SAFE RIGGING HANDBOOK

TEKFEN

TEKFEN CONSTRUCTION

prepared by
Tekfen Construction & Installation Co., Inc.
Total Quality Management

graphic design
Hasan Özer Uzunboy

print
Ofset Yapimevi

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Index

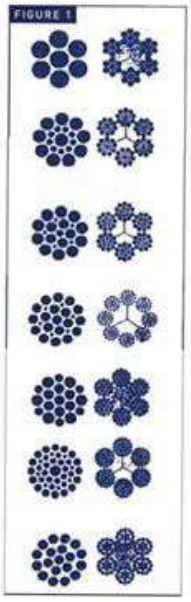
1. Lifting Accessories

The lifting accessories are as follows:

- Wire Ropes
- Chains
- Synthetic Web Slings
- Hooks
- Shackles
- Eye bolts
- Lifting and Spreader Beams

1.1. Wire Ropes

FIGURE 1



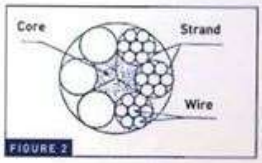


FIGURE 2

Wire ropes are used in the industry in such jobs as weight pulling and load lifting. The reasons why the wire ropes are preferred rather than linen ropes are as follows:

- They are stronger, though at the same weight and diameter,
- Their strength is constant even in wet and dry conditions,
- Their length does not change in various climatic conditions,
- They have longer life and durability.

1.1.1. Structures of Wire Ropes

A rope is composed of 6 or 8 strands wound around a linen core. Each webbing is braided with thin metallic wires among themselves.

8 x 12 means that each rope has 8 strands and each strand has 12 wires. The way of manufacturing wire ropes is based on this principle. The elasticity of a strand increases with increased number of wires.

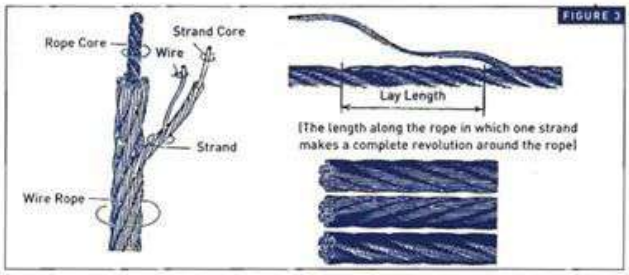
1.1.2. Reasons for Weakening of Wire Ropes

- Selection of wrong size relative to construction or quality.
- Handling rope in contact with the load when use.
- Failure to timely lubricate the rope, causing wear to occur in rope wires during lifting and lowering the load.
- Twisting of rope.
- Effect of temperature, moisture and acids.
- Stretching ropes on one another or in reverse direction.
- Kinking.
- Overloading.

1.1.3. Selection of Wire Ropes

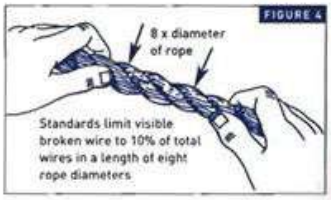
In selecting and using a steel wire rope, the following properties should be considered:

FIGURE 3



- Way of manufacturing of wire, material and rope core used,
- Number of wires per strand,
- Way of winding strands of rope,
- Maximum load of rope and its carrying the load with a certain safety coefficient,

FIGURE 4



- Flexibility and fatigue resistance,
- Resistance to kinkings,
- Resistance to impacts, deformations and crushings.

1.1.4. Inspection of Wire Ropes

Frequent Inspection: All slings shall be inspected by the person handling the sling each day they are used. These visual checks should be concerned with discovering gross damage, which may be an immediate hazard:
Distortion of rope in the sling such as kinking, crushing, unstranding, bird caging, main strand displacement, or short rope lengths or unevenness of outer strands should provide evidence that the sling or slings should be replaced.
General corrosion condition, number, distribution, and type of visible broken wires should also be considered in the inspection.

Periodic Inspection: A periodic inspection shall be performed by a designated person at least annually and shall be recorded.

1.1.5. Removal Criteria for Wire Rope Sling

No precise rules can be given for determination of the exact time for replacement of a wire rope sling since many variable factors are involved.

Conditions such as the followings should be sufficient reason for replacement.

- Five broken wires in one strand in one lay or ten randomly distributed broken wires in one lay.
- Regulations limit visible broken wire 10 % of total wires in a length of eight rope diameters.
- Severe localized abrasion or scraping.
- Kinking, crushing, bird caging or any other damage resulting in distortion of the rope structure.
- Evidence of heat damage.
- End attachment are cracked, deformed, or worn to the extent that the strength of the sling is substantially affected.
- Severe corrosion of the rope or end attachments.

1.1.6 Rope End Attachment

1.1.6.1. Wedge Socket Connection

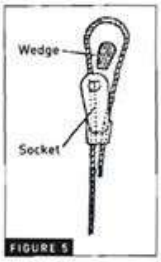


FIGURE 5

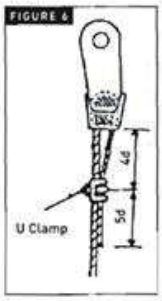


FIGURE 6

- Rope is inserted into the socket by bending it in U form.
- A wedge is placed in rope bend as shown in the figure on side.
- The rope end is pulled so as to ensure that the wedge enters into the socket and tightens the rope.
- U clamp is mounted such that it will be at a distance of 4 rope diameters to the socket and 5 rope diameters to the rope end.
- Rope socket is mounted by placing the U bolts of the clamp in a manner that they will not be at the rope end. U bolt clamps must never face to the rope end.

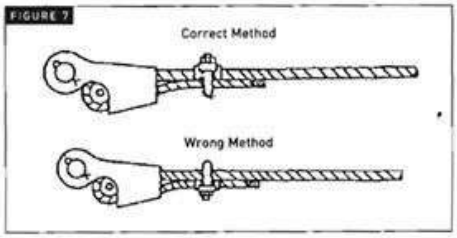


FIGURE 7

1.1.6.2. Cable Clip Connection

- Rope is bent in U form and clamped at a place closer to the rope end.
- The eye piece of the rope is clamped.
- Other clamps are mounted such that there will be a distance of 6 rope diameters between both end clamps.

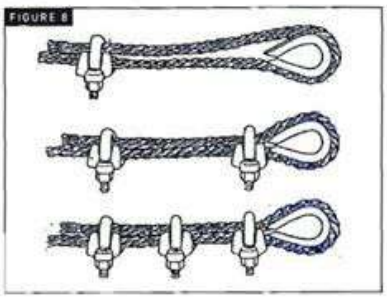


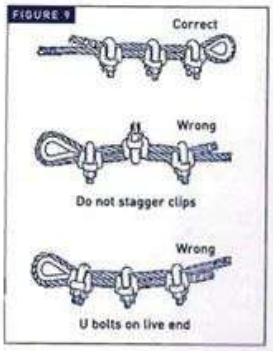
FIGURE 8

U bolts of all clips should be on dead end of rope. Live ends rest in clip saddle.

As mentioned above, U bolts of the clamps should be at the rope end. Clamps must never be offset mounted. (Fig. 9)

In the following table, the number of clips, distance between clips and clip size to be used according to rope diameter are provided.

FIGURE 9

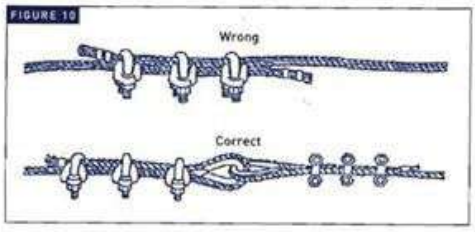


Rope Diameter mm	Rope Diameter inch	Number of clips	Distance between clips (mm)	Clip size (mm)
8-16	5/16-5/8	4	80	9,5-14
19	3/4	5	110	16
22	7/8	5	130	18
25	1	5	150	16
28	1 1/8	5	180	18
31	1 1/4	6	200	22
34	1 3/8	7	230	22
38	1 1/2	8	250	22

1.1.6.3. Interconnecting Two Ropes

Never use any kind of clip to directly connect two straight lengths of rope. If this is necessary, use the clips to form on eye (with thimble) in each length and connect the eyes together. (Fig. 10)

FIGURE 10



1.1.7. Maintenance and Lubrication of Steel Wire Ropes

The first point to be noticed in maintaining steel wire ropes is that the ropes are correctly unwound from sheaves.

Since breaks and kinks reduce the life-cycle of a wire rope, such breaks and kinks should be prevented. If there is no possibility of fixing a sheave with steel wire rope wound on it in a manner to allow it to rotate freely, one end of the wire rope should be fixed at a proper place and the sheave should be rotated as much as required.

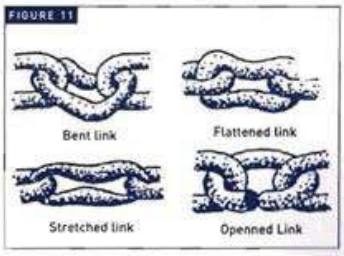
Wire rope sheaves should not be unwound by pulling from wire rope. Otherwise, breaks occur in the rope.

When winding a new wire rope over a wire rope sheave or drum, the initial winding is very important. If the windings of a rope are wound closer to one another regularly and tightly, the subsequent rows properly follow depending on the initial winding rows. A properly wound rope will have less wear and longer life compared to an improperly wound rope. Several parts and wires of a rope have relative movements. The strands formed by thin wires as well as the wires of such strands rub against one another during lifting and lowering of the load since they move continuously. As a result of such rubbing, they abrade one another. In order to prevent wear of steel ropes, entend their life and avoid their rusting, the steel ropes should be lubricated . Lubrication should be done with a hard brush applied on steel ropes. Before lubrication, the steel rope should be cleaned with a hard brush.

1.2. Chains

Due to their structure, chains are more stronger and easier-to-use lifting components. Chains have a wider range of fields of use since they are used as a sling, resistant to impacts, suitable to use for sharp-edge loads and they are safe.

FIGURE 11



Hardened chains are durable. Furthermore, depending on the characteristics of a job, the high strength steel chains are also used. When chains are not used properly, rustings, crackings, wears, stretchings and bendings may occur.

