Reading Material on Material Handling

HUMAN RESOURCE DEVELOPMENT CENTRE
An ISO 9001: 2000 CERTIFIED INSTITUTE
ROURKELA STEEL PLANT
STEEL AUTHORITY OF INDIA LTD.

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1.0 LECTURE CONTENT :

Shifting of material from one place to another place, safely, smoothly and with minimum efforts without damaging the machine/equipments is called rigging.

SAFE METHOD OF WORK

1. BEFORE SLINGING :

- *Check work area is safe as clear as practicable*
- *Assess weight and size of lift*
- *Check instructions are correct*
- *Select suitable tackle with correct working load*
- *Obtain assistance if considered necessary*

2. SLINGING :

- *Position hook over load centre*
- *Attach slings etc. using adequate packings if required*
- *Check sling bight correct*
- *Check shackle pin and eye bolts secure*
- *Check angle of sling is safe*

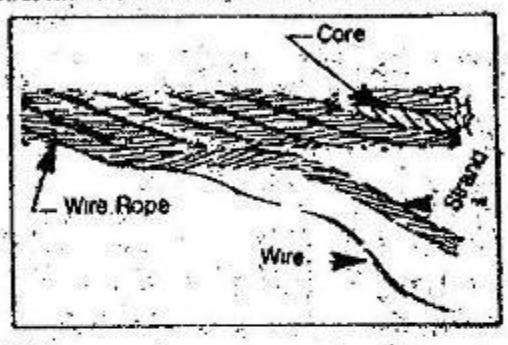
3. LIFTING :

- *Stand in view of crane driver*
- *Stand clear of swing*
- *Hands clear of bight*
- *Signal to hoist a little*
- *Signal to stop & hold*
- *Examine balance and security of tackle*
- *If safe, signal continue hoist and to destination*

1 WIRE ROPE CONSTRUCTION :

Wire rope consists of three essential components as shown below

a) Wire that forms the strand
b) A core
c) The multiwire strands laid helically round the core.



Wire ropes are identified by:

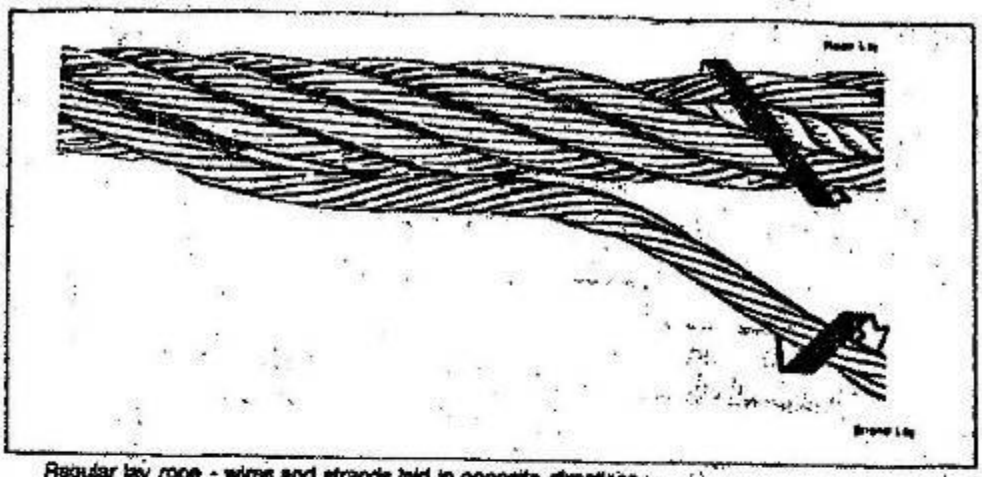
- the way the wires have been laid to form strands.
- the way the strands have been laid around the core.

Normally following types of lays are in use :

a) REGULAR LAY: In this the ropes are made in such a way that the direction of the wire lay in the strand is opposite to the direction of the strand lay in the rope.

b) LANG LAY. In langs lay the strands lay and rope lay are in the same direction.

Langs lay rope - wires and strands laid in the same direction



Regular lay rope - wires and strands laid in opposite directions

1.2 ROPE CORES:

Rope cores are supplied either with fibre or with steel cores, the choice being largely dependent on the use for which the rope is intended.

a) FIBRE CORE: Most wire ropes used for slings have a fibre core included in the lay and this fibre is used as a reservoir for the lubricant which should be applied to the rope wires to prevent internal abrasion. But fibre core gets damaged when it is subjected to heat.

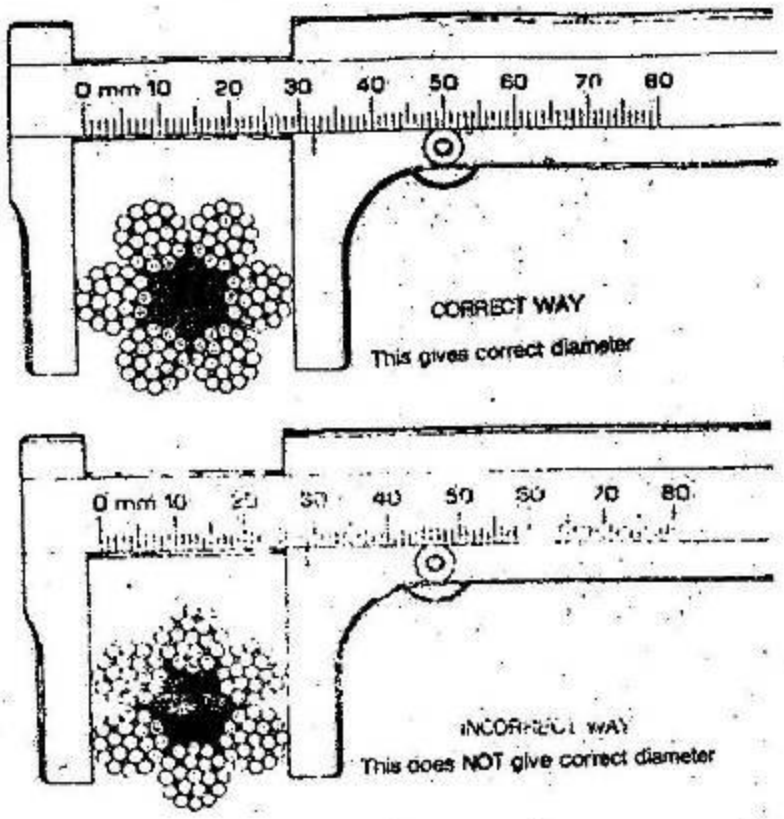
b) METAL CORE: Metal core ropes are used for jobs that are being subjected to excessive heat. In this the strands are formed round a metal core, which provides adequate support for the outer strands.

NORMALLY THE ROPE CONSTRUCTIONS ARE DESCRIBED BY INDICATING FIRST THE NUMBER OF STRANDS AND THEN THE NUMBER OF WIRES IN EACH STRAND.

Example: 6x7, 6x19, 6x37

ROPE SIZE :

A wire rope is usually measured by its dia. The correct and incorrect methods of measuring a rope dia is shown below.

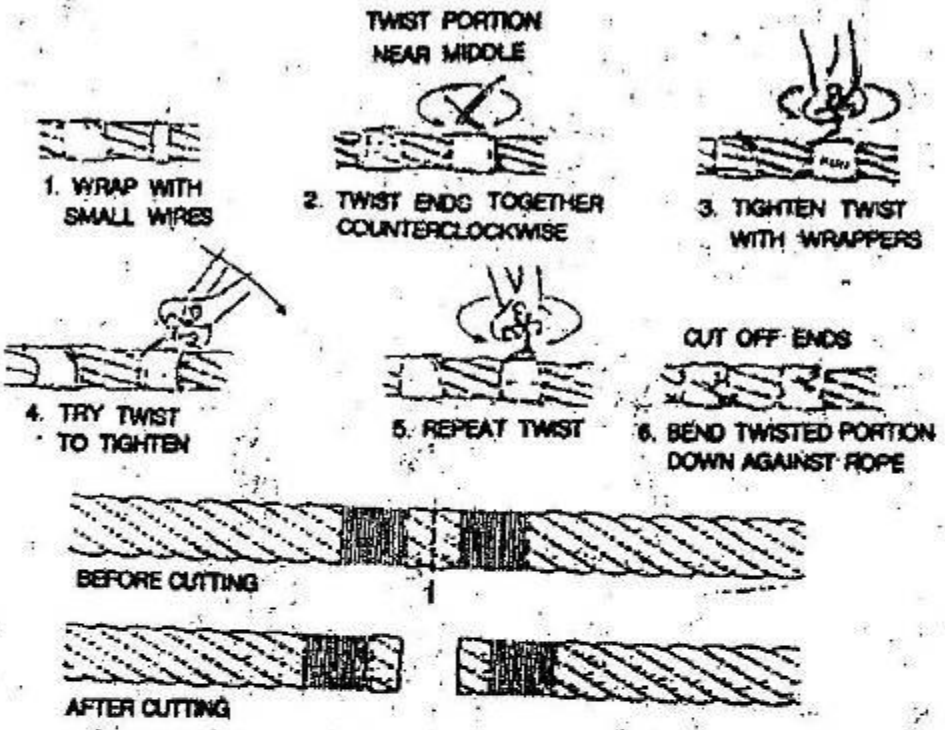


Measurement of rope diameter

1.3 SEIZING A WIRE ROPE :

Before cutting a wire rope it is necessary to apply seizing on both sides of the place where the cut is to be made. Different methods of seizing a wire rope ends are indicated below.

SEIZING A WIRE ROPE :



1.4 KNOTS, BENDS AND HITCHES

FIBRE ROPES : Fibre ropes are normally manufactured from Manila, Hemp, or Sisal. Manila is considered to be the best material in view of its toughness, strength, and reliability. It stands up well to wear and weather.

KNOTS BENDS AND HITCHES IN FIBRE ROPES :

KNOTS : A knot is the intertwining of the end of a rope within a portion of the rope. Knotted ropes are never used for overhead lifting.

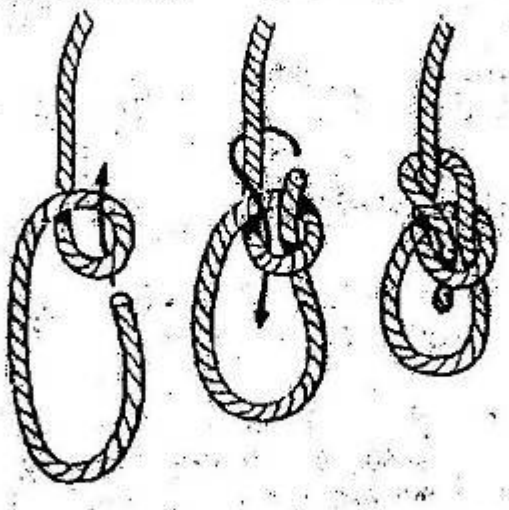
BEND : A bend is the intertwining of the ends of two ropes or of the same rope to make one continuous or endless rope.

HITCH : A hitch is the attachment of a rope to a post, pole, ring, hook or other objects.

PREPARATION OF KNOTS, BENDS & HITCHES IN FIBRE ROPES :

A. BOW LINE KNOT : It is used for making loops. Steps to be followed are :

- Form a loop in the rope.
- Pass the end of the rope through loop.
- Round the main part of the rope and back through the loop.

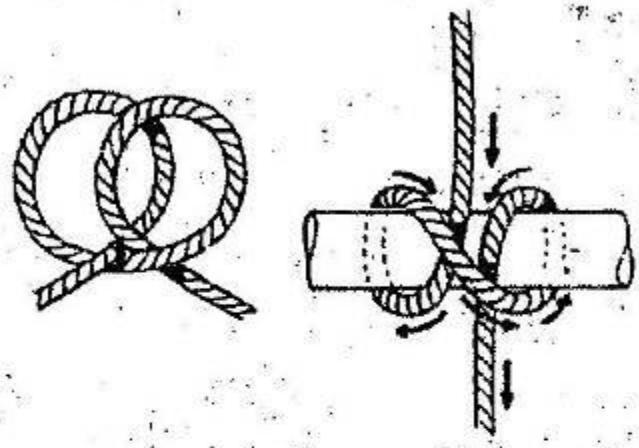


B. REEF KNOT : It is used for tying two ropes together of equal size. Steps to be followed are:

- Form an open ended loop with one rope
- Pass the short end of the other rope through the loop under the two legs of the first rope.

C. CLOVE HITCH : Steps to be followed :

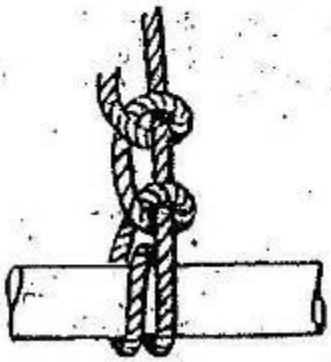
- Pass the short end of the rope over the pole/post and back over itself.
- Pass round the pole again and under itself.



D. ROUND TURN & TWO HALF HITCH:

Steps to be followed :

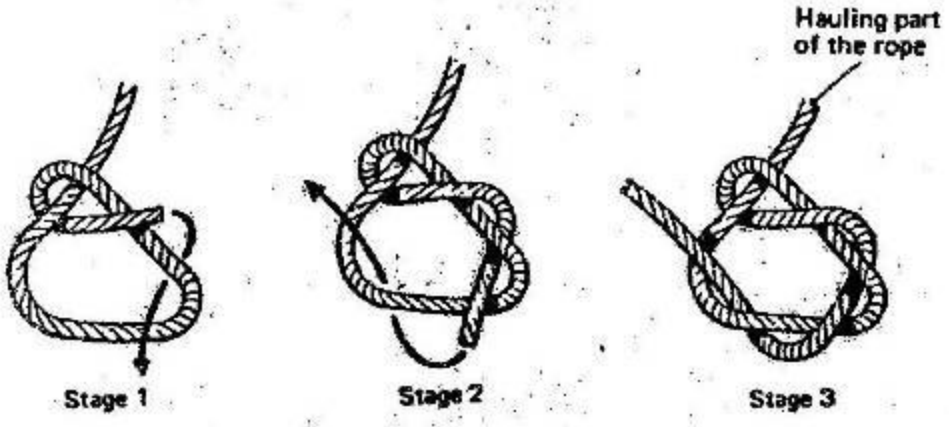
- Take the short end of the rope.
- Form a round turn around the post
- Make two half hitches on the working part of the rope.



