SRA APPROVED INSTALLER TRAINING COURSE

CERTIFICATE IN COMPETENCY

safetyroofanchors.com.au

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COURSE CONTENTS

Introduction to SRA

Safety Roof Anchors is an Australian company established and operated by rope access technicians and certified riggers, with many years of hands on experience.

After numerous years spent working at heights, we decided it was time to put our practical knowledge to use and create better, safer products that are robust yet easy to install.

We have dedicated years to research and engineering of our products which are now supported by independent testing carried out by a certified NATA laboratory. The result is a line of products that is robust, modular and easy to install and use.

Our range of rope access and fall arrest anchor points and static lines has been fully engineered and rigorously tested. All parts are genuine SRA products, designed and manufactured specifically for use in industrial rope access and fall arrest applications.

Our unique way of fixing into light structures such as metal roofs and timber trusses, provides unrivalled strength due to the maximised use of the host structure working in unison with the anchor point. As a result, we have bridged the gap between rope access and fall arrest anchor points which means that all of our products can be used in both applications.
Our approach is different because we know that only the best will do when you are working at height.

We are driven by innovation and quality, to provide you with the products you can trust when it matters most.

Installation of SRA Products

- SRA cannot be held responsible for any product that is not installed correctly.
- Persons installing SRA products must be approved SRA product installers.
- All persons installing SRA products must know the 'Working at Heights' regulations, have completed 'Height Safety Training' and be competent in all the relevant Australian standards applicable to the work they are performing.
- Any installation instructions are SRA recommended methods and must be adhered to.
- SRA cannot be held responsible for incorrect installation documentation or procedures.
- SRA will endeavour to help and give guidance where necessary but cannot be held responsible for any 'misinterpretations' or 'incorrect' advice.
- SRA cannot warrant the structure to which the product is installed to. Assessment must be made by a qualified structural engineer; unless it is clear to a competent person it is structurally adequate.
- E&OE apply to all SRA documentation.

MODULE 1:

WHAT ARE ANCHOR POINTS & STATIC LINES?

2.1 What are anchor points and why are they so important?

Anchor points are attachment devices enabling access to otherwise unprotected edges and structures, to the trained personnel, designed for protection from fall from heights. They are usually required in vertical or sloping environments such as roofs of buildings, dams, bridges and other structures over 2m.

There are many types of anchor points and therefore the anchor point installer must determine:

1. Purpose of anchor point (fall arrest, rope access or re-direction)
2. System layout
3. Host structure and anchors' suitability (concrete, steel, multiple brick walls, steel purlins, roof sheet, timber rafters etc.)
4. Rating of anchor point in kN (1 or 2 person anchor)

2.2 What are life lines (static lines) and why are they so important?

Life lines are attachment devices using a series of anchor points connected together with a (stainless) steel cable. They can be of horizontal (roof) or vertical (ladder) configuration. They offer continuous protection to the personnel working at height.

The physics behind life lines (static lines) are much more complicated when compared to anchor points. Great care must be taken when assessing the structure! The end anchors must be able to resist both the lateral tensile forces developed in the line as well as the directly applied forces at right angles to the line, resulting from the arrested fall.

SRA static line is a proprietary system for multiple users. This means that its design and manufacture is based on calculations confirmed by static and dynamic testing of critical configurations in all relevant substrates.

MODULE 2:

SOME COMMON BASIC TERMINOLOGY

3.1 Difference between rope access, fall arrest, fall restraint and 2 person anchor:

- **Rope Access** (or Industrial Rope Access or Work Positioning) is a relatively new industry which has evolved from basic climbing techniques. Rope access technicians use a twin rope technique to abseil buildings and structures. Rope access anchor points must be rated at minimum 12 kN. There are a minimum of 2 anchor points within the system (i.e. twin rope technique).

- **Fall Arrest** is situations where a person attached to an anchor device, via an approved harness and lanyard, has taken a fall and the anchor point arrested his/her fall. A fall arrest anchor point has to be rated at a minimum of 15 kN.

- **Fall Restraint** is a situation where a person is attached to an anchor device, via an approved harness and lanyard, in such a manner that it is physically impossible to fall over the edge.

- A **2 Person Anchor** is rated at 21 kN. Understand however that it is usually not the anchor itself which will fail; it will most likely be that the host structure won't be able to withstand 21 kN.

Don't use 2 person anchors if you don't have to!

Design a better system which doesn't require operators to share the anchors! SRA doesn't rate any of its anchor points as 2 person anchors because we don't advocate sharing the anchors in the first place. By rating an anchor point as a 2 person anchor you are actually increasing your own liability while you don't have to! The host structure can be treacherous!

3.2 Definitions of abbreviations and terms

- **1 kilo Newton** (1kN) is a measurement unit of force **(not to be confused with weight)**

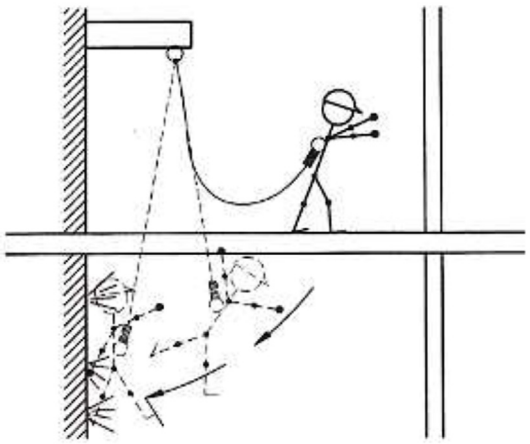
- 1kN = approximately 100KG 10kN = 1,000KG (1T) 15kN = 1,500 KG (1 T)

- **SWL (Safe Working Load)** is the load that a piece of lifting equipment, lifting device or accessory, can safely utilize to lift, suspend, or lower a mass without fear of breaking. It is generally considered to be the breaking load of the components, divided by an appropriate factor of safety, giving a 'safe' load that can be lifted, suspended or carried.

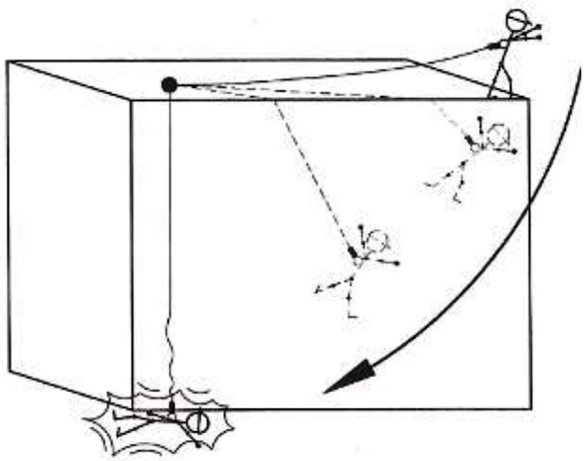
- **WLL (Working Load Limit)** is a replacement term for SWL describing capacity of items such as hooks, slings, shackles and anchors.

- **MBS (Minimum Breaking Strength)** is often marked on the equipment by the manufacturer and is generally 5-10 times more than WWL

- **Pendulum effect** is a situation when a person attached to a piece of rope or lanyard falls over the edge and continues to swing until he/she hits the ground or side of the building. The swinging motion can also sever the rope or lanyard on the edge of the building.

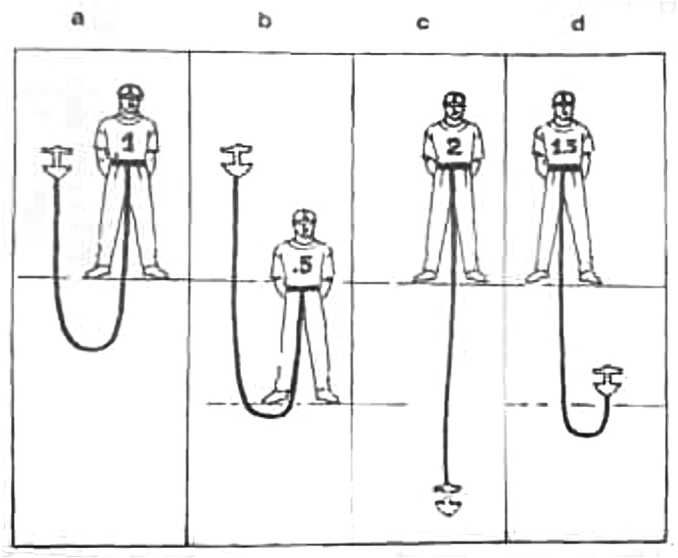


(a) Pendulum effect simple case



(b) Pendulum effect-anchorage line sliding along edge

- **Fall factor** is a method of describing the length of a free fall an attached person can take in relation to the length of their lanyard as well as their position in relation to the anchor point. For example a person standing ABOVE the anchor point will fall over the length of the whole lanyard. This is called a Factor 2 fall. A fall where a persons' harness attachment point is at the same height as the anchor is called a Factor 1 fall. This is because the fall distance is shorter; usually ½ of the lanyards' length.



- **Aid climbing** refers to a rope access technique, used by abseilers, to move across the structure using a series of anchor points and 3 lanyards (cow tails) with foot loops, connected to a rope access harness. Aid climbing routes are often installed in overhangs of buildings. You must be an abseiler to install aid routes, unless you are able to install from a scaffold or machinery.