1.2.1. Points to be Noticed in Handling Chains

Chains should be selected depending on the characteristics of a job for which they are to be used and the weight of load to be lifted. Chain selection should be done by the competent technical staff qualified in this field.

1.2.2. The Grades of Chain

The grade number of a chain is stamped on approximately every twentieth link or every meter. If there is any doubt as to the grade making or if there is no load tag attached to the chain, it must be regarded as the lowest grade ; that is , Grade 30.

1.2.3. Inspection of Chains

All chains used for lifting purposes should be inspected before and after use. It should also be inspected very closely for the defects every month. The following defects should be looked for in each inspection:

- Stretching or bending in any link of more than 10 percent,
- Damaged links from sharp edges,
- Deep rust,
- Nicks, cut or gouges that reduce the link diameter by 10 percent,
- Cracks in any link (by soaking the chain in oil, cleaning the oil off, then dusting it with powder, cracks will appear as a discoloration; a powder mixed with magnetic particles and dust onto the chain will also reveal cracks),
- A number of small dents like peen hammer marks (this is an indication of fatigue or work hardening),
- Wear in link seat in more than 10 percent of link diameter,
- Weld defects and any other link deformation,
- Knotted chains.

Like hooks, chains can also be X-rayed to detect some defects. Conditions such as the above should be sufficient reason for replacement.

1.2.4. Heat Damage

Do not expose a chain to temperatures greater than 260°C. Safe working loads need to be reduced when chains have been exposed to such temperatures. When exposed to 480°C or greater, chain must be condemned.

1.2.5. Chain Usage

- Never exceed a chain's safe working load.
- Do not use a damaged chain.
- Avoid shock-loading chain ; that is, loading chain suddenly.
- Do not cross , twist, kink or knot chain.
- Do not drop chain from a height.
- Use packing on loads with sharp edges.
- Use only the correct size and grade of chain.
- Do not weld or oxycut.
- Hammerlocks and pin lock fitting may be used to alter or repair chains.
- Ensure that chain fittings have a safe working load equal to or more than the chain attached.
- Do not use mild steel chain of less than 8mm diameter or alloy steel chain of less than 6mm diameter.
- Do not place the links of a chain on the load hook, but use a ring or an attachment (for example, a chain shortened).
- Only use chains with a safe working load tag.

1.2.6. Storage and Maintenance

Inspect every chain regularly, and remove damaged sections or replace the whole chain.

Do not repair or hammer chain, and do not heat-treat it.

Chains should always be inspected before being stored. They should be stored under cover in a dry area. Where possible, chains should be hung off racks or pegs. Chains that are not to be used for long periods should be lightly oiled.

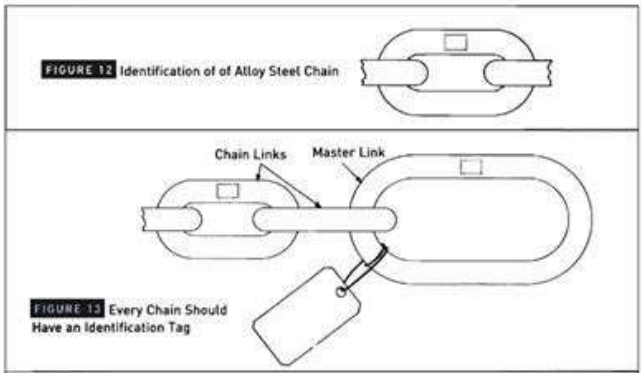


FIGURE 12 Identification of of Alloy Steel Chain

FIGURE 13 Every Chain Should Have an Identification Tag

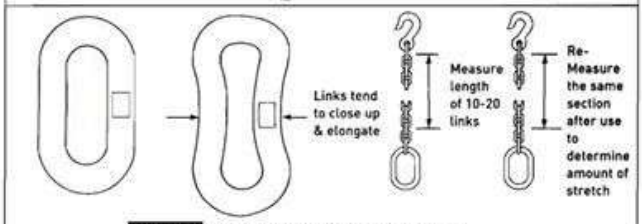


FIGURE 14 Look for Chain Stretch During Inspections

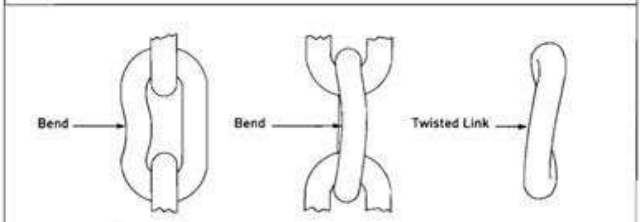


FIGURE 15 Inspect All Links for Bends, Twists and Damage

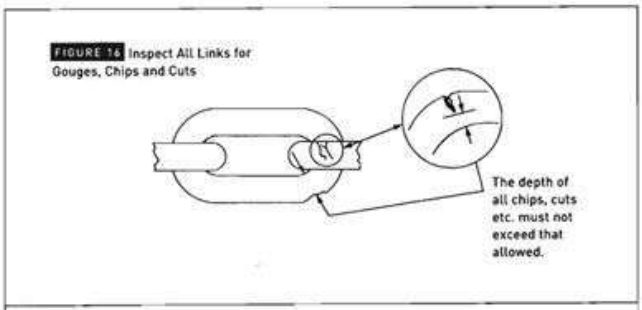


FIGURE 16 Inspect All Links for Gouges, Chips and Cuts

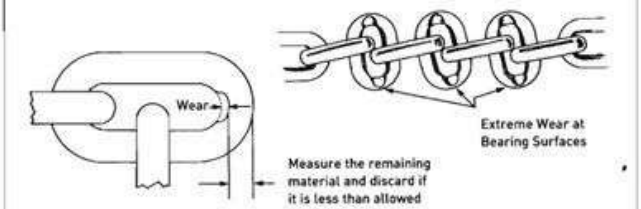


FIGURE 17 Inspect All Links for Wear at the Bearing Surfaces

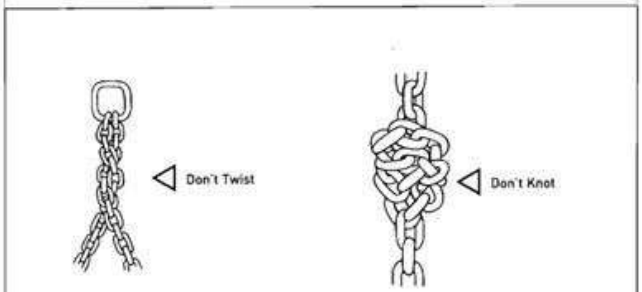


FIGURE 18 Never Twist or Knot a Chain

1.3. Synthetic Web Slings

Synthetic web slings offer a number of advantages for rigging purpose:

- Their relative softness and width means that they have much less tendency to mar or scratch finely machined, highly polished or painted surfaces and have less tendency to deformation, crush fragile objects compared to fibre rope, wire rope or chain slings.
- Because of their flexibility ,they tend to mold themselves to the shape of load.
- They are not affected by moisture and certain chemicals.
- They do not rust and thus do not stain ornamental precast concrete or stone.
- They are non-sparking and can be used safely in explosive atmosphere.
- They minimize twisting and spinning during lifting.
- Their light weight permits ease of rigging, their softness precludes hand cuts ,and the danger of harm from a bump by a free swinging is minimal.
- They are elastic and stretch under load more than either wire rope or chain and are thus able to absorb heavy shocks and cushion the load.

Synthetic web slings are available in a number of configurations find application in the industry:

Endless or Grommet Sling - both ends of one piece of webbing are lapped and sewn to form a continuous piece. They can be used as vertical hitches, bridle hitches, in choker arrangements or as basket slings .Because load contact points can be shifted with every lift, wear is evenly distributed and sling life is extended.

Standard Eye and Eye - webbing assembled and sewn to form a flat body sling with an eye openings in the same plane as the sling body. The eyes may either be full web width or may be tapered by being folded and sewn to a width narrower than the webbing width.

Twisted Eye - an eye and eye type with twisted terminations at both ends. The eye openings are at 90°to the plane of the sling body. This configuration is also available with either full width or tapered eyes.

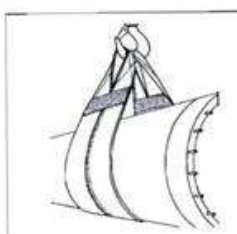


FIGURE 19 Synthetic web slings do not Damage or Crush Like Wire Ropes or Chain

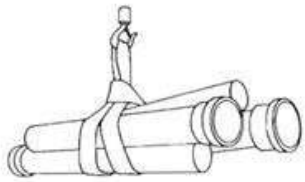


FIGURE 20 Pipe handling illustrates the tendency of webbing slings to mold themselves to load. This allows handling irregularly shaped loads securely.

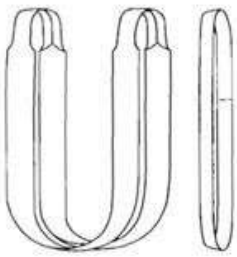


FIGURE 21 Endless or grommet slings.

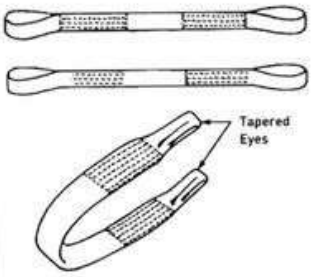


FIGURE 22 Standard Eye and Eye Slings.

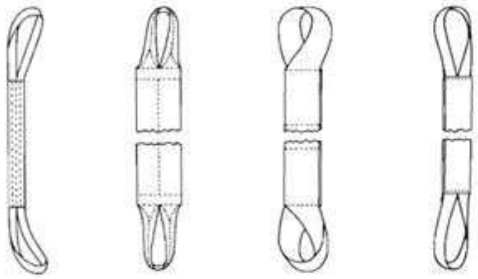


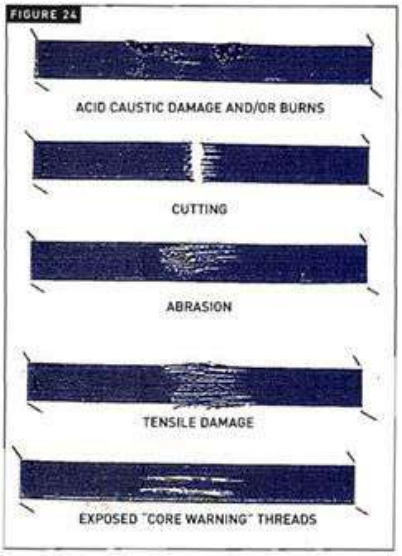
FIGURE 23 Twisted Eye Slings.