E. TIMBER HITCH ; Steps to be followed :

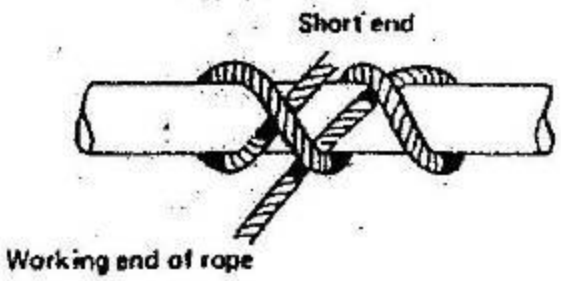
- Pass the short end of the rope round the load and over and under itself.
- Pass the short end of the rope over and under the first loop made round the load.
- Continue passing the short end of the rope over and under the first loop a minimum of three times.
- Pull in the hauling part of the rope to tighten the hitch round the load.

NOTE : THIS HITCH MUST NEVER BE USED FOR LIFT



F. ROLLING HITCH : Steps to be followed:

- Pass the short end of the rope over the load and back over itself twice.
- Pass round the load again and secure the trailing end by feeding it under and through the last turn made round the load.



1.5 SPLICING IN FIBRE ROPES :

Splicing in fibre ropes consists of three main steps:

1. Unlaying the strands of the rope.
2. Placing the rope ends together.
3. Interweaving the strands and tucking them together.

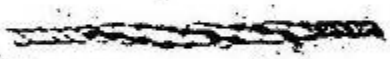
NORMALLY FOLLOWING FOUR TYPES OF SPLICING IS DONE IN FIBRE ROPES:

A) SHORT SPLICE : Short splice is as strong as the rope in which it is made but it causes an increase in the diameter of the rope for a short

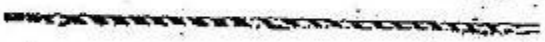
B) LONG SPLICE : Long splice is as strong as the rope itself. It has a neater appearance and can be passed through pullies.

distance. Short spliced ropes can not be passed through pullies.

C) EYE SPLICE : The eye splice or side splice is used for making a permanent loop in the end of a rope. The loops are used for fastening the rope to a ring or hook.



SHORT SPLICE



LONG SPLICE

EYE SPLICE

CROWN OR BACK SPLICE

D) CROWN OR BACK SPLICE : Where the end of a rope is to be finished off to prevent underlaying and a slight enlargement of the end is not objectionable a crown splice can be made to finish the ends.

1.6 SAFE LOAD FOR FIBRE ROPES

For calculating safe working load of manila ropes:

- change the rope dia. in eights of an inch.
- square the numerator and multiply by 20.

Example: For 1/2" dia manila rope

1/2" = 4/8"

swl = 4x4x20 = 320 lbs. = 145 kgs.(approx.)

SWL FOR MANILA ROPE:

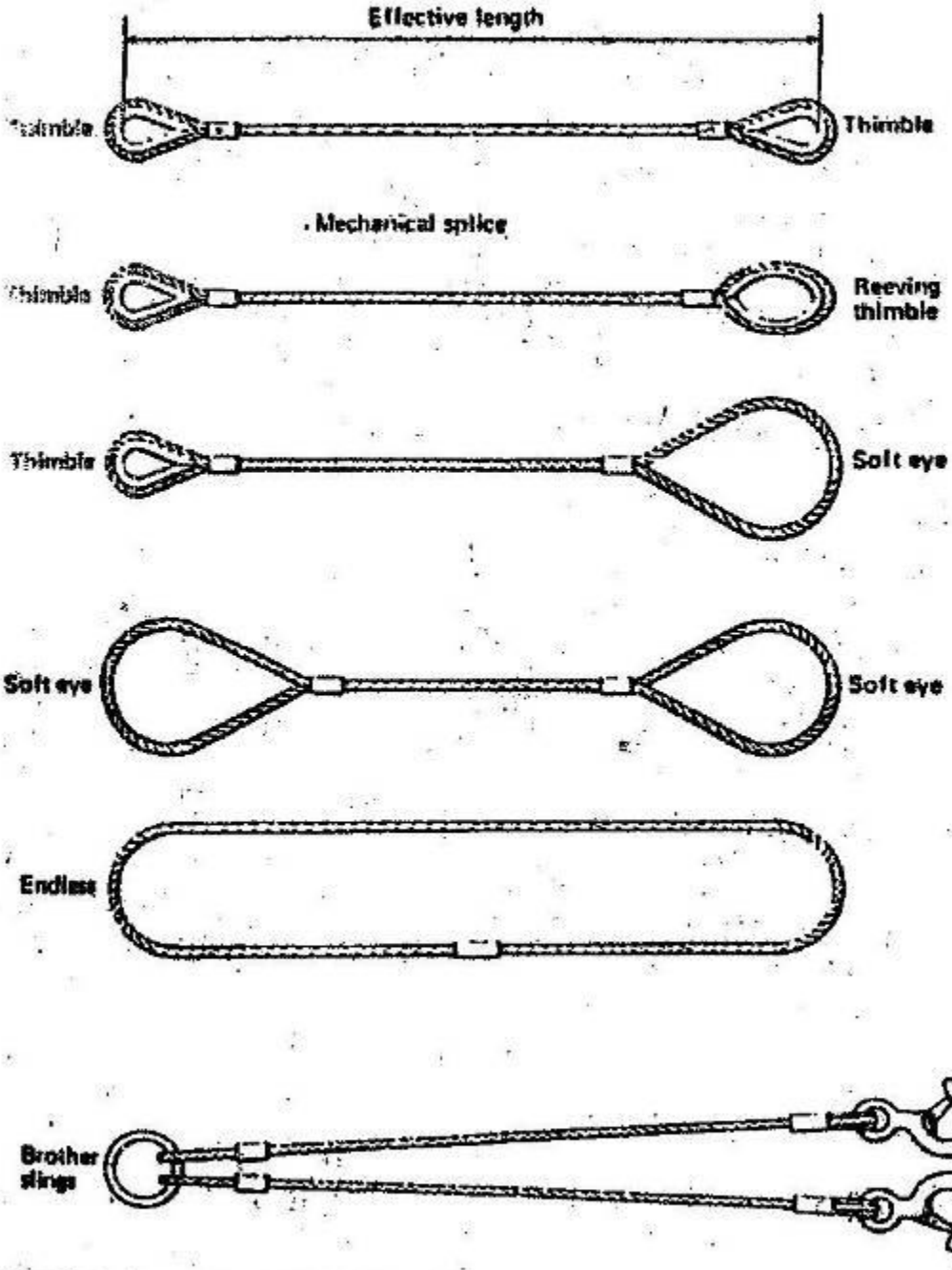
Type of Rope	$\frac{1}{4}$"	$\frac{1}{2}$"	$\frac{3}{4}$"	1"	$1\frac{1}{2}$"	2"
Manila Rope	36.25 kg.	145 kg	326.25 kg.	580 kg.	1305 kg.	2320 kg.

POINTS TO WATCH IN THE CARE OF A FIBRE ROPE:

1. It will rot so keep it away from water.
2. It deteriorates with heat and will burn.
3. Never use near acid.
4. Check external wear due to dragging over rough surfaces.
5. Avoid local abrasion due to the passages of the rope over a sharp edge.
6. Internal wear caused by repeated flexing of the rope.

"ALL THE KNOWLEDGE AND SKILL USED IN PRODUCING A SATISFACTORY SLING IS OF NO AVAIL, IF THE SLING HAS NOT BEEN MAINTAINED AND PROPERLY APPLIED TO A LOAD TO ENSURE THAT THE LOAD IS NOT LIABLE TO FALL AND CAUSE INJURY TO MEN AND MACHINES."

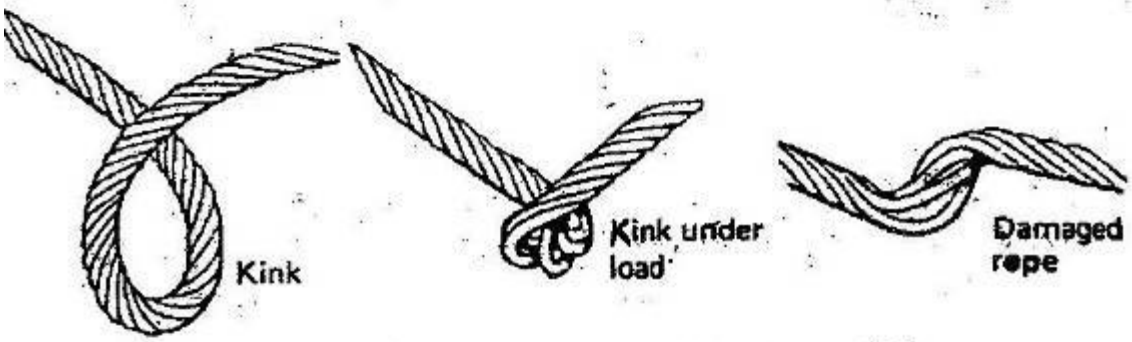
1.7 WIRE ROPE SLINGS :



1.8 CARE AND USE OF WIRE ROPES:

- NEVER TIE A KNOT IN A WIRE ROPE WHEN SLINGING A JOB.
- AVOID SHARP EDGES. USE PROTECTION PACKING OR TIMBER.
- NEVER LAND AND LOAD ON STROPS. USE PACKING
- NEVER PULL STROPS FROM UNDER A LOAD WITH CRANE
- AVOID KINKING. NEVER PULL A TWIST IN.
- ALWAYS USE PULLIES OF STANDARD SIZE FOR ROPE DIAMETER.

Following fig. shows the kinking and damage of a rope.



1.9 SMALL TACKLES USED IN RIGGING :

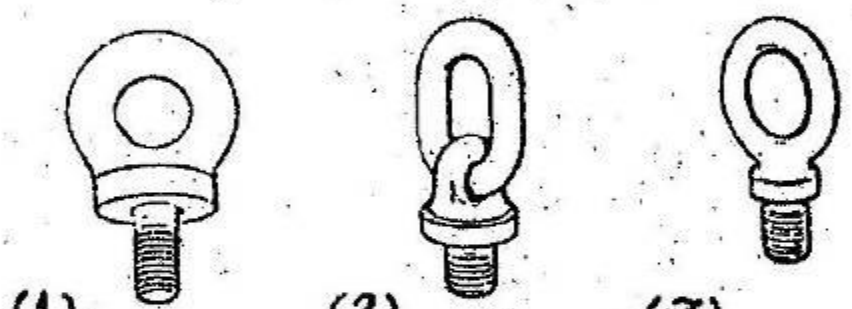
SHACKLES : Shackles provide location points for rings, eyes and hooks and allow slings to automatically adjust themselves and prevent bends & kinks.

EYE BOLTS : Eye bolts are screwed into location holes, provided in loads for attachment of shackles and slings. Normally following three types of eye bolts are in use.

1. COLLAR EYE BOLT: This has a smaller eye and a large collar with a machined under face which is relieved to allow a radius between collar and shank and to provide a thread runout.

2. EYE BOLT WITH LINK: This is used for general lifting purpose and has a link forged in the eye.

3. DYNAMO EYE BOLT: This is designed for vertical lifting only.



1.10 WIRE ROPE SPLICING :

Splicing in wire ropes requires skill and care. Long splice is the best for wire ropes. Normally following types of splices are done in wire ropes.

1. LONG SPLICE: The recommended length of wire rope (in feet) required to make a long splice is 40 times the dia. of the rope in inches.

   Example:

   For 1/2" dia. rope, splice length = 1/2x40 = 20 feet i.e. 10 feet of each rope to be joined.

2. SHORT SPLICE: It is normally used for making an eye in the end of a wire rope with thimble or without thimble. The recommended extra length (in feet) to allow for a short splice is 3 times the dia in inches.

Example:

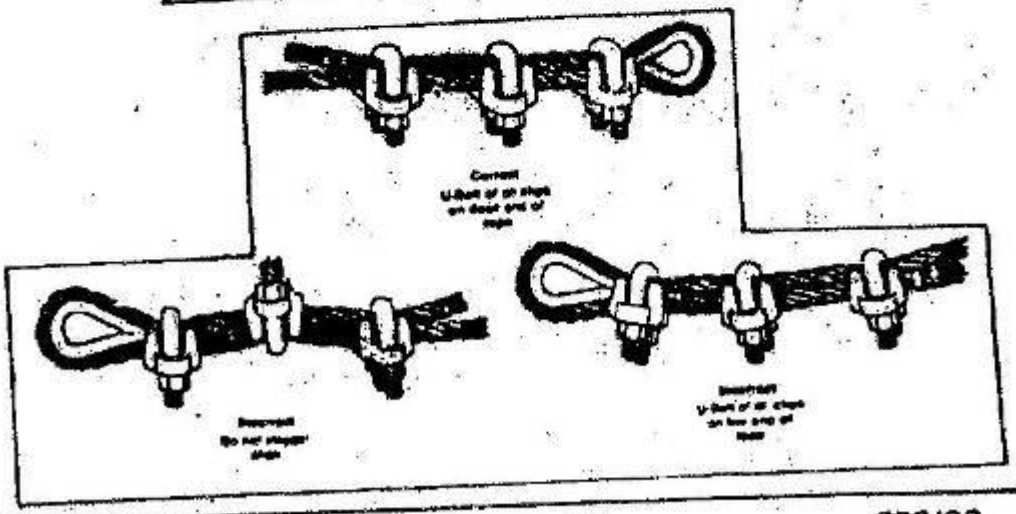
For 3/4" dia. rope, the extra length required will be 3/4 x 3 = 9/4 feet.

