Light Lifting Systems

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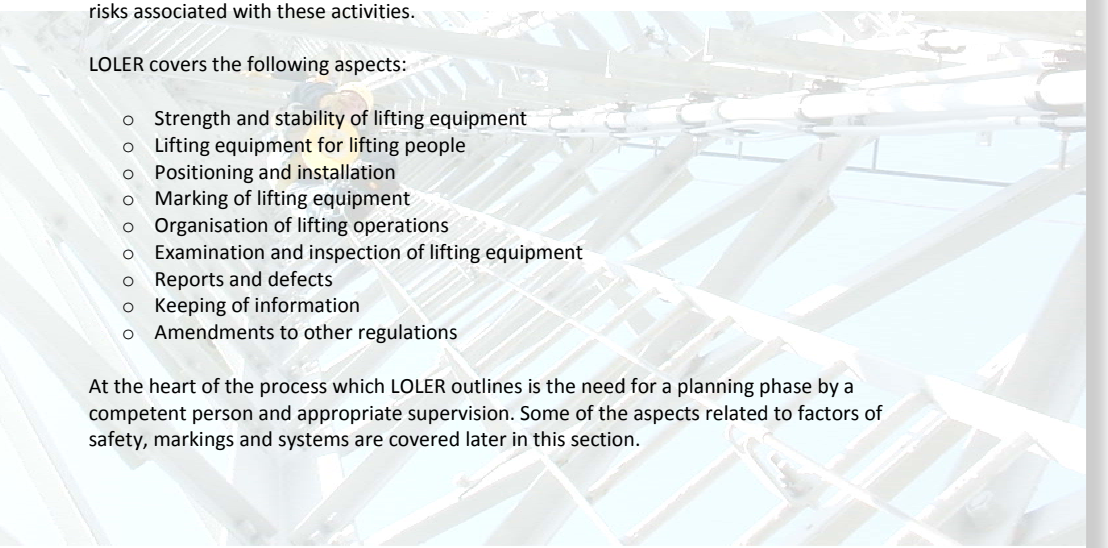
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Health & Safety Regulations

In addition to the pieces of legislation and regulations already outlined during the course there is a need when considering lifting and lowering operations to have an understanding of the implications two other important regulations. Under the Health & Safety at Work Act (Application outside Great Britain) Order 1995 all of these regulations are extended to all offshore activities and sub-sea installations on the Great Britain continental shelf.

Lifting Operations and Lifting Equipment Regulations (1998) LOLER

The 17 regulations of LOLER apply to all lifting equipment used in the work place, whether it is used to lift loads or people, and no sector of industry is exempt. The aim is to reduce the risks associated with these activities.



LOLER covers the following aspects:

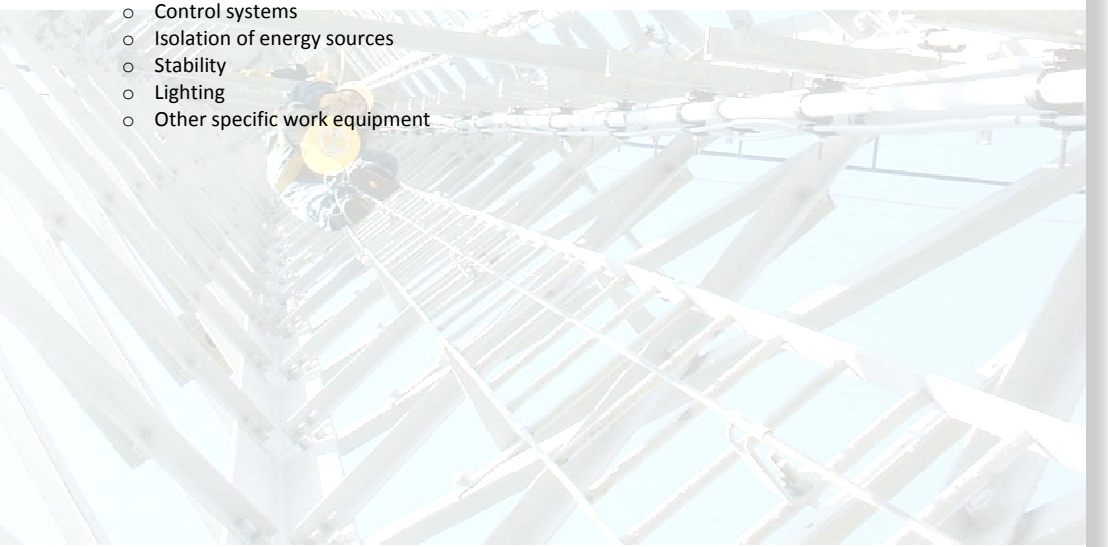
- Strength and stability of lifting equipment
- Lifting equipment for lifting people
- Positioning and installation
- Marking of lifting equipment
- Organisation of lifting operations
- Examination and inspection of lifting equipment
- Reports and defects
- Keeping of information
- Amendments to other regulations