1.3.1. Inspection of Synthetic Web Slings

Synthetic web slings must be visually inspected before each use. Sling shall be removed from service if inspections reveal any one of the following defects.

1. If slings rated capacity tag is missing or not readable,
2. Acid or caustic burns,
3. Melting or charring of any part of slings surface,
4. Snags, punctures, tears or cuts,
5. Broken or worn stitches,
6. General wear, stretch, or tensile damage exceeding the manufacturer's standards,
7. Expose " Core Warning" threads.

FIGURE 24



1.4. Hooks

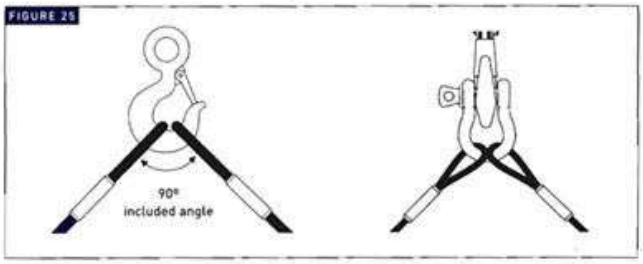
Hooks are one of the mostly used type of rigging hardware. They are made in many different sizes and shapes to meet a wide range of applications. They can be attached to load blocks, slings, and other lifting devices such as lifting beams. Preferably, hooks should be embossed with the size, rated capacity and equipped with latches(catches).

1.4.1. Correct Use of Hooks

When the included angle is greater than 90°, use shackles to attach the sling legs to the hook. Using a shackle prevents the slings from coming out of the hook and the rated capacity of the hook from being reduced.

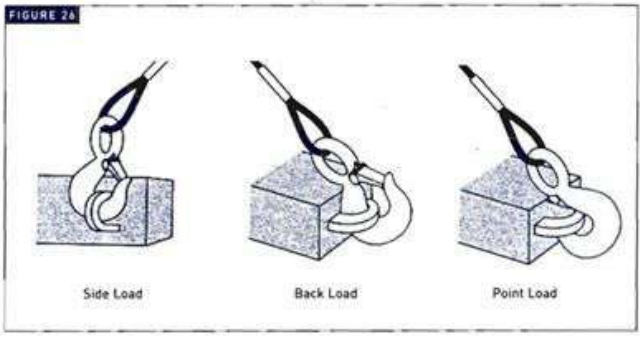
When using two slings placed in a hook ensure that the included angle between the slings is not greater than 90 Degrees. This prevent the slings from coming out of the hook and prevents point loading which reduces hook capacity. (Fig. 25)

FIGURE 25

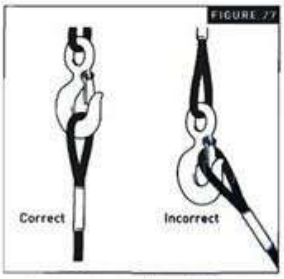


Never side load, back load, or point load a hook. All reduce hook strength and create an unsafe condition. Point loading can reduce hook capacity as much as 60 %. (Fig. 26)

FIGURE 26



The sling or lifting device must always be seated properly in the bowl of the hook. (Fig. 27)

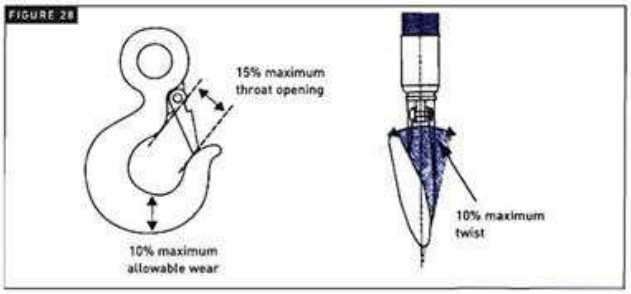


1.4.2. Inspection of Hooks

Before use, hooks must be inspected by a competent person and removed from service when any of the following conditions exists:

- Cracks, nicks or gouges.
- Twist exceeding 10 degrees from plane of unbent hook. (Fig. 28)
- Latch engagement, damage or malfunction.
- Throat opening exceeding 15 %. (Fig. 28)
- Wear exceeding 10% of original dimension. (Fig. 28)
- Damage from heat.
- Unauthorized repairs

Never repair, alter, or reshape a hook by welding, heating burning or bending, unless approved by the hook manufacturer.



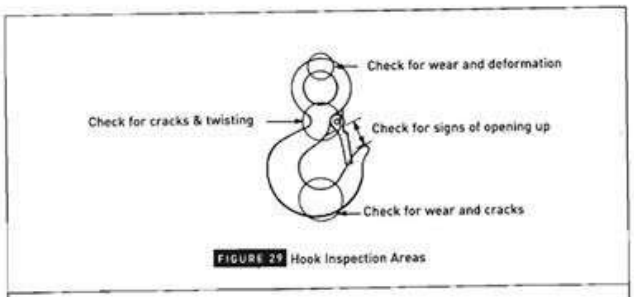


FIGURE 29 Hook Inspection Areas

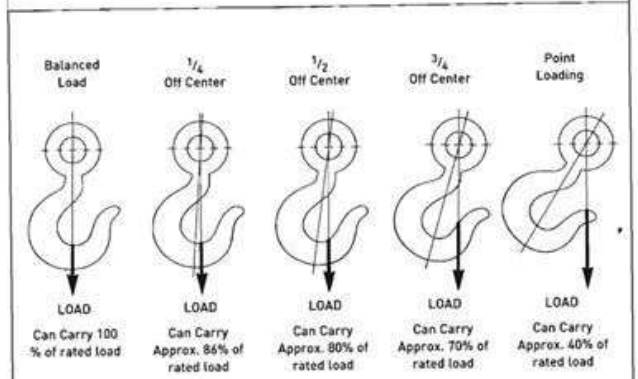


FIGURE 30 Effect of Eccentric Loads on Hook Capacity

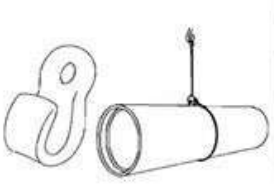


FIGURE 31 Standard Choker Hook

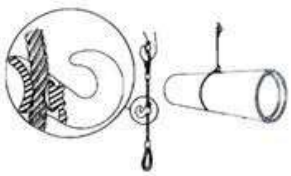


FIGURE 32 Adjustable Sling Choker Hook

1.5. Shackles

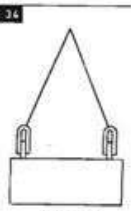
1.5.1. Correct Use of Shackles

Shackles should be fitted to the load in a manner that allows the shackle body to take load in a true line along its centerline. Not in such a way that bending loads are induced, other than those for which the shackle has been designed. [Fig. 34]

FIGURE 33

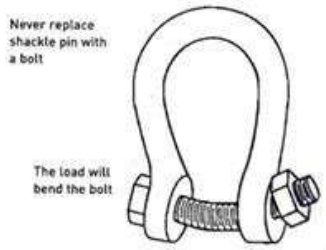
Correct

FIGURE 34



Incorrect

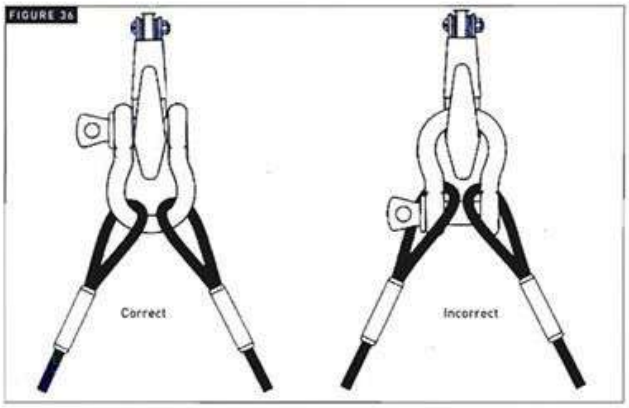
FIGURE 35



Incorrect replacement of shackle pin

The correct way to use a shackle with a hook is with the shackle pin positioned across the hook. [Fig. 36]

FIGURE 36



When the used hook is small, some packing is required to stabilize the shackle. [Fig. 37]

Avoid using a shackle with the sling riding across the pin. This movement could cause it to unscrew. [Fig. 38]

FIGURE 37

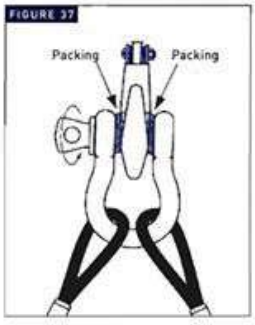


FIGURE 38

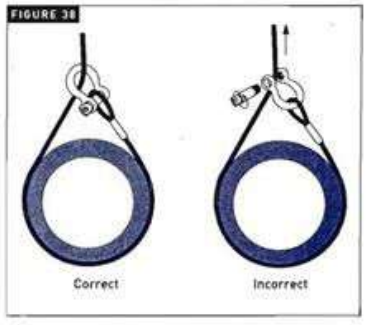
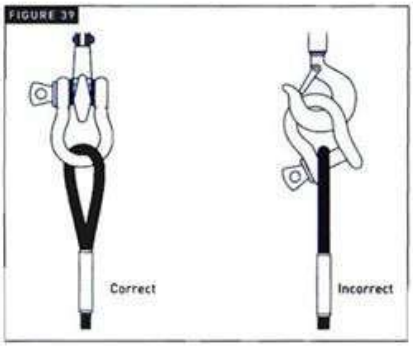


FIGURE 39



Shackle pin must be in the hook and the slings should be installed into the shackle body. (Fig. 39)

1.5.2. Inspection of Shackles

Shackles should be inspected before use to ensure that:

- The body of the shackle and the pin are both identifiable as being of the same quality grade,
- All markings are readable specially the Safe Working Load. (SWL),
- The pin is of the correct type,
- The threads of the pin and the body are undamaged and seated well,
- The shackle and pin are not distorted and must be aligned,
- The shackle and pin are not unduly worn (in case of more than 10% reduction in diameter, they must be replaced),
- The shackle and pin are free from nicks, gouges, cracks and corrosion.