SAFE WORKING LOAD FOR WIRE ROPE SLINGS

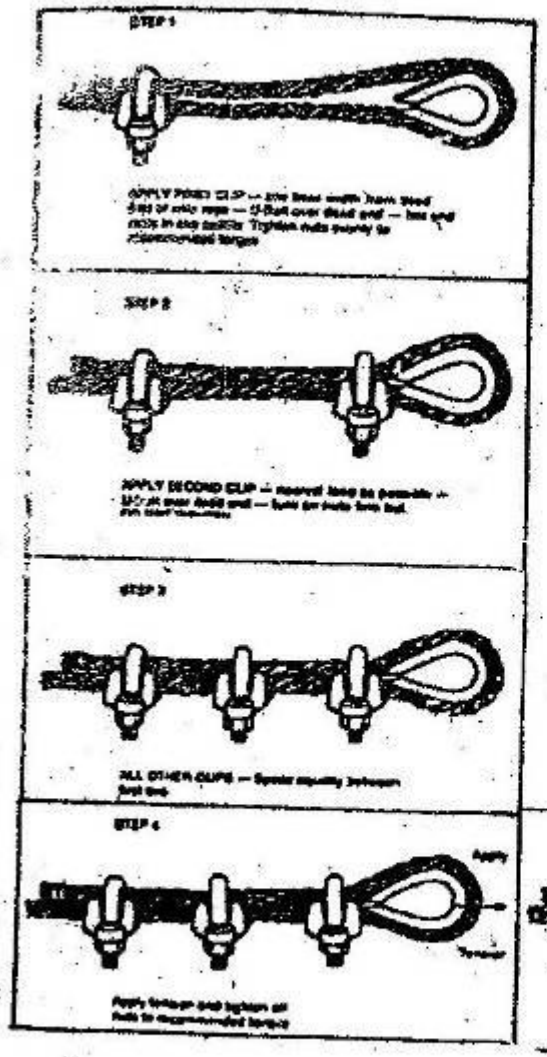
SWL = ROPE DIA. × ROPE DIA. × 8
Examples: (a) ½ in diameter rope SWL = ½ × ½ × 8 = 2 tons (b) ⅝ in diameter rope SWL = ⅝ × ⅝ × 8 = 3.125 tons (c) 1 in diameter rope SWL = 1 × 1 × 8 = 8 tons

1.11. WIRE ROPE CONNECTIONS WITH BULL DOG GRIPS :

ROPE CONNECTION:

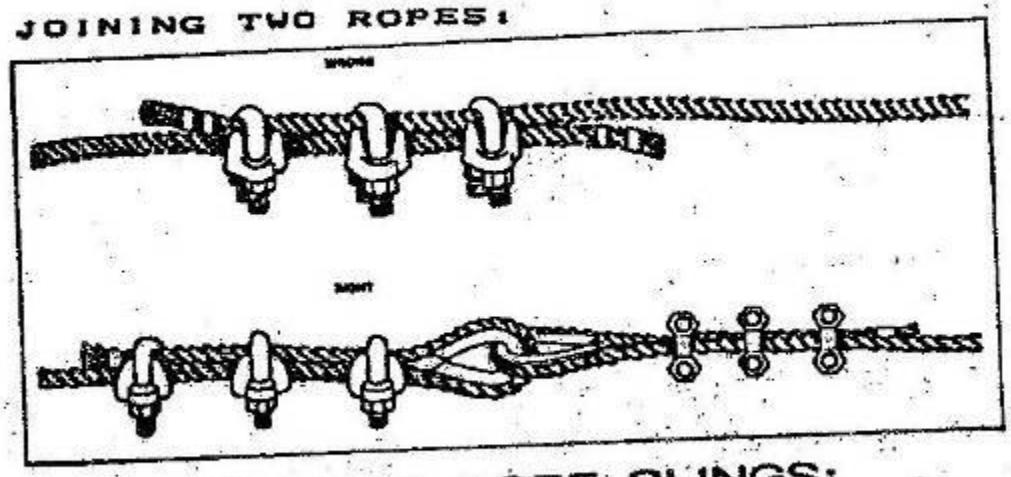


ROPE CONNECTION:



INSTALLATION OF WIRE ROPE CLIPS						
Rope diameter mm	in	Minimum no. of clips	Amount of rope turn back from thimble mm	in	Torque unlubricated bolts Nm	lbf ft
3	1/8	2	83	3¼	-	-
4	5/32	2	98	3⅞	-	-
5	3/16	2	120	4¾	20	15
6	7/32	2	140	5½	40	30
7	1/4	2	165	6½	61	45
8	5/16	2	175	7	88	65
9	11/32	3	298	11⅞	88	65
10	3/8	3	305	12	130	95
11	7/16	3	305	12	130	95
12	1/2	4	457	18	176	130
14	9/16	4	462	18	305	225
16	5/8	5	660	26	305	225
18	11/16	6	864	34	305	225
20	3/4	6	940	37	488	360
22	7/8	7	1120	44	488	360
24	15/16	7	1220	48	488	360
26	1	7	1295	51	583	430
28	1 1/16	7	1345	53	800	590
32	1 1/8	8	1605	71	1016	750
34	1 3/16	8	1960	73	1015	750
36	1 1/4	8	2135	84	1015	750
40	1 5/16	10	2540	100	1016	750
44	1 3/8	10	2680	105	1625	1200

JOINING TWO ROPES:

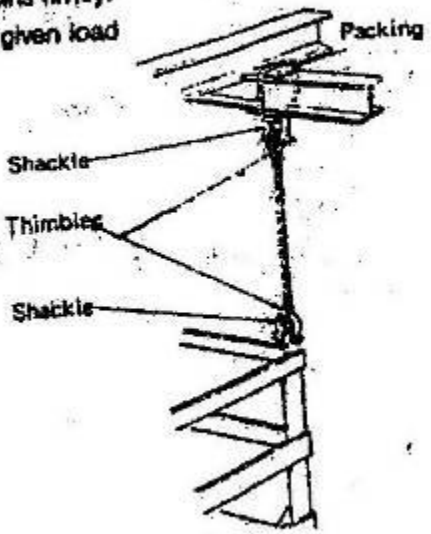


.12 USE OF WIRE ROPE SLINGS:

Given below are some examples of safe use of wire rope slings. Before using any sling make sure that the size of the wire rope is suitable for load to be lifted.

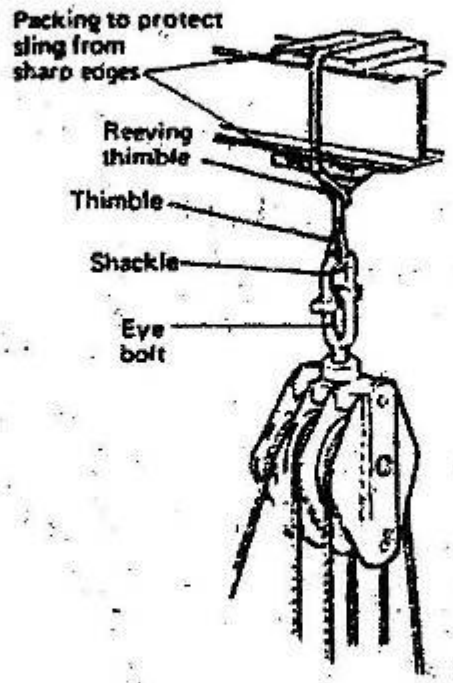
SLINGS WITH TWO THIMBLES:

- Fit the thimble ends of the sling to the suspension points.
- Screw the shackle pins firmly.
- Finally suspend the given load



SLINGS WITH ONE THIMBLE & A REAVING THIMBLE

- Pass the sling over the structure, with packings if necessary to protect the sling.
- Pass the thimble through the reaving thimble
- Fit a shackle to the thimble where load is to be given.
- Screw the shackle pin firmly.
- Lift the given load.



SLINGING WITH TWO SOFT EYES:

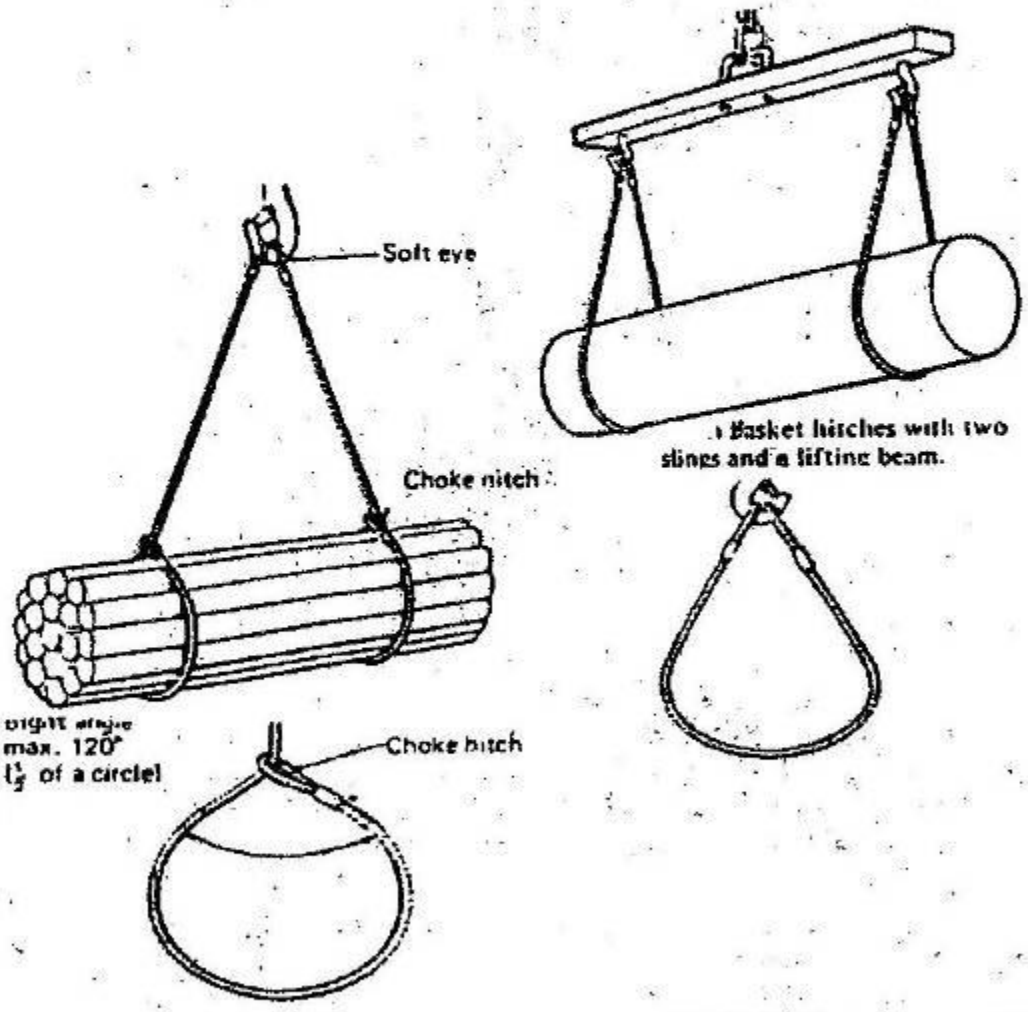
BY MAKING A CHOKE HITCH:

- Pass the sling round the load.
- Place packings if necessary to protect the sling.
- Pass one soft eye through the other end soft eye.
- Fit the free soft eye on the lifting hook.
- Before starting the lift take up the slack and check that the load is properly balanced.

NOTE: MAKE SURE THAT THE BIGHT ANGLE IS LESS THAN 120 DEG.

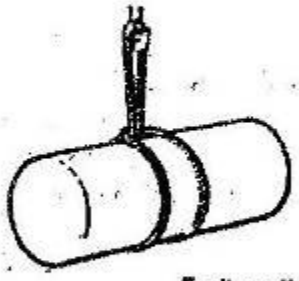
2. BY MAKING BASKET HITCH

- Place one end of the sling on the crane hook.
- Pass the sling round the load to be lifted.
- Place the other end of the sling on the crane hook.
- Make two basket hitches with lifting beam if the load to be lifted is long.



Endless slings :

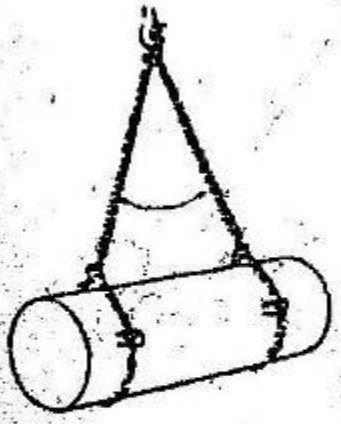
-Pass the sling round the load and back through its own loop.
-Fit the free end loop directly on to the lifting hook.
-Check that the load is central before commencing the lift.

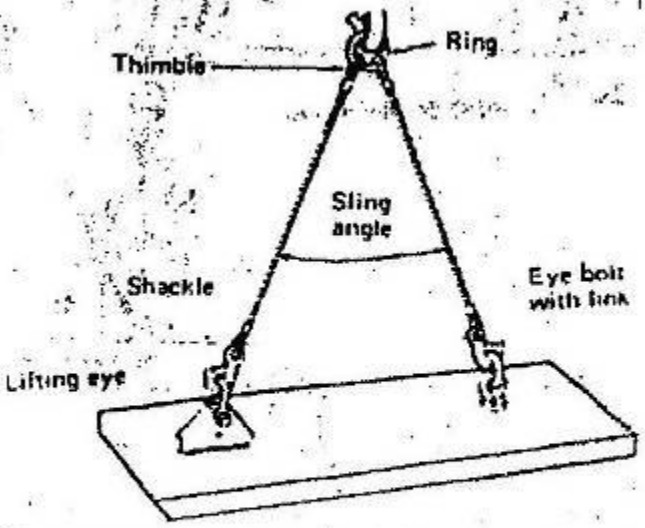


Endless slings

BROTHER (DOUBLE) WIRE ROPE SLING :

Given below are examples of using a brother wire rope slings in both cases the hook points are facing outwards.