At the heart of the process which LOLER outlines is the need for a planning phase by a competent person and appropriate supervision. Some of the aspects related to factors of safety, markings and systems are covered later in this section.

Provision and Use of Work Equipment Regulations (1998) PUWER

The 35 regulations of PUWER apply to the use of all work equipment including those used to lift loads. The regulations cover in details the following aspects:

- Suitability of work equipment
- Maintenance
- Inspection and markings
- Specific risks and warnings
- Information, instruction and training
- Conformity
- Dangerous parts of machinery and protection against specific hazards
- Control systems
- Isolation of energy sources
- Stability
- Lighting
- Other specific work equipment



Equipment Markings & Factors of Safety

Dependent upon the origin and purpose of equipment used for lifting the markings will vary and it is essential that the markings and terminology are fully understood.

Typically equipment will either come from an industrial lifting background or a mountaineering background. The intended use and therefore the markings are very different.

Industrial lifting equipment will come with markings in respect of a Safe Working Load (SWL) or more recently a Working Load Limit (WLL). Both of these terms refer to the same characteristic, which is the load which can be repeatedly applied to the equipment, without any damage by virtue of the load itself, i.e. what the equipment can lift in Kg's. This is in fact a fraction of the actual load at which the equipment will fail.

Mountaineering and industrial climbing equipment is designed to take dynamic loads, for instance when a person falls, and is therefore marked with a Minimum Breaking Strain (MBS). This is (at least in theory) the actual breaking strain of the equipment, and is normally given in the form of a force i.e. in Newtons (N) or Kilo Newtons (KN). One Newton is approximately 0.1Kg, . as such when used for lifting, we have to apply a fraction of this figure in order to establish what load it can repeatedly lift.

Factors Of Safety

The table below outlines the factors of safety related to the three different types of equipment as defined by their material and for the two classifications of loads i.e. equipment and people.

