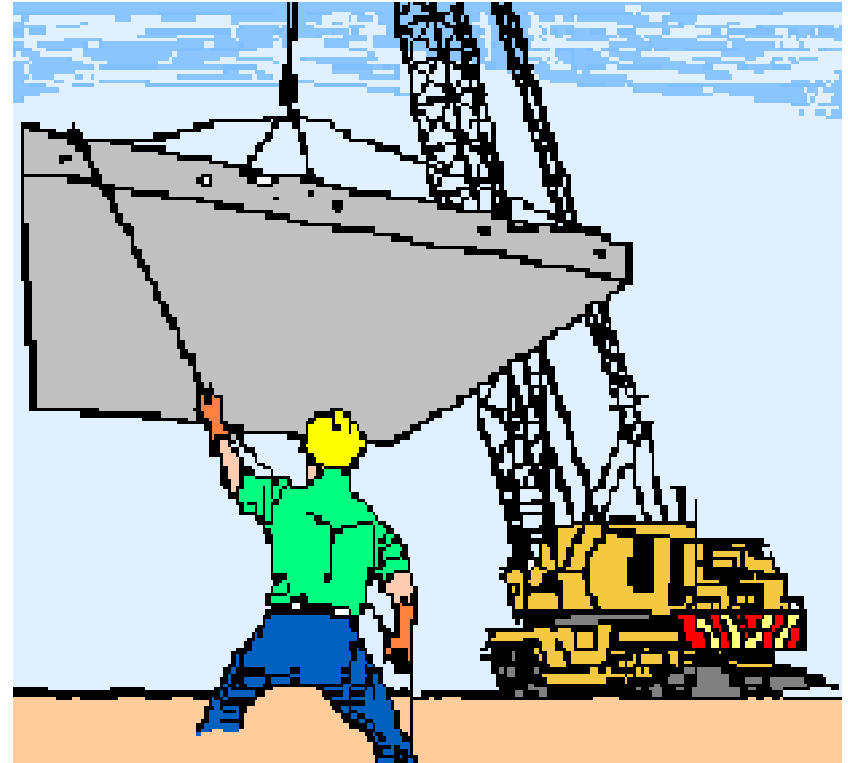


Crane and Lifting Safety (For Rigger and Operator)



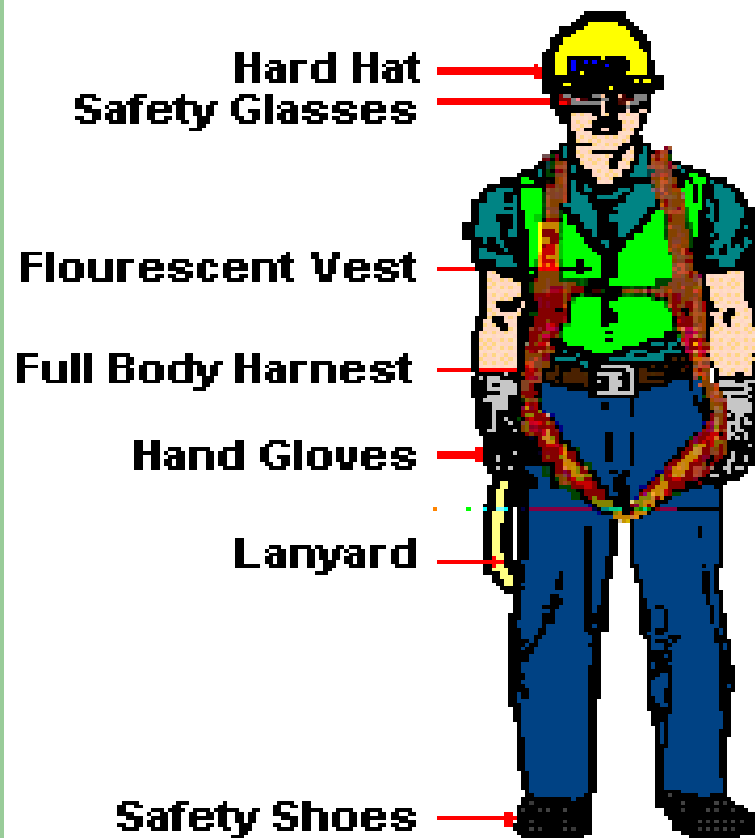
Training Outline

- Introduction
- Personal Protective Equipment (PPE)
- Manual Lifting Safe Practices
- Crane Lifting Safe Practices
- Lifting Equipments Safe Practices
- Lifting Near Power Line
- Rigging and Slings
- Lifting Equipments
- Wear & Damage of Rigging Equipments
- Static Line
- Pipe Rigging Incident-1
- Pipe Rigging Incident-2

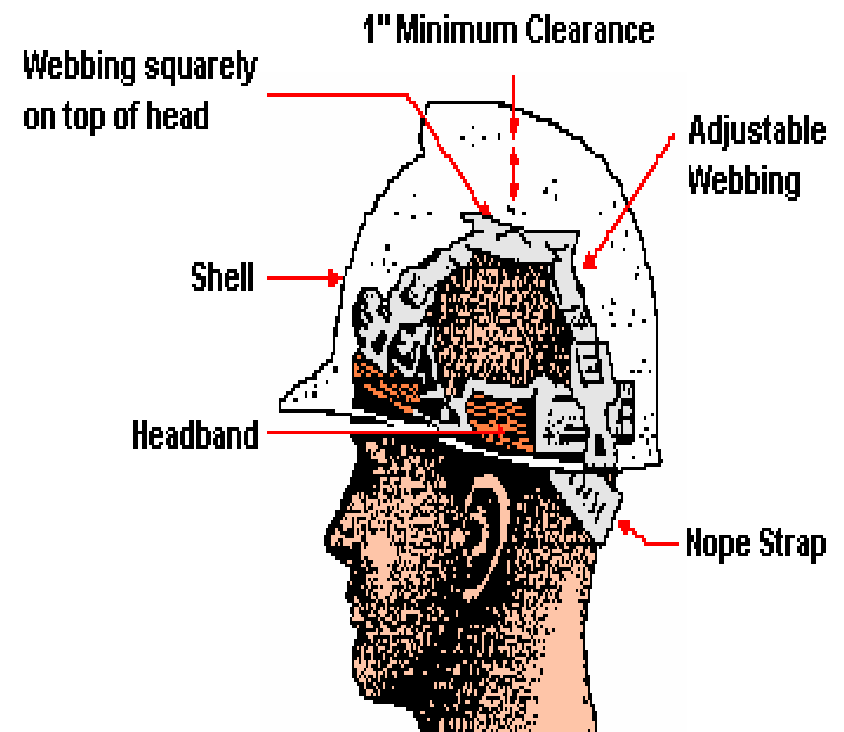
Introduction

- Lifting is very common in the construction industry as a method for material transfer. Through mechanical means such as cranes, lifting equipment and manual handling.
- The risk of injury can be reduced through training and application of correct lifting & handling techniques.

Personal Protective Equipment (PPEs) worn by Riggers



Hard Hat

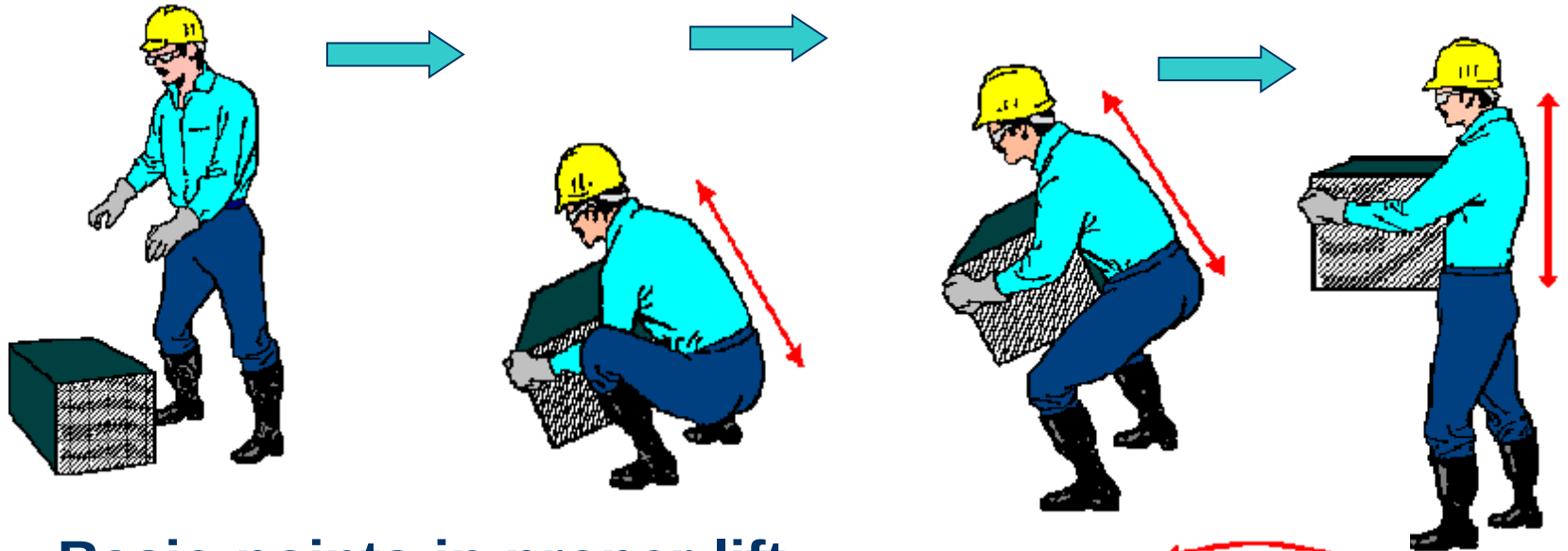


Manual Lifting Safe Practices

Improper manual lifting can result in a variety of occupational injuries, i.e. musculoskeletal injuries, cumulative trauma disorders hernia, and most common – back injuries which can even lead to a permanent partial or total disability. Avoidance of these expensive and most often debilitating injuries requires maximum awareness on proper body mechanics and correct lifting techniques.