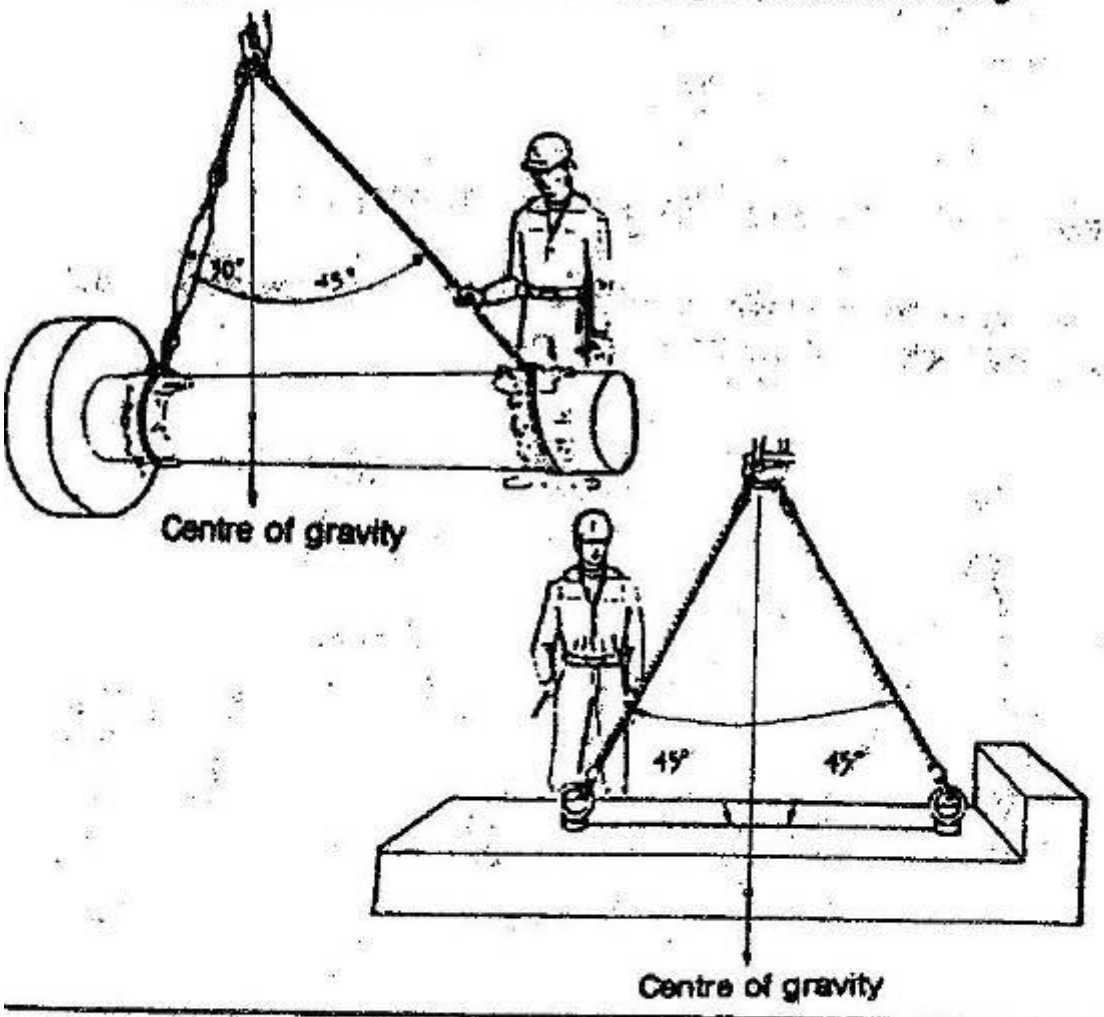
SLINGING OF UNBALANCED LOADS :

Steps to be followed:

- Position the crane hook vertically over the centre of gravity of the load.

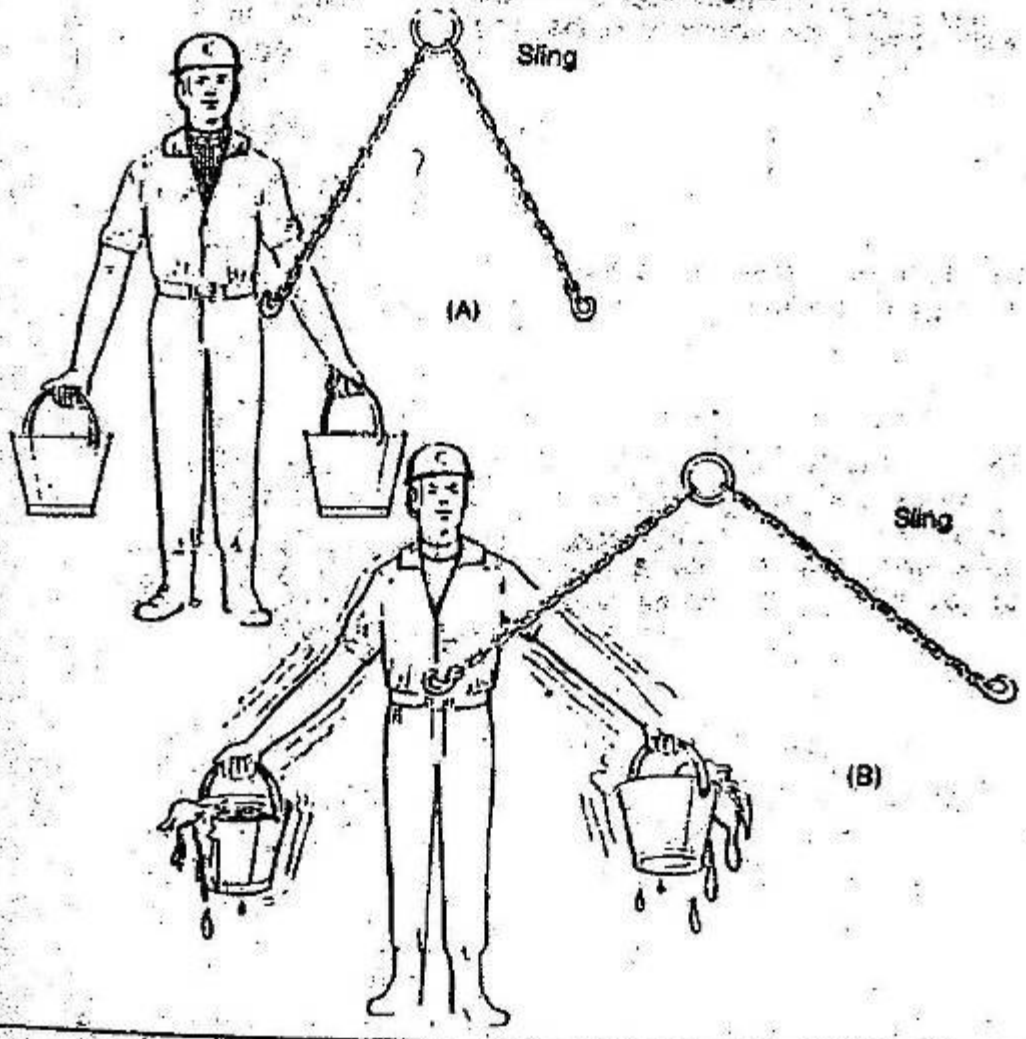
- Attach slings of equal length at an equal distance from the marked centre of gravity.

- Take the slack and check the balancing of load before lifting.



1.13 SLING ANGLES:

The stresses in the legs of a sling increases as the angle between them increases. The example given below very clearly demonstrates the effects of lifting a load at narrow and wide angles.



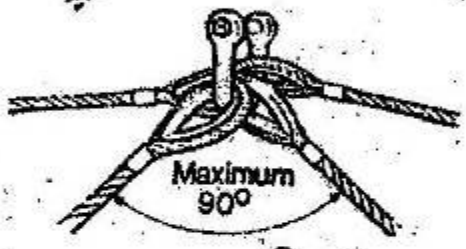
NOTE: WHEN DETERMINING THE WEIGHT TO BE LIFTED THE LIFTING GEAR MUST BE INCLUDED AS PART OF THE LOAD. THIS INCLUDES ANY CRANE BLOCKS ROPE AND WIRE FALLS.

LOADING CRANE HOOKS WITH SLINGS:

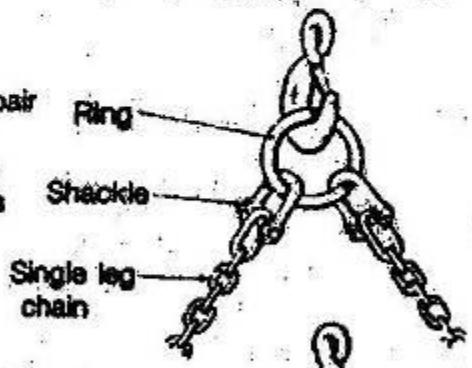
Load crane hooks with slings within an angle of 90°

Increasing angles of more than 90° will rapidly reduce the efficiency of the sling.

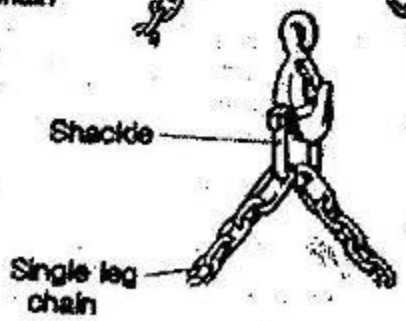
Use a Dee or Bow shackle to collect more than two thimbles.



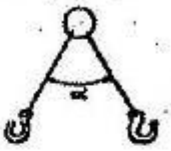
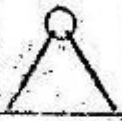
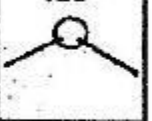
Use a shackle or ring and a pair of shackles when fitting slings to a hook. This will prevent the hook being strained as the slings spread and take up the load.



Check that the angle of the slings is correct before starting a lift.



SAFE WORKING LOAD CHART FOR WIRE ROPE SLINGS

Rope dia. mm	Single sling one part lift 	Endless sling two part lift 	Single and two leg sling two part lift   Included angles				
Leg load	Included angles α=0°–120°	Included angles α=0°–120°	0° 	30° 	60° 	90° 	120° 
9	0.762	1.524	1.524	1.421	1.270	1.069	0.762
11	1.016	2.032	2.032	1.93	1.78	1.422	1.016
13	1.32	2.64	2.64	2.54	2.284	1.83	1.32
14	1.678	3.35	3.35	3.2	2.9	2.34	1.678
16	2.081	4.16	4.16	4.02	3.63	2.9	2.08
19	3.048	6.096	6.096	5.85	5.24	4.26	3.048
22	4.064	8.128	8.128	7.83	7.01	5.69	4.064
26	5.39	10.78	10.78	10.37	9.30	7.56	5.39
32	8.34	16.65	16.65	16.08	14.42	11.76	8.34
38	12.0	24.0	24.0	23.2	20.78	16.9	12.0
44	16.49	32.98	32.98	31.8	28.42	23.3	16.49
51	21.46	43.0	43.0	41.5	37.25	30.35	21.46

Where the included angle "alpha exceeds 120° in reeved slings (see one part lift columns) the safe working load must be reduced by half.

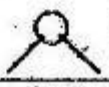
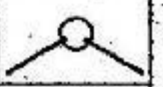
Always put packing on sharp edges to prevent damage and where possible never put a sling round a radius of less than three times the rope diameter.

SAFE WORKING LOAD CHART FOR MILD STEEL SINGLE & DOUBLE LEG CHAIN SLINGS:

Mild steel chain slings
single and double leg chain slings

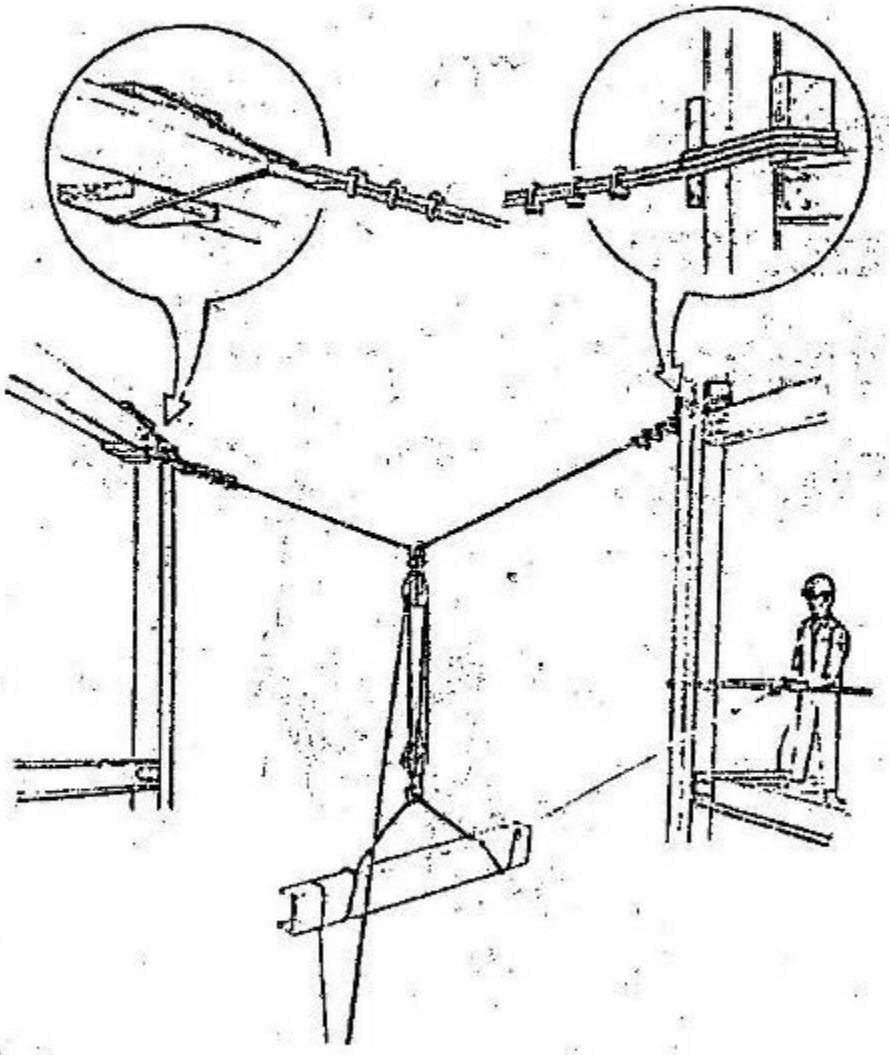
Safe working load chart
Load in tonnes (t)