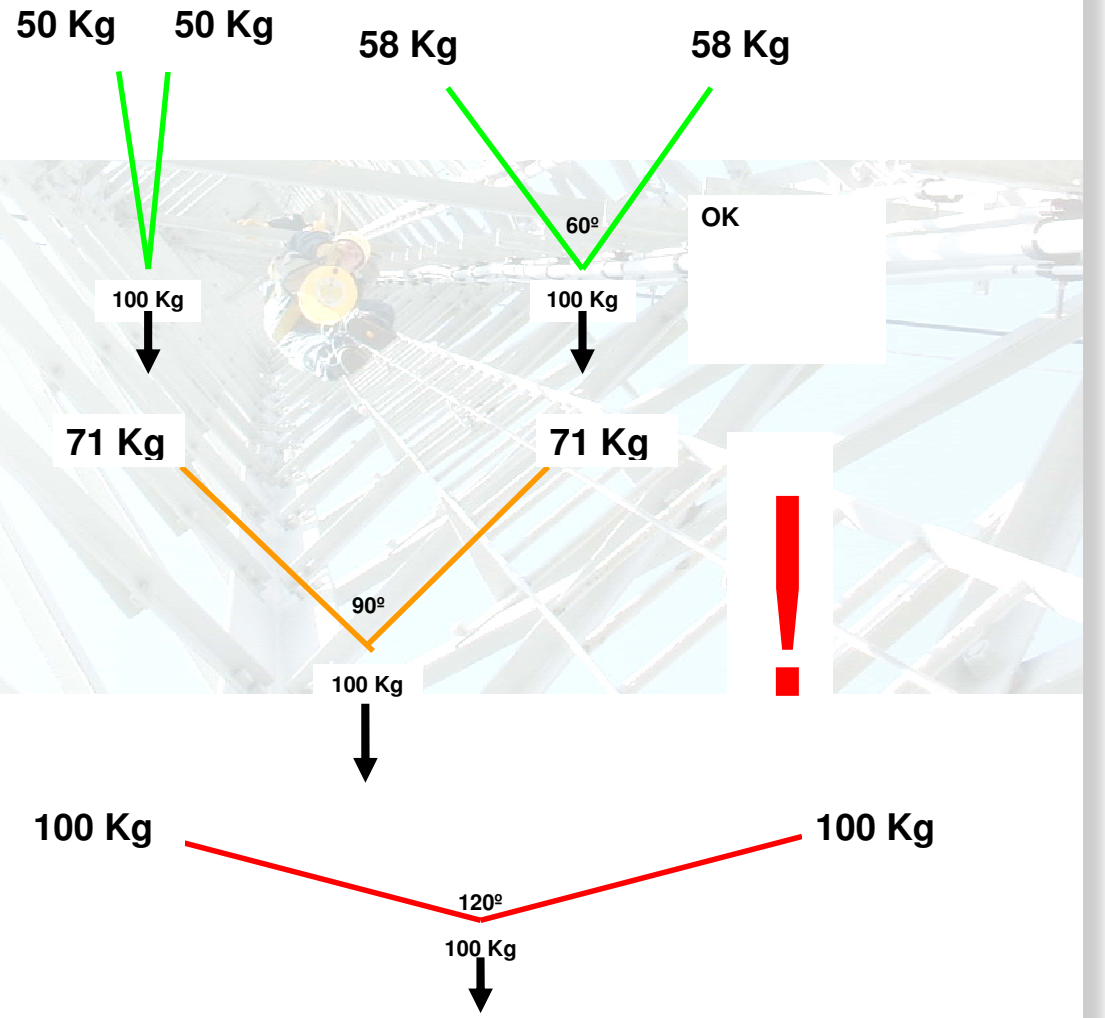
	Equipment	**People**
Metal Items	1/5	1/10
Fabric Items	1/7	1/14
Ropes	1/10	1/20

For example

1. A lifting sling marked with a SWL of 1000kg has a breaking strain of 7000kg and should be used to lift a maximum of 1000kg for equipment or 500kg for people.
2. A climbing Karabiner with a MBS of 25kN (2500kg) should only be used to lift a maximum of 500kg of equipment or 250kg of people.

Included Angles

When using more than one sling to lift a load it is important to consider the angle between the two legs (Included Angle) as this can have a major effect on the actual load being applied both to the sling legs themselves and to the connector joining the legs together. Below are some examples of the effects as the included angle is increased.



Safe Lifting / Lowering Systems

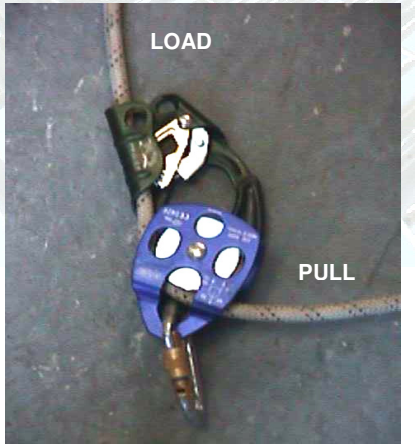
In order to create and operate a safe lifting / lowering system, there is a need to ensue firstly that the equipment is suitable and that there is an organisational system to control the lift activities.