- **EWP (Elevated Work Platform)** some examples of EWPs are cherry picker and scissor lift.

MODULE 3:
STANDARDS

1.1 Who is a “competent person”?

According to AS/NZS1891 competent person is:

“A person who has, through a combination of training, education and experience, acquired knowledge and skills enabling that person to correctly perform a specific task.”

- Are you a competent person?
- What are your qualifications?

Installed anchor points and static lines must not be used until they are tested and certified!

- Are you covered by Professional Indemnity insurance?

1.2 Standards and codes of practice relating to installation of anchor points and static lines

WHS Act 2011

AS/NZS 1891.2:2001 Industrial Fall Arrest Systems and Devices – Horizontal Lifeline and Rail Systems

AS/NZS 1891.4:2009 Industrial Fall Arrest Systems and Devices – Selection, Use and Maintenance

ISO 22486 (2003) replaces AS/NZS 4488(1997)

Part 1: Fundamental principles for a system of work

Part 2: Code of Practice

COP Safe Work on Roofs – Commercial Buildings

COP Safe Work on Roofs – Residential Buildings

Safe Working at Heights guide

1.3 Standards relating to manufacture of anchor points

AS/NZS 5532:2013 Manufacturing Requirements For Single-Point Anchor Device Used For HarnessBased Work At Height

MODULE 4:

ANCHOR POINT SYSTEM DESIGN AND LAYOUT PLAN

4.1 System design

To design a correct anchor point system one must answer a few basic questions:

- What is the system to be used for?
- How many people will be using the system?
- What is the access to the roof/ structure?

When planning the system layout, one should visit the site (if possible) to make certain the host structure will be able to withstand the loads imposed on it during the use of the system. Assessment must be made by a qualified structural engineer; unless it is clear to a competent person it is structurally adequate!

System design includes knowing the quality of concrete, size of the timber members, purlin gauge, condition and thickness of the roof sheet and thickness of brick walls.

In case the site visit is not practicable, gather as much information about the host structure as possible. You can make use of plans, drawings and Google Earth images or speak to the person in charge of the building and ask questions!

Ensure there is safe access to the roof/ structure area. You may need to consider EWP, ladder use, installation of a hatch, installation of a ladder bracket etc.

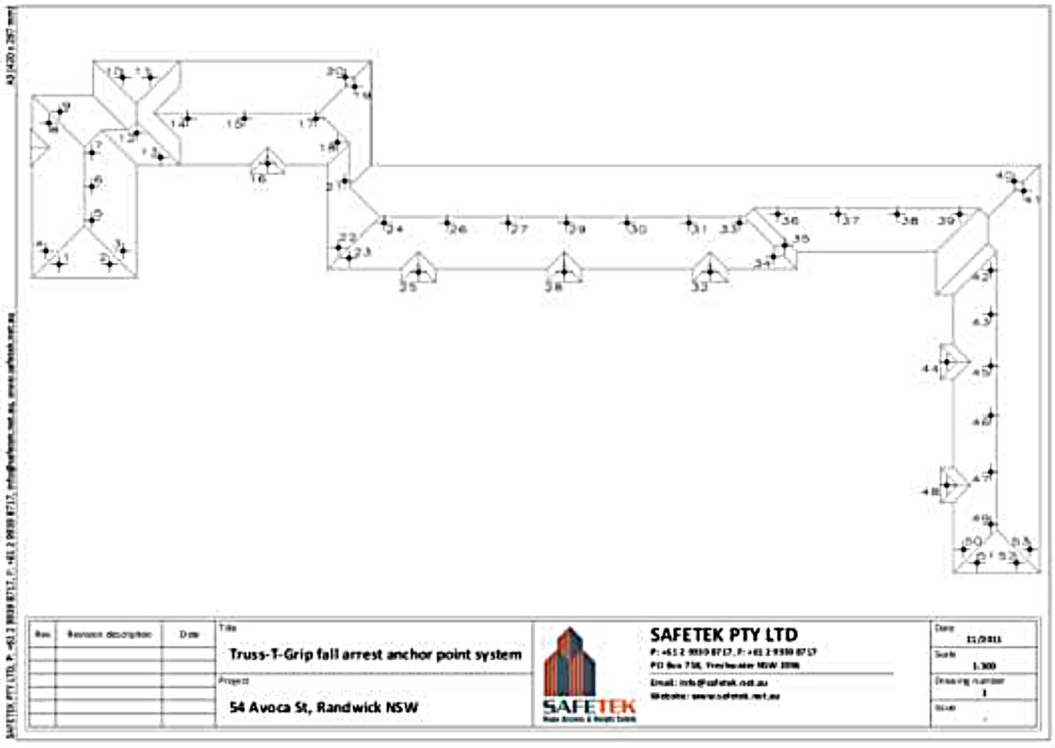
■ Decide on the type(s) of anchor you will be using.

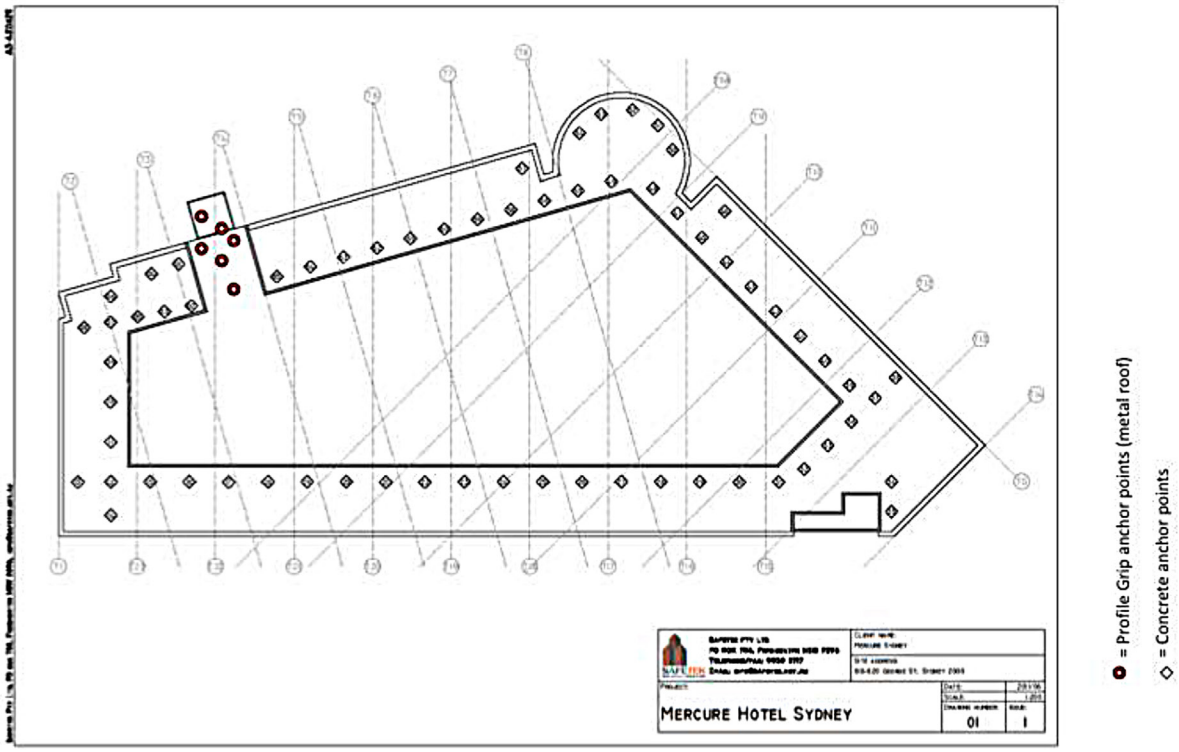
It is always better to plan to install more anchor points than less. Keep in mind that, especially when designing anchor point systems for abseiling, the number of rope access technicians that can work on site at the same time is often dependant on the availability of anchorage points. For example, if a builder needs a window cleaning job finished quickly, the cleaning contractor needs to utilise more abseilers and therefore will need more anchorage points.

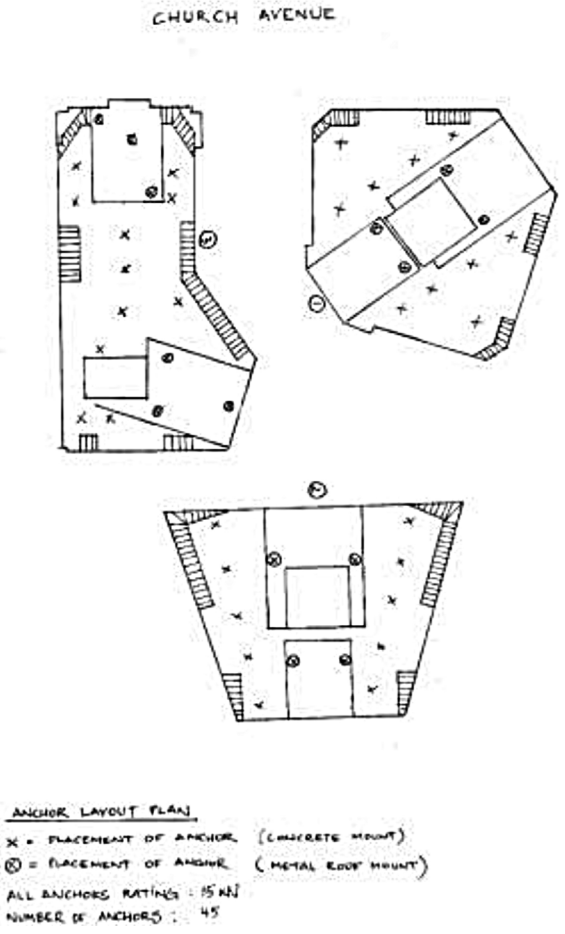
In any case, a few extra anchor points for the purposes of rescue are always a good idea!