Note:
One tonne (t) = 2,200 lb

Dia. of chain link (mm)	Safe working load of single leg	Angle of sling legs				
		0° 	30° 	60° 	90° 	120° 
5	0.3556	0.762	0.7116	0.659	0.508	0.3556
9	0.8128	1.648	1.573	1.423	1.169	0.8128
11	1.118	2.219	2.134	1.931	1.575	1.118
13	1.524	3.048	2.947	2.641	2.134	1.524
16	2.34	4.675	4.52	4.064	3.3	2.34
18	3.403	6.86	6.61	5.948	4.84	3.403
22	4.625	9.25	8.95	8.04	6.551	4.625
26	6.096	12.19	11.79	10.58	8.65	6.096
29	7.675	15.33	14.82	13.31	10.89	7.675
32	9.5	19.05	18.36	16.51	13.48	9.5

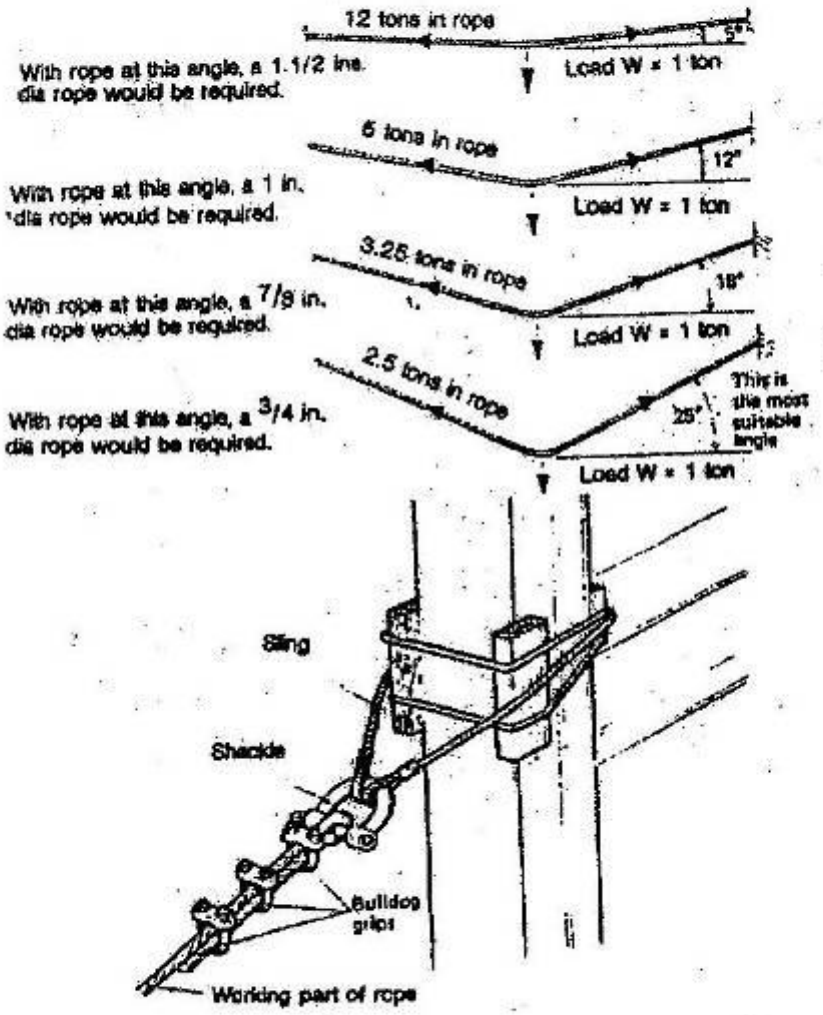
1.14 WIRE ROPE BLONDINS:

A blondin is a method of supporting a load usually during lifting operations, where there is no suitable anchorage above the point of lift, as shown below.



SAFE ANGLES FOR WIRE ROPE BLONDIN

The following diagrams show a rope supporting a load of one ton and various angles of the rope to the horizontal. It shows that by increasing the angle the dia. of rope required will vary considerably.

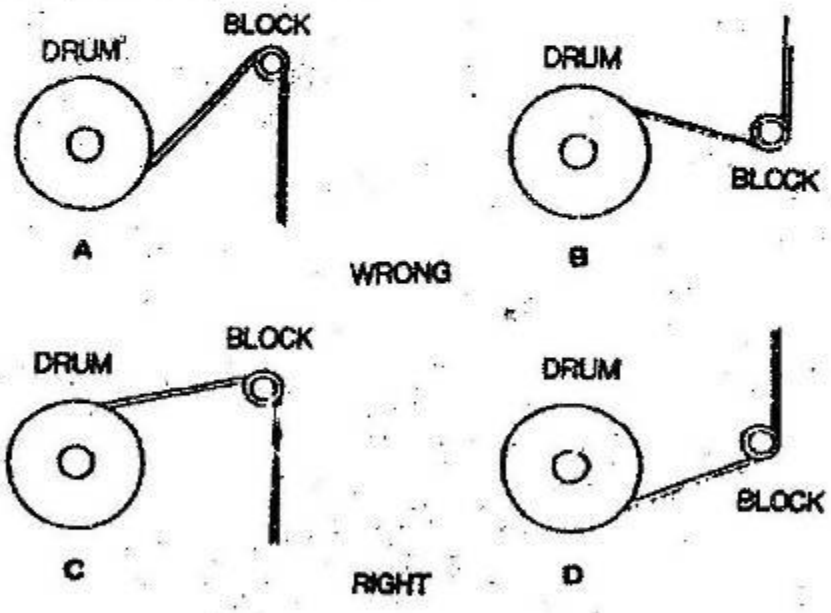


1.15 PULLEY AND ROPE DIA RATIO:

All wire ropes over sheaves and drums are subjected to cyclic bending stresses, so the wire rope will eventually fatigue. The magnitude of these stresses depends upon the ratio of pulley/drum dia. to the rope dia. As a field rule of thumb the minimum pulley dia is 20 times the dia of the rope.

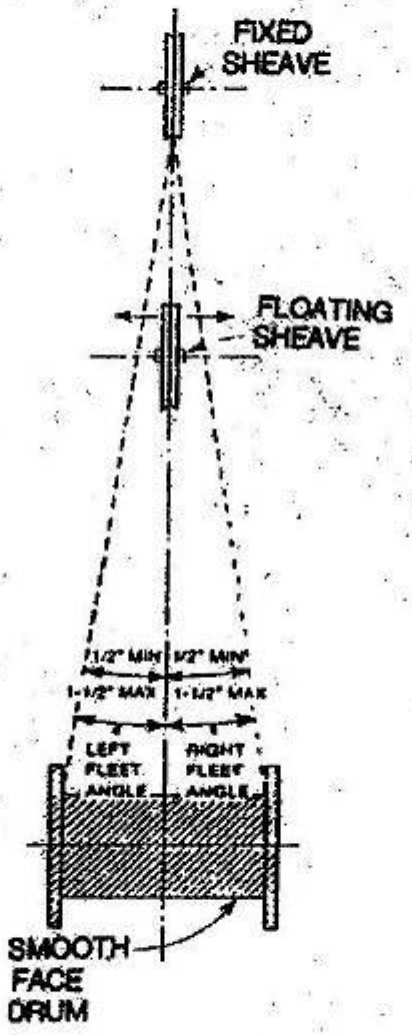
Example:
For 1" dia rope the size of the pulley will be 1x20 = 20"

Whenever possible the drums and blocks with sheaves should be arranged so as to avoid reverse bends.



1.16 FLEET ANGLE:

The fig. given below shows an installation where the wire rope runs from a fixed sheave over a floating sheave and then on to the surface of a smooth drum.



The included angle between the line drawn through the middle of the fixed sheave perpendicular to, the drum and a second line drawn from the flange of the drum to the base of the groove in the sheave is called fleet angle.

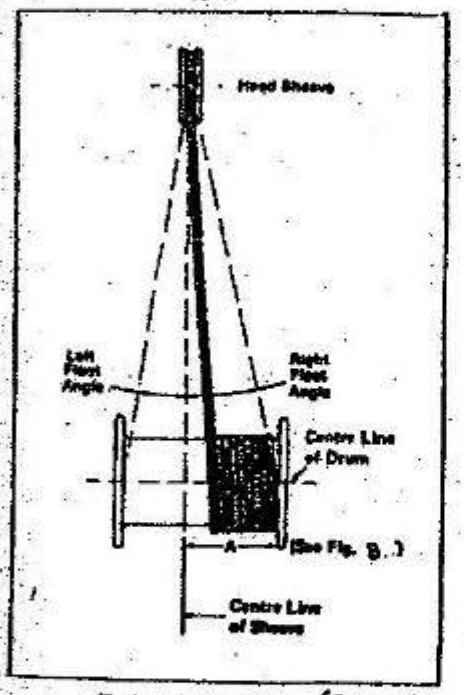
The drum flange represents the farthest position to which the rope can travel across the drum.

THE SUGGESTED FLEET ANGLE FOR SMOOTH DRUM

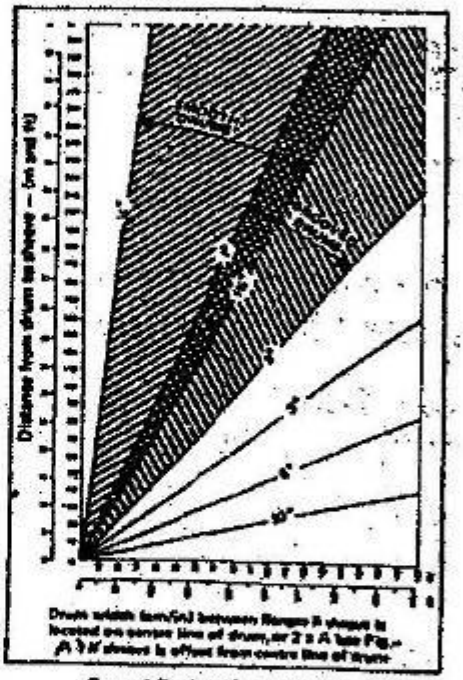
1^{0} - 2^{0}

AND FOR GROOVED DRUMS:

$1/4^{0}$ - $1\frac{1}{4}^{0}$



Fleet angle relationships (Fig.-A)



Correct fleet angle ranges for smooth and grooved drums (Fig.-B)

17 USE OF HOIST AND DRUMS:

In order to achieve the best results from hoist and drum assemblies, following points must be checked before hand :

Make sure that:

- It has adequate power and operational characteristics to perform all hoisting, holding and lowering functions.

- It is provided with suitable clutching or power engaging devices, which facilitates immediate starting and stopping of the drum motion.

- It is provided with self setting brakes that is capable of supporting all rated loads with recommended reeving.

The drum has sufficient rope capacity with recommended rope size and reeving to perform all hoisting and lowering functions.

- At least 2 to 3 full wraps of rope remain on drum in all service conditions.

- Grooved drums have the correct groove pitch for the dia of the rope.

- The projection of the drum flanges is either twice the rope dia or $2\frac{1}{2}$" beyond the last layer of the rope (which ever is more)

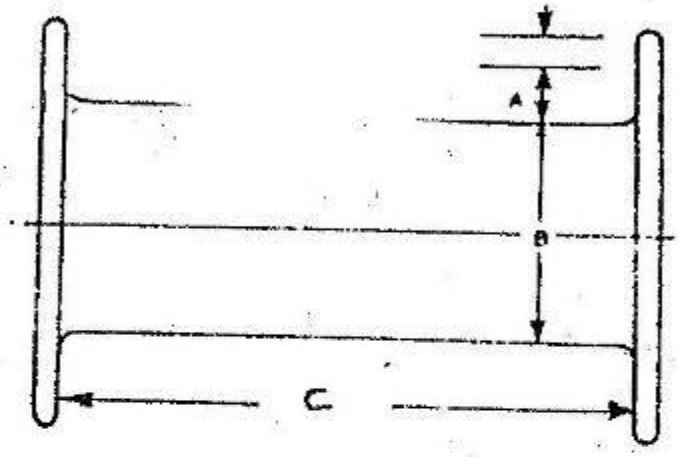
- The fleet angle for grooved drums is between $\frac{1}{4}^{o} - 1\frac{1}{4}^{o}$ and for smooth drums it is between $1^{o} - 2^{o}$

DRUM CAPACITY:

The length of the rope that can be accomodated on a drum can be found out by following formula:

Drum capacity (feet of rope) = (B+A) x A x C x F

Where, B = Drum dia.
A = Depth of the flange
C = Distance between the flanges
F = factor for the size of rope to be installed.