In addition the practical plan detailing the lift itself, we will have to deal with aspect such at where the load will be moved from and to, what systems will be in place to prevent the load from falling and to control access to the danger zone under a suspended load and how the load will be stabilised to give directional and motion control.

Below are detailed some of the practical systems which can be used in light lifting systems to:

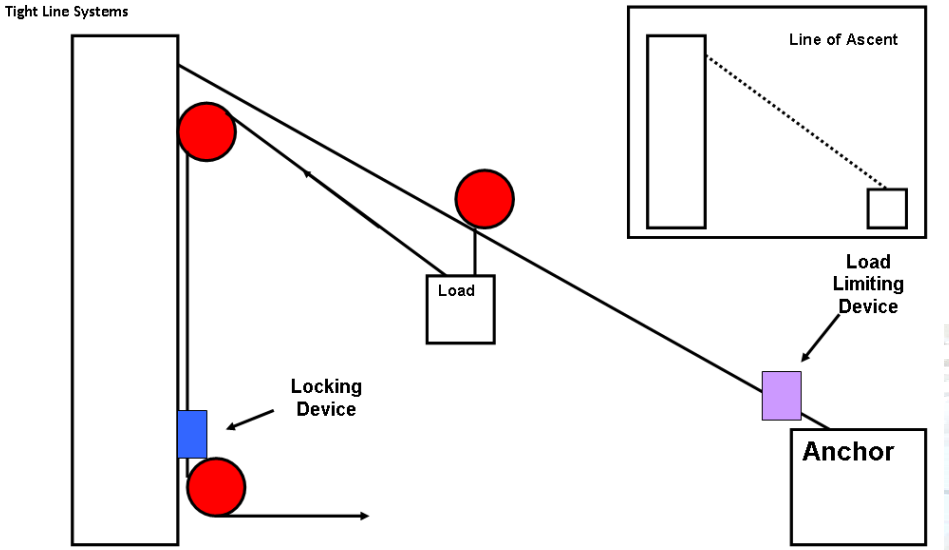
1. Act as a fail-safe brake to prevent the load falling during a lift.
2. A semi tight line to give simple directional control of the load without the need for other ropes or manpower, providing there is no conflict with obstructions under the landing point.
3. A tight line system to give more advanced and infinitely adjustable control to the loads' position to allow the load to clear obstructions below the landing point.

Fail Safe Brake

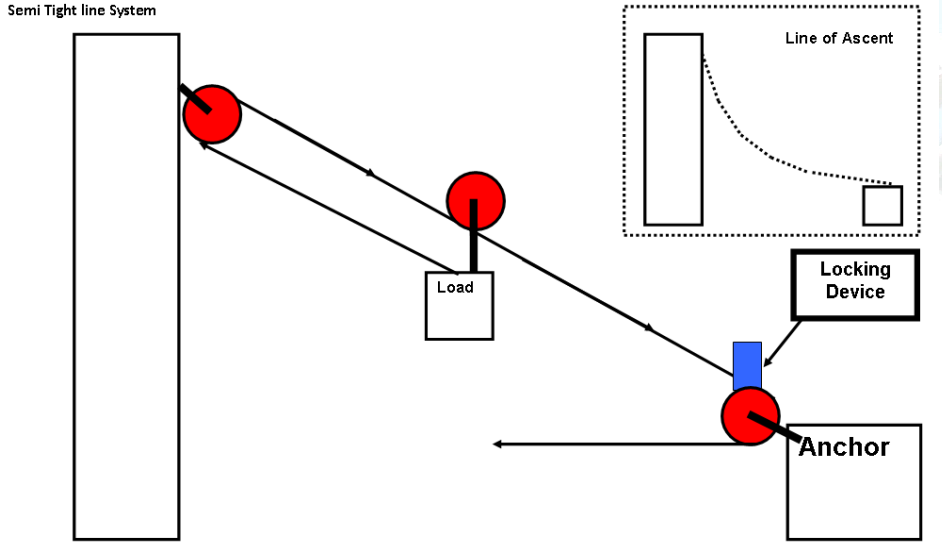


Each of the above systems can be used for lowering simply by replacing the failsafe locking device with an auto locking descender.