Never Exceed 120 Degrees included angle. Because the capacity of the shackle will be tremendously reduced.

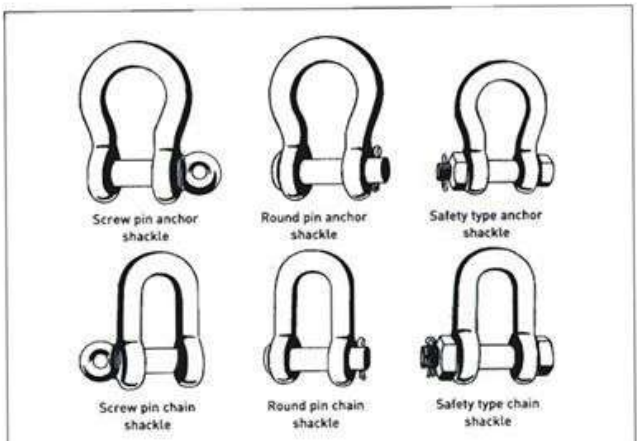


FIGURE 40 Typical Shackles

FIGURE 41 Replacing Shackle Pins

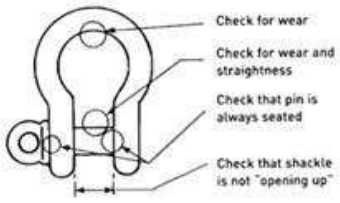
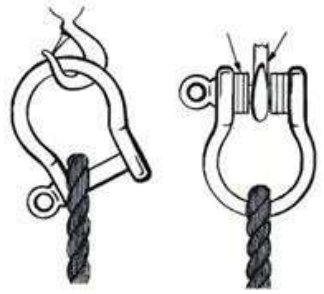


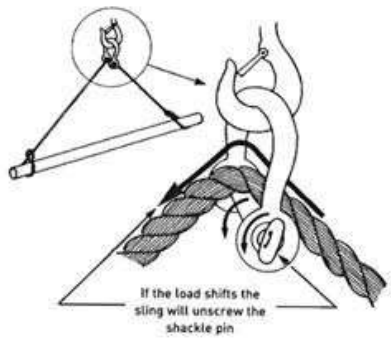
FIGURE 42 Shackle Inspection Areas



Poor Practice
Never allow shackle to be pulled at an angle -the legs will open up

Good Practice
Pack in the pin with washers to centralize the shackle..

FIGURE 43 Eccentric Shackle Loads



If the load shifts the sling will unscrew the shackle pin

FIGURE 44 Do not use Screw Pin Shackles if the Pin can Roll Under Load and Unscrew

1.6. Eye Bolts

Eye Bolts are often already installed in electric motors, etc, but still they have to be checked always for a safe working load stamp before using them to lift a load. If there is no safe working load stamped on the bolt, do not use it and find alternative means of slinging the load.

There are two types of eye bolts used:

Plain or shoulderless eye bolts: only to be used for lifting at an angle, as with two or more slings.

Collared or flanged eye bolts: can be used for lifting at an angle, as with two or more slings.

1.6.1. Correct Use of Eye Bolts

If using a single eye bolt to lift a load, use some means to prevent the load from turning and the bolt from undoing. Attach a fibre rope (tagline) to control the load.

Do not lift the load any higher than is absolutely necessary.

The correct method of attaching a sling to an eye bolt is to use a shackle. Never pass the slings through the eye and back to the hook.

Before using an eye bolt to lift a load:
- It must be checked for defects,
- It must be packed so that the eye bolt is screwed down flush with packing or surface,
- It must be turned to the direction of the pull,
- The Safe Working Load (SWL) should be checked.

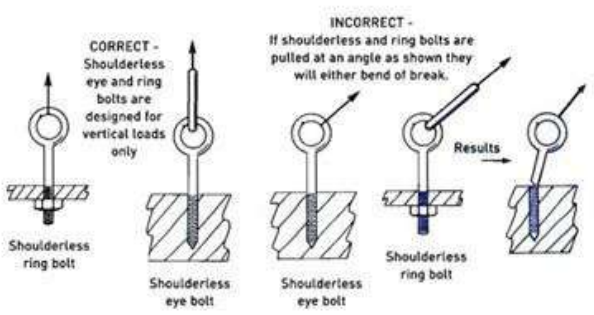


FIGURE 45 Use of Eye Bolts

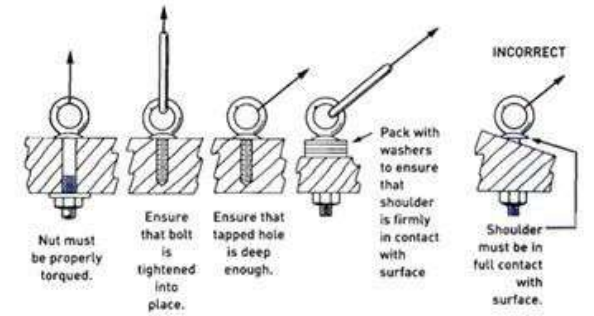


FIGURE 46 Use of Shoulder Type Eye and Ring Bolts

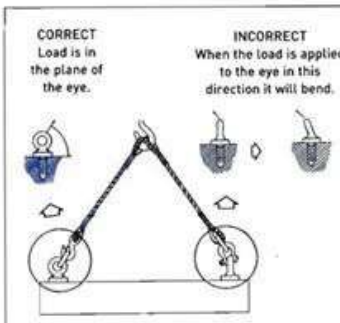


FIGURE 47 Orientation of Eye Bolts

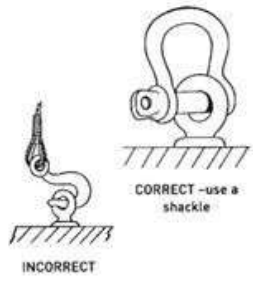


FIGURE 48 Never Insert the Point of a Hook in an Eye Bolt

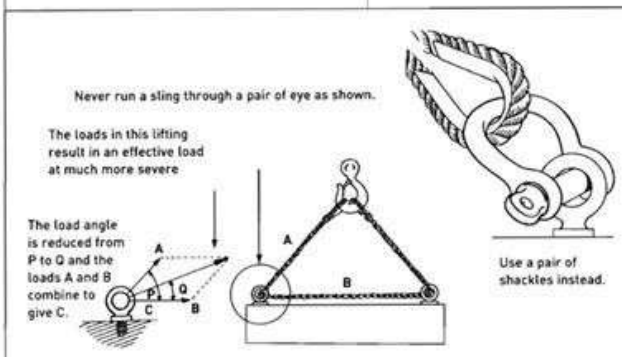


FIGURE 49 Lifting with Eye Bolt

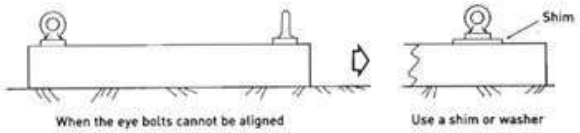


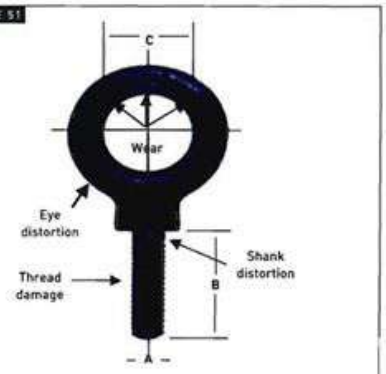
FIGURE 50 Alignment of Eye Bolt

1.6.2. Inspection of Eye Bolts

Before use, eye bolts must be inspected visually by a competent person. If any of the following conditions exists, the eye bolt must be removed off service:

- Bent or distorted eye or shank,
- Nicks and gouges,
- Obvious wear,
- Worn, corroded and/or distorted threads,
- Heat damage,
- Absence of Safe Working Load (SWL) marking.

FIGURE 51



In addition, tapped receiving holes must be cleaned and inspected for thread wear and deterioration. Any alteration or repair to eye bolts, such as grinding, machining, welding, notching, stamping, etc. is not permissible. Eye bolts which have visible signs that alterations or repairs have been made must be removed from service and should be destroyed.

1.7. Lifting and Spreader Beams

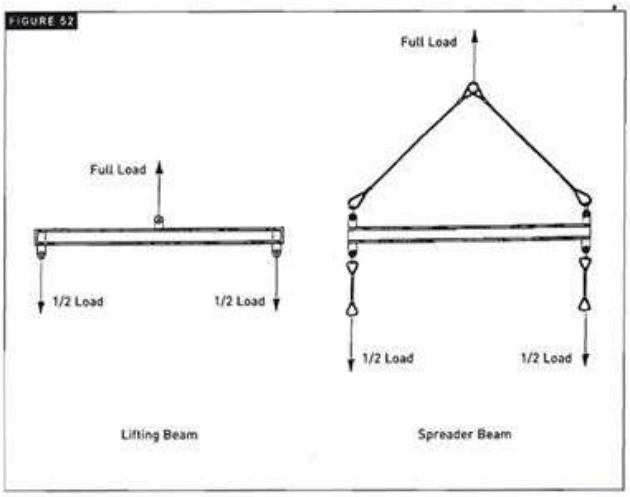
Lifting beams support a load during a lift. They are designed for bending, and have a top-centered lug or hole at each end on the bottom side. Spreader Beams help to maintain the distance of a rigging device (sling, link, shackle) so that side-loading on a load or lifting lug does not occur. Lifting and Spreader Beams help to eliminate the possibility of a load tipping, sliding, bending or being crushed by a sling.