- When designing systems be aware of the pendulum effect!
- Create a ‘System Layout Plan’ and submit it to the client together with your quote. Refer to the drawing during the installation.

4.2 System layout plan







There are many ways of creating a functional layout plan depending on availability of drawing programs and your ability to use them.

There is nothing wrong with a hand drawn layout plan as long as it is tidy and functional.

MODULE 5:
HOST STRUCTURES AND METHODS OF FIXING

5.1 Host structures

Anchor points can be installed in to a variety of host structures. The most common examples include:

- **Concrete** (AA400 series)
- **Natural stone** (AA400 series)
- **Steel purlins** (AA403)
- **Steel beams** (AA 400 series)
- **Steel purlins and roof sheet combinations** (Profile Grip)
- **Timber batons and roof sheet combinations** (Profile Grip)
- **Timber trusses and rafters** (Truss-T-Grip)
- **Double brick walls** (AA400 series)

5.2 Concrete anchors (AA400 series)

For installation in concrete either a chemical or mechanical fixing can be used. SRA recommends Hilti products. The choice depends on the intended use of the anchor. For example, use chemical anchors in most installations outside, to help with water proofing of the hole. Mechanical anchors (HSL-GR or HST3- R) are an asset in tensile anchor installations in overhangs when installing an aid climbing route.

Chemicals include Hilti HVU, Hilti HIT-RE-500.

Different chemical are often used for different situations. For example RE-500 is suitable for curing under water and is therefore also suitable for fixing into natural stone as there can be water present.

Hilti HVU sachets are pre-measured for the rod size so there is no issue with the amount of chemical squeezed into the hole, compared to using injection type of chemical. They are also great on hot days because they won't dry out like their injection chemical counterparts.

SRA has developed an eyebolt setting tool enabling the installer to use Hilti HVU sachets. This was previously not possible as the eyebolts must be drilled in to activate the chemical and start the curing process. The setting tool is compatible with Mini SDS Plus and is therefore suitable for most types of rotary hammer drills.

HIT is a cheaper option when installing larger quantities of anchors but there can be an issue with the air bubbles inside the hole. It can be also hard to use on hot days as it dries quickly inside the nozzle, rendering it useless.

Hilti mechanical anchors recommended for SRA product installation:

- Hilti HSL-GR stainless steel in M12 and M10
- Hilti HSL 3 & Hilti HSL 3B in M12. Indoor use only!
- Hilti HST3-R in M12

Through bolts:

- Use rods with backing plates

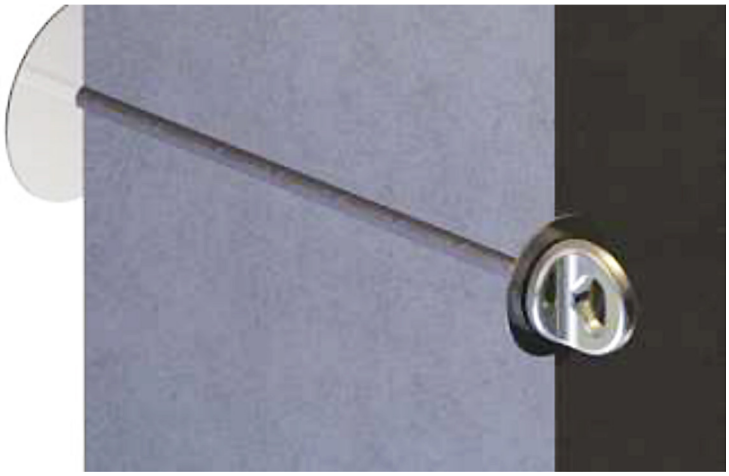
The size of the backing plate is important, especially when installing through multiple brick walls. The backing plates should capture as many bricks as possible i.e. you wouldn't use a small backing plate that covers only one brick. The aim here is to spread the load over a larger surface area and capture at least 3-4 bricks, or possibly more using custom made backing plates. If unsure, consult an engineer!

5.3 Direction of pull

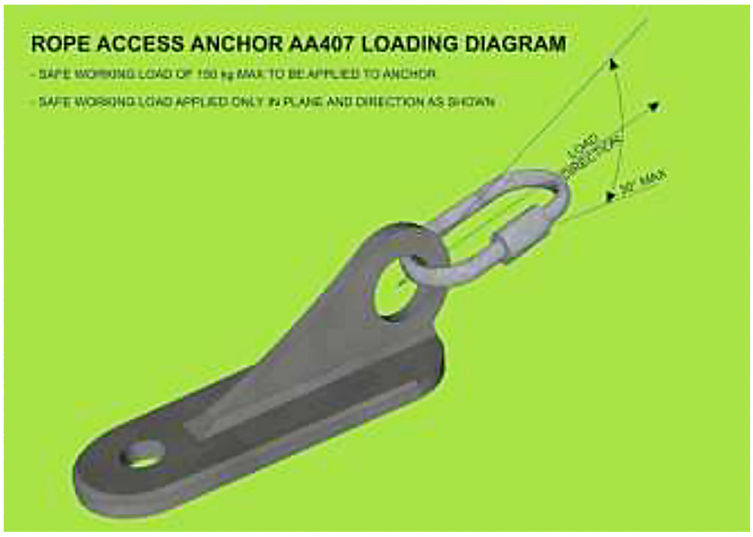
Collared eye bolts, installed either chemically or mechanically into concrete (and natural stone), must not be loaded under an angle greater than 20° with the surface they have been installed in to (AS/NZS 1891.4:2009 Industrial Fall Arrest Systems and Devices – Selection, Use and Maintenance).

This means that eye bolts must be loaded in **SHEER** only. Direction of pull exceeding 20° is considered **tensile** loading. Loading the eye bolts under tension can result in catastrophic failure should the chemset fail. The SRA **AA407** swivel anchor has been developed for loading under an angle up to 30°. Should the anchor point serve as a tensile anchor, the system designer must consider one of the following options:

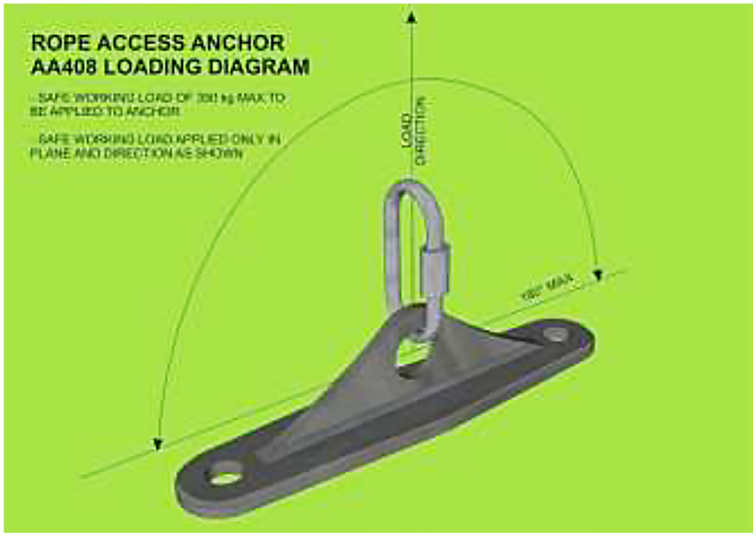
1. Install a double bolt anchor such as **AA408** which provides the safety factor of 2 bolts.
2. Install through bolt **AA400T** with a backing plate on the other side of the wall.