Tight Line Systems



Semi Tight line System

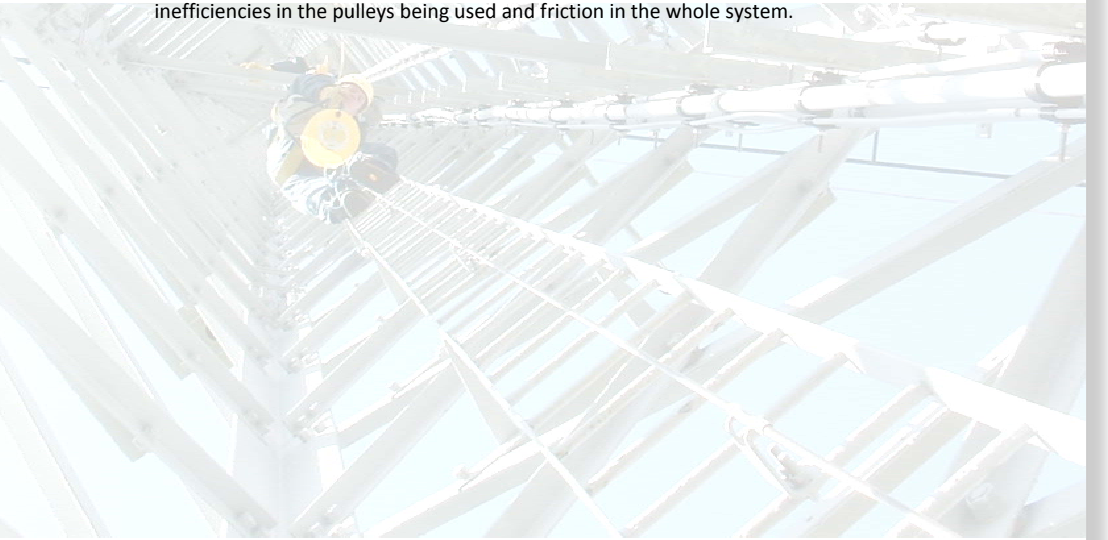


Efficiency Advantages of Pulley Systems

Pulleys can be integrated into the simple systems or those shown above to provide a more mechanically efficient system of lifting which requires less effort. The price you pay for this is more length of rope being needed. With any of these systems a fail safe is still required .

You will see from the following pages:

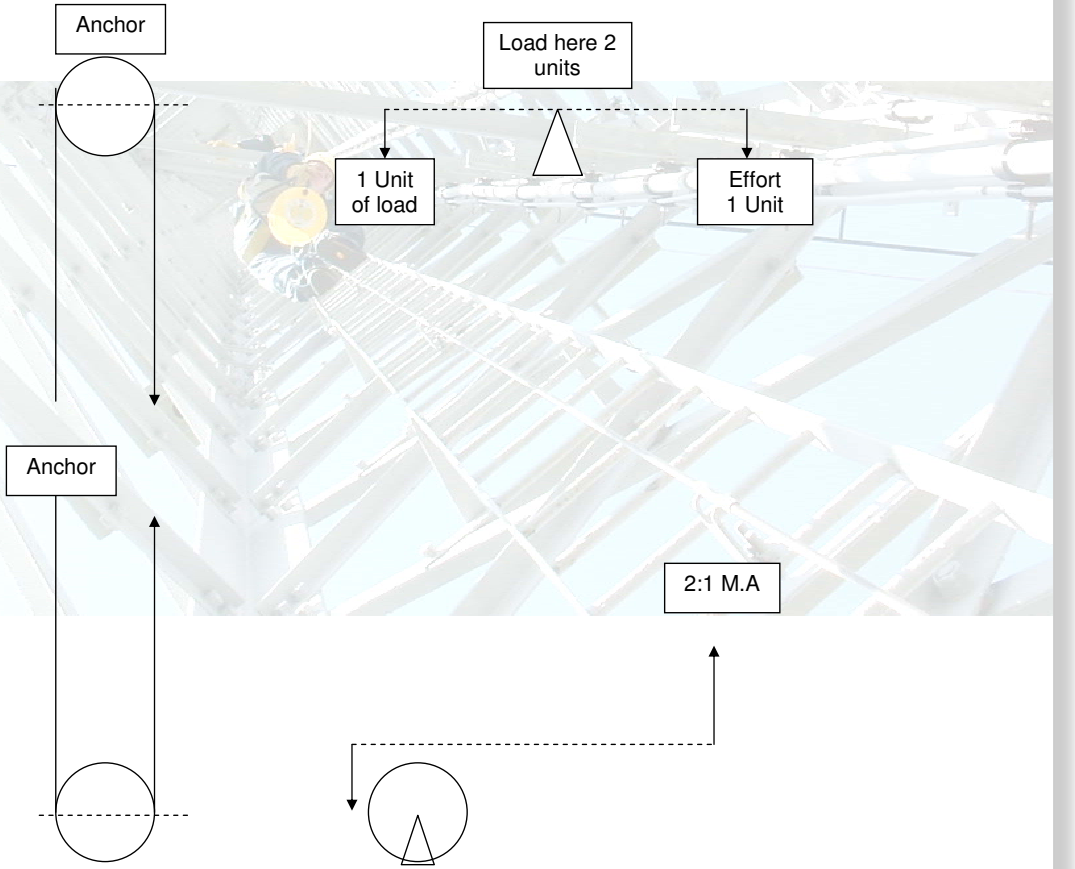
- The optimum size of pulleys is 4 times the rope diameter, any more and you do not gain any real advantage in respect of less effort required. This is primarily due to the inefficiencies in the pulleys being used and friction in the whole system.