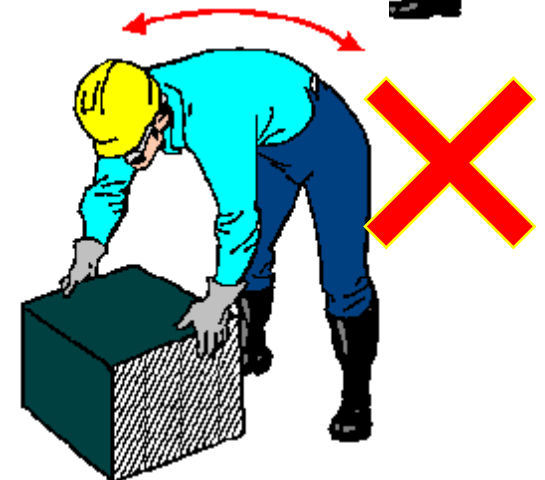


Manual Lifting Safe Practices

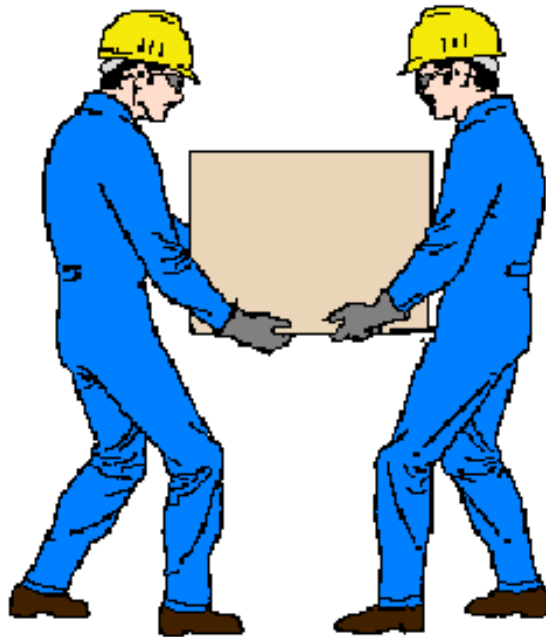


Basic points in proper lift:

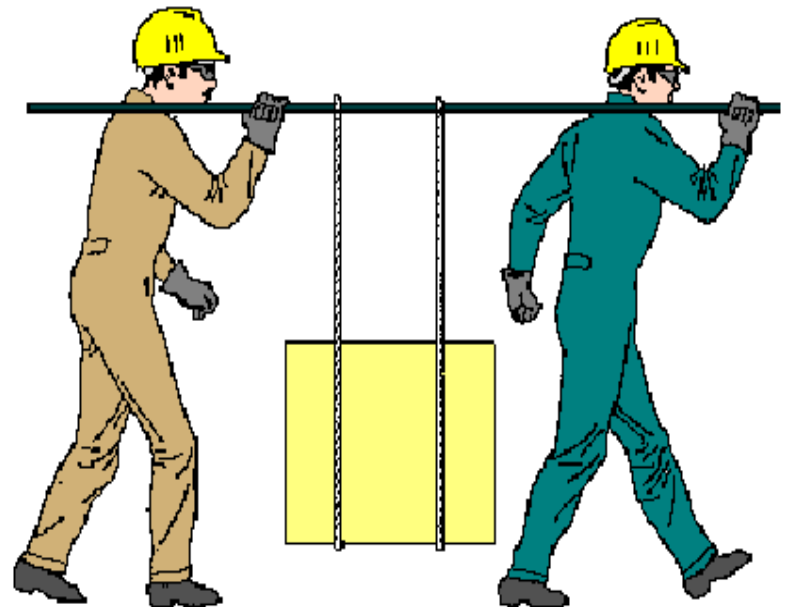
- Firm grip
- Back straight
- Arms & load close to the body
- Feet apart