AA400T – through bolt anchor



AA408 anchor – tensile and sheer loading

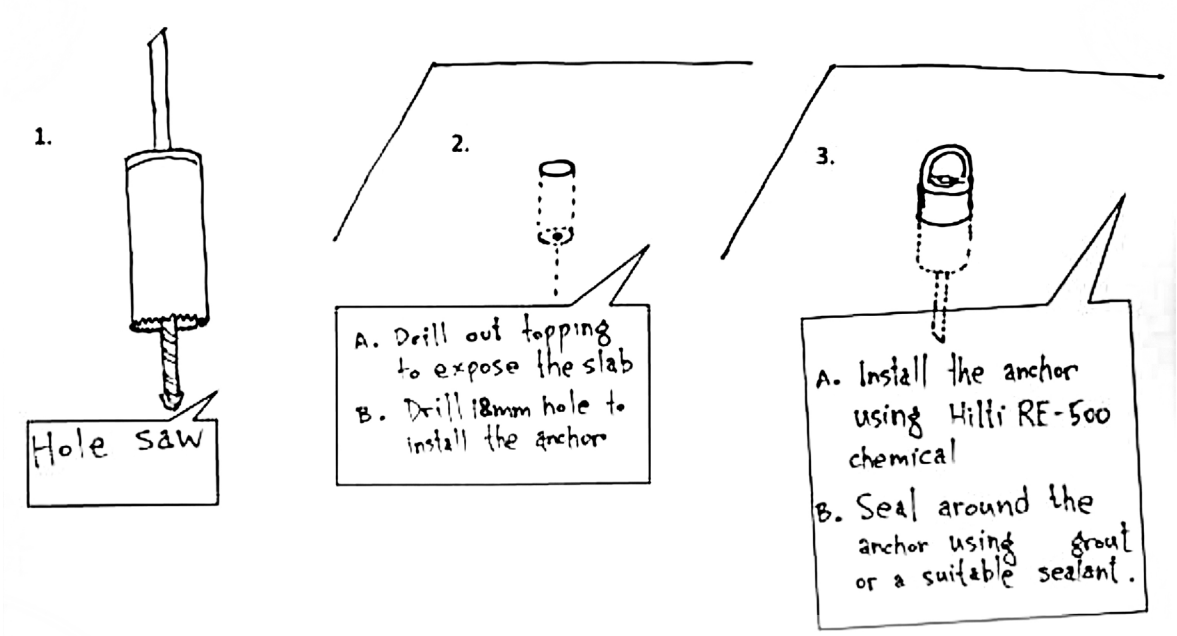


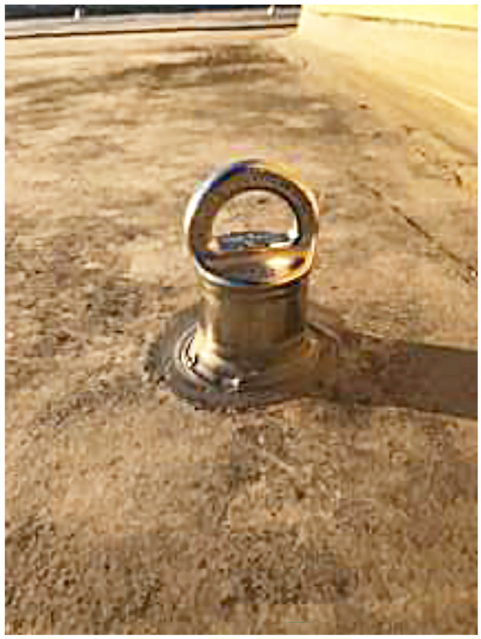
AA406 anchor – sheer loading only

5.4 Concrete roofs with topping

Some old concrete roofs have a layer of topping over the concrete slab. This topping is typically around 00mm thick and sealed off with a membrane making it hard to spot. Once identified, the installer is generally faced with 2 options:

AA405 - the easiest option

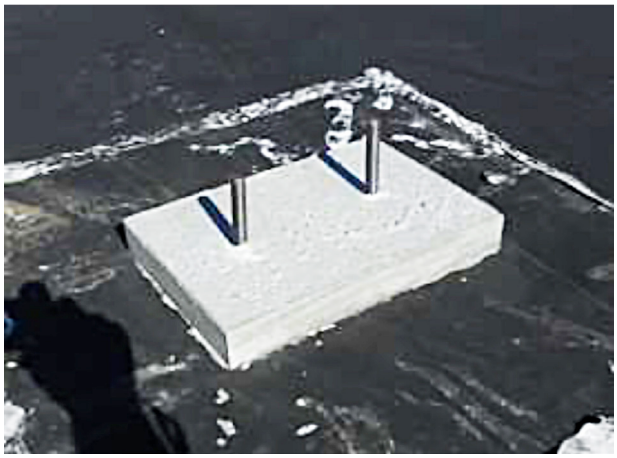




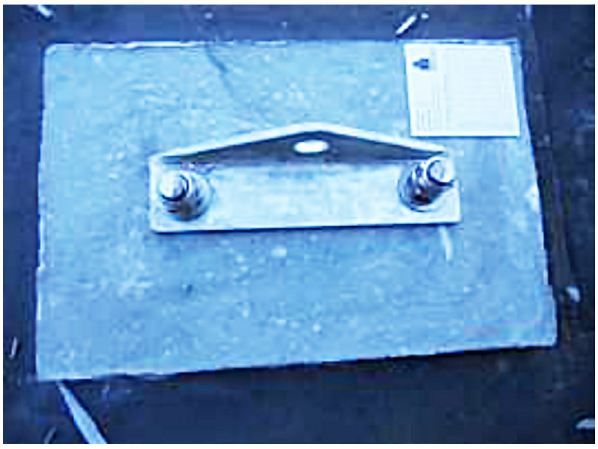
AA408 on reinforced Sika grout hobs - for all applications where the loading angle exceeds 20°with the roof (i.e. tensile applications)

Note: For the ease of annual testing & re-certification it must be remembered that fixings must stay **exposed** above the surface and not get buried under the insulation.Hilti mechanical anchors recommended for SRA product installation:

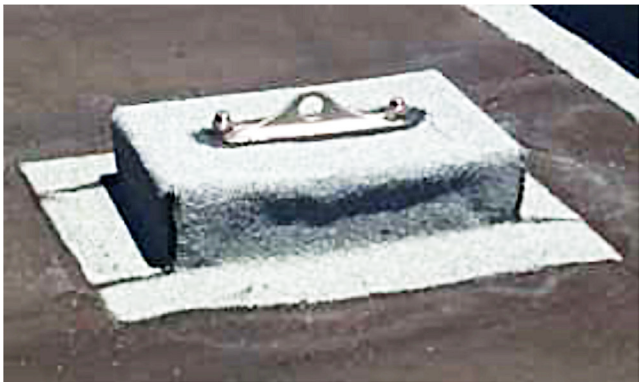
A. Insulation is removed and the slab is exposed



B. Grade 316 stainless steel M16 rods are installed and reinforced Sika Grout hobs are constructed



C. Grade 316 stainless steel anchors are installed on the hobs



D. The hobs are water proofed with membrane (different anchor model shown AA408

E. Different water proofing technique shown - stainless steel flashing over membrane

Advantages of concrete hobs:

- Eliminate all water proofing issues around the anchor.
- All parts of the system are visible and can be visually inspected and tested at any time.
- Easy rigging, including tensile applications.
- Fully engineered system

5.5 M12 vs. M16 rod size

As per Hilti standards, the depth of embedment is 110mm for M12 and 125mm for M16 rods.

The above application (concrete hobs) is the one of the very few examples where we recommend M16 rods. The reason for this is that the rods are longer than usual and we want to avoid any flex (possible tensile loading) should the hob fail.
In all other installations into concrete we recommend M12 rods as their strength is more than sufficient for the 15kN requirement. The depth of embedment is less when compared to theM16 rods and therefore the slab thickness requirement is also reduced, which can be a huge benefit particularly on older buildings. Furthermore there is less wear and tear on the drilling equipment and the overall cost of chemicals is cheaper.

5.6 Annual testing and re-certification

Every friction or glued in anchorage shall be proof loaded to 50% of the designed ultimate strength (as specified in the table below) in accordance with the 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 the design load shall also be carried out as part of the subsequent periodic inspection. (AS/NZS 1891.4:2009 Industrial Fall Arrest Systems and Devices – Selection, Use and Maintenance)

Certification must be done by a competent person holding professional indemnity insurance!

STRENGTH REQUIREMENT FOR ANCHORAGES

kilonewtons

	Purpose of anchorage	Ultimate strength in direction of loading (minimum) (see Note 1)
(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
	~~Restrained fall-arrest—restraint line anchorage~~	~~6~~
	~~Total restraint only—no risk of a fall~~	~~6~~
(b)	*Horizontal lifelines* (see Note 2)	
	End anchorages	See Clause 6.2.4
	Intermediate anchorages	
	—diversion less than 15 degrees	12
	—diversion 15 degrees or more	12+ (see Note 3)

When installing rods for SRA AA400 series anchors into concrete, leave at least 3 threads showing above the lock nut. When the time comes to test the fixing you won't need to unscrew the lock nut and instead you will be able to screw an eye nut onto the rod and proof load it.

All fixings are to be proof loaded. Do not proof load the eye only, unless it's an AA402 anchor (eye bolt). If there are multiple fixings, proof load them individually!

5.7 Steel roof anchor points – Allfit 360˚, Maxifit 360˚, Profile Grip series (SURFACE MOUNT ANCHORS)

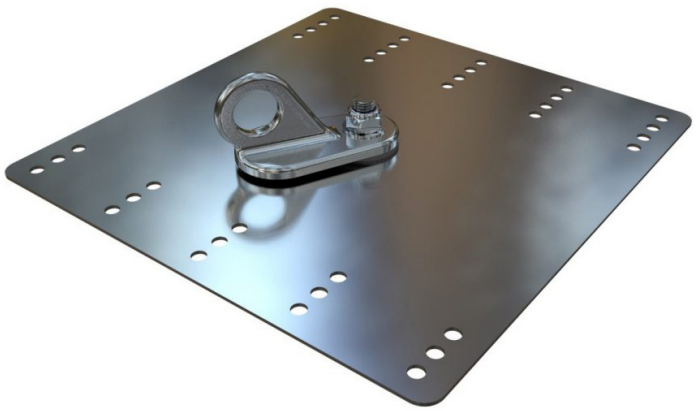
There are many types of steel roof sheeting used in Australia. Some roof profiles used are typical for some areas and construction periods as well as volumes of rainfall typical for that area.