How Pulleys work.

A pulley is a lever; this leverage effect can be used to generate a mechanical advantage. (M.A)

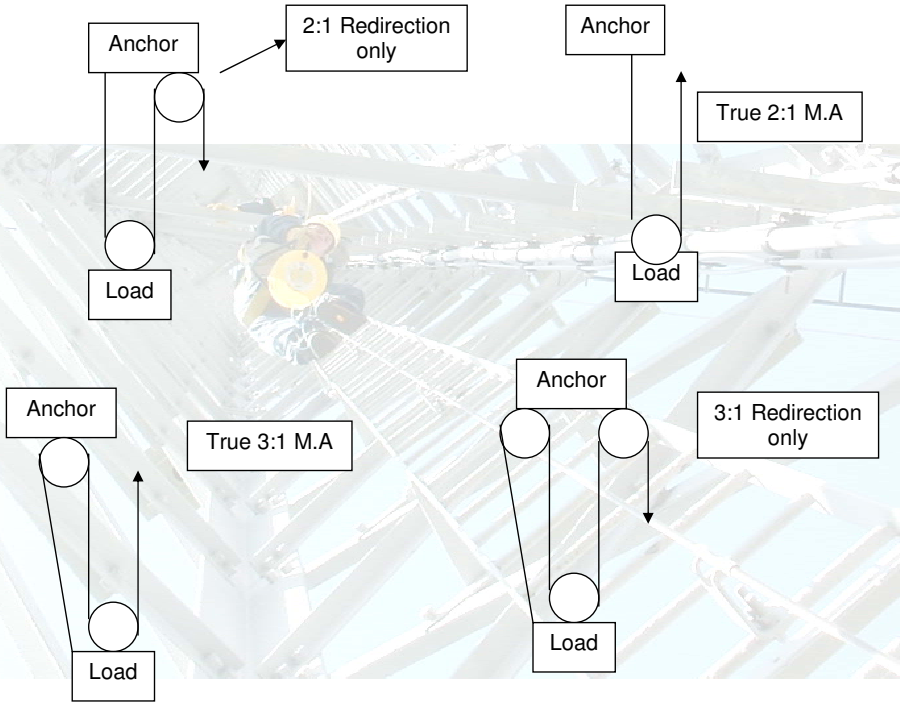
If we pull down on a simple pulley we generate a see - saw effect. 1 unit of force goes in to hold 1 unit of force on the other side.