Manual Lifting Safe Practices

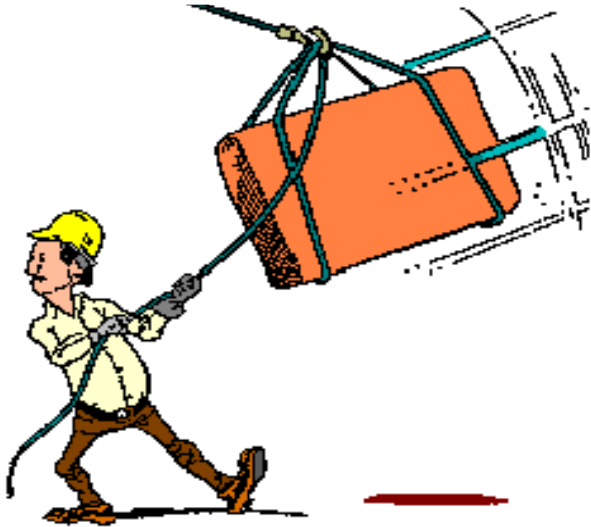


Two – Man Carry



Two – Man Pole Lift

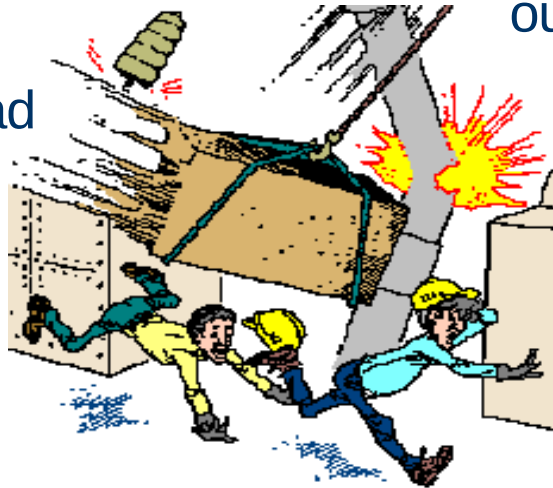
Crane Lifting Safe Practices



Keep an eye on the load

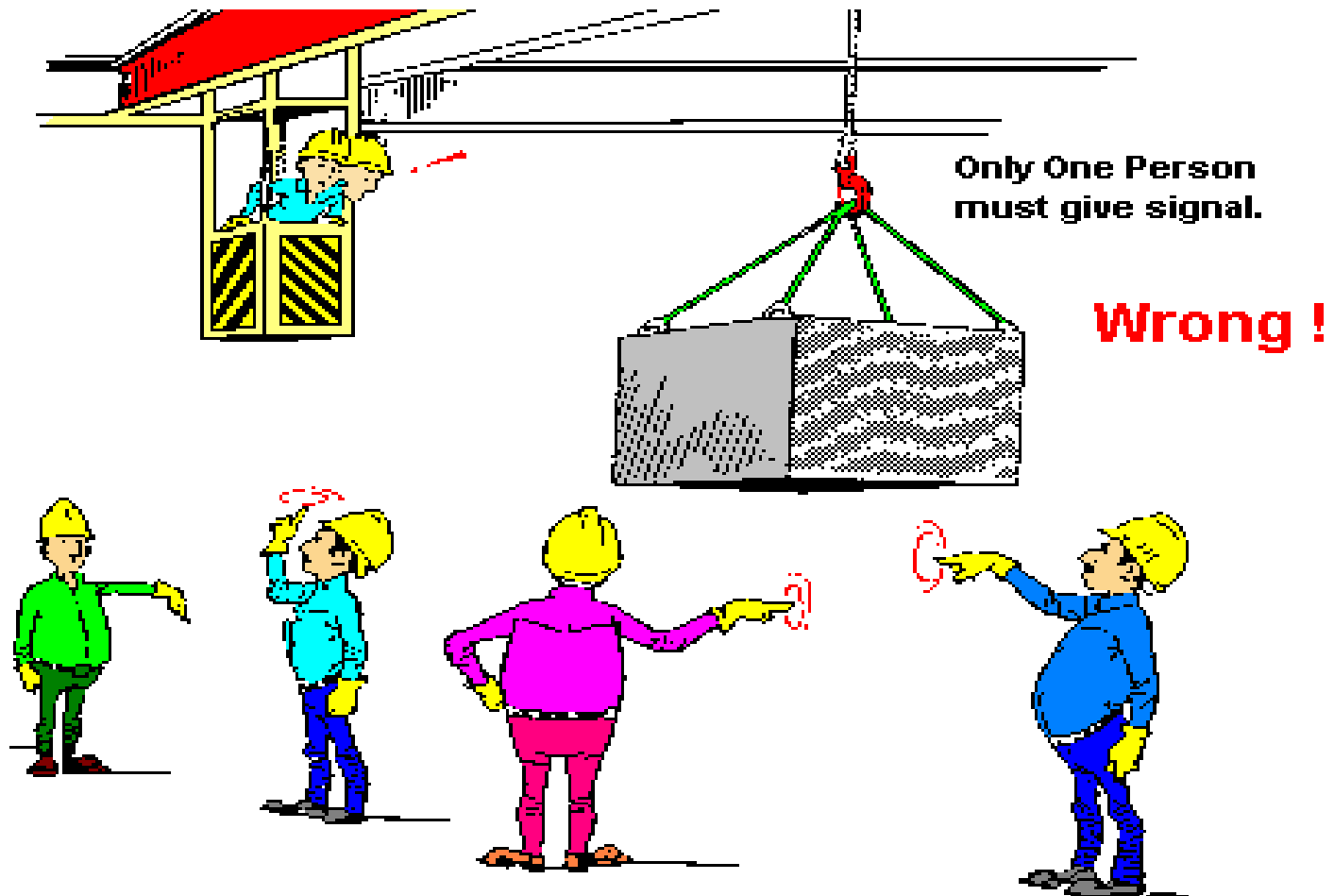


Keep all parts of your body out from the load

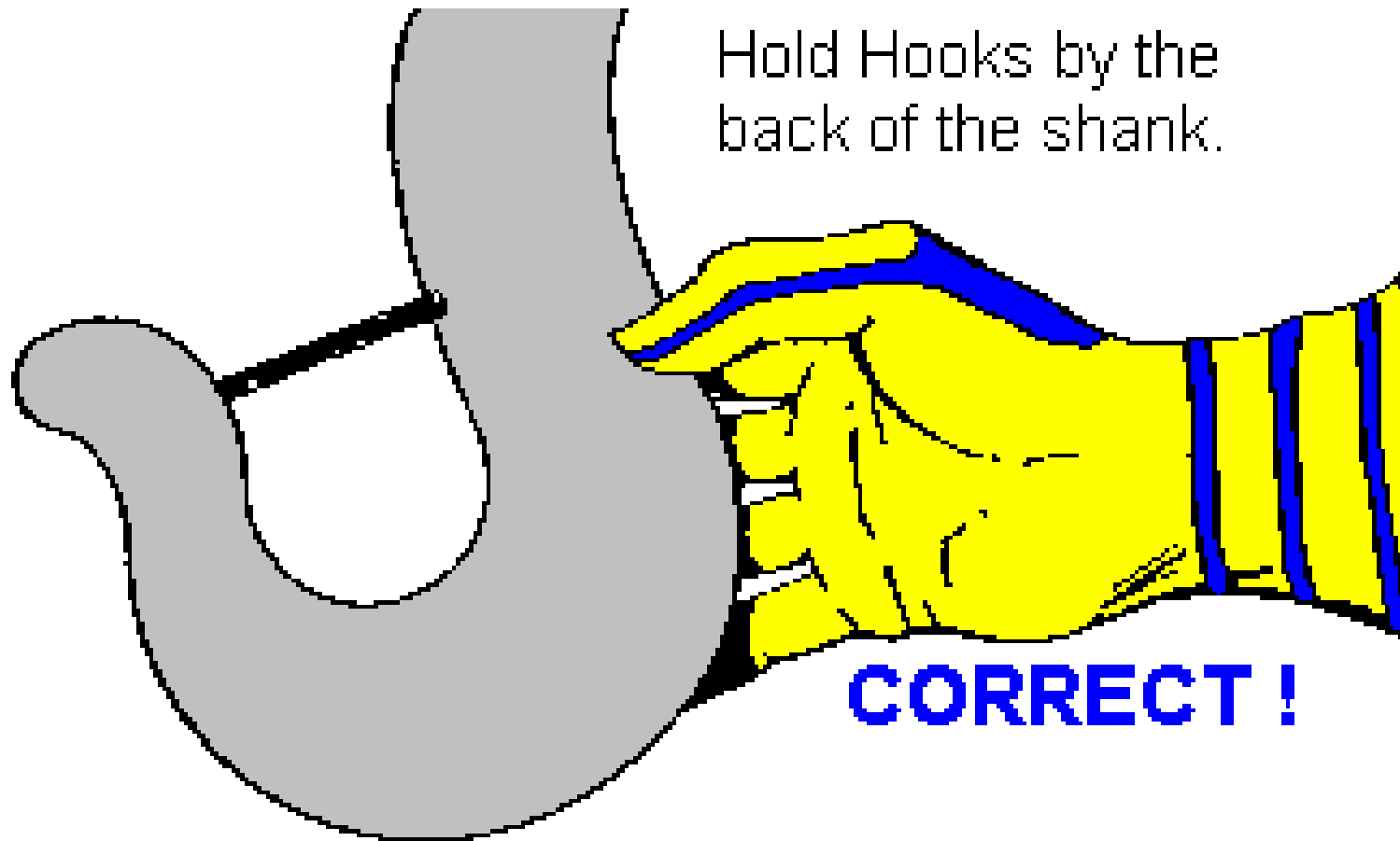


Keep the load low & slow

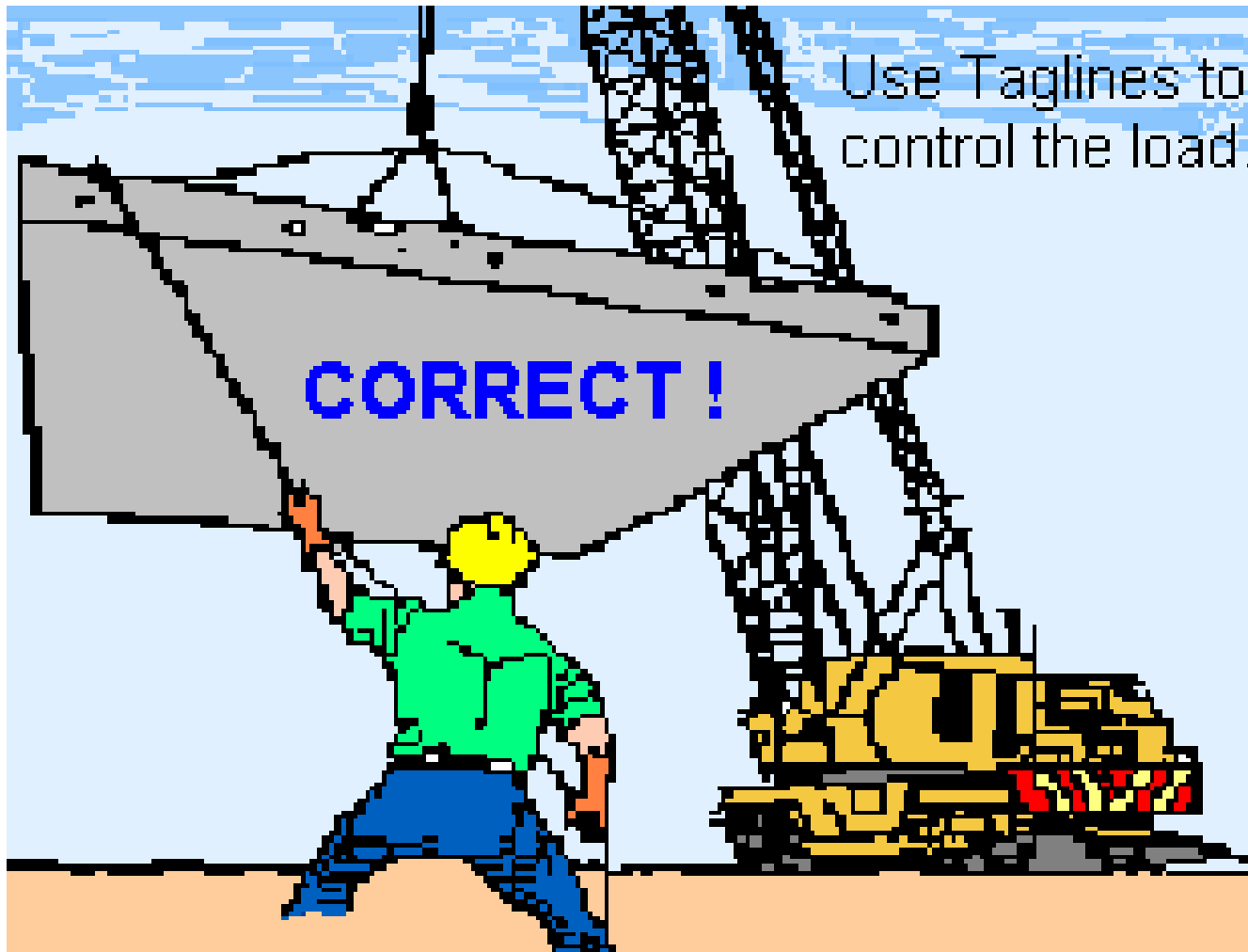
Crane Lifting Safe Practices