Metal deck roofs can be built on both steel and timber structures. The roof sheets are typically held either by screws (e.g. Corrugated) or clips (e.g. Klip-lok type).

When installing into metal roofs, some basic rules need to be observed:

1. The roof sheet must be in good condition (no excessive corrosion)
2. The size and gauge of the steel purlin must be observed
3. The timber baton size must be observed
4. The correct screws must be used for either timber or steel structure
5. Overlap and underlap of roof sheets must be observed
6. Minimum distance from the roof's edge must be observed
7. Profile Grips must be loaded in sheer only

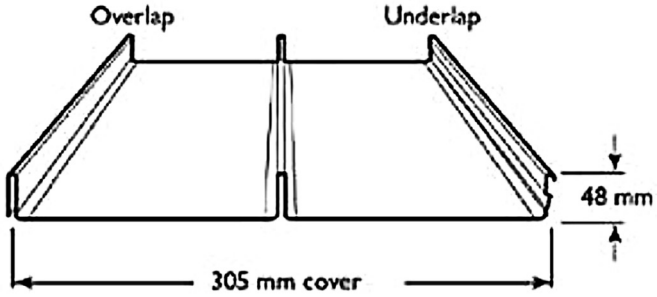
Allfit 360˚ - Designed for a hassle-free installation into majority steel roofs. Surface mount anchor suitable for rope access and fall arrest



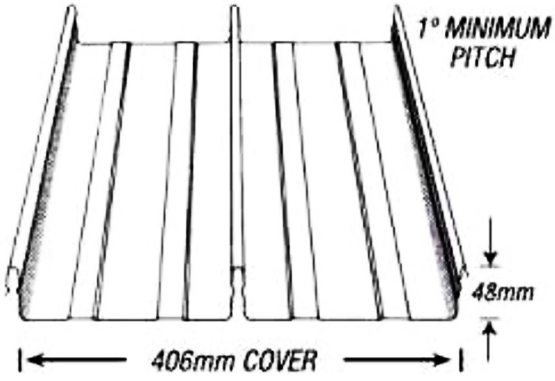
Maxifit 360˚ - Designed for a hassle-free installation into Spandek profile and some other larger span profiles. Surface mount anchor suitable for rope access and fall arrest

Profile Grip series

PG1 – Designed to provide the best fit to Longline roof sheet, PG1 can be used for rope access as well as to support a fall arrest load of 15 kN



PG2 – Designed to provide the best fit to Brownbuilt roof sheet, PG2 can be used for rope access as well as to support a fall arrest load of 15 kN

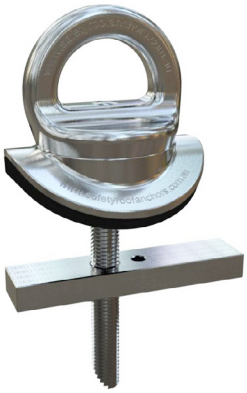


Purlin anchors AA403 and AA403C

Suitable for metal deck roofs with steel purlins. Minimum purlin gauge must be at least 150mm x 1.2mm

AA403 – typical Klip lock or screwed on sheet applicationprofiles. Surface mount anchor suitable for rope access and fall arrest

AA403C – corrugated sheet application



5.8 Timber trusses and rafters – Truss-T-Grip® series (Australian Patent 744587)

Timber trusses and rafters are utilised in many residential and government buildings around Australia and are therefore a good market to get into, provided the right products are used. Truss-T-Grip® anchor points offer an unrivalled strength and ease of installation, supported by engineering and independent testing. Truss-T-Grip® is a trade mark of SRA and is patented in Australia, USA and Europe.

The key feature of the Truss-T-Grip series anchor points is that their installation doesn't rely on penetration of the timber members. Rather, it utilises a unique clamp system which compresses the timber, rather than splitting it, in the event of arresting a fall.

Drilling of trusses and rafters significantly weakens them and also voids the builder's warranty.

Truss-T-Grip anchor points are suitable for both fall arrest as well as abseiling, when installed according to SRA's instructions!

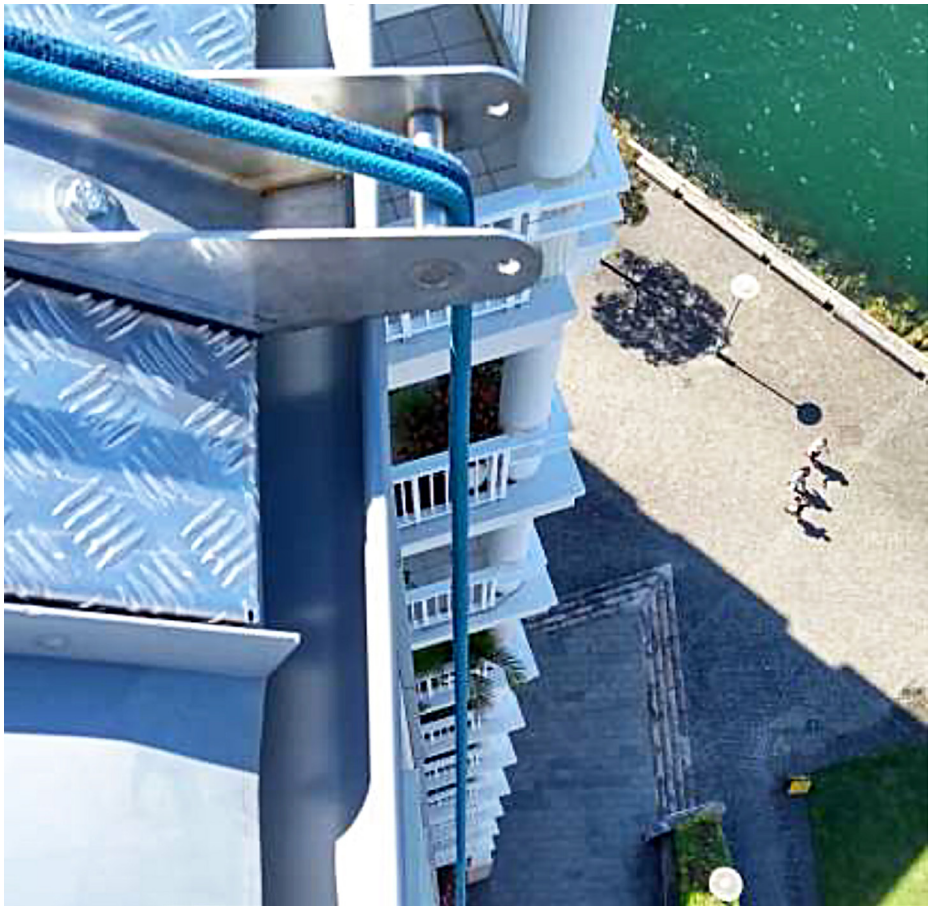
They can be installed in under 1 minute with very basic tools such as a spanner and hammer. Due to the ease of installation they are also ideal for use as temporary anchors.

Truss-T-Grip anchors are stocked in the most common rafter sizes (100x50mm and 90x35mm) but can be made to suit any timber member.

It has to be understood that a timber rafter is very strong when loaded along its length. When loaded sideways it can only withstand a fraction of the force and can fail catastrophically. Extra nogging and armour plates must be installed between the rafters to provide for side loading!

5.9 Edge Protection – Gutter Jumper (EP01)

To protect gutters and other delicate building edges during rope access, SRA has developed a Gutter Jumper - a portable rope diversion device made of heavy-duty aluminium chequered plate and a welded bracket. It has been rigorously tested over a 2-year period and provides an ideal balance of toughness and portability.