A Lifting Beam, Spreader or Equalizer Beam should be designed by a qualified engineer. For questions or concerns related to any beam used in lifting on a project, contact your safety representative.

A Lift or Spreader Beam should be:

- Inspected frequently by a qualified engineer,
- Stamped with a maximum capacity,
- Identified by some recordable marking/number,
- Load tested to design specifications.

FIGURE 52



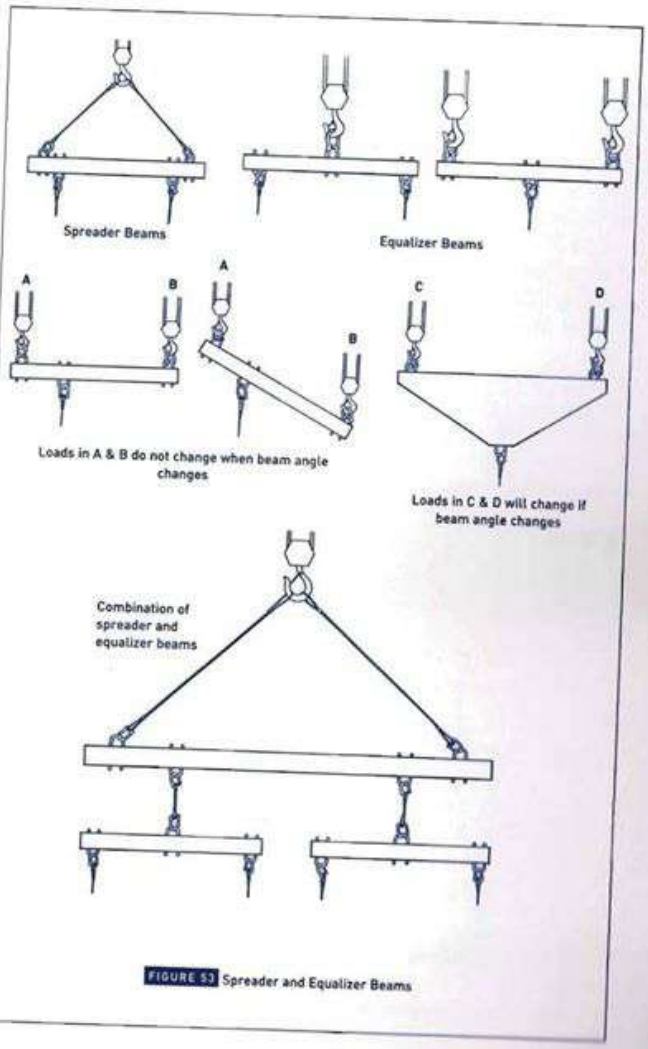


FIGURE 53 Spreader and Equalizer Beams

2. Types of Slinging

2.1. Single Vertical Hitch

In this type of slinging, it is very difficult to control the load. A single vertical sling may turn when the load is hung. As a result of such turning, the rope may be broken or scraped. Since the whole load is on a single sling, lifting and carrying will not be performed safely. (Fig. 54)


FIGURE 54

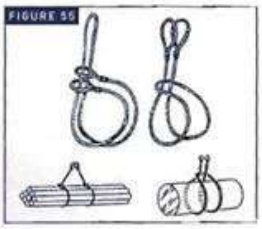


FIGURE 55

2.2. Choker Hitch

The choker hitch is used for block loads with balanced center of gravity. The loads are choke-hitched exactly at their center of gravity. The weight of load is equally distributed over both legs. (Fig. 55)

2.3. Basket Hitch

In this type of slinging, either a single sling alone or two slings are used together in form of a basket. In a basket hitch, the load is equally distributed over both legs. In this type of slinging, care should be taken to avoid crushing of the sling under load or jamming elsewhere. (Fig. 56)

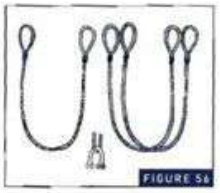


FIGURE 56

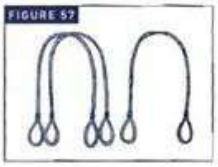


FIGURE 57

2.4. Legs Bridle Hitches

In this type of hitches, the legs of the sling are downward. The sling ends are installed on the load, while its center is installed on the hook. (Fig. 57)

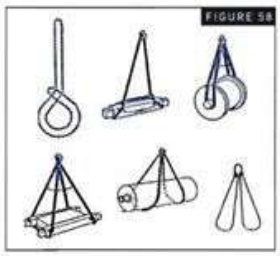


FIGURE 58

2.5. Endless Hitch

This type of hitch is mostly used in chain slings. The load is equally distributed over both legs. The center of gravity of the load should be taken into account in rigging. Specially for cylindrical loads, care should be taken to avoid sliding of the load through the sling. (Fig. 58)

2.6. Eye and Eye Hitch

Eye and Eye hitches have two types: wire rope or chain, varying according to the name of use. Single eye sling should never be used alone. Otherwise, it causes the load to turn and release. (Fig. 59)

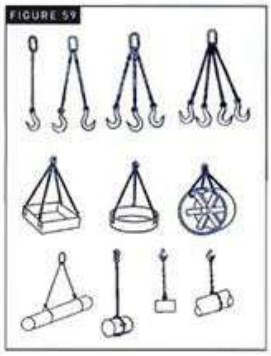


FIGURE 59

2.7. Double Wrap Basket Hitch

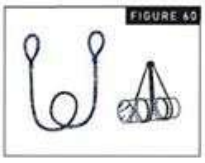


FIGURE 60

A double wrap basket hitch is used for lifting plain cylindrical loads. Since the load is kept within sling wrapping, the sling keeps contact with the load by 360°. Care should be taken for slinging cylindrical loads at their center of gravity. (Fig. 60)

2.8. Examples of Slinging

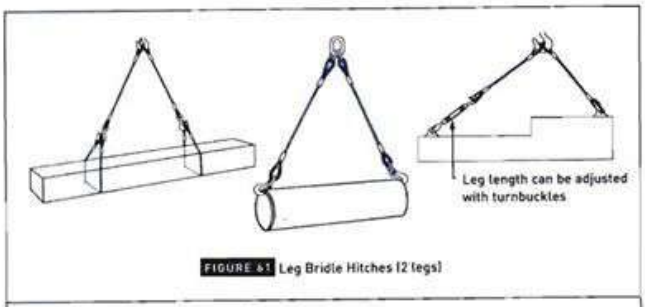


FIGURE 61 Leg Bridle Hitches (2 legs)

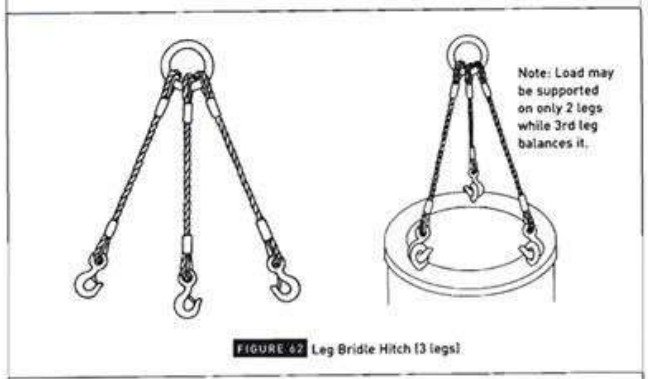


FIGURE 62 Leg Bridle Hitch (3 legs)

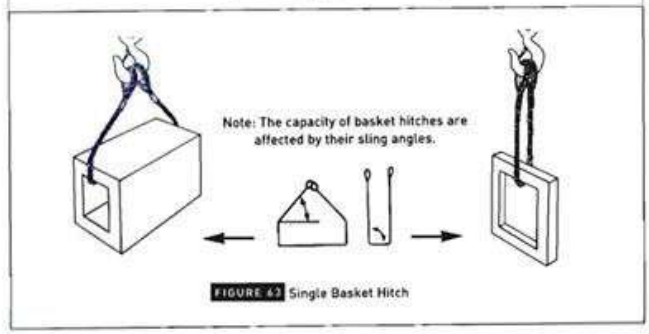
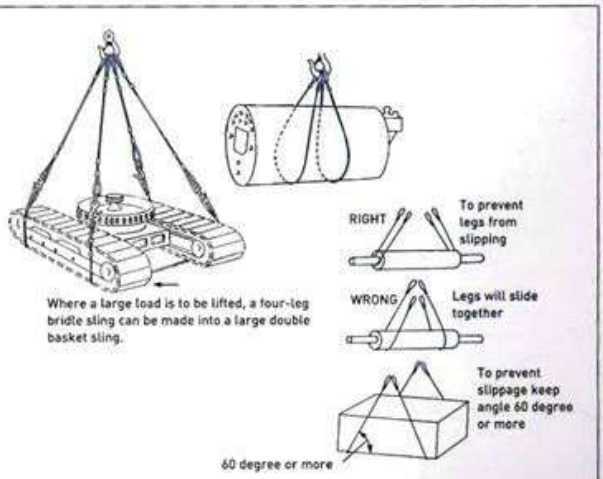


FIGURE 63 Single Basket Hitch



Where a large load is to be lifted, a four-leg bridle sling can be made into a large double basket sling.