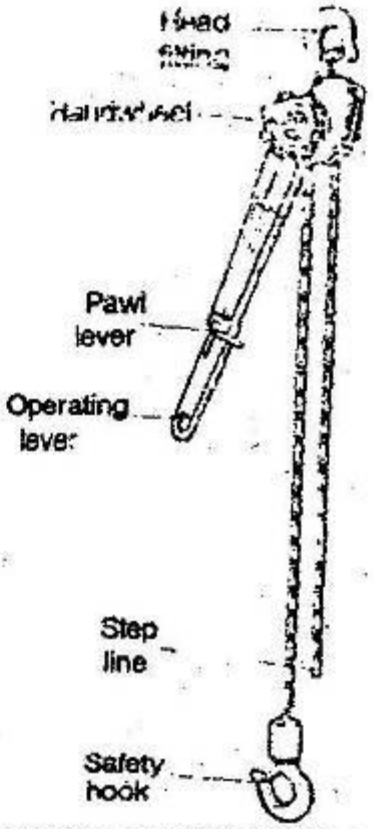


DRUM OR REEL CAPACITY FACTORS F

Nominal rope diameter mm	Nominal rope diameter in	F
8	5/16	4.160
9	11/32	2.670
10	3/8	1.860
11	13/32	1.370
13	1/2	1.050
14	9/16	0.828
16	5/8	0.672
18	11/16	0.445
22	7/8	0.342
25	1	0.265
29	1 1/8	0.207
32	1 1/4	0.167
35	1 3/8	0.138
38	1 1/2	0.116
41	1 5/8	0.099

1.18 USING RATCHET PULL LIFTS:

Attach the head fitting to a suitable anchorage taking in to account the load to be lifted, lowered or pulled.



HOISTING OR PULLING OPERATION:

- Turn the pawl lever to neutral position.
- Turn the hand wheel to adjust the chain to the required length.
- Attach the load to the bottom hook using correct size slings/shackles.
- Turn the paul lever to the up position.
- Turn the hand wheel to take up the slackness in the chain.
- Operate the handle backward and forward to lift or pull the load

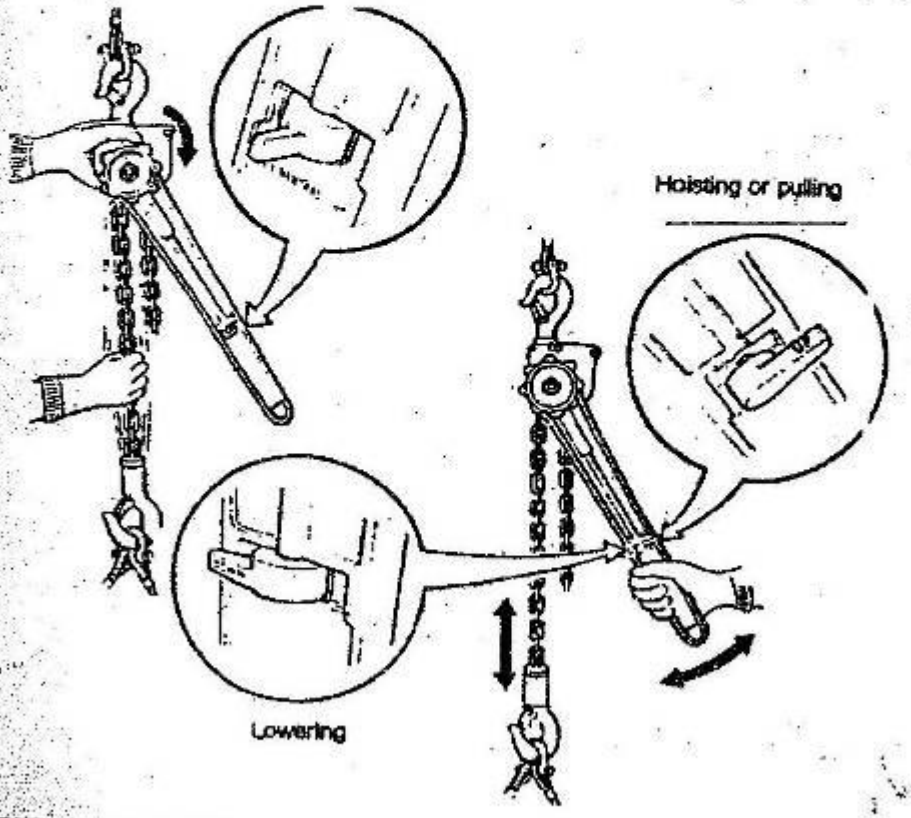
LOWERING OPERATION:

- Turn the pawl lever to the down position.

- Operate the handle backwards and forwards to lower the load.

- When the load has reached in secure position operate the handle to slacken the chain.

- Turn the pawl lever to the neutral position and turn the hand wheel to give sufficient length of chain so that the slings and shackles can be released.



1.19 USING PULLING & LIFTING M/C:

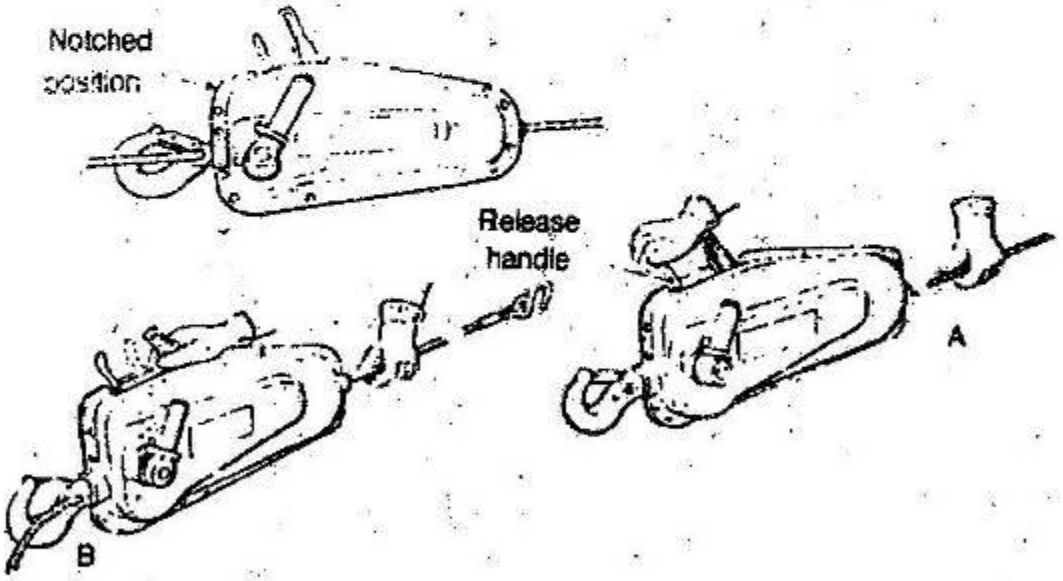
It is a multipurpose tool to pull and lift a given load in work situations. Following steps are important for smooth and safe operation.

1. Uncoil the special wire rope used in the machine, in a straight line to prevent loop.

2. Push the release handle into the notched position to open the jaw inside the m/c

3. Insert the tapered end of the wire rope into the machine at the hole in pos (A)

4. Push the rope through the machine until it comes out at (B).



5. Anchor the machine using the correct slings, and fit them to the hook attached to the machine.

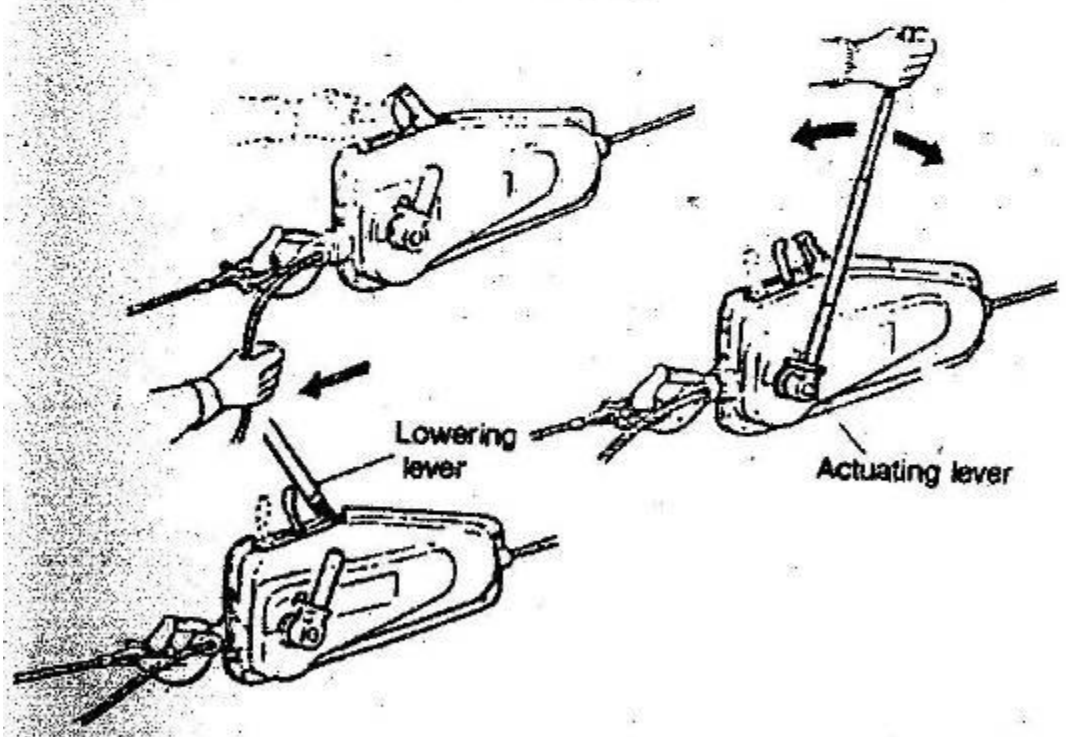
6. Pull the wire rope through the machine until the required length is reached and the rope becomes tight on the load.

7. Lift the release handle out of the notched position and allow it to return to the operating position under its spring pressure.

8. Fit the operating handle on the actuating lever and move the handle to and fro.

THIS ACTION PULLS THE ROPE AND AUTOMATICALLY LOCKS IT IN POSITION WHEN THE OPERATING HANDLE IS RELEASED.

9. For lowering or slackening off fit the operating handle to the lowering lever and move the handle to and fro.



RELEASING THE WIRE ROPE FROM THE MACHINE:

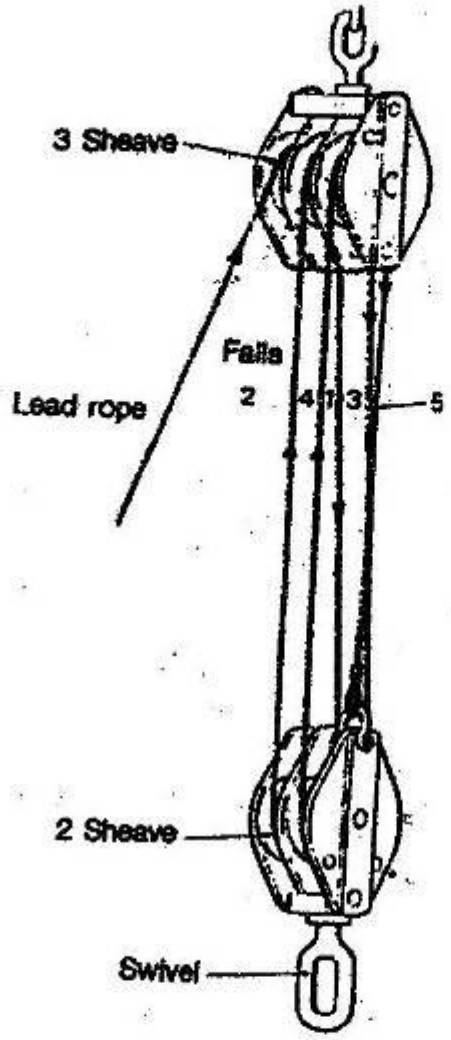
1. Fit the operating handle on to the lowering lever and move the handle to and fro until the rope becomes loose.

2. Remove the anchoring sling.

3. Push the release handle to the notched position to open the jaws inside the m/c
4. Pull the rope back through the machine

1.20 USING SHEAVE BLOCKS:

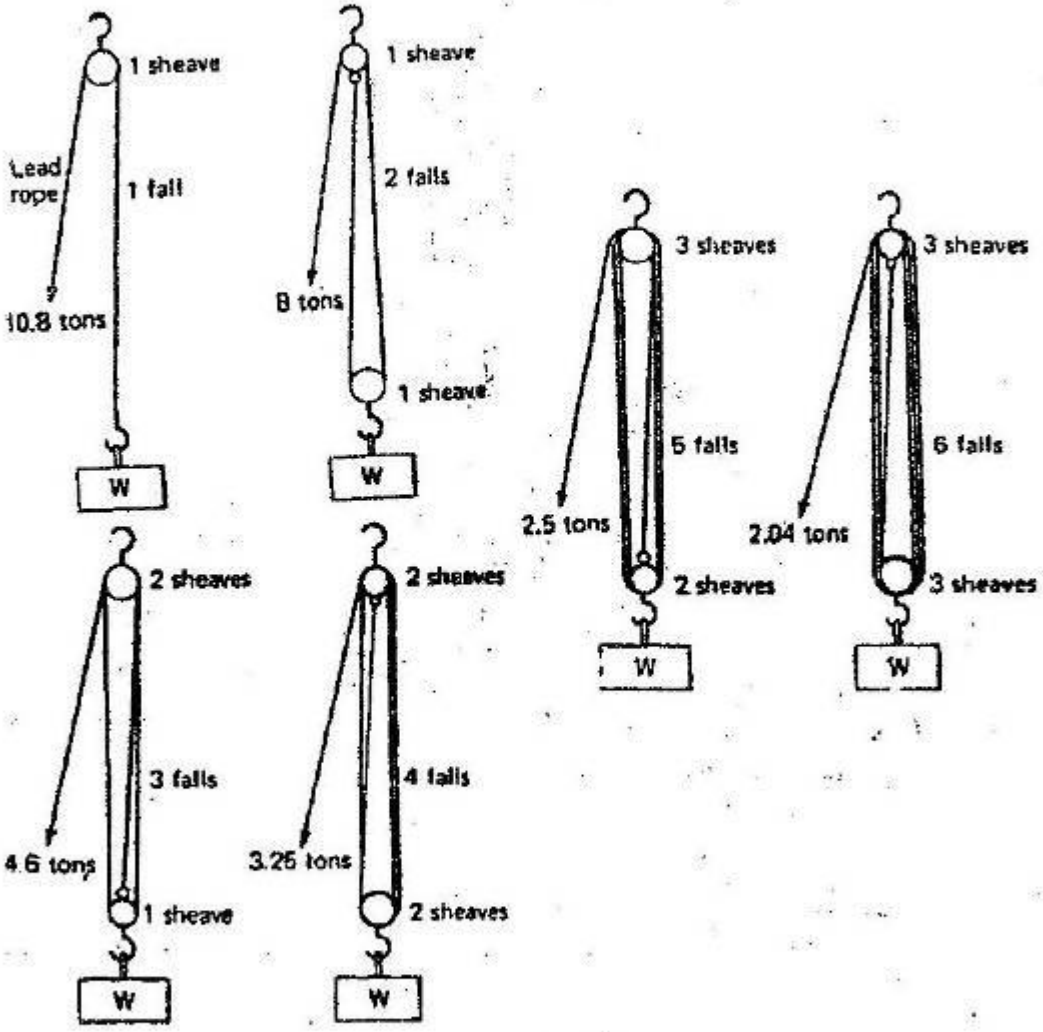
The use of sheave blocks reduces the pull required on the lead rope to lift a load. The pull required reduces as the number of falls increases. The example shown here is a combination of one 3 sheave block with swivel eye and one 2 sheave block with swivel eye.