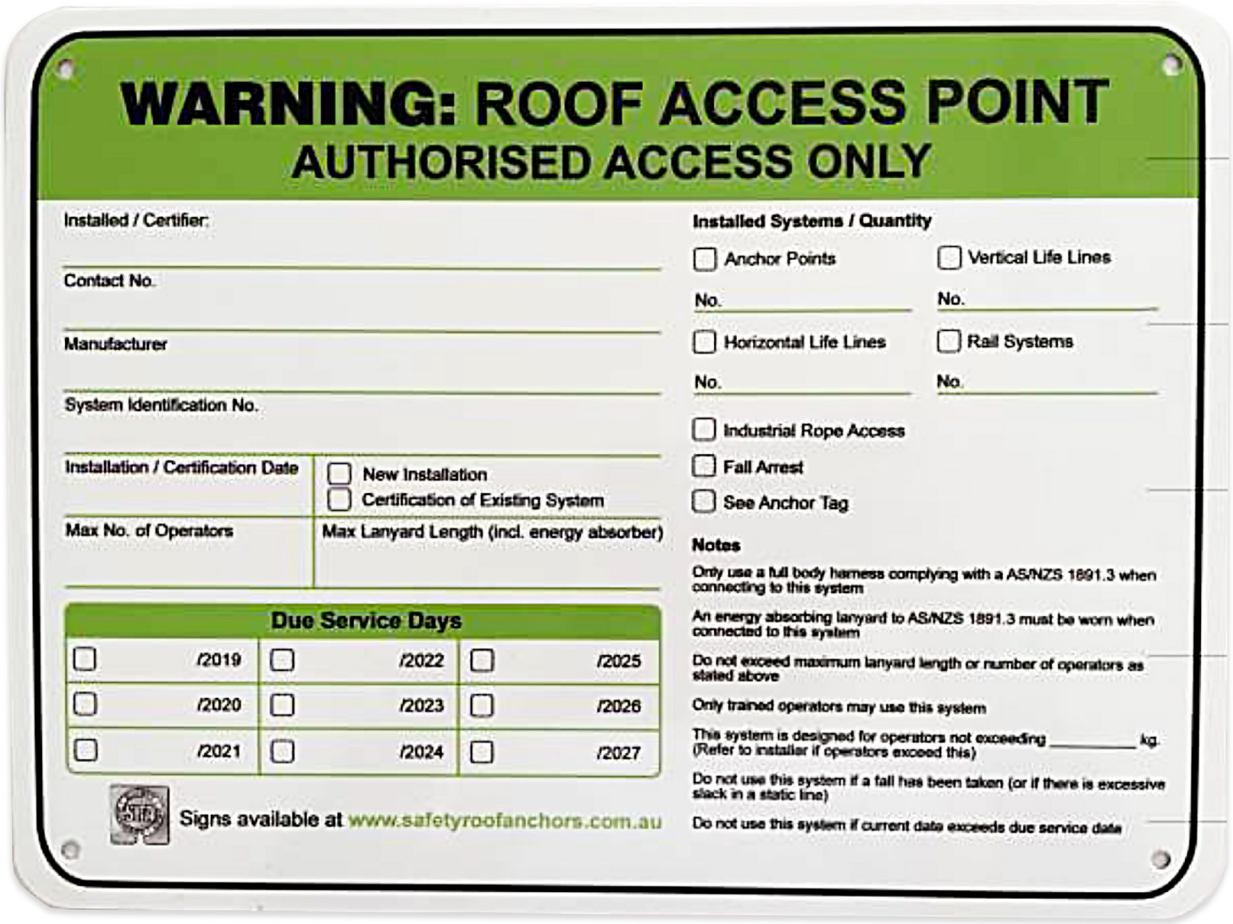


MODULE 6:
SIGNAGE

Each permanently installed anchor point must have a weather proof tag attached to it identifying:

1. The installer
2. Date of installation and certification
3. Rating and purpose of the anchorage
4. Maximum number of people (max 2) permitted to be connected to the anchor at any one time

A compliance plate listing all parts of the system and their quantity must be attached at the roof access area.

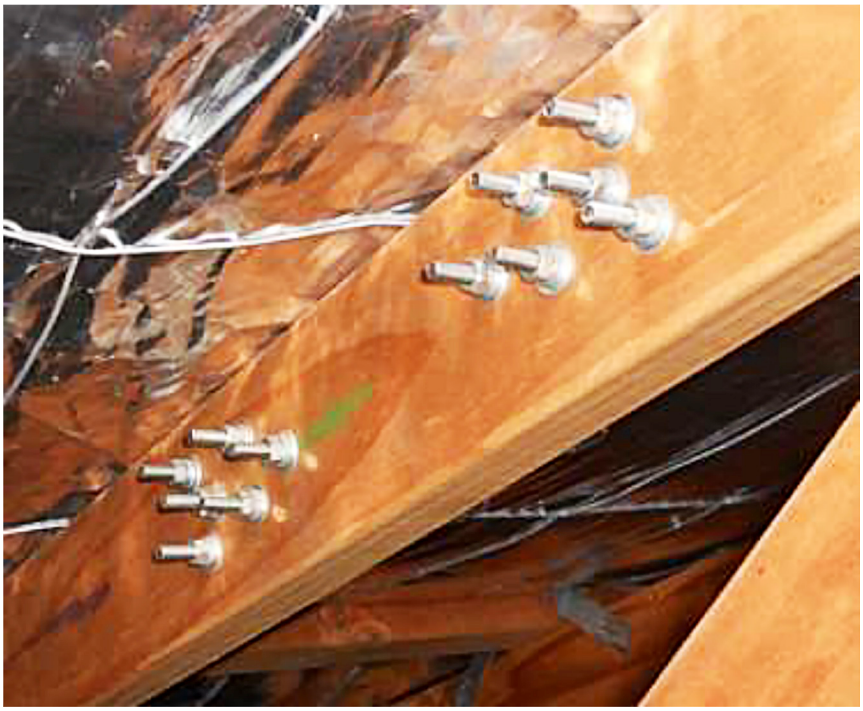


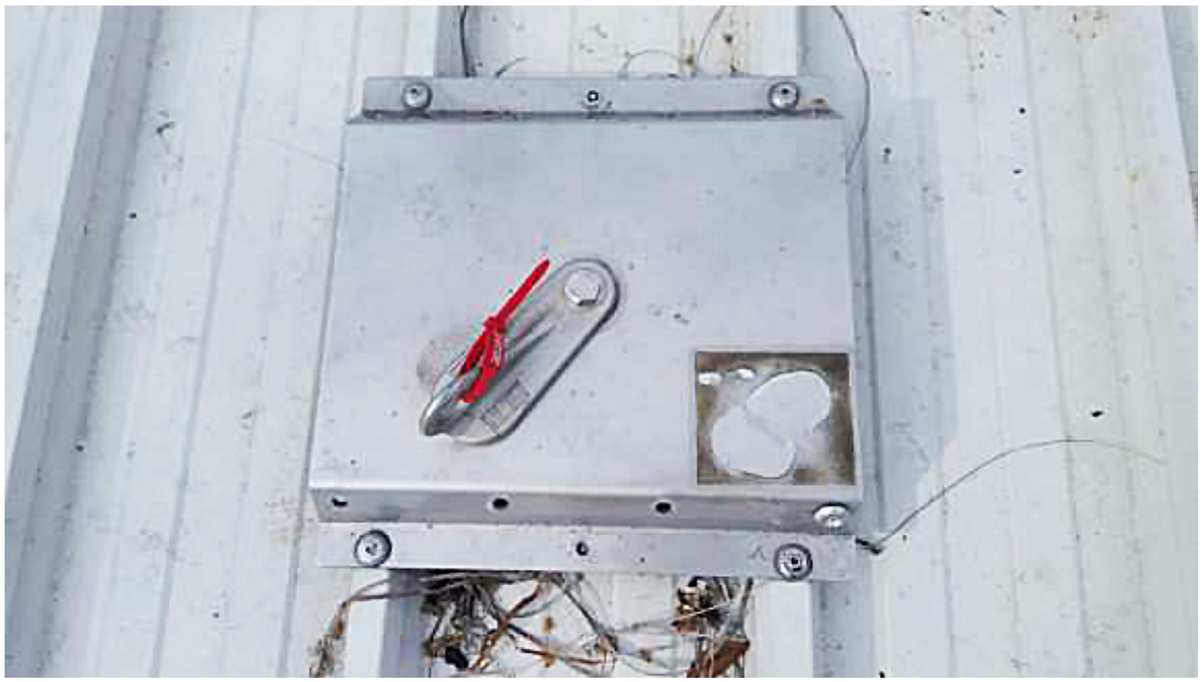
MODULE 7:
INCORRECT INSTALLATION

Due to unclear regulations in height safety it is not uncommon to see installations which are clearly not right. It is up to you as an installer to identify these products and report them to the client who will hopefully listen and employ your services to uninstall them and to replace them with better, fully compliant products.

Prior to AS/NZS 5532:2013 there was no requirement for the anchor points to be live tested by the manufacturer. As a result we can see many home-made anchor devices as well as regular anchors installed in the wrong way.

See the examples below:





The above pictures are just a few examples of incorrect installations that you can expect to see on roofs.

VECTOR
FORCES

Vector forces become apparent whenever there is an internal angle greater than 0° between two or more rigging components or anchorage points.

For ease of explanation, a vector force is typically trying to pull horizontally as well as vertically. This has a multiplying effect on the loads that are felt at the anchor points and likewise the tension exerted within the rigging equipment, be it ropes, slings, strops or chains. The effects of vector forces must always be taken into account when undertaking rigging tasks to ensure that these forces do not exceed the safe working load capacity of the equipment, components and anchor devices used within the system.

Force is an influence that has both magnitude and direction, it is usually given in the dynamic unit of Newtons (N). For ease of explanation we have used kilograms on this page.

The Basics

To start with the basics, if we imagine a load of 100kg suspended equally from two slings then each sling would equally share half of the loads weight.

In the situation illustrated to the right, the weight of the load = 100kg. The load is supported by two slings of equal configuration with no internal angle, so 100kg / 2 = 50kg. This means that each sling and anchor point is being subject to 50kg or 50% of the loads weight.