FIGURE 64 Double Basket Hitches

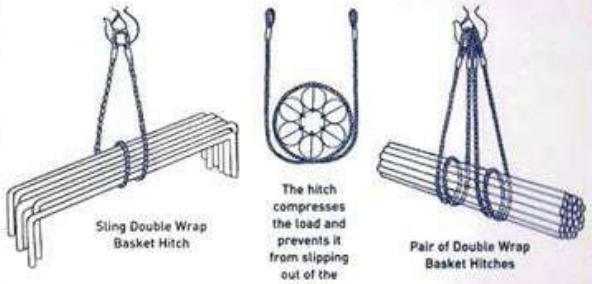


FIGURE 65 Double Wrap Basket Hitch

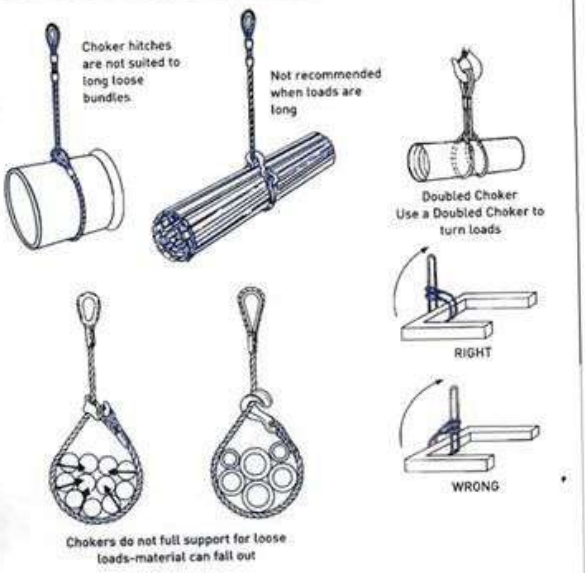


FIGURE 66 Single Choker Hitches

FIGURE 67 Double Choker Hitches

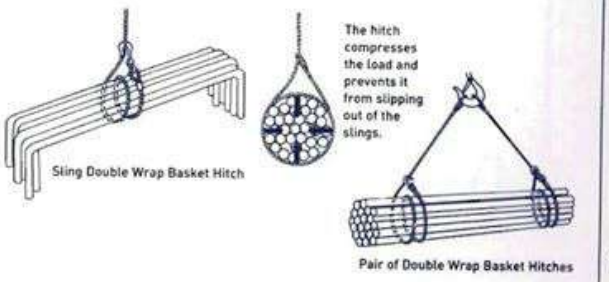


FIGURE 68 Double Wrap Choker Hitches

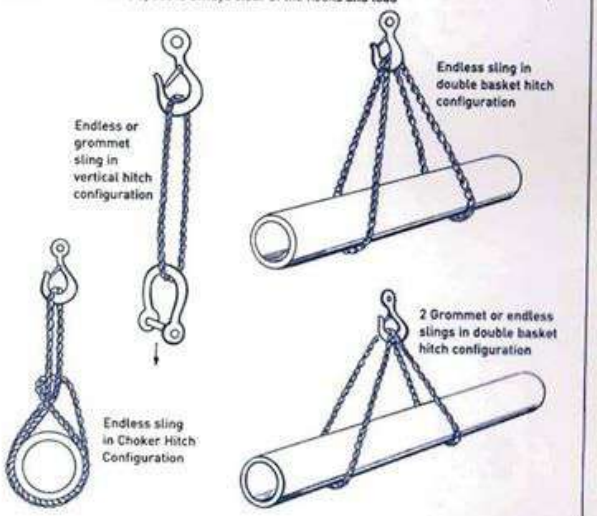
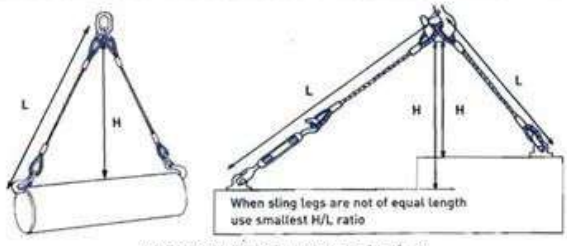


FIGURE 69 Endless Slings or Grommet Slings



Weight = SWL (of single vertical hitch) x H/L x 2

FIGURE 70 Determination of Capacity of 2-Leg Bridle Hitches

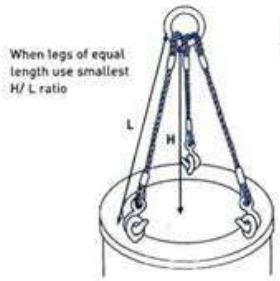
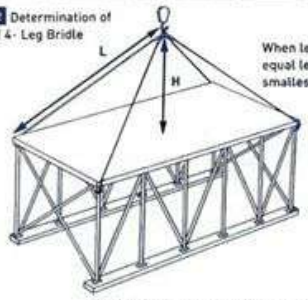


FIGURE 71 Determination of Capacity of 3- Leg Bridle Hitches

Note: Load may be supported on only 2 legs while 3rd leg balances it. Therefore the recommended safe weight to load is

Weight = SWL. (of single vertical hitch) x H/L x 2

FIGURE 72 Determination of Capacity of 4- Leg Bridle Hitches



Note: Load may be carried by only 2 legs while other legs only balance it. Therefore the recommended safe weight to load is:

Weight = SWL (of single vertical hitch) x H/L x 2

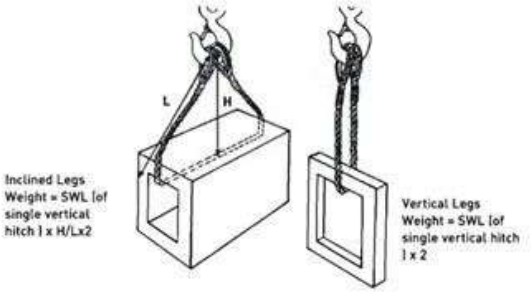


FIGURE 73 Determination of Capacity of Single Basket Hitch

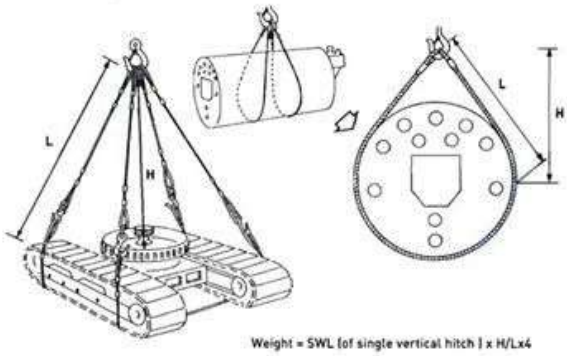


FIGURE 74 Determination of Capacity of Double Basket Hitch and Inclined Legs

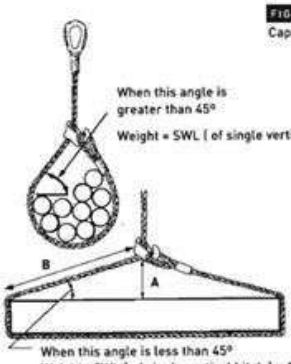


FIGURE 75 Determination of Capacity of Single Choker Hitch

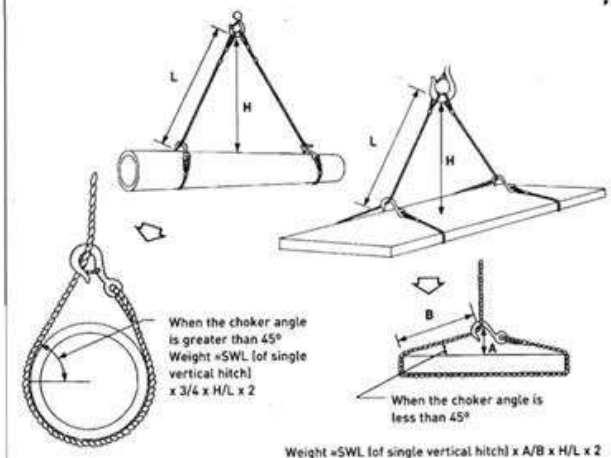


FIGURE 76 Determination of Capacity of Double Choker Hitch

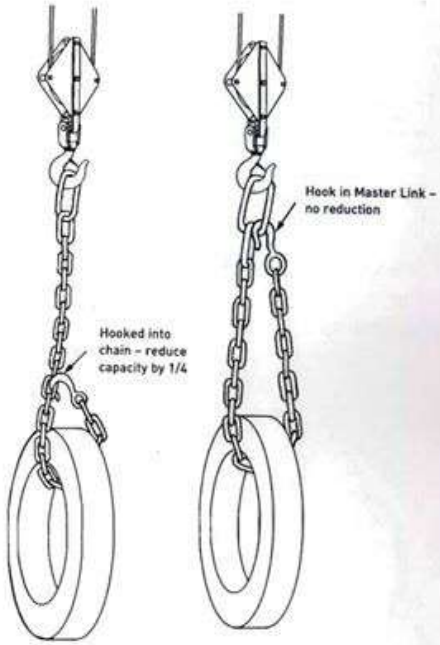


FIGURE 77 Chain Slings

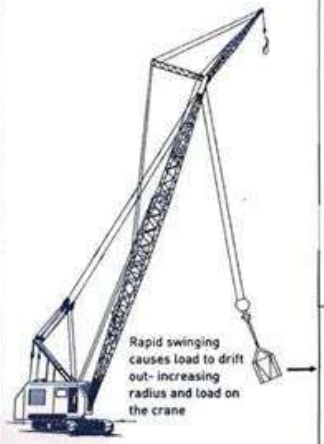


FIGURE 78 Keep the Load Under Control at All Times

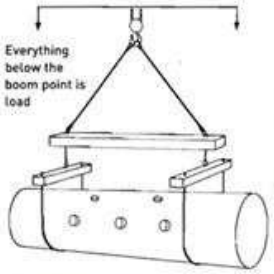


FIGURE 79 All Rigging Equipment Must be Counted as Part of the Load

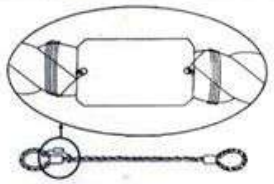


FIGURE 80 All Slings Should Carry Identification Tags

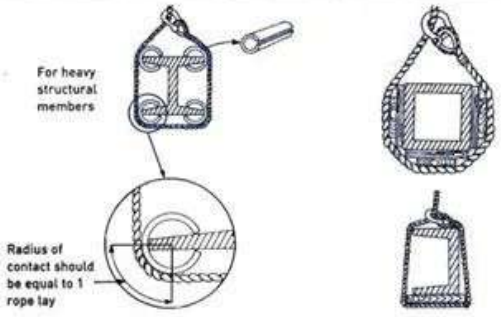


FIGURE 81 Ensure that Slings are Protected at All Sharp Corners on Heavy Items.

FIGURE 82 Never Wrap a Rope Around a Hook

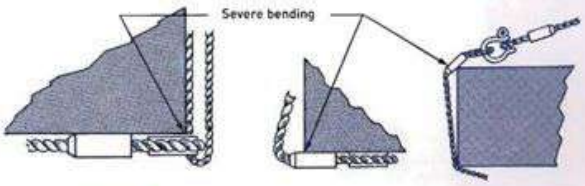
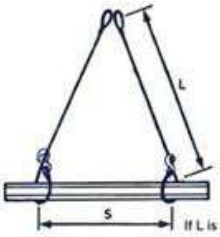


FIGURE 83 Do not Permit Bending Near Any Splice or Attached Fitting



If L is greater than S then sling angle is OK

FIGURE 84 Check on Sling Angle

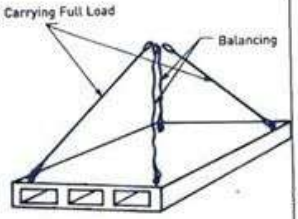


FIGURE 85 On a Rigid Object the Load Could Be Carried On Only 2 Legs or Sling While Other Legs Only Serve to Balance

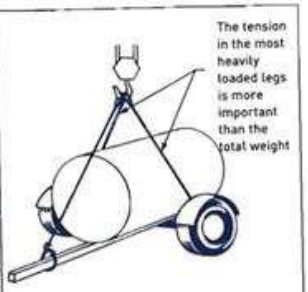
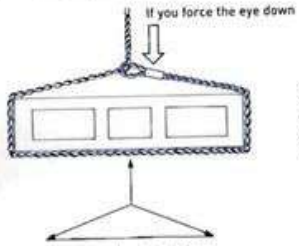
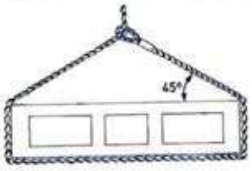


FIGURE 86 Know What the Load in Each Sling Leg will be Before the Lift is Made





INCORRECT – Cutting action of eye splice on running line

CORRECT - Use thimbles in the eyes

INCORRECT – Shackle pin bearing on running line can work loose

CORRECT - Shackle pin can nottum

FIGURE 87 Eye connections

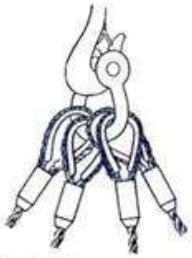


FIGURE 88 Whenever 2 or more ropes are to be Placed Over a Hook- Use a Shackle

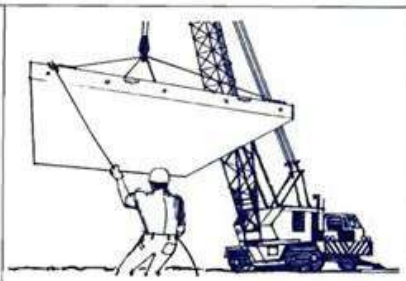


FIGURE 89 Use Tag Lines to Control All Loads

FIGURE 90 Before Being Unhooked All Loads Must Be Safely Landed and Properly Locked

FIGURE 91 Load and Secure All Materials so as to Prevent Any Movement or Possibility of Dislodgement

FIGURE 92 Stay Away From Me When They are Being Pulled Out From Under Loads.

3. Appendicies

Appendix-1 Examples for Safe Working Load Calculation

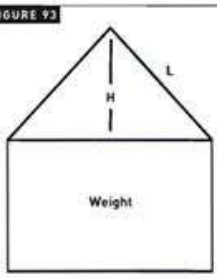
A way to find the capacity of the required sling:

SWL = L/H x Weight/No of Slings

No of Slings = 1 (For 1-leg slings)
No of Slings = 2 (For 2-leg slings)
No of Slings = 2 (For 3-leg slings)
No of Slings = 2 (For 4-leg slings)

Note: For 3-leg and 4-leg slings, 2 legs should be considered to carry the load whereas the others to balance it.

FIGURE 93



One-leg Slings:

SWL = L/H x Weight/No of Slings
SWL = 1/1 x 1000/1
SWL = 1000 kg
Sling capacity must be at least 1000 kg. (Fig. 94)

Two-leg Slings:

SWL = L/H x Weight/No of Slings
SWL = 1/1 x 1000/2
SWL = 500 kg
Each sling capacity must be at least 500 kg. (Fig. 95)

FIGURE 94

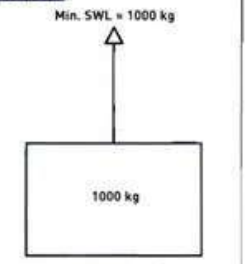


FIGURE 95

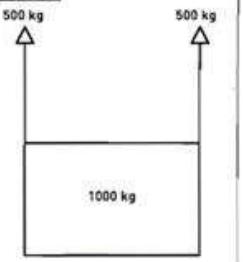
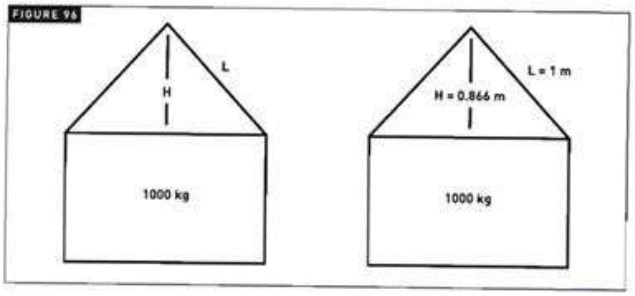


FIGURE 96



The required sling safe working load at angle (2 leg slings)

SWL = L/H x Weight/No. of slings
SWL = 1/0.866 x 1000/2
SWL = 577 kg

Each sling capacity must be at least 577 kg. (Fig. 96)

Three-Leg Slings

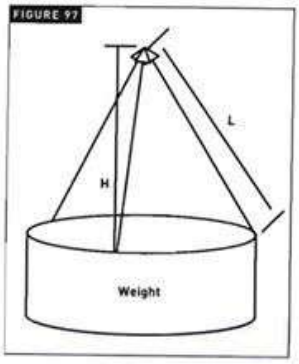
SWL = L/H x Weight/No. of slings

L= 1 m & H= 0.866m
Weight = 1500 kg

SWL = 1/0.866 x 1500/2
= 1.15 x 750
= 862 kg

Each sling capacity must be at least 862 kg. (Fig. 97)

FIGURE 97



Note: Always consider number of slings are 2 for both three and four leg slings. The other legs only balances the load.

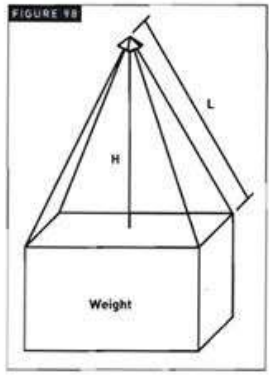
For-leg Slings

L = 1 m & H = 0.866 m
Weight = 1500 kg

SWL = L/H x Weight/No. of slings
= 1/0.866 x 1500/2
= 1.15 x 750
= 862 kg

Each sling capacity must be at least 862 kg. (Fig. 98)

FIGURE 98



Sling Angle Factors

"Angle Factors" that apply to Two-Legged Slings, are the factors used to calculate the tension according to the angle between slings.

Sling angle factors

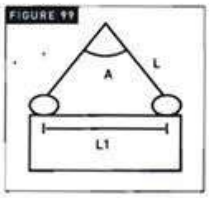
Sling angle	Factor
30° and bellow	load x 0.5
31° to 60°	load x 0.6
61° to 90°	load x 0.7
91° to 120°	load x 1

Therefore, if you sling a load using two slings at an angle of 60° multiply the weight of the load by 0.6 to find out how much tension is in each sling. The answer will give you required safe working load of each sling.

Finding Sling Angle (the angle between slings, which is in this case A)

Sling Length = L
Tle distance between the lifting lugs = L1
If L = L1 A = 60 Degrees
If L = 3/4 of L1 A = 90 Degrees
If L = Half of L1 A = 120 Degrees

FIGURE 99



Appendix-3 Density of Materials

Material	Density kg/m³	Density lb/ft³
Aluminium	2725	170
Brass	8350	520
Bronze	8650	540
Copper	8820	550
Iron	7690	480
Lead	11350	708
Magnesium	1770	110
Oil	810	50
Paper	1130	70
Steel	7850	490
Water (Salt)	1025	64
Water (Average)	800	50

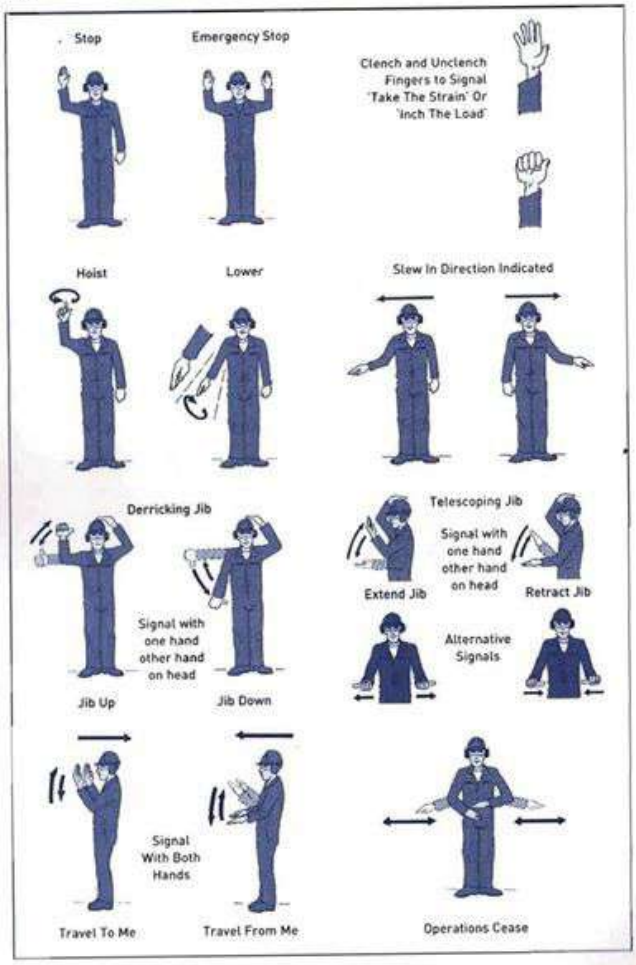
Note:

1- In some cases the above figures average only and the actual weight may vary according to particular composition / water content, etc.
2- All figures have been rounded for conveinence of use.
3- When dealing with hollow body, check for any contents and whether such contents are liable to move.
4- For calculation purposes:

Weight
1 kg = 2.2 lbs (pound)

Density
To convert lbs/ft3 to kg/m3, multiply by 16.02.

Appendix-4 Recommended Hand Signals For Crane Operations



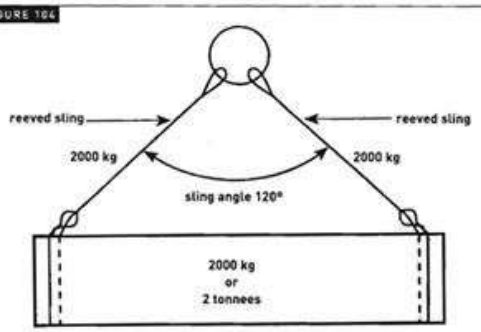
Included angle less than or equal to 120°

To calculate each sling size for the above load of 2000 kg and sling angle of 120° the following procedure applies:

Tension = Load x 1

Tension = 2000 x 1 = 2000 kg

FIGURE 104



Appendix-2 Typical Web and Round Slings With SWL and Mode Markings

THE S.W.L ARE IN TONNES

A Safe Working Load (SWL) and Working Load Limit (WLL) label is sewn into the sling, the capacity can also be designated by colour coding the entire fabric of the sling.

FIGURE 105

Single Leg Sling				
Assembly Mode	Straight	Choke	Basket Parallel	Basket 90°
Endless Web Sling & Round Sling				
Mode Factor	1	0.8	2	1.4

W.L.L.	Color	SWL - Mode of Assembly - S.W.L.			
0.5	*	0.5	0.4	1.0	0.7
1.0	Violet	1.0	0.8	2.0	1.4
1.5	White	1.5	1.2	3.0	2.1
2.0	Green	2.0	1.6	4.0	2.8
3.0	Yellow	3.0	2.4	6.0	4.2
4.0	Orange	4.0	3.2	8.0	5.6
5.0	Red	5.0	4.0	10.0	7.0
6.0	Brown	6.0	4.8	12.0	8.4
8.0	Blue	8.0	6.4	16.0	11.2
10.0	*	10.0	8.0	20.0	14.0
12.0	*	12.0	9.6	24.0	16.8

Appendix-5 Lifting / Rigging Dictionary

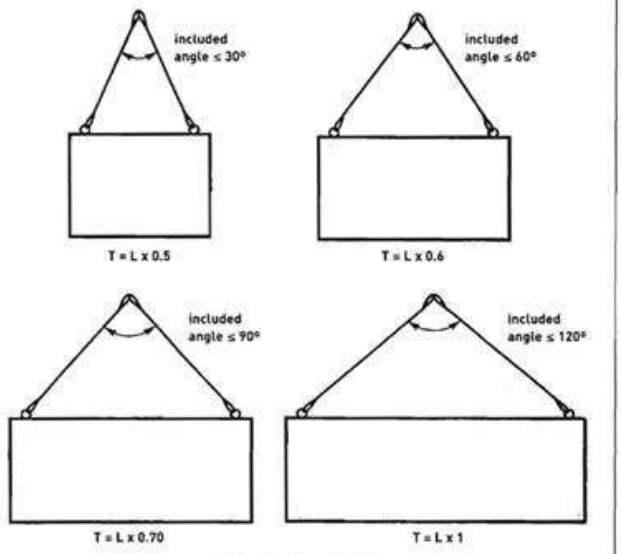
A2B (Anti Two Blocking)	İki yönlü emniyet sviçleri
Abrasion	Aşınma
Angle	Açı
Back up alarm	Geri vites alarmı
Banksman	İşaretçi
Basket Hitch	Sepet tipi sapanlama
Bend	Eğilme
Bolt	Civata
Boom	Bom
Boom angle	Bom açısı
Boom angle indicator	Bom açı göstergesi
Brake	Fren
Broken wire	Kırık tel
Cab	Kabin
Center of gravity	Ağırlık merkezi
Certificate	Sertifika
Chain	Zincir
Chain grade	Zincir alaşım değeri
Choker hitch	Boğma sapanlama
Colour code	Renk kodu
Corrosion	Korozyon/Paslanma
Counterweight	Denge ağırlığı
Cracked	Çatlak
Crane	Vinç
Crane levelling	Vinci düzleme
Crawler Crane	Paletli vinç
Crushing	Ezilme
Cut	Kesilme
Damage	Hasar
Defect	Kusur
Deformed	Defolu
Density	Malzeme yoğunluğu
Diamater	Çap
Display	Gösterge
Distortion	Deformasyon
Double	Çift

Double wrap basket hitch	Çiftli sepet bağlama
Drum	Tambur
Excavation	Kazı
Extension	Uzatma
Eye bolt	Vidalı askı mapası
Factor of safety	Emniyet katsayısı
Fully extended outrigger	Tamamen açılmış vinç ayağı
Gantry crane	Ayaklı köprülü vinç
Gross load	Gros yük
Ground	Zemin
Ground condition	Zemin durumu
Hand signals	El işaretleri
Hardhat	Baret
Heat damage	Isı deformasyonu
Hook	Kanca
Hook block	Kanca bloku
Horn	Korna
Housekeeping	Temizlik/Düzen
Identification tag	Etiket
Inspection	Denetleme
Jib	Jib
Kinked	Bükülmüş
Knot	Düğüm
Lattice boom	Kafes Bom
Lay	Halat adımı
Length	Uzunluk
Levelling	Düzleme
Lifting	Kaldırma
Lifting accessories	Kaldırma aksesuvarları
Lifting equipment	Kaldırma ekipmanları
Lifting lug	Kaldırma noktası
Lifting plan	Kaldırma planı
Lifting point	Kaldırma noktası
Lifting tackle	Kaldırma takımı
Limit switch	Limit akım kesicisi
Link	Askı halkası
LMI (Load Moment Indicator)	Yük moment göstergesi

Load	Yük
Load chart	Yük diagramı
Load radius	Yük kaldırma yarıçapı
Log book	Jurnal
Lubrication	Yağlama
Maintenance	Bakım/onarım
Manbasket	İnsan kaldırma sepeti
Master link	Ana askı halkası
Mobile crane	Mobil vinç
Moment	Döndürme kuvveti
Oil	Yağ
Outrigger	Vinç ayağı
Over heat	Hararet
Overhead power lines	Açık havai hatlar
Overload indicator	Aşırı yük göstergesi
Pad	(ayak) takozu
Pedestal crane	Rıhtım vinci
Permit	İzin
Personal Protective Equipment (PPE)	Kişisel koruyucu malzeme
Pin	Mandal
Portal crane	Gezer vinç
Pressure	Basınç
Radius	Yarıçap
Rigger	Sapancı
Rope	Urgan halat
Route	Rota
Safe load indicator	Güvenli yük kaldırma göstergesi
Safety latch	Güvenlik mandalı
Screen wiper	Silecek
Shackle	Mapa
Shackle pin	Mapa mandalı
Shave	Makara
Single	Tek
Single vertical hitch	Tek halatlı sapanlama
Sling	Sapan
Sling angle	Sapanlama açısı
Splice	Ekleme

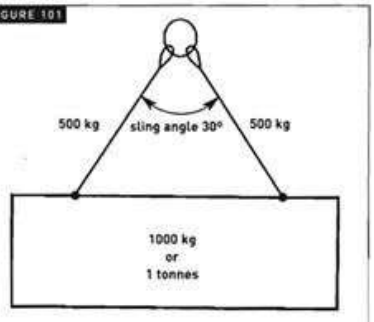
Spreader beam	Kaldırma traversi
Storage	Depolama
Strand	Kordon
Swinging	Sallanma
Swivel	Fırdöndü
SWL (Safe Working Load)	Güvenli Kaldırma Yükü
Synthetic polyester sling	Bez sapan
Sythetic web sling	Bez sapan
Tag line	Kılavuz halat
Tandem lifts	Çift vinçle kaldırma
Telescoping boom	Teleskopik bom
Tensile	Gerilme
Thread damage	Vida dişi hasarı
Throat opening	Kanca ağız açıklığı
Tower crane	Kule vinç
Turnbuckle	Vidalı gerdirme
Twist	Burkulma
Tyre	Lastik
Tyre pressure	Lastik basıncı
Underground utilities	Altyapı hizmetleri
Waistcoat	Yelek
Wedge socket	Kamalı başlık
Weight	Ağırlık
Wheel chok	Takoz
Wind	Rüzgar
Wind speed	Rüzgar hızı
Wire rope	Çelik halat
Wire rope clips	Kelepçe
Wire rope sling	Tel halat
WLL (Working Load Limit)	Çalışma ağırlığı limiti
Working radius	Çalışma yarıçapı
Worn	Aşınmış

FIGURE 100



T: Tension (for each sling)
L: Load

FIGURE 101

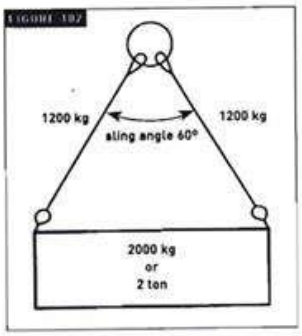


Included angle less than or equal to 30°

Tension = Load x 0.5

TensioN = 1000 x 0.5 = 500 [kg]
Thus the tension on each leg is 500 kg

FIGURE 102



Included angle less than or equal to 60°

At a sling angle of 60°, the slings will have the same lenght as the distance between their anchorage points.
To calculate each slings size for the above load of 2000 kg and sling angle of 60°, the following procedure applies:

Tension = Load x 0.6

Tension = 2000 x 0.6 = 1200 kg

Included angle less than or equal to 90°

To calculate each sling size for the above load of 2000 kg and sling angle of 90°, the following procedure applies.

Tension = Load x 0.70

Tension = 2000 x 0.7 = 1400 kg

FIGURE 103