If we add another pulley at the end of the system it ONLY redirects, it does not improve the M.A

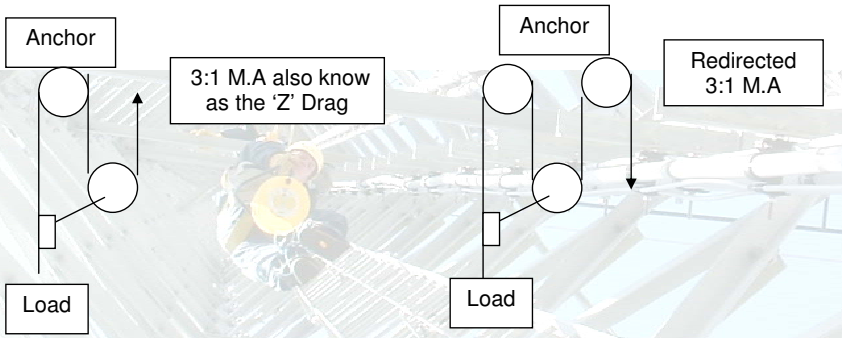
In simple pulley system all pulleys move at the same speed.

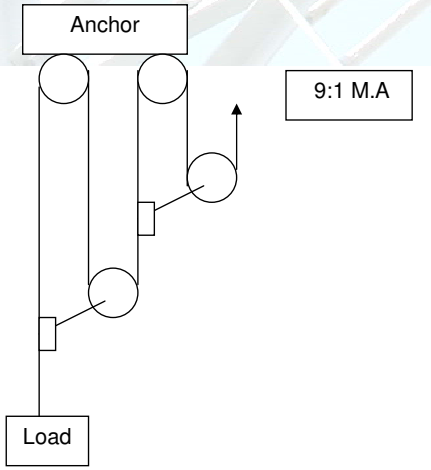
We often use a redirection if we want to lift from the ground.



Compound Pulleys

These act upon another system or rope. Pulleys move at different speeds.









Could use Protraxion instead of pulley and handled ascender





Please find below a number of photos of some basic lifting and rigging techniques. These are examples of the standard systems we teach that utilise mechanical advantage, and safe lifting practices.

	As an anchor point at the top of a location that you need to lift too, we use Industrial Slings with a safe working load of 1 tonne. This is tied off using a Prussik knot.
	For a straightforward lift of light loads, the rope is directed through a pulley, and combined with a 'hand ascender', which combines to create a break system. This does not add a mechanical advantage to the system, though it allows for the rope to be automatically caught if released by those in control.

	This system utilises the pulley and brake as seen in the previous picture. To create a mechanical advantage to this system, a SKR block has been used to grab the rope and create a 3:1 pulley system. This method is also known as a Z drag.
	In the same way as above, a mechanical advantage has been created using a hand ascender. This is exactly the same as above only using a different piece of equipment to create the advantage.

	This system is again the same as the previous two pictures. The difference here is that an extra pulley has been added. This reduces the level of friction, therefore making a more effective 3:1 mechanical advantage.
	This device, known as a 'Petzl ID' does the role of the pulley and the hand ascender in the previous pics. This device can be used as part of a mechanical advantage system for light loads only. The ID also has built in brake, lock and safety systems.

	This is part of a lifting system that finds the ‘load’ being hauled diagonally up the ‘haul line’. A small fixed cheek pulley is used. To cater for a 3-way load, the ‘Alpine Butterfly’ knot is used. A figure of 8 knot is used to connect to the load.
	The same system is in place here as above. In this picture, the 3-way load is taken by a Delta Maillion. There are advantages and disadvantages to this type of system.



For more in-depth and specific systems, we are also able to use rope access techniques combined with lifting and rigging principles. This allows advanced rescue and access methods.

If there are any specific scenarios where you would wish to use lifting, rigging, rescue or access methods, we would be happy to discuss any thoughts or ideas you may have.
For any further information, advice or training, please do not hesitate to contact us; we are able to cater to specific needs, requirements, environments or scenarios.

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