Crane Lifting Safe Practices



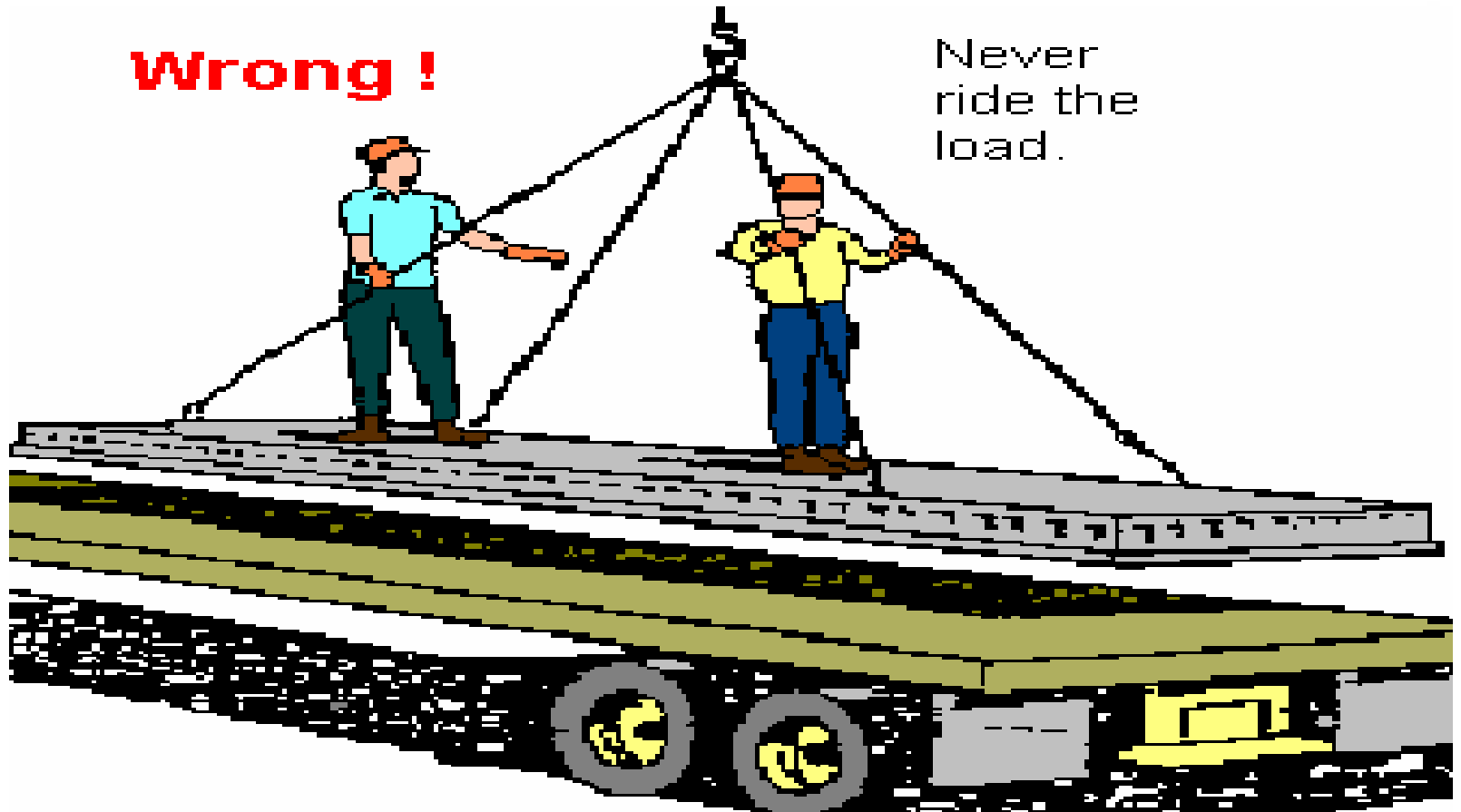
Crane Lifting Safe Practices



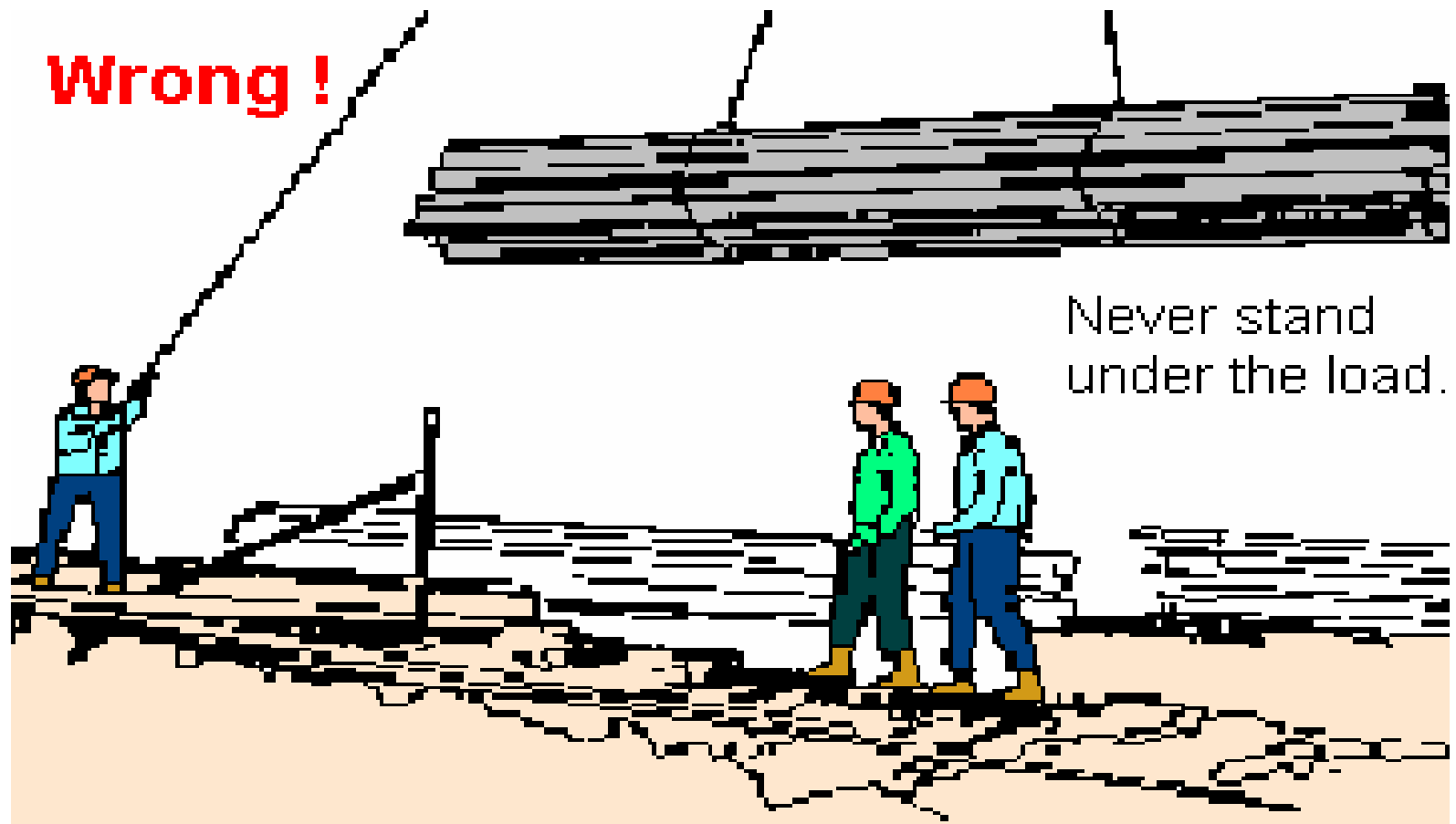
Crane Lifting Safe Practices

Wrong !

Never
ride the
load.

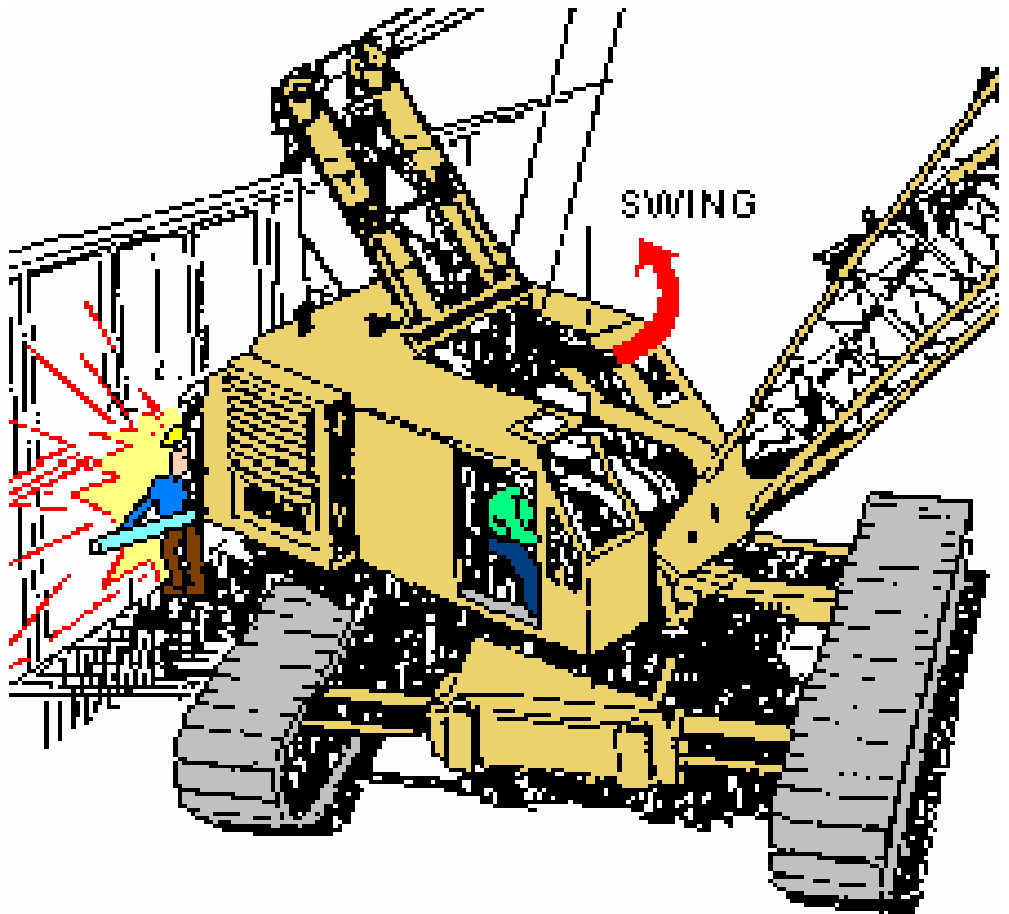


Crane Lifting Safe Practices



Crane Lifting Safe Practices

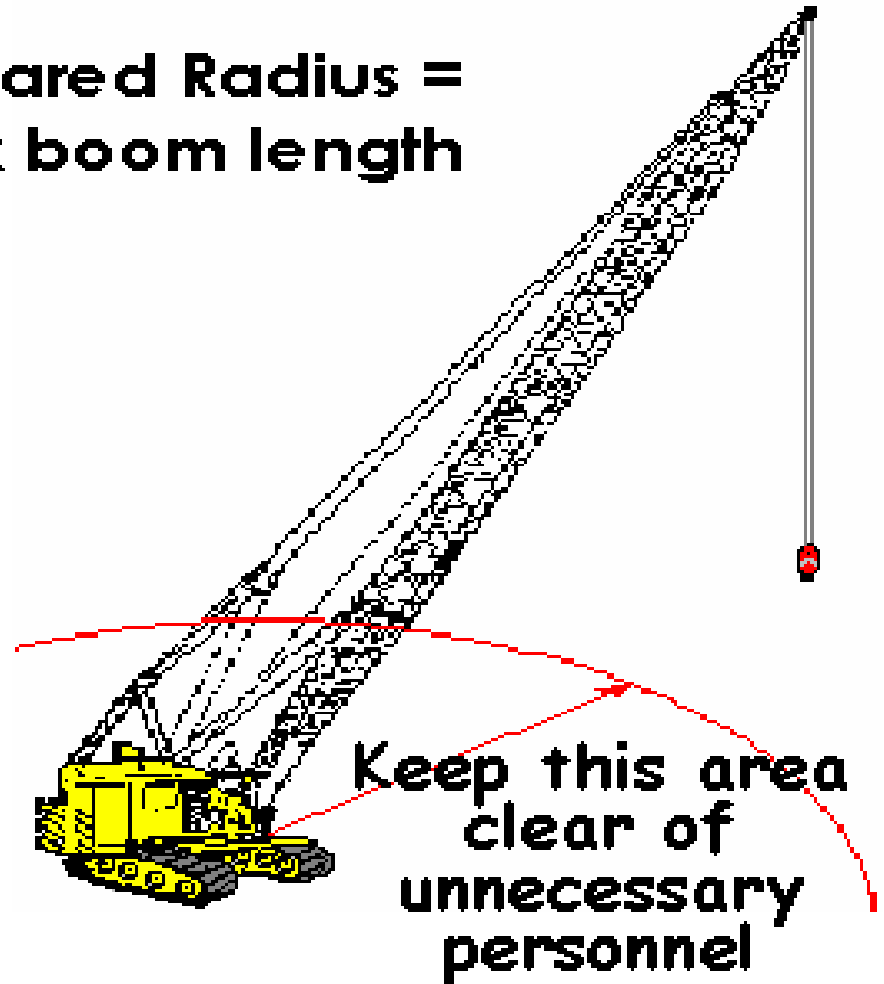
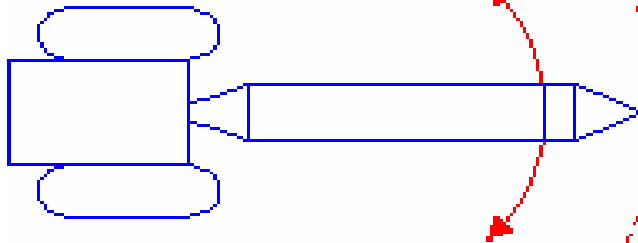
Barricade the areas in which person could be trapped or crushed