This set will give 5 falls of rope i.e. (3+2). A fall is the length of the rope between the top and bottom block.

CALCULATING THE LOAD IMPOSED ON A LEAD ROPE

- Divide the load to be lifted (including lifting gear) by the number of falls.
- Multiply the result by the appropriate factor given in the following



THESE FACTORS TAKE INTO ACCOUNT THE EXTRA PULL REQUIRED IN THE LEAD ROPE TO OVERCOME THE FRICTION OF SHEAVE BLOCKS

Example:

To lift 20 tons with 3x2 combination of rope blocks:

wt. to be lifted/nos. of falls = 20 tons/5 = 4

4 tons multiplied by factor 1.25 from the table above = 4x1.25 = 5.0 tons

Friction Force = 3% of Sheave Load (Typical for good roller bearing sheaves.)

Number of Parts of Line N	Multiplication Factor F
1	1.03
2	1.06
3	1.09
4	1.13
5	1.16
6	1.20
7	1.23
8	1.27
9	1.31
10	1.35
11	1.39
12	1.43
13	1.47
14	1.51
15	1.56
16	1.61
17	1.65
18	1.70
19	1.76
20	1.81

Friction Force = 5% of Sheave load (bronze bushing sheaves)

Number of Parts of Line N	Multiplication Factor F
1	1.05
2	1.10
3	1.16
4	1.22
5	1.28
6	1.34
7	1.41
8	1.48
9	1.55
10	1.63
11	1.71
12	1.80
13	1.89
14	1.98
15	2.08
16	2.18
17	2.29
18	2.41
19	2.53
20	2.65

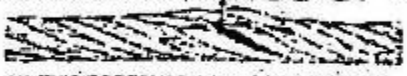
1.21 INSPECTION OF WIRE ROPES:

A ROPE WILL BE CONSIDERED UNSERVICEABLE WHEN IN ANY LENGTH OF 10 DIAMETERS. THE BROKEN WIRES EXCEED 5% OF TOTAL NUMBER OF WIRES.

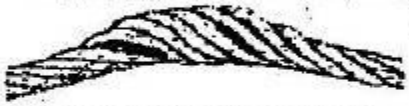
EXAMPLE:

On 1/2" rope of 6x19 construction the number of broken wires in, 1/2x10 = 5" length must not exceed 5% (i.e. 6x19 = (114x5)/100 = say 5 wires

Typical examples of wire rope deterioration



(A) THIS ROPE WAS DAMAGED BY BEING ROLLED OVER SOME SHARP OBJECT

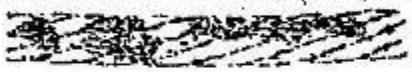


(B)THIS EFFECT OF DRUM CRUSHING IS EVIDENCE OF BAD WINDING CONDITIONS

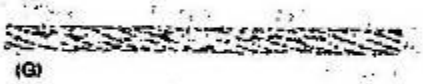
(C)AN OCCURRENCE THAT IS CALLED POPPED CORE

(D)THIS IS A TYPICAL BIRD CAGE CONDITION

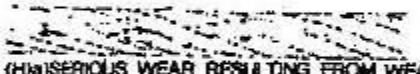
(E)THIS IS THE APPEARANCE OF A TYPICAL TENSION BREAK, A RESULT OF OVERLOADING



(F)HERE THE STRAND WIRES WERE SNAGGED

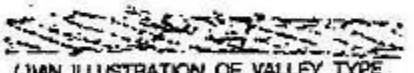


(G)

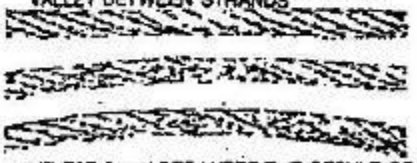


(H)a)SERIOUS WEAR RESULTING FROM WEAR EXCESSIVE BENDING AND b)LOCALIZED BROUGHT ABOUT BY POOR OUT-OF PRACTICE

(I)THIS IS AN ILLUSTRATION OF A SERIOUS CONDITION WHERE THE ROPE SLIDES OVER OR AGAINST ITSELF



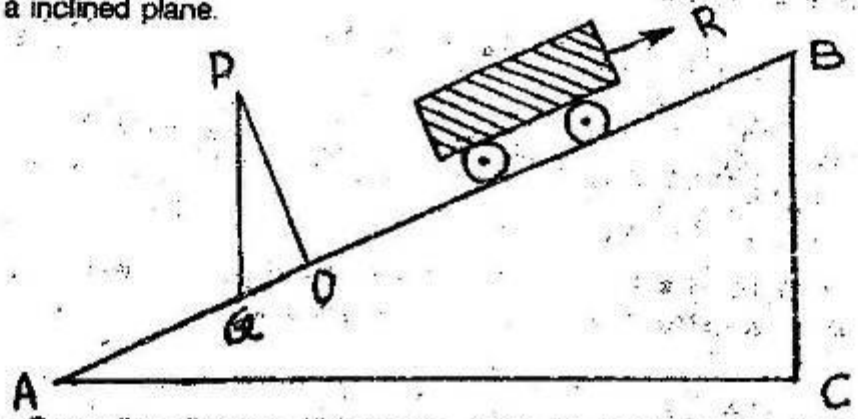
(J)AN ILLUSTRATION OF VALLEY TYPE FATIGUE BREAKS FLEXING THE ROPE EXPOSES BROKEN WIRES HIDDEN IN VALLEY BETWEEN STRANDS



(K)THESE DAMAGES WERE THE RESULT OF BAD DRUM WINDING

1.22 USE OF INCLINED PLANE, CROW BARS AND ROLLERS:

INCLINED PLANE These are normally used for hauling on rollers or skids up a ramp or to a truck. Example given below explains the method to determine the approx. pull required to haul the load on a inclined plane.



- Draw the diagram ABC to the scale to represent the inclined plane (i.e. 1m in 5m).

- Draw a vertical line PQ to a suitable scale to represent the load (say 1t=1mm)

- From P draw a line PQ at right angle to the inclined plane AB.

- Using the same scale measure the length of line PQ and find out the force reqd. to pull the load.

NOTE: RESISTANCE DUE TO FRICTION MUST BE ADDED TO THIS FIG. FOR ACTUAL PULL REQUIRED.

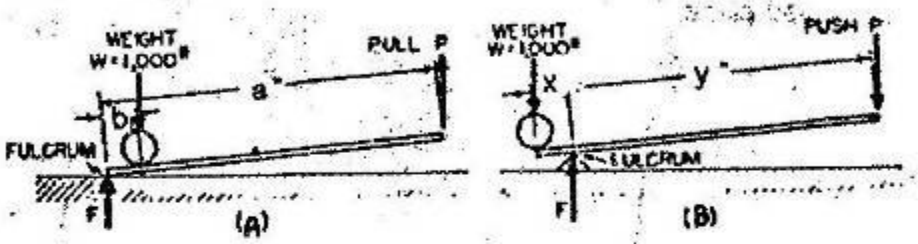
1.23 USE OF CROW BARS:

A crow bar can be used as a lever in two ways as indicated below:

a) In fig. A the upward pull P on the handle lifts the weight W. In this case the toe of the crow bar pivots about the fulcrum (F), so the force P will be calculated as:

$P \times a = W \times b$

i.e. $P = (W \times b)/a$



b) In fig. B a crow bar is being used in different way. The fulcrum is between the force and the load. In this case,

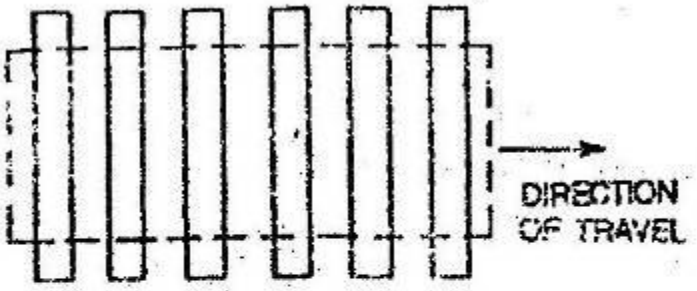
$P = (W \times x)/y$

1.24 USE OF ROLLERS AND WEDGES:

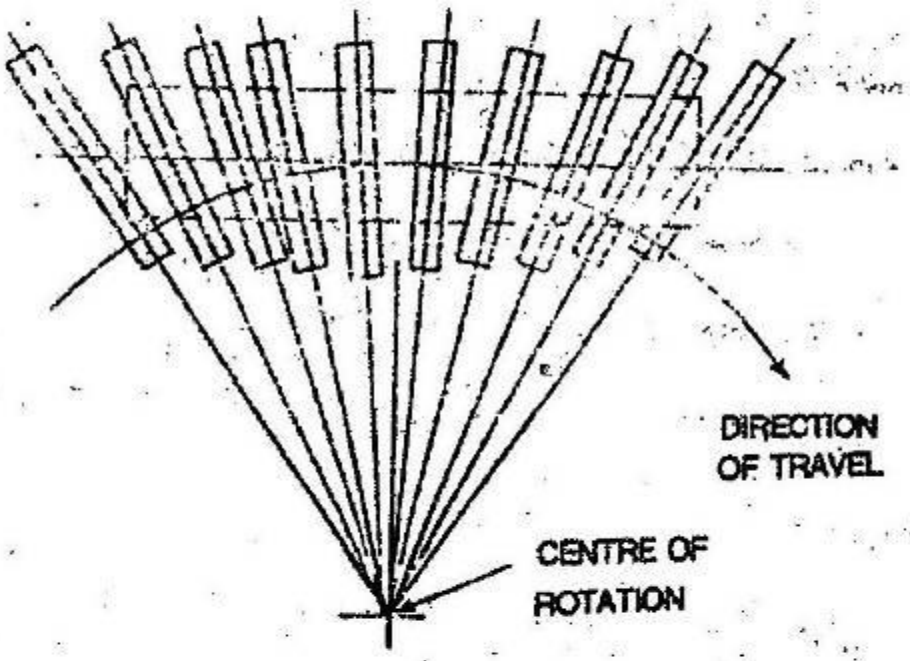
Rollers are used for shifting of heavy loads. The number of rollers depends on the size and weight of load to be shifted.

While moving the load several rollers are placed in front of the load. In addition to those under it. As the load rolls slowly forward the rollers left behind are moved in front of it.

For making a turn with a load on rollers the front rollers must be inclined slightly in the direction of the turn and the rear rollers in opposite direction as shown below. The inclination of the rollers can be made by striking them sharply with a sledge.



Using rollers during a straight run.



Using rollers during a turn.

1.25 USE OF MECH. AND HYD. JACKS:

For placing skids or rollers below the load it is necessary to lift and lower the load. Jacks are used for this purpose. Some of the common types of jacks in use are:

- RATCHET JACKS
- SCREW JACKS
- HYDRAULIC JACKS

JACKS CARE & MAINT :

* All moving parts of the jacks requiring lubrication should be regularly lubricated.

* Hydraulic jacks should be filled only with hydraulic fluid recommended.

* Keep the threads of screw jacks free from dirt and grit.

* Hydraulic jacks must be stored in vertical position.

* Always tie the hyd. jacks with manila rope, while lifting /shifting a load.

NOTE:

NEVER USE LONGER/EXTENDED LEVER. ONLY USE THE LEVER FURNISHED WITH JACK.

BEFORE PUTTING THE HYD. JACK ON LOAD VENTING MUST BE DONE TO REMOVE THE TRAPPED AIR IF ANY.

1.26 SCAFFOLDING & PORTABLE LADDERS:

For working at elevated level above the ground scaffoloding and ladders are required for making temporary working space. Following instructions must be followed while erecting/working on a scaffold.

* Never make leg adjustments when any one is on the scaffold.

* Always include guard rails & toe boards when working over 6' - 6" platform, whether on scaffolds or inter connecting bridges.

* When upper most platform height exceeds three times the narrowest base dimension tie the scaffold securely to a building or any nearby rigid structure.

* Always tie scaffolds in high wind conditions.

* Do not try stretch the platform height with adjustable legs. Where additional height is required add more sections or mid level platforms.

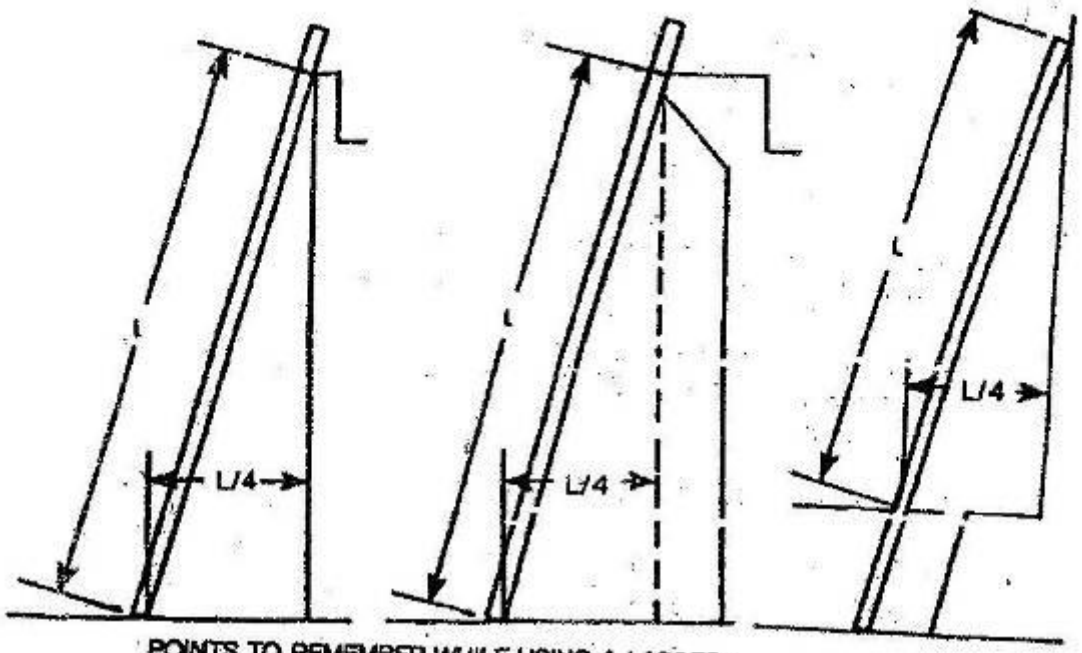
* Do not climb or stand on diagonal braces.

* Do not use ladder against or on a scaffold.

* Never pull, push or lean against a wall or ceiling when standing or sitting on a scaffold.

CORRECT ANGLE FOR USING LADDER:

Horizontal distance from the base of a ladder to a point directly below the uppermost support should be about one fourth of the inclined length of the ladder from the base to the point of support. Length of the ladder can be measured by counting the number of rungs. (rungs are normally kept 12" apart)



POINTS TO REMEMBER WHILE USING A LADDER:

* Ladder with broken or missing treads, rungs or cleats, or splintered side rails must not be used.

* Ladders to be placed such that the rails have a secure footing and support at the top.

* When ascending or descending a ladder one must face the ladder.

* No one should go up and down a ladder without the free use of both hands. For handling any material rope to be used.

* Before attempting to climb up a ladder, remove oil or grease from the soles of your shoes.

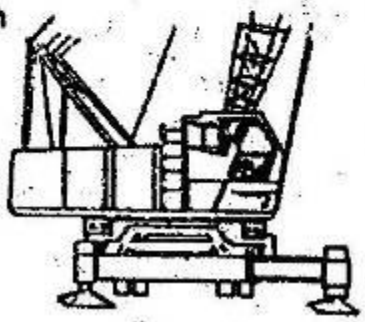
127 USE OF MOBILE CRANE:

Mobile Cranes are normally used to shift/lift heavy material, where EOT cranes or lifting tackles can not be used. The operation of mobile cranes must be guided by the rating plate recommendations on following factors:-

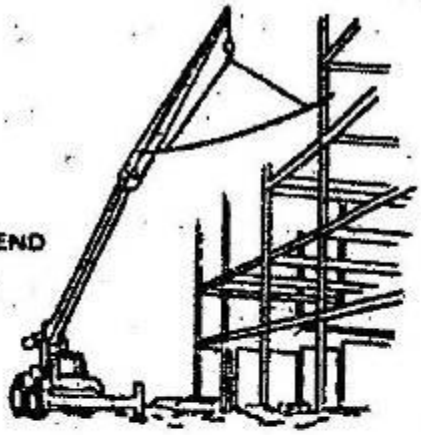
- Load to be lifted
- Boom length
- Boom radius
- Lifting quadrants
- Out riggers position

Causes of crane failure.

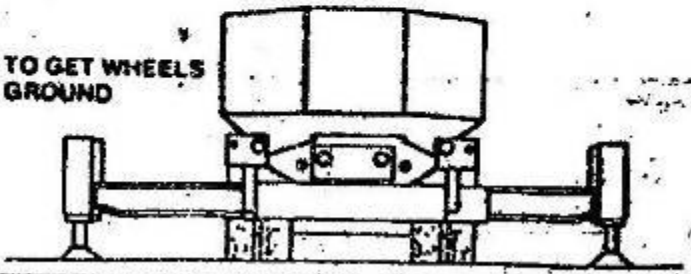
(A) FAILURE TO EXTEND ALL OUTRIGGER BEAMS



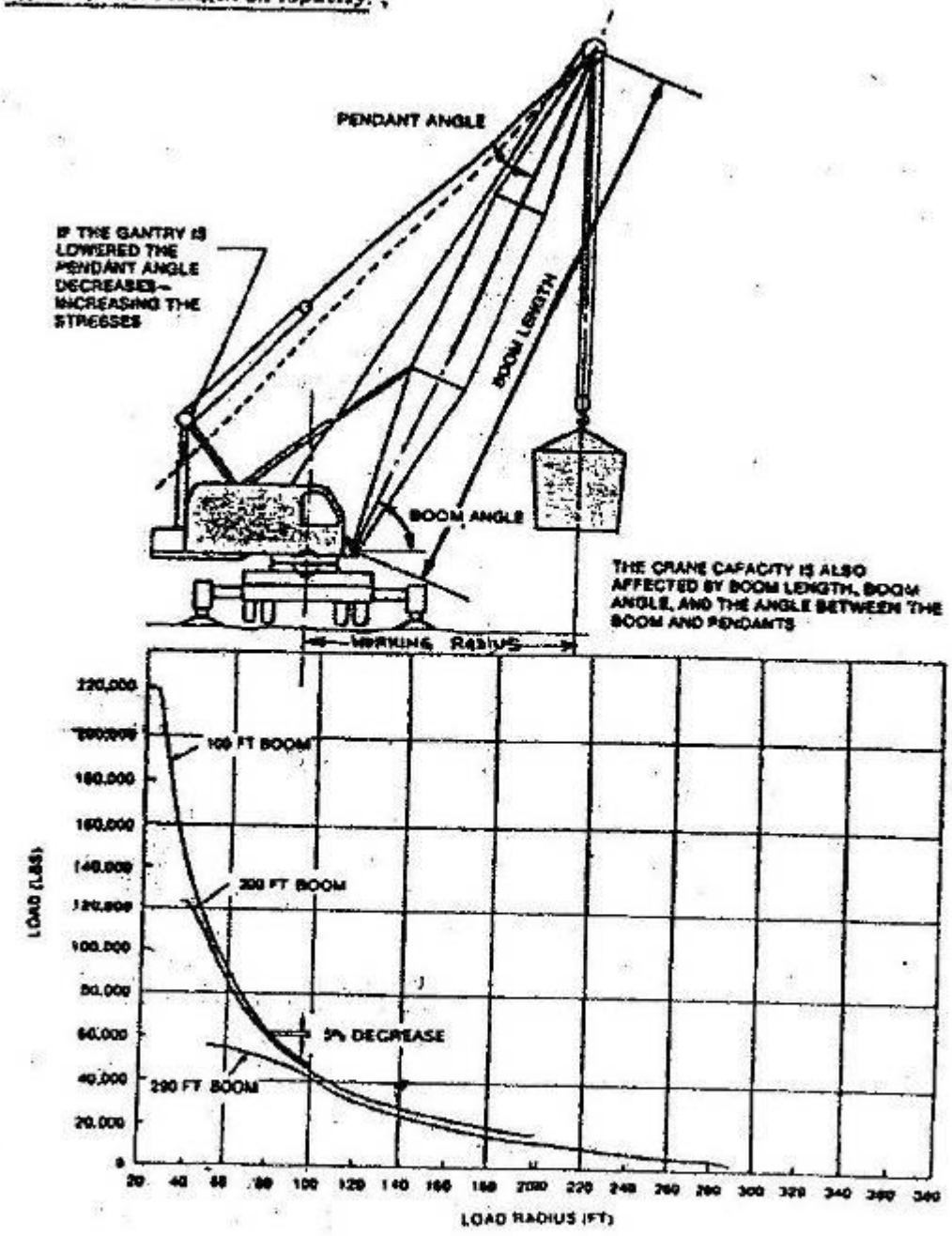
(B) FAILURE TO FULLY EXTEND OUTRIGGER BEAMS

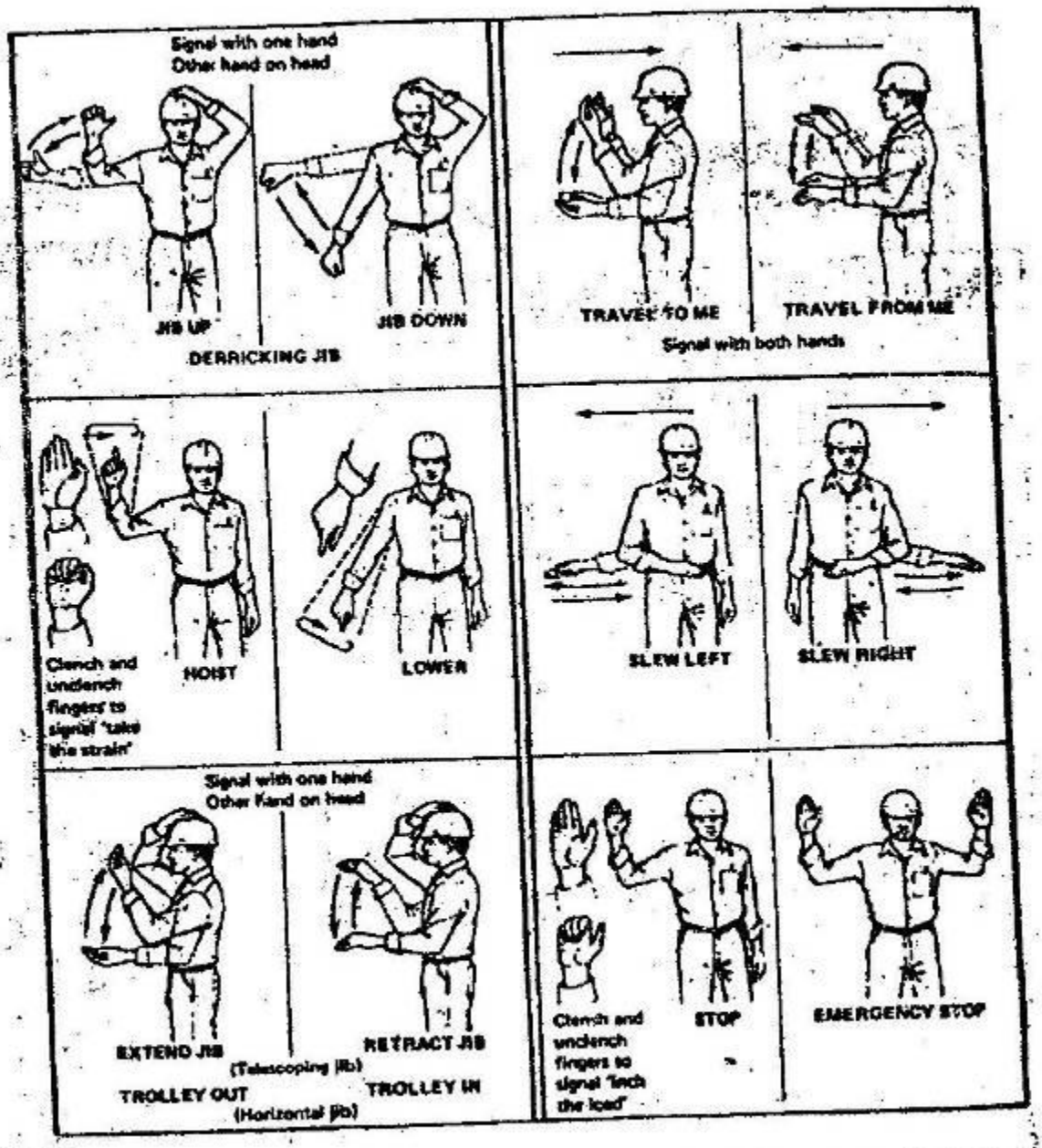


(C) FAILURE TO GET WHEELS OFF THE GROUND



Effect of boom length on capacity.




Signal with one hand
Other hand on head
JIB UP
JIB DOWN
DERRICKING JIB
TRAVEL TO ME
TRAVEL FROM ME
Signal with both hands
Clench and unclench fingers to signal 'take the strain'
HOIST
LOWER
SLEW LEFT
SLEW RIGHT
Signal with one hand
Other hand on head
EXTEND JIB
RETRACT JIB
(Telescoping jib)
TROLLEY OUT
TROLLEY IN
(Horizontal jib)
Clench and unclench fingers to signal 'inch the load'
STOP
EMERGENCY STOP

THE SIGNALLER (BANKSMAN) MUST BE IN A SAFE POSITION FROM WHERE HE CAN BE SEEN CLEARLY BY THE CRANE OPERATOR AND FROM WHICH HE CAN SEE THE CRANE LOAD THROUGHOUT THE LIFTING OPERATION, IF THIS IS PRACTICABLE. THE SIGNALLER SHOULD FACE THE CRANE OPERATOR.

ADDITIOANAL COMPETENT SIGNALLERS MUST BE POSTED IF OBSTRUCTIONS PREVENT THE LOAD BEING SEEN CONTINUOUSLY BY A SIGNALLER DURING PART OF THE LIFTING OPERATION.

STANDARD CODE OF SIGNALS FOR OVERHEAD TRAVELLING CRANES