The Ideal Angle

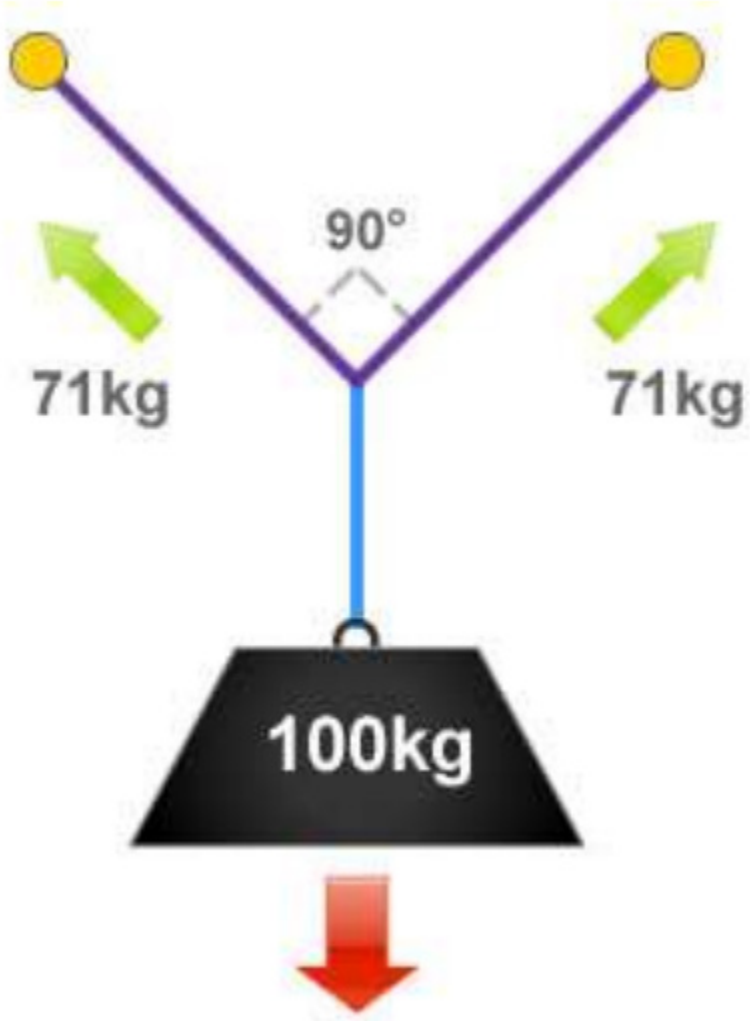
As the internal angle between the rigging slings increases then additional forces (vector forces) begin to be applied to each sling / anchor point.

When rigging ropes the 'ideal angle' is approximately 45°, at the ideal angle there would be 54% of the loads weight being distributed to each anchor device. Although this is over half of the original weight of the load we have still gained an advantage vby sharing it between the two anchor points.

The “OK” Angle

An internal angle of 90° between ropes and rigging components is sometimes referred to as the ‘OK’ angle. At this angle 71% of the loads weight will be distributed to each anchor component, so in this example that will be 71kg.

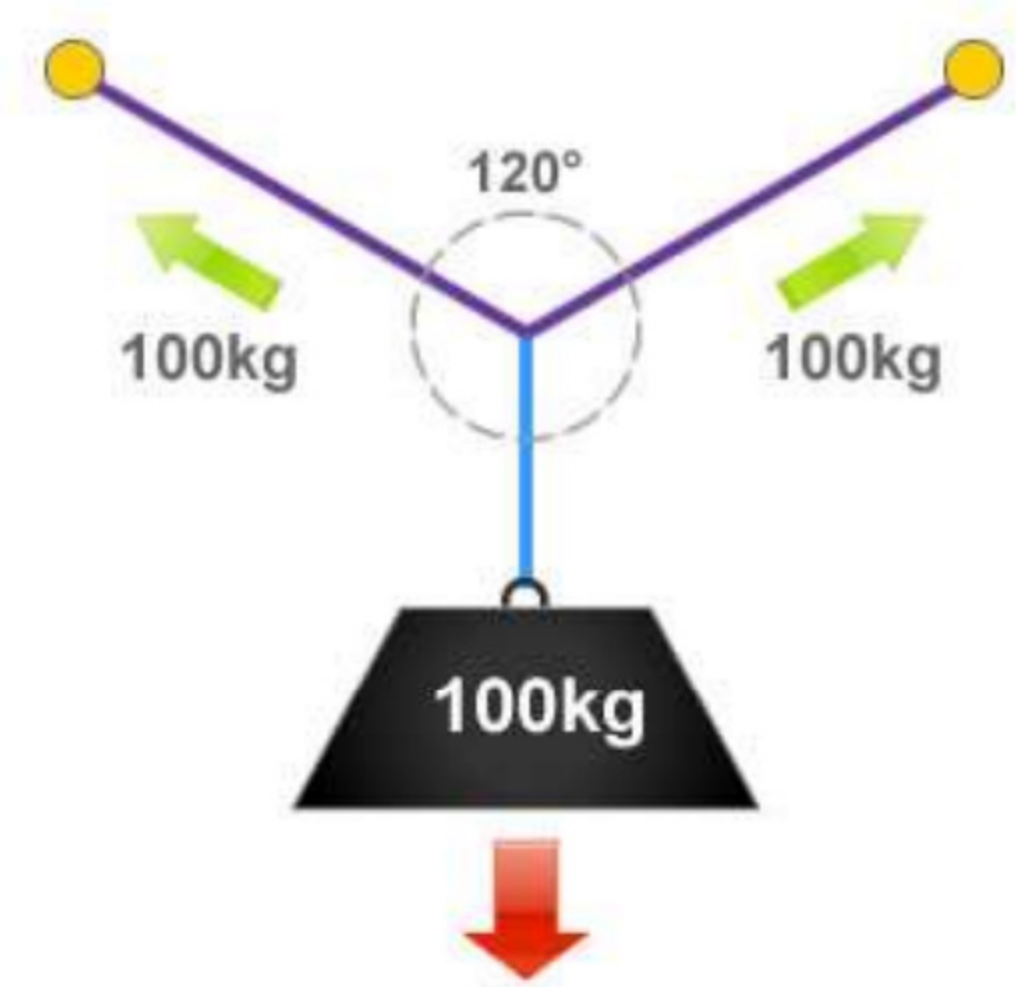
It is often easier to roughly estimate a 90° or right-angle when undertaking rigging tasks. By staying at or below this angle ensures that we don’t load our anchor components with excessive forces.



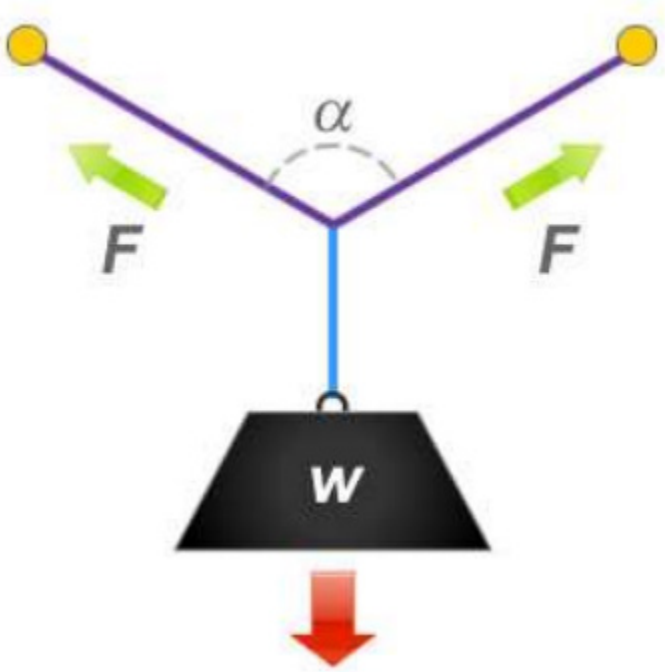
The Critical Angle

A basic way to understand the effect of vector forces is to imagine that if a full circle equates to 360° and this was split into three equal parts we would end up with three angles of 120°, as show in the illustration on the right. An internal angle of 120° is also defined as the 'critical angle'.

Because everything is in equilibrium at the critical angle of 120°, whatever the load weighs is what we have being exerted to each anchor point and each item of rigging equipment. So in this example it is 100kg or 100% of the loads weight.



The Calculations



Vector forces can be calculated using mathematical formula. So far on this page we have used kilograms to represent the loads in the illustrations. As a kilogram is a measurement of mass, this should be converted to weight (Newtons) to calculate the resultant force correctly.