Crane Lifting Safe Practices

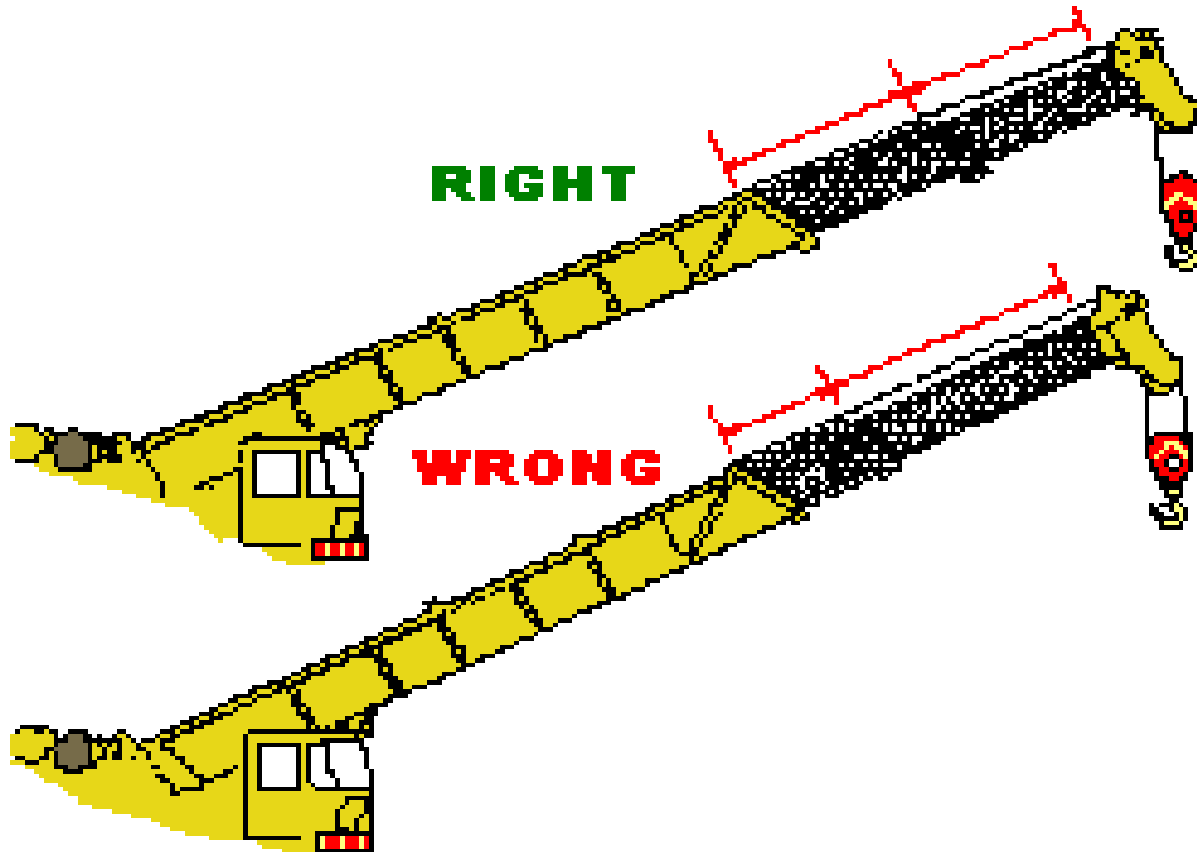
**Cleared Radius =
1.5 x boom length**

**Keep personnel
out of this area**



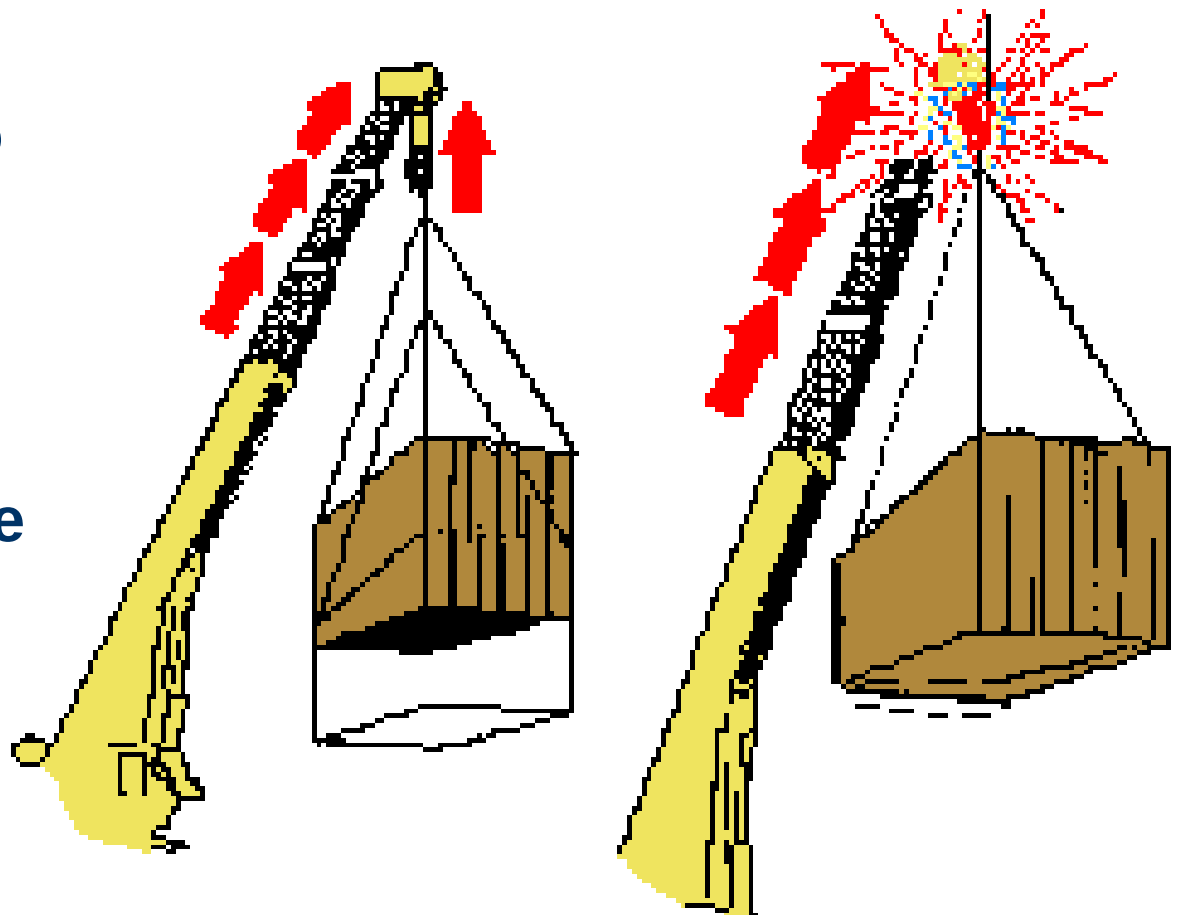
Crane Lifting Safe Practices

Pay attention to the boom sections . . they should be kept **EQUAL**. Unequal boom give **NO structural stability**.



Crane Lifting Safe Practices

Pay attention to the remaining rope between the hoist block and boom tip, while raising the load. . . **Prevent two-blocking !**



Crane Lifting Safe Practices

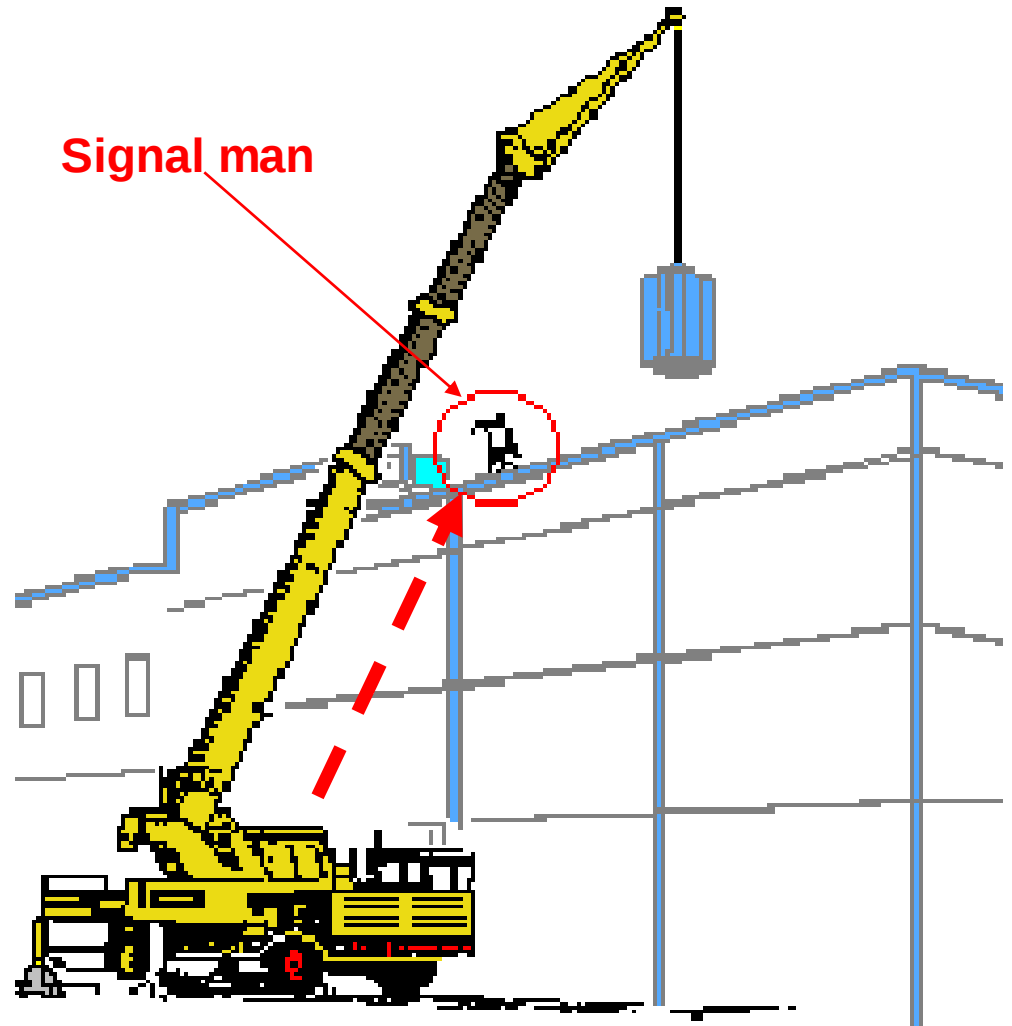
When visibility is Poor. .

**NO Lifting! No
Crane Work!**

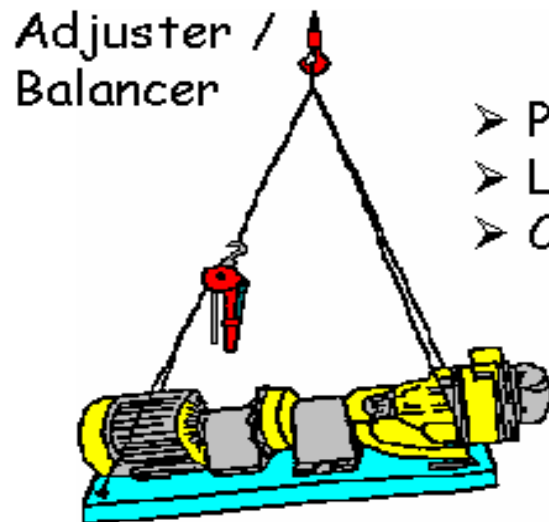
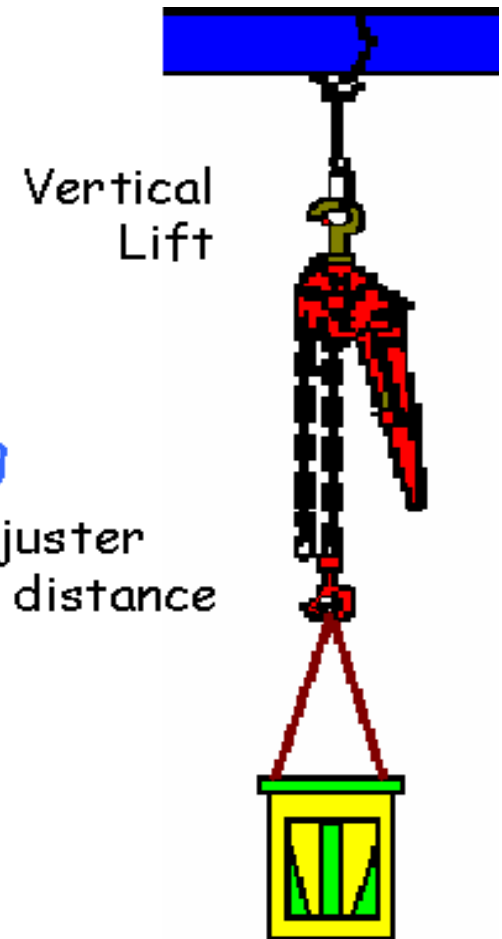
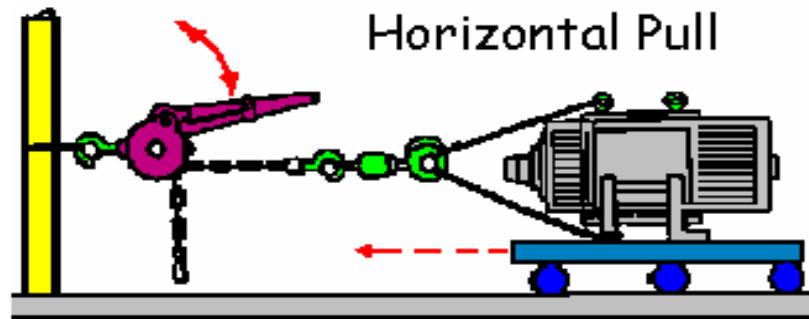


Crane Lifting Safe Practices

**Signal man
should
position in full
view of the
operator!**



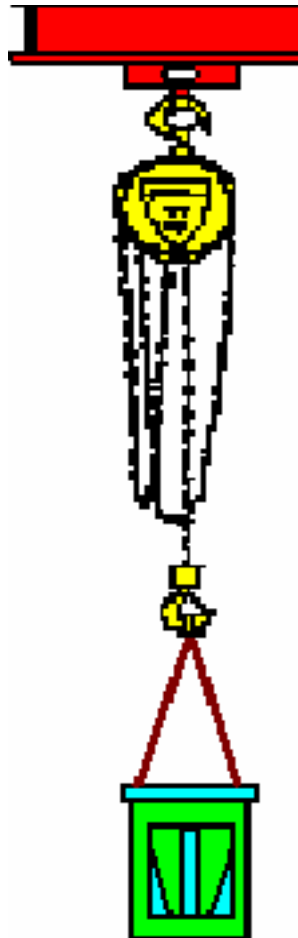
Lifting Equipments Safe Practices



Come-A-Long

- Pulling, Lifting & as Adjuster
- Limited height & short distance
- Capacity up to 6 tons

Lifting Equipments Safe Practices

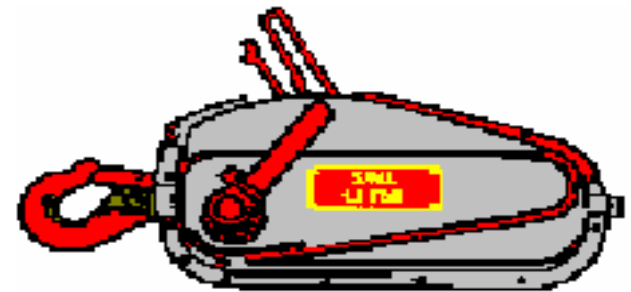


Chain Block

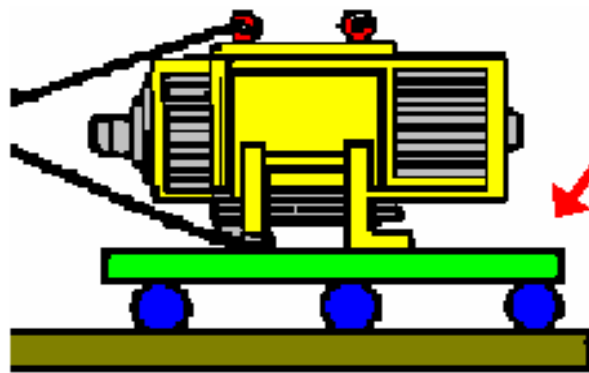
- Pulling, Lifting & as Adjuster
- Limited height & short distance
- Capacity up to 6 tons

Tirfur or Hand Operated Winch

- To pull and ease off wire rope
- Making manual moves over greater distance
- Up to 10 tons



Lifting Equipments Safe Practices



Skid ➤ To support load that is being moved on rollers

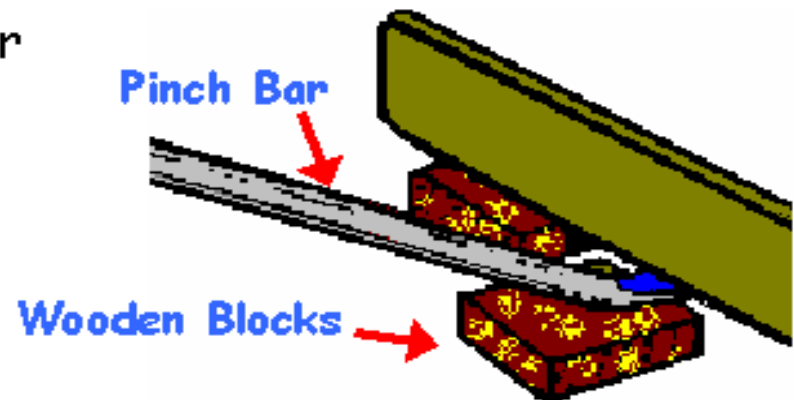
Rollers ➤ To move load in areas of limited access
➤ 3"-4" clearance from each side
➤ 3 pieces minimum

Wooden Blocks

- Blocking or cribbing a load
- Only straight & flat timber

Pinch Bar

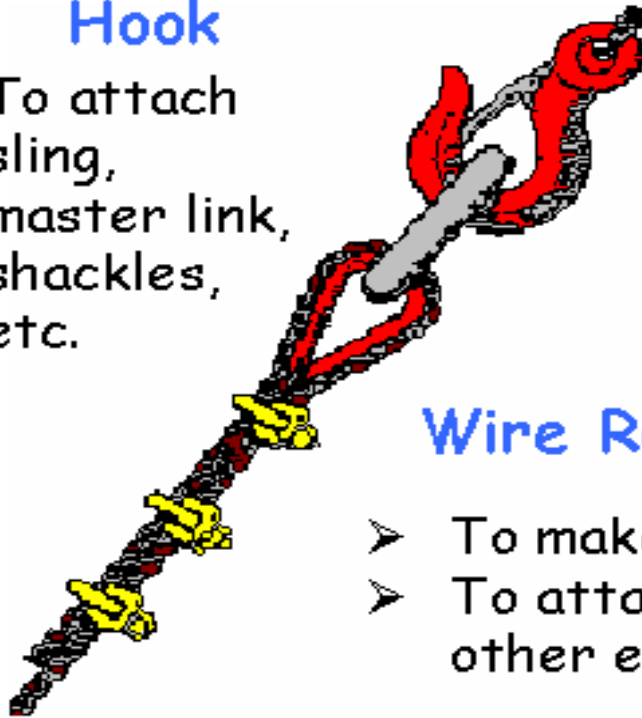
- To lever & move load in areas of limited access
- Chisel End - for prying
- Taper End - for aligning



Lifting Equipments Safe Practices

Hook

- To attach sling, master link, shackles, etc.



Shackle

- Connect hook to sling eye
- Connects sling to eye



Wire Rope Clip

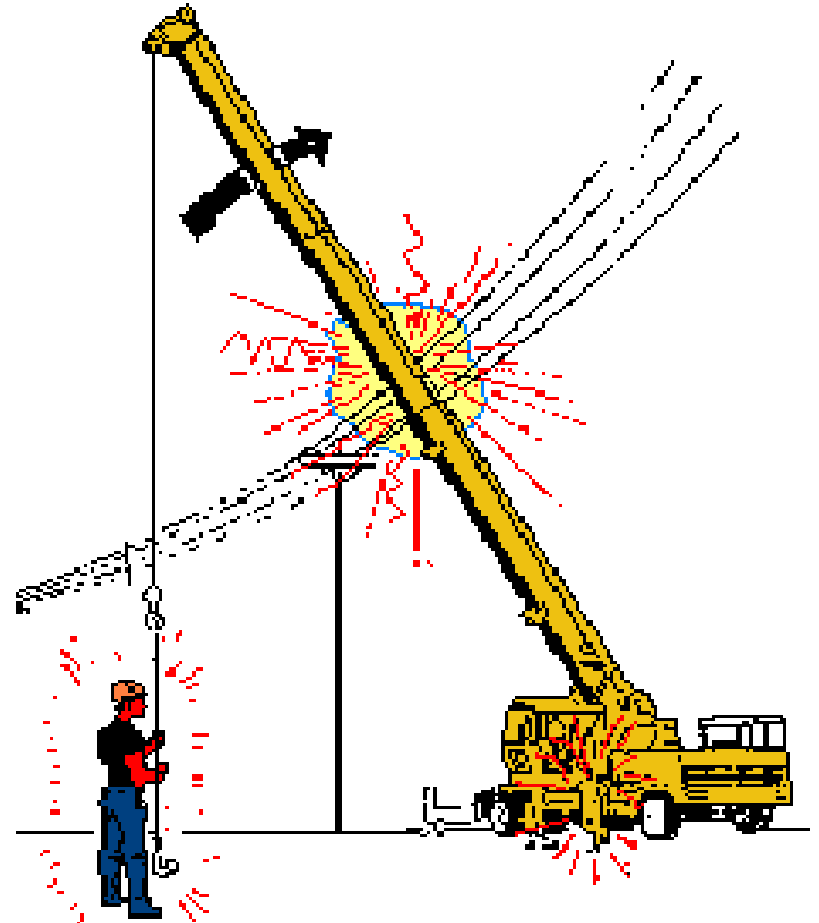
- To make an eye
- To attach wire to other equipment

Wire Rope Sling

- To lift load
- Secure load to hoist cranes and other lifting equipment

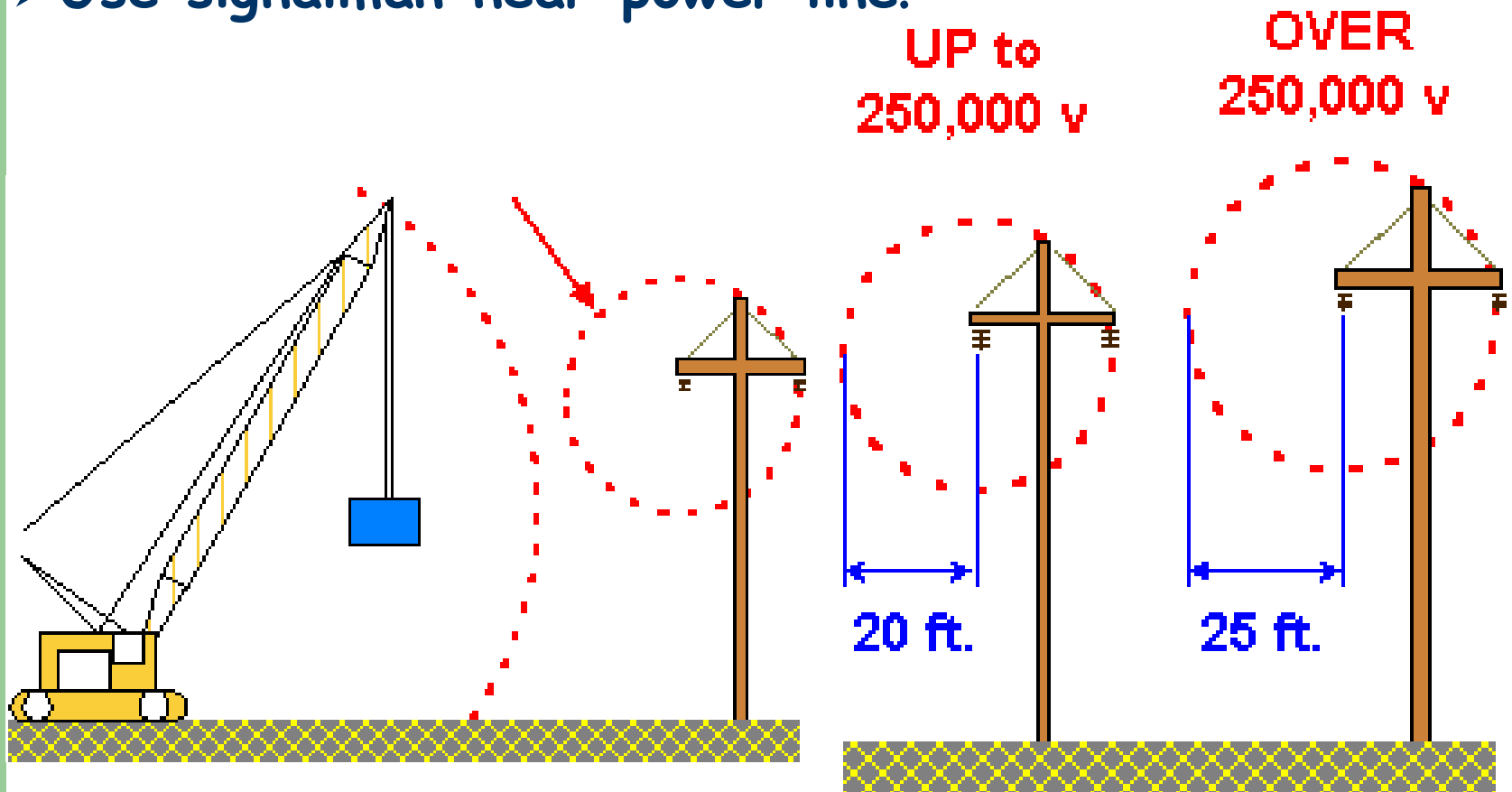
Lifting Near Power Line

**Never take chance,
know and observe
Absolute Limit of
Approach!**



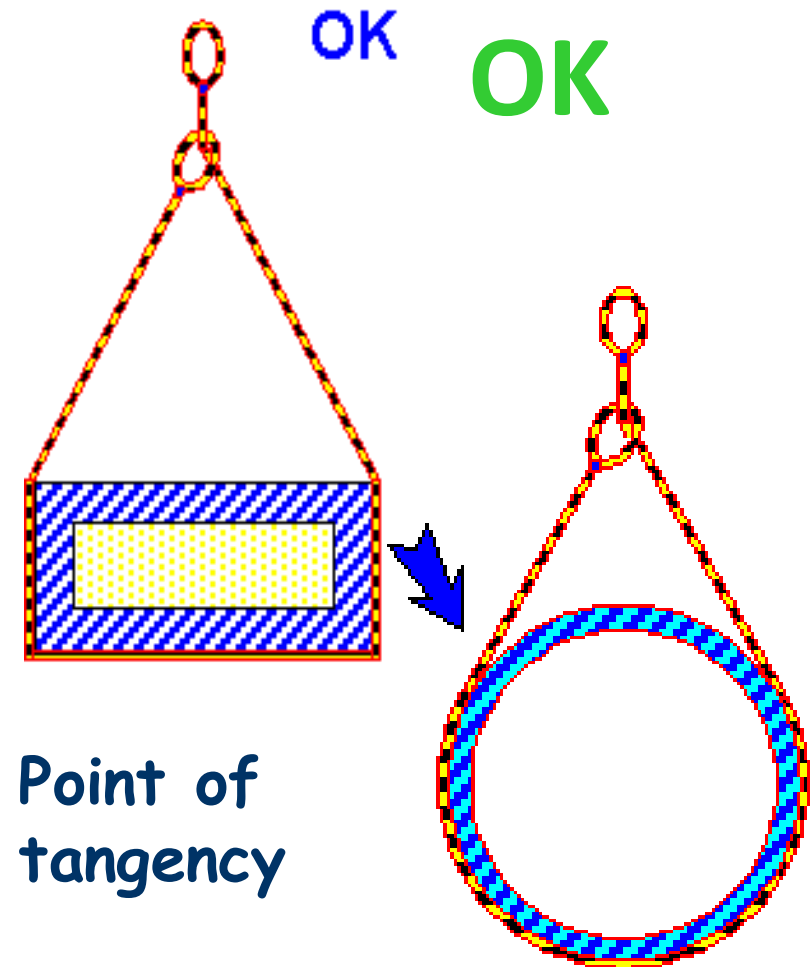
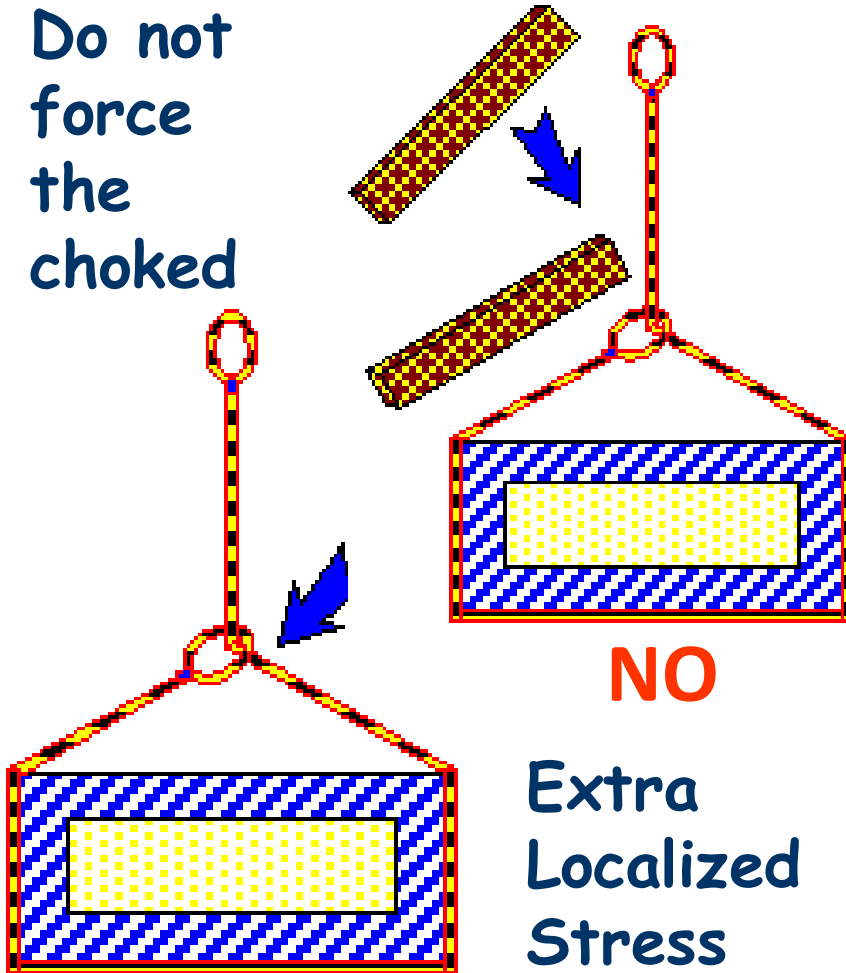
Lifting Near Power Line

➤ Use signalman near power line!



Rigging and Slings

Do not
force
the
choked



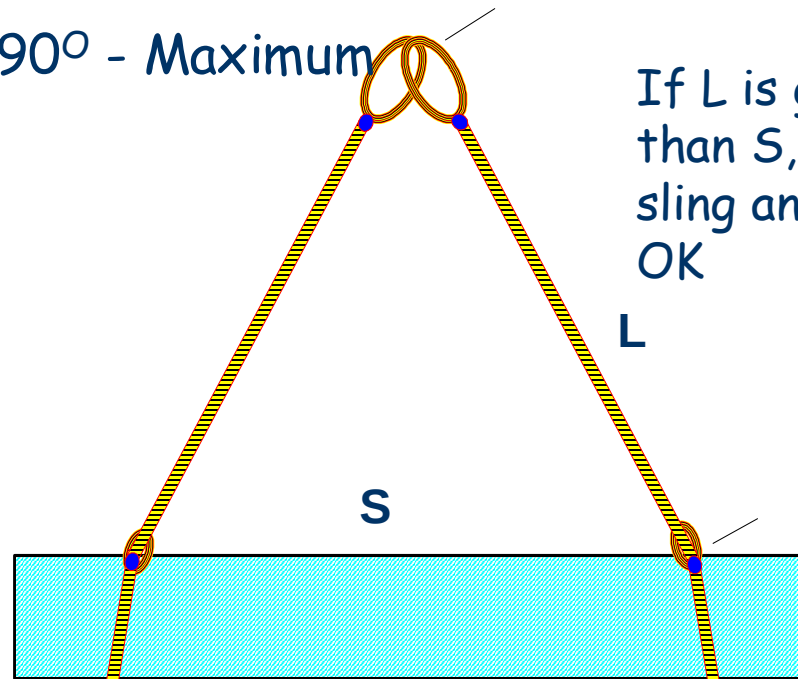
Rigging and Slings

Lifting Angles (in between legs):

60° - Safest (most recommended)

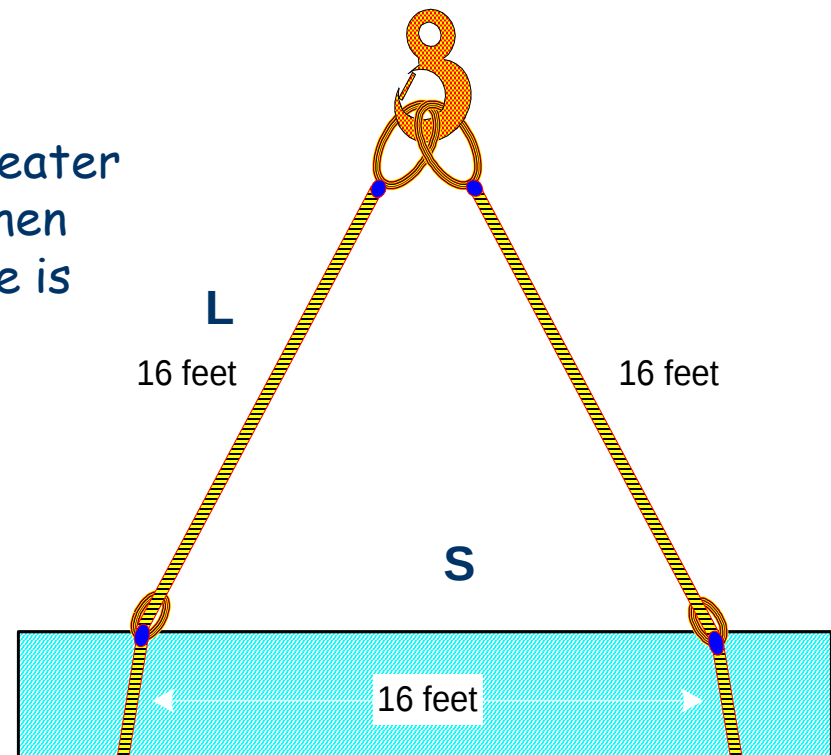
40° - Minimum

90° - Maximum



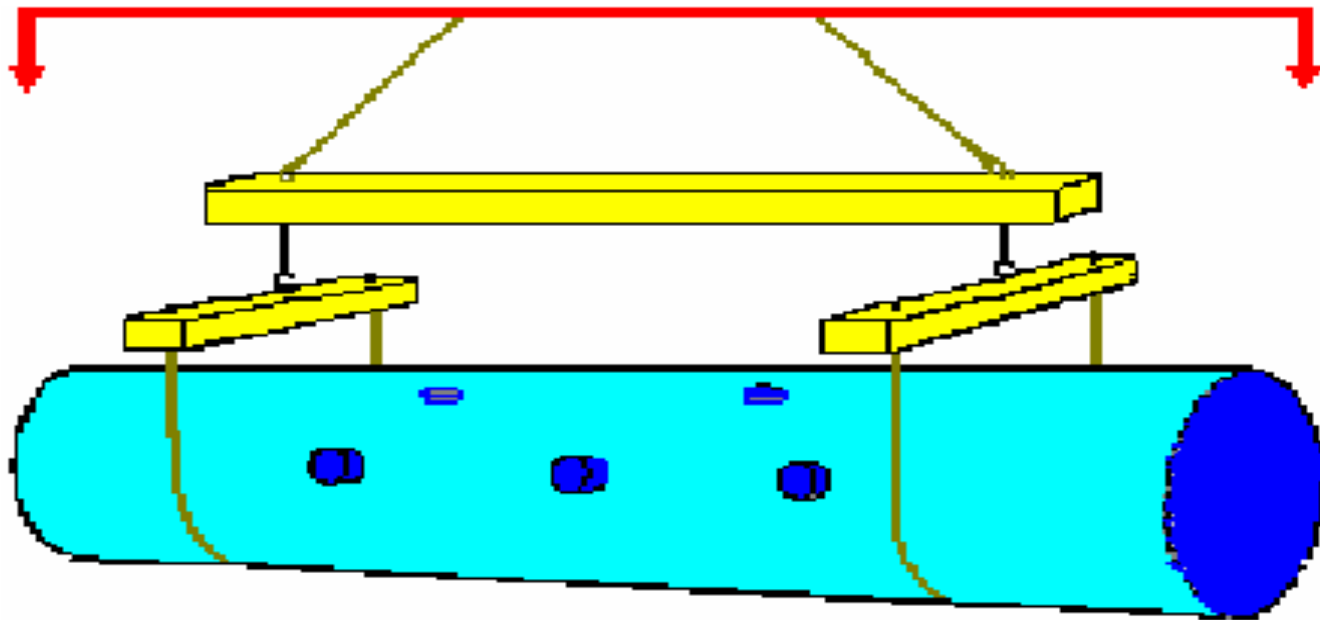
If L is greater than S, then sling angle is OK

60° Lifting Angle



Rigging and Slinging

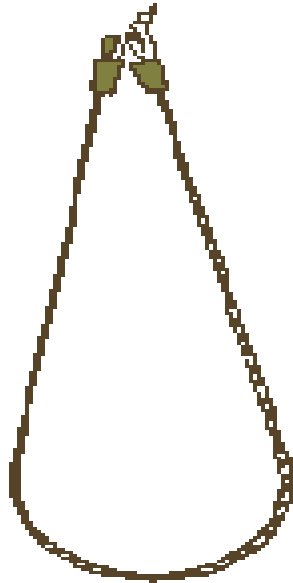
All rigging equipment must be counted as part of the load.



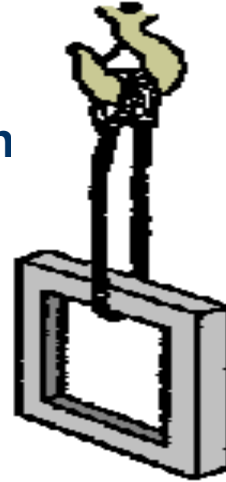
