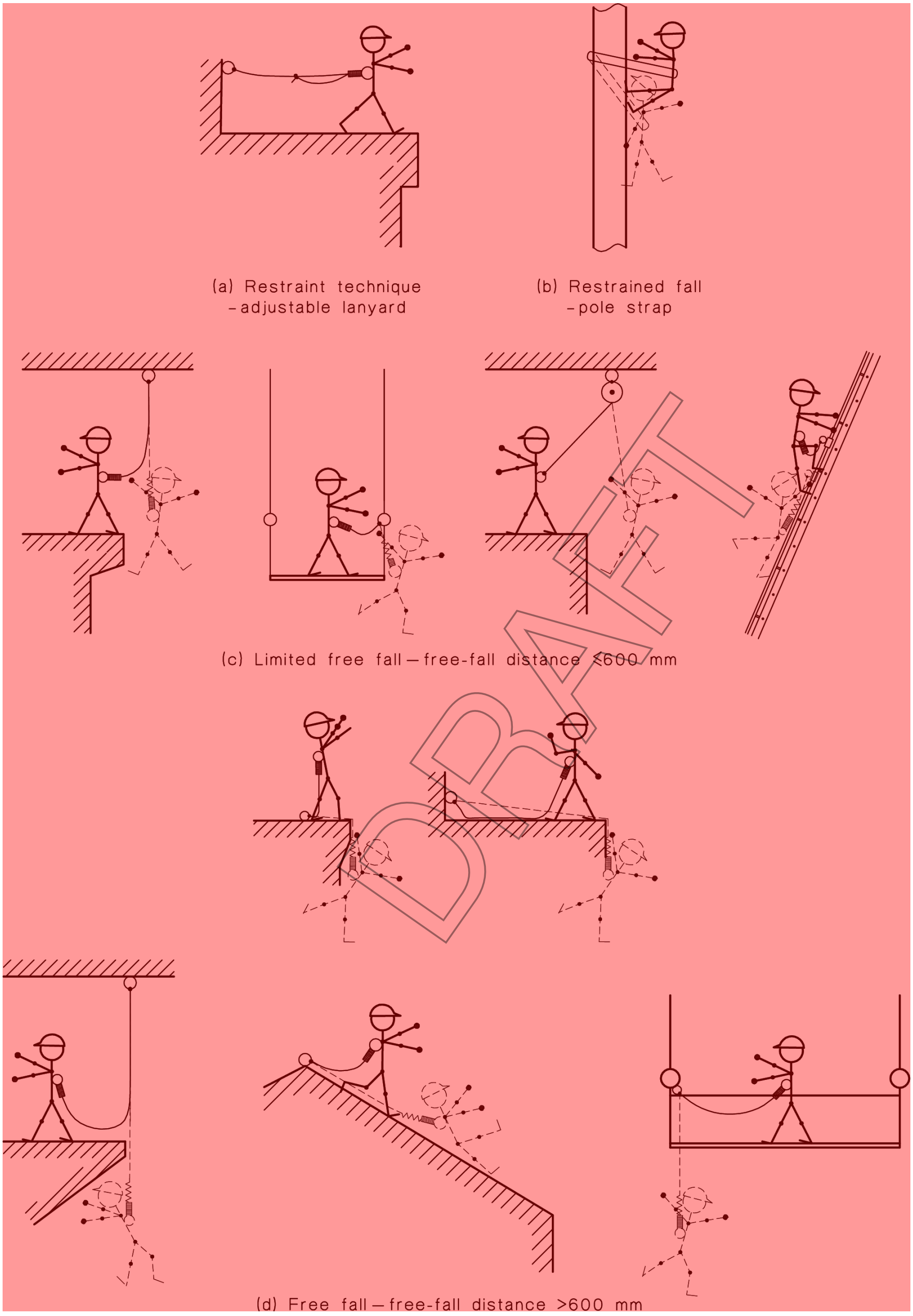


Figure 2.1—Typical restraint/fall situations

2.1.3 Compatibility of components and systems

A fall arrest system shall comprise items that are compatible with one another. For example, when using connectors, there shall be negligible risk that any of the following will occur such that the connection will be released:

(a) Loading of a gate on a connector unless the gate is designed to be loaded.

(b) Loading of a connector in such a way that the locking device can be inadvertently knocked or pushed, and released, leading to the possibility of disconnection.

(c) Lack of free movement between mating components so that possible jamming will cause unintentional loading that will lead to a connector being released.

(d) Exposing the connector to excessive wear from a mating surface such as the inside surface of an anchorage point.

Typical cases of compatibility problems that might arise with connections to anchorage points are illustrated in Figure 2.2.

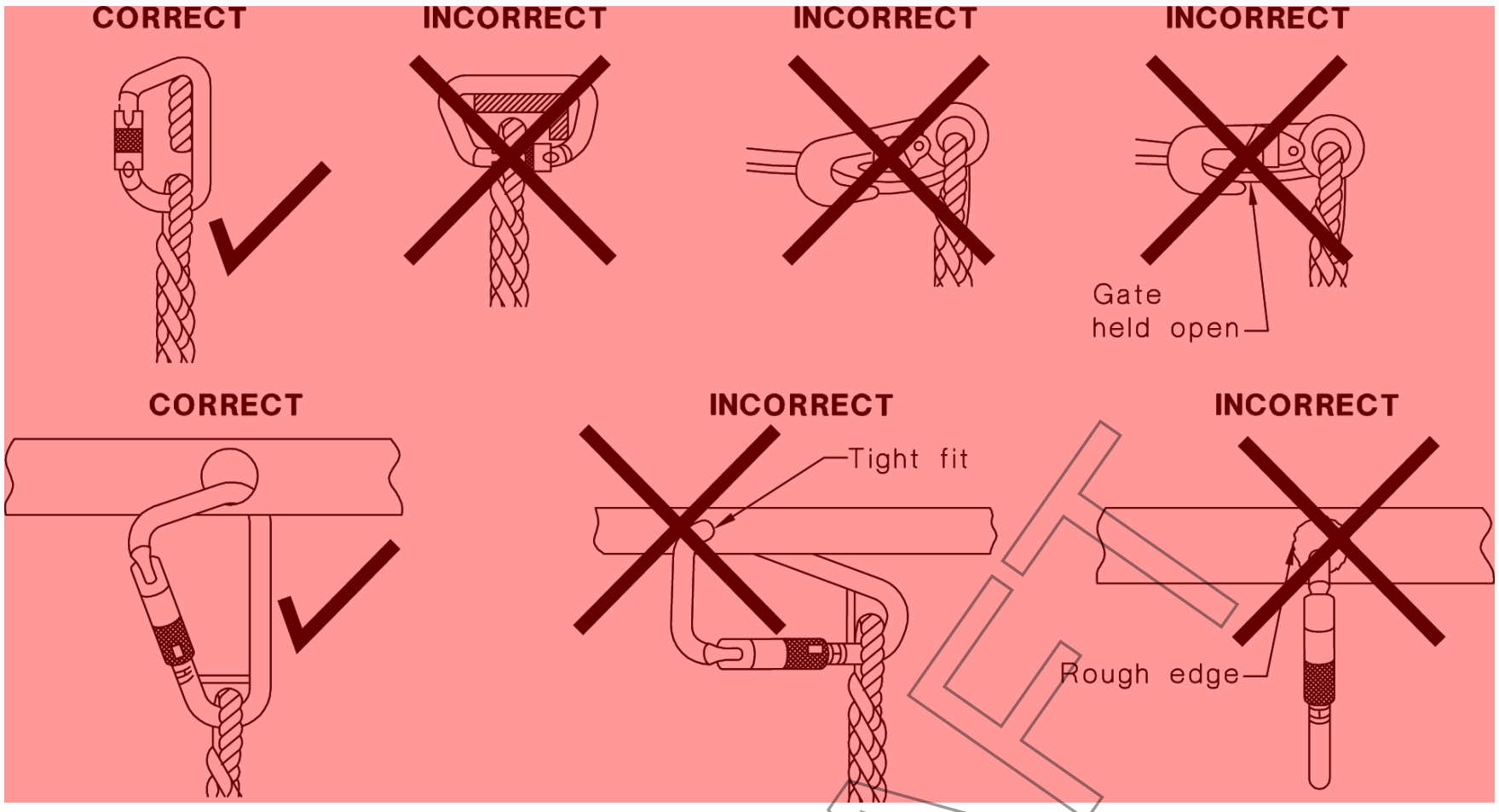


Figure 2.2 – Compatibility between connectors and anchorage points

In selecting personal equipment special attention should be given to the ease with which an operator can transfer between common user systems without exposure to the risk of a fall.

Further advice on the problem of inadvertent release of attachment hardware is given in Clause 4.3.6.

2.1.4 Work in adverse environments

Specialist equipment may be required for work in adverse environments. Such environments include the following:

(a) Natural hazards, including wet weather, wet or icy surfaces, sand, dust and high winds.

(b) Chemical hazards.

(c) Heat hazards, including hot surfaces, sparks and naked flame.

(d) Mechanical hazards, including power cutting tools and sharp edges.

(e) Free flowing solids such as grain in silos.

Where a risk assessment indicates that one or more of these hazards are likely to be encountered, the equipment supplier or other competent person should be asked for help both in selecting suitable equipment and in advising of any special precautions to be taken in its use.

2.1.5 Work task hazards

Work tasks that may be especially hazardous include the following:

(a) Welding.

(b) Using power tools, especially cutting tools.

(c) Use of abrasives.

(d) Use of chemicals likely to have an adverse effect on equipment.

(e) Electrical work.

(f) Work in explosive or flammable atmospheres.

(g) Work in confined spaces.

Where one or more of these tasks is likely to be encountered, consideration should be given to the following:

(i) The adoption of altered work practices such as the use of two separate lanyards.

(ii) The provision of protective sleeves or covers.

(iii) The purchase of special equipment designed to cope with these hazards.

2.1.6 Rescue and first aid

Analysis of each work environment should include consideration of the provisions for first aid and rescue of a person working at height who becomes incapacitated, e.g. as a result of a fall, and the preparation of a recovery plan for such an event.

The following should be considered in the preparation of such a plan:

(a) Provision of a means of calling for help by a person whose fall may not have been seen or noticed by others on site.

(b) Provision for possible self recovery or recovery by such means as fall-arrest devices equipped with winching mechanisms for raising or lowering.

(c) The need to rescue an incapacitated person from a location difficult to reach and requiring the use of height safety equipment by the rescuer, and not necessarily following a fall.

(d) The possible need to pre-deploy rescue systems.

(e) The possible need to render urgent first aid to a person prior to rescue coupled with need to get that person to ground as quickly as possible for professional medical assessment and treatment, and assessment of condition of personal protection equipment.

(f) The need to manage the threat of suspension intolerance (trauma) by speedy deployment of a rescue system, generally within a few minutes, and whether there needs to be a person at ground level to minimize further injury as well as managing suspension intolerance (trauma).

(g) The following principles:

(i) Rescue should not be reliant on emergency services.

(ii) Rescue should not endanger rescuers or other persons.

(iii) Rescue should not depend on any action by the person being rescued.

Provision for rescue should take into account that even an apparently uninjured person may only be able to be suspended in a harness for a short period after sustaining a fall without beginning to suffer suspension intolerance (trauma), may have serious consequences (see Appendix A).

2.2 Safe use of equipment and systems

2.2.1 General safety requirements and recommendations

Circumstances vary for each industry and specific problems requiring some modification to the requirements and recommendations in this Standard may arise depending on the industry and the task to be undertaken. The underlying safety principles should, however, be taken into account.

The following requirements and recommendations are applicable to the management or supervision of any work with fall-arrest equipment:

(a) Users of fall-arrest systems shall be connected to at least one fall-arrest system whenever they are at risk of a fall.

(b) Systems and equipment shall be used in such a way as to minimize as far as practicable the fall distance of a potential fall, e.g. by removing as much slack from the system as possible.

(c) Fall-arrest equipment shall be fitted and used in accordance with the manufacturer's instructions.

(d) Fall-arrest equipment shall be carefully handled to ensure parts are not damaged.

(e) Users should satisfy themselves immediately before and after use that the equipment is in good order and condition and has been inspected, serviced where required and maintained in accordance with Section 9.

(f) Equipment which is defective shall not be used and shall be either destroyed or marked "defective" and repaired in accordance with manufacturer's instructions.

(g) Users shall check for correct assembly of equipment before placing any load on it. Of particular concern is the possibility of clothing becoming entrapped in snaphooks or other connectors, and preventing complete closure of the latch and locking mechanism.

(h) A particular fall-arrest system shall only be used if there is adequate fall clearance (see Section 7) for that system to operate correctly.

(i) Hand tools, if carried by the user, should be secured in such a way e.g. by means of a tether, that they will not impede the user's progress or the operation of fall-arrest equipment.

(j) After use, the equipment shall be stored as indicated in Clause 9.8.

(k) If the equipment has been used to arrest a fall, the equipment shall be withdrawn from service and referred for inspection in accordance with Clause 9.5.

(l) If there is a risk of falling objects injuring people below the work area appropriate control measures shall be put in place, e.g. an exclusion zone or a protective structure.

NOTE Reference should also be made to the particular guidelines for the use of specific devices as detailed in Sections 3 to 6.

2.2.2 Pendulum effect and snagging

Situations that may result in lateral movement or “swing” during a fall and so produce the pendulum effect, have the potential to result in either the operator striking objects to one side of the fall path or in snagging of the lanyard or anchorage line of a fall-arrest device, which may reduce its effectiveness in arresting the fall. Appropriate preventative steps include attention to the positioning of single anchorages, or the use of diversion anchorages (see Clause 3.2.3) or horizontal lifelines.

2.2.3 Falls over sharp edges

A fall over a sharp edge where the anchor point is behind the sharp edge can result in stress on a lanyard or anchorage line where it strikes the edge during the fall. This can lead to failure to arrest the fall safely or in an extreme case, breakage of the lanyard. Relocation of the anchorage point, selection of a different anchorage type or a protective covering over the sharp edge can reduce this possibility.

Further treatment of such problems specific to fall-arrest devices is given in Clause 5.2.4.

2.2.4 Fragile work surfaces

On a fragile work surface such as a roof, the possibility of a fall through the surface as well as off the edge, needs to be considered. The following factors need to be taken into account:

(a) *The potential fall distance* If a fixed length lanyard is used, a greater fall distance could result from a fall through the surface at a point closer to the anchorage point than at the edge of the surface.

(b) *Available fall clearance in accordance with* The area below the surface as well as below its edges needs to be checked for obstructions which could infringe on fall clearance.

(c) *Sharp edges* The area below the surface needs also to be checked for sharp edges which could lead to snagging or cutting of lanyards or the anchorage lines of fall-arrest devices, or to personal injury.

(d) *Swing clearance* The presence of lateral obstacles that could cause personal injury if the pendulum effect is encountered, should be checked.

The use of walkways, preferably with handrails, is the preferred means of movement across fragile surfaces. Their use becomes essential if matters raised in Items (a) to (d) cannot be dealt with adequately.

2.1 Hierarchy for selecting fall-protection systems

Working at heights presents a multitude of risks that should be assessed and controlled.

Fall-protection systems shall be selected to minimize free fall distance and potential injury. The following systems are listed in descending order of priority:

NOTE All fall-protection equipment is personal protection equipment (PPE). The priority order is aligned with the hierarchy of controls, i.e. PPE that eliminates the hazard is located at the top of the list, whereas PPE with administrative controls is located at the bottom of the list.

(a) Total restraint.

(b) Restrained fall.

(c) Limited free fall.

(d) Free fall.

(e) Restraint technique.

Fall-protection systems should be fit for purpose and be as high as reasonably practicable on the above list. For example, if it is reasonably practicable to use option (c), then this should be selected in preference to option (d).

Jurisdictional legislation and requirements may also apply when applying the complete hierarchy of controls for working safely at heights and/or the prevention of falls.

2.2 Task considerations

The fall-protection system shall be selected to enable safe execution of the task.

The following aspects of the task shall be assessed:

(a) Access to the work area.

(b) How the system prevents access to the fall hazard.

(c) How the equipment affects movement around the work area.

(d) Tools and equipment that will be used for the task, and any potential interactions with the fall-protection system.

2.3 General system type

2.3.1 Configuration of fall-protection systems

Fall-protection systems shall be configured according to Table 2.1 and the requirements given in Sections 3, 4 and 5.

Fall-protection systems shall not allow a fall greater than 2 m.

Table 2.1 does not prevent the use of alternative configurations, provided the system performs as described in Clauses 2.3.2 to 2.3.6.

Table 2.1 – Fall-protection system configurations

System	Anchor (see Section 3 for requirements and additional information)	Minimum anchor rating	Harness (see Section 4 for requirements and additional information)	Connecting system (see Section 5 for requirements and additional information)
Total restraint	Anchor or horizontal rail system (HRS) or horizontal life line (HLL)	Not specified in this document	Full, lower body or combination harness	Fixed length connection (not described in the AS/NZS 1891 series)
Restrained fall	The anchorage	12 kN	Full, lower body or combination harness	Pole strap
Limited free fall	Anchor or HRS or HLL	12 kN	Full, lower body or combination harness	Lanyard or fall-arrest device (Types 1 to 4)
Free fall	Anchor or HRS or HLL	15 kN	Full body or combination harness	Lanyard
Restraint technique	Anchors	15 kN	Full body or combination harness	Lanyard

2.3.2~~.7~~ Total restraint

Total restraint is ~~expressly~~a ~~omitted~~system ~~from~~that does not allow a user to reach a fall hazard. This document does not cover the ~~scope~~equipment used in this system and the selection and use of this ~~Standard~~equipment. ~~For~~See ~~further discussion see~~ Appendix ~~-~~A ~~F~~for information about total restraint.

~~2.2.8 Degradation of equipment~~

~~The strength and performance of equipment can become degraded due to causes such as wear, exposure to adverse environments, poor maintenance or the general effects of ageing. Inspection requirements are summarized in Section 9.~~

~~2.2.9 Labels and signs~~

~~Relevant AS/NZS Standards for personal fall-arrest equipment require that they be permanently marked or labelled to indicate their purpose, correct use, limitations and other relevant information aimed at reducing the incidence of misuse or mis-fitting of the equipment.~~

~~Descriptive and instructional signs are also required for fixed installations such as anchorages and horizontal lifelines or rails to control possible overloading and advise on correct use. Specific detail on the information to be provided on signs is given in Clause 3.2.5 for anchorage points and Clause 6.3(j) for horizontal lifelines and rails.~~

~~Descriptive and instructional signs shall be firmly fixed to a suitable base near the item and shall be sufficiently durable to remain in place and legible for the duration of the installation.~~

~~Hazard warning signs shall conform to AS 1319 (Australia only).~~

~~Equipment data and maintenance documentation requirements are given in Clause 9.10.~~

~~2.2.10 Equipment combinations~~

~~Combinations of equipment from a single manufacture shall be used only in accordance with the manufacturer's instructions. Where it is proposed to combine equipment from more than one manufacturer, each separate item should be used in accordance with its manufacturer's instructions and the components checked for compatibility with one another, again, obtaining advice from one or both manufacturers.~~

2.3.3 Restrained fall

Restrained fall is a system of work where free fall is not possible and any fall is partially restrained. See Figure 2.1.

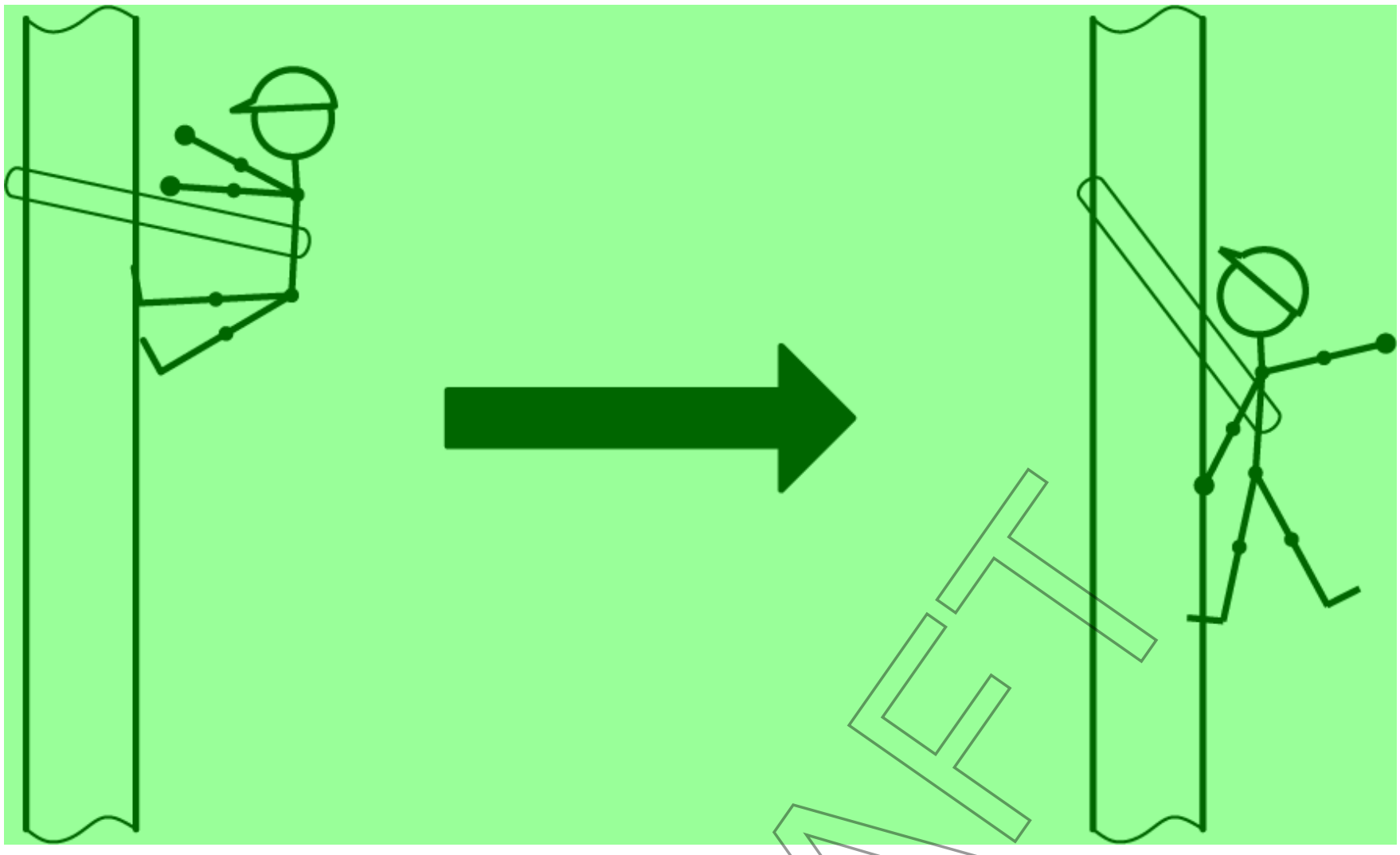
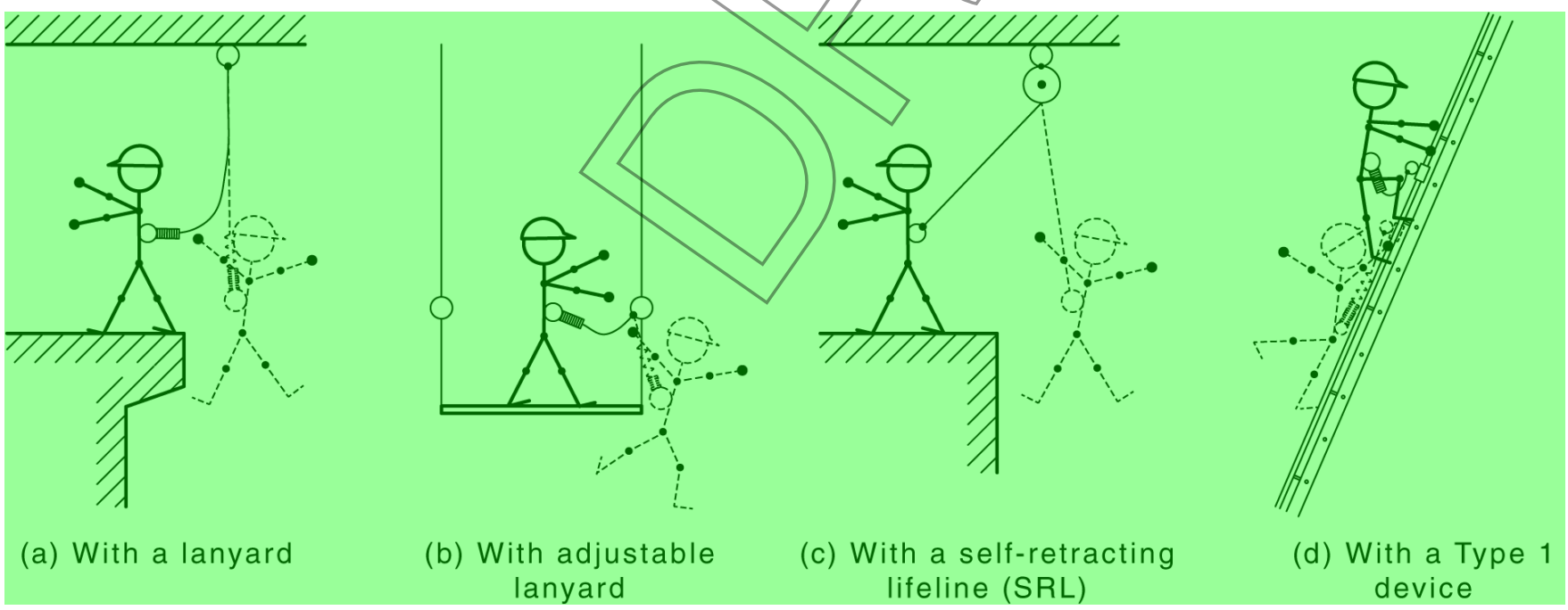


Figure 2.1 – Example of restrained fall using a pole strap

2.3.4 Limited free fall

A limited free fall system is one that allows a free fall of no greater than 600 mm. See Figure 2.2.



(a) With a lanyard (b) With adjustable lanyard (c) With a self-retracting lifeline (SRL) (d) With a Type 1 device

NOTE Free fall distances less than 600 mm.

Figure 2.2 – Examples of limited free fall

2.3.5 Free fall

A free fall system is one that allows a free fall between 600 mm and 2 m. See Figure 2.3 for examples of how free fall can occur.

NOTE Free fall can occur either vertically or on a slope where it is not possible to walk without the assistance of a handrail or hand line.

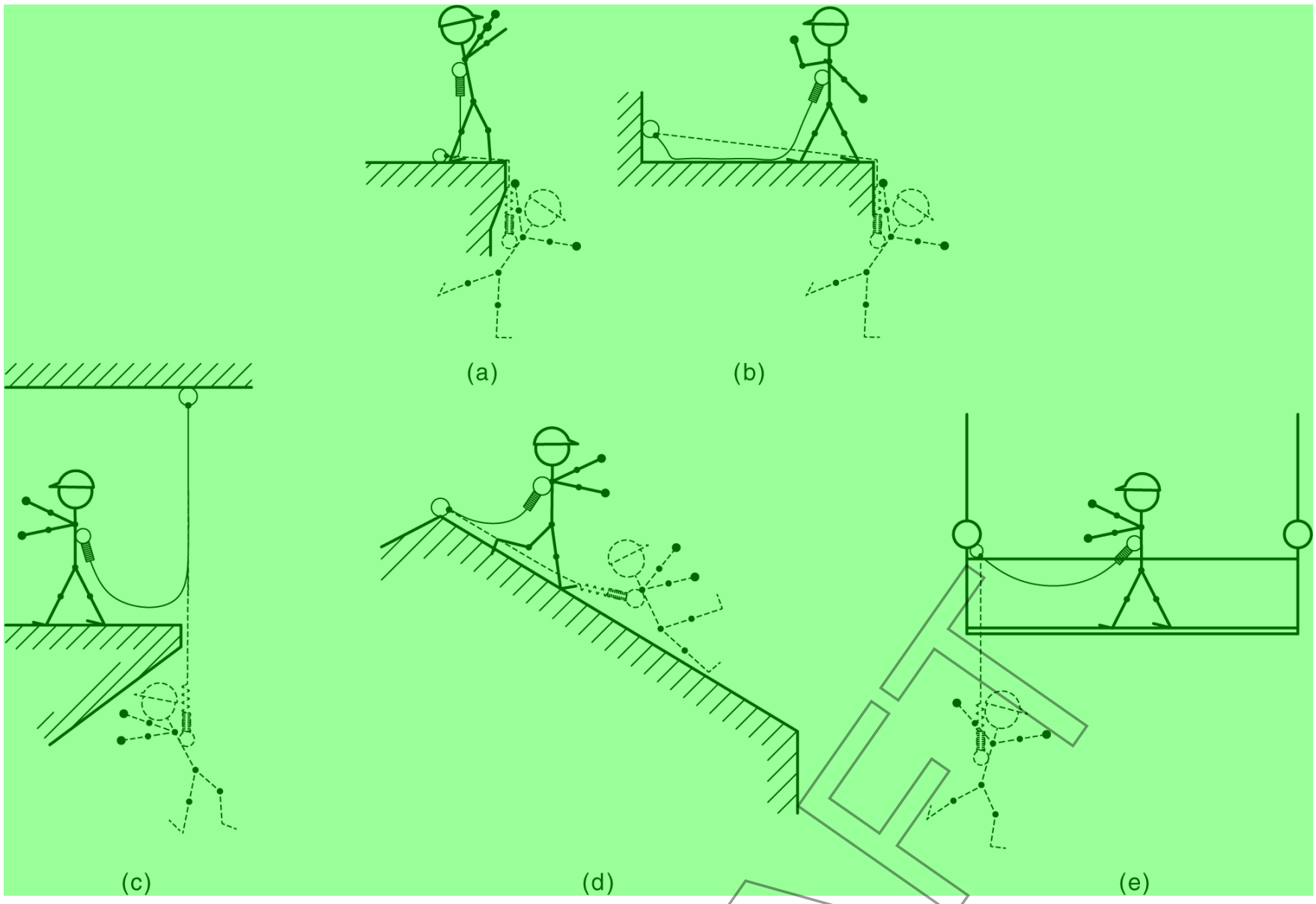


Figure 2.3 – Five examples of how free fall can occur

2.~~2~~3.~~5~~6 Restraint technique

All equipment selected for use in a restraint technique ~~and limited free fall equipment and their anchorages~~system shall be ~~fall-arrest~~ rated ~~to ensure adequate safety levels.~~

~~Restraint technique entails the use of a harness and adjustable lanyard or other component that can be adjusted for length by the user to maintain a restraint condition in different situations as the distance from anchorage to a potential fall zone varies.~~

~~Restraint technique may however, fail to prevent a fall in some or all of the following typical situations, viz. –~~

~~(a) the user can inadvertently reach a position where a fall over an edge is possible; or~~

~~(b) the user makes an error in adjusting the length of an adjustable lanyard such that a free fall position can be reached; or~~

~~(c) there is a danger of the user falling through the surface (e.g. roofing material); or~~

~~(d) there is support failure on a movable platform leading to a fall; or~~

~~(e) there are any other reasonably likely misuses or failures of the system that could lead to a free fall.~~

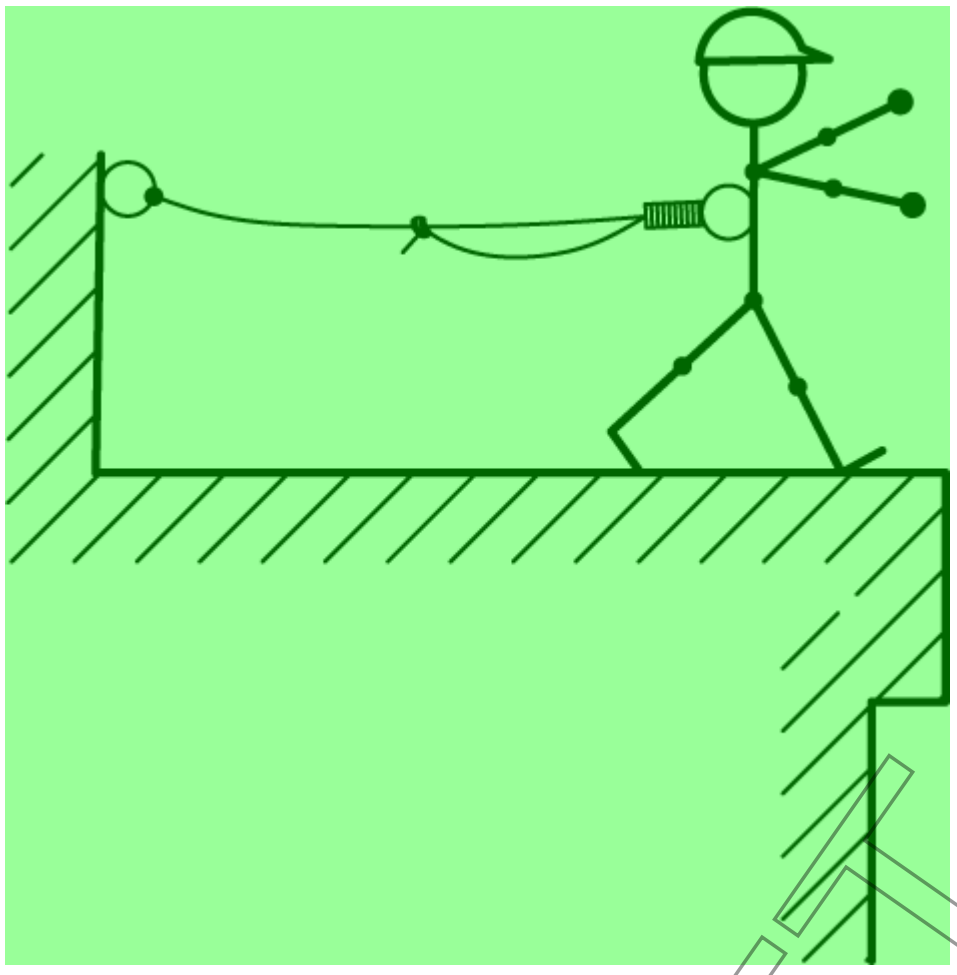
~~The requirement~~ for fall-arrest ~~rated equipment and anchorages is designed to cover these eventualities~~.

Restraint technique is ~~suitable~~a ~~for~~system ~~use~~of work where the system is manually adjusted to prevent the user ~~can~~from ~~maintain~~reaching ~~secure~~a ~~footing~~fall ~~as~~hazard ~~set~~(see ~~out~~Figure ~~in~~ 2.4 for an example). It shall not be used when the system is intended to be under load. See Clause 2.~~2~~5.~~6~~5 ~~without~~for ~~having~~guidance.

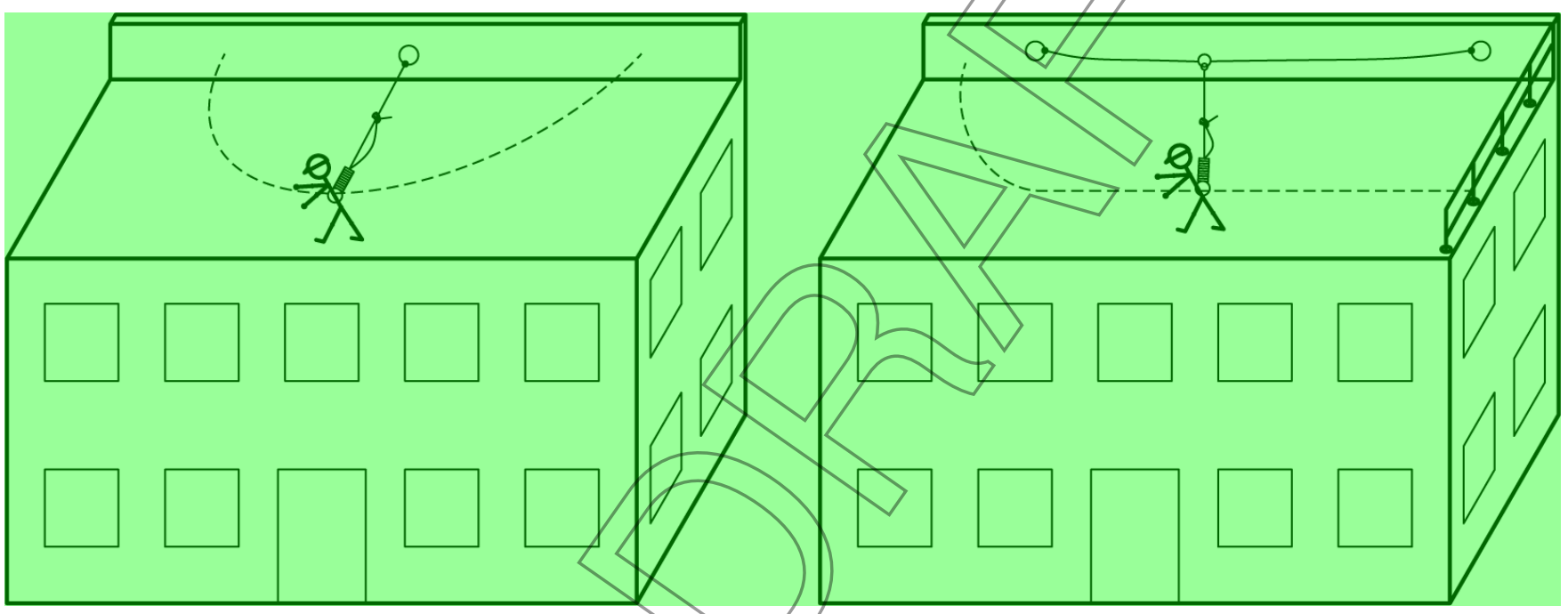
NOTE Restraint technique can be used when there is insufficient fall clearance for a fall-arrest system, for example, work on a roof where it is possible to ~~tension~~fall over the edge or through the surface and can result in a free fall distance exceeding 2 m.

A risk assessment shall be conducted to identify all fall hazards, including roof edges, skylights or other penetrations. The risk assessment shall also identify hazards arising when the system is manually adjusted, as incorrect adjustments can lead to a fall.

(a) Section view



(b) With building context



NOTE The user cannot reach the edge if the lanyard is correctly adjusted.

~~Typical restraint technique situations are illustrated in Figure 2.3.~~

~~Despite the requirement to equip the user for fall arrest, restraint technique should be employed whenever practicable as providing an extra level of safety by reducing the potential for exposure to falls.~~

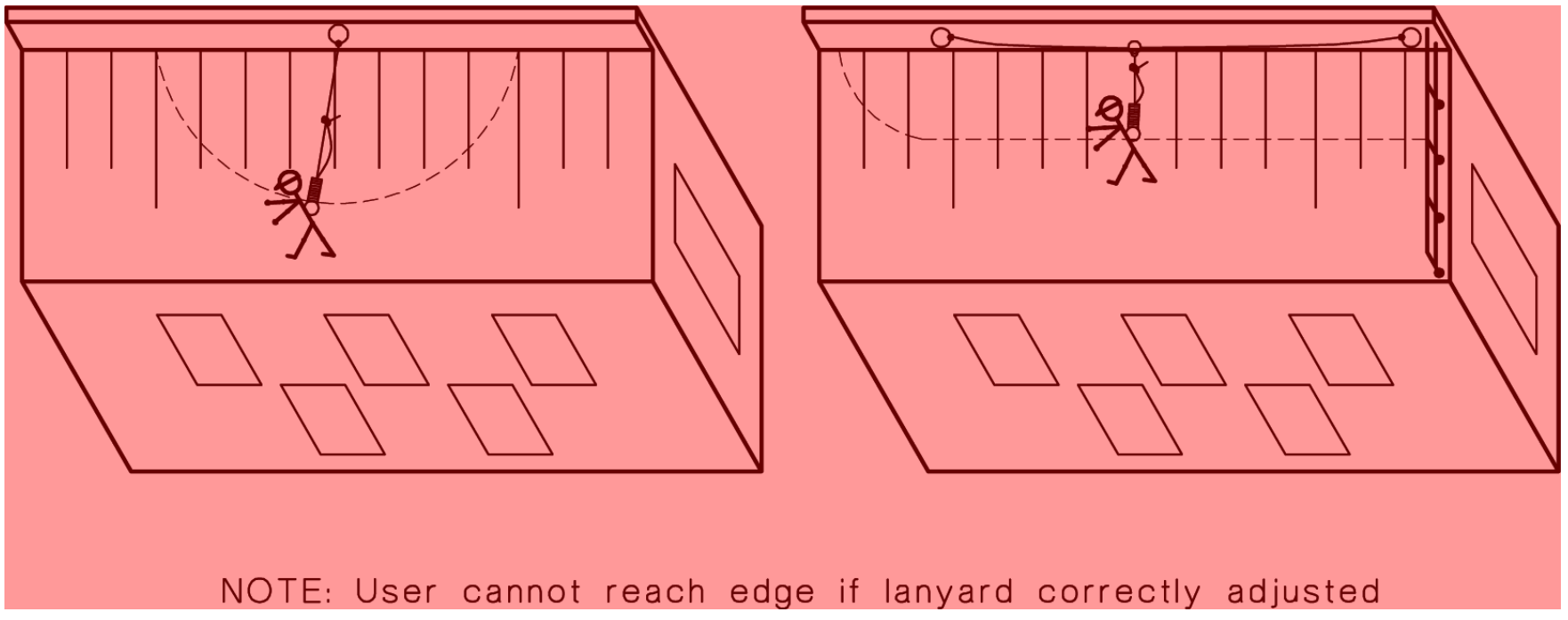


Figure 2.~~34~~ – ~~Examples~~Example of restraint technique showing a correctly adjusted lanyard

~~2.2.6 Working on slopes and work positioning~~

~~Where a user at risk of a fall can maintain secure footing on a sloping surface without tensioning the lanyard or safety line, or requiring additional support such as hand hold, fall arrest equipment attached to anchorages of commensurate strength shall be used. Factors that need to be considered as to whether secure footing can be maintained are as follows:~~

(a) The degree of slope. Slopes in excess of 15° from the horizontal should always be checked for risk of a fall.

(b) Surface slipperiness or skid resistance, change from dry to wet conditions and whether the surface is likely to be oily or otherwise slippery.

(c) Surface roughness likely to become a tripping hazard.

(d) Security when carrying heavy loads or operating hand-held equipment.

(e) Unusual weather conditions, high winds, snow, ice or frost.

(f) The grip provided by footwear, e.g. sole material and tread pattern.

Where a user cannot maintain secure footing without the aid of lateral support alternative means of access or support shall be provided, e.g. a harness and pole strap, a walkway in accordance with AS 1657 or a work positioning system such as a rope access system in accordance with AS/NZS ISO 22846 Parts 1 and 2.

2.4 Equipment selection due to task and environmental hazards

Equipment shall be suitable for the task and the environment.

NOTE 1 One way to assess suitability is to consult the product instructions.

EXAMPLE When engaged in hot works, select a harness and connecting system that is made from heat resistant materials.

Task hazards include, but are not limited to:

(a) Chemicals and paint.

(b) Welding.

(c) Heat generated by the task.

(d) Sparks.

(e) Rotating machinery.

Environmental hazards include, but are not limited to:

(i) The fall hazard.

(ii) Sharp edges.

(iii) Fragile working surfaces.

NOTE 2 The use of walkways with handrails is the preferred means of movement across fragile surfaces.

NOTE 3 When working near a fragile surface, fall clearance calculations should include the distances resulting from falling through the surface (see Section 7).

(iv) Confined spaces.

(v) Environmental temperature, e.g. heat, cold.

(vi) Physical contamination, e.g. dust, dirt, oils and grime.

2.5 Use of fall-protection systems

2.5.1 General principles

The general principles for use of fall-protection systems are:

(a) When a work positioning system is used, additional control measures (such as a fall-protection system) shall also be implemented to provide protection in the event of system failure.

NOTE Users should consider and evaluate the risk of failure with the use of work positioning systems such as pole straps, confined space rope positioning devices and winches.

(b) Fall-protection systems shall minimize free fall and swing fall.

(c) Equipment shall be installed, used, stored and maintained in accordance with –

(i) the product instructions; and

(ii) Section 8 of this document.

(d) Equipment shall be inspected before and after each use, in accordance with the product instructions and Section 8 of this document.

(e) Equipment that has failed an inspection shall be removed from service in accordance with Section 8 of this document. This shall be recorded in the inspection register (see Clause 8.2).

(f) Equipment that has been used to arrest a fall shall be –

(i) removed from service in accordance with Clause 8.7; and/or

(ii) destroyed in accordance with Clause 8.7.

2.5.2~~.11~~ Training ~~and competency~~

~~Users~~Each ~~of fall arrest equipment and all people undertaking tasks associated with harness based work at heights~~user shall be trained ~~and assessed in accordance with the requirements set out below:~~

~~NOTE Guidance for the provision of training and competency assessment is given in Appendix E.~~

~~(a) *Training and competency assessment*~~

~~Training and competency assessment shall be conducted at five levels as follows:~~

~~(i) *Height safety theory*~~

~~All people falling under the competency classifications in Items (ii), (iii), (iv) and (v) shall undergo training in height safety theory to a standard equal to that of a nationally accredited general height safety course for operators.~~

~~(ii) *Height safety operator*~~

~~Operators at entry level who are required to perform harness based work at heights shall be trained and assessed in a nationally accredited general height safety course or a course of equal standard, to a level of competence where they can work under a supervisor. Such training and assessment shall take into account the type of work to be conducted, the structure(s) on which they work, the fall protection equipment they are to use and first response rescue methods.~~

~~(iii) *Height safety supervisor*~~

~~Supervisors shall be assessed as competent if they can demonstrate competence~~ in the ~~work~~safe ~~requirements of Item (ii) and in addition, can demonstrate their ability to work unsupervised, to supervise on the job, entry level and other operators when performing harness based work at heights and to participate in first response recue.~~

~~(iv) *Height safety equipment inspector*~~

~~People to be designated as equipment inspectors shall be trained and assessed in height safety theory, see Item (i), and in the identification and assessment~~use of all ~~defects that may occur on any equipment they may be required to inspect. This includes application~~components of ~~manufacturers'~~their ~~recommendations~~fall-protection ~~where~~system. ~~they~~See ~~exist~~Appendix B for ~~particular items of equipment.~~

~~(v) *Height safety manager*~~

~~The category of height safety manager shall apply to people who may have tasks associated with harness based work at heights, which include but are not necessarily limited to people who –~~

~~(A) are responsible for the management and administration of people performing harness based work at heights;~~

~~(B) design infrastructure upon which people may be exposed to a fall from height risk or equipment that may be used while working at heights;~~

~~(C) make decisions about the suitability of equipment when purchasing or specifying for purchase, equipment (such as tools and personal protective equipment) that may be required for use in areas where fall from height risks exist; or~~

~~(D) participate in safe work practice development for harness based work at heights.~~

~~The~~recommended training ~~and assessment of height safety managers shall include where appropriate, additional height safety theory, the technical skills specific to their work and risk and systems management~~outcomes.

~~NOTE Retailers, resellers and the providers of hire equipment should be aware of any duty of care they may be required to observe when supplying equipment covered by the AS/NZS 1891 series of Standards directly or indirectly to operators, by encouraging those operators to acquaint themselves with height safety theory.~~

~~(b) *Competency reassessment*~~

~~All competencies shall be reassessed at appropriate intervals.~~

~~(c) *Records of training and competency*~~

~~Records shall be kept for each person who has been trained and assessed as competent. The level of competence achieved shall be recorded.~~

2.3 Fall protection on moveable platforms

Users of moveable platforms that require occupants to use fall-arrest rated equipment such as building maintenance units, swing stages and boom type elevating work platforms may find difficulty in providing adequately for the anchoring of fall-arrest equipment to the platforms. The following requirements and recommendations for the fall protection of people working on these platforms therefore need to be observed:

(a) If an anchorage point with minimum ultimate strength of at least 12 kN cannot be found, the operator shall be limited to the use of a work method that is designed to prevent a fall, i.e. use of restraint technique (see Clause 2.2.5) which will prevent the operator reaching or climbing to a position from which a fall is possible. Fall-arrest rated equipment shall be worn.

(b) If an anchorage with an ultimate strength of 12 kN or more but less than 15 kN is available, a system allowing either restrained or limited free fall may be used.

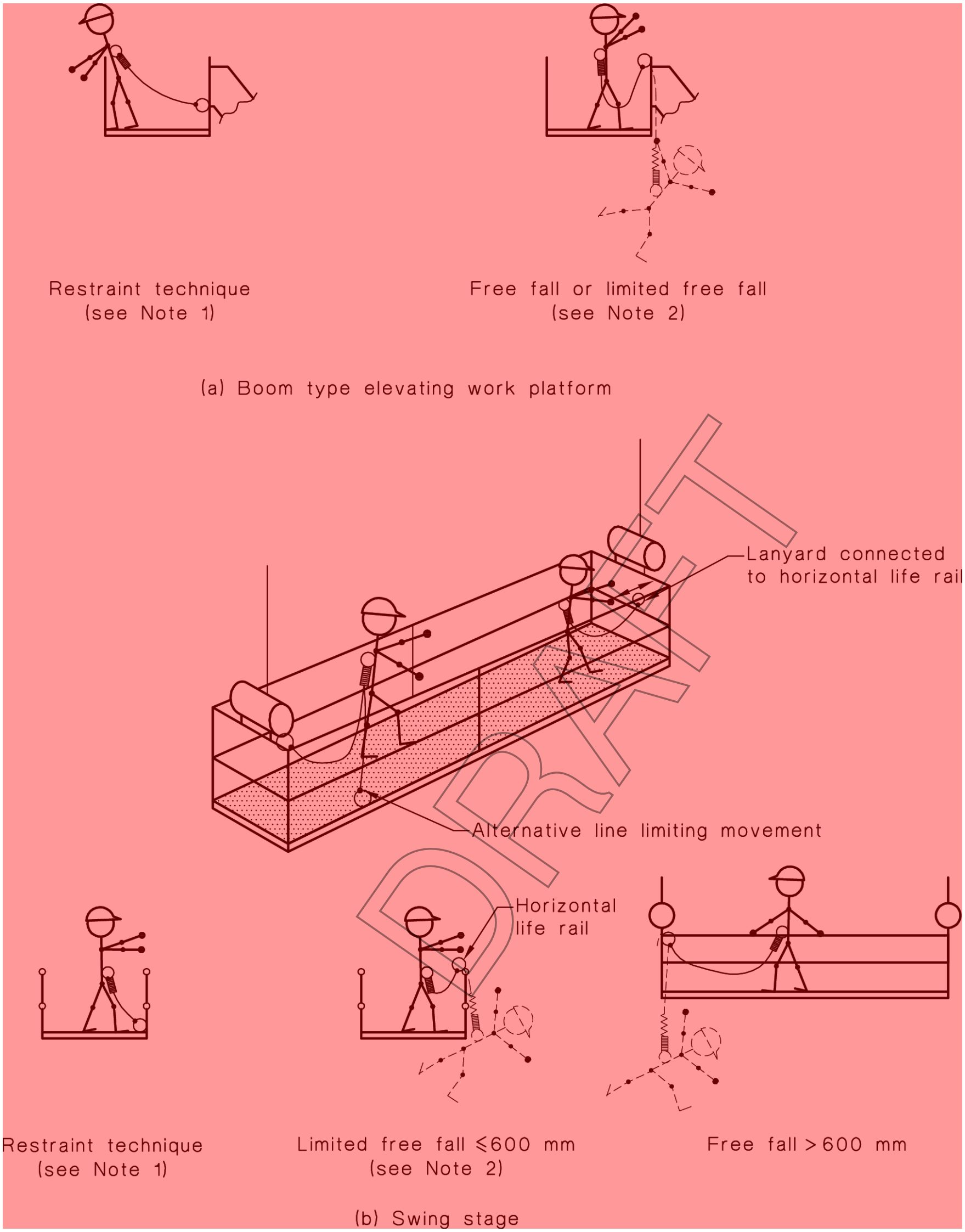
(c) An operator should not be allowed to reach a position from which a free fall is possible unless attached to an anchorage of ultimate strength at least 15 kN.

(d) In a potential free-fall situation the possibility of encountering the pendulum effect (see Clause 2.2.2) should be considered. This can occur when the anchorage point is neither directly above nor directly behind the operator at the point at which the fall occurs. A typical case is a fall from one end of a swing stage where the operator is anchored to the centre of the stage. A horizontal lifeline or rail within the stage is a possible solution provided adequate strength end anchorages can be found.

(e) The personal fall-arrest equipment to be used is specified in Table 2.1.

Typical cases are illustrated in Figure 2.4.

NOTE Further advice on the anchorage points for these equipments may be obtained by reference to relevant parts of AS 1418 and AS 2550.



NOTE 1 It is unlikely that total movement limitation can be achieved in either a swing stage or a boom type elevating work platform due to the minimum requirements for lanyard length in the normal working situation and to the possibility of stage or platform support failure.

NOTE 2 By selection of an appropriate anchor position and use of a short lanyard potential fall distance can be limited to 600 mm or less.

Figure 2.4 – Fall protection on moveable platforms

3 Anchorages

NOTE This Section should be read in conjunction with the relevant general requirements and recommendations relating to all systems and equipment given in Section 2.

3.1 Anchorage selection

3.1.1 General

Selection of the type and location of anchorages will depend on the nature and location of the task and the type of construction of the building or supporting structure. A summary of types of anchorage, their strength requirements and their application is given in Table 3.1or AS/NZS 5532.

NOTE Certain structures may not be capable of providing anchorages of adequate strength for fall-arrest purposes as required by this Standard. In such cases alternative methods of protecting workers working at heights, based on appropriate risk assessment, will need to be developed.

Table 3.1 – Strength requirement for anchorages

Purpose of anchorage	Ultimate strength in direction of loading (minimum) (see Notes 1 and 4)
(a) Single point anchorages	-
- Free fall arrest – one person	15
- Free fall arrest – two persons attached to same anchor	21
- Limited free fall arrest (including rope access anchorages)	12
- Restraint technique	12 or 15 (see Note 3)
(b) *Horizontal lifelines*	-
- End anchorages	See Clause 6.2.4
- Intermediate anchorages	-
- diversion less than 15°	12
- diversion 15° or more	12+ (see Note 2)

Kilonewtons

NOTE 1: As far as practicable all single point one-person anchorages should meet the 15 kN requirement regardless of primary purpose.

NOTE 2: Horizontal component of forces induced during a fall arrest (multiplied by a safety factor of 2.0) is to be added as indicated in Clause 6.2.5.

NOTE 3: Anchorage strengths applicable when using a restraint technique, see Clause 2.2.5, are either 15 kN or 12 kN depending on whether the ultimate fall risk is free fall or limited free fall.

NOTE 4: "Ultimate strength" means that the anchorage may yield at the stated load but must not fail.

3.1.2 Single point anchorages suitable for direct connection of personal fall-arrest equipment

In addition to any specific requirements of the manufacturer of the anchorage system or other related equipment, the following requirements and recommendations for the selection and location of anchorages apply:

(a) The anchorage and the structure to which it is attached shall be capable of sustaining an ultimate load equal to that shown in Table 3.1 for the corresponding anchorage purpose for single person use when loaded in the direction of the lanyard, anchorage line, or restraint line during a fall arrest. This load requirement shall be increased by 6 kN (i.e. to 21 kN) if two people are to use the one point. The maximum number of people connected to any one point shall be two.

As far as practicable, all single-point anchorages for single-person attachment should have an ultimate strength of 15 kN even though Table 3.1 specifies a lesser strength for some categories.

The building or structure and anchorage points shall be assessed by an engineer, unless it is clear to a height safety supervisor that the anchorage system is structurally adequate. An example of where an engineer may not be required is where an anchorage sling of adequate strength is secured around a solid permanent structure such as a plant room. However, if any doubt exists as to the structural adequacy of the anchorage, an engineer shall make the assessment. If called upon to make the assessment the engineer shall certify in writing that all combinations of loads in a worst case situation can be safely contained by the proposed structure and anchorage points.

(b) The following conditions shall apply to the use of anchorages in each of the purpose categories listed in Table 3.1:

(i) *Free fall arrest* Required in any situation where a free fall in excess of 600 mm is a possibility.

(ii) *Limited free fall arrest* Limited to any situation where there is no risk of a free fall in excess of 600 mm.

(c) Signage in accordance with Clause 3.2.5 shall be provided.

(d) Fall-arrest anchorages shall, except as given below, be located in positions where there is adequate fall distance before the user can strike a lower obstruction, having regard to the fall-arrest equipment likely to be used (see Section 7). Examples include striking any machinery or open window, door or panel during a fall. If it is not possible to provide clearance from all obstructions a person might strike, the requirements of Section 7 shall be observed.

(e) Lanyards or anchorage lines shall be able to be attached to the anchorages before the operator moves into a position where there would be risk of a fall, unless the operator is already protected by another fall-arrest system.

(f) Possible deterioration of anchorages or substrate damage, e.g. that caused by chemical attack, corrosion or atmospheric conditions, should be considered in selecting the anchor material and design.

(g) Where used, drilled-in anchorages such as friction and glued-in anchorages shall be placed so that the shear load is at least twice the tension load. For collared eye-bolts this translates to a pull at an angle not exceeding 20° to the surface in which the bolt is installed.

Every friction and glued-in anchorage shall be proof loaded to 50 % of the design ultimate strength specified in Table 3.1 in accordance with manufacturer's instructions after installation and prior to its initial use. The proof load shall be applied as an axial pull-out force. Proof loading to 50 % of design load shall also be carried out as part of subsequent periodic inspections.

3.1.3 Anchorages requiring use of a sling

Requirements and recommendations for the selection and location of anchorages are as follows:

(a) All relevant requirements and recommendations in Clause 3.1.2 are applicable.

(b) The sling shall be of sufficient length so that it can be rigged with the angle between the legs no greater than 120° (see Clause 3.2.4(b)) unless allowance has been made for the higher loads in the legs of the sling which would be imposed by a greater angle.

3.1.4 Horizontal lifelines and rails

These forms of anchorage are used where the user needs to be able to move laterally over significant distance while connected to the system. Requirements for anchorages for flexible lines and for horizontal rails are covered in Section 6.

3.1.5 Components, used in anchorage systems

A non-exhaustive list of Standards for components used in anchorage systems is given for information in Appendix B.

3.2 Safe use of anchorages

3.2.1 General requirements

A suitable anchorage point should be as close as practicable to vertically above the place of work to reduce the liability to swing. Where the possibility of swing in the event of a fall is unavoidable, the requirements and recommendations of Clause 3.2.3 should be observed.

Adequate fall clearance needs to be provided below the operator. The required clearance shall be calculated as set out in Section 7.

Strength requirements for anchorages for use with various fall-arrest systems are specified in Table 3.1. The type of fall-arrest system attached to an anchorage point shall be compatible with the anchorage strength indicated on any sign associated with the anchorage point.

A rope or webbing anchorage line should not be placed around a structural member with sharp edges unless suitably protected, e.g. by use of a protective sleeve.

3.2.2 Safe access

A safe means of access to an anchorage point in accordance with AS 1657 should be provided. This should take into account the possibility of a fall prior to the operator connecting securely to the anchorage, and after disconnection at the conclusion of the task.

Provision shall also be made for the protection of users while transferring between fall arrest systems (see also Clause 6.3(e)).

3.2.3 Avoiding lateral swing – The pendulum effect

If there is a lateral offset between the line from the anchorage point to the operator and the line or direction of potential fall, in the event of a fall the operator may suffer hazardous lateral swing. This is commonly known as the pendulum effect. Two common consequences of the pendulum effect are illustrated in Figures 3.1(a) and 3.1(b). The hazard in the first case is a horizontal collision with a fixed object. In the second case it is a greatly extended fall distance. If the length of unsupported line is equal to or more than the height of the edge above the ground, the operator will strike the ground or other obstacle.

Where the pendulum effect cannot be avoided altogether by use of alternative or changeable anchorage points it shall be controlled to the extent necessary to minimize injury in the event of a fall. The following are ways in which this may be done:

(a) *Dual anchorages* The operator is connected to two separate anchorage points using a twin-tail lanyard in a way that will limit lateral swing in the event of a fall, as illustrated in Figure 3.1(c). Connection to the operators harness via a single energy absorber is essential to ensure that in the event of a fall the fall-arrest force does not exceed 6 kN.

(b) *Diversion anchorage* The lanyard assembly or anchorage line is diverted through a second anchorage point or a connector tethered to a second anchorage point as illustrated in Figure 3.1(d), and the lanyard or line runs freely through

the anchorage point or connector. Care is needed in this case in determining what the maximum resultant fall-arrest force on the diversion anchor is likely to be. As demonstrated in Figure 3.1(c), it may be significantly greater than that on the primary anchorage. The calculated resultant force on the diversion anchor should be based on 6 kN maximum lanyard/anchorage line force and subjected to a factor of safety of 2.

(c) *Edge stops* Stops such as vertical projections are placed along the edge of the roof, platform or stage on which the operator is working, as shown in Figure 3.1(f). In the event of a fall, the distance the line can slide along the edge is limited by the stops. Edge stops should not be located in such a manner as to provide a trip hazard themselves, particularly if close to the edge of a roof or other potential fall location.

3.2.4 Safe use of anchorage slings

Where slings are to be used to provide anchorages for fall-arrest equipment other than horizontal life lines, e.g. on a building by rigging each sling around one or more posts, beams or other structures, the safety requirements and recommendations are as follows:

(a) It shall be verified that the anchorage strength of the structure around which each sling is to be rigged, meets the requirements of Clause 3.1.2(a).

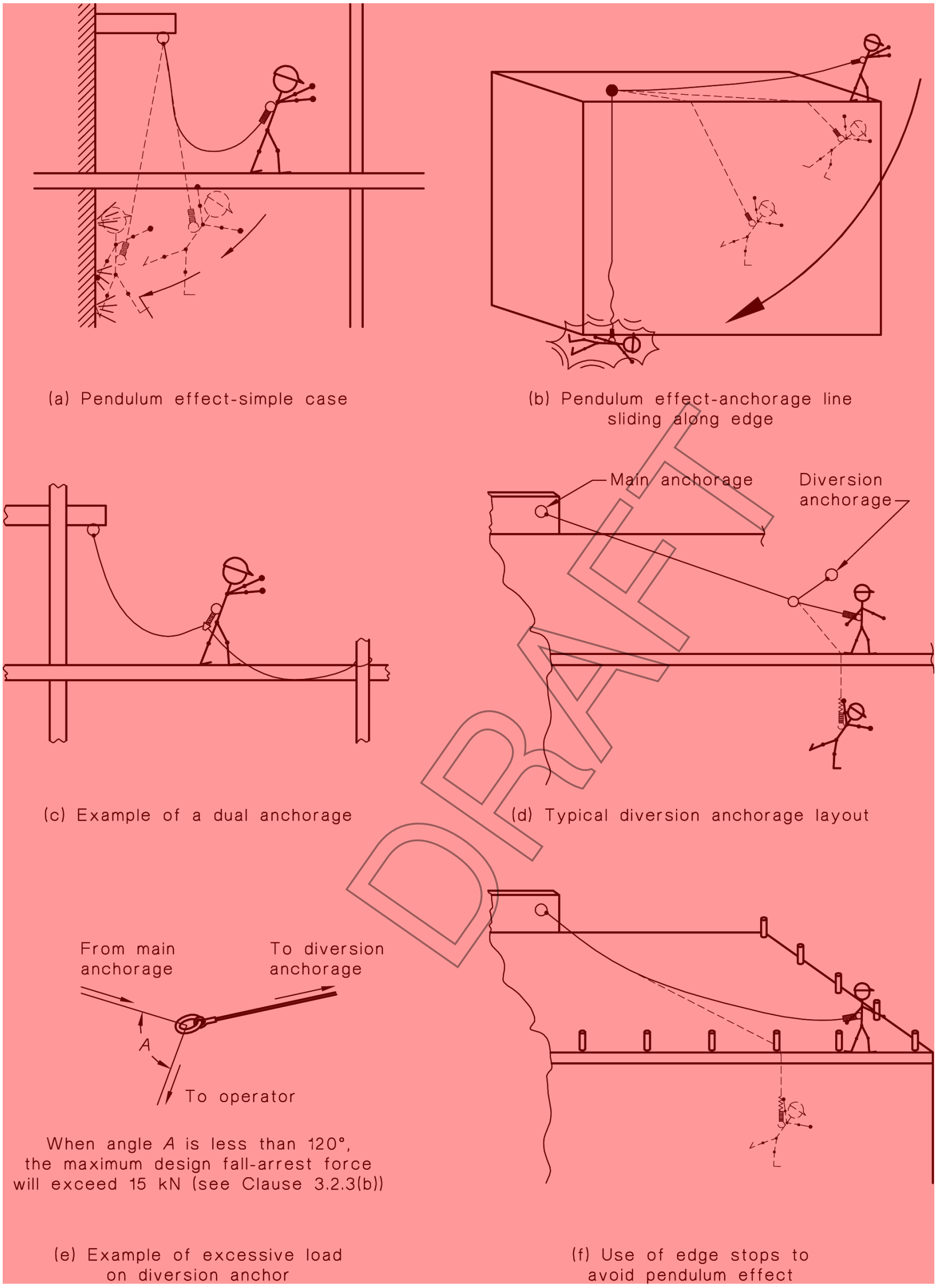
(b) The angle between the sling legs, as illustrated in Figure 3.2, should not exceed 120°. A sling should not be rigged with a choked pull unless it has been designed for this manner of rigging. A choked sling has a reduced load capacity and should not be used unless this has been taken into account.

NOTE Rigging a sling with a greater angle between the legs than shown in Figure 3.2 may result in the safe working load of the sling being exceeded, unless it has been calculated that in a particular case, a greater angle can be permitted without exceeding the safe working load.

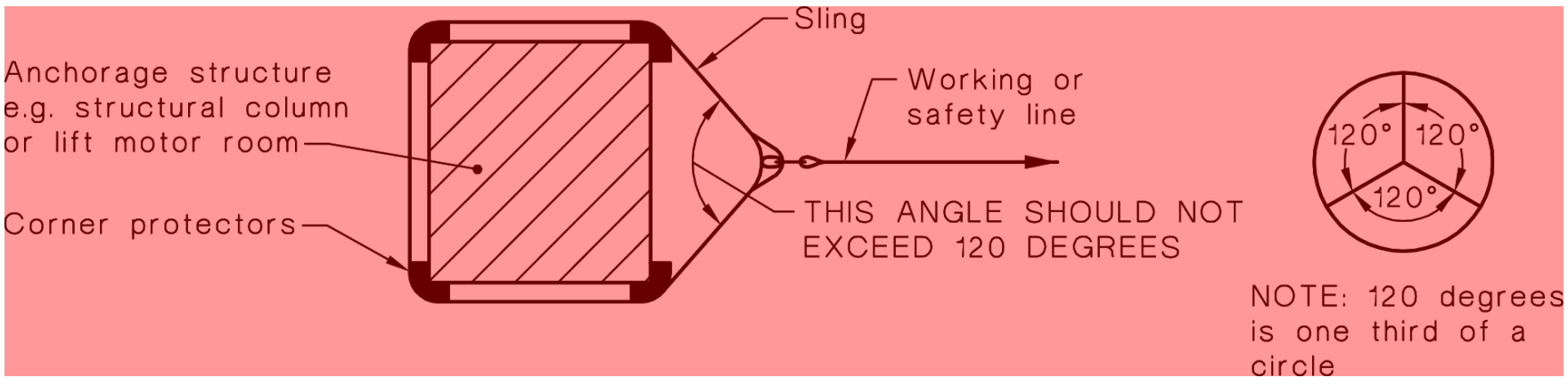
(c) Protection shall be provided at all locations where slings would otherwise be subject to abrasion or cutting which may lead to sling failure, e.g. at sharp corners and edges.

(d) Where required, a means shall be provided for preventing the sling from slipping along the member to which it is attached, e.g. a double wrap or attachment at a cross member.

(e) When connecting a line to the eyes of a sling, a connector capable of accommodating both eyes without causing unsafe loading of the latch, as shown in Figure 3.3, shall be provided. Normally, an intermediate connector between the sling eyes and the line connector will be required. Connectors of an appropriate shape, either a pear-shaped karabiner or a triangular tube nut connector should be used.



~~Figure 3.1 – Avoiding lateral swing (the pendulum effect)~~



~~Figure 3.2 – Method of rigging an anchorage sling~~

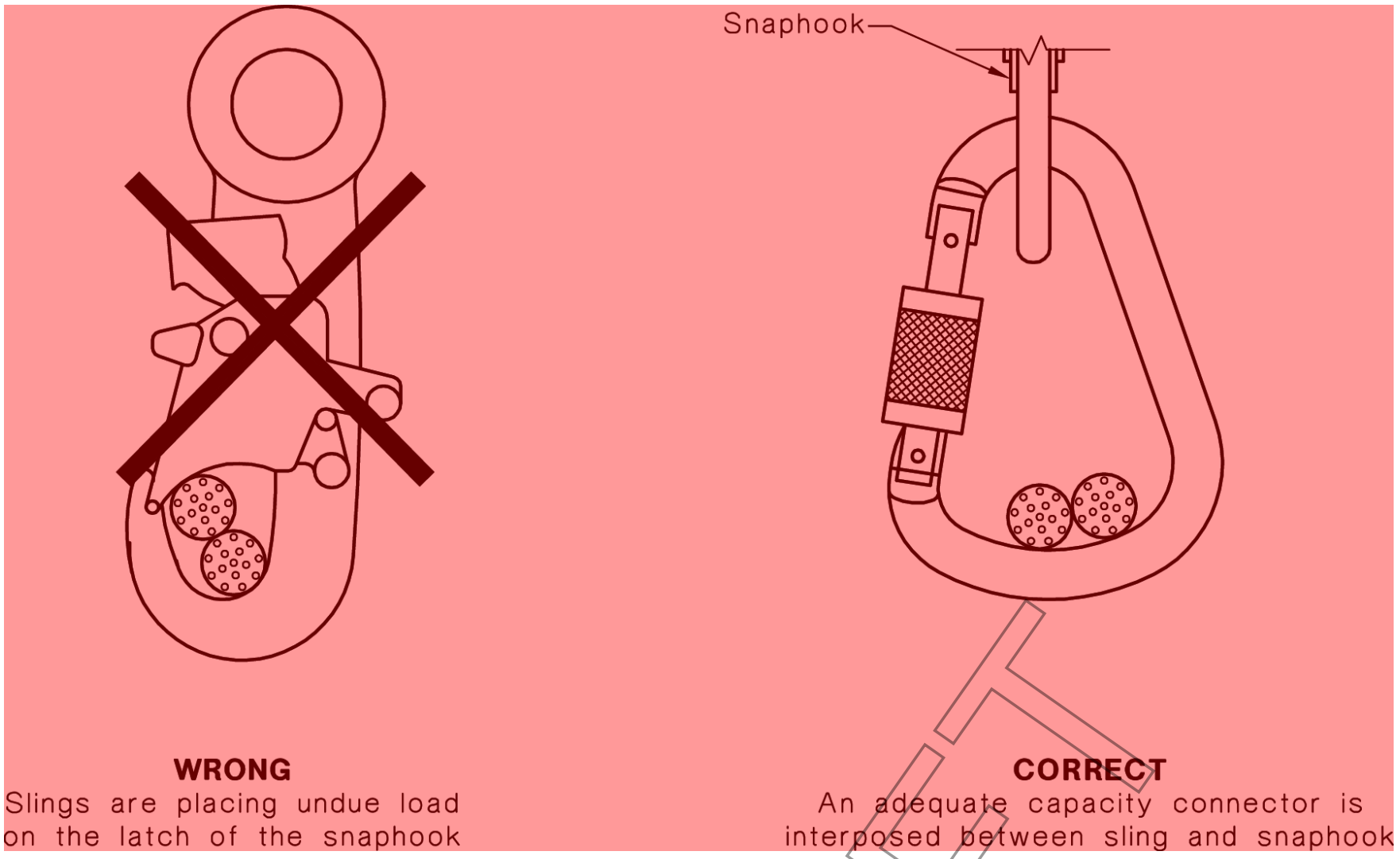


Figure 3.3 – Unsafe loading of a snaphook

3.2.5 Signs at anchorage points

Signs in accordance with Clause 2.2.9 shall be provided for each anchorage point which will be in place for a period longer than one month. The sign shall show the following information:

(a) Name of installer and installation date, or if an existing structure has been certified, the name of the certifier and the certification date.

(b) The highest purpose category in Table 3.1 for which the anchorage is suitable.

(c) The ultimate strength rating if less than 15 kN. In this case words to the effect that the anchorage is not to be used for fall-arrest shall be added to the sign.

(d) The maximum number of people (not more than two) who are permitted to be connected to the anchorage at any one time.

If an anchorage point is to be used only for a period of less than one month and is not therefore labelled, it shall be removed as soon as it is no longer required.

At permanent installations the information shall be shown either on a sign located at each anchorage point or alternatively, on a plan prominently displayed at the entry to the area.

4 Harnesses lanyards, pole straps and fittings

NOTE This Section should be read in conjunction with the relevant general requirements and recommendations relating to all systems and equipment given in Section 2.

4.1 Designation and selection of harnesses

4.1.1 General requirements

Harnesses, lanyards, pole straps and related fittings shall conform to the requirements of AS/NZS 1891.1or AS 1891.5.

Users should use equipment which is appropriate to the fall-arrest situation that could arise in their work. Table 4.1 lists all harnesses described in this Section together with lanyards and pole straps described in Clause 4.2. The Table summarizes the principal uses of each and indicates whether they are permitted for fall-arrest under either free, limited free or restrained fall conditions.

Belts or waist straps alone in lieu of a harness shall not be used for any fall-arrest (including restraint technique) application covered by this Standard.

Table 4.1 – Use of harnesses and associated devices in fall-arrest systems

Device	Principal uses	Whether permitted for fall-arrest		
		Free fall	Limited free fall	Restrained fall
Full body harness	Any situation with risk of any fall including restraint technique.	Yes	Yes	Yes
Lower body harness	Risk of limited free fall, restrained fall including with pole strap, restraint technique.	No	Yes	Yes
Harness with confined space retrieval attachments*	Risk of free fall in a confined space where provision for rescue is also required.	Yes	Yes	Yes
Lanyard – single fixed – single adjustable	Connection of a harness to an anchorage or lifeline.	Yes	Yes	Yes
Lanyard – twin tail	As above with facility for transferring among anchorages.	Yes	Yes	Yes
Pole strap	Connection to a harness for work positioning on a pole.	No	No	Yes

* Formerly known as a “confined space harness”.

Selection of a suitable harness should be taken into account the following:

(a) Observance of the use requirements and guidance for full- and lower-body harnesses given in Clause 4.1.2 and Clause 4.1.3.

(b) Ease of rescue including self-rescue.

(c) Ease of putting on and taking off.

(d) Wearer comfort during normal work including if suspended for any reason.

(e) Ability to adjust components to fit the various body shapes likely to use it.

(f) Ability to spread the load of a fall arrest on the wearer’s body and provide a measure of comfort while the wearer is suspended after a fall.

Consideration should be given to selecting a single harness to cover all of the work situations in which a particular user may need to operate. Unless a users work situations are confined exclusively to restrained or limited free fall risks, the appropriate selection is the full body harness. This will tend to ensure that the user does not wear a harness that gives a lower standard of protection than required in a particular case.

2.5.3 Rescue plan

A rescue plan for a person who has suffered a fall or is otherwise incapacitated shall be developed prior to starting work at height.

The correct equipment shall be available and used for the rescue.

The person conducing the rescue shall be a competent person.

The rescue plan shall include all of the following elements:

(a) Provision for self-rescue.

(b) Ability to call for external help.

(c) Ability to rescue a person from all locations on site.

(d) Sufficient number of competent people to perform a rescue.

(e) First aid provisions, during and after the rescue.

(f) Timeliness of the rescue to limit harness suspension trauma.

NOTE Harness suspension trauma is a reaction to being upright and immobile, for example, if held in a vertical stretcher, or suspended inanimate in a harness. Blood pools in the legs potentially lead to unconsciousness. If the condition develops unchecked, it can be fatal. Further information about this topic can be found at https://www.anzcor.org/home/first-aid-management-of-injuries/guideline-9-1-5-first-aid-management-of-harness-suspension-trauma/.

The rescue plan shall not include:

(i) Reliance on emergency services.

(ii) Practices that endanger rescuers, casualty or others.

(iii) Reliance solely on actions performed by the casualty.

2.5.4 Dropped objects

Dropped object hazards shall be identified and control measures implemented. Controls should be applicable to the industry and the jurisdiction.

NOTE 1 Objects that can be dropped at height pose a significant risk to those below the work area. Examples of how this can be controlled includes drop nets, exclusion zones below the work area, securing tools with a tool lanyard, and overhead protective structures.

NOTE 2 ANSI/ISEA 121 is an example of a standard that includes performance requirements of dropped objects prevention solutions.

2.5.5 Working on inclined surfaces

A fall-arrest system shall be used for any work area –

(a) where the work surface is inclined; or

(b) is slippery,

such that if a person loses their footing, they slide towards a fall hazard.

If the surface is inclined or slippery such that the fall-protection system supports the user's weight, then either of the following shall be used:

(i) A work positioning system [see Clause 2.5.1(a)]; or

NOTE 1 This includes industrial rope access systems as described in AS/NZS ISO 22846 Parts 1 and 2.

(ii) Passive fall prevention.

NOTE 2 Passive fall prevention includes engineering controls.

2.5.6 Working on moveable platforms

When working at height on a moveable platform, such as an elevating work platform, swing stage or building maintenance units, the available fall clearance and swing fall risk shall be reassessed prior to moving the platform.

NOTE Movable platforms can move around the environment and, hence, the available fall clearance can change during work. Moveable platforms are also less rigid than fixed working surfaces. A fall-arrest load can cause the platform to move, thereby increasing swing fall. See Section 7 for more information on fall clearance and swing fall.

A risk assessment shall be conducted to determine a suitable fall-protection system. The risk assessment shall include the following:

(a) The available fall clearance and swing fall risk.

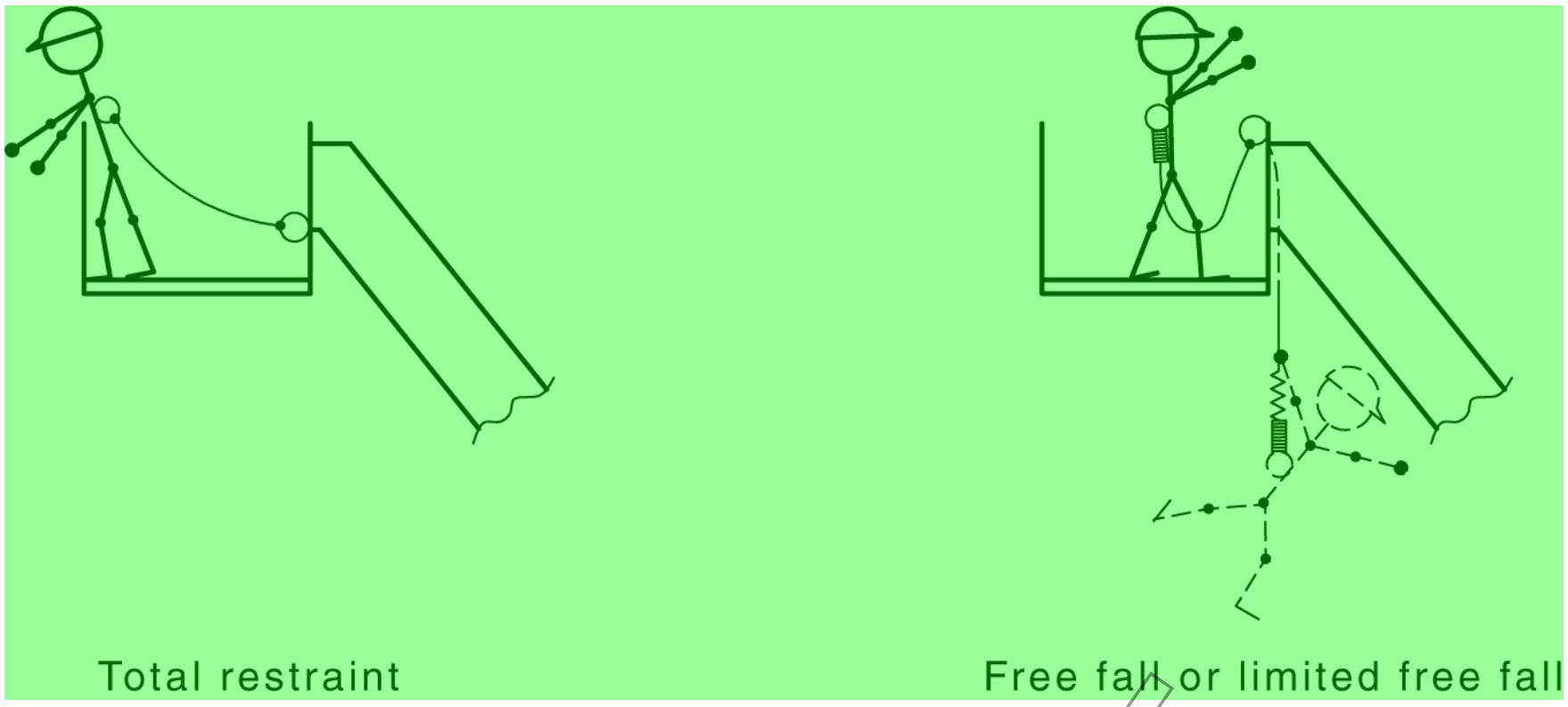
(b) Available anchor and rating, in accordance with Table 2.1.

(c) Possibility of falling out of the platform.

(d) Adjustability of the connecting system.

Examples of working on moveable platforms are shown in Figure 2.5.

(a) Elevating work platform



NOTE 1 It is unlikely that total movement limitation can be achieved in either a swing stage or a boom type elevating work platform due to the minimum requirements for lanyard length in the normal working situation and the possibility of stage or platform support failure.

NOTE 2 The potential fall distance can be minimized by selecting an appropriate anchor position and minimizing the lanyard length by using an adjustable lanyard.

Figure 2.5 – Examples of fall-protection on moveable platforms

2.5.7 Product instructions

The product instructions for all pieces of equipment shall be made available to users of the equipment. The user shall follow the product instructions for each piece of equipment in their system.

2.5.8 Labels, signs and markings

All fall-protection equipment shall be permanently marked in accordance with the requirements of the relevant Standards.

NOTE Relevant Standards include, but are not limited to, AS/NZS 5532 for anchors, AS 1891.5 for lanyards and pole straps and AS/NZS 1891.1 for harnesses.

3 Anchor selection and use

3.1 General

This section includes guidance for selecting and using different types of anchors. Selection of the type and location of anchors will depend on the nature and location of the task and the type of construction of the building or supporting structure.

A competent person shall assess potential anchorages in accordance with the product instructions.

If the suitability of the anchorage is not evident to a competent person, then a professional engineer shall assess the anchorage. The assessment shall include certification in writing that the anchorage is capable of sustaining a load equivalent to the rating of the attached anchor or anchors. Minimum anchor ratings are given in Table 2.1.

NOTE Some anchorages may not be capable of sustaining loads in accordance with the requirements of this document. In such cases, alternative methods to protect workers working at heights should be developed based on a risk assessment.

If a strop is used to extend an anchor or mobile attachment point, then it shall be rated to the equivalent load as the anchor to which it is attached.

3.2 Anchor selection

3.2.1 Single point anchors

Single point anchors provide one location (a single point) for attachment of a connecting system.

NOTE 1 Portable anchors can be installed and removed from the anchorage as required, for example, a tripod or davit (see Figure 3.1).

NOTE 2 Fixed anchors have a single attachment point. Once installed, the product cannot be removed from its location without disassembly, for example, a concrete chemically fixed anchor or a sheet metal riveted anchor (see Figure 3.2).

Single point anchors shall conform to AS/NZS 5532.

In addition to the general requirements in Clause 2, the following applies:

(a) Where repeated access is required, permanent anchors shall be used.

(b) An anchor shall be positioned so that a user is not exposed to a fall hazard while they are connecting to the anchor.

(c) An anchor system shall be designed to allow transition between systems without exposing the user to a fall hazard.

(d) The anchorage shall be capable of sustaining the applicable loads.

(e) The anchor placement shall minimize free fall and swing fall.

(f) Multiple connectors shall not be attached to a single attachment point.

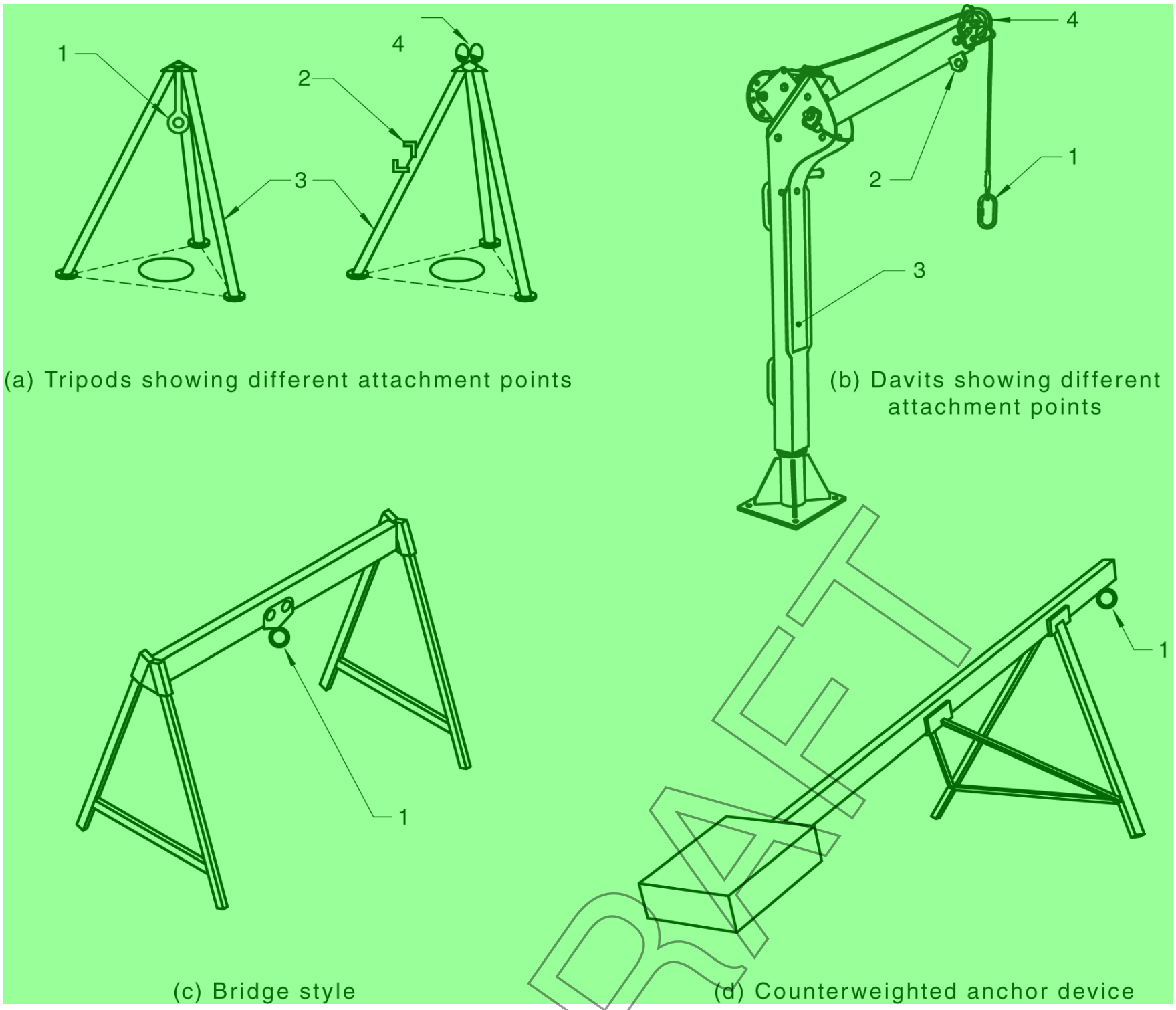
The following matters should be considered when selecting the type of single point anchor:

(i) Permanent anchors typically take up less space than temporary anchors.

(ii) Control measures should be applied if the connecting system can contact an edge.

NOTE 3 Control measures can include installing a temporary anchor to prevent the connecting system from contacting a hazardous edge, for example, davits, tripods or needles.

(iii) Single point anchors limit the user to a localized area.



KEY

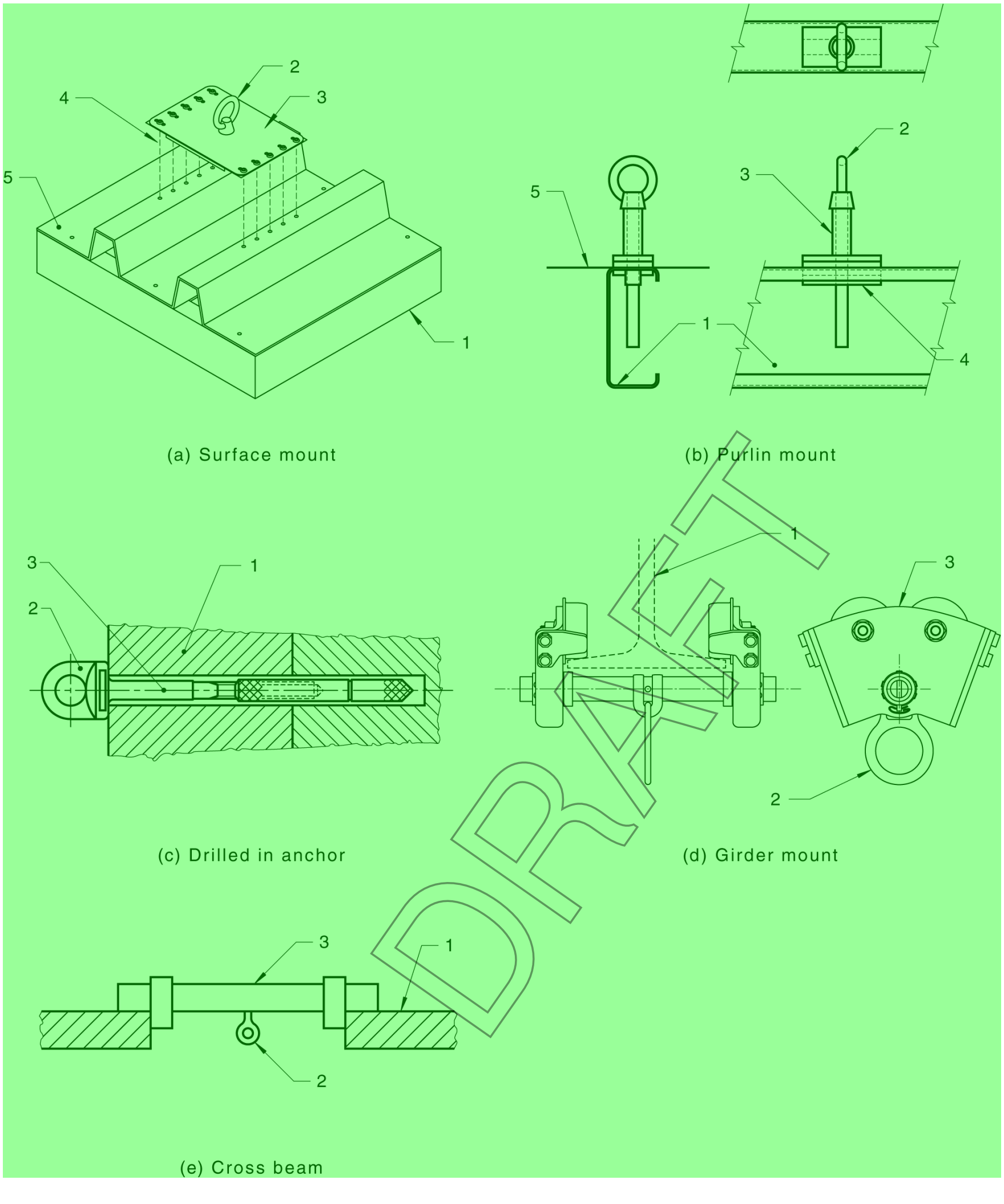
1. Personnel attachment point

2. Equipment attachment point

3. Anchor device

4. Pulley wheels for guiding self-retracting lifeline

Figure 3.1 – Examples of portable anchors



KEY

1. Structure

2. Personnel attachment point

3. Anchor device

4. Fixings

5. Roof sheeting

Figure 3.2 – Examples of fixed anchors

3.2.2 Horizontal lifeline and rail systems

Horizontal lifelines (HLL) and horizontal rail systems (HRS) can allow the user to move along the length of the HLL or HRS to reach a fall hazard. The fall-arrest equipment [such as a lanyard or a self-retracting lifeline (SRL), etc.] is attached to a mobile attachment point or directly to the HLL or HRS.

NOTE 1 Horizontal lifeline systems are flexible line systems that generally comprise a cable fixed between two end anchors. These systems often incorporate intermediate anchors along with mobile attachment devices which can be capable of passing across intermediate anchorages without disconnection.

NOTE 2 Horizontal rail systems are rigid systems that generally comprise a metallic structural member along which one or more mobile attachment devices can be attached. Each mobile attachment device provides a travelling attachment point for a user's connection system.

Horizontal lifelines and rails shall conform to AS/NZS 1891.2.

In addition to the general requirements in Section 2, the following applies:

(a) The anchorage shall be capable of sustaining the applicable loads.

NOTE 3 The load exerted on the anchorage by HLL and HRS can be higher than loads exerted on a single point anchor.

(b) HLL and HRS shall be placed so that any deflections under load do not contact a fixed object.

(c) Swing fall shall be assessed and managed when selecting an HLL and HRS. See Clause 7.3.

NOTE 4 The system will deflect when a fall occurs while connected to an HLL or HRS. If the fall occurs towards the end of a span, then the mobile attachment point can slide to the middle of the span. See Figure 3.3.

NOTE 5 If a fall occurs when working off-centre while connected to an HLL or HRS, the user will swing back in line. See Figure 3.4.

(d) Access to the HLL and HRS shall not expose the user to a fall hazard.

(e) HLL shall not be selected when work positioning techniques are used.

The following matters should be considered when selecting the type of HLL and HRS:

(i) HLL and HRS are typically constructed from metal which may corrode in some environments.

(ii) HRS generally have short spans and require additional connections to the anchorage compared to an HLL.

(iii) HRS typically have a higher number of components and are more complex compared to HLL. See Section 8 for inspection guidelines.

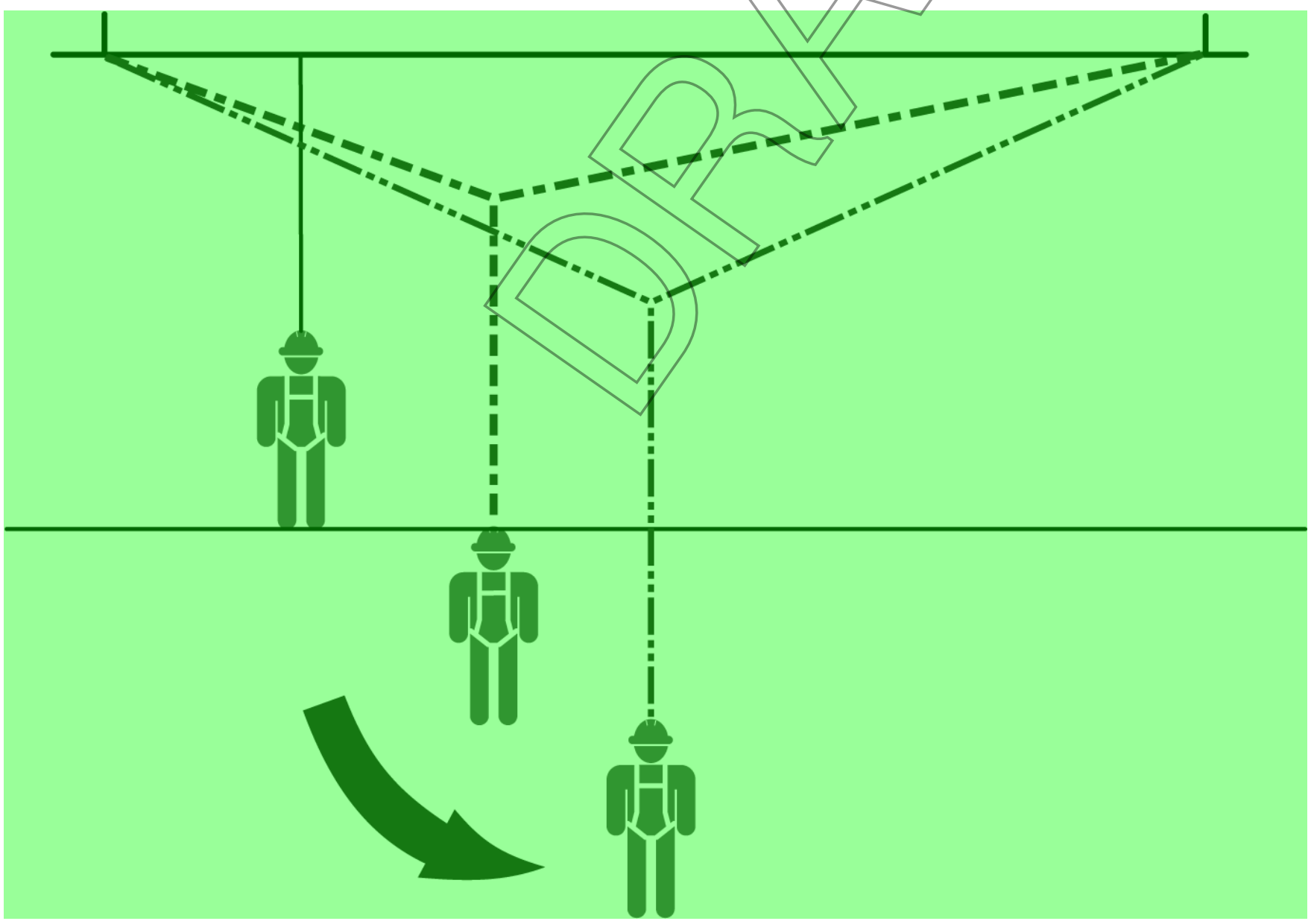


Figure 3.3 – Swing fall: mobile attachment point can slide to the middle of the span

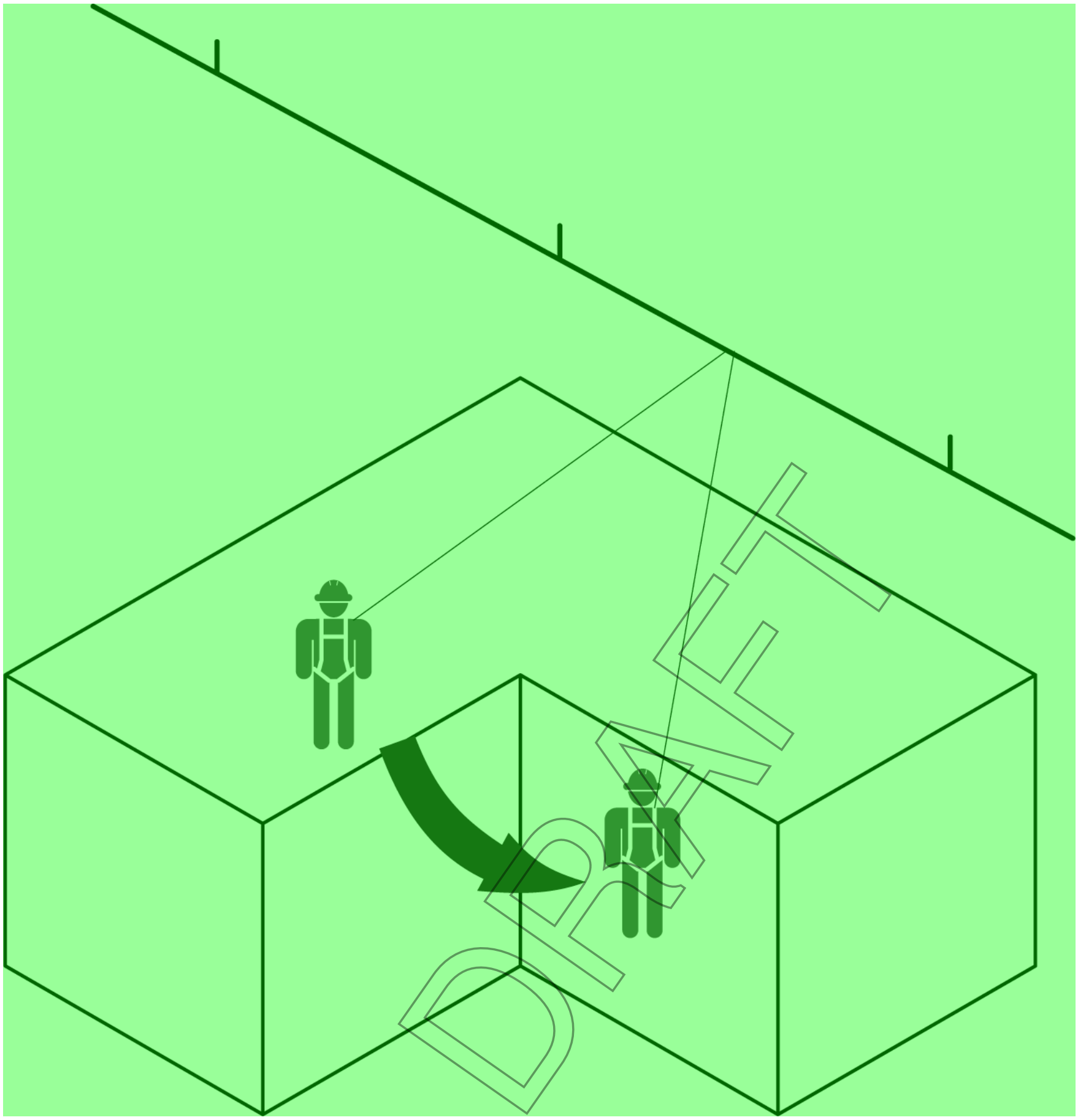


Figure 3.4 – Swing fall: user will swing back in line if a fall occurs while working off-centre

3.3 Anchor use

3.3.1 User information

User information for anchors shall be available at the –

(a) location; and

(b) time of use.

NOTE 1 The form of information can include signage, labels, quick response (QR) codes, radio frequency identification (RFID) and near field communication (NFC) tags, and reports provided by installers and certifiers.

NOTE 2 Information content is covered in AS/NZS 5532. This includes manufacturer identification, product identification and product ratings.

3.3.2 Diversion anchors

Diversion anchors are used to divert a connecting system and reduce swing fall (see examples in Figure 3.5).

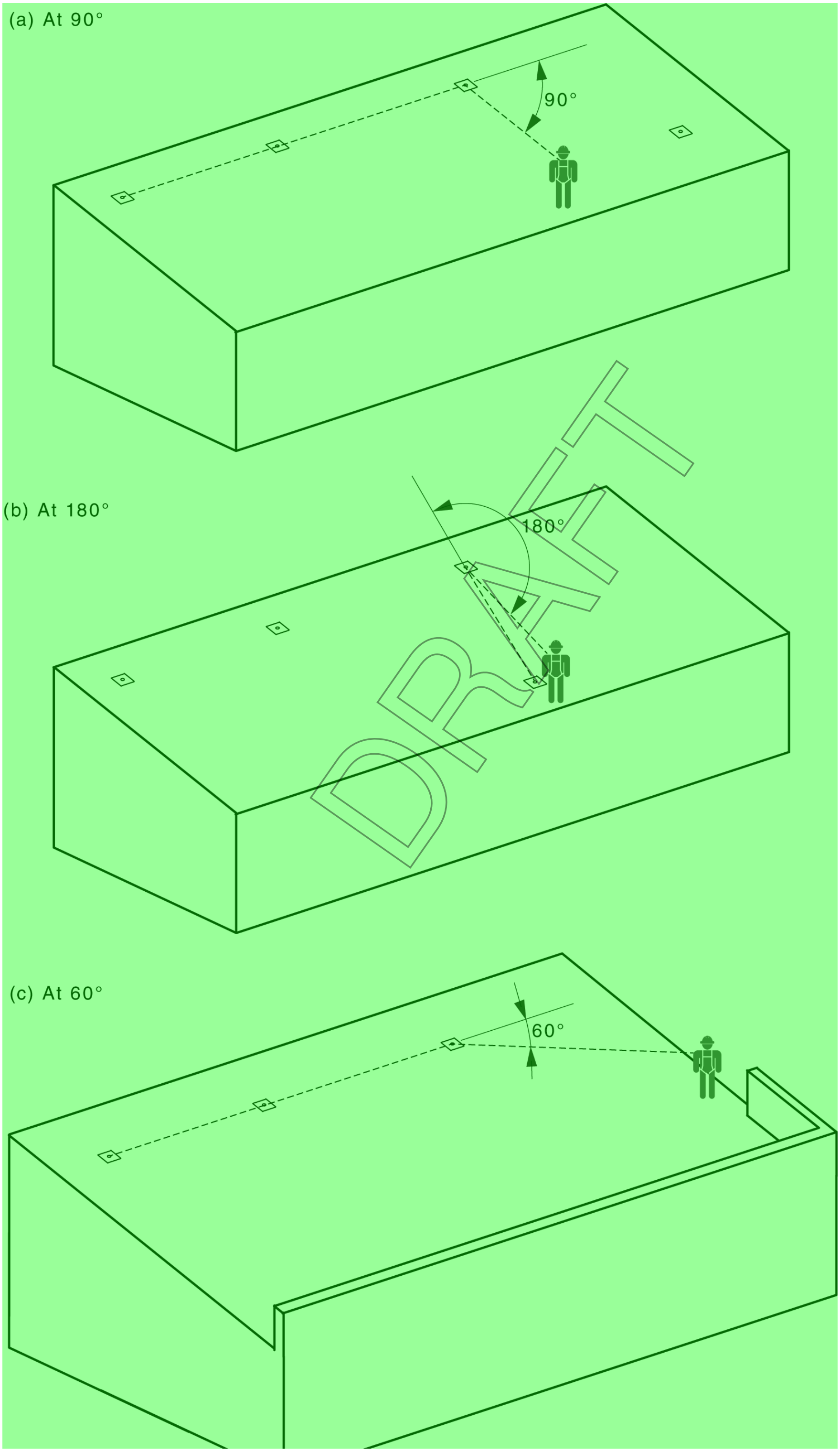
NOTE 1 A fall can transfer a load to the diversion anchor that exceeds its design loads.

If a diversion is above 60 °, then –

(a) the anchor system shall be assessed by load calculation; or

(b) the connecting system shall be re-anchored.

NOTE 2 Re-anchoring can include an alpine butterfly or equivalent knot tied into the connection system and connected to the anchor. An example is shown in Figure 3.6.



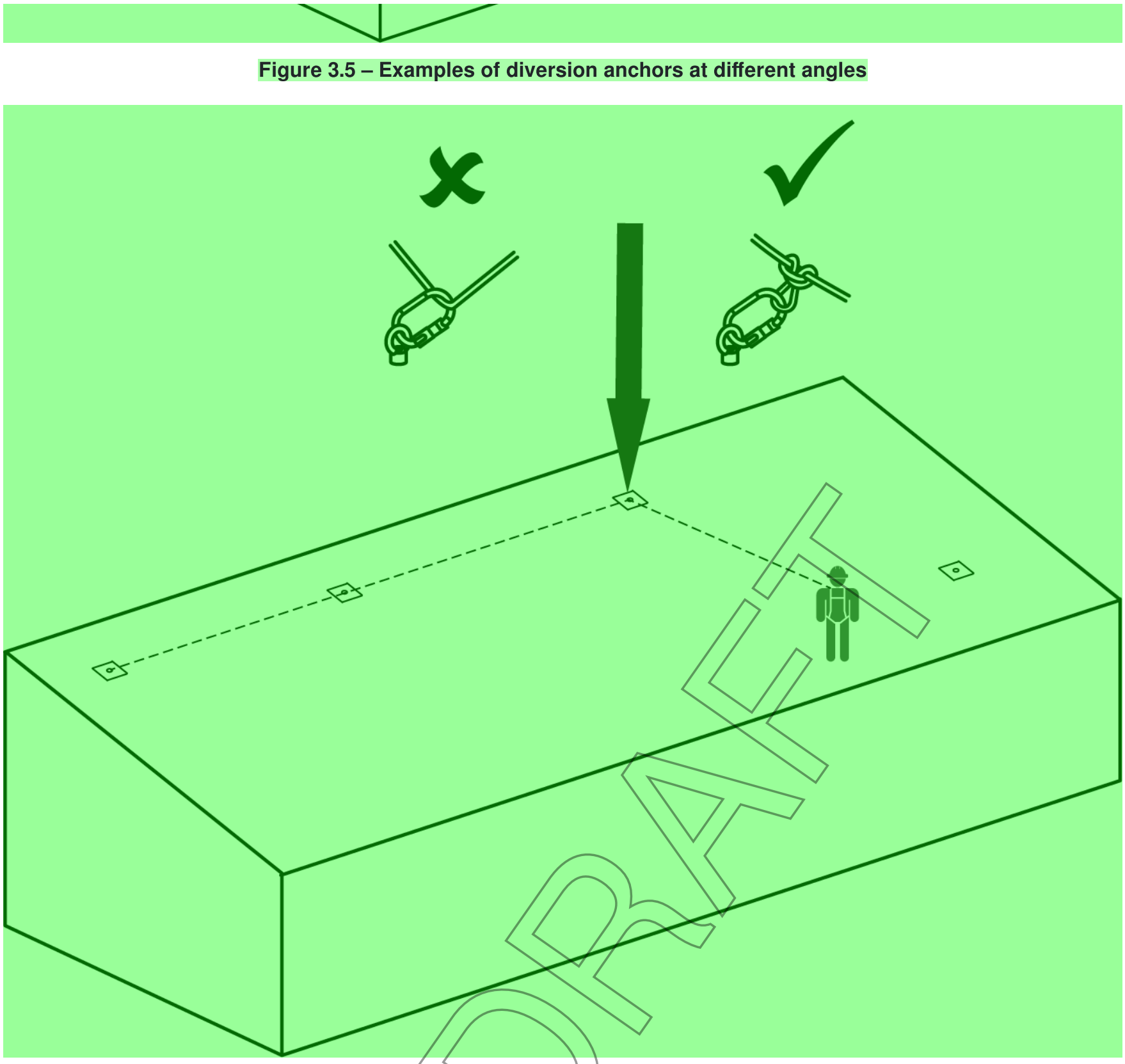


Figure 3.5 – Examples of diversion anchors at different angles

Figure 3.6 – An example of diversion anchor with an alpine butterfly knot

3.3.3 Anchor slings

Anchor slings –

(a) are a single point anchor (see Clause 3.2.1); and

(b) are wrapped around an anchorage to create an anchor.

Anchor slings shall:

(i) Be rigged such that the sling can sustain the rated load.

NOTE 1 Different rigging styles can affect the rated load. See Figure 3.7 for examples of sling configurations.

(ii) Be protected from sharp edges.

(iii) Have an internal angle of less than 120 ° when rigged in a basket configuration (see Figure 3.8), unless otherwise specified in the product instructions.

(iv) Have a compatible connector to suit the direction of loads (see Clause 6.3).

NOTE 2 This could include a pear-shaped karabiner or a screwlink (Type Q) connector.

(v) Have a means to prevent the sling from slipping along the anchorage.

NOTE 3 This can take the form of a double wrap or attachment at a cross member.

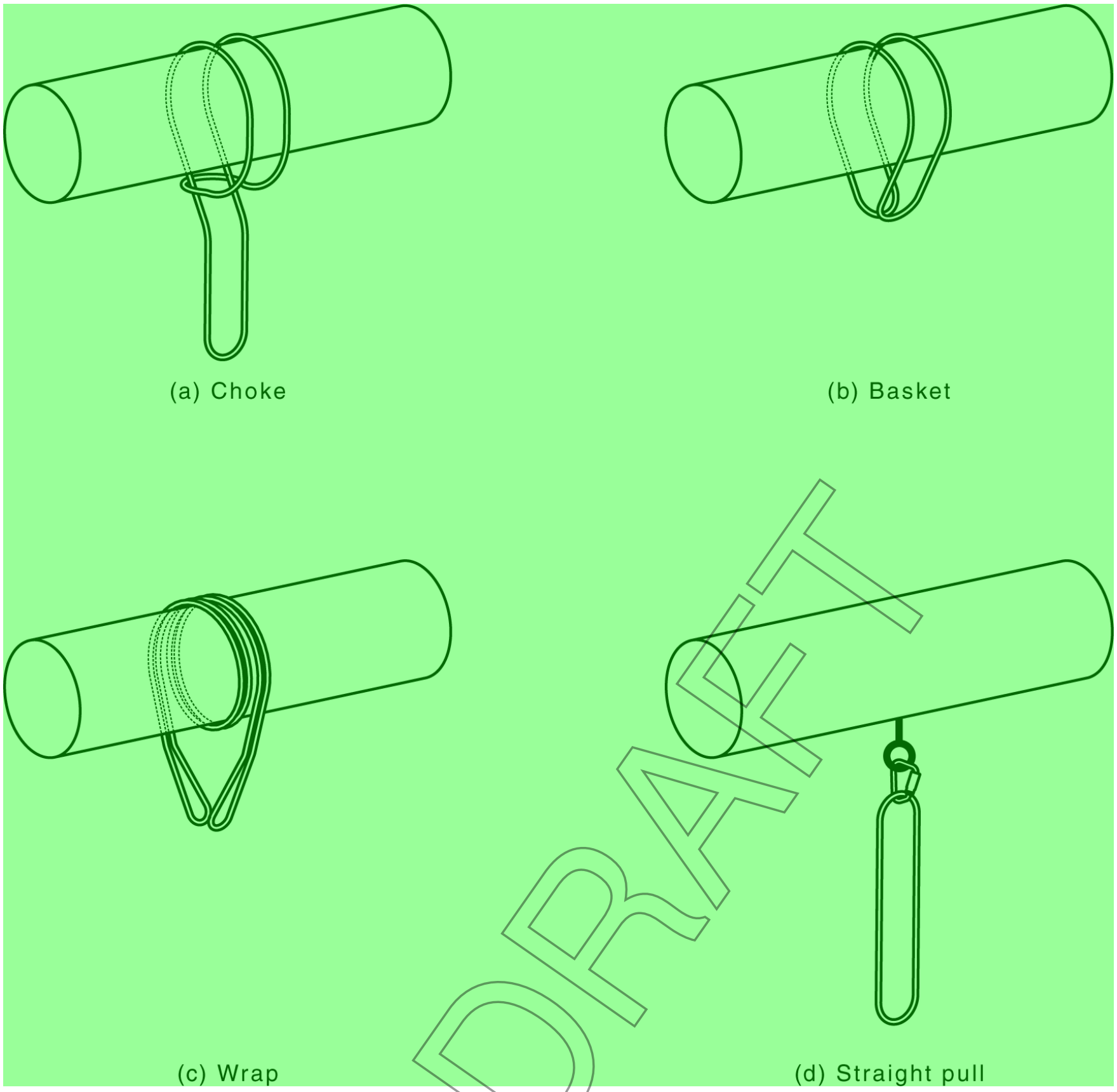


Figure 3.7 – Examples of sling configurations

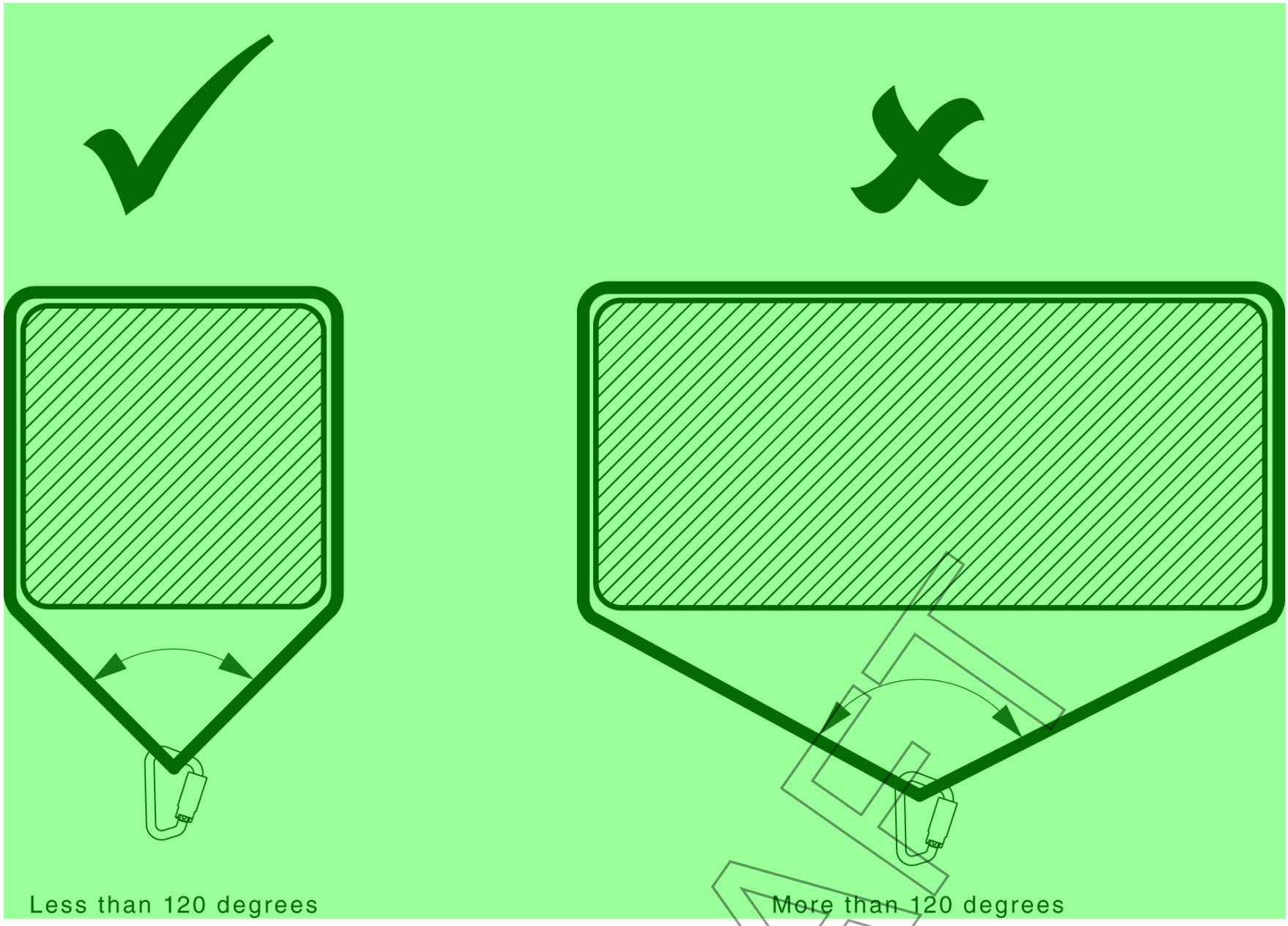


Figure 3.8 – Internal angles for basket configuration

4 Harnesses

4.1 General

Harnesses shall be selected according to –

(a) the work type; and

(b) the system type.

The harness shall conform to AS/NZS 1891.1.

NOTE See Table 2.1 for guidance on the appropriate harness for use in different systems.

4.2 Harness selection

4.2.1 General

Factors that should be considered when selecting a harness include:

(i) Ease of rescue, including self-rescue.

NOTE For access and possible rescue or retrieval through a narrow entry point, retrieval attachment points fitted to the shoulders of the harness are recommended. They should be used in conjunction with a spreader bar, a pair of lifting straps or a lifting bridle.

(ii) Ease of donning and doffing.

(iii) User comfort. This applies to normal work and during suspension.

(iv) Ability to adjust components to fit the user's body shape.

4.~~1~~2.2 Full~~-~~ body harnesses

~~The~~A full~~-~~ body harness comprises a single assembly of interconnected shoulder and leg straps which may ~~incorporate~~include a waist or other horizontal straps. ~~designed~~They ~~to~~are ~~increase~~a ~~the~~combination ~~bearing~~of ~~area~~webbing, ~~on~~attachment ~~the body~~points and ~~to~~adjusters ~~prevent~~or ~~the~~other ~~wearer~~components ~~falling out~~capable of adjusting the harness ~~during~~to ~~a~~fit ~~fall.~~the ~~It is not capable of being separated into two or more elements without damage which will render all parts unusable~~user.

Examples of typical full-body harnesses are shown in Figure 4.1.

~~The full-body harness shall be used in any situation where a free fall of more than 600 mm is possible. It is also recommended for use in conjunction with a pole strap for pole work provided it is fitted with the appropriate side attachment points.~~

~~Attachment points are provided on~~A full body ~~harnesses~~harness ~~as~~should ~~follows:~~have at least one of the following centreline attachment points for fall-arrest –

(a) ~~At~~at ~~least one centre~~the front ~~attachment point, either~~ chest ~~or waist, or both.~~area;

(b) ~~A rear attachment point at the dorsal but never at the~~front waist ~~level.~~area; or

(c) ~~The~~rear ~~above~~dorsal area.

Additional attachment points can ~~all~~ be ~~used~~included for ~~fall~~pole ~~arrest~~straps, ~~i.e.~~retrieval ~~free~~and ~~falls~~total ~~greater~~restraint ~~than~~as ~~600~~follows – ~~mm.~~

(~~d~~i) ~~Side~~side attachment points at waist level ~~may be provided exclusively~~ for ~~use in pairs for attachment of a~~ pole ~~strap. For this purpose the harness needs to be the waist strap type shown in Figure 4.1(b).~~

~~(c) A harness that is to be used for access and possible rescue or retrieval through narrow confined spaces, is to have confined space retrieval attachment points as follows:~~

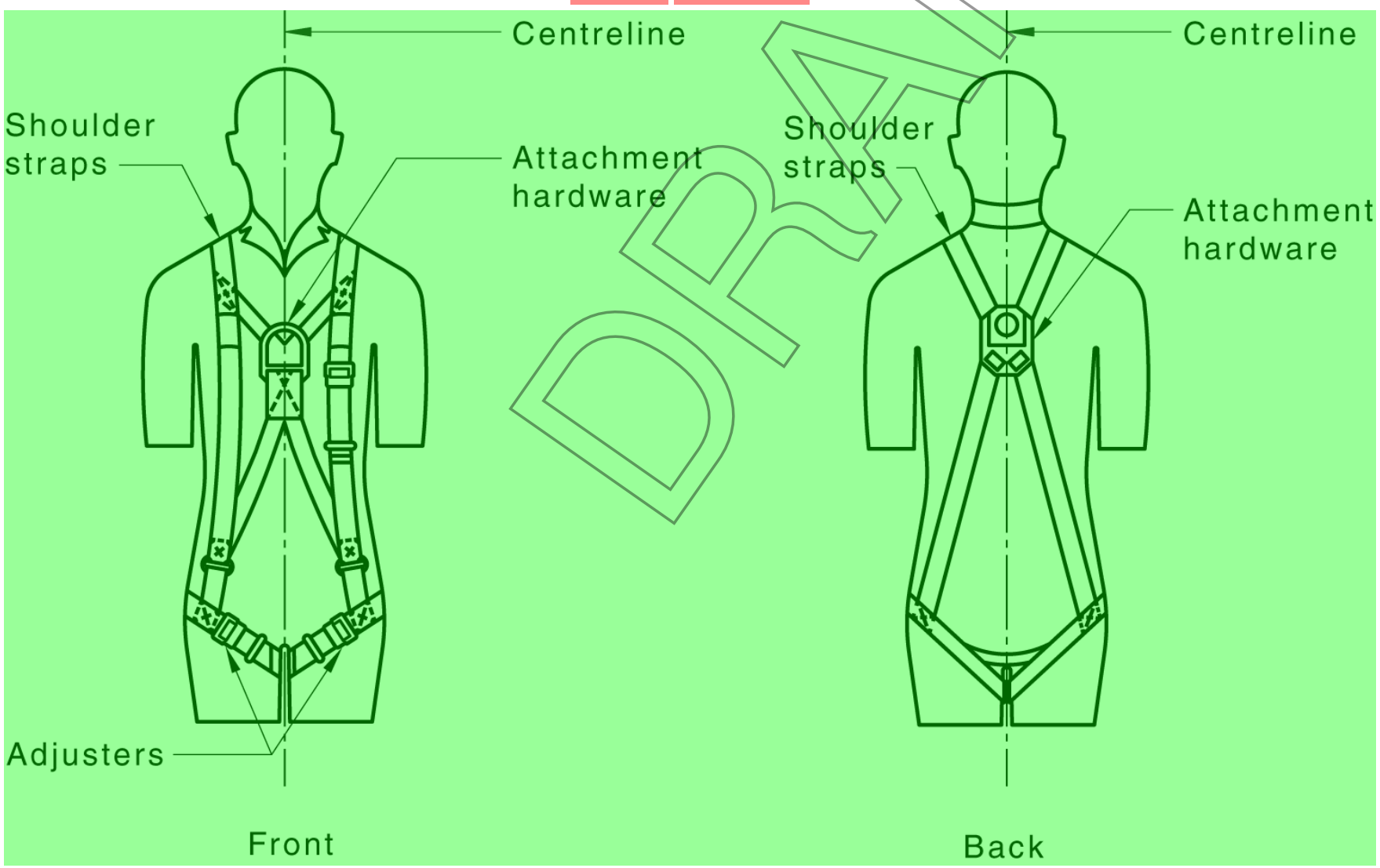
~~(i) Retrieval attachments points fitted to the shoulder~~ straps ~~of the harness in a manner that will retain the wearer in a head-up position when being lifted and to which is attached either a spreader bar, a pair of lifting straps or a lifting bridle.~~;

(ii) ~~Wrist~~shoulder ~~straps~~attachment ~~attached~~points ~~to~~for retrieval; or

(iii) centreline attachment at the ~~spreader~~rear ~~bar~~waist ~~that~~area ~~enable~~for ~~the~~total ~~wearer's arms to be raised above the head to facilitate rescue and which are readily detachable from the wrist~~restraint.

(a) Harnesses without waist strap

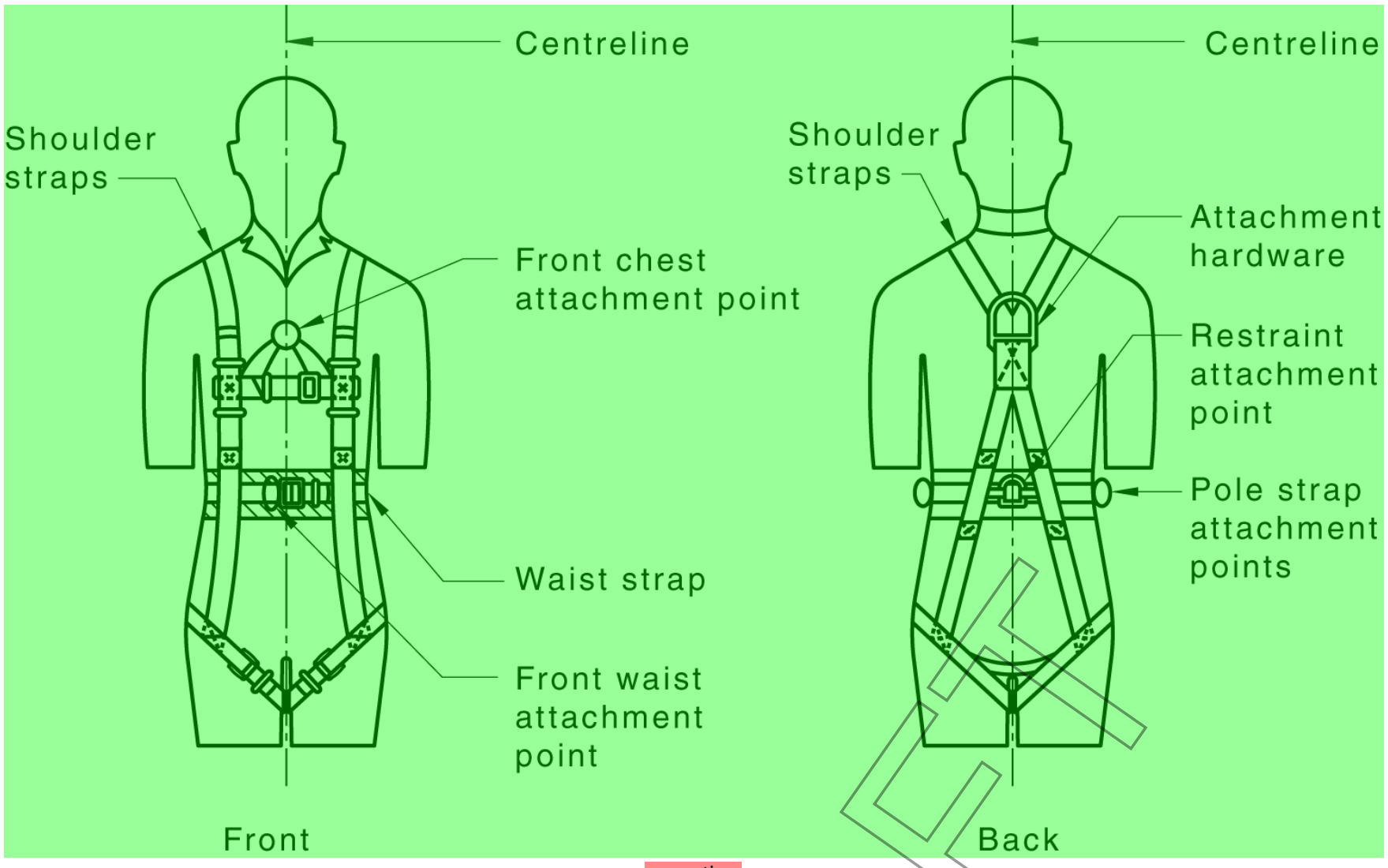
~~Shoulder attachments~~



~~points~~

(b) ~~shall~~Harnesses ~~not~~with ~~be~~waist ~~used~~strap

~~for~~



~~arresting~~

Figure ~~a fall~~4.

~~The purchaser needs to specify which~~1 – Examples of ~~these~~typical ~~options~~full-body ~~is required to accord with the type of work for which it is to be used.~~harnesses

4.~~1~~2.3 Lower~~-~~ body ~~harness~~harnesses

~~The~~A lower~~-~~ body harness comprises ~~an~~a single assembly enclosing the thighs and waist, which can include a combination of ~~an~~webbing, ~~adjustable~~attachment ~~waist~~points ~~strap~~and ~~connected~~adjusters or other components capable of adjusting the harness to ~~a pair of leg loops by means of front straps, and other straps such as a sitting strap which passes under~~fit the ~~pelvis so as to support the lower part of the~~user.

Lower body ~~in~~harnesses ~~a sitting position. It does~~shall not ~~have shoulder straps.~~

~~The lower-body harness should~~ be used for free fall applications.

NOTE 1 Lower body harnesses are intended for use in ~~conjunction~~ladder work with a ~~pole~~short, ~~strap where a restrained fall is possible and a short~~300-mm lanyard ~~(up to 300 mm)~~ or ~~connector where a limited free fall is possible. These situations include both ladder and~~for pole work utilizing pole straps.

NOTE ~~The lower~~ 2 A full body harness ~~may be used with a longer lanyard when used in restraint technique (see Clause 2.2.5) provided a fall greater than 600 mm~~ is ~~not~~preferable ~~possible~~for all applications.

~~Selection~~ If the user of a ~~suitable~~lower ~~lower-~~body harness ~~should~~becomes ~~take into account the factors listed in Clause 4.1.1(a) to (f). In addition~~inverted, ~~the~~there ~~requirement to constantly support the wearer's weight in~~is a ~~work~~risk ~~positioning~~that ~~situation~~they will ~~need to be taken into account when considering fit and comfort.~~

~~People with certain body shapes may tend to~~ slip out of ~~a~~the ~~lower-~~harness. This will vary according to factors such as body shape, mass, or the position of the harness ~~if~~on ~~inverted~~the body. ~~If this is likely to happen, a full-body harness should be used. Advice may need to be sought from a competent person.~~

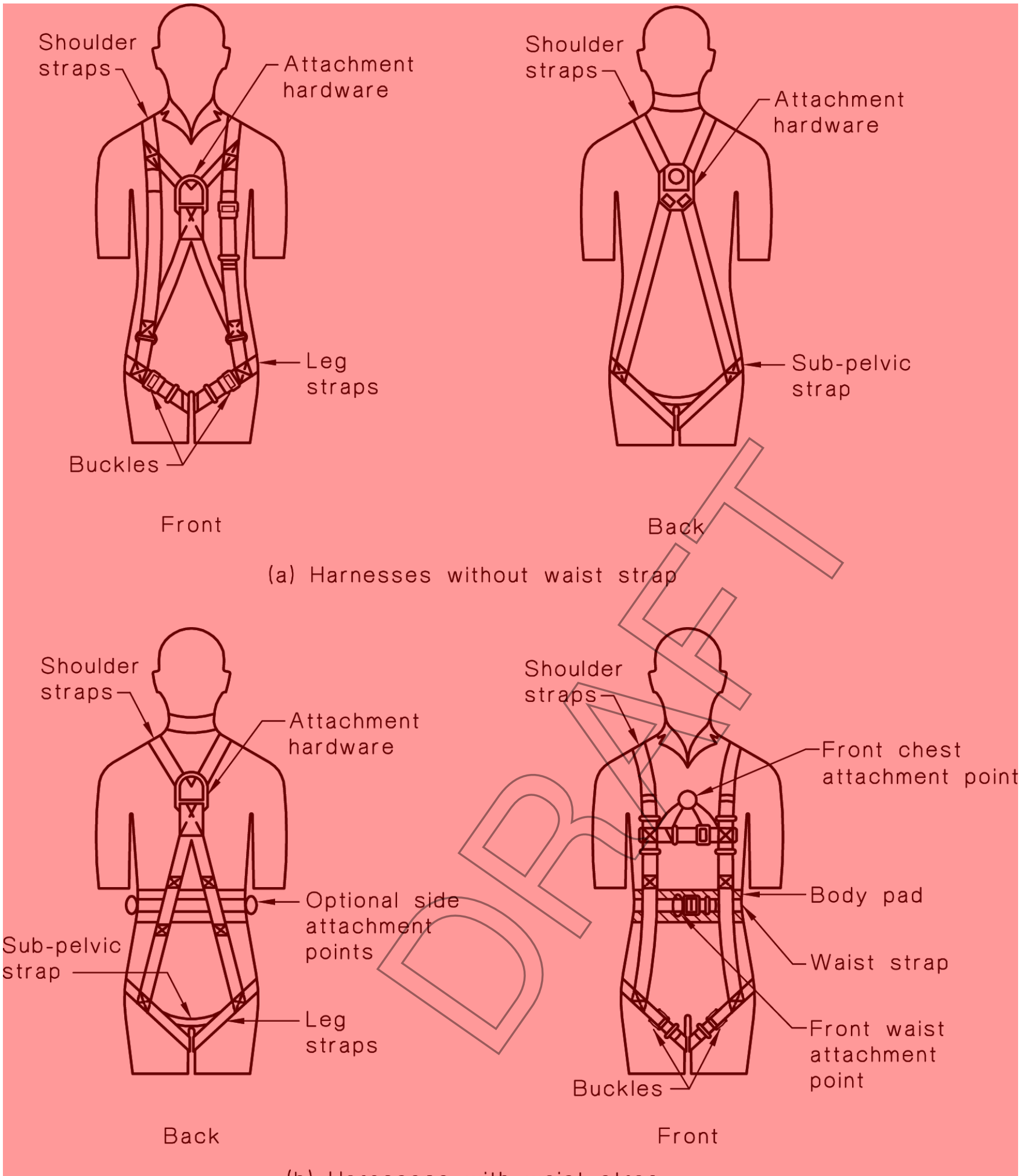
Attachment points ~~on~~can ~~lower body~~include ~~harnesses~~the ~~are provided –~~ following:

(a) Side attachment points at ~~centre front~~ waist level for ~~use~~pole ~~with a short lanyard for limited free fall or for connection when using restraint technique; and~~straps.

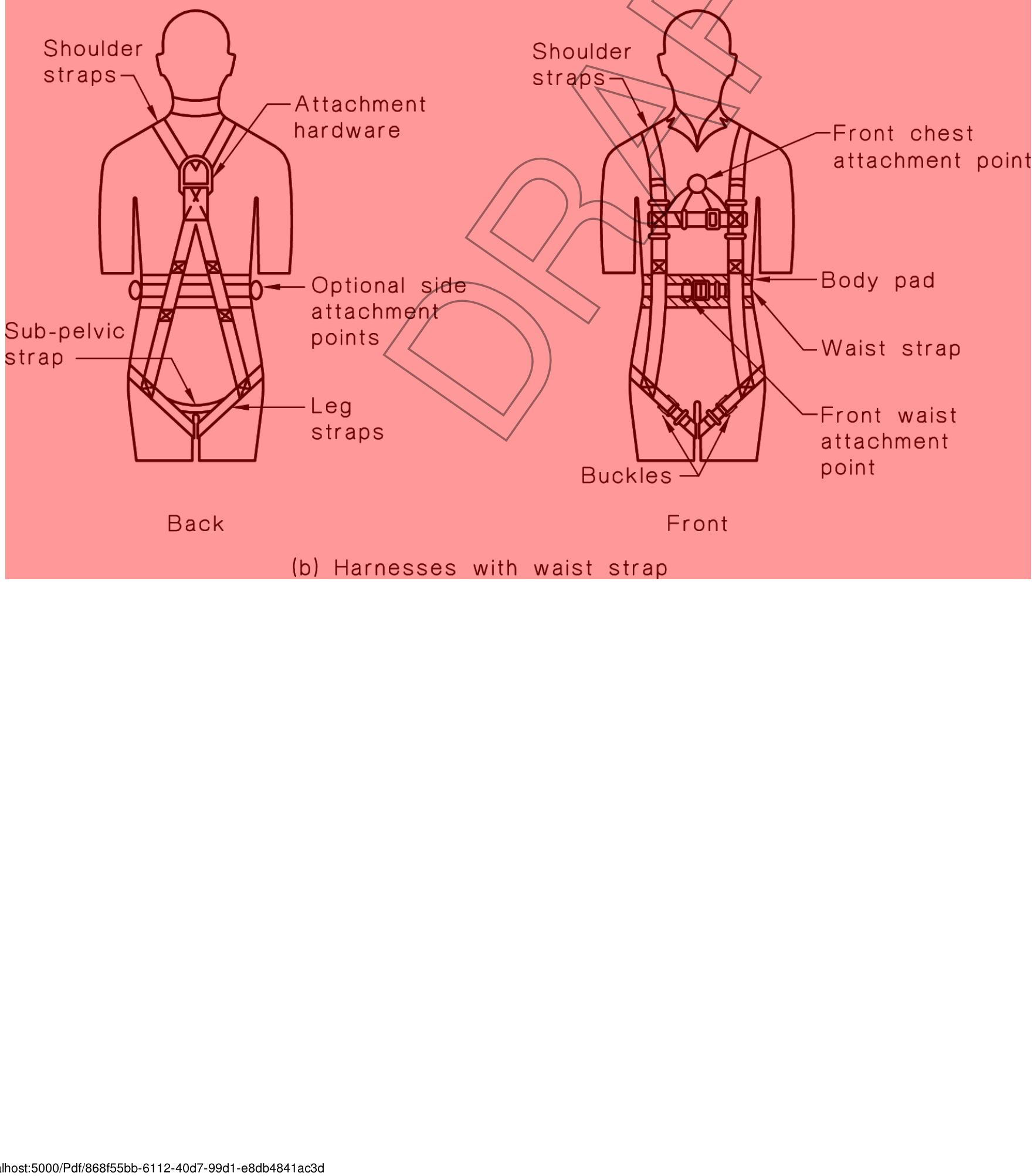
(b) ~~on~~Centreline ~~each side~~attachments at the rear waist ~~level when required~~area for ~~exclusive~~total ~~use~~restraint.

(c) ~~in~~Centreline ~~pairs~~attachment ~~with~~points ~~a~~for ~~pole~~limited ~~strap~~free fall arrest at the front waist area.

~~Rear~~Examples ~~attachment~~of ~~points are never provided on a~~typical lower-body ~~harness~~harnesses are shown in Figure 4.2.



(a) Harnesses without waist strap



(b) Harnesses with waist strap

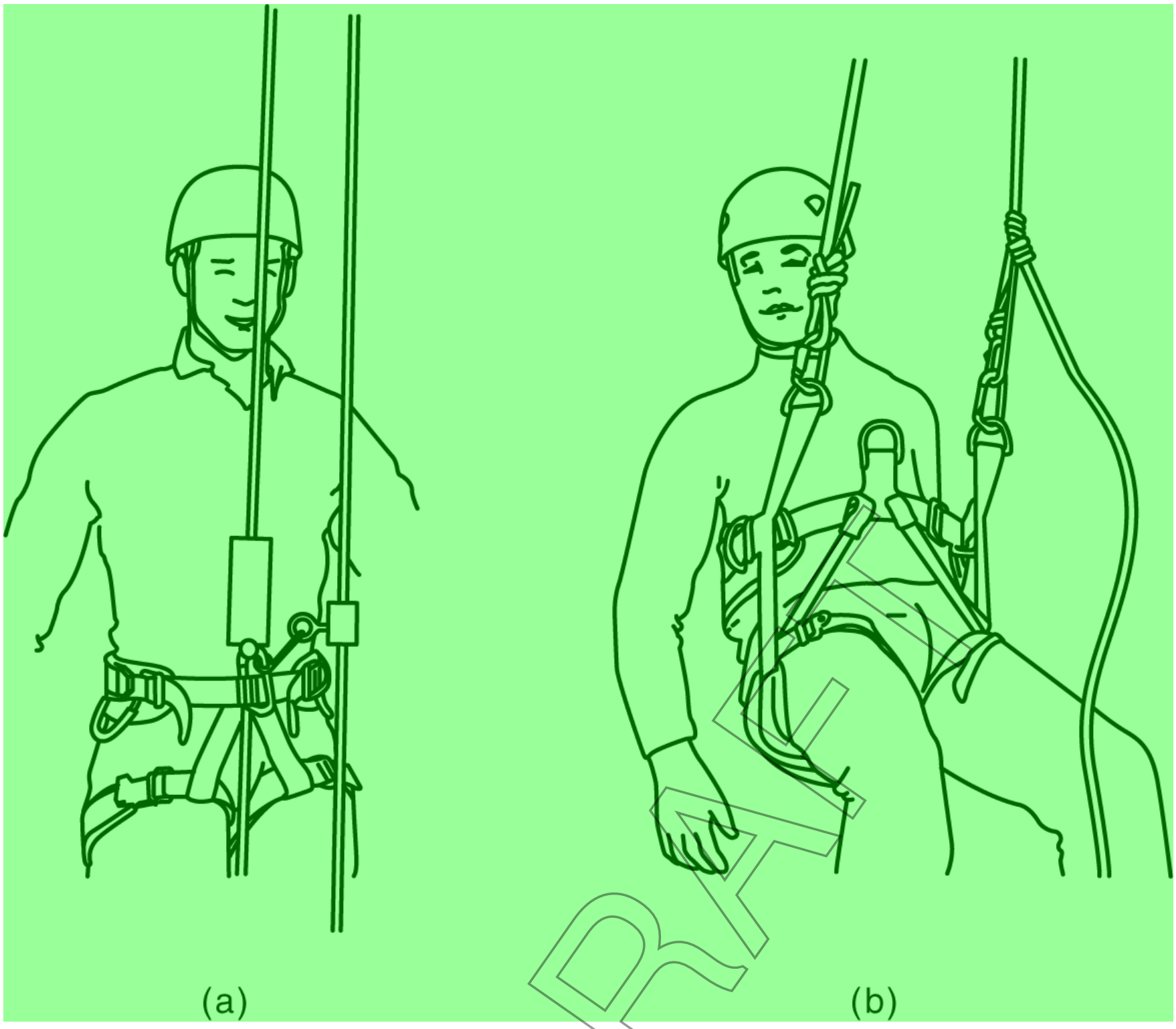


Figure 4.~~1~~2 – ~~Examples~~Two examples of typical ~~full-~~lower body harnesses

~~4.2 Designation and selection of lanyards pole straps and related equipment~~

4.2.4 Upper body assemblies

The upper body assembly is a single assembly which, when connected to a lower body harness, encloses the shoulders, thighs and torso. It can include a combination of webbing, attachment points, adjusters or other components capable of adjustment to fit the user.

An upper body assembly shall not be used on its own.

4.2.5 Combination assemblies

A combination harness comprises a lower body harness that is connected to a removable upper body assembly. This creates a full body harness (see Clause 4.2.2).

The following applies to assembled combination harnesses:

(a) The components shall –

(i) support the whole body of the user;

(ii) manage the load applied to the body; and

(iii) prevent the user falling out of the harness.

(b) The lower body harness and upper body assembly shall be compatible with each other, as described in the product instructions.

An example of a combination harness is shown in Figure 4.3.

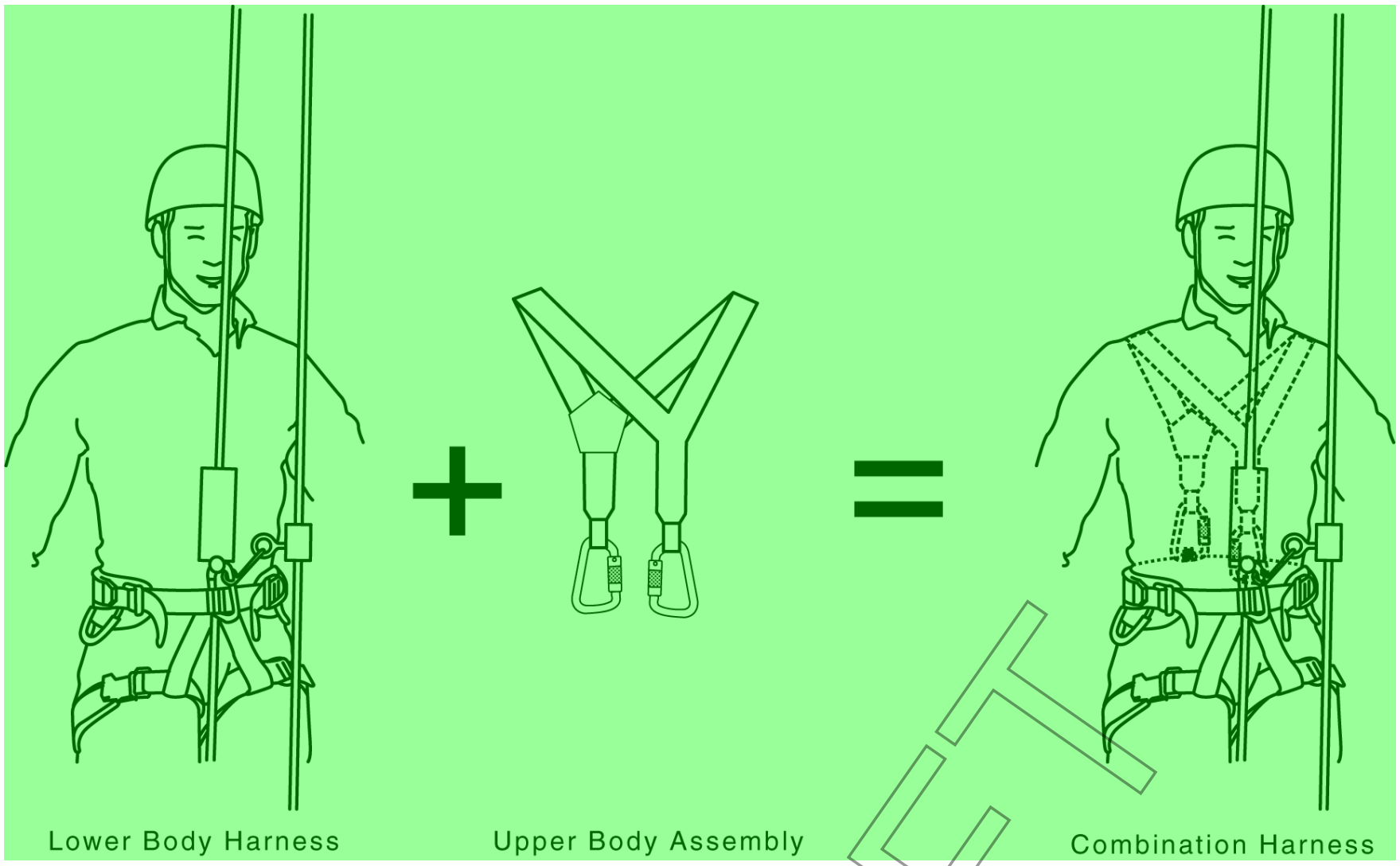


Figure 4.3 – Example of a combination harness

4.3 Harness use

When using a harness, the following requirements apply:

(a) A full-body harness or a combination harness shall be used in any situation where a free fall of more than 600 mm is possible.

(b) Side attachment points on the waist strap component of a harness shall be used exclusively as a pair for the attachment of a pole strap.

(c) The centre rear attachment point on the waist strap of a harness shall only be used for total restraint.

(d) Waist belts or straps alone shall not be used for any application covered by this document.

(e) Retrieval attachment points shall not be used for arresting a fall.

(f) The harness shall not become a choking hazard.

NOTE This is a potential hazard for some crossover style harnesses when rescuing a user by the shoulders.

(g) As a final check before use, the leg and waist straps shall be tightened so that when a hand is passed below the strap and made into a fist, it cannot be pulled out of the strap (see Figure 4.4).

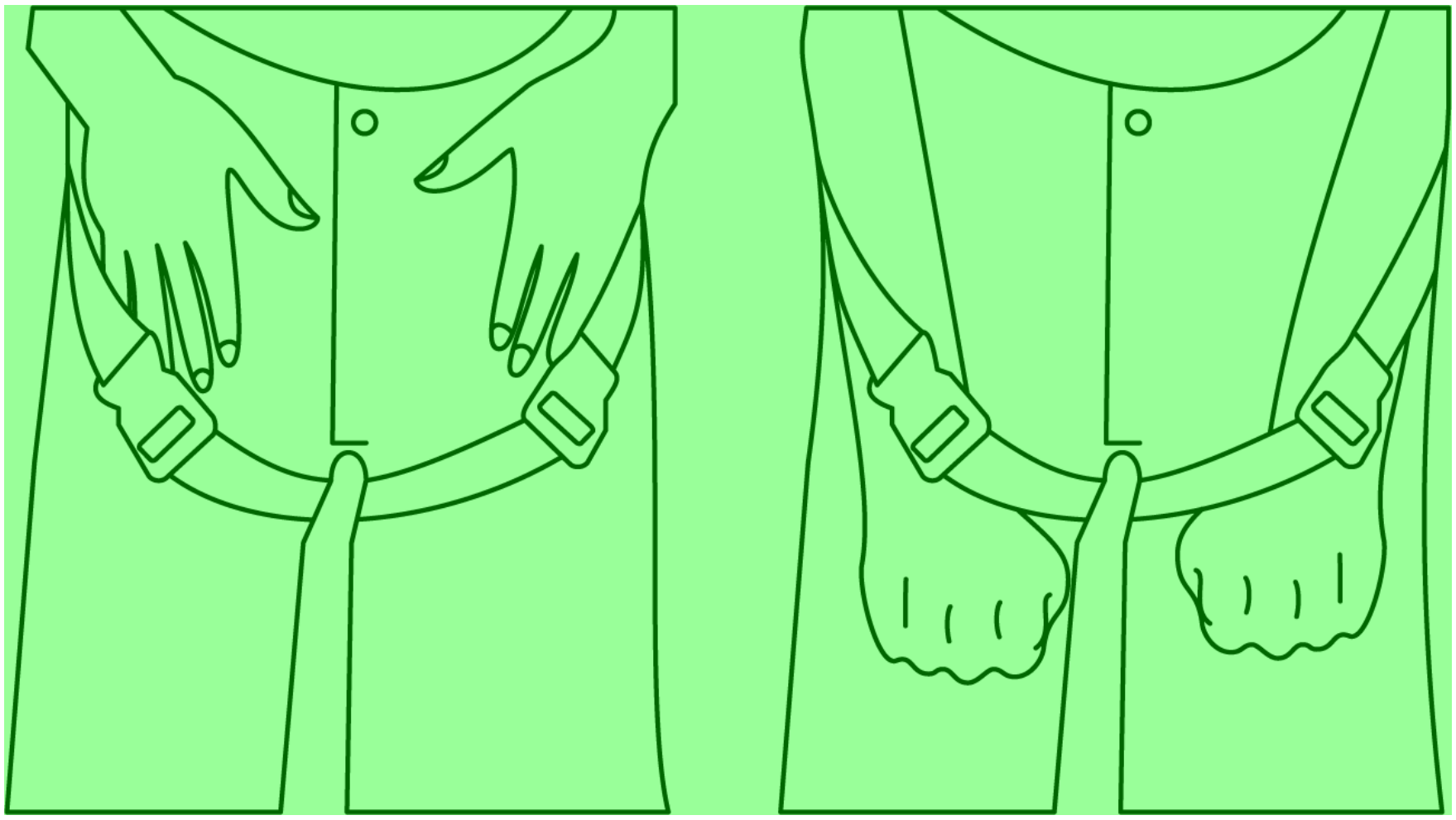


Figure 4.4 – Strap fitment test before use

When donning a harness, the attachment point should be located in accordance with Table 4.1.

Table 4.1 – Attachment point locations when donning a harness

Attachment point	Purpose	Location
Sternal	Free fall, limited free fall rescue, restraint technique	On the centreline of the chest at mid-sternum height
Dorsal	Free fall, limited free fall rescue, restraint technique	On the centreline of the back, between the shoulder blades
Side waist	Pole straps	On either side of the body, at hip height
Front waist/ventral	Free fall, limited free fall rescue, restraint technique	On the centreline of the body just below the navel
Retrieval	Rescue	One on the top of each shoulder
Rear waist/restraint	Total restraint	On the centreline of the back, at hip height

[a] On a full body harness, the selection of front waist/ventral attachment points for fall-arrest should be undertaken through a risk assessment.

5 Connecting systems

5.1 General

The connecting system is the component(s) that –

(a) connects the user's harness to the anchor; and

(b) limits the maximum arrest force on the user to less than 6 kN (except for pole straps).

The following requirements apply:

(i) Lanyards and pole strap shall conform to AS 1891.5.

(ii) Fall-arrest devices shall conform to AS 1891.3.

5.2 Types of connecting systems

~~4~~5.2.1 ~~Lanyard~~Lanyards

~~The purpose of a lanyard is to connect a harness to an anchorage point, horizontal life line or rail, or other acceptable form of anchorage. A lanyard is designed to limit the force on the harness attachment point during a fall arrest, to 6 kN. This is normally achieved by use of a personal energy absorber as part of the assembly, but not necessarily so if –~~

~~(a) the lanyard material alone is capable of meeting the requirement and has a feature which clearly indicates whether the lanyard has been stressed to a point where it has lost its energy absorbing properties; or~~

~~(b) the fall distance is so restricted that a fall-arrest force of 6 kN cannot be achieved, for example, where a short lanyard not exceeding 300 mm in length is used for connection of a lower body harness to a ladder fall-arrest system.~~

~~Lanyard configurations and corresponding free fall distances are dealt with in Section 8.~~

~~Where a lanyard may be subjected to flame, heat or the action of power cutting or abrading tools which could damage a fibre lanyard, a steel rope or chain lanyard should be considered. Steel rope or chain lanyards shall be fitted with energy absorbers.~~

A lanyard ~~may~~can take one of the following forms:

(~~i~~a) *Single-line lanyard assembly* – A single line of fixed length (see Figure 5.1).

(a) Lanyard assembly with energy absorber

(b) Lanyard assembly that has inherent energy absorption capabilities

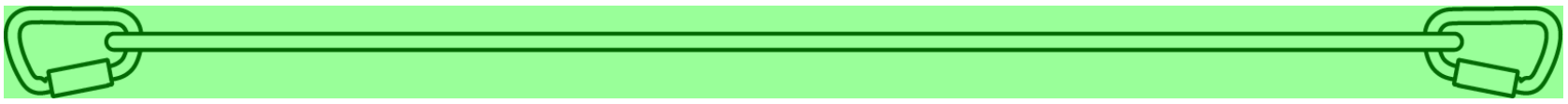
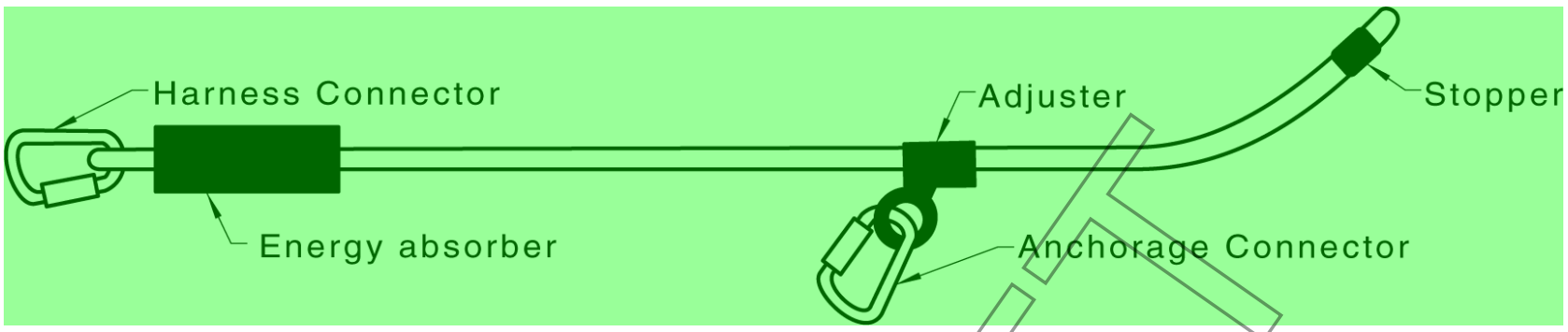


Figure 5.1 – Examples of single line lanyards

(b) *Adjustable lanyard assembly* – A lanyard that incorporates a length adjusting device. Examples are shown in Figure 5.2.

(a) Lanyard assembly with energy absorber and adjuster permanently attached to the line



(b) Lanyard assembly with energy absorber attached to adjuster on the line

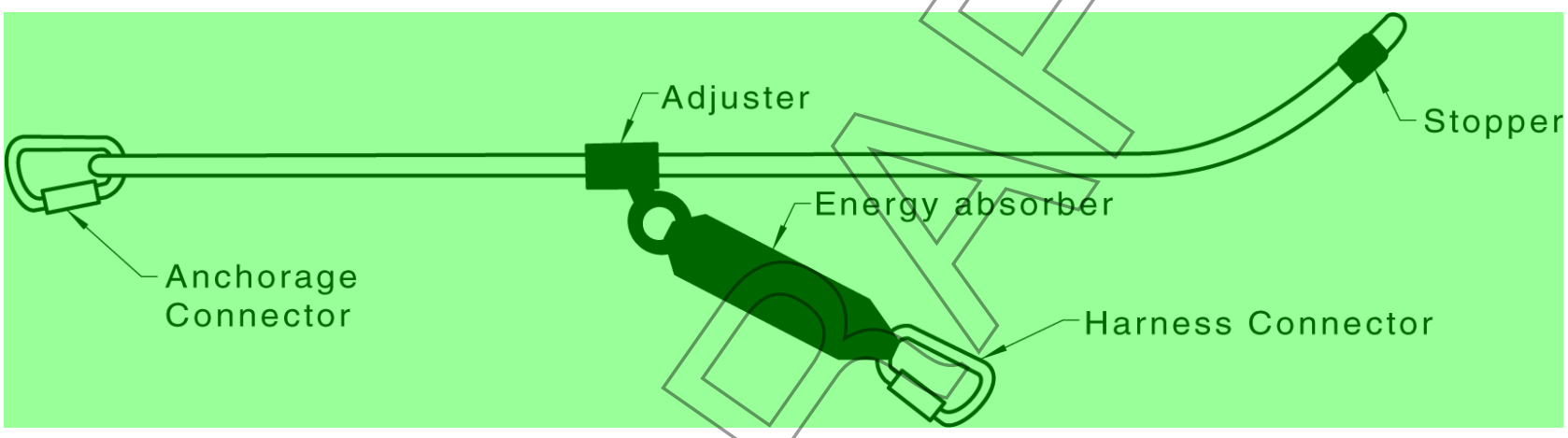


Figure 5.2 – Examples of an adjustable lanyard assembly

(c) *Twin line lanyard assembly* – A lanyard with two lines. Examples of when they can be used include:

(i) When connecting to two anchors at the same time.

(ii) ~~*Adjustable lanyard* – A lanyard incorporating a length adjusting device designed so that no component can be separated~~Transferring from ~~the~~one ~~assembly~~anchor ~~without~~to ~~causing damage that would render the lanyard unusable. It is appropriate where the adjustable feature is needed for a variety of different use situations and the risk of misuse is manageable. An example is shown in Figure 4.2~~another.

(iii) ~~*Twin tail lanyard* – A lanyard having two tails each of which separately meets all the requirements of single line lanyard. It is appropriate for use when transferring between attachment points so that the user is always connected to~~Passing an ~~anchorage via one or other of the tails. Another use would be passing~~ intermediate ~~anchorages~~anchor when moving along a horizontal lifeline.

~~Use of a twin-tail lanyard requires that the point for safe storage of the not-in-use tail to be provided either on the other tail or the harness by the manufacturer, is used correctly at all times when only one tail is connected to an anchorage.~~

An example of a twin ~~tail~~line lanyard is shown in Figure ~~4~~5.3.

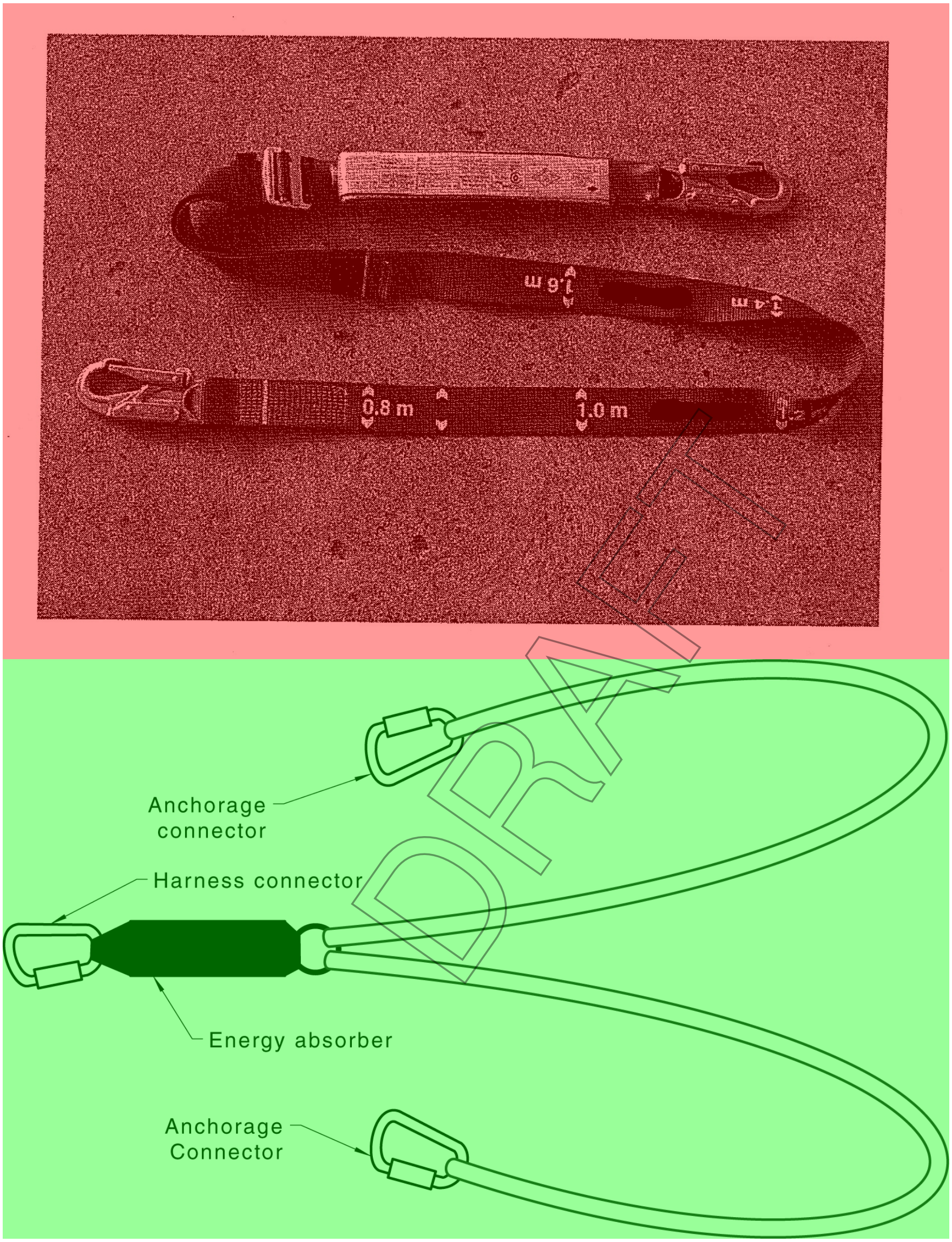
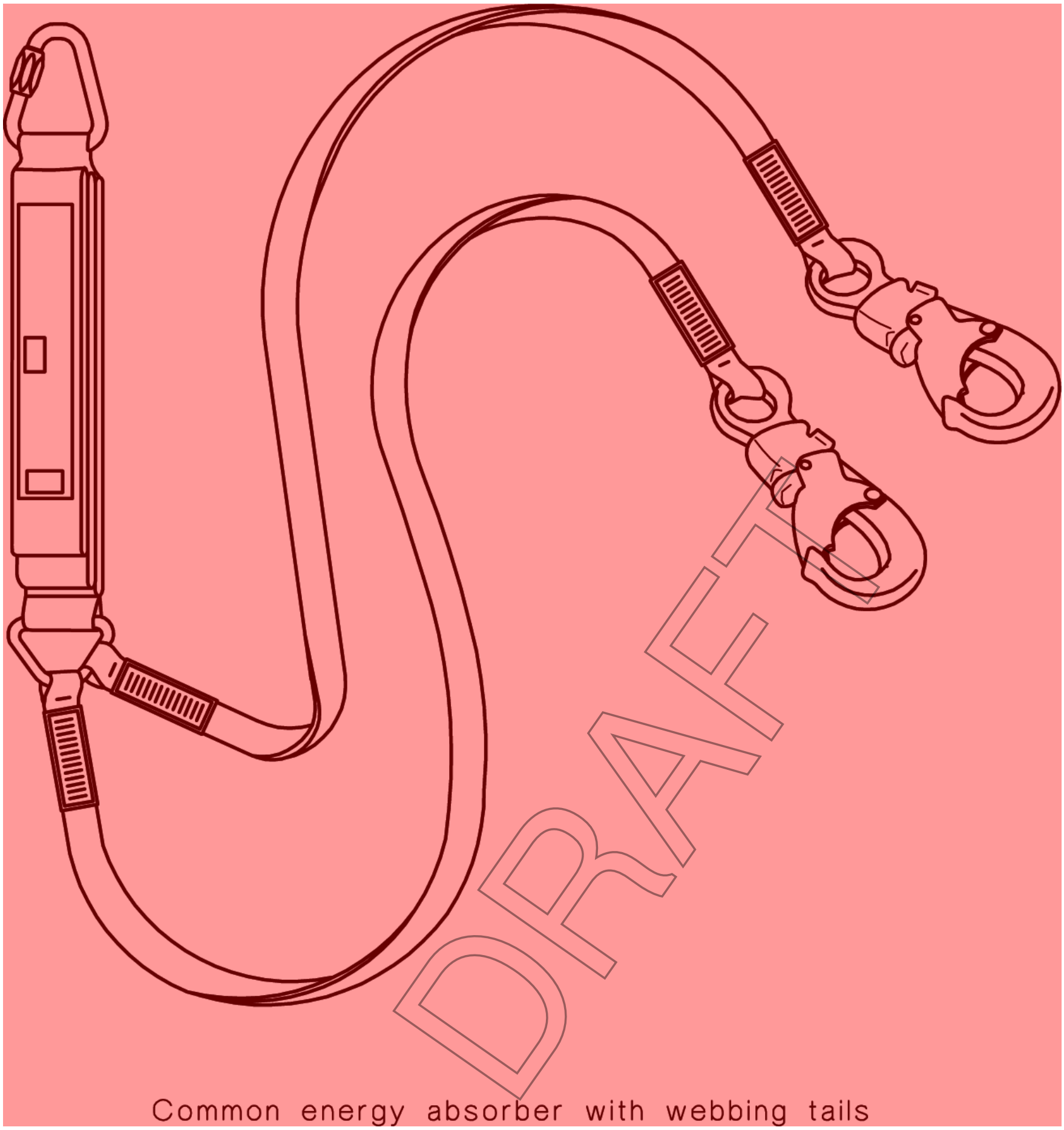


Figure 4.2 — Example of an adjustable lanyard



~~Figure 4~~5.3 – Example of a twin~~-tail~~ line lanyard

(d) *Leading edge lanyard assembly* – A lanyard constructed from a material that prevents it from being severed if it comes into contact with a leading edge during a fall. An example of a leading edge lanyard assembly is shown in Figure 5.4.

NOTE The leading edge testing component is not covered by AS 1891.5. Refer to product instructions for the suitability of lanyard assemblies for use with a leading edge.

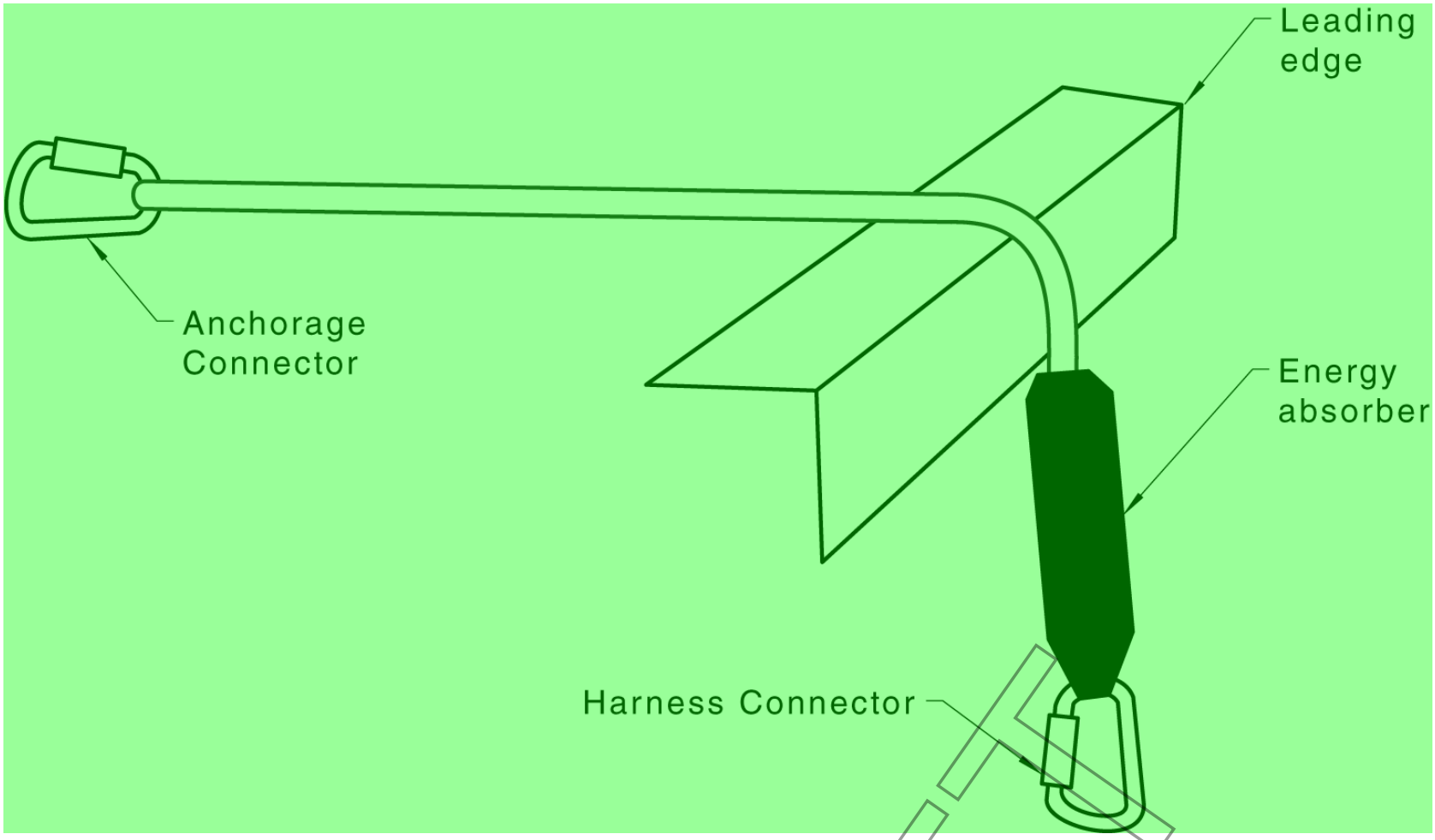


Figure 5.4 – Example of a leading edge lanyard

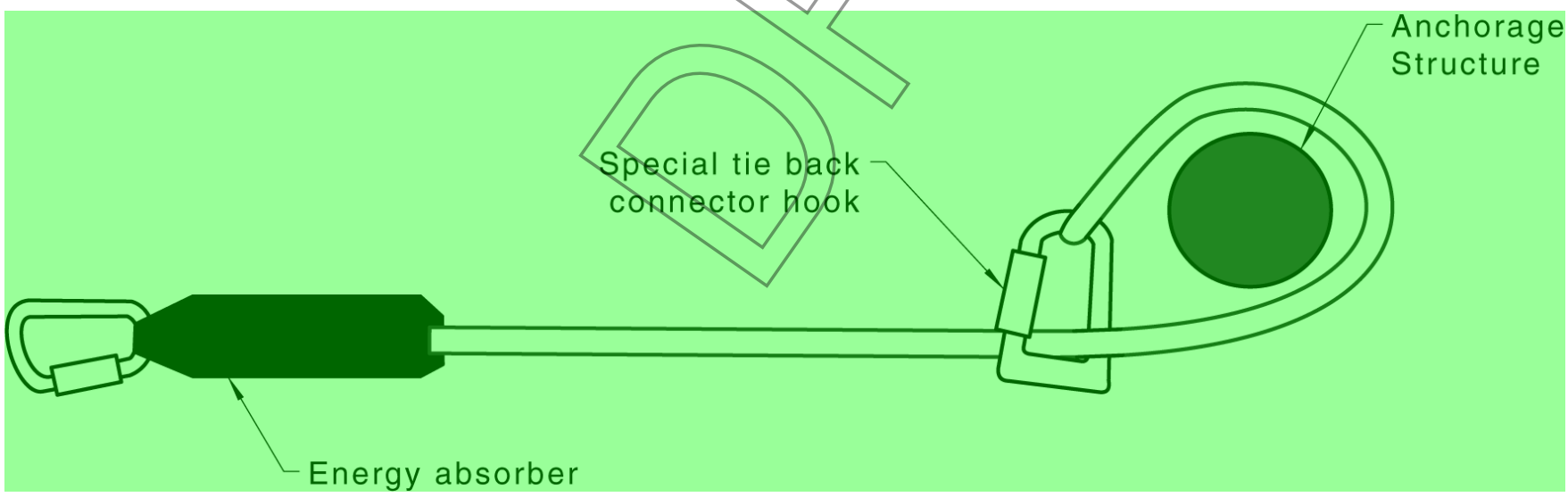
(e) *Tie back lanyard assembly* – A lanyard designed to "tie back" around an anchorage. A tie back lanyard assembly can either have –

(i) a connector designed specifically for this purpose; or

(ii) a dedicated D-ring in the leg of the lanyard to facilitate tying the lanyard around an anchorage.

Figure 5.5 shows two examples of a tie back lanyard assembly.

(a) Tie back lanyard assembly with energy absorber and a special tie back connecter hook to tie back on its own leg



(b) Tie back lanyard assembly with energy absorber and a dedicated tie back connector in the leg of the lanyard

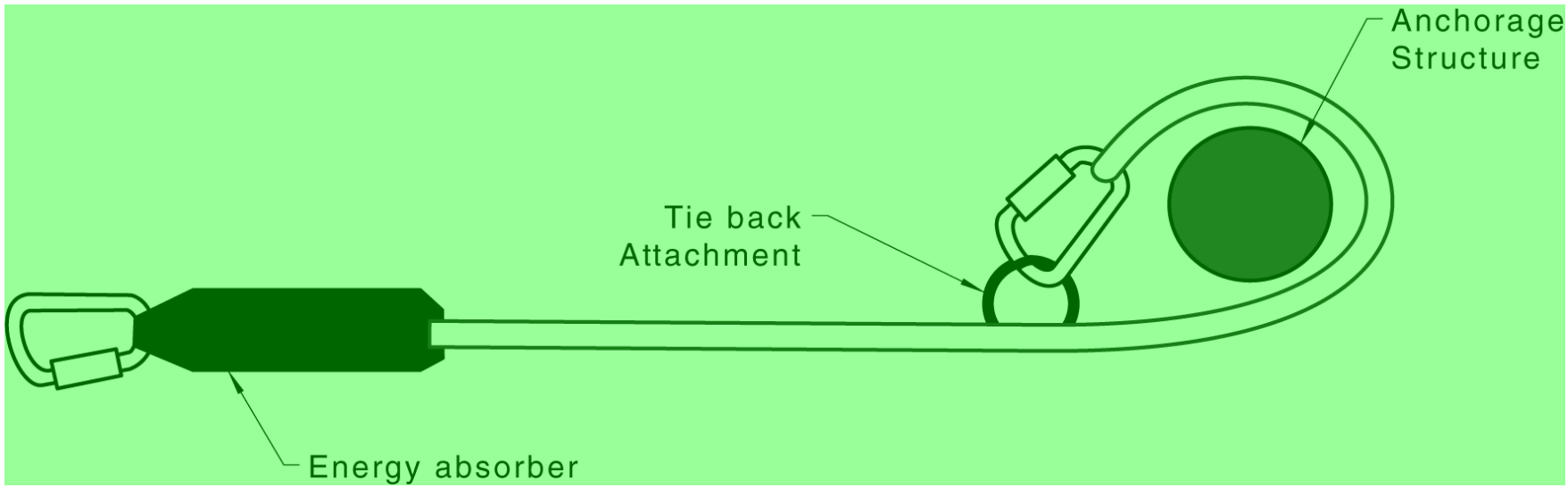


Figure 5.5 – Examples of tie back lanyard assemblies

5.2.2 Fall-arrest devices

Fall-arrest devices are categorised as follows:

(a) *Type 1 device (includes rope and rail grabs)* – Type 1 devices –

(i) are attached to a rail, rope or cable lifeline that are –

(A) fixed vertically; or

(B) 15 ° either side of the vertical; and

(ii) can move up and down the rail or line at a predetermined maximum rate to follow the movement of the user; and

(iii) locks in the event of a fall.

NOTE An example of use is a ladder fall-arrest system, using a rigid rail or a flexible line attached to the ladder.

(b) *Type 2 device (also known as fall-arrester, inertia reel or self-retracting lifeline)* – Type 2 devices –

(i) are generally attached to an anchor;

(ii) pay out a line which is attached to the user's harness;

(iii) have a mechanism that automatically extends or retracts with the movement of the user; and

(iv) have a locking mechanism that activates in the event of a fall.

(c) *Type 3 device* – This is similar to a Type 2 device with an additional winching mechanism.

(d) *Type 4 device* – This is similar to a Type 2 device with an additional automatic descending device that activates after the fall has been arrested.

Typical fall-arrest devices are illustrated in Figure 5.6.

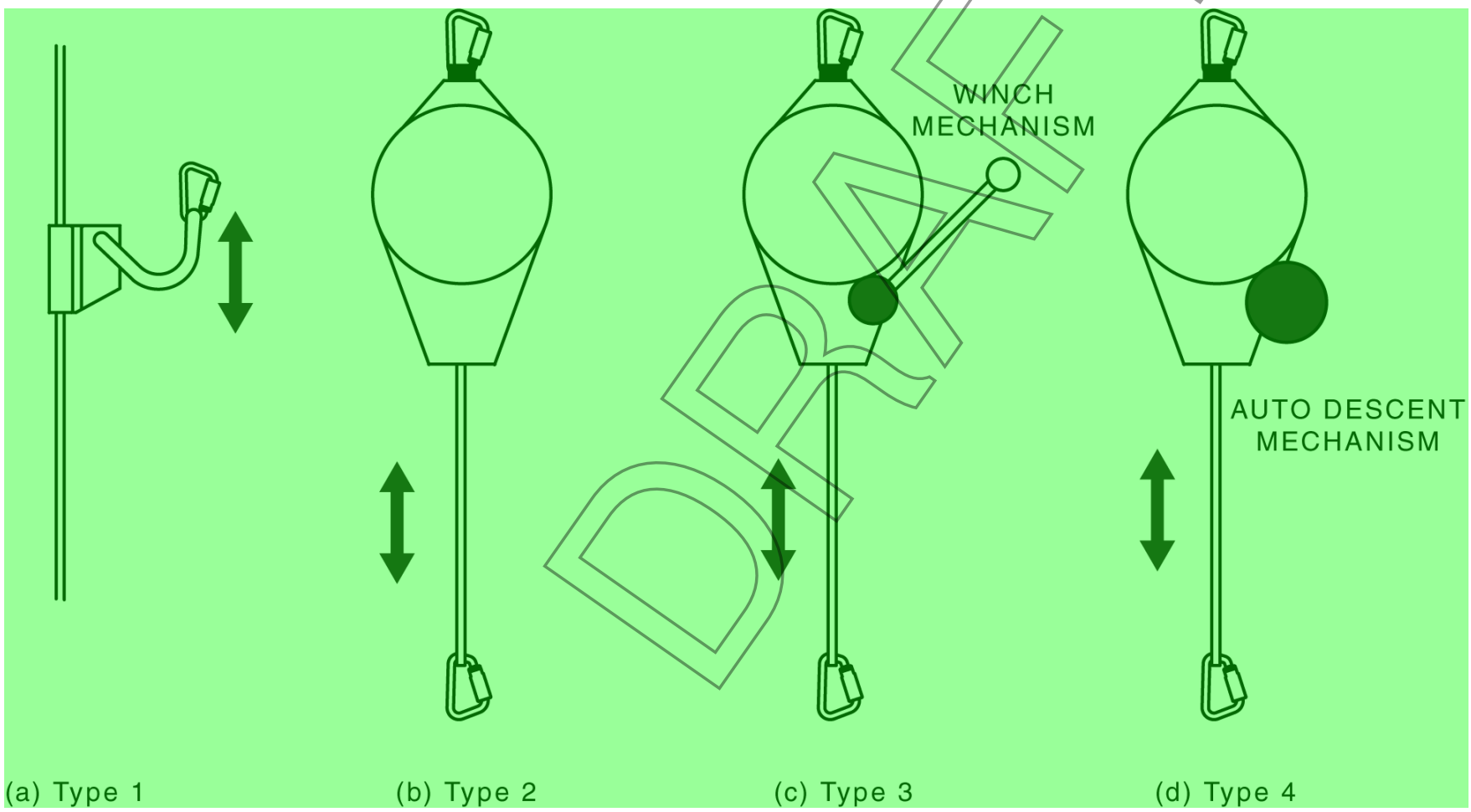


Figure 5.6 – Examples of typical fall-arrest devices

5.3 Connecting system selection

In addition to the general requirements in Clause 2, the following requirements apply:

(a) Pole straps shall be selected –

(i) for working on a pole;

(ii) where a free fall cannot occur; and

(iii) for use with side waist attachment points.

(b) Fall-arrest devices shall not be selected for applications where the locking function is impeded in the event of a fall.

NOTE Some fall-arrest devices require a minimum velocity or acceleration before they will arrest a fall. For this reason, they may not be suitable for use on unstable surfaces like grain or sand where there is a possibility of a user being slowly submerged. Working on sloped surfaces may also prevent a fall-arrest device from functioning correctly if the worker does not achieve the required velocity or acceleration before reaching the edge.

(c) Lanyards shall be selected for applications where a fall-arrest device does not lock correctly [see Note in (b)].

(d) Hazards that affect the connecting system shall be assessed and controlled to prevent malfunction. See Clause 2.4 for potential hazards.

(e) A connecting system shall be selected to minimize free fall, and thus prevent the user from striking the ground or any obstruction. See Clause 7.4 for free fall calculations.

(f) A connecting system shall be selected that will allow the execution of a rescue plan.

(g) A connecting system shall be selected to allow transition between systems without exposing the user to a fall hazard.

5.4 Connecting system use

5.4.1 General

In addition to the requirements in Clause 2.5.1, the following applies:

(a) The connecting system shall be used to minimize free fall distance.

(b) The connecting system shall be checked to ensure that the primary and secondary latch closes when it is connected to a harness or anchor point.

(c) Only specifically designed twin tail assemblies shall be connected to two anchors. This does not apply to pole straps.

(d) There shall be only one energy absorber between the user and the anchor, unless otherwise specified in the product instructions.

NOTE 1 More than one energy absorber will increase the arrest force experienced by the user.

(e) Connecting systems with two connectors for attachment to anchors shall have the energy absorber attached to the user's harness, unless otherwise specified in the product instructions.

(f) If only one of two connectors is in use, then the other shall be stowed in a location that prevents the product short circuiting the energy absorber. See Figure 5.7.

NOTE 2 Short circuiting of the energy absorber of a twin tail lanyard could occur when the second leg is attached in a manner to the harness or user that during a fall event, the second leg becomes taut or ensnared, preventing the energy absorber from deploying and increasing the arresting force to above 6 kN.

(g) Connecting systems shall be attached to either of the following points on a harness –

(i) fall-arrest attachment points; or

(ii) limited free fall attachment points.

This does not apply to pole straps.

(h) A work method should be selected that prevents the connecting system contacting a leading edge. If this is not possible, then a leading edge rated connecting system shall be used in situations where a connecting system could contact a leading edge.

NOTE 3 The AS/NZS 1891 series does not include any testing to establish the suitability of a product for contact with a sharp edge. The user should refer to the product instructions to ensure that a product will be appropriate where unavoidable contact with a sharp edge is anticipated.

NOTE 4 Examples of Standards that cover this topic include ANSI/ASSE Z359.13, ANSI/ASSE Z359.14 and VG 11.074 (EU vertical recommendation for use sheets).

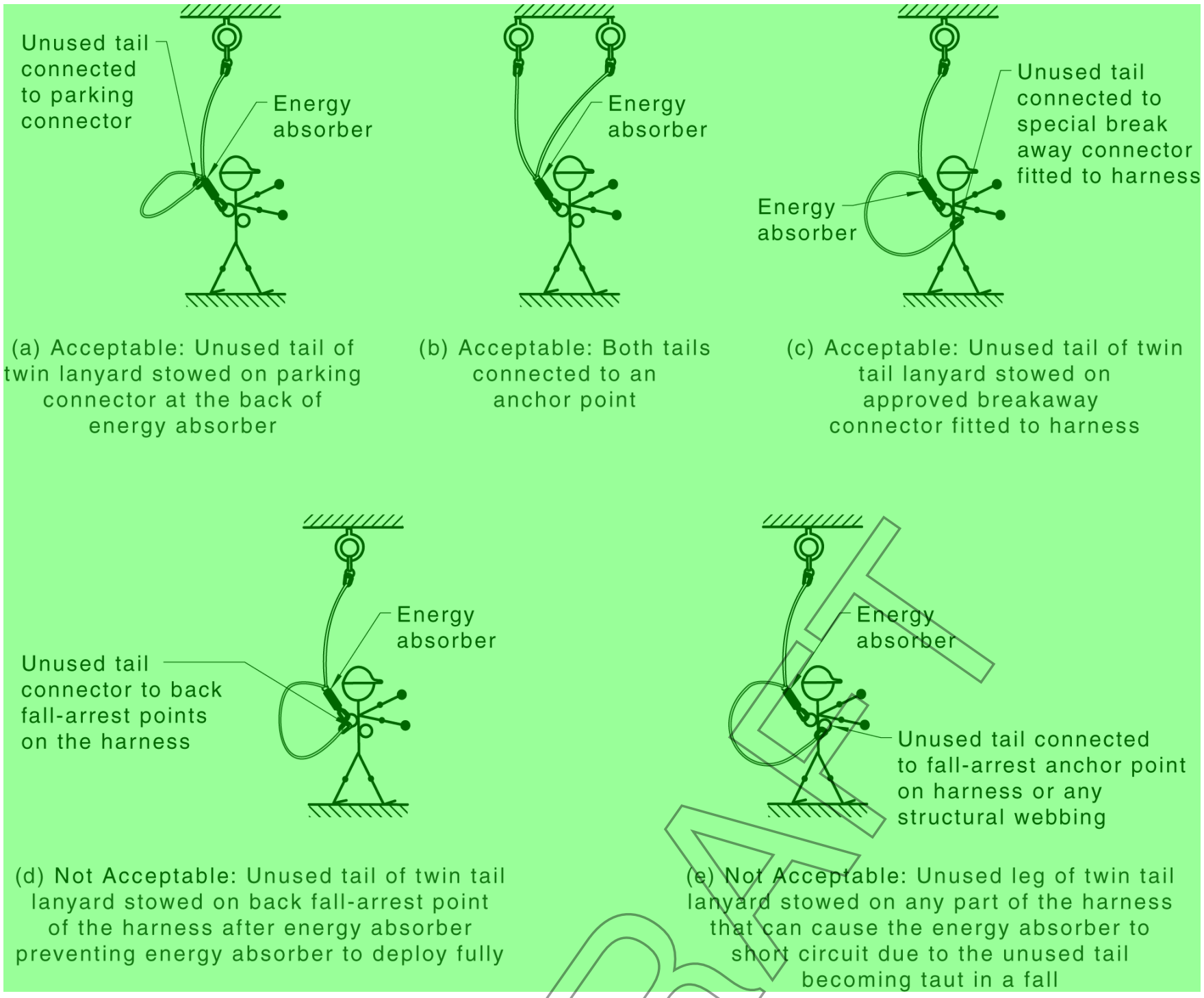


Figure 5.7 – Acceptable and non-acceptable methods for stowing tails of a twin lanyard

5.4.~~3.7~~2 ~~Backhooking~~Back hooking

~~Backhooking~~Back ~~(also known as "choking")~~hooking refers to a ~~lanyard~~connecting ~~or~~system ~~safety~~that ~~line~~is passed around a structure~~ or structural member~~ and hooked back onto itself.

A ~~Most~~connecting ~~double~~system ~~action snaphooks are~~shall not ~~designed~~be ~~for~~back ~~this purpose. Their use in this way may lead to cross gate loading~~hooked, ~~roll out or bending of the snaphook across the corner of the structure. If the hook has a sharp edge, cutting the lanyard may also occur. Even an apparently well rounded hook may have a sharp edge due to wear.~~

~~Backhooking shall be permitted if the lanyard or safety line is fitted with a connecting facility designed for backhooking such as a sewn loop or a purpose designed connecting point in a suitable position. A running ring or other connector specifically designed for the purpose may be used provided that~~unless it is ~~not subjected to side loading due to choking or bending against~~ a ~~sharp~~tie ~~edge.~~back ~~The~~lanyard ~~choke angle shall not exceed 120° (i.e.~~assembly as ~~shown for a sling connection~~described in ~~Figure 3.2~~).

~~In addition to the above, padding shall be added to any sharp edges on the structure over which the lanyard will pass, together with provision as necessary to prevent movement of the lanyard on the structure in service. Consequential reduction of the effective length of the lanyard may also need to be considered.~~

~~Examples of acceptable and unacceptable backhooking methods are shown in Figure 4.8.~~

~~The preferred alternative to backhooking where a connection is to be made around a structural member, is to use an anchorage sling, see~~ Clause ~~3~~5.2.1(e).~~3.~~

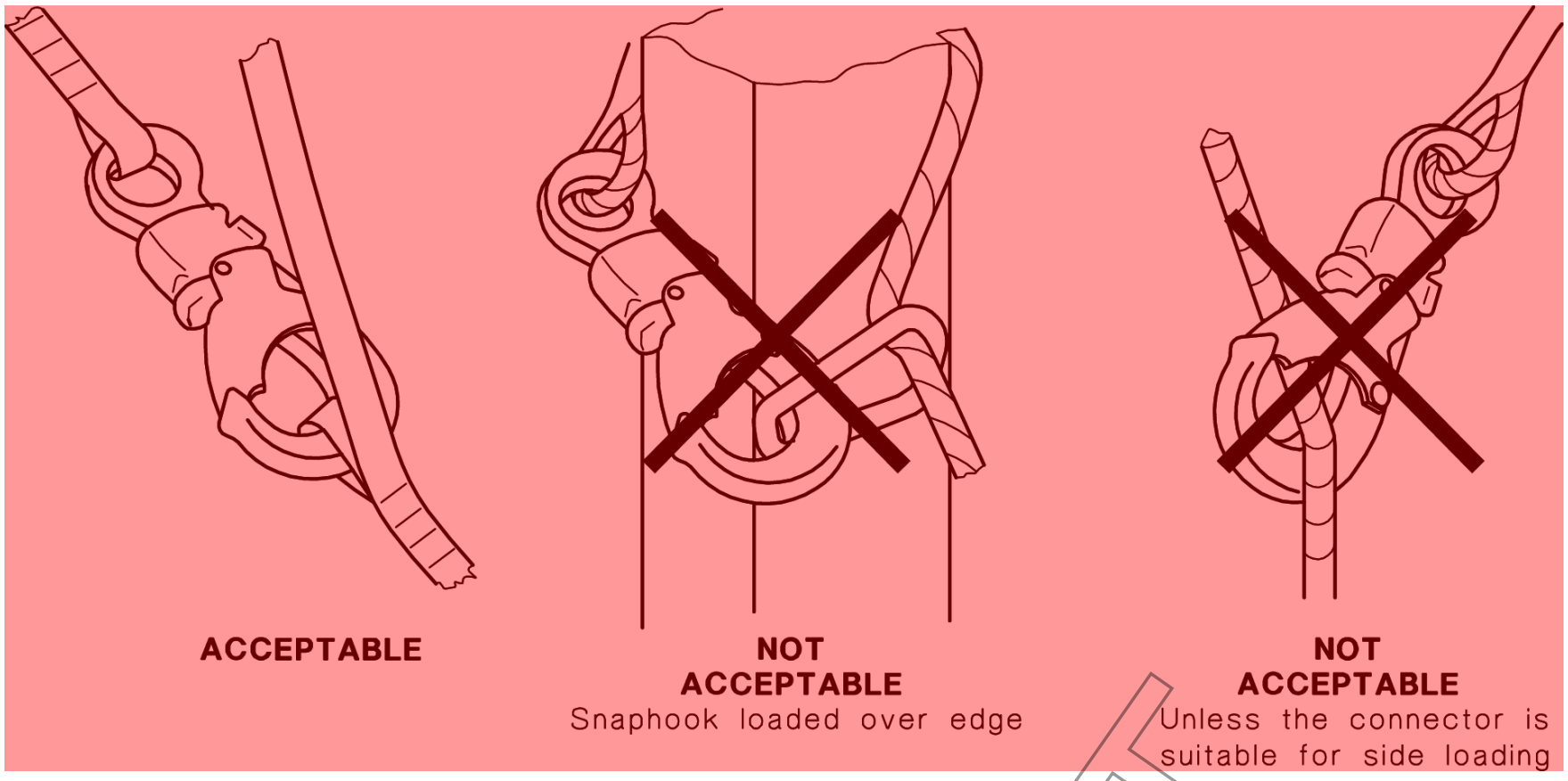


Figure 4.8 – Backhooking of lanyards

5 Fall-arrest devices, selection and safe use

NOTE This Section should be read in conjunction with the relevant general requirements and recommendations relating to all systems and equipment given in Section 2.

5.1 Equipment designation and selection

5.1.1 Designation of devices

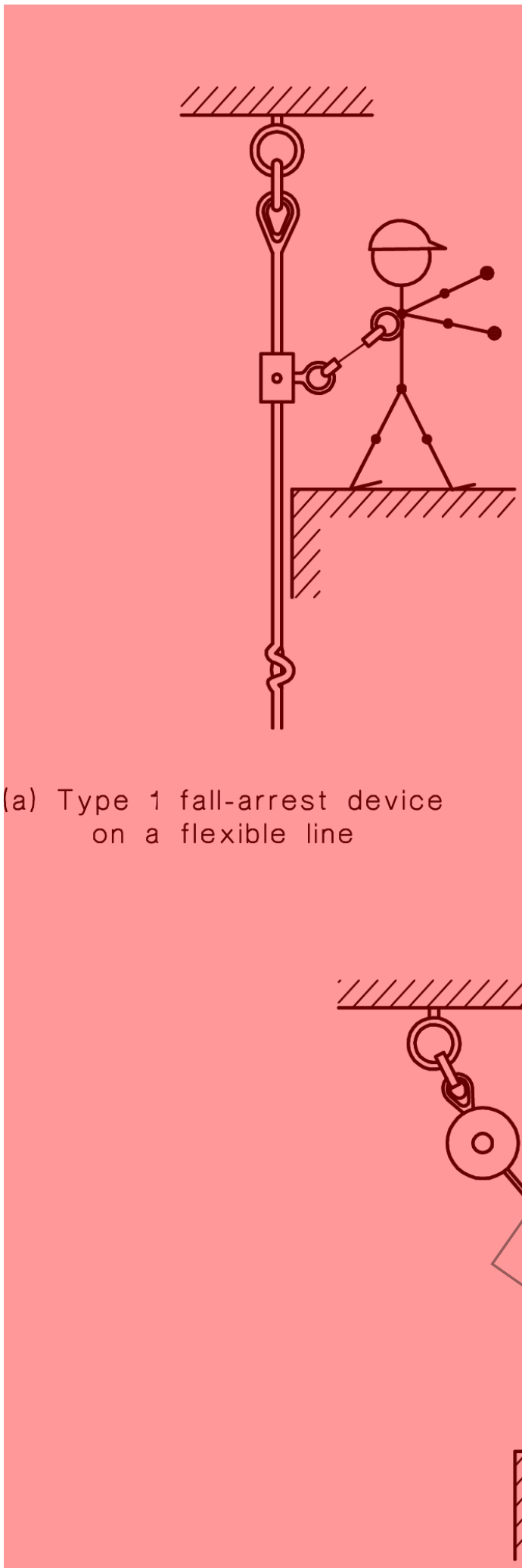
Fall-arrest devices shall conform to the requirements of AS/NZS 1891.3.

Typical fall-arrest devices are illustrated in Figure 5.1. They are categorized and used as follows:

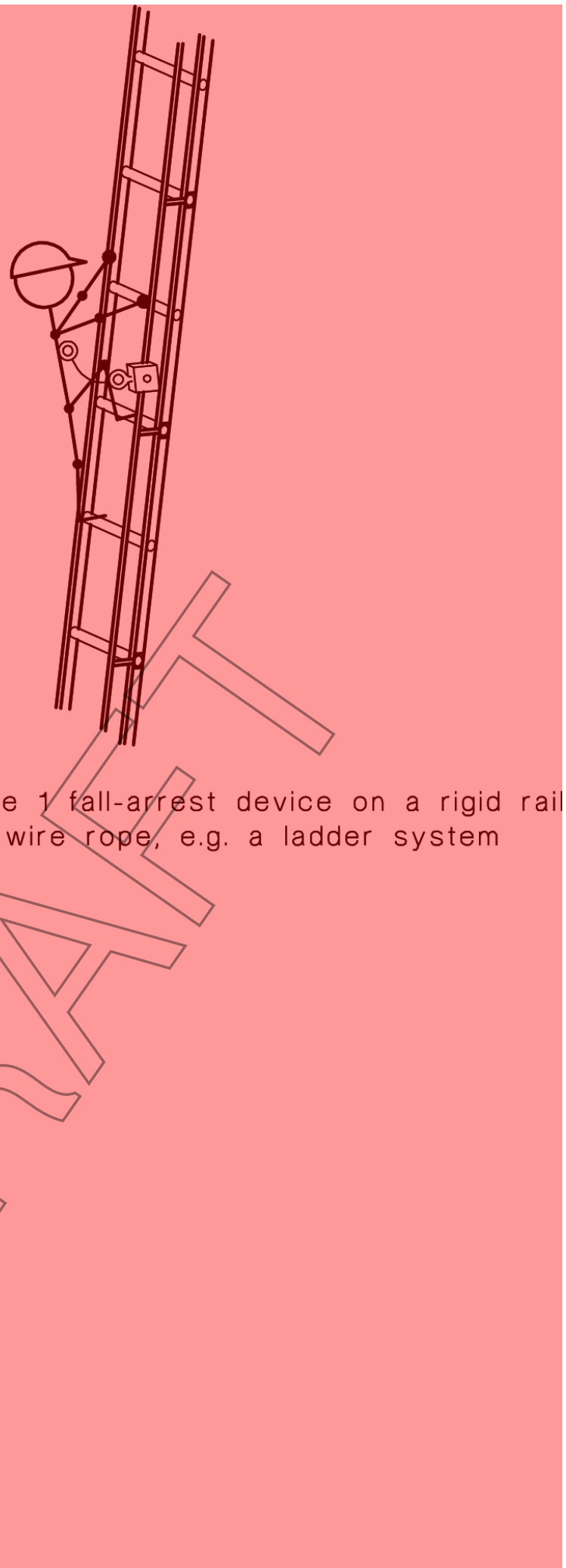
(a) *Type 1 device (includes rope and rail grabs)* The Type 1 device is attached to a fixed vertical or substantially vertical rail or a fixed vertical flexible line and can move up and down the rail or line at a predetermined maximum rate to follow the movement of the user. The user is connected via a short lanyard to the activating lever which locks the device in the event of a fall. A typical use of a Type 1 device is as a ladder fall-arrest system, using a rigid rail or a flexible line attached to the ladder.

(b) *Type 2 device (also known as fall-arrester, inertia reel, self-retracting lifeline)* The Type 2 device is generally attached to an anchorage point and pays out a line which is attached to the user's harness. The line is controlled by a spring loaded reel which adjusts the line length as the wearer moves up and down in the course of the work. Under fall-arrest conditions the reel locks by means of the inertia reel or similar mechanical principle.

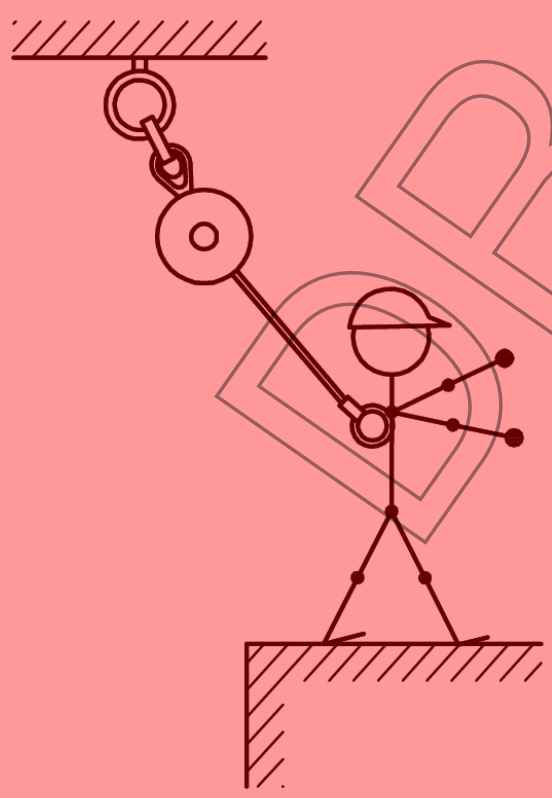
(c) *Type 3 device* The Type 3 device is similar to the Type 2 device with the addition of a winching mechanism.



(a) Type 1 fall-arrest device on a flexible line



(b) Type 1 fall-arrest device on a rigid rail or wire rope, e.g. a ladder system



(c) Type 2 fall-arrest device, e.g. an inertia reel

Figure 5.1 – Typical fall-arrest devices

5.1.2 Selection

Matters which need to be taken into account in the selection of fall-arrest devices are as follows:

(a) These devices allow the worker to work at different heights and to move up and down with the device operating automatically. They are thus suitable for ladder work or any other work involving climbing or frequent height change.

(b) Most devices rely on some initial downward acceleration of the wearer in the event of a fall to activate the locking mechanism that arrests the fall. Some devices may not therefore be suitable where the potential fall is down a slope or into a fine grain material or free-flowing solid, or any other situation where the fall velocity may be reduced below that required to lock the device. Specialist advice should be sought if working under such conditions.

(c) Matters relating to Type 1 devices are as follows:

(i) If the device is part of a ladder fall-arrest system, verification of the adequacy of anchorages for the line or rail should be sought from the manufacturer or installer. The manufacturer's recommendations shall be rigidly adhered to, to ensure that design stresses on the system are not exceeded.

(ii) The device may not be suitable for use on a slope if the speed at which the user slides down the slope is insufficient to activate the arrest mechanism. The manufacturer's advice should be obtained in such cases.

(d) Matters relating to Type 2 and 3 devices are as follows:

(i) The device should be anchored to a point above the user which will not be offset by generally more than 30° from the vertical or such other angle specified by the manufacturer. This is illustrated in Figure 5.2 as a cone within which the user should be confined.

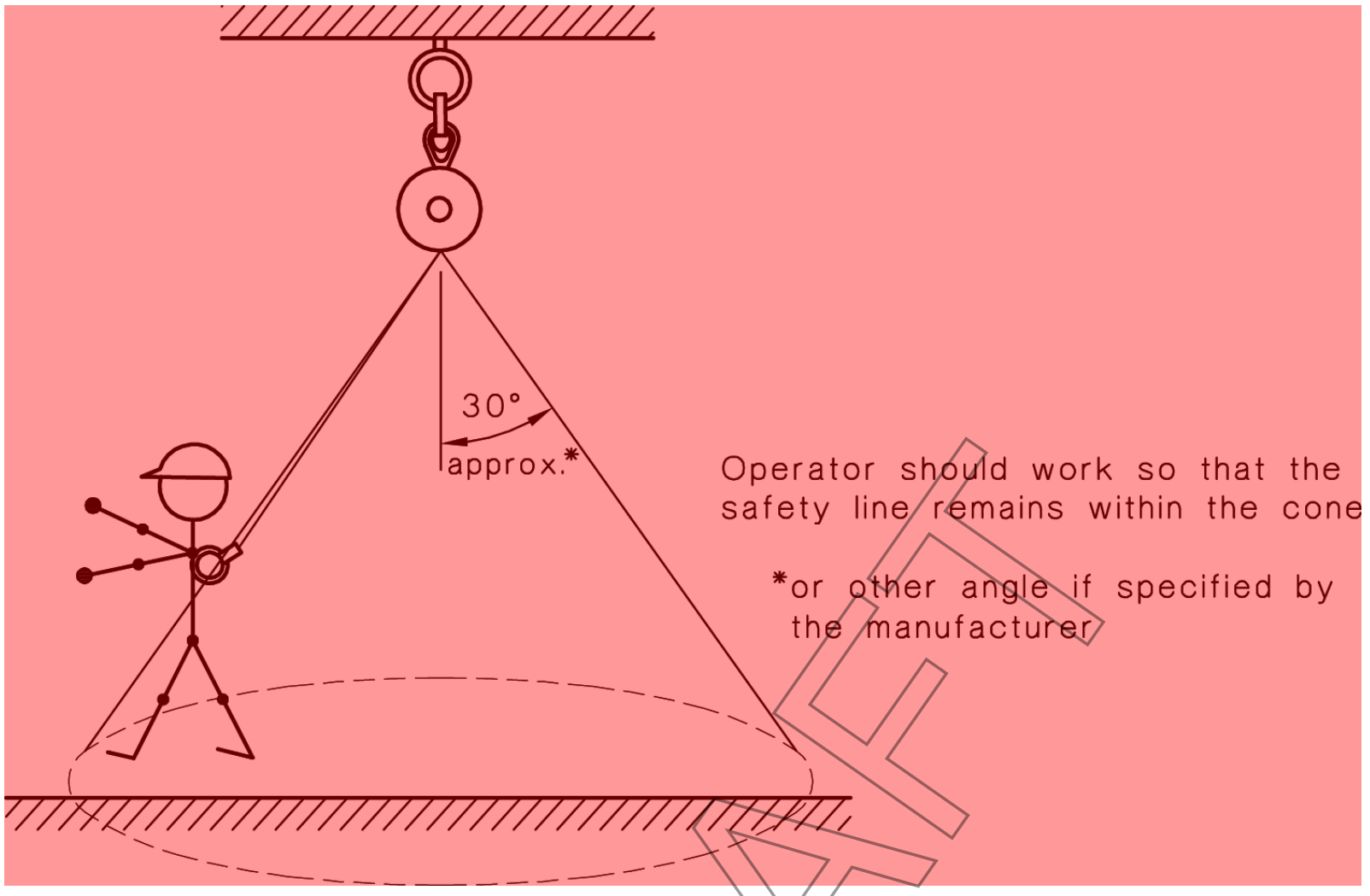


Figure 5.2 – Limit of operation of a Type 2/3 fall-arrest device

(ii) The cone angle in Item (i) and Figure 5.2 should be reduced where the height of the device above the user is enough for the person to fall into an uncontrolled swing and possibly be injured by striking a structure or coming to rest after the swing, in a position that would make rescue difficult or impossible. This could typically be the case if the device were more than about three times the height of the user above floor level.

(iii) In normal use the device should not be used when the fall could take place on a slope where the speed at which the user slides down the slope is insufficient to activate the arrest mechanism, typically less than about 60° from the horizontal. The manufacturer's advice should be obtained if the device is to be used on shallower slopes.

(iv) If the manufacturer states that the device can be used in a substantially horizontal mode similar to that described in Clause 5.2.4, the user needs to obtain verification that if a fall takes place over an edge, the line will not fail at the edge and that the device will operate satisfactorily. Such verification should be in the form of test results over a representative variety of edges with free fall distances at least equal to those to be encountered on the site.

(v) In normal use, Types 1, 2 and 3 devices are designed not to allow a free fall greater than 600 mm. If they are to be used in a configuration which could lead to a greater free fall, e.g. that described in Clause 5.2.4, the manufacturer's advice should be sought as to whether they are capable of sustaining the greater free fall.

(vi) Devices using webbing lines should be equipped with swivels if the user has to turn around frequently. Swivels at both anchorage end and user end may be needed.

5.2 Safe use of equipment

5.2.1 General

Matters relating to specific types of fall-arrest device are covered in Clause 5.2.2 and 5.2.3. The following are matters general to all fall-arrest devices:

(a) The likelihood of lateral swing during a fall is greater at the end of a long flexible anchorage line than with a lanyard alone. In such a situation users should restrict lateral swing (see Clause 3.2.3).

(b) A fall-arrest device shall not be used as a work positioning device, i.e. by locking it off to support an operator in a position or location where there is risk of a free fall.

(c) A fall-arrest device, anchorage point or anchorage line shall not be used to secure more than one person unless designed to do so, see Clause 3.1.2(a).

(d) The user should make an external visual inspection of the device, anchorage line and harness immediately before use to check that there are no apparent defects.

(c) The user should check the operation of the braking system for apparent defects.

5.2.2 Type 1 fall-arrest devices

The following requirements apply specifically to Type 1 fall-arrest devices:

(a) The frontal attachment point on the harness shall be used with a Type 1 fall-arrest device when used as a ladder fall-arrest system.

(b) A flexible anchorage line used with a Type 1 device shall be fitted with a suitable end stop prior to use.

NOTE On fibre ropes, a tight figure-of-eight knot with at least a 300 mm tail is acceptable.

(c) Where a Type 1 device must be assembled onto an anchorage line in a particular orientation, the device shall be assembled on the line according to instructions or other indications on the device.

5.2.3 Types 2 and 3 fall-arrest devices

The following requirement and recommendation apply specifically to Types 2 and 3 fall-arrest devices:

(a) Anchorage lines should, as far as is practicable, not be left extended when not in use as this may expose the line to dirt and corrosion and will stress the retractor spring.

(b) Devices shall not be used lying on their side as the line may not feed evenly back onto the reel and hence affect operation of the retractor mechanism.

5.2.4 Anchorage lines extended laterally

Safe use problems are likely to arise if fall-arrest devices are used in situations where the anchorage line is extended laterally from an anchorage point before reaching a point where the user is at risk of a fall as illustrated in Figure 5.3. Unless specific advice is given by the manufacturer of the fall-arrest device that the particular equipment can safely be used in this way, *it shall not be so used*.

The problems in using fall-arrest devices this way are described as follows:

(a) Figure 5.3(a) shows a work method using a Type 2 fall-arrest device where the reel/retractor unit is attached to an anchorage point some distance laterally from a typical working position where the user is at risk of a fall.

(b) Figure 5.3(b) shows what could happen in a fall as follows:

(i) If the edge at point Z is sharp –

(A) the high friction developed between line and edge at point Z could cause the fall-arrest force in the short vertical section of the line to greatly exceed the maximum of 6 kN specified as acceptable in this Standard and any energy absorber at the anchorage point or within the device could become ineffective; or

(B) the bending stress in the line at point Z could be great enough to cause its failure.

(ii) If the edge at point Z is relatively smooth; either –

(A) the line may continue to run over it but at a relatively reduced rate, insufficient to operate the inertia mechanism in the reel, and the user will continue to fall; or

(B) there may be an appreciable unrestrained fall after which the fall-arrest loading may be applied to the device as a shock load it may not be able to cope with.

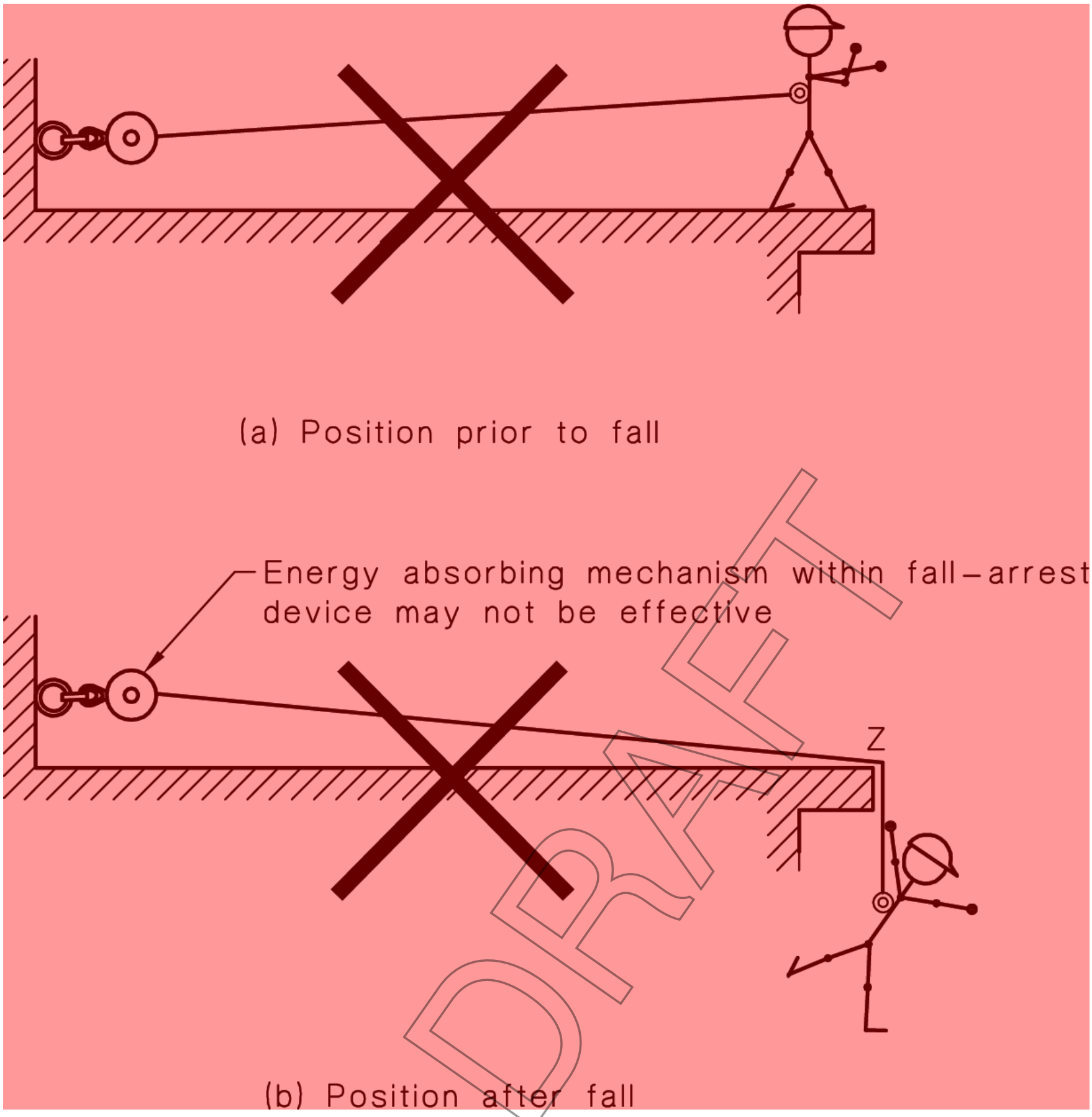


Figure 5.3 – Safe use problem using a laterally extended anchorage line

The illustrations in Figure 5.3 have particular relevance to a Type 2 or 3 fall-arrest device attached directly to the anchorage point. If the device is attached directly to the user's harness, the possibility of line fracture and shock loading, Items (b)(i)(B) and (b)(ii)(B) will still be present. It is presumed that a Type 1 fall arrest device would not be used in this situation unless it had some form of retraction device, in which case the problems would be the same as for a Type 2 device fitted to the user's harness.

A pendulum effect of the type illustrated in Figure 3.1(b) could also occur where the anchorage line is not at right-angles to the edge in the horizontal plane when the fall occurs.

These problems are best resolved by avoiding the situation altogether, i.e. by locating the anchorage point vertically or nearly vertically above the user, or selecting a different fall-protection system.

If however, equipment has been authorized by its manufacturer for use in this way, manufacturer's instructions for such use and any limitations on its use shall be strictly observed.

A check should also be made in accordance with Section 8 to determine whether the normally acceptable drop of 600 mm for Types 1, 2 and 3 devices is likely to be exceeded. If this is likely to be so, action in accordance with Clause 8.1 will be required.

6 Horizontal lifelines and rails

NOTE This Section should be read in conjunction with the relevant general requirements and recommendations relating to all systems and equipment given in Section 2.

6.1 System types and description

Horizontal lifelines and rails are essentially linear anchorages which allow users of fall-arrest equipment the flexibility of lateral movement, without having to disconnect from the anchorage. The various types of system are classified and described as

follows:

(a) *Rigid systems (rails)* Rigid systems generally comprise a steel or other metallic structural member along which one or more mobile attachment devices run, each providing a travelling anchorage for connection of a personal lanyard or fall-arrest device. The strength of the rail and its fixing to the supporting structure is determined by structural design calculation further detail on which is not provided in this Standard.

(b) *Flexible lines — Proprietary systems* Such systems are also known as “engineered” systems. They comprise flexible lines with end anchorages and usually intermediate anchorages along with mobile attachment devices which may be capable of passing across intermediate anchorages without disconnection from the line and to which personal fall-arrest equipment may be connected. The system components and recommended rigging configurations need to be traceable to prototype or sample testing to AS/NZS 1891.2. The systems are usually provided either in kit form with rigging instructions for the various configurations they have been designed for, or as a completed installation by or under the control of the supplier.

(c) *Flexible lines — Prescribed configurations* These systems are configurations prescribed and tabulated in AS/NZS 1891.2 Supp 1 as deemed to comply with that Standard. They offer an alternative to a proprietary system, but rely for their safe operation on strict observance of the requirements of AS/NZS 1891.2 Supp 1. They comprise flexible lines with end and intermediate anchorages, as do proprietary systems, but rely on conventional attachment hardware such as snaphooks and karabiners for connection of personal fall-arrest equipment to the line. These devices are not capable of passing across intermediate anchorage points without disconnection. A typical arrangement is shown in Figure 6.1.

6.2 System and equipment selection

6.2.1 System type selection

Equipment covered by this Section shall comply where relevant with AS/NZS 1891.2 and AS/NZS 1891.2 Supp 1.

The following matters should be considered when selecting the type of system appropriate for a particular use:

(a) For permanent systems that are to be used frequently and where the parent structure is suitable, rigid rails should be considered. While both rail structure and associated equipment may be more costly, the system will generally have the following advantages over the flexible line:

(i) Multiple users can be more readily accommodated provided the structural strength is adequate.

(ii) There are no intermediate anchorage points to pass.

(iii) There are negligible deflections in the rail when arresting a fall.

(iv) The rail will readily carry the weight of a Type 2/3 fall-arrest device.

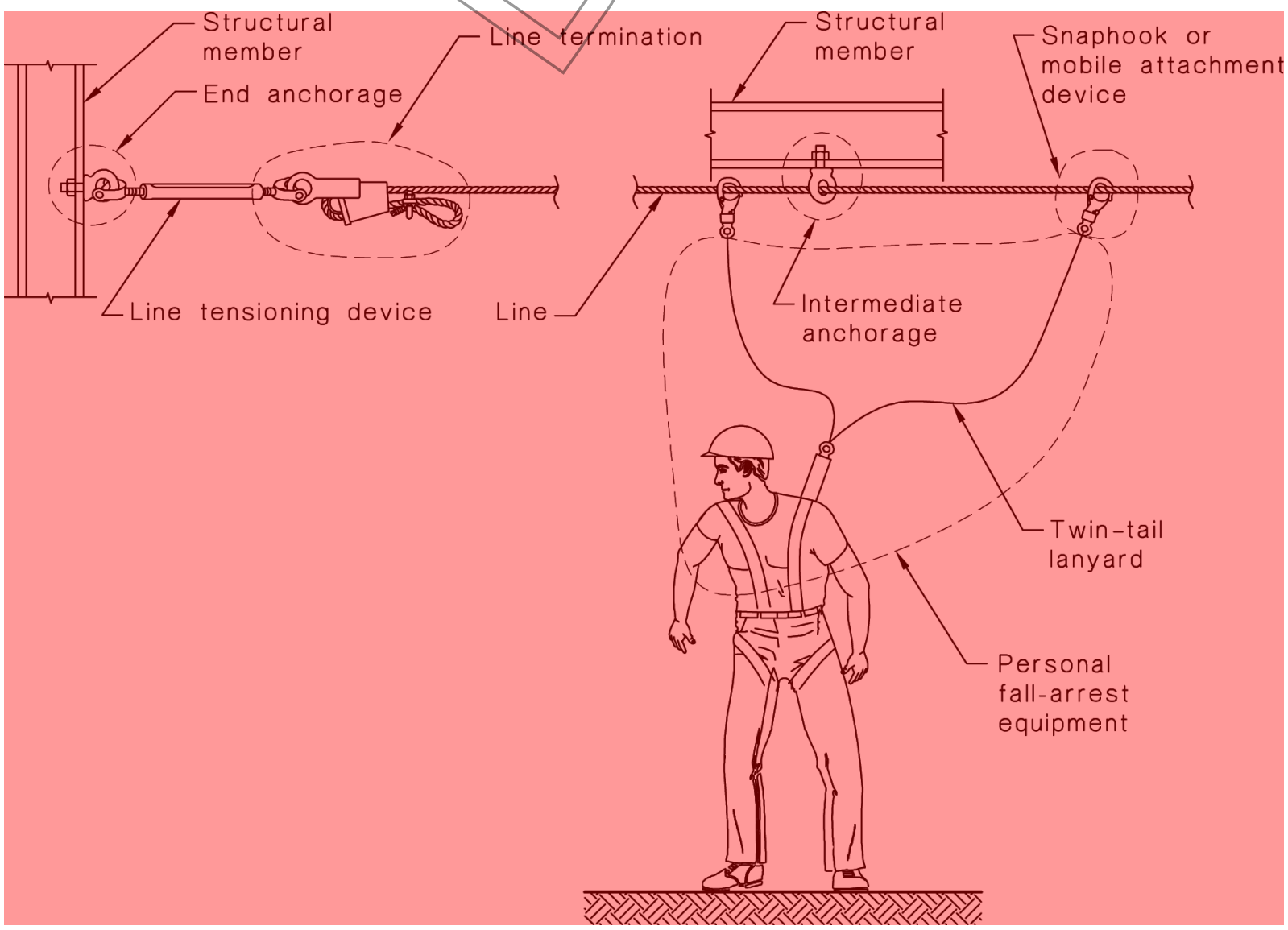


Figure 6.1 — Typical arrangement of a prescribed configuration system

(v) In multiple use, one person falling is less likely to pull others off.

(vi) The system can be designed by structural analysis alone without the need for tests for verification of performance.

(b) For permanent systems likely to be used less frequently the flexible steel wire rope system may be more suitable. These systems will generally have the following advantages over the rigid rail:

(i) Configurations can be more flexible.

(ii) Can tolerate greater distances between support points on structures.

(iii) Are often more readily installed on existing structures.

(iv) Can be used on greater slopes.

(v) May be less visually intrusive.

(c) Where temporary installations are used, it is necessary to ensure that they will not be required beyond the time that they begin to deteriorate beyond safe limits, e.g. due to wear or exposure.

(d) The nature of the structure to which the system is to be attached may dictate which type is more suitable. Some structures may be more suited to the predominantly vertical loads imposed on the supporting structure by a rigid rail system, by being able to provide closely spaced points of support. Flexible line systems will require a structure which can resist high anchorage forces, predominantly horizontal, at each end of the line, but do not need anchorage points, end or intermediate, to be so closely spaced.

(e) Orientation of the system will have a bearing on selection. Flexible lines will generally be more suited to sloping runs and surfaces, and to negotiating corners.

(f) Architectural considerations may favour one system over another.

Architectural considerations shall not be allowed to compromise safety.

6.2.2 Other selection criteria

The following matters should be considered when making a final selection within each system type:

(a) The number of users which the system can accommodate at one time, both in total and who might be involved in a multiple fall from an individual segment.

(b) Ability to handle short runs if required. Single span short run flexible lines will generally exert very high horizontal loadings on end anchors and are not recommended unless steps are taken to reduce the loading, e.g. in proprietary systems by use of line energy absorbers.

(c) Relationship between expected frequency of use and rate of wear on rails, lines and other components.

(d) Suitability of the system for the operating environment, considering the effects on both performance and maintenance requirements of environmental factors.

(e) Ease with which users may safely access the system at the desired access points, either at the ends or at points along its run.

(f) Ability to pass intermediate anchorage points without disconnection, especially if using a heavy Type 2 or Type 3 fall-arrest device attached to the mobile attachment device.

(g) Projected life span and rate of deterioration of main elements.

(h) Suitability of the system or configuration for the fall distance available beneath the installation.

(i) Ease with which the system can be maintained and cleaned.

(j) Use of a prescribed configuration system as an alternative to a proprietary system where, for example, there are economies in so doing or no proprietary system will fit the particular situation.

6.2.3 Selection of ancillary equipment

Ancillary equipment selection requirements and recommendations are as follows:

(a) *Mobile attachment devices* Requirements are as follows:

(i) *Rigid rail systems* These systems will usually be provided with purpose-designed devices which are not normally removable from the rail without removing a retaining device. Where such devices are provided, alternative means of connection to the system shall not be used.

(ii) *Flexible line proprietary systems* Such systems will often have purpose-designed mobile attachment devices provided, including devices designed to operate on sloping lines. These may also be designed to cross purpose-designed intermediate anchorage points without disconnection from the system. Where such devices are provided or intended to be used with the system, no alternative means of connection to the system shall be used.

(iii) *Flexible line systems without purpose-designed mobile attachment devices* If a system is not provided with purpose-designed connections, e.g. a prescribed configuration system, connection to the system shall be by means

of attachment hardware, i.e. snaphooks or karabiners meeting the requirements of AS 1891.5. Provision shall be made for intermediate anchorage points to be crossed without the user becoming disconnected from the system, e.g. by means of a twin-tail lanyard, see Clause 4.2.1(iii) and Clause 4.3.3.

(b) *Line terminations* Requirements and recommendations for the selection of line termination fittings are as follows:

(i) *Line tensioners* These will be required in most cases to tension the line to the tension either prescribed by the system manufacturer or in the prescribed configuration tabulations so as to achieve the predicted performance of the system under fall arrest. They may range from simple turnbuckle type devices to more complex types offering a tension measurement, or they may be combined with an energy absorber.

(ii) *Line energy absorbers* A line energy absorber is not considered to be essential for the safety of users as all users of the system are expected to be equipped with personal energy absorbers. However, a line energy absorber can contribute to the softening of the effects on a persons body in a fall arrest, and can act as a secondary safety measure in the event of misuse of the system, but in so doing is likely to extend the fall distance.

NOTE This does not negate the requirement for personal energy absorbers to be used.

If a system relies on a line energy absorber to restrict end anchorage fall arrest forces to safe levels, care shall be taken to ensure that the device is always fitted and maintained in working order.

Line energy absorbers shall not be fitted to prescribed configuration systems.

6.2.4 Provision of end anchorages for horizontal lifelines

Particular care is needed that end anchorages of the required strength in the required directions are provided. The general requirements for anchorages set out in Clause 3.1.2 will also apply in this case, however, the anchorage strength shall be as set out either in manufacturers instructions or in the prescribed configuration tables. It will usually be considerably greater than the 15 kN or 21 kN required for single point anchorages.

6.2.5 Provision of intermediate anchorages for horizontal lifelines

The general requirements for anchorage points set out in Clause 3.1.2 will apply in this case. Where the line is straight through the intermediate anchor or is diverted horizontally not more than 15°, an anchorage and a corresponding support on the structure capable of sustaining a vertical force of 12 kN is required. If the horizontal diversion is greater than 15° it is necessary to calculate the resultant of the maximum fall arrest forces in the line on each side of the anchorage, apply a safety factor of 2.0 and provide also for this horizontal loading. The horizontal and vertical loadings are to be provided for independently of one another. This process is explained in more detail in AS/NZS 1891.2.

Rope apertures are required to prevent damage to the rope and to allow it to run freely through the aperture unless the supports for the apertures are designed to distort to absorb the fall arrest energy and the system performance predictions take the restricted rope movement at the aperture into account.

6.2.6 Pendulum effect

Where a fall takes place near an end or intermediate anchorage on a flexible line, the mobile attachment device will tend to run towards the centre of the span causing the user to suffer a form of the pendulum effect (see Clause 3.2.3). The degree to which this will occur will depend upon how much friction there is between the mobile attachment device and the line, and the deflection angle of the line. This will be greater for longer spans and for synthetic fibre rope or webbing line materials. The problem is illustrated in Figure 6.2. If there is a likelihood that a user could collide horizontally with a fixed object in such a fall, either the configuration of the line should be altered, e.g. by providing an end or intermediate anchorage directly above the fixed object, so that the user will not swing into the object, or an alternative not involving a horizontal lifeline (e.g. a rigid rail) substituted.

6.3 Safe use of systems and equipment

The following are general requirements and recommendations for the safe use of horizontal life line and rail systems and equipment:

(a) *Personal equipment* Personal protective equipment appropriate to free fall conditions selected in accordance with Section 4 shall be worn in conjunction with a horizontal life line or rail.

(b) *Multiple falls* Only systems which have been designed to resist the fall arrest forces caused by near simultaneous multiple falls should allow more than one person at a time to be connected to any one span of the system. If one person were to fall and the resulting deflection of the line were so great as to exceed the lanyard length of people nearby such that they could be pulled over also, that system or part of the system shall not be used for more than one person at a time.

(c) *Clear fall area* When arresting a fall, flexible life line systems will invariably deflect downwards to a greater extent than static loading might suggest. Adequate fall clearance determined in accordance with Section 7 shall be provided. Adequate lateral clearance in the event of a user suffering the pendulum effect (see Clause 6.2.6) shall also be provided.

(d) *Loading of lines in service* Flexible line systems shall not be subjected to any operator loading in normal service other than substantially horizontal forces arising from use of restraint technique, i.e. they shall not be used for work positioning purposes, unless specifically designed and certified for such use.

NOTE A primary reason for this requirement is to prevent creep in any part of the system, such as energy absorbers, which might, over time, alter its fall-arrest performance characteristics.

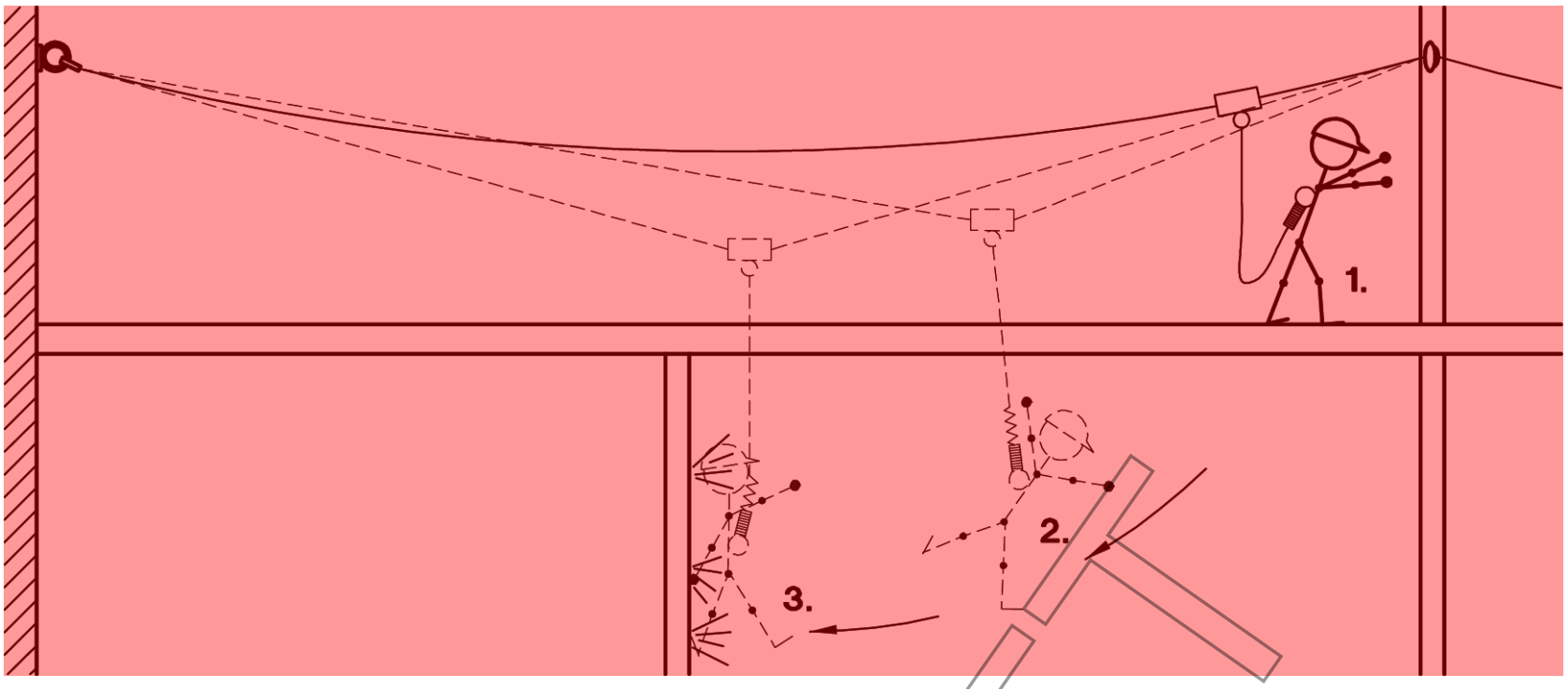


Figure 6.2 – Fall from a horizontal lifeline – Pendulum effect

(e) *Continuity of connection* Provision shall be made for users to approach and connect onto a horizontal lifeline or rail system either without being exposed to a fall-risk situation or if so exposed, protected by means of another fall-arrest system with provision for transferring to or from the line or rail while always connected to one system or the other. The approach may comprise for example, a fully protected walkway or a ladder equipped with a ladder fall-arrest system. The same requirements apply to leaving the system or transferring between two systems.

(f) *Line termination hardware* All termination hardware including turnbuckles shall be effectively locked or otherwise secured from inadvertent opening.

(g) *Line tension* The line tension needs to be within limits set by the supplier or designer. This may be given as a torque or other load reading on a tensioning device, a special tensioning tool that limits the tension which can be applied or a defined sag at mid-point of a nominated span. Overtensioning of the line may result in increased load in the end anchorages, or in the extreme failure of the system in the event of a fall.

(h) *Line energy absorbers* If a line energy absorber shows signs of permanent extension, the system shall not be used until the item is replaced.

(i) *Installation by competent person* All systems shall be installed by a competent person (see Clause 1.4.2)

(j) *System information plates* A system information plate in accordance with Clause 2.2.9 shall be displayed at each regular entry point to any permanently installed horizontal lifeline or rail system. The plate shall provide the following information:

(i) Manufacturer's and installer's name and installation date.

(ii) A unique identification number.

(iii) An instruction that a personal energy absorber or a fall-arrest device with energy absorbing properties must be used.

(iv) Any special instructions for use, including the number of users allowed on the system or on any one span at once.

(v) Servicing requirements and instructions, together with inspection and servicing intervals and the dates on which they are to be carried out.

(vi) The month and year by which the system should be taken out of service unless it has been re-certified by a competent person in accordance with manufacturer's instruction as safe for continued use. This date shall be not more than 10 years from the date of original installation nor more than 5 years from any subsequent re-certification.

5.4.2.23 Pole strapstraps

The purposefollowing ofapplies aspecifically to pole strap is to support a worker on a pole both during normal working and in the event of a restrained fall. It may be used with a full-body or lower-body harness with suitable attachment points. A personal energy absorber shall not be used in conjunction with a pole strap, and a pole strap shall not be used wherever there is the possibility of a free fall.

Selection of a suitable pole strap should take into account the following:straps:

(a) The needharness forconnectors materialshall otherbe thanengaged syntheticbefore webbing or rope, e.g.

(i) steel wire rope or steel chain, for use whereloading the workpole entailsstrap use of power cutting tools such as saws or angle grinders; or

(ii) natural fibre rope, for use wherewith the workuser's entails both the use of naked flame and where there are live electrical conductors within reachweight.

(b) EaseThe pole strap should be positioned on the structure so that the pole strap cannot slip.

NOTE The reader is reminded of connectionthe aroundrequirement in Clause 2.5.1(a) polefor andadditional easecontrol of adjustment of length to allow a comfortable working positionmeasures.

Natural fibre material should not be used for any purpose other than provided for in Item (a)(ii).

4.2.3 Attachment hardware

Examples of attachment hardware other than permanently closed rings are shown in Figure 4.4. Descriptions of these devices and recommended selection criteria are given as follows:

(a) *Snaphooks* These comprise a hook-shaped body and gate. The gate can be opened to receive a suitable and compatible attachment point such as a ring on a harness, or the eye of a lanyard or sling.

Snaphooks should be selected for –

(i) the relative size of the hook opening and the objects the wearer will be expected to connect to; and

(ii) ease of operation. If the operator would routinely be working wearing gloves this should also be considered.

The snaphook is required under AS 1891.5 to be the self-closing and self-locking type that has a locking gate overriding the latch such that it remains closed until the hook is intentionally opened by means of two separate manual operations.

If the locking latch is either physically removed or its action defeated, it is possible with some manipulation of the hook and what it is connected to for the connection to be released. Consequently it is essential to make sure that the hook and the two latches are operational during the pre-use inspection.

NOTE Single action snaphooks (i.e. hooks that have a single latch and can be opened by one movement) have not been endorsed by AS/NZS 1891.1 since the publication of the 1995 edition.

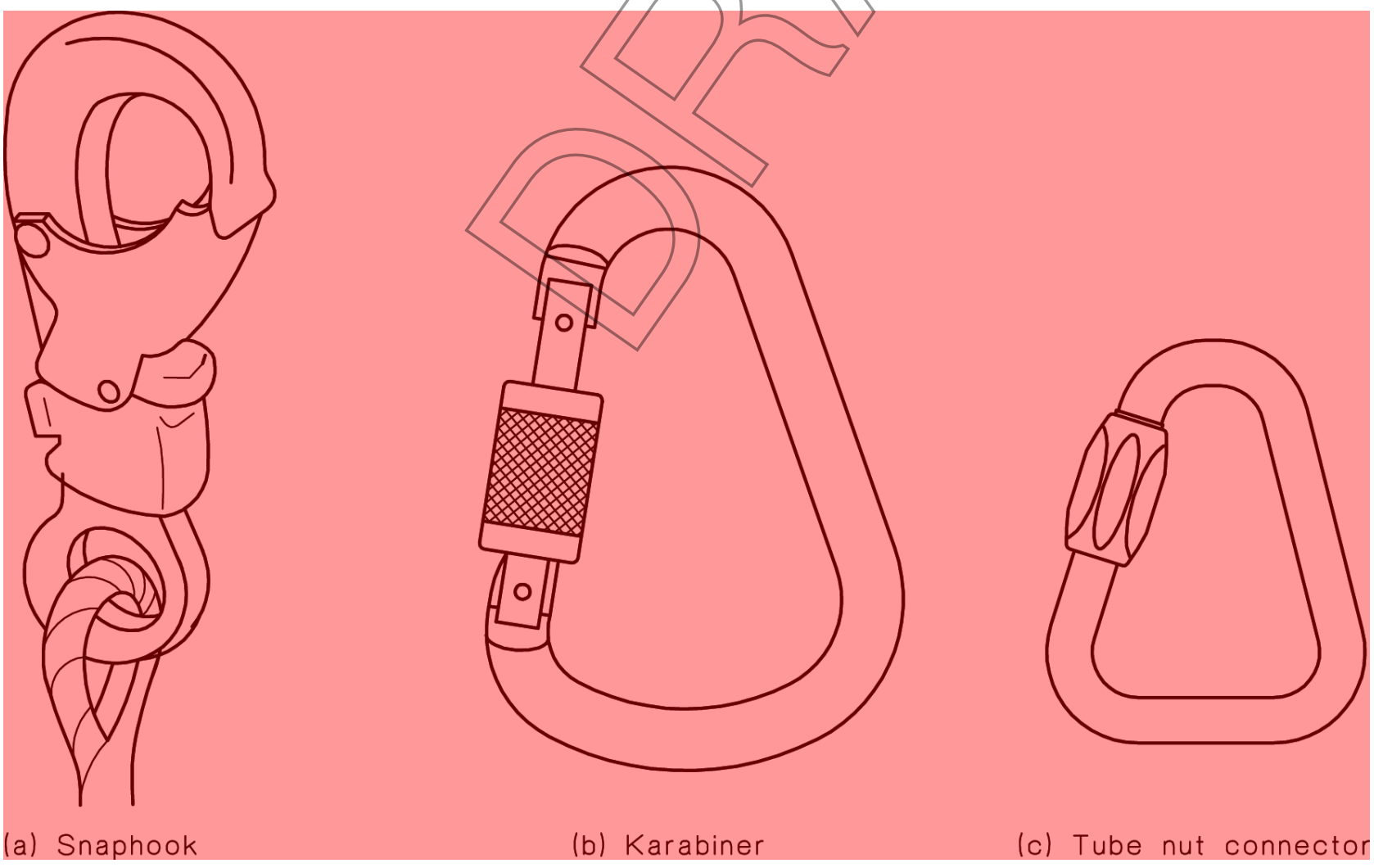


Figure 4.4 – Examples of attachment hardware

(b) *Karabiners* These comprise a connector with a spring loaded gate. The gate opens to receive a mating connection and when released, automatically closes to retain the connection. Karabiners are required under AS 1891.5 to be self-closing and have a locking device so that the karabiner is only capable of being unlocked and opened by two or more separate manual operations.

Karabiners are available with a number of different locking mechanisms, each with its own characteristics as follows:

(i) *Screw gate* These require the operator to screw a small ferrule into position on the latch to effectively lock the gate. This has the advantage of requiring the operators to deliberately take action to secure themselves and while so doing, confirm the connection and maintain awareness of the condition of the locking mechanism.

Care is especially needed in the following cases:

(A) That the operators do in fact close the locking action. If they do not, it may, under manipulation, leave the connection prone to “roll out”.

(B) That operators do not over tighten the locking ferrule.

(C) That the karabiner is not left inverted in situations of vibration where the ferrule can either become loose or over tightened over a period of time.

Over tightening may cause the unit to jam.

(ii) *Double and triple action karabiners* These have a spring loaded locking ferrule that requires two or more actions to release the gate, usually a twist followed by a combination of sliding and twisting of the ferrule. The advantage of these devices is that they lock the latch automatically. Even with this process there is a need for the user to confirm that the ferule has moved into place and that latch is locked. There have been situations where the ferrule has become inoperable due to the ingression of dust or other particulate matter. Consequently the equipment must be maintained in good serviceable condition.

Particular care is needed that all karabiners are correctly orientated to sustain the impact in the event of a fall.

If side or gate loading is a possibility (see Clause 4.3.6(b)), a karabiner with a captive eye or split pin which will hold the device in the correct position, should be selected.

Karabiners are commonly available in aluminium alloy, plain carbon or alloy steel varieties. Although aluminium karabiners may be sufficiently strong for use as fall-arrest connectors; steel items may be preferred, especially in a harsh working environment, as they are more robust and less susceptible to abrasion. Both materials are susceptible to corrosion in adverse environments.

(c) *Tube-nut connectors* These comprise an open loop, the sides of the opening terminating in a pair of aligned screw threads arranged so that a single tubular nut can close the loop by simultaneously engaging both threads. Tube-nut connectors are among the safest types of attachment hardware in that they require a succession of screwing actions to open them, and they are not prone to roll-out as are other connectors which rely on spring mechanisms for security. They can be further secured by the use of a spanner or a thread adhesive. Because the locking mechanism is slow to operate they are not suitable at the anchorage end of a lanyard assembly. They are suitable at the harness end of a lanyard assembly, providing operators do not frequently need to disconnect them from the harness. The triangular type is suitable for 3-way loading such as connecting anchorage sling ends together.

NOTE A tube nut connector is not classified as a karabiner or snaphook, and hence is not subject to the requirement for two separate opening/closing actions, nor is it required to be self-closing or self-locking.

4.3 Safe use of harness, lanyard and pole strap systems

4.3.1 General requirements

The following general requirements and recommendations are relevant to the harness, lanyard and pole strap systems:

(a) All users shall be warned about the hazards of using only a belt or waist strap in lieu of a harness as specified for any of the fall-arrest or restraint applications covered by this Standard to protect against a potential fall. Attention should be drawn to the likelihood of a user sustaining severe internal injuries unless the greater bodily support of a harness is provided.

(b) Side attachment points on the waist strap component of a harness shall be used exclusively as a pair for the attachment of a pole strap. Attention should be drawn to the probability that use of one side only for fall-arrest attachment will lead to severe injuries and equipment failure in the event of a fall.

4.3.2 Harness/lanyard combinations

The following are requirements and recommendations for the safe use of harness/lanyard combinations:

(a) Harnesses are required to have attachment points marked for the purpose for which they are to be used, i.e. fall arrest, limited (free) fall, pole strap or retrieval. Only attachment points in the first two of these categories shall be used for the attachment of lanyards.

(b) Users shall be trained in determining which lanyard attachment point is the safest and most effective for the particular work to be done or work location having regard to the mode or modes of fall most likely to be suffered.

(c) The available clearance underneath a wearer shall be checked against the fall clearance requirements determined in accordance with Section 7.

(d) All necessary steps should be taken to ensure that the anchorage point is capable of bearing the load of a fall-arrest as specified in Clause 3.1.2 and Clause 3.1.3. Re-testing of friction and glued-in anchorages by proof loading in accordance with Clause 3.1.2(g) shall be carried out if there is any concern that proof loadings carried out at installation or at a subsequent time may no longer be reliable, e.g. due to age deterioration.

(c) The harness should fit the wearer securely. Each available adjustment should be properly adjusted to the wearers body shape. This is particularly important in the case of the lower body harness to ensure that the wearer will be retained in the event of a fall.

(f) Lanyards should be used in such a way that in the event of a fall, the fall distance will be minimized. Adjustable lanyards may help to reduce unwanted slack and hence reduce fall distance. Lanyard configurations and corresponding free fall distances are dealt with in Section 8.

(g) The use of two separate lanyards attached to one harness for the purpose of transferring among anchor points is not recommended. A fall when both are connected can result in the fall arrest force exceeding 6 kN. A twin tail lanyard, see Clause 4.3.3, shall be used for this purpose.

4.3.3 Twin-tail lanyards

Wherever a person is required to move from one anchorage point to another or to pass an intermediate anchorage on a horizontal lifeline (in the absence of a mobile attachment device), it is recommended that a twin tail lanyard be used. The following requirements apply to the use of these items:

(a) The common end shall always be attached to the harness.

(b) A tail when not in use shall be stowed in accordance with the manufacturer's instructions, e.g. by attachment to the stowage point on the harness or other tail of the lanyard specifically provided for the purpose. Stowage in any other manner, e.g. by wrapping around the body, can result in unintended "short circuiting" of the lanyard during fall arrest which can cause serious injury.

Two separate lanyards are not recommended as a substitute for a twin tail lanyard, see Clause 4.3.2(e).

4.3.4 Harness/pole strap combinations

The following are requirements and recommendations for the safe use of harnesses in combination with pole straps:

(a) Before trusting the pole strap, the user should look to make sure that the connectors to the harness are properly engaged, with the snap hook(s) or other connectors securely hooked and locked into the pole strap attachment points on both sides of the harness. As an added safety measure, users should ensure that they are firmly supported by leaning back in the harness before releasing their hand holds.

(b) Wherever practicable, the user should ensure that the pole strap is attached to or over a secure part of the structure where it cannot slip off.

(c) Before climbing or changing position while wearing a harness, the user should ensure that it will not become caught or snagged during the movement.

(d) When desapping poles, or trimming or topping standing trees, desapping chains and not ordinary pole straps should be used, and extra care taken because the pole strap is in a hazardous position. Chain or wire rope pole straps have considerably lower energy absorbing properties than a webbing pole strap, and therefore a fall under these circumstances will be much more severe than with a webbing pole strap.

(e) If a webbing or fibre rope pole strap is to be used where cutting or abrading tools are in use, consideration should be given to the use of a secondary safety system, typically a lanyard connecting the frontal waist attachment point to an anchorage located so as to restrict any free fall to 600 mm.

(f) During ascending or descending, both of the user's arms and hands shall be completely unencumbered, to permit complete freedom of movement for grasping supports.

(g) The combination of a pole strap with a harness should not be used for work other than pole work, tree climbing, or tower work.

4.3.5 Attachment hardware – General

The following are general requirements and recommendations for the safe use of snaphooks and karabiners with other attachment hardware including that permanently attached to fall arrest equipment:

(a) All mating components shall be checked to ensure that they are compatible with one another. Components should not be able to jam in one another in a way which may overstress one or the other, e.g. in some snaphook to snaphook connections, or affect the operation of the items being connected. Incompatible components may also be subject to inadvertent release as described in Clause 4.3.6. The check should be repeated each time there is a change in either component.

(b) Each time a device is attached to another device a check shall be made to ensure that both the primary latch and secondary locking device are secure. This should become a regular habit regardless of whether the secondary locking device is engaged manually or automatically.

(c) As most attachment hardware items are not designed to resist bending stresses, they shall not be used in a manner which will subject them to bending loads. A potential misuse is shown in Figure 4.5.

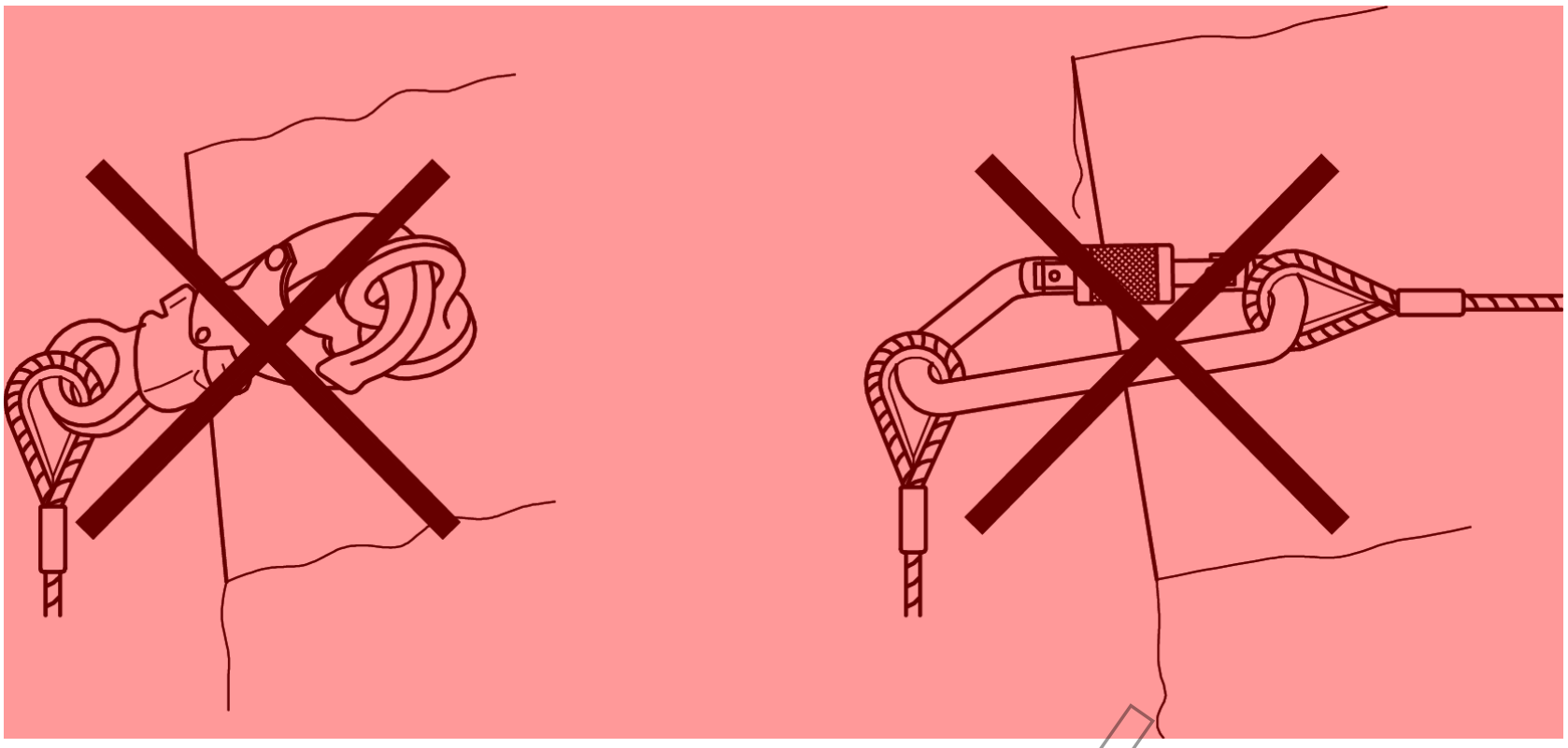


Figure 4.5 — Improper loading of a snaphook or karabiner resting on an edge

(d) Some snaphooks are not suitable for direct connection to fibre rope or webbing due to the potential for side loading of the gate and consequent roll-out (see Clause 4.3.6(a)), or damage to the rope or webbing. A check should be made with the manufacturer before using a snaphook this way. A check should also be made from time to time that no sharp edge is being built up within the snaphook.

(e) A screwgate karabiner or tube-nut connector should be orientated in use so that the screwgate or nut screws downwards to engage.

(f) Some snaphooks have a locking mechanism with a substantial knob protruding from the back of the snaphook. To prevent these causing injury in a fall, when a lanyard is connected to a harness this type of snaphook should be orientated with the knob away from the body.

4.3.6 Attachment hardware – Usage problems

An important safety issue in the use of attachment hardware is inadvertent release which can be initiated in a number of ways as follows:

(a) *Simple roll-out* Although this is largely a problem with single action snaphooks and to some extent karabiners it can occur with double action snaphooks (see Item (c)). Figure 4.6 illustrates how either a small diameter eye-bolt or a rope loop can roll out of a single action snaphook or a double action snaphook if the locking gate is first tripped. High side loadings can also lead to cross-gate failure. Single action snaphooks shall not be used for primary load bearing connections.

(b) *Gate loading* This can occur in various ways. Figure 3.3 illustrates how two or more large cross-section components in a snaphook of inadequate size can, when loaded, exert undue force on the gate. Loading of the gate of a karabiner can occur if it is displaced through 90° so that the load is no longer taken parallel to the spine of the karabiner, see Figure 4.7. If the gates of these devices are to be loaded in this way their strength is reduced from about 22 kN when loaded parallel to the spine, to 12 kN or less when loaded across the gate. A fall-arrest loading could therefore cause the gate to fail and the load to be released. Gate loading can be avoided by the methods recommended in Clause 3.2.4(e) and Clause 4.2.3(b).

(c) *Inadvertent tripping of locking gate* Although considerably less likely than simple roll-out of a single acting connection, it is possible to inadvertently trip the locking gate of a snaphook or karabiner and at the same time suffer roll-out through the main gate. A typical case could be the self-locking karabiner where the spring actuating the quarter-turn locking of the second gate can be insufficiently strong to resist inadvertent rotation of the barrel, e.g. against the operators clothing. If this happens simultaneously with a twisting of the connection it can lead to roll-out. The following items can lead to roll-out in connectors once the locking gate is tripped:

(i) Small diameter eyebolts.

(ii) Triangular D-rings.

(iii) Rope or webbing loops.

The checking of a connection for possible susceptibility to roll-out entails firstly determining how easily moving contact with clothing or equipment can cause initial tripping of the locking gate. If this is relatively easy, simultaneously twisting the connection in all possible directions will find whether a subsequent roll-out is possible after the locking gate has been tripped.

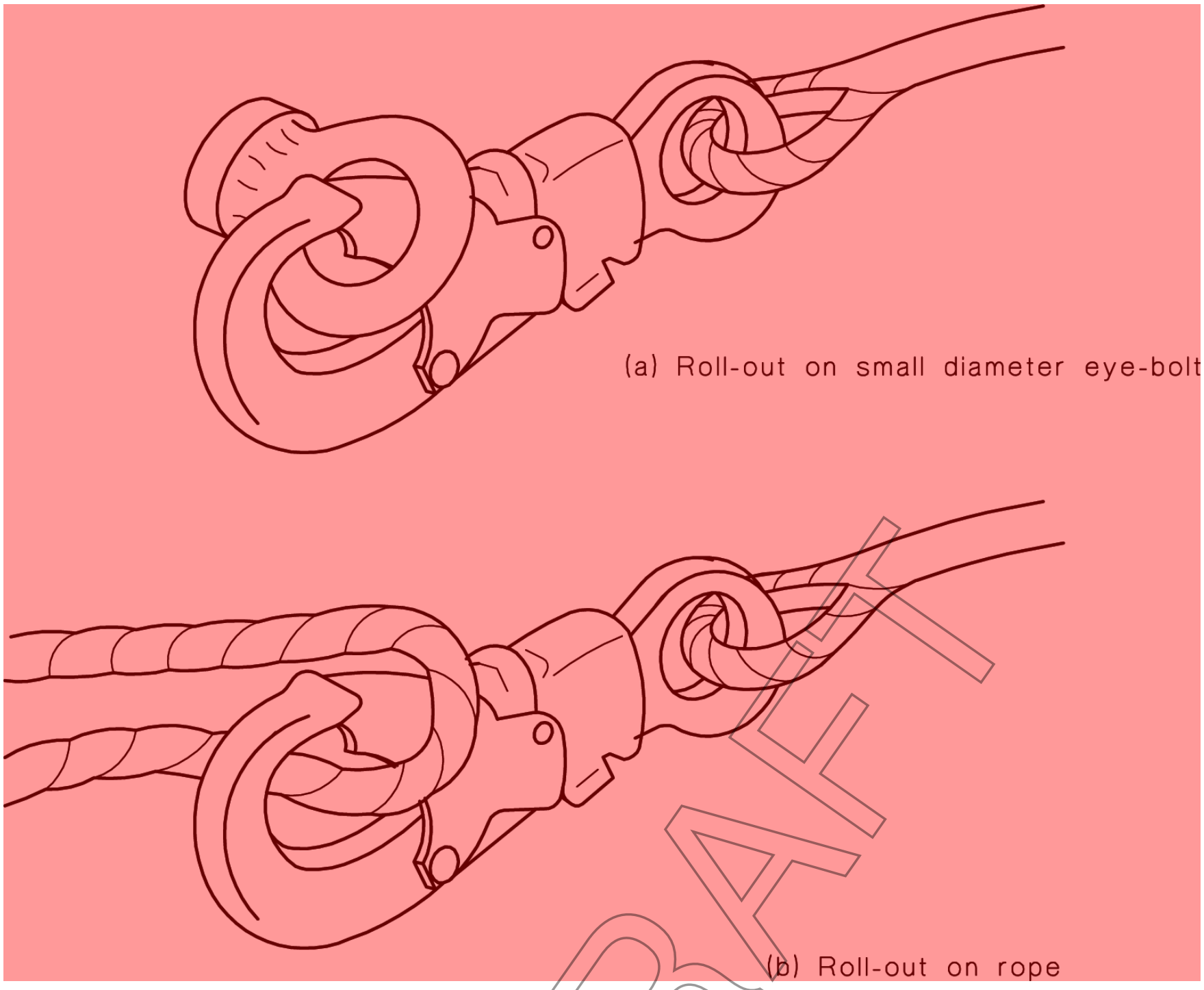


Figure 4.6 – Snaphook roll-out

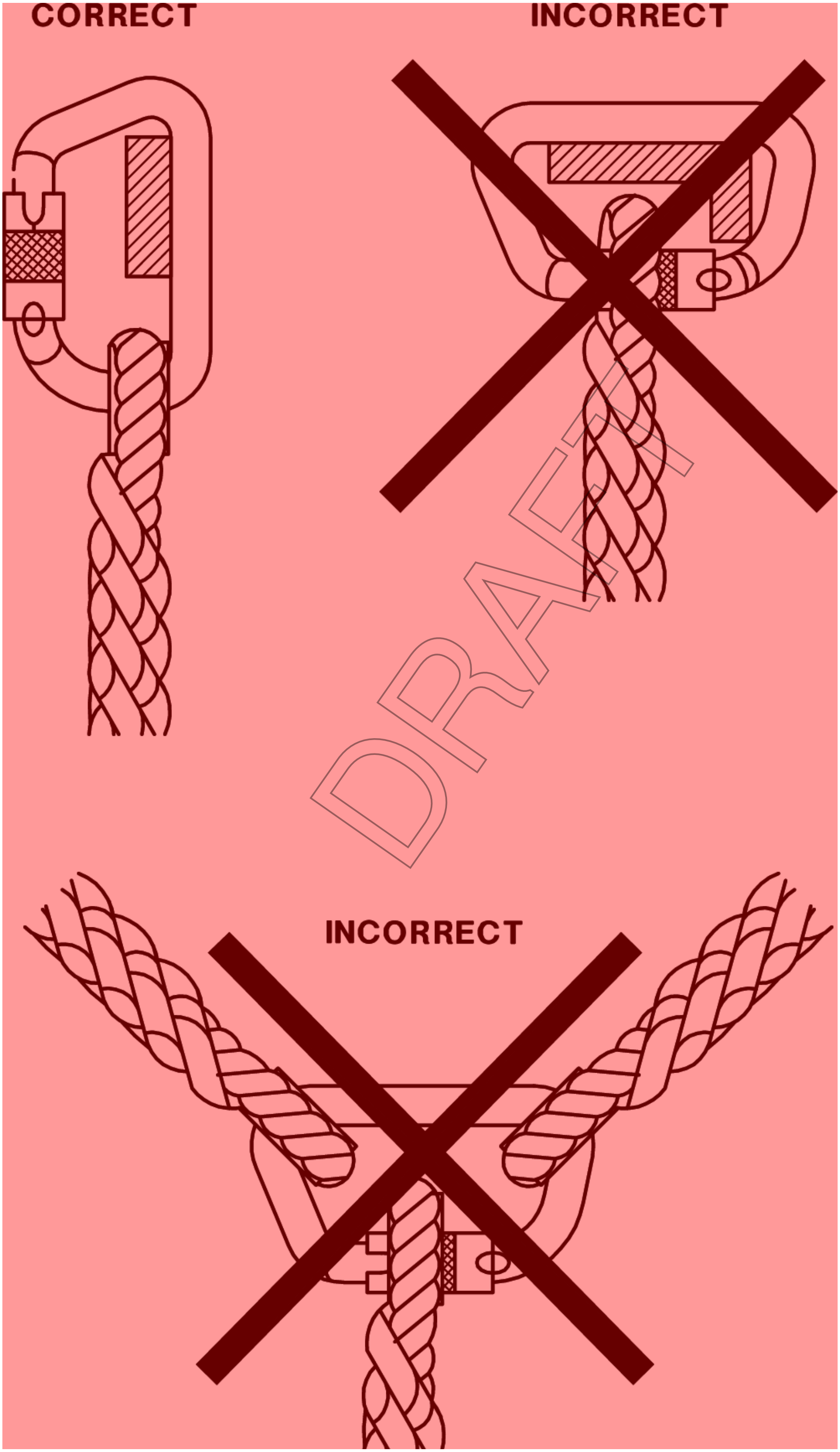


Figure 4.7 – Loading of a karabiner

5.4.4 Adjustable lanyards

Adjustable lanyard assemblies shall be adjusted to the shortest practical length to minimize the possible fall distance.

5.4.5 Fall-arrest devices

In addition to the requirements in Clause 5.4.1, the following requirements apply specifically to fall-arrest devices:

(a) When climbing a ladder, Type 1 fall-arrest devices shall be connected to either –

(i) the sternal attachment point on the harness; or

(ii) the front waist attachment point on the harness.

(b) A termination (such as a knot, swage or sewn termination) shall be incorporated to prevent Type 1 devices coming off the end of the anchor line.

NOTE For example, a figure-of-eight knot with at least a 100 mm a tail on a fibre rope.

(c) Type 2, 3 and 4 retractable devices shall be stored with the line material full retracted inside the housing.

(d) Type 3 and 4 devices shall be installed to allow the safe operation of the rescue function.

Examples of typical fall-arrest devices are shown in Figure 5.8.

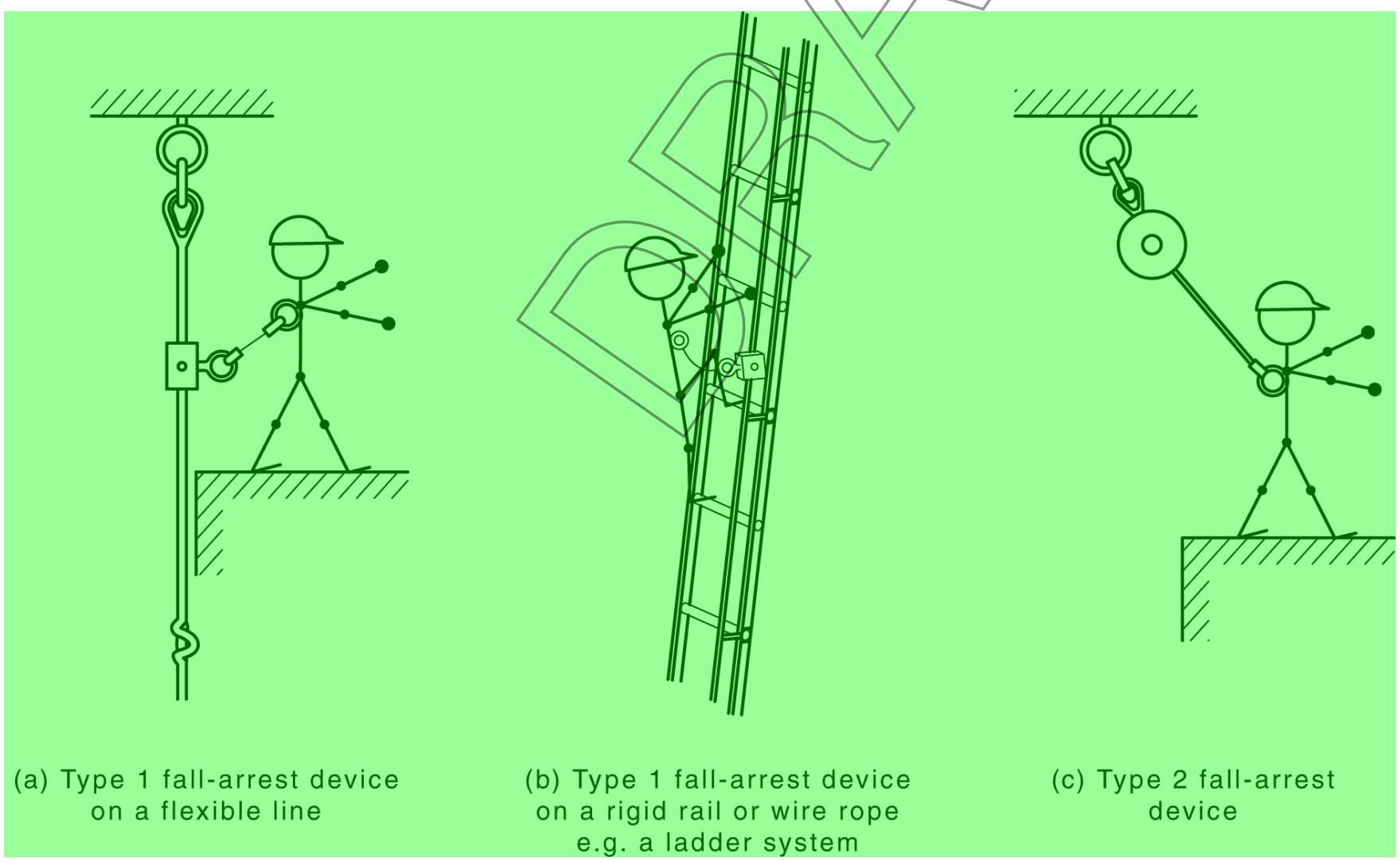


Figure 5.8 – Examples of typical fall-arrest devices

6 Connectors

6.1 General

The connector shall be selected according to the work and system type.

NOTE Refer to AS 1891.5 for further information.

6.2 Types of connectors

6.2.1 Snap hooks

Snap hooks comprise a hook-shaped body and gate (see Figure 6.1). The gate can be opened to receive a suitable and compatible attachment point such as a ring on a harness, or the attachment point of an anchor.

Snap hooks shall have the following features:

(a) Self-closing.

(b) Self-locking.

(c) Minimum resistance of 6 kN for the gate face.

(d) Minimum resistance of 6 kN for the gate side.

(e) A locking latch that secures the gate.

NOTE 1 This will ensure that the gate remains closed until the hook is intentionally opened by means of two or more separate manual operations.

Snap hooks should be selected for:

(i) The relative size of the hook opening compared to the object size that it will be connected to.

(ii) Ease of operation.

NOTE 2 If the user routinely works while wearing gloves, then this should also be considered.

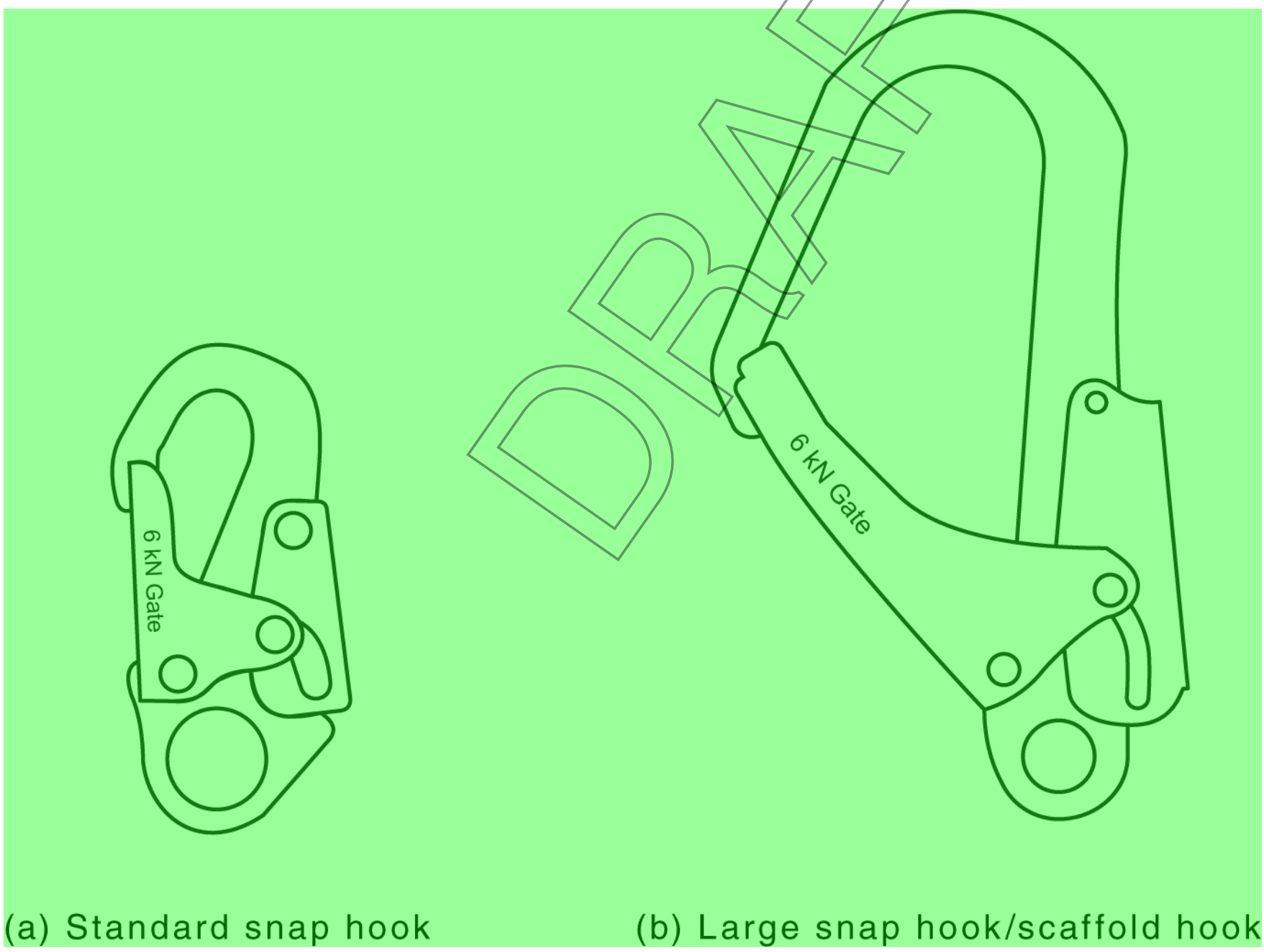


Figure 6.1 – Examples of snap hooks

6.2.2 Karabiners

Karabiners comprise a connector with a spring-loaded gate (see Figure 6.2). The gate opens to receive a connection and when released, automatically closes to retain the connection.

Karabiners shall have the following features:

(a) Self-closing.

(b) Minimum resistance of 6 kN for the gate face [see Figure 6.3(a)].

(c) Minimum resistance of 6 kN for the gate side [see Figure 6.3(b)].

(d) Minimum longitudinal strength of 22.2 kN [see Figure 6.3(c)].

(e) A locking mechanism that secures the gate.

NOTE 1 This will ensure that the gate remains closed until the karabiner is intentionally opened by means of two or more separate manual operations.

Karabiners are available with different locking mechanisms. They shall be selected based on –

(i) the application; and

(ii) the environmental conditions.

Users of manually locking karabiners (such as screw gate karabiners) shall lock the gate prior to use.

NOTE 2 Unlocked gates are prone to “roll out”.

NOTE 3 Over-tightening the locking sleeve can inhibit disconnection.

NOTE 4 Vibration can adversely affect the locking sleeve mechanism.

Users of self-locking karabiners (such as double and triple action karabiners) shall check that the karabiner is locked prior to use.

NOTE 5 The advantage of these devices is that they are designed lock the gate automatically.

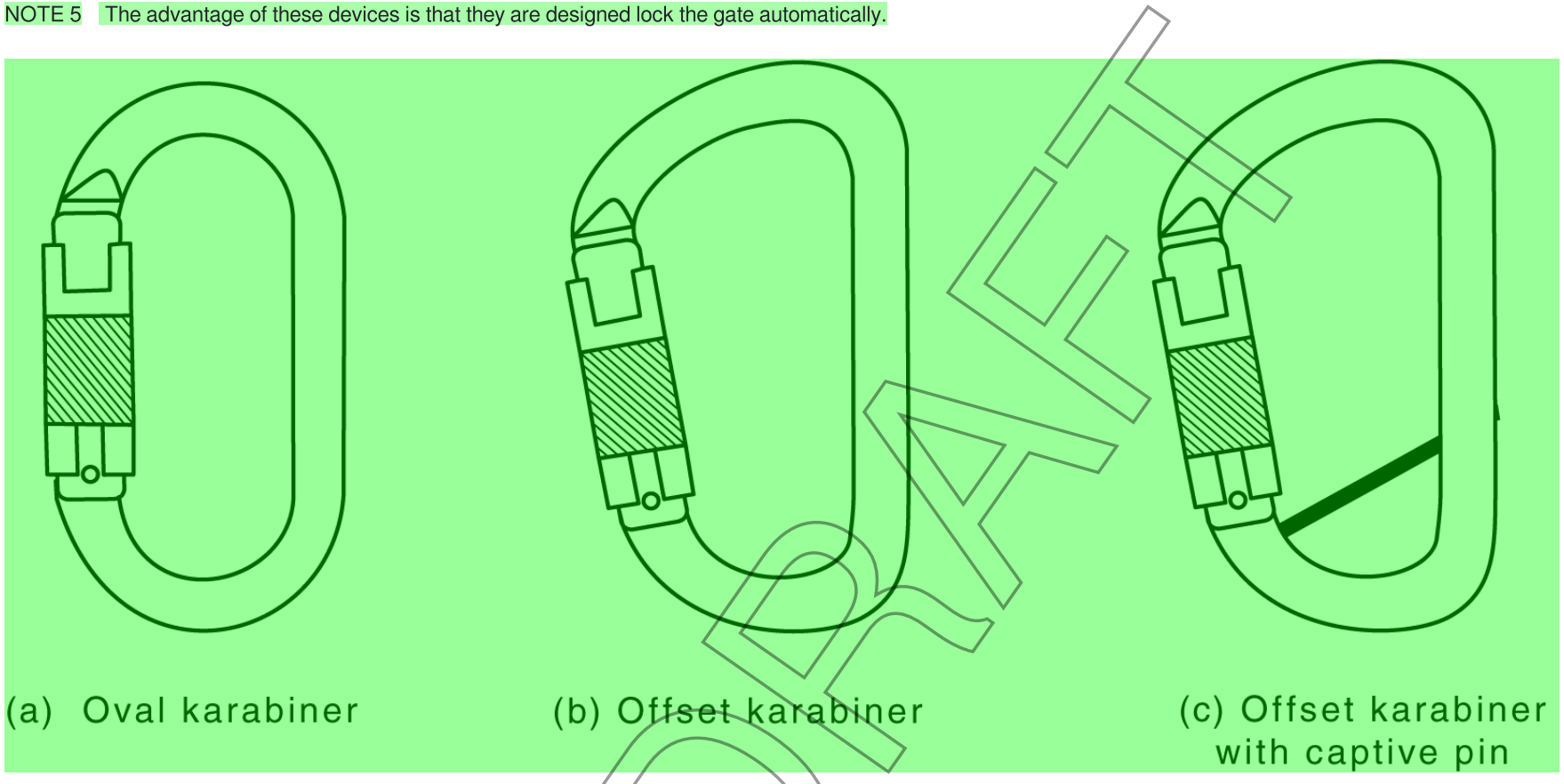


Figure 6.2 – Examples of karabiners

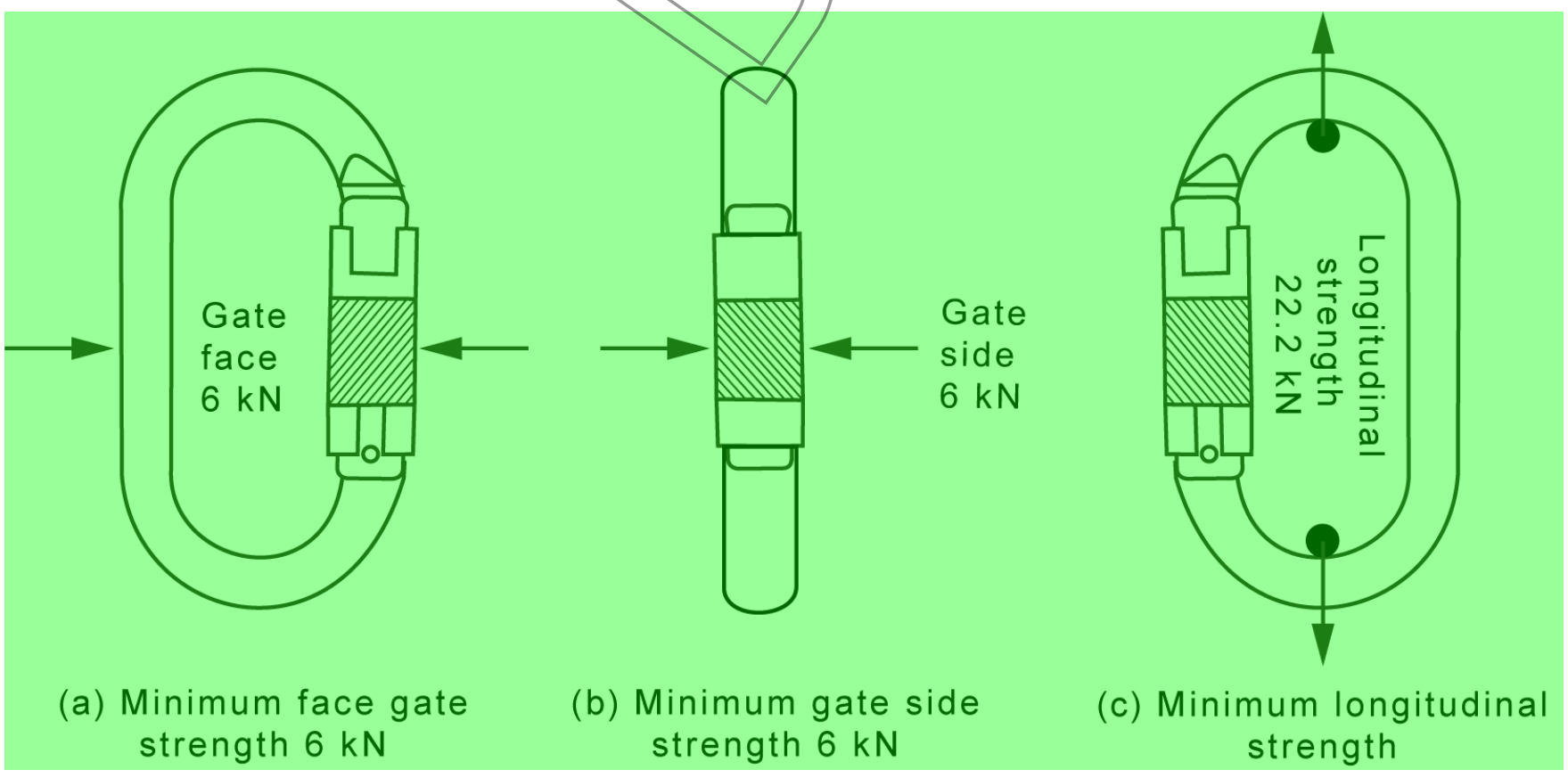


Figure 6.3 – Illustration of minimum strength for karabiners

6.2.3 Screwlink connectors (class Q connectors)

Screwlink connectors (class Q connectors) comprise an open loop (see Figure 6.4). The sides of the opening terminate in a pair of aligned screw threads that are arranged so that a single tubular nut can close the loop by simultaneously engaging both threads.

NOTE These are also referred to as quick link connectors.

Screwlink connectors shall conform with BS EN 362.

Screwlink connectors shall be closed in accordance with the product instructions.

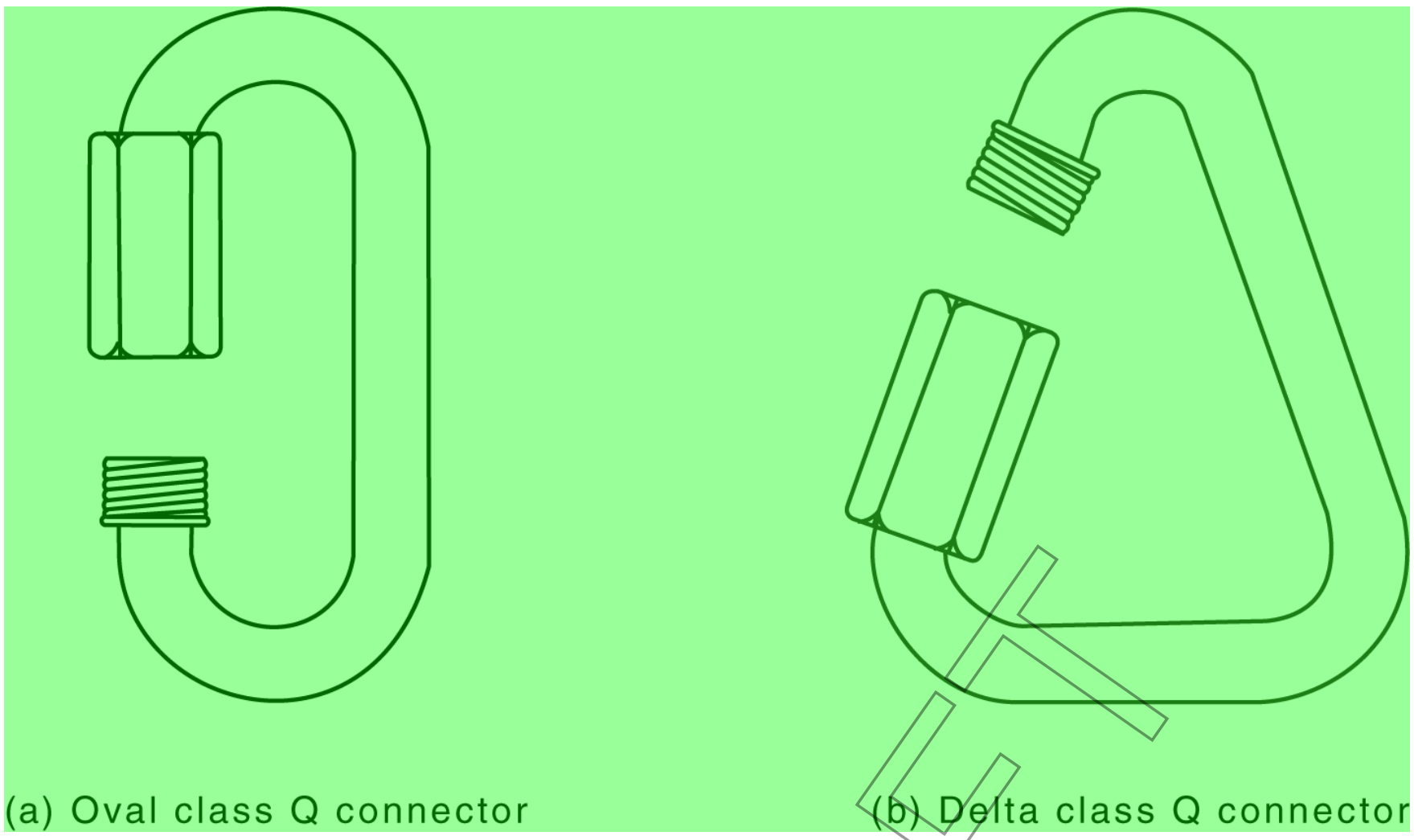
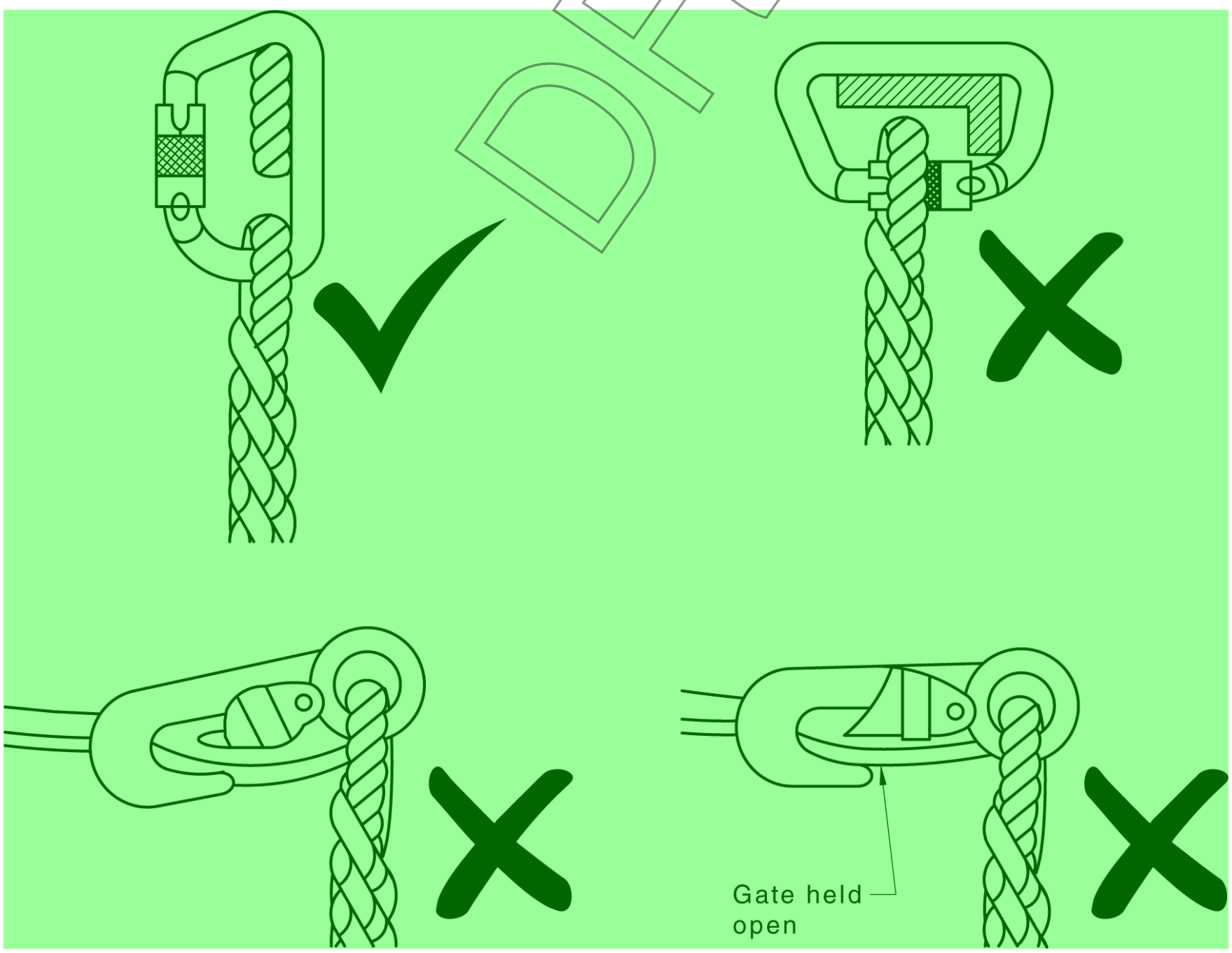


Figure 6.4 – Examples of screwlink connectors

6.3 Compatibility

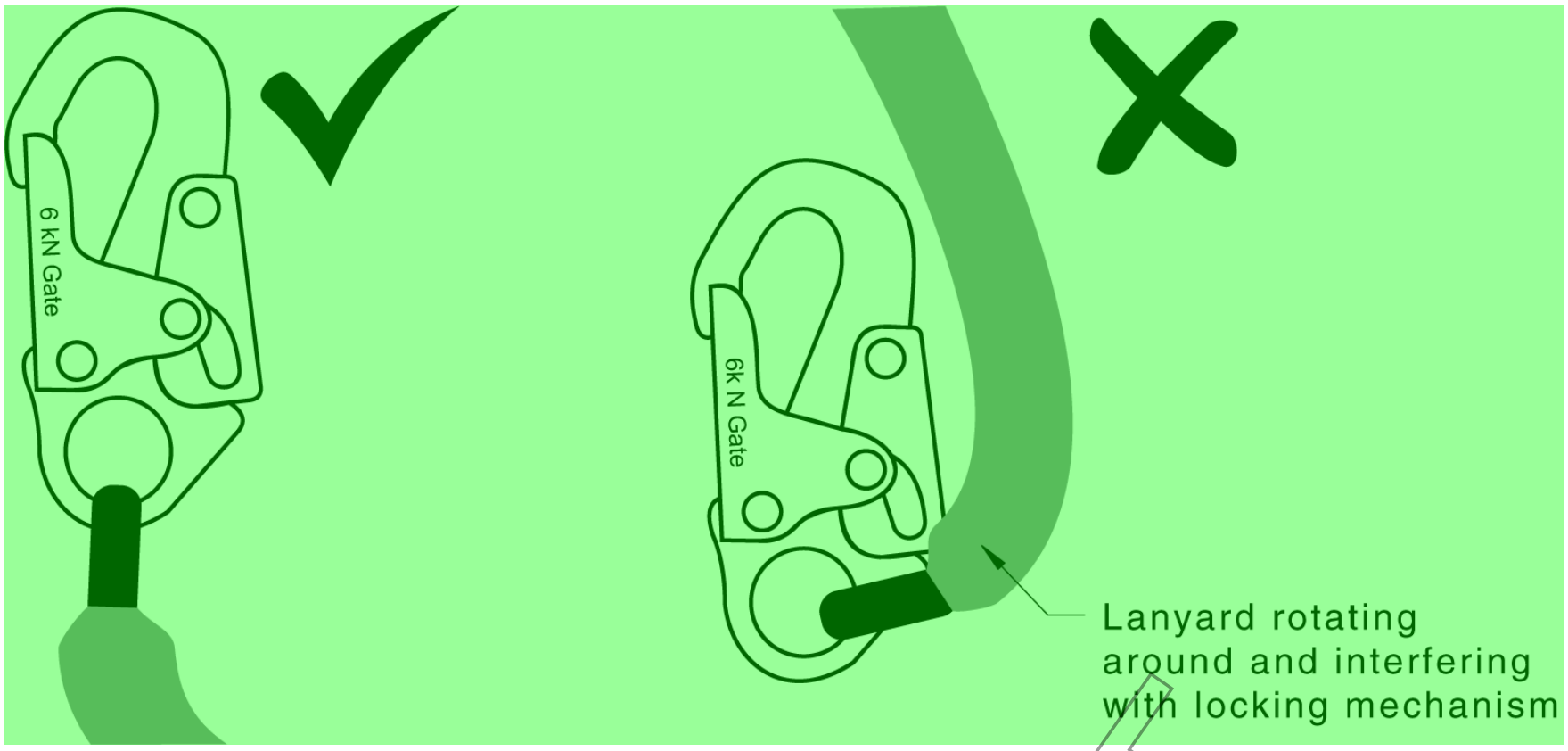
A fall-protection system shall comprise items that are compatible with each other. See Figure 6.5 for examples of compatible and incompatible connections.

(a) Loading of a gate on a connector

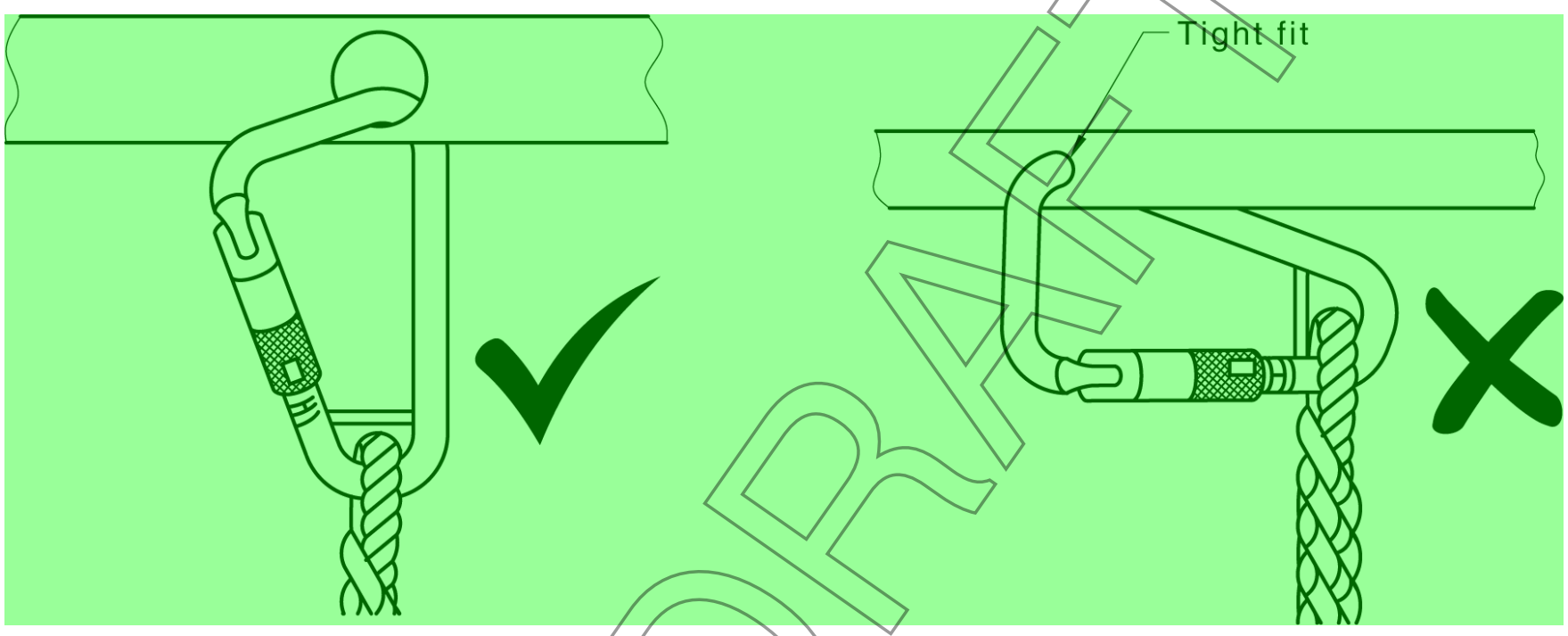


NOTE Some connectors allow the gate to be loaded. Refer to the product instructions.

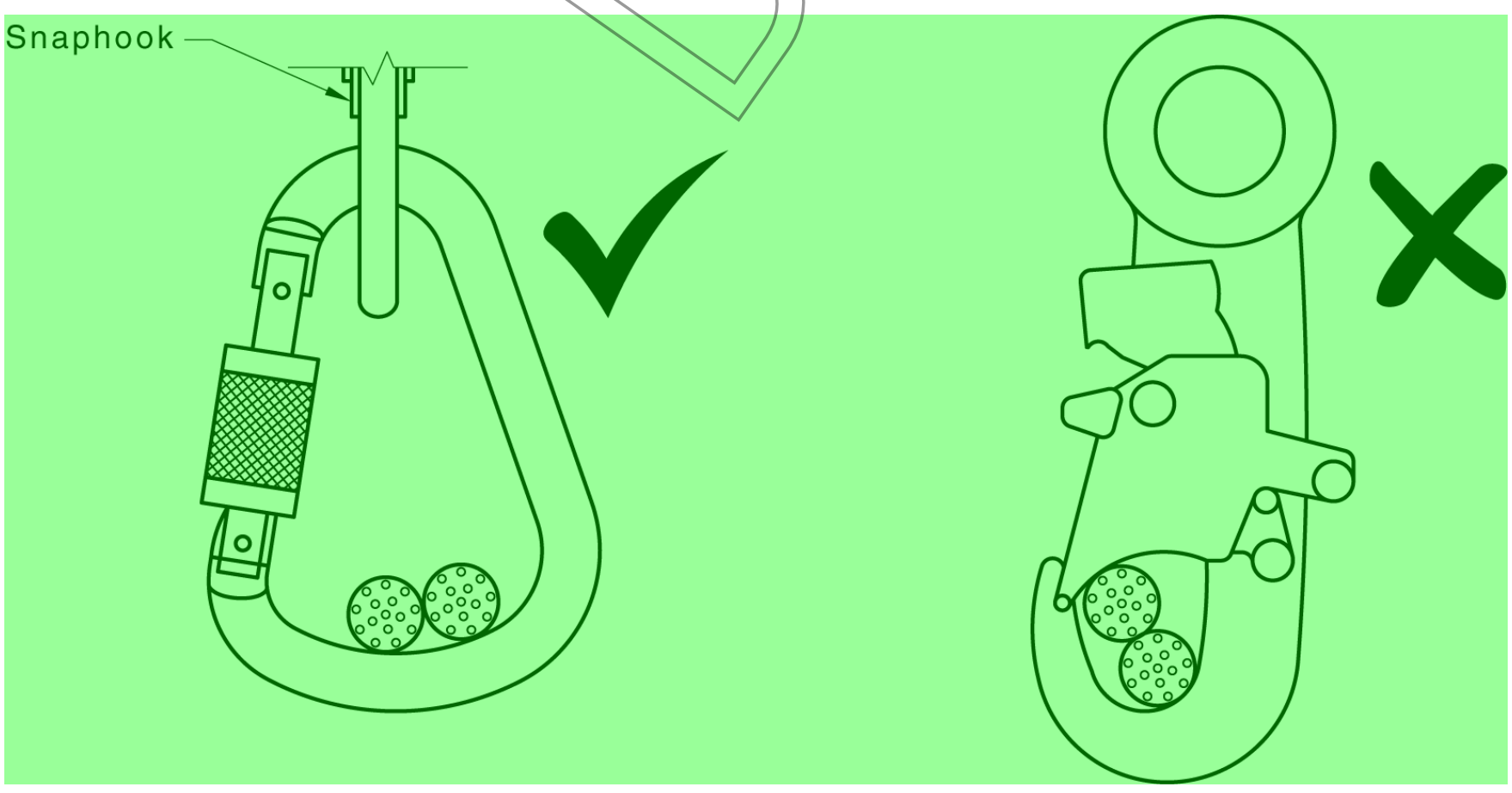
(b) Loading of a connector such that the gate can become unlocked



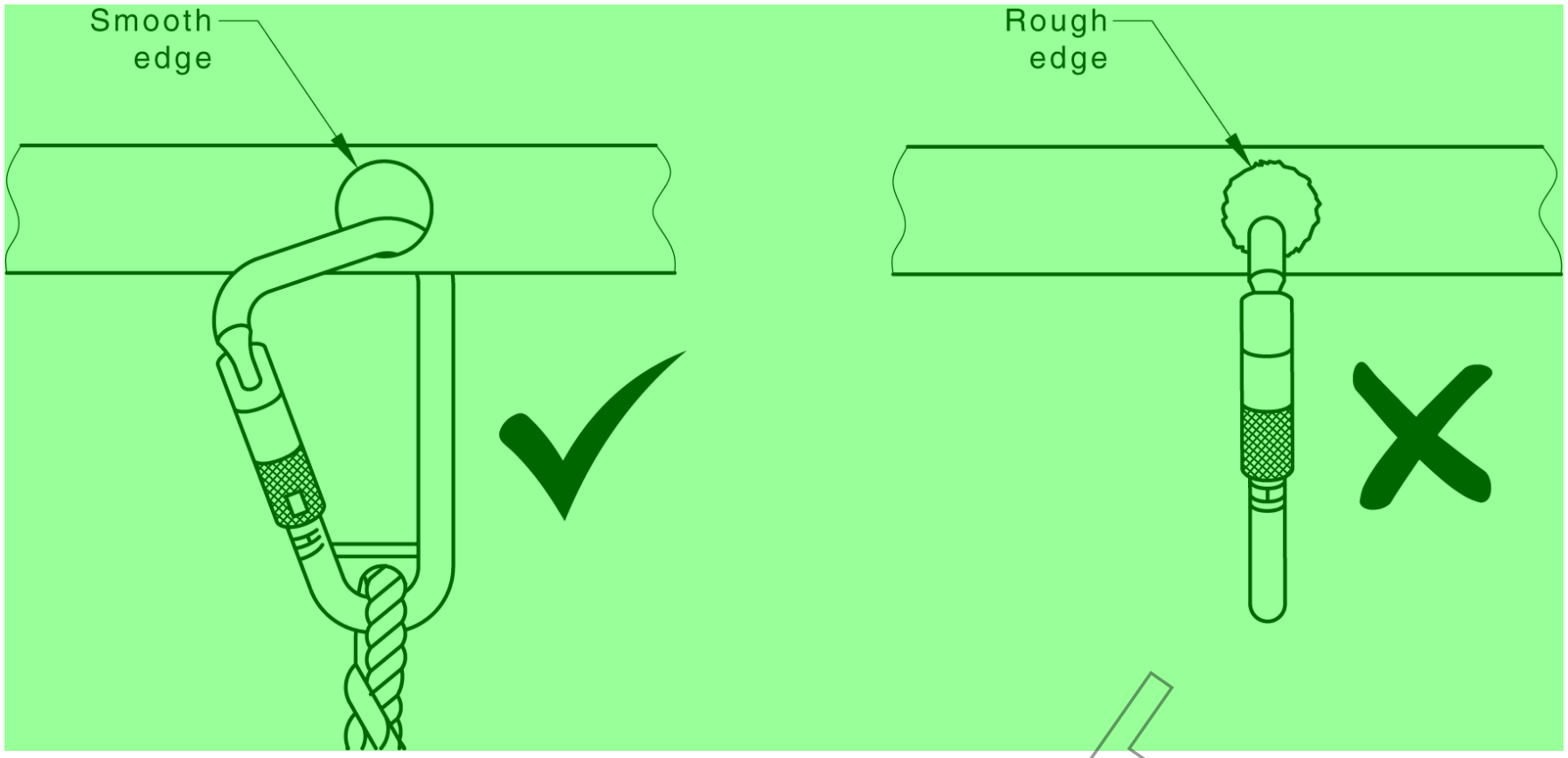
(c) Insufficient clearance for the connector to orient correctly



(d) Insufficient clearance within the connector



(e) Connector exposed to a rough edge, which can contribute to material wear



(f) Connector exposed to bending stress

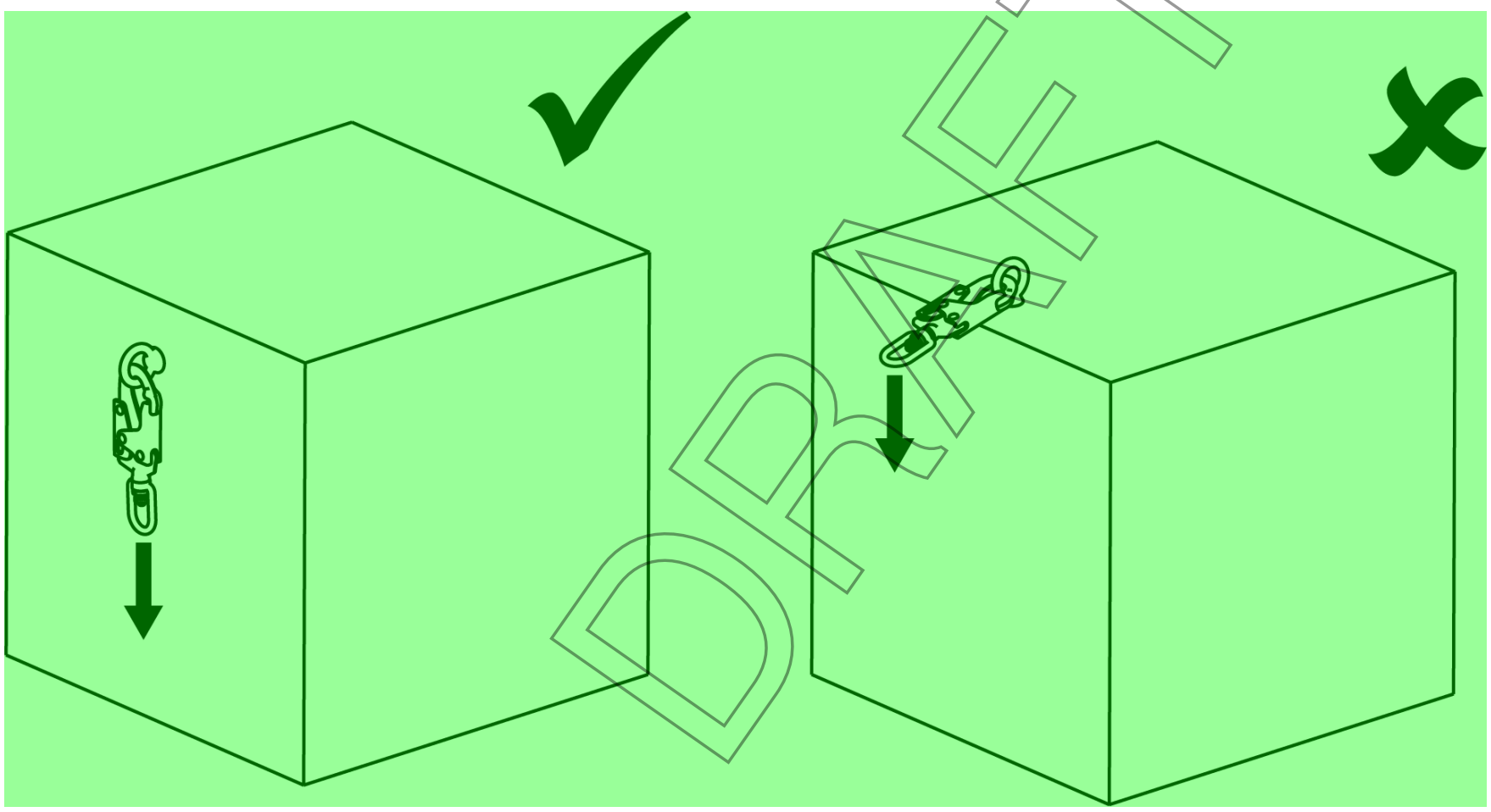


Figure 6.5 – Examples of compatible and incompatible connections

6.4 Roll out

Roll out of a connector can occur when the gate is loaded (see Figure 6.6). Factors that can cause the gate to open when it is loaded include –

(a) overloading;

(b) locking mechanism failure; and

(c) inadvertently activating the latch.

Compatible connections can reduce the risk of roll out.

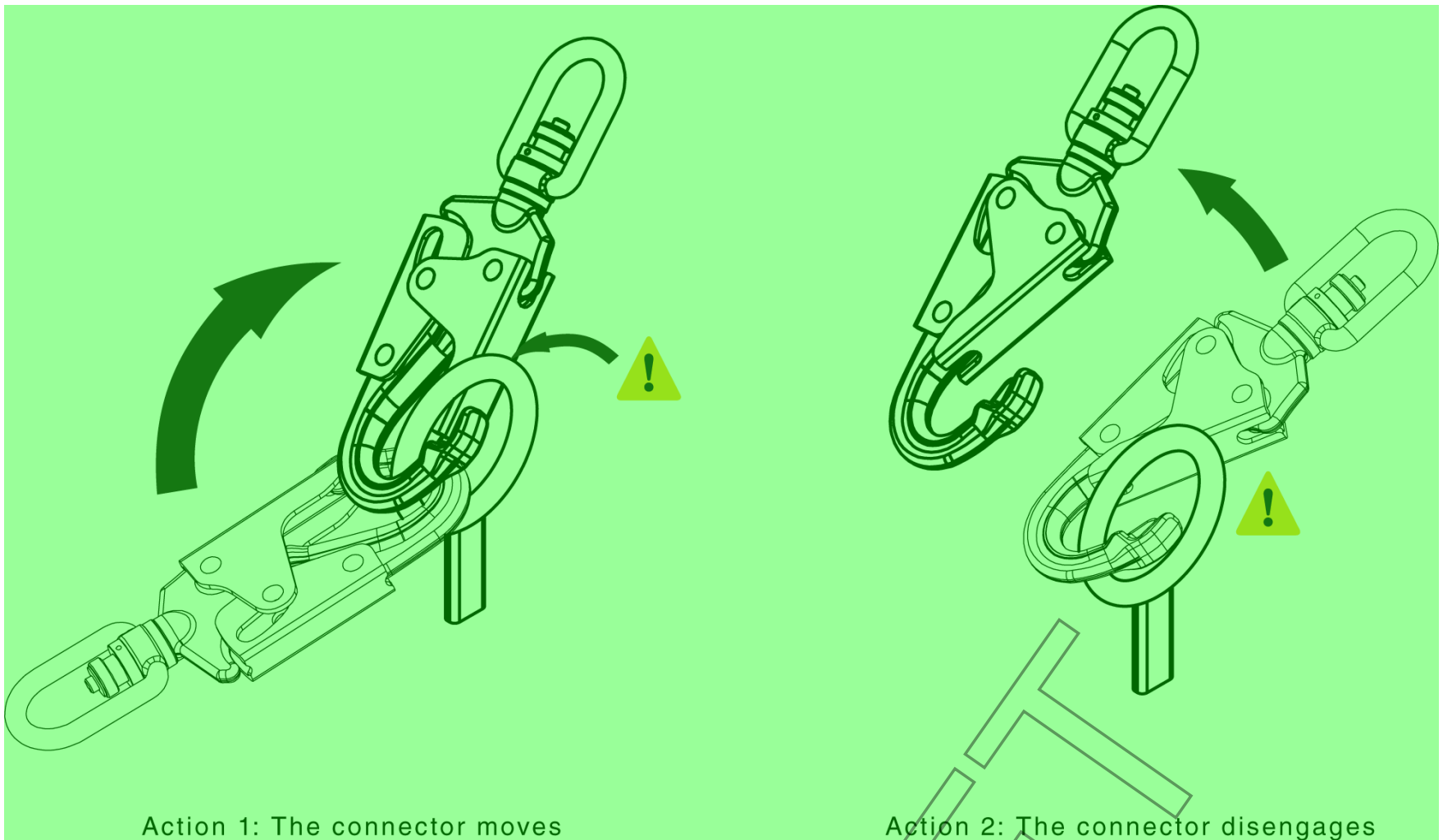


Figure 6.6 – Example of connector roll out

7 Fall clearance, swing fall and fall distance

7.1 General

Fall-protection systems shall be designed to prevent users striking a surface or object as a result of a fall. To achieve this, the following three elements shall be taken into account –

(a) fall clearance;

(b) swing fall; and

(c) fall distance.

7.2 Fall clearance

Fall clearance (FC) shall be greater than the following combined values: A + L + E + 2.8 m

where:

A = Anchor deflection

L = Functional length of connection system

E = Extension of the energy absorber

NOTE 1 2.8 m is illustrated in Figure 7.1, and accounts for (a) 300-mm slippage in the harness; (b) the height of the connecting system attachment to the harness (H), usually taken as 1.5 m, i.e. the average distance of the D-ring to the ground; and (c) a 1-m safety factor.

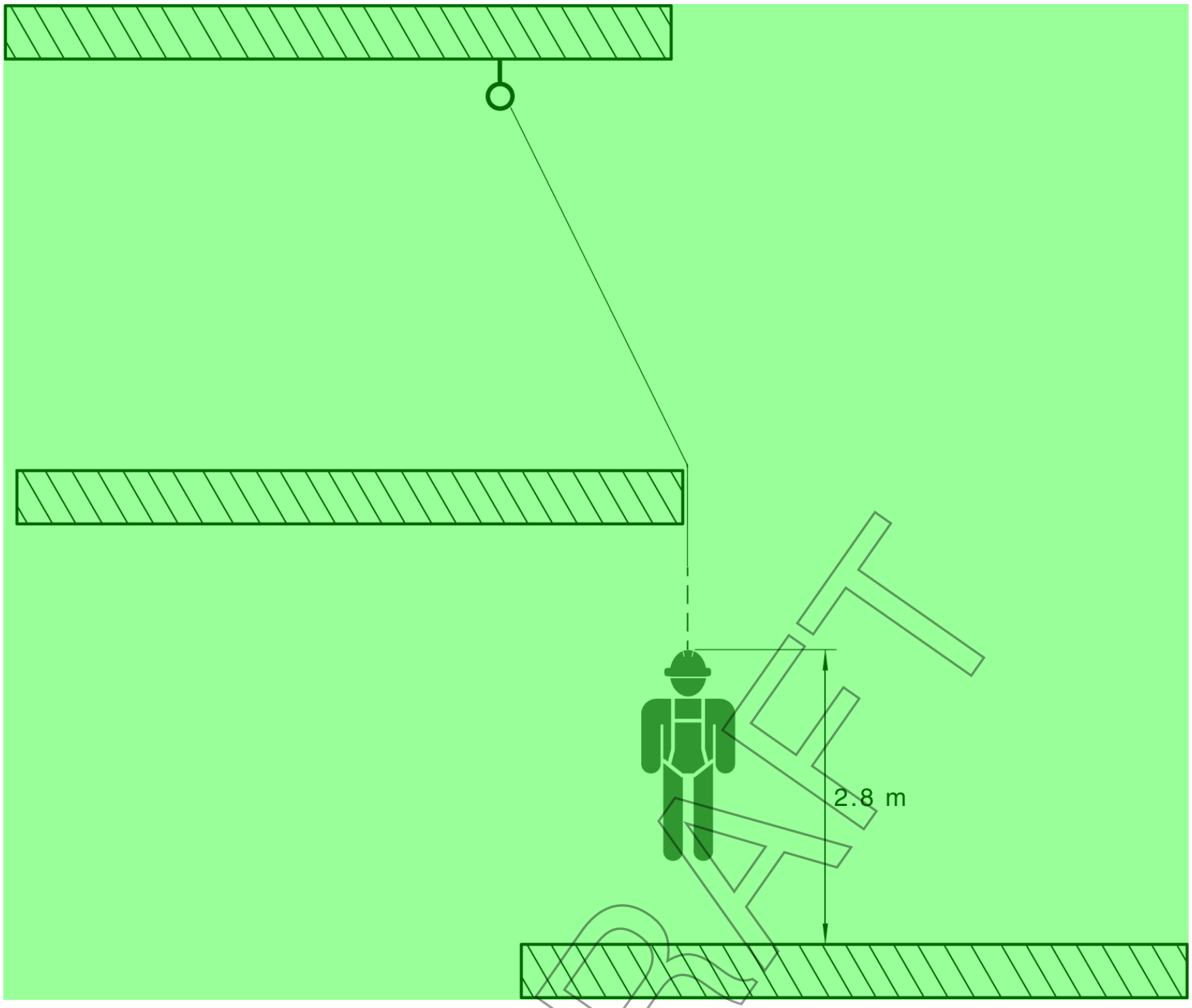


Figure 7.1 – Illustration of the combined 2.8 m

The terms in the above equation are defined and illustrated as follows:

(a) Fall clearance (FC). The shortest distance from the anchor to the ground/object that can be struck during a fall (see Figure 7.2).

(b) Deflection of the anchor (A) [see Figure 7.3].

NOTE 2 Refer to the product instructions for deflection of anchors.

(c) Functional length of the connection system (L). The length of the connection system between the harness attachment and the anchor attachment, including slack (see Figure 7.4).

NOTE 3 This does not include the length of adjustable systems beyond the point of adjustment.

(d) Extension of the energy absorber (E) [see Figure 7.5]. This includes –

(i) any activation distance for fall-arrest devices; and

(ii) the extension of an energy absorber.

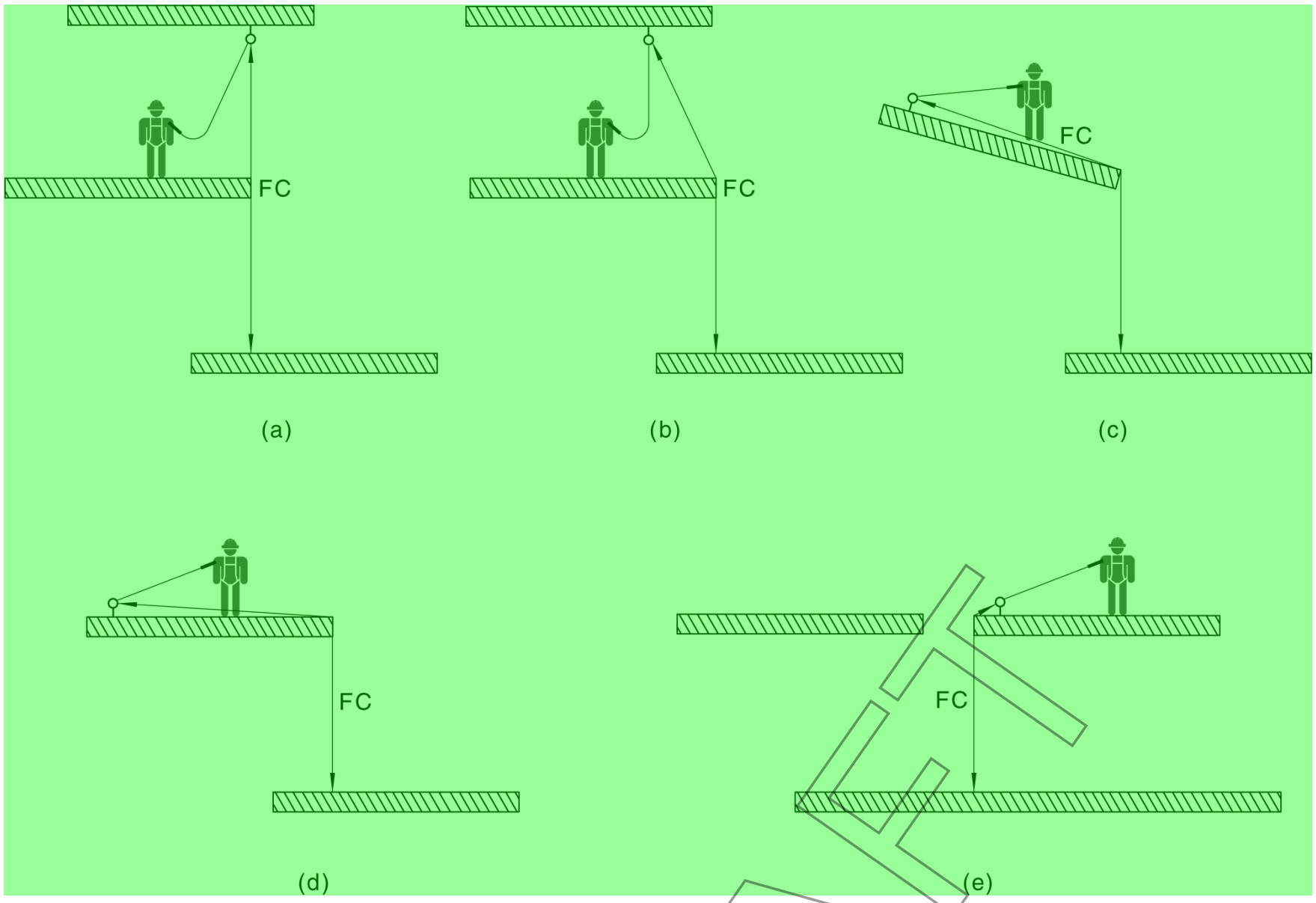


Figure 7.2 – Examples of fall clearance (FC)

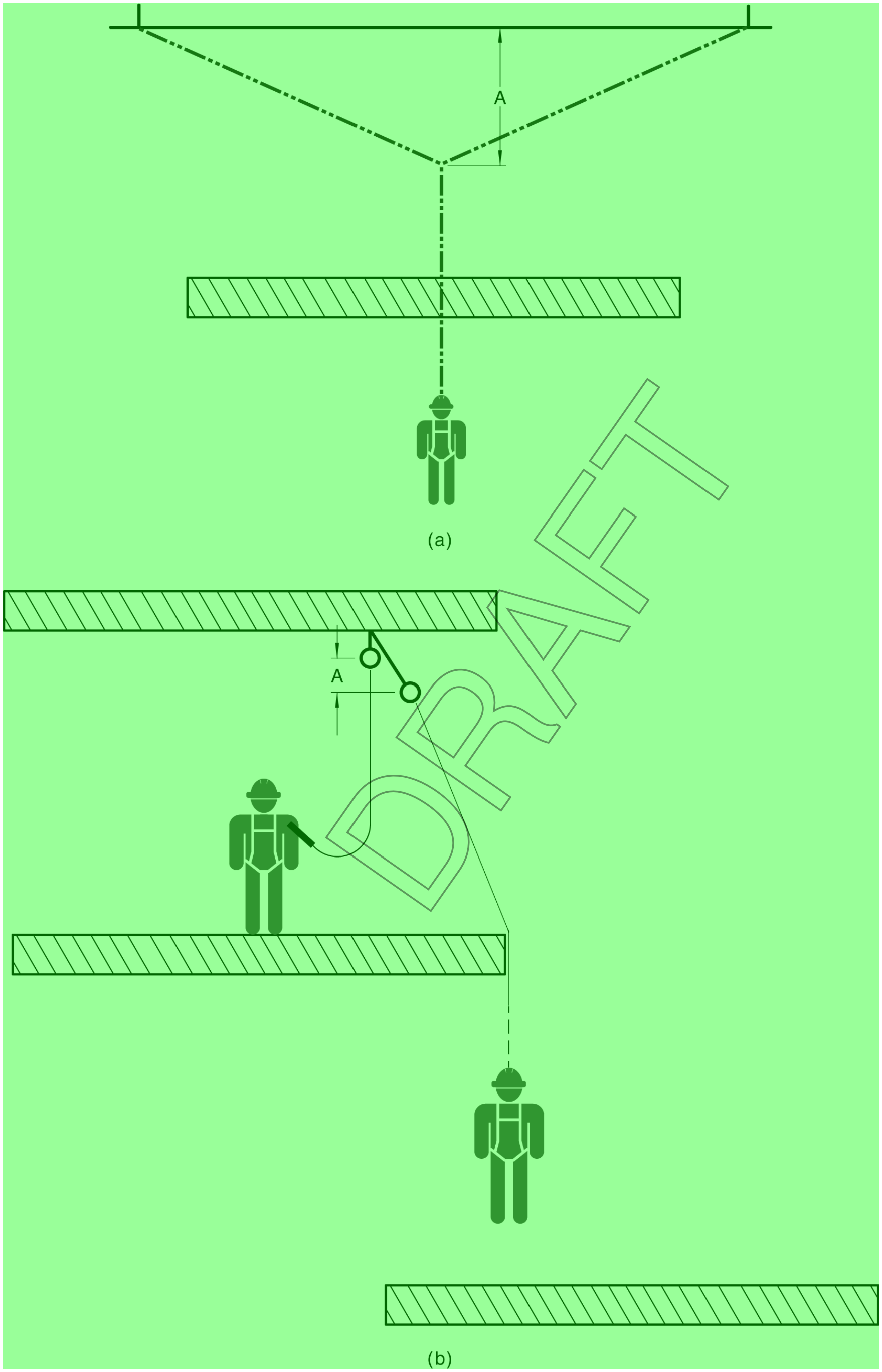
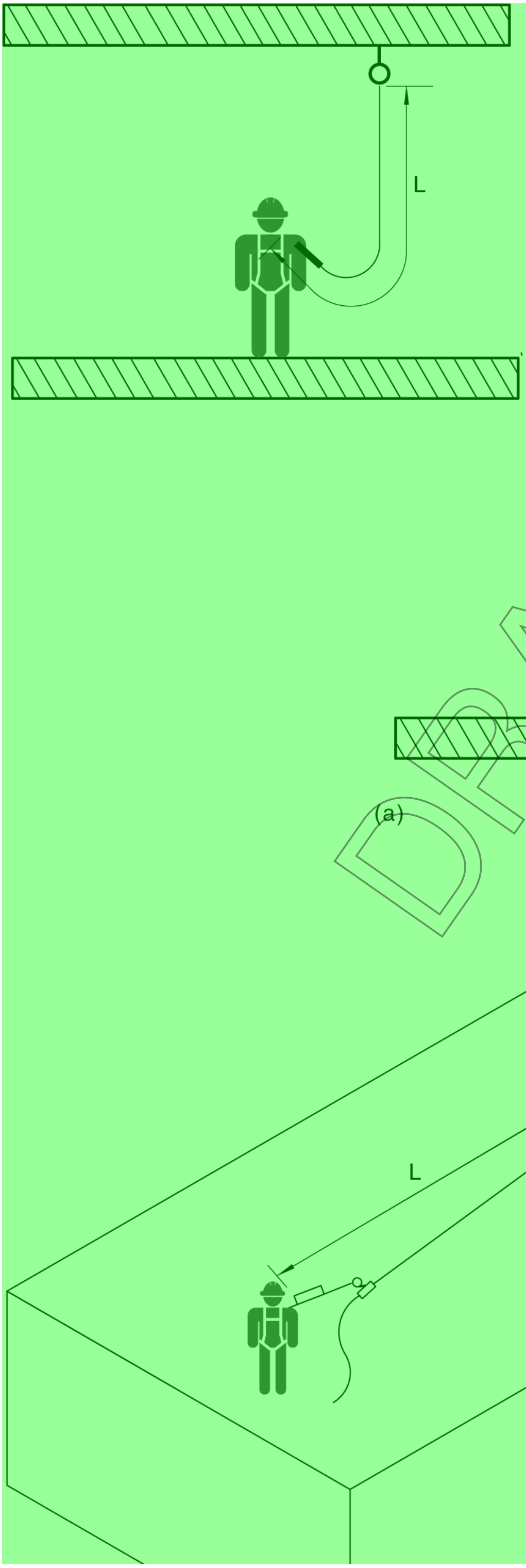


Figure 7.3 – Examples of anchor deflection (A)



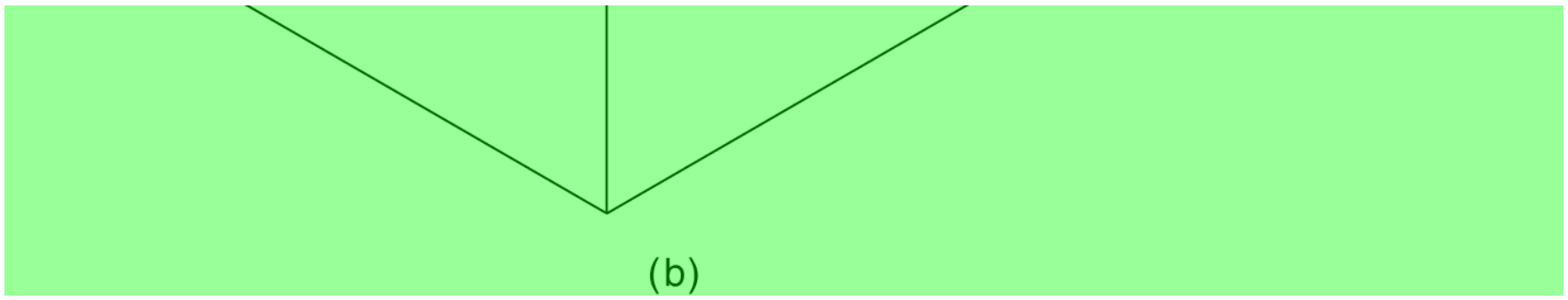


Figure 7.4 – Examples of the functional length of the connection system (L)

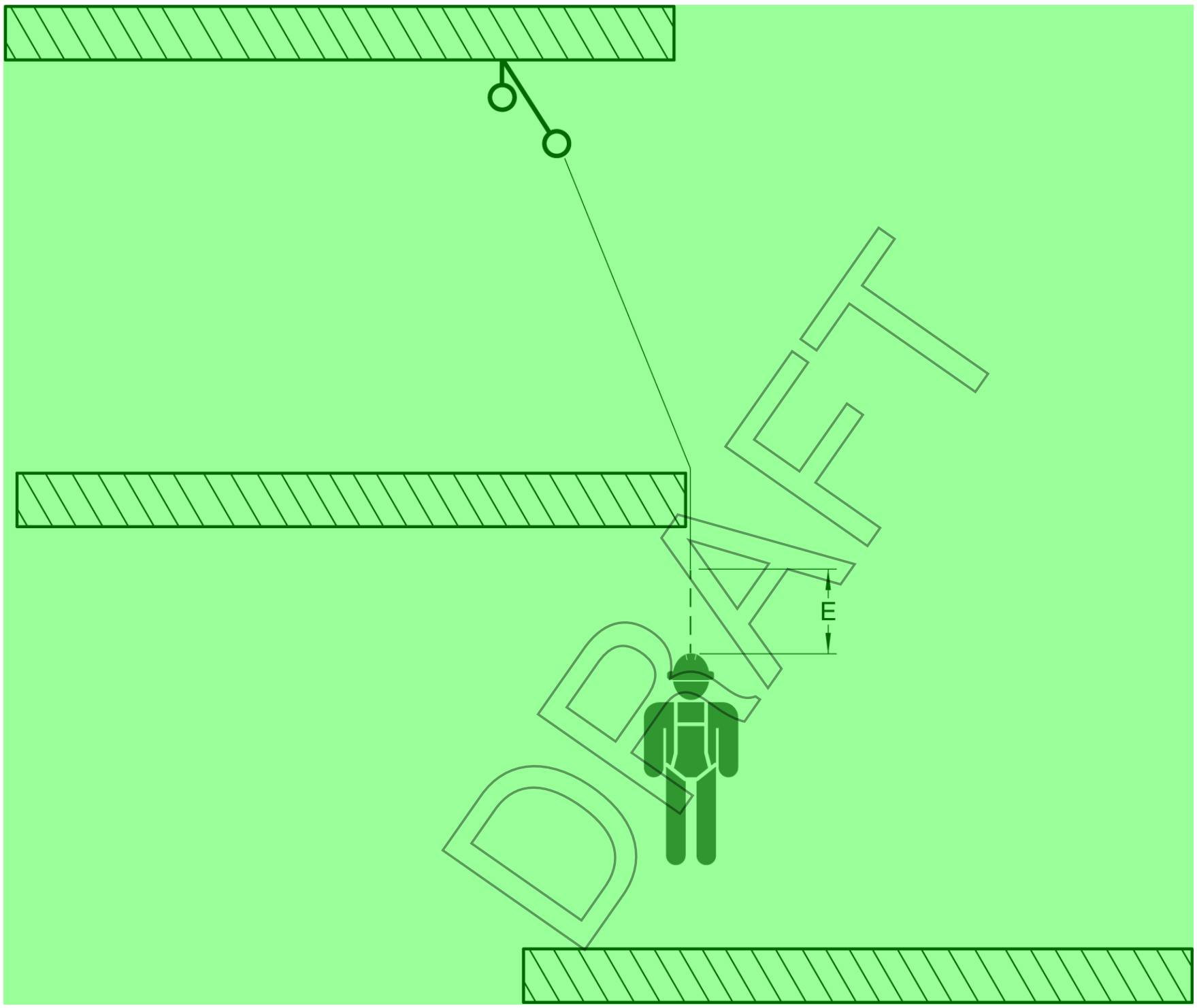


Figure 7.5 – Example of an energy absorber extension (E)

7.1 General

If a fall-arrest system is to be used, it is essential that there be adequate clearance under the system so that in the event of a fall the user of the system will not strike the ground or will either not strike or will suffer minimal consequences from striking, any other obstacle beneath the system.

Where fall arrest systems are used and the user is in close proximity to the structure or other obstacles (e.g. bracing steelwork on lattice structures) clearance from all obstructions in the event of a fall may not be possible. In such cases, the selection and use of a fall arrest system shall be based on minimizing the risk of injury to the user. Adjustable lanyards can be used to help reduce fall distance by reducing or eliminating unwanted slack.

Fall distance will vary according to the type of fall arrest system or equipment used. A full examination of all factors likely to contribute to fall distance together with adequate provision for residual clearance shall be made.

7.2 Calculation and estimation of factors

The elements of fall distance are illustrated in Figure 7.1. These elements shall be taken into account where appropriate and the total fall distance calculated or estimated from the following:

(a) *Anchorage deflection* This shall be obtained as follows:

(i) *Fixed single anchorage point* – zero allowance unless the structure to which the anchorage point is attached is likely to deflect under the loading of a fall arrest by more than 50 mm, in which case the deflection of the anchorage point under a loading of 15 kN, obtained either by calculation or test loading, shall be included.

(ii) *Horizontal or vertical rail* – as for Item (i) above.

(iii) *Horizontal life line* – as follows:

(A) Predetermined performance system– as advised by manufacturer or supplier of system.

(B) Prescribed configuration system –

(1) overall line length less than 10 m – 0.7 m;

(2) overall line length between 10 m and 30 m – 1.1 m;

(3) overall line length between 30.01 m and 100 m – 1.3 m;

(4) overall line length more than 100 m – 1.5 m.

(b) *Length of lanyard* If a lanyard is used as part of the fall-arrest equipment, its overall length with the personal energy absorber in unextended state shall be taken into account.

(c) *Start position of fall arrest device* Where a Type 1, 2 or 3 fall-arrest device is used, the vertical distance of the worst case start position of the device below the anchorage point, life line or rail shall be included. The start position shall be –

(i) the lowest point on the anchorage line a Type 1 device is likely to reach during normal work; or

(ii) the lowest point the attachment point of the anchorage line of a Type 2/3 device on the operator's harness is likely to reach during normal work.

In the absence of a more accurate estimate in a particular case, this position shall be taken as the operator's foot level.

(d) *Extension or travel of fall arrest equipment* Extension or travel of other items of fall-arrest equipment, where used, shall be taken into account as follows:

(i) *Personal energy absorbers and fall arrest devices*

Extensions of the devices listed below shall be in accordance with the manufacturer's recommendation. In the absence of such recommendations (or independently certified results of test loadings) the distances shown shall be considered as the maximum extensions likely to occur:

(A) Personal energy absorber, as follows:

Fall distance mm	Energy absorber extension mm
600	300
1000	500
1500	600
2000	900

(B) Type 1 fall-arrest device (1000 mm).

(C) Type 2 or Type 3 fall-arrest device (700 mm).

NOTE Permitted maximum extension values under product testing may be greater than the above.

(ii) *Lanyard with integral energy absorbing properties* – The extension of the lanyard under a load of 6 kN.

(iii) *Long anchorage line* – If the anchorage line of a Type 1 fall-arrest device is so long or the anchorage line of a Type 2 or Type 3 fall-arrest has been extended prior to a fall so much that either are liable to appreciable extension under the loading of a fall-arrest, the extension of the line under a load of 6 kN should be added.

(e) *Height of operator* The height of the attachment point on the operators harness above his foot level when standing upright, shall be taken into account. An allowance of 1.8 m which will also allow for some movement in the harness, will usually be sufficient. Additional allowance shall be made for extension straps or elasticized harnesses where appropriate.

(f) *Operator inversion* Operator inversion is likely if a lower body harness is used. Additional clearance to avoid head strike shall be provided.

(g) *Lateral offset of anchorage point* Where the anchorage point is laterally offset from the users' position prior to a fall, the following effects on fall distance shall be taken into account:

(i) If the user is using a lanyard as in Figures 7.1(a) and (d) no addition to fall distance is necessary.

(ii) If the user is using a fall-arrest device, a lower start position based on the maximum lateral distance from the anchorage point the user is likely to travel to, as determined according to Figure 7.2, shall be adopted.

Users falling under these conditions may encounter the pendulum effect. This shall be dealt with either in accordance with Clause 3.2.3 or by using a different fall-arrest system such as a horizontal lifeline or rail to minimize any pendulum

effect.

Users may also encounter unintentional snagging of the lanyard or fall-arrest anchorage line. Although this will normally decrease the fall distance, no account of such decrease shall be taken in calculating the fall clearance.

(h) *Residual clearance* An allowance of up to 1.0 m should be made for residual clearance.

The fall clearance shall be expressed as a vertical distance below the anchorage point for the operator's personal fall-arrest equipment which in the case of a horizontal life line shall be its unloaded level.

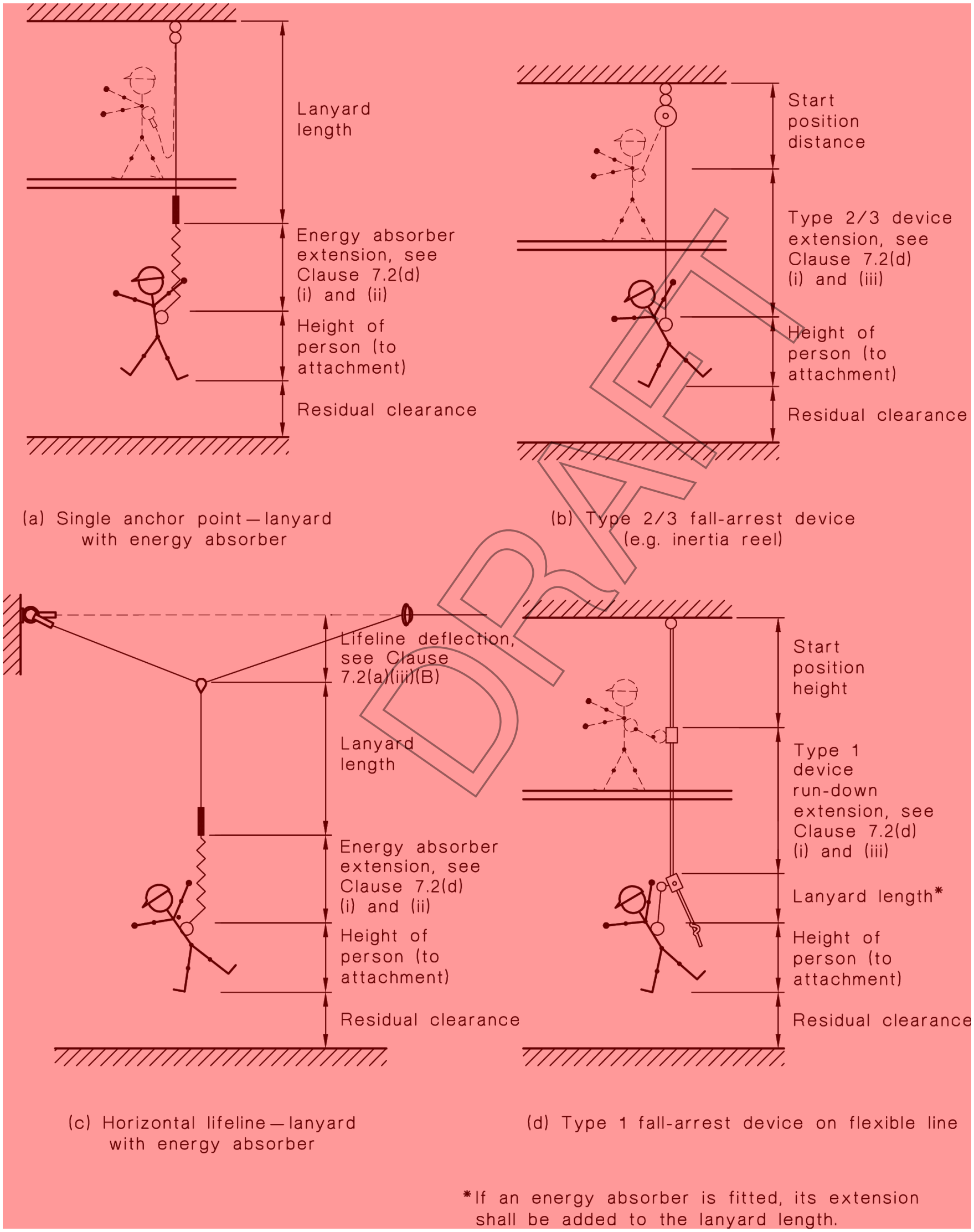


Figure 7.1 — Determination of minimum required fall clearance

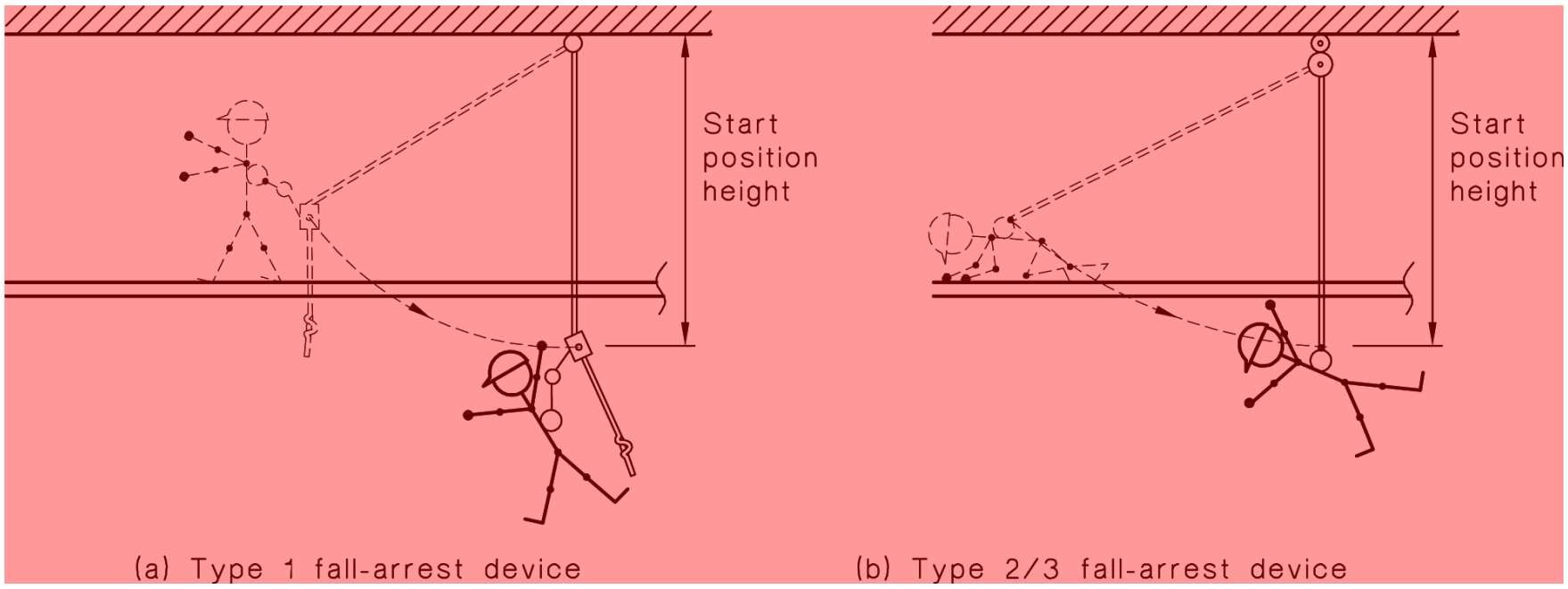


Figure 7.2 – Effect of lateral offset when using a fall-arrest device

8 Effect of equipment configuration on free-fall distance

8.1 Equipment performance

Fall-arrest equipment, specifically harnesses and lanyards meeting the requirements of AS/NZS 1891.1or AS 1891.5 (but excluding Types 1, 2 or 3 fall-arrest devices, see Clause 5.1.2(d)(iv)) will be marked with the maximum allowable free fall, 2.0 m for full-body harnesses and 600 mm for lower-body harnesses.

Full-body harnesses and lanyards will not necessarily be capable of arresting falls in excess of 2 m without compromising the inbuilt safety factor. If a situation arises where a fall through a greater height is either likely to occur or there is a demand to permit a system of work that entails the risk of such a fall, in the first instance, the hierarchy of fall protection options should be revisited to see whether a better alternative form of fall protection is available. Failing this, assistance should be sought from a competent person in obtaining appropriate equipment or to verify that existing equipment is suitable after taking into account the application of appropriate safety factors to the increased loading.

Lower-body harnesses shall not be used where the fall distance will exceed 600 mm.

8.2 Measurement of free-fall distance

Free-fall distance for a user equipped with a fixed length lanyard is calculated from the following:

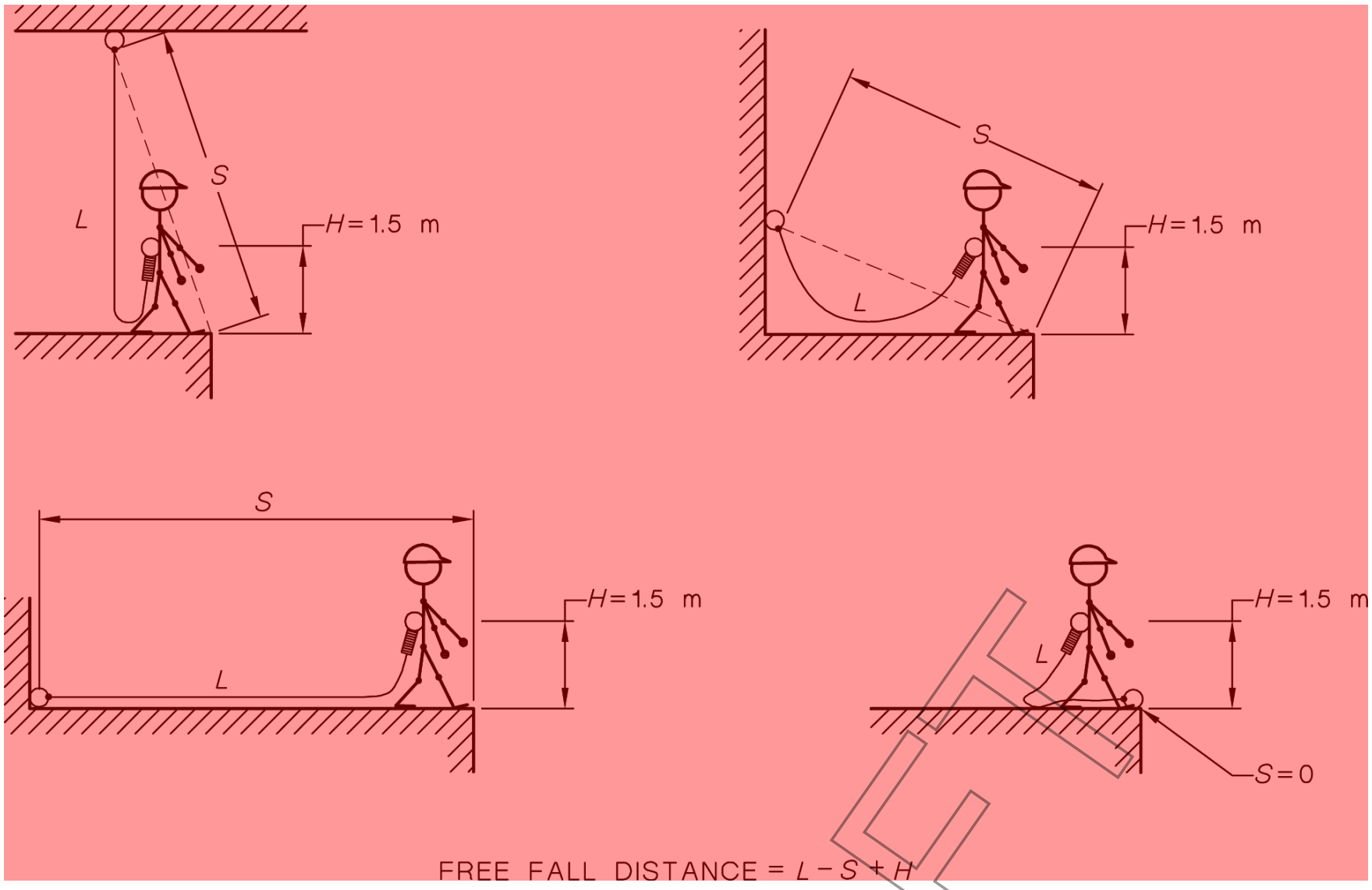
Free-fall distance	=	length of the lanyard (before any extension of the energy absorber) (*L*)
		minus
		the straight-line distance *from* a fixed point anchor or position of a mobile attachment device on a horizontal lifeline or rail, to the point on the edge over which the user falls (*S*)
		plus
		1.5 m, the expected maximum height of the lanyard attachment to the harness with the user standing up (*H*).

This calculation is illustrated in Figure 8.1. If there is a lateral offset between the point on the edge at which the fall occurred and the nearest point on the edge to the anchorage point, the user will suffer the pendulum effect in a fall and may fall a further distance under partially restrained conditions. Certain configurations shown in this Figure may result in a free-fall distance greater than 2.0 m (see Clause 8.3).

If Types 1, 2 and 3 devices complying with AS/NZS 1891.3 are directly connected to the user and used with the anchorage point within approximately 30° of the vertical above the user, free fall distances can generally be expected to fall within an acceptable range.

If a user is connected to a Type 1 fall-arrest device by means of a short lanyard, an additional free-fall distance which may be as much as twice the lanyard length, may be encountered. To limit overall free-fall distance, the lanyard length in this case shall be limited to 300 mm except where the system configuration will restrict the free-fall distance to less than 600 mm with a longer lanyard.

The use of a Type 2/3 fall-arrest device with a laterally extended anchorage line as described in Clause 5.2.4, can result in a significant free fall before any load is placed on the device's fall-arrest mechanism. Use of the devices in this way is not permitted under this Standard unless specific advice is given by the manufacturer that it can be so used under prescribed conditions, in which case the manufacturer's advice should also be sought as to what free fall conditions are acceptable for their equipment. Use of devices in this way will usually result in free-fall distances greater than the 600 mm allowable for Type 2/3 fall-arrest devices.



NOTE Some configurations may result in a potential free-fall distance in excess of 2.0 m (see Clause 8.3).

Figure 8.1 — Measurement of free-fall distance–Fixed length lanyard

8.3 Fall distances

The following sets out the hierarchy of acceptability of fall distance:

(a) *Fall distance minimization in the range 0 to 2.0 m* Limiting the free fall distance to the absolute minimum consistent with the operator's work task is the *ideal* situation and will minimize all hazards likely to arise from a fall including degree of injury, effects of misuse or mis-application of equipment, or errors in locating and using anchorage systems. Use of a Type 1 fall-arrest device with a 300 mm or shorter lanyard, or a Type 2 or 3 fall-arrest device used in accordance with Clause (i) will normally result only in a limited free fall of 600 mm or less.

(b) *Fall distance not exceeding 2.0 m* The maximum free fall distance of 2.0 m specified in AS/NZS 1891.1and AS 1891.5 will if observed, ensure that all fall-arrest equipment when used correctly will perform within specification.

(c) *Fall distance exceeding 2.0 m* Free falls greater than 2.0 m are not acceptable under normal circumstances. Demands to provide for greater fall distances should be dealt with as recommended in Clause 8.1.

8.4 Configurations using fixed length lanyards

8.4.1 Configurations in the ideal range

Figure 8.2 illustrates examples of the use of lanyards to limit potential free-fall distances to the ideal minimum.

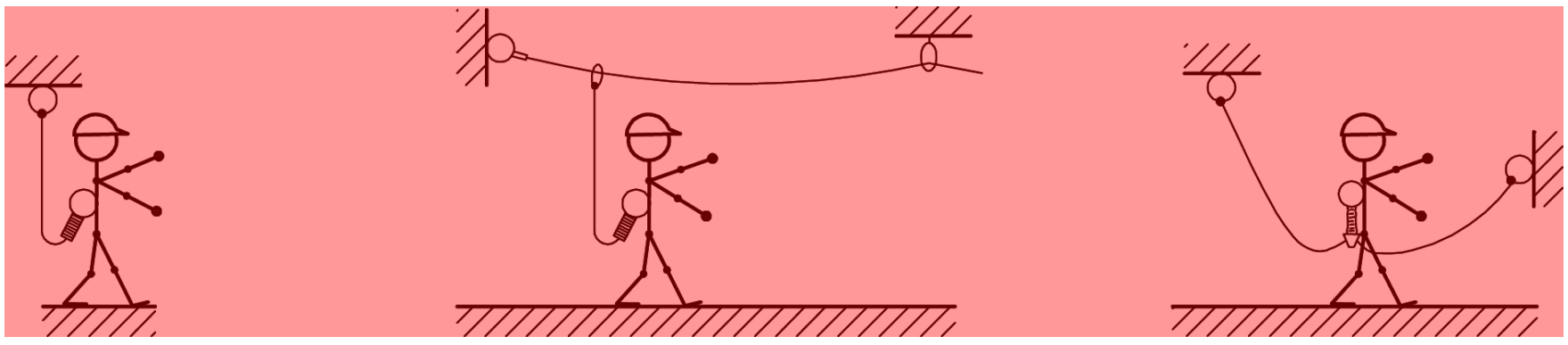


Figure 8.2 — Typical lanyard configurations – Ideal range

In this situation, anchorage points are above the level of the attachment point on the harness, the anchorage is either vertically above the user or a dual anchorage system is in use, and the lanyard length is selected or adjusted to provide minimum slack consistent with the work task.

8.4.2 Configurations up to the maximum fall limit of 2.0 m

Figure 8.3 illustrates typical situations where up to the maximum fall distance of 2.0 m will be achievable.

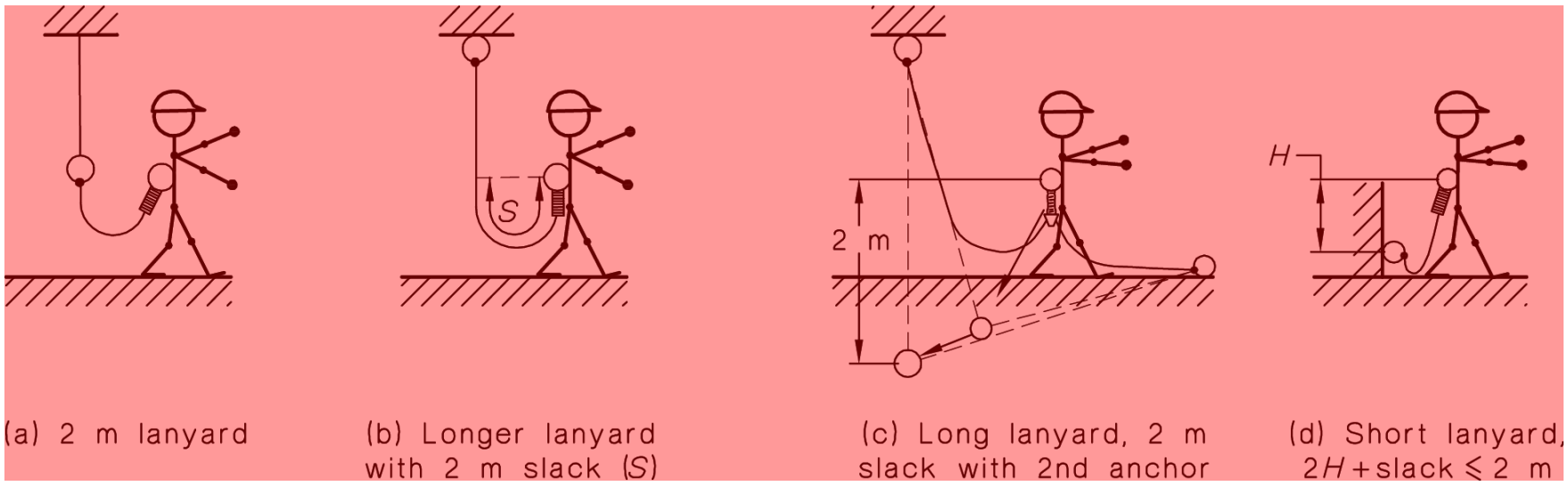


Figure 8.3 – Typical lanyard configurations – Maximum range (2.0 m maximum free fall)

In most practical situations the anchorage point needs to be at or above the level of the attachment point on the harness. If below the attachment point there could be difficulty in obtaining enough working slack in the lanyard if the maximum free fall of 2.0 m is not to be exceeded.

In each case a check on fall distance as set out in Clause 8.2 is required to ensure that the maximum of 2.0 m is not exceeded.

8.4.3 Configurations where the fall limit of 2.0 m will be exceeded

Figure 8.4 illustrates typical situations where the fall distance of 2.0 m will be exceeded. Demands to provide for fall distances greater than 2.0 m should be dealt with as recommended in Clause 8.1.

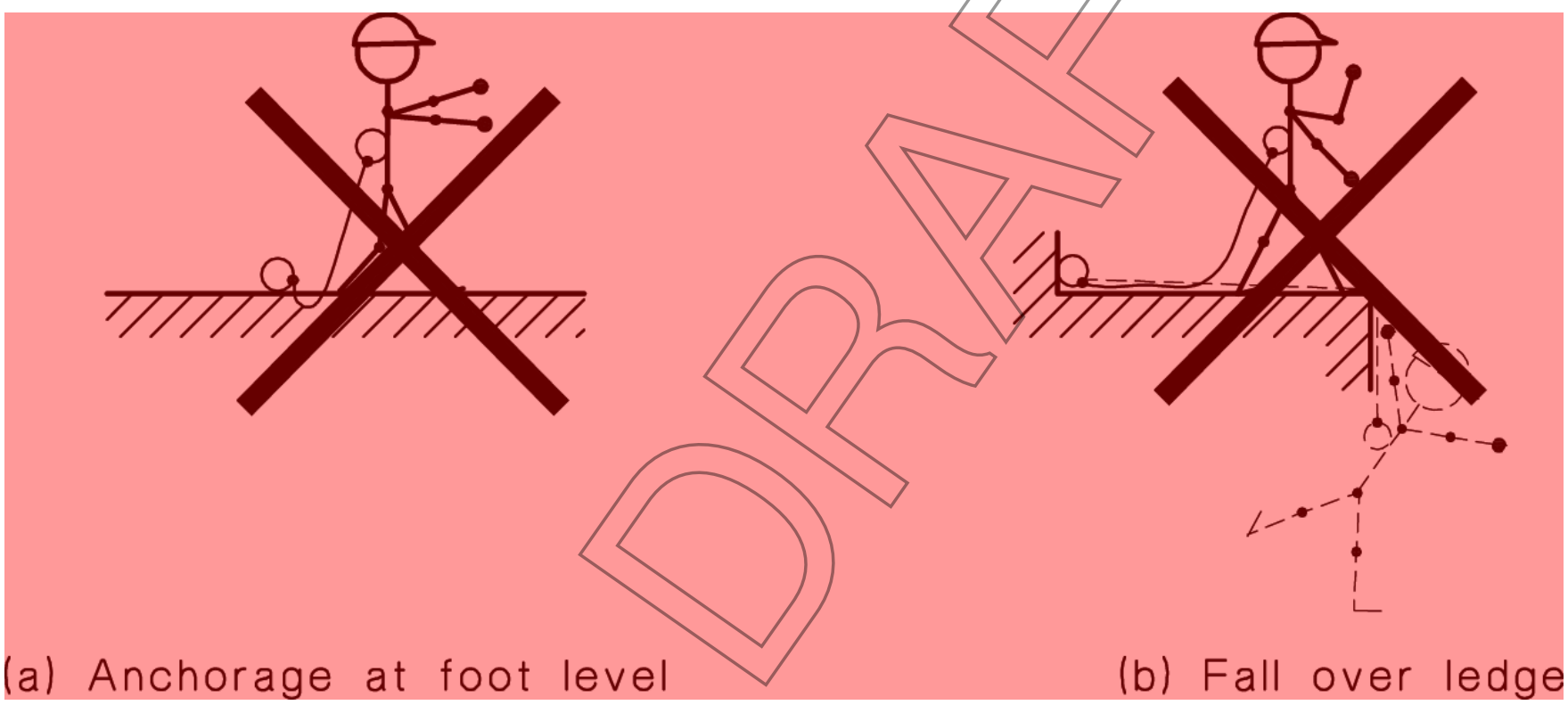


Figure 8.4 – Typical lanyard configurations – Unacceptable range

8.5 Configurations using type 2/3 fall-arrest devices

Typical configurations using Type 2/3 fall-arrest devices are shown in Figure 8.5.

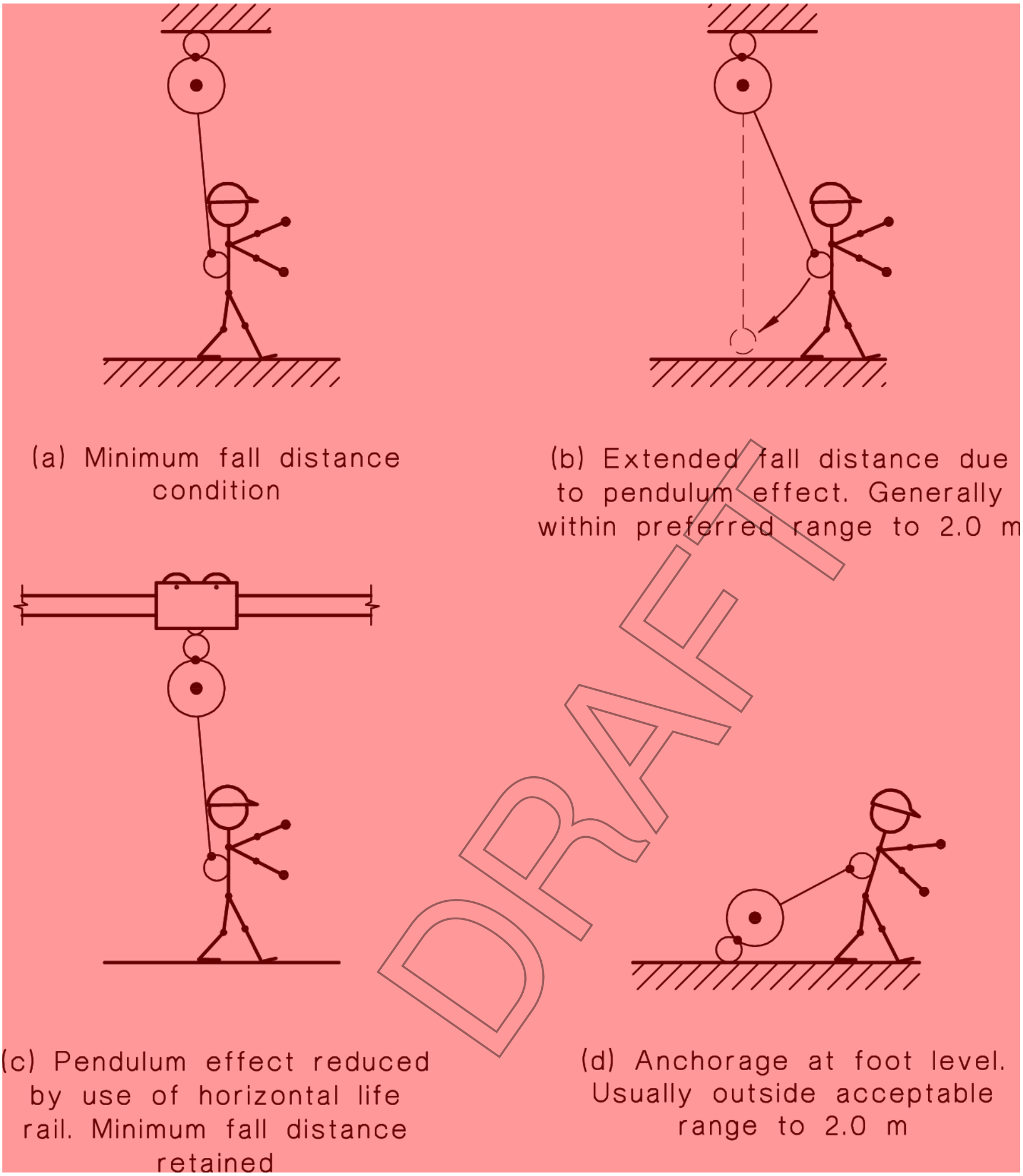


Figure 8.5 – Configurations using type 2/3 fall-arrest devices

9 Inspection, maintenance and storage

9.1 Summary of inspection requirements

Requirements for the inspection of equipment are summarized in Table 9.1.

Table 9.1 – Summary of inspection frequencies

Items	Reference	Inspection frequency (Note 1)
Personal equipment including harnesses, lanyards, connectors, fall-arrest devices including common use devices	Clause 9.2	Inspection by a height safety operator (see Note 2) before and after each use.
Harnesses, lanyards, associated personal equipment Fall-arrest devices (external inspection only) Ropes and slings	Clause 9.3.2 Clause 9.3.4(a) Clause 9.7	6-monthly inspection by a height safety equipment inspector (see Note 3)
Anchorages – drilled-in type or attached to timber frames	Clause 9.3.3	12-monthly inspection by a height safety equipment inspector (see Note 3)
Anchorages – other types	Clause 9.3.3	Frequency of inspection by a height safety equipment inspector as recommended by the manufacturer to a maximum of 5-yearly. 12-monthly inspection in the absence of such recommendations (see Note 3)
Fall-arrest devices – full service	Clause 9.3.4(b)	Frequency of service by a height safety equipment inspector as recommended by the manufacturer to a maximum of 5-yearly. 12-monthly service in the absence of such recommendations (see Note 3)
Horizontal and vertical lifelines – steel rope or rail	Clause 9.3.5	Frequency of inspection by a height safety equipment inspector as recommended by the manufacturer to a maximum of 5-yearly. 12-monthly inspection in the absence of such recommendation (see Note 3)
Horizontal or vertical lifelines – fibre rope – webbing	Clause 9.3.5 and Clause 9.7	6-monthly inspection by a height safety equipment inspector (see Note 3)
All items of personal and common use equipment	Clause 9.4	Inspection by a height safety equipment inspector on entry or re-entry into service (see Note 3)
All items which have been stressed as a result of a fall.	Clause 9.5	Inspection by a height safety equipment inspector before further use (see Note 3)

NOTE 1 Where used in harsh conditions, more frequent inspection may be required.

NOTE 2 If the user or operator of the equipment is not competent to carry out this inspection it is to be undertaken by another person who is competent, see Clause 9.2.

NOTE 3 All inspections except those by the operator are to be documented (see Clause 9.10).

9.2 Operator inspection

The following items shall be subjected to inspection by the height safety operator of each item before and after each use to ensure that it is in a serviceable condition:

(a) *Personal equipment* – harnesses, lanyards, connectors, fall-arrest devices.

(b) *Common use equipment* – ropes, slings, fall-arrest devices, mobile attachment devices.

Where an operator is not competent to carry out this inspection, e.g. an operator in training, the inspection shall be carried out by an operator who is competent or a height safety supervisor.

Inspection shall be by sight and touch. It shall include the opening of any equipment where access for daily inspection is provided, to ensure that internal components are in satisfactory condition. This requirement includes the opening or removal of temporary rope or line protectors, to enable rope to be properly inspected. Operation of the locking mechanism on fall-arrest devices shall also be checked.

It should be impressed upon operators that their lives depend upon the continued efficiency and durability of their equipment and that a proper inspection at each time of use is their first line of defence against the hazards of faulty equipment.

Training and assessment of height safety operators shall include competency in carrying out the operator inspections specified in this Clause.

9.3 Regular scheduled periodic inspection

9.3.1 General

All items of equipment which are in regular use shall be subjected to periodic inspection and where applicable, servicing, at the manufacturer's recommended intervals. The intervals given in Table 9.1 for each item, shall apply in the absence of such recommendations. The inspection and servicing shall be carried out by the person specified in Table 9.1.

Items used under harsh conditions, e.g. in wet, dusty, abrasive or corrosive environments, shall be inspected more frequently, generally at twice the frequency specified in Table 9.1.

NOTE Product Standards for each of the items dealt with in this Clause place an obligation on manufacturers to provide maintenance instructions and recommended maintenance/inspection/ service intervals.

9.3.2 Harnesses, lanyards and associated equipment

Items shall be checked in accordance with manufacturer's instructions to determine whether there is excessive wear or any other faults liable to render the item unsafe during a fall arrest.

NOTE A recommended check list of items to be inspected is given at Appendix C.

9.3.3 Anchorages

Anchorages shall be visually inspected for signs of deterioration which might make them unserviceable, together with any other requirements contained in manufacturers' instructions.

The parent structure shall also be visually inspected for modifications or deterioration which might lead to loss of anchorage strength.

Drilled-in anchorages such as friction or glued-in anchorages shall be proof tested in accordance with Clause 3.1.2(g) as part of each inspection.

9.3.4 Fall-arrest devices

These are subjected to inspection and servicing in accordance with the following requirements and recommendations:

(a) *Inspection*

In addition to manufacturers' recommendations, each device shall be externally inspected as specified below.

Devices shall be cleaned of any contaminant likely to hinder the correct operation of the device such as dirt, grit, sand, cement, oil and grease. Free movement of all moving parts, firm tension on any springs and correct operation of the locking action shall all be checked. The examination shall include a search for signs of corrosion. Except for servicing as specified in Item (b) where dismantling may be indicated, each of the above operations and checks shall be carried out as far as possible without dismantling the device.

Flexible anchorage lines used with Type 2/3 fall-arrest devices shall be inspected for wear, cuts, looseness, extension, interstrand wear, corrosion, stiffness, brittleness and condition of terminations.

Retracting fibre rope and webbing anchorage lines may, over a period, increase in diameter due to fluffing up of the fibres or, alternatively, they may become swollen following prolonged exposure in wet conditions. This may make the line retract sluggishly. If this occurs, the device shall be taken out of service immediately and quarantined for repair or disposal.

NOTE A further detailed check list of items to be inspected is given at Appendix D.

(b) *Servicing*

The full service shall include dismantling of the item by a competent person if recommended by the manufacturer.

In addition, all of the items in Item (a) above shall be attended to. The check list items in Appendix D are also relevant.

(c) *Service label or tag*

Each fall-arrest device shall have a service label or tag for recording the last date on which it was fully serviced and shall include the date on which the next service is due.

9.3.5 Horizontal and vertical life lines and rails

The inspection shall be carried out in accordance with manufacturer's instructions. Particular attention shall be paid to the items in the following check list:

(a) Inspection of line anchorage points and rail support anchorages in accordance with Clause 9.3.3.

(b) Any modification or deterioration of the parent structure which might lead to a loss of anchorage strength.

(c) Condition and correct operation of line tensioners and line energy absorbers on horizontal life lines.

(d) Evidence of wear, cuts, looseness, extension, interstrand wear, corrosion, stiffness, brittleness or fraying of steel cables, ropes or webbing used as horizontal flexible life lines or vertical lines used in conjunction with Type 1 fall arrest devices with special attention given to lines in the vicinity of horizontal life line intermediate anchorages.

(e) Integrity of cable terminations.

(f) Condition of rigid rails to ensure that the rails and all connecting fittings (brackets, plates, clips, nuts, bolts and washers) are intact and properly tightened and free from corrosion, dirt, grit, sand, cement, oil, grease and other contaminants, and that end stops are in good condition.

(g) Condition of permanently installed mobile attachment devices including travelling them the entire length of the line or rail to verify their correct function.

(h) Presence of contaminants which could affect operation of the system or individual devices.

9.4 Inspection on entry or re-entry into service

9.4.1 Entry into service of a new item

Each item shall be inspected as specified in Clause 9.3 before being placed into service, giving particular attention to whether the item has been correctly assembled and whether all component parts are present including instruction manuals where required.

9.4.2 Re-entry into service after an item has been repaired

Each item shall be inspected as specified in Clause 9.3 before being placed into service giving particular attention to whether the item has been correctly repaired and reassembled. This inspection should also give attention to parts of the equipment which were not subject to the repair as these may be due for their periodic inspection independently of the repair taking place.

9.4.3 Re-entry into service after a period of storage or out of service

Before use, each item shall be inspected as specified in Clause 9.3 after a period of storage or out of service in excess of the nominated inspection or service interval for that item, or where the item has been stored under conditions suspected of adversely affecting its condition. This requirement also applies to fixed or permanent installations when used less frequently than the maximum inspection interval.

9.5 Equipment which has arrested a fall or shows a defect

Any piece of equipment including both personal and permanently installed items, which has been used to arrest a fall or which shows any defect during operator or periodic inspection shall be withdrawn from service immediately and a replacement obtained if necessary. A label indicating the condition or defect should be attached to the equipment, and it should be examined by a height safety equipment inspector who will decide whether the equipment is to be destroyed or repaired if necessary and returned to service. In the latter case, details of any repair shall be documented and a copy given to the operator.

9.6 Life expired equipment

Life expired equipment shall be taken out of service as follows:

(a) *Personal equipment* – items which have been marked with a date by which they are to be taken out of service in accordance with AS/NZS 1891.1or AS 1891.5 and that date has been reached, shall be taken out of service and destroyed.

(b) *Horizontal life lines and rails* – items which according to their associated system information plate are either to be taken out of service or re-certified by a certain date shall either be dismantled or have recertification that the system is safe for continued use completed before the nominated date (see also Clause 6.3(j)(vi)).

9.7 Inspection of ropes and slings

Inspection of the following items should be in accordance with the reference shown:

(a) Working and safety ropes – AS 4142.1.

(b) Flat synthetic webbing slings – AS 1353.2.

(c) Wire rope slings – AS 1666.2.

(d) Synthetic fibre rope slings – AS 4497.2.

9.8 Storage and transport

Conditions of storage and transport should ensure that no part of the equipment is subjected to unnecessary strain or pressure or to excessive heat, humidity or moisture and that the equipment is protected from contact with sharp edges, corrosive substances and other possible causes of damage. Equipment should be air-dried at ambient temperature before storage.

Items made from synthetic materials should be stored away from direct sunlight in a cool, dry place.

9.9 Maintenance

Equipment shall be maintained in accordance with manufacturer's instructions.

9.10 Equipment data and maintenance records

To ensure the traceability of maintenance records, a record card, history sheet or similar record shall be kept for each of the items of equipment dealt with in this Standard. Documentation on the maintenance and servicing history of an item of equipment shall be freely available to operators and users for at least the life of the item of equipment.

The following lists the information to be recorded for each item of equipment where appropriate:

(a) Manufacturer's, supplier's or installer's name and address.

(b) Manufacturer's batch number.

(c) Serial or identifying number.

(d) Year of manufacture.

(e) Details of recommended connections to harnesses.

(f) Type of anchorage line to be used.

(g) Suitability and limitations on various usages.

(h) Date of purchase.

(i) Date first put into service.

(j) Dates and details of inspections and services.

Appendix A

(informative)

Suspension intolerance (trauma)

Suspension intolerance (trauma), also known as orthostatic intolerance or in medical terms "pre-syncope", is a natural human reaction to being upright and immobile (e.g. if held in a vertical stretcher, or suspended inanimate in a harness). Blood pools in the legs potentially leading to unconsciousness. If the condition is allowed to develop unchecked, it could be fatal.

In clinical trials, although some subjects experienced no effects after prolonged suspension, others experienced fainting or loss of consciousness in just a few minutes. The initial indications are that a person's susceptibility may be unrelated to fitness level or any other obvious physical condition or attributes.

Although the condition is still being researched, it is recommended that certain measures be taken to reduce its effects or delay its onset. It appears to help if the person is suspended in a substantially horizontal position or with the knees elevated. Additional seat straps to enable a person to sit, or straps/stirrups designed to enable a person to transfer some of their weight to their legs, are available. These can be used to facilitate raising the knees, adopting a more horizontal position or leg action to maintain return circulation.

It is clear however, that an effective incident response plan is necessary to ensure that following an incident, the person can be removed from the suspended position as quickly as possible.

NOTE There are suggestions that once a person is released from suspension, minor changes to standard first aid treatment may assist recovery. The Australian Resuscitation Council has reviewed the matter and has published Guideline 8.25, *Harness suspension trauma – First aid management* that recommends essentially normal first aid treatment plus the administration of oxygen if available. The Guideline and any revisions is on the Council's website www.resus.org.au

Appendix B

(informative)

Standards for components used in anchorage systems

The following is a non-exhaustive list of Standards for components used in anchorage systems.

AS 1138, *Thimbles for wire rope*

AS 1353.1, *Flat synthetic-webbing slings, Part 1: Product specification*

AS 1353.2, *Flat synthetic-webbing slings, Part 2: Care and use*

AS 1380.1, *Fibre-rope slings, Part 1: Product specification*

AS 1380.2, *Fibre-rope slings, Part 2: Care and use*

AS 1438.1, *Wire-coil flat slings, Part 1: Product specification*

AS 1438.2, *Wire-coil flat slings, Part 2: Care and use*

AS 1666.1, *Wire-rope slings, Part 1: Product specification*

AS 1666.2, *Wire-rope slings, Part 2: Care and use*

AS 2317, *Collared eyebolts*

AS 2321, *Short-link chain for lifting purposes*

AS 2741, *Shackles*

AS 2759, *Steel wire rope - Use, operation and maintenance*

AS 3569, *Steel wire ropes*

AS 3585, *End fittings for synthetic flat-webbing and round slings*

AS 3775.1, *Chain slings - Grade T, Part 1: Product specification*

AS 3775.2, *Chain slings - Grade T, Part 2: Care and use*

AS 3776, *Lifting components for Grade T chain slings*

AS 4142.1, *Fibre ropes, Part 1: Care and safe usage*

AS 4142.2, *Fibre ropes, Part 2: Three-strand hawser-laid and eight-strand plaited*

AS 4142.3, *Fibre ropes, Part 3: Man-made fibre rope for static life rescue lines*

AS 4497.1, *Roundslings - Synthetic fibre, Part 1: Product specification*

AS 4497.2, *Roundslings - Synthetic fibre, Part 2: Care and use*

AS/NZS 5532, *Manufacturing requirements for single-point anchor device used for harness-based work at height*

ISO 7531, *Wire rope slings for general purposes - Characteristics and specifications*

Appendix C

(informative)

Inspection of harnesses, lanyards and associated equipment — Check list

This Appendix lists components to be inspected and the conditions or faults to be checked.

Component	Condition or fault to be checked
Webbing	Cuts or tears Abrasion damage especially where there is contact with hardware Excessive stretching Damage due to contact with heat, corrosives, or solvents Deterioration due to rotting, mildew, or ultraviolet exposure Activation of fall indicators where fitted
Snap hooks and karabiners	Distortion of hook or latch Cracks or forging folds Wear at swivels and latch pivot pin Open rollers Free movement of the latch over its full travel Broken, weak or misplaced latch springs (compare if possible with a new snap hook) Free from dirt or other obstructions, e.g. rust
D-rings	Excessive “vertical” movement of the straight portion of the D-ring where it is retained by the webbing, so that the corners between the straight and curved sections of the D become completely exposed. Cracks, especially at the intersection of the straight and curved portions Distortion or other physical damage of the D-ring Excessive loss of cross-section due to wear
Buckles and adjusters	Distortion of other physical damage Cracks and forging laps where applicable Bent tongues Open rollers
Sewing	Broken, cut or worn threads Damage or weakening of threads due to contact with heat, corrosives, solvents or mildew
Ropes	Cuts Abrasion or fraying Stretching Damage due to contact with heat, corrosives, solvents, etc Deterioration due to ultraviolet light or mildew
Chains	Physical damage Security of attachments to snap hooks, rings, and similar components

NOTE: Excessive vertical movement of the ring in its mounting can allow the nose of larger snap hooks to become lodged behind the straight portion of the D, in which position the snap hook can often accidentally “roll out” of the D under load.

Appendix D

(informative)

Inspection of fall-arrest devices — Check list

This Appendix lists components of fall-arrest devices to be inspected and particular conditions/faults to be checked.

Component	Condition/fault to be checked	
Rope or webbing including anchorage lines for Type 2/3 devices	Cuts Abrasion or fraying Stretching Damage due to contact with heat, corrosive, or solvents Excessive dirt or grease impregnation Anchorage of the anchorage line to the anchorage point (Type 1 devices) Anchorage of the rope end to the drum when the rope is fully extended (Type 2/3 devices)	
Fall-arrest device body	*Mounting ring*	Physical damage or wear, especially at any pivot points Cracks, especially in corners Mounting security
	Body	Physical damage such as significant dents, distortion, corrosion, or cracks Presence of foreign bodies such as small stones within body (to be checked without dismantling) Loose or missing screws, nuts or similar objects (external check only) Position of the clutch compression indicator button (fitted only to rewind drums with steel rope)
	Fall-arrest indicator (if fitted)	Signs of activation
	Correct use labels and service label or tag	Presence and legibility
Locking mechanism and rope guides	Excessive wear or ridging on externally visible rope guides Secure locking and holding of rope locking mechanism when the rope is given a sharp tug Free running of rope through the anchorage with no tendency to stick or bind, and on rewind drum anchorages, complete rewinding of the rope without loss of tension	
Hardware	Condition and locking action of any associated snaphooks or links	
Fall indicators	Evidence of activation	

Appendix E

(informative)

Guidance for the provision of training and competency

E.1 Core training elements

Training is essential in providing persons with the competence to successfully implement and comply with legislative obligations and to manage tasks while working at height. The information in this Appendix provides guidance in the form of a common set of “core training elements” that outline the knowledge and skills generally required for the safe conduct of tasks where fall from height risks exist. The core training elements do not seek to provide specific training content of a technical or prescriptive nature; this is up to the training provider. They are, however, intended to provide a consistent approach to the development and delivery of training courses.

The core training elements in this Appendix have been developed in recognition of the requirements outlined in this Standard. The information should assist organizations and training providers to determine the extent of the competencies required by different target groups. Table E.1 provides guidance on core training elements and corresponding performance criteria.

E.2 Identifying key competency requirements

There are many methods for identifying the key competencies that a person may need to enable them to conduct their role associated with working at heights. A person may need competencies that fall within the following broad roles:

(a) Design, specify, manufacture, install or modify work areas where fall-from-height risks exist or where plant is to be installed in such areas and may create height safety problems.

(b) Design, specify, manufacture, or install equipment, including safety equipment, in areas where fall-from-height risks exist.

(c) Off-site supervision or management of persons who may be exposed to fall-from-height risks.

(d) Connect to or use either a work positioning or fall-arrest system.

(e) Install control measures, either temporary or permanent, to reduce the risks associated with working in areas where fall-from-height risks exist.

(f) Participate in first response rescue methods.

There may be specific roles that may not fall within the broad roles given above. These will need to be taken into account when determining the competency requirements for these specific roles.

In Table E.1 the recommended core training elements and performance criteria have been matched to the broad roles given above.

Table E.1 – Recommended core training elements and performance criteria

Core training element	Performance criteria	Broad roles Clause E.2 Items as follows:
1. Demonstrate an understanding of legislation, standards and codes of practice relevant to height safety.	1.1 Identify legislation, standards and codes of practice relevant to the target groups listed in Clause E.3.	a, b, c, d, e, f
	1.2 Describe the responsibilities and obligations relevant to the target groups listed in Clause E.3.	a, b, c, d, e, f
2. Identify the criterion that defines when controls to reduce the risk of fall must be implemented.	2.1 Describe the physical and inherent hazards of falling.	a, b, c, d, e, f
	2.2 Identify the risks of exposure to the inherent hazards of work at height and the potential health and safety effects.	a, b, c, d, e, f
	2.3 Identify areas where fall from height risks occur in the workplace.	a, b, c, d, e, f
3. Assess risks associated with conducting tasks in areas where fall from height risks exist.	3.1 Demonstrate knowledge of the principles of risk management.	a, b, c, d, e, f
	3.2 Conduct a risk assessment of the inherent hazards of an area where fall from height risks exist.	a, b, c, d, e, f
	3.3 Conduct a risk assessment of the task related hazards of working at height.	a, b, c, d, e, f
	3.4 Document risk assessments conducted.	a, b, c, d, e, f
	3.5 Participate in the risk assessment process.	a, b, c, d, e, f
	3.6 Demonstrate knowledge of when risk assessments need to be reviewed and revised.	a, b, c,
	3.7 Identify sources of information on working at height hazards, associated risks and risk control measures.	a, b, c, d, e, f
4. Identify and implement risk control measures.	4.1 Identify risk control measures in accordance with the hierarchy of risk control for both the work environment and the access method/system.	a, b, c, d, e, f
	4.2 Describe methods for the isolation of potentially hazardous services connected to working at heights.	a, b, c, d, e, f
	4.3 Demonstrate the correct selection and fitting of harnesses	d, e, f
	4.4 Demonstrate competence in pre-use inspection of height safety equipment.*	d, e, f
	4.5 Demonstrate the correct selection and use of lanyards, connection devices and anchorages.*	d, e, f
	4.6 Demonstrate knowledge of the correct installation and use of appropriate height safety systems (Work Positioning/Fall arrest) and the hazards and limitations associated with each.*	a, b, c, d, e, f
	4.7 Demonstrate competence in installing height safety systems specific to structures being worked on, safe work systems, access system and or types of equipment used as appropriate*.	e
	4.8 Evaluate the effectiveness of risk control measures.	d, e, f
	4.9 Demonstrate knowledge of the correct selection, use and maintenance of personal protective equipment to be used for work at heights	a, b, c, d, e, f
	4.10 Demonstrate knowledge of the correct selection and use of communication systems between persons within a work team.	c, d, e, f
5. Apply first response rescue methods	5.1 Demonstrate competence in performing emergency rescue specific to structures being worked on, safe work systems and or types of equipment used as appropriate.	f
	5.2 Demonstrate knowledge of the correct selection and use of communication systems for contacting emergency services.	f

* To be in accordance with manufacturer's instructions.

NOTE In New Zealand there may be alternative requirements imposed by the New Zealand Qualifications Authority.

E.3 Target groups

Training is divided into five broad target groupings as follows:

(a) *Height safety theory* Basic height safety theory for all people associated with harness based work at heights. At the basic level it is pitched to operators up to and including supervisor level to height safety technologists and to equipment inspectors.

(b) *Height safety operator* Training in the skills needed to perform harness based work at heights under direct supervision of a height safety supervisor.

(c) *Height safety supervisor* Training and assessment in skills needed to perform harness based work at heights unsupervised, to supervise entry level and other operators, and to participate in first responses rescue.

(d) *Height safety equipment inspector* Training in the skills needed to detect faults in equipment and to determine remedial action.

(e) *Height safety manager* Training for people involved in the selection, design, manufacture or installation of height safety systems or equipment, or the development of control measures or work practices, in the technical skills appropriate to their tasks together with, as appropriate, training in risk management and systems management.

The key competencies listed in Clause E.2, having been identified for each of the above target groups, will then need to be tailored to the level of training needed for each group.

E.4 Competency assessment

Before a person conducts any tasks associated with working in an area where fall from height risks exist both the task and the work environment should be assessed to confirm that the person's competence is appropriate for that task. Persons should be reassessed, at appropriate intervals, to confirm ongoing competency relevant to their tasks associated with working in a fall risk environment, in particular persons required to perform emergency rescues need to be reassessed on an annual basis. A person should be retrained whenever they cannot demonstrate ongoing competency. The duration of retraining should be sufficient for the person to demonstrate the required competencies.

E.5 Training course duration

The competency needs of the various target groups should reflect the duration of training courses. Prior knowledge and learning should be considered and, where applicable, may reduce training duration. Target groups who, for example, set up height safety systems or have to be capable of performing other tasks such as a rescue will require specific competencies based on the degree of risk and the nature and complexity of tasks to be conducted. In these instances the duration of the training courses should be commensurate with attaining the relevant competency.

E.6 Trainers and assessors

The trainers and assessors should be knowledgeable in all relevant aspects of working at heights and conversant with relevant legislation, codes of practice and standards.

7.3 Swing fall

Swing fall, also referred to as the pendulum effect or lateral swing, shall be assessed when selecting and setting up a fall-arrest system. See Appendix C for more information about swing fall.

NOTE 1 Swing fall can expose the user to new hazards and increase their total fall distance [see Figure 7.6 (a)].

Swing fall shall be minimized. Examples of how this can be achieved include:

(a) Selecting an alternative work system (see Clause 2.3).

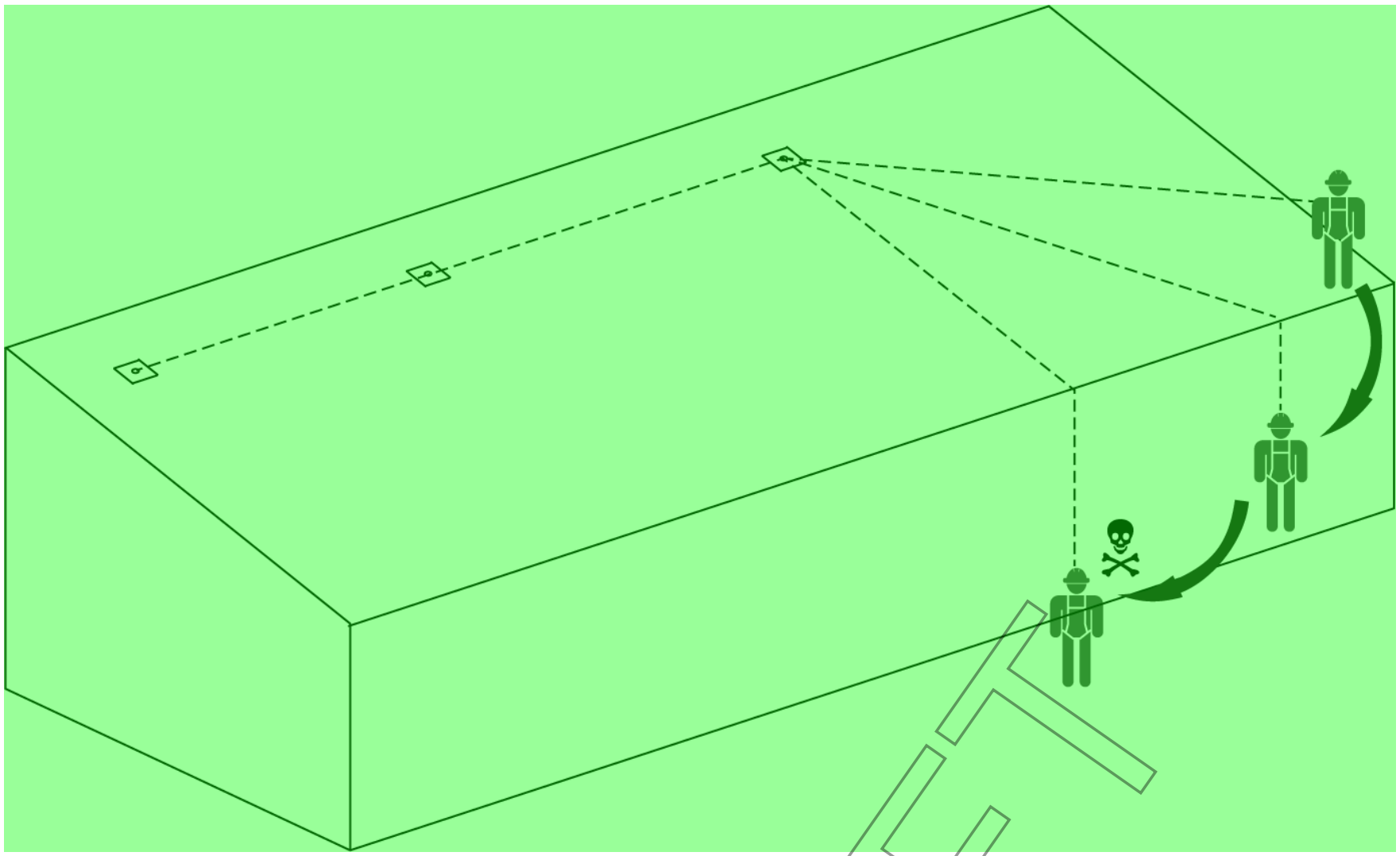
(b) Using a diversion anchor (see Clause 3.3.2). Figure 7.6(b) shows an example of how a diversion anchor can mitigate swing fall.

(c) Using dual anchors [see Figure 7.6(c)].

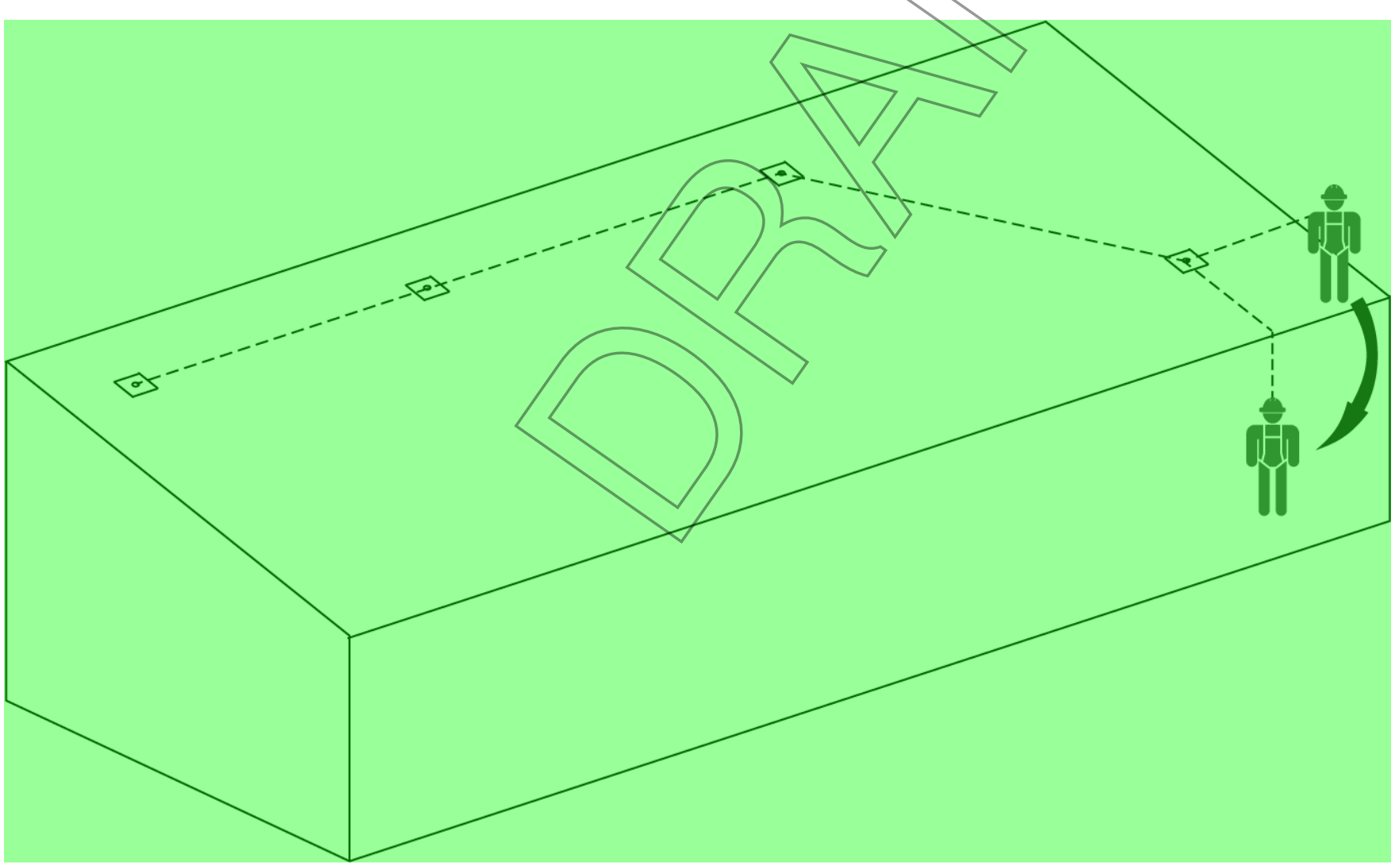
NOTE 2 Dual anchors can minimize lateral swing in the event of a fall by limiting horizontal movement.

(d) Using an anchor in an alternative location, such as above or beside the worker.

(a) Swing fall



(b) How a diversion anchor can mitigate swing fall



(c) How dual anchors can mitigate swing fall

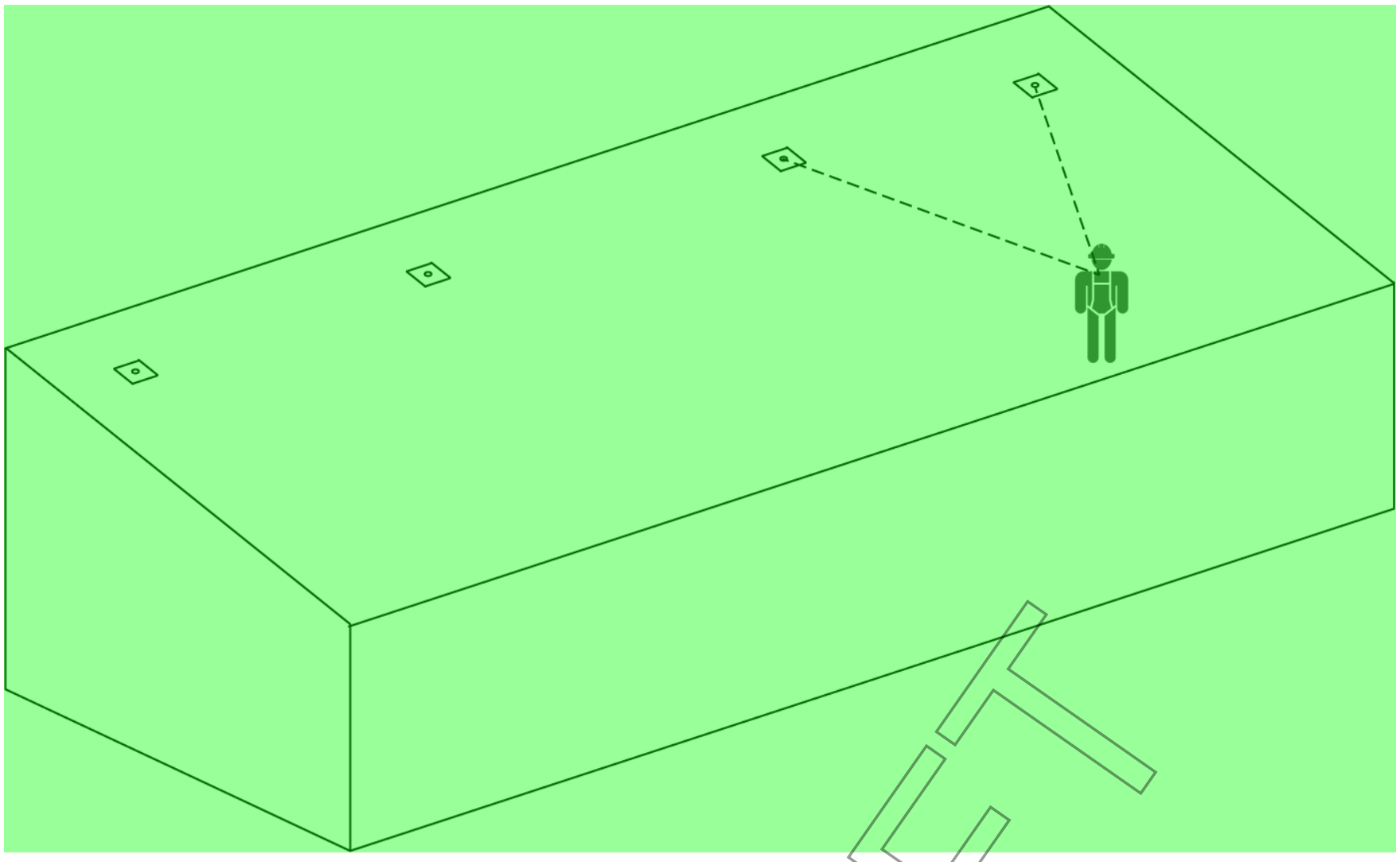


Figure 7.6 – Examples of swing fall and how it can be mitigated

7.4 Free fall distance

Free fall distance (FF) is the distance a user will fall before the fall-protection system begins to arrest the fall.

Free fall distance shall be equal to the following combined values: L - S + H

where:

L = functional length of the connecting system (see Clause 7.2)

S = the straight-line distance from the anchor device to the nearest fall hazard (see Figure 7.7)

H = the height of the connecting system attachment to the harness (see Note 1 in Clause 7.2)

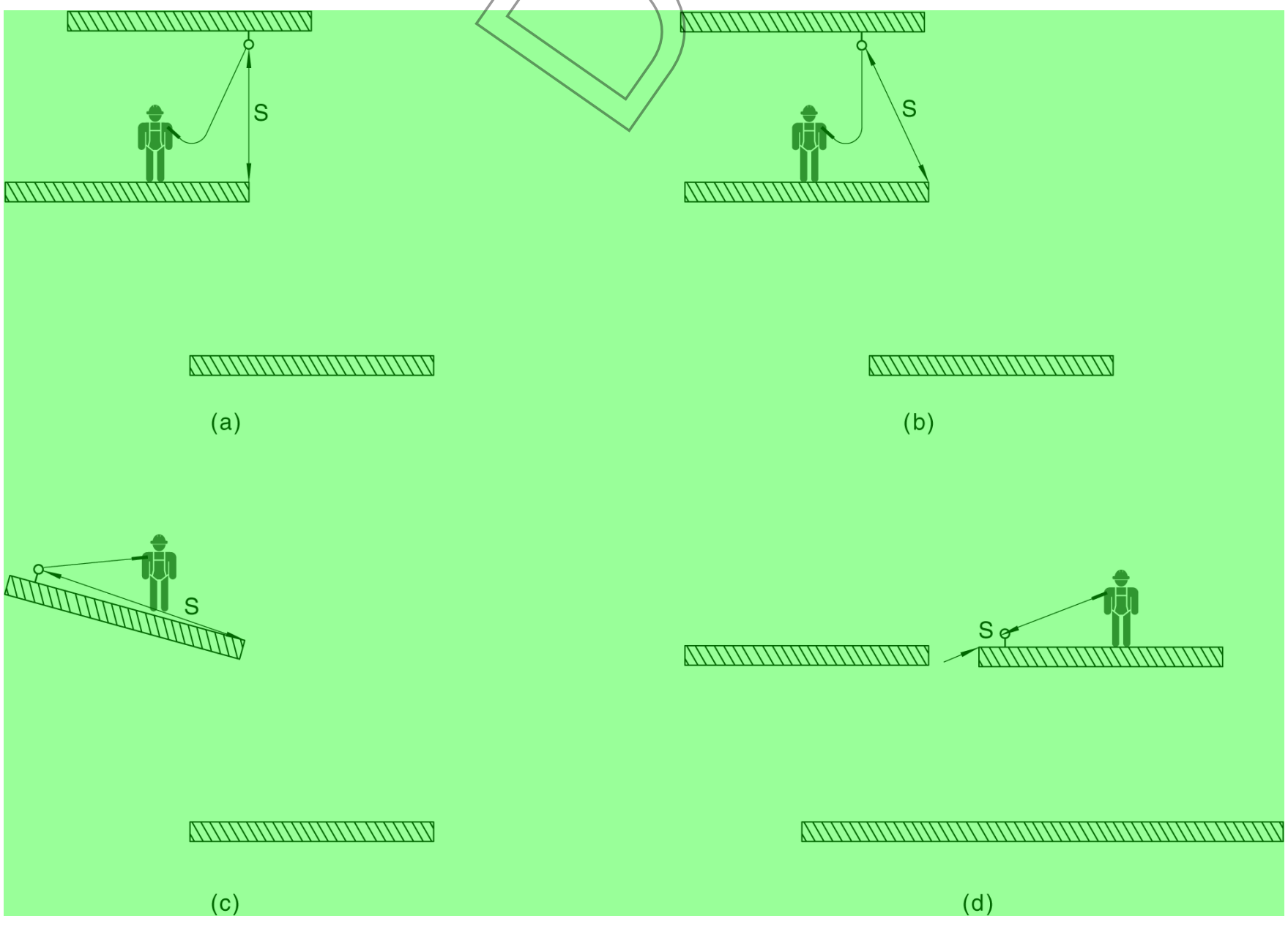


Figure 7.7 – Examples showing the straight-line distance (S) used for calculating free fall distance (FF)

8 Traceability, inspection, maintenance and storage of equipment

8.1 Traceability

All components of a fall-protection system shall be traceable to the point of purchase by either –

(a) the manufacturer's unique identifier;

(b) the user-installed identifier; or

(c) a combination of (a) and (b).

User-installed identifiers shall –

(i) be in accordance with the product instructions; and

(ii) not inhibit product performance.

The user-installed identifier shall be installed in a way that prevents the connection system from attaching to it.

8.2 Inspection register

An inspection register shall be maintained for all components of a fall-protection system. The register shall clearly record the following:

(a) Component identifier.

(b) Date of first use/entry into service inspection date.

(c) Remove from service date (if applicable).

(d) The inspection date and the name of person who conducted the inspection.

(e) Evaluation of the component against the product instructions.

NOTE 1 For example, an assessment that results in a pass/fail.

(f) Notes about monitoring issues that arise during the inspection.

NOTE 2 If issues are identified with a component, then more frequent inspections may be needed.

(g) Next inspection date.

The inspection register shall be kept for the life of the component. Records should also be kept for components after removal from service.

8.3 Scheduled periodic inspections

Components shall be inspected –

(a) by a competent person;

NOTE 1 See Appendix B for training outcomes for people who conduct inspections.

(b) in accordance with the procedures described in the product instructions; and

(c) in accordance with the time intervals nominated in Table 8.1.

If the inspection period has expired, then the component shall be inspected prior to use in accordance with (a) and (b).

NOTE 2 For example, the inspection can be postponed if the component is not expected to be used within the time period given in Table 8.1.

Table 8.1 – Maximum interval between inspections for components of a fall-protection system

Product	Maximum interval between inspections [a]
Single point anchors	12 months
Horizontal lifelines and rail systems	12 months
Chemical and friction fasteners	12 months
Textile components	6 months
Harnesses	6 months
Lanyards and pole straps	6 months
Fall-arrest devices	6 months

[a] Equipment used in harsh environments such as heat, corrosive or chemical exposure may require more frequent inspections than that listed in this table.

8.4 Inspection criteria

8.4.1 General

This clause includes the inspection criteria to determine if products are suitable for use.

Products shall be inspected for the following:

(a) Markings on products are legible or have a user-installed identifier.

NOTE This can include manufacture date, batch, load rating and relevant Standard.

(b) The components are in accordance with manufacturer criteria.

(c) Any additional inspection requirement specified by the manufacturer.

Additional requirements specific to the device category also apply; see Clauses 8.4.2 to 8.4.6.

8.4.2 Anchors, horizontal lifelines and horizontal rail systems

The load rating shall be present.

Anchors shall conform to AS/NZS 5532. Horizontal lifelines and rail systems shall conform to AS/NZS 1891.2.

Friction or chemical fasteners shall be proof tested in accordance with Clause 8.8.

8.4.3 Harnesses, lanyards and pole straps

Harnesses shall have a remove from service date on the product. Harnesses shall not be used if the remove from service date has passed.

Harnesses shall conform to AS/NZS 1891.1. Lanyards and pole straps shall conform to AS 1891.5.

8.4.4 Fall-arrest devices

Fall-arrest devices shall conform to AS 1891.3.

There shall be no contaminants, such as dirt, that restrict device movement.

For Type 2, 3 and 4 fall-arrest devices, a “lock off” check shall be conducted in accordance with the product instructions.

8.4.5 Textile components

Textile components shall be inspected for, but not limited to, the following:

(a) Cuts or tears.

(b) Abrasion damage, especially where there is contact with hardware.

(c) Stretching.

(d) Activation of fall indicators if applicable.

(e) Broken, cut or worn threads on load bearing elements.

(f) Damaged or weakened threads due to contact with heat, corrosives, solvents, mildew or rotting.

(g) Dirt or grease impregnation.

(h) Effects of exposure to ultraviolet light.

NOTE This may be indicated by colour fading, degradation of the surface material, abrasive to touch or stiffness of the material.

(i) Exposure to paint or chemicals.

8.4.6 Metallic components

Metallic components shall be inspected for, but not limited to, the following:

(a) Cracks, especially at the intersection of any straight and curved portions.

(b) Distortion or other physical damage.

(c) Missing/broken strands or wires.

(d) Bird caging of wire ropes.

(e) Distortion of the hook or latch of a connector.

(f) Wear of moving parts, such as swivels and latch pivot pins.

(g) Restricted movement of the latch over its full travel.

(h) Dirt, rust or other obstructions.

The following shall be in accordance with the product instructions:

(i) Wire rope terminations.

NOTE 1 This includes checking the swages, splices or sockets.

(ii) Chain terminations, hooks and latches.

(iii) Connector function.

NOTE 2 This includes checking for broken, weak or misaligned latch springs.

(iv) Cross-sectional wear.

NOTE 3 The cross-sectional diameter should not be reduced by more than 5 %.

8.5 Storage and transportation

Equipment shall not be damaged –

(a) in storage; or

(b) during transportation.

Equipment constructed from synthetic materials shall be stored away from direct sunlight in a cool, dry place.

Equipment should be air-dried at ambient temperature before storage.

8.6 Service and repair

Serviceable products shall be serviced in accordance with the product instructions.

Non-serviceable products that require repair shall be removed from service (see Clause 8.7).

8.7 Removal from service

Equipment shall be removed from service if –

(a) it has been used to arrest a fall;

(b) it has failed an inspection (see Clause 8.4); or

(c) the remove-from-service date has been reached.

Equipment that has been removed from service shall be –

(i) identified as defective;

NOTE 1 Identification can include a label attached to the product.

(ii) re-inspected by a competent person; or

NOTE 2 Defective products can be returned to the manufacturer for further inspection.

(iii) destroyed.

8.8 Proof testing for chemical fasteners and friction fasteners

8.8.1 General

Chemical fasteners and friction fasteners used in conjunction with systems and products covered by this document shall be proof-tested –

(a) at the time of installation in accordance with Clause 8.8.4; and

NOTE This test is to determine if the installation has been completed correctly.

(b) annually, in accordance with Clause 8.8.2 or 8.8.3 (as applicable).

8.8.2 Single fastener components

Components with a single fastener shall be proof-tested annually in accordance with Clause 8.8.4.

NOTE Components with a single fastener can include anchors, intermediate/end supports or brackets in a horizontal lifeline or rail.

8.8.3 Multiple fastener components

Multiple fastener components shall be proof-tested annually in accordance with Clause 8.8.4, unless all the following requirements are met:

(a) Calculations have been performed in accordance with Clause 8.8.5.

(b) The fastener manufacturer's installation requirements have been met.

(c) The fastener manufacturer's warranty is valid.

(d) Installation data are available, including evidence of –

(i) proof loading at time of installation; and

(ii) the fastener specifications.

8.8.4 Method

The following requirements apply to single and multiple fastener proof testing:

(a) The load shall be applied in the axial direction.

(b) Shear loads shall not be applied to the fastener.

(c) Fasteners shall be loaded to –

(i) 50 % of the design load provided in the product specifications; and

(ii) Not less than 7.5 kN.

(d) The load shall be held for not less than 30 s.

8.8.5 Calculations

Calculations shall be performed for multiple fasteners by –

(a) hand/manually, based on the information provided by the fastener manufacturer; or

(b) using software provided by the fastener manufacturer.

Calculations shall –

(i) include all forces and moment loads applied to the fasteners; and

(ii) take in to account concrete condition, thickness, compressive strength and edge distance.

Appendix ~~F~~A

(informative)

Total restraint

The purpose of this appendix is to draw a clear distinction between the work method described in this document as restraint technique, and the concept of "total restraint" which is expressly omitted from the scope of this document.

Total restraint does not allow a user to reach a fall hazard.

It is applicable in the following circumstances:

(a) When an energy absorber is not required.

(b) If the connecting system is adjustable, and the user cannot reach a fall hazard.

(c) When the surface is structurally sound.

(d) If there is no opportunity to disconnect and reconnect to another point from which a fall position could be reached.

(e) When there is no load in the harness.

Total restraint systems are usually found as permanent installations on completed buildings or structures. It is not usually possible to provide and maintain a system as total restraint on a job site where work conditions and the nature of tasks are variable.

Total restraint is not applicable in the following circumstances:

(i) Areas that can be reached with the equipment being used and where a fall is possible.

NOTE For example, use of a lanyard, whether fixed length or adjustable, which permits access to a fall hazard.

(ii) Where there is a risk of falling through the surface.

(iii) Platform failure.

Equipment used solely for total restraint is not specified in the AS/NZS 1891 series. This document does not provide advice about equipment nor anchorage strengths needed for total restraint. Fall-arrest equipment can be suitable for total restraint. The user should ensure that equipment is suitable for total restraint before using it.

~~F.1 General~~

~~The purpose of this Appendix is to draw a clear distinction between the work method described in this Standard as restraint technique, and the concept of "total restraint" which is expressly omitted from the scope of this Standard. It aims to prevent fall arrest situations, including restraint technique, being misclassified as total restraint and the consequential provision of inappropriate protection systems.~~

~~F.2 Definition~~

~~Total restraint is defined as the control on a person's movement by means of a connection to an anchorage in such a way that it will physically prevent the person from reaching any position at which there is risk of a fall, either over an edge, through a surface or due to a failed moveable platform.~~

~~F.3 Restraint systems~~

~~In the great majority of temporary installations, systems thought to be total restraint do have residual fall risks and hence are, and should be treated, as restraint technique (see Clause 2.2.5).~~

~~Systems commonly mistaken as being total restraint are those that -~~

~~(a) are mainly total restraint but have small areas that can be reached with the equipment being used and where a fall is possible;~~

~~(b) require or permit people to use their own equipment thus providing a potential for an inappropriately long lanyard, whether fixed length or adjustable, to be used such that a fall becomes possible;~~

~~(c) allow passage onto a surface where there is a risk of falling through the surface; or~~

~~(d) may be designed to prevent a person falling out of a moveable platform but will not protect that person in the event of a platform failure.~~

~~As an example, the situations shown in Figure 2.3 could be regarded as total restraint if -~~

~~(i) the personal energy absorbers were omitted;~~

~~(ii) the lines were non-adjustable and did not exceed the length illustrated;~~

~~(iii) the surface was structurally sound; and~~

~~(iv) there was no opportunity to disconnect and reconnect to another point from which a fall position could be reached.~~

~~Total restraint systems are usually found as permanent installations on completed buildings or structures. It is not usually possible to provide and maintain a system as total restraint on a job site where work conditions and the nature of tasks are variable.~~

~~F.4 Equipment~~

~~Equipment solely for total restraint application is not specified in the AS/NZS 1891 Series of Standards and furthermore, this Standard gives no advice on the equipment or anchorage strengths needed for total restraint, other than that fall-arrest equipment is suitable for total restraint use. It is therefore up to the user to ensure the suitability of other equipment used for total restraint.~~

~~Amendment control sheet~~

~~AS/NZS 1891.4:2009~~

~~Amendment No. 1 (2021)~~

~~Revised text amendment~~

~~Summary: This Amendment applies to:~~

~~• Preface~~

~~Clauses 1.1, 1.3, 1.5, 2.2.6, 3.1.1, 4.1.1, 4.2.3, 6.2.3, 8.1, 8.3 and 9.6~~

~~Table 2.1~~

~~Appendix B~~

~~Published on 4 June 2021.~~

Appendix B

(informative)

Recommended training outcomes

B.1 Harness-based work

The training outcomes for harness-based work should include demonstration of the following:

(a) Awareness of relevant legislative requirements.

(b) Knowledge of relevant Standards, Codes of Practice and Industry association codes.

(c) The ability to implement rescue plans and use rescue equipment.

(d) The correct fitting, adjustment and use of equipment appropriate to the work that will be undertaken.

NOTE 1 Equipment can include, but is not limited to, full body harnesses and combination style harnesses, twin line lanyards, restraint equipment and fall-arrest devices Type 1, 2, 3 and 4.

NOTE 2 This includes how to access and apply product instructions.

(e) Pre-use inspection of equipment.

(f) How to identify a suitable anchor in accordance with Section 3.

(g) Risk management of hazards, such as dropped objects.

NOTE 3 Examples of dropped objects management can include tool lanyards, barricades.

(h) An understanding of suspension intolerance and associated first aid casualty management.

B.2 Management of harness-based work

In addition to the training outcomes listed in B.1, the training outcomes for the management of harness-based work should include development of the following abilities:

(a) Selection a suitable fall-protection system in accordance with Clause 2.1.

(b) Selection of appropriate equipment for the task in accordance with Clause 2.4.

NOTE This includes anchor identification.

(c) Able to define rescue plans in accordance with Clause 2.5.3.

(d) Able to facilitate the training of harness-based workers trained in accordance with Clause B.1.

(e) Able to define a method to control dropped objects in accordance with Clause 2.5.4.

(f) Creation of safe work method statements.

(g) Ability to monitor the effectiveness of controls for working at height.

(h) Able to implement a system for managing inspection and maintenance of fall-protection equipment.

B.3 Periodic inspection of height safety equipment

The training outcomes for the periodic inspection of height safety equipment should include the ability to inspect the following equipment:

NOTE 1 This includes how to access and apply product instructions.

(a) Textile components.

NOTE 2 This may include webbing and rope.

(b) Metallic components.

NOTE 3 This may include D-rings, O-rings, connectors and adjusters.

(c) Energy absorbers.

(d) Type 1, 2, 3 and 4 fall-arrest devices.

The training outcomes should also include the ability to identify when equipment needs to be removed from service in accordance with Clause 8.7.

B.4 Periodic inspection of height safety systems

The training outcomes for the periodic inspection of height safety systems should include the ability to inspect the following:

NOTE 1 This includes how to access and apply product instructions.

(a) Single point anchors.

(b) Horizontal rail systems.

(c) Horizontal lifelines.

(d) Type 1 fall-arrest devices.

NOTE 2 This includes the cable or rail system to which the device is attached.

(e) The anchorage.

(f) Friction and chemical fasteners.

NOTE 3 This includes proof testing; see Clause 8.8.

The training outcomes should also include:

(i) Awareness of proof testing equipment calibration requirements.

(ii) Awareness of tagging and report requirements.

(iii) The ability to identify when equipment needs to be removed from service in accordance with Clause 8.7.

Appendix C

(informative)

Swing fall

Fall-arrest systems can behave similar to a pendulum during a fall. If the user’s connecting system is attached to an anchor on the edge of the building 2m to their right and they fall off the edge, then they will swing in an arc. This is called “swing fall”.

NOTE Example of how a pendulum works: A person holds a ball in their outstretched left hand. The ball has a string tied around it and the person is holding the other end of the string in their right hand, close to the centre of their chest. When the person drops the ball, it will swing towards them, past the centre of their chest where it is being held and swings out to their right side.

When setting up a fall-arrest system, any objects directly below the fall edge should be evaluated. To account for swing fall, the following factors should also be considered:

(a) Are there hazards in the potential swing path of the user? This could include scaffolding, another part of the building, or the ground. Striking an object in the swing path can severely harm the user.

(b) Are there obstructions that can snag the connecting system during the swing? This can catastrophically damage the connecting system or prevent it from working as intended in arresting the fall.

(c) What is the fall clearance? Swing fall increases the required total fall clearance. This should be evaluated in conjunction with the product instructions.

EXAMPLE A user is working in the northeastern corner of a building and has connected a 2-m lanyard to an anchor that is 1 m from the east edge of a building and 2 m from the northern edge (see Figure C.1). The user may believe that they are working in restraint technique because their 2 m lanyard is in tension against the anchor. This would be true for fall hazards over the northern edge of the building. However, if they are working in the northeastern corner, then the eastern edge of the building is a fall hazard. In that scenario, the user is not working in restraint technique because (a) the lanyard is 2 m in length; and (b) the anchor is only 1 m from the eastern edge.

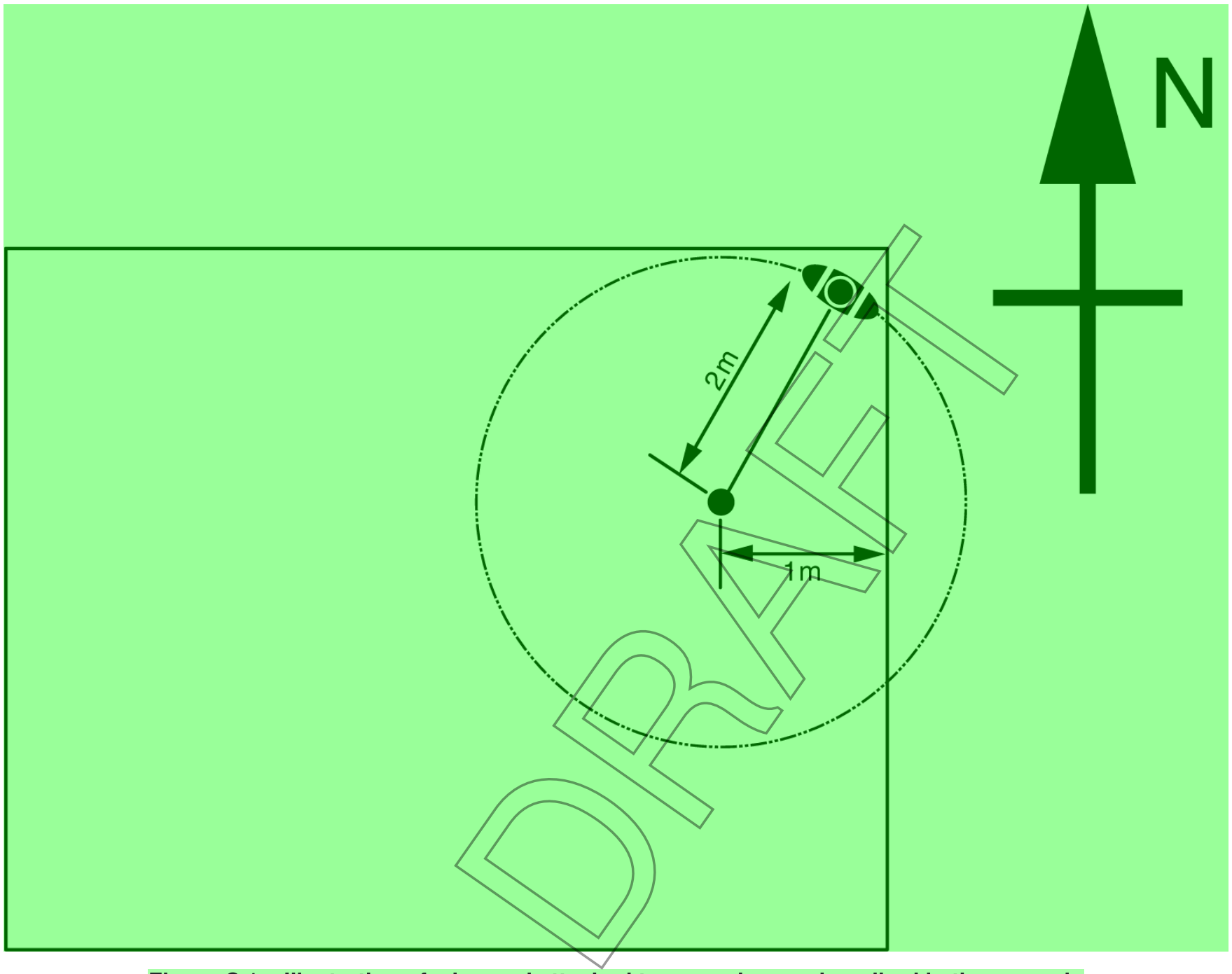


Figure C.1 – Illustration of a lanyard attached to an anchor as described in the example

Bibliography