Providing that the rigging components are sharing the weight of the load equally, such as in a 'Y' hang then the following equation can be used:

$$F = \frac{(w \times 0.5)}{\cos(\alpha \times 0.5)}$$

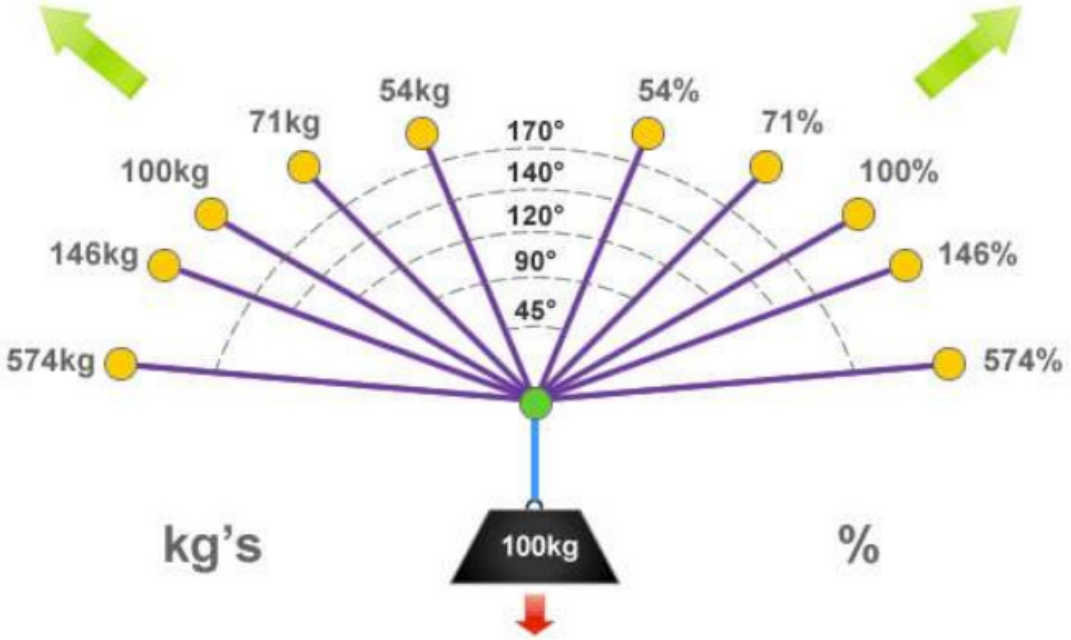
Where:

F is the resultant force exerted to each anchorage.
W is the weight of the load.
α is the internal angle between the two slings.

Force is an influence that has both magnitude and direction, it is usually given in the dynamic unit of Newtons (N). For simplicity we have used kilograms for the examples on this page.

Vector Force Chart

This chart displays the resultant force applied to each anchor point / rigging component when the load is equally shared in a Y-hang rigging configuration. The ratio is also given in percentages as this is often an easier way to calculate forces relevant to the specific weight of the load.



Notice that when the critical angle of 120° is exceeded, then these forces increase dramatically. If an angle of 175° could be achieved (although this would be extremely difficult) then with a 100kg load there would nearly be 1150kg being felt by each anchor component. Something worth keeping in mind when working with Tensioned Lines, Cross Hauls and Tyrolean's!

Using Percentage Ratio

It is not always the case that the load will weigh 100kg, it is far easier to calculate the relevant vector forces from a percentage ratio. This can be achieved by using the formula:

$$F = w \times \left(\frac{\%\ factor}{100} \right)$$

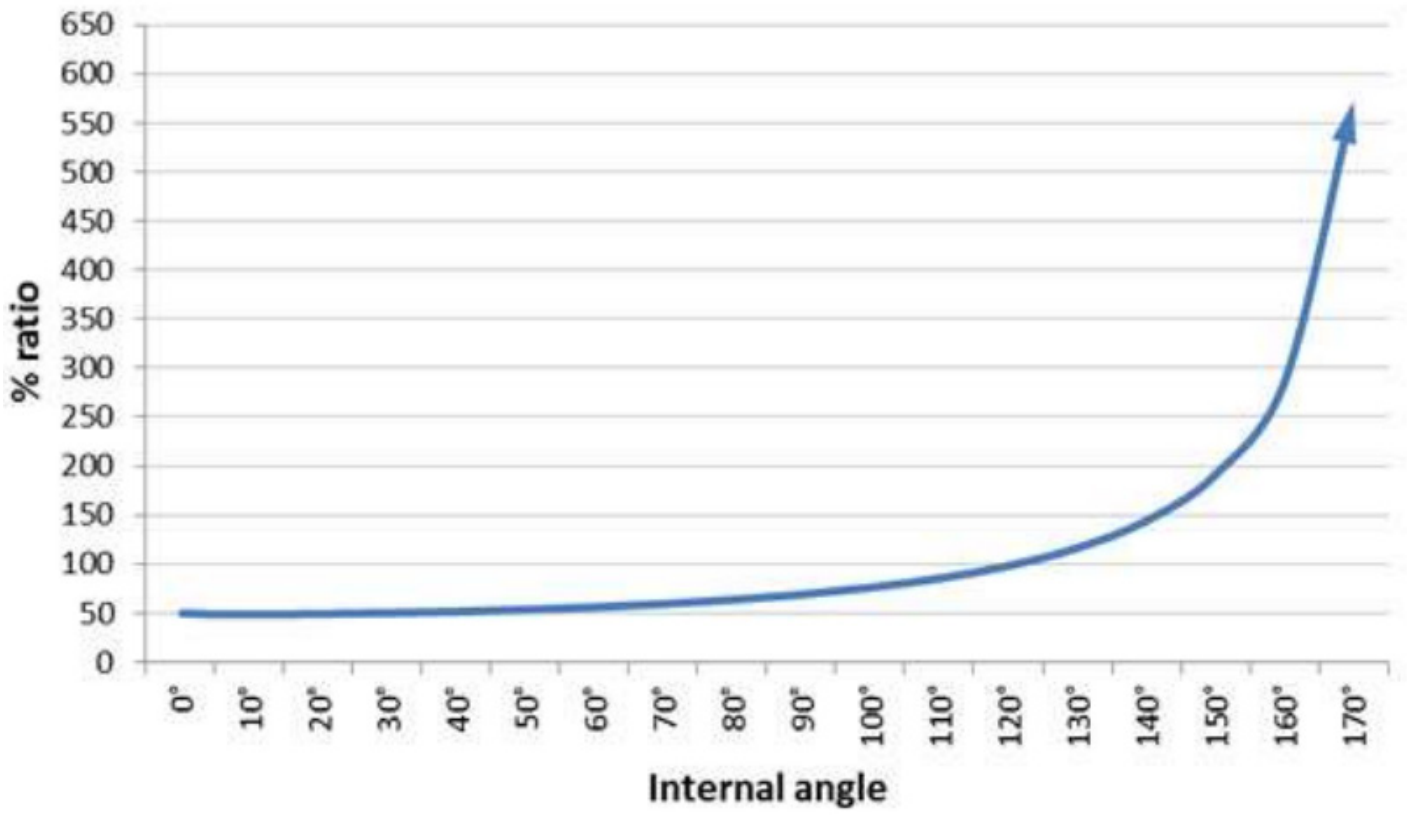
For example if we had a load weighing 76kg suspended from a Y-hang rigging configuration with an internal angle of 75° then:

$$F = 76 \times \left(\frac{63.0}{100} \right) = 47.8$$

ANGLE	% RATIO	ANGLE
0°	50.00	65°
5°	50.1	70°
10°	50.2	75°
15°	50.4	80°
20°	50.8	85°
25°	51.2	90°
30°	51.8	95°
35°	52.4	100°
40°	53.2	105°
45°	54.1	110°
50°	55.2	115°
55°	56.4	120°
60°	57.7	125°

Vector Force Graph

The graph below displays the relationship between the internal angle and the percentage ratio. At 180° this line would continue to rise vertically, meaning that from a mathematical point of view the force exerted on each anchor point would be infinite.



See more at: http://www.ropebook.com/information/vectorforces#sthash.vgUdv4vK.dpuf

SAMPLE
CERTIFICATE

Height Safety Access System Certificate

☐ New System ☑ Existing System

Client:	Owners of Strata Plan or building owner etc
Site Address:	
System Location:	Roof of the building.
Date Installed:	N/A
Date Certified:	20/03/2018

Systems Tested/Certified

☑ Anchor Points	☐ Life Lines/Static Lines	☐ Track Systems	☐ Inertia Reels

ANCHOR POINTS - TOTAL QUANTITY 22

Quantity	Anchor Type	Host Structure	Fixing	Rope Access	Fall Arrest	Manufacturer/Code
	Eye Bolts			☐	☐	
	Surface Mounts			☐	☐	
	Through Bolts			☐	☐	
	Rafter Anchors			☐	☐	
22	Purlin Anchors	**Steel Purlin/Steel Roof Sheet Combination**	**Through Bolt M12**	☑	☐	**Unknown**

Test Description			
☐ Applied axial pull out of force of 6kn (as per AS/NZS 4488.2 1997 Industrial Rope Access Systems)			
☐ Applied axial pull out of force of 7.5kn (as per AS/NZS 1891.4 2000 Industrial Fall Arrest Systems and Devices)			
☐ Applied axial load force and inspected in accordance with AS/NZS 1981.2 Supp 1 - 2001 Industrial Fall Arrest Systems and Devices - Horizontal Life Lines and Rail Systems			
☑ No Load Test required - Visual Inspection Only			
Test Results			
Sample No.	**Load Applied**	**Pass / Fail**	**Anchor Rating (kN)**
22x purlin anchor	N/A	Pass	12KN

Test Equipment Used		
☐ Hilti Tester 4 S/N 59604	Calibration Date	
☐ Load Cell AD 4326A	Calibration Date	
☑ None Required		
Attachments		
☐ Photo(s)	☐ Spec Sheet	☐ Layout Plan

The Height Safety Access System is to be used by rope access personnel and other competent contractors with current NSW accreditation for work at heights only.

It is compulsory to inspect all parts of the system every 12 months to ensure their continued integrity as a fall arrest / rope access system.

???????? 20 March 2018

Director

Anchor Point Certificate JK V2 Dec 2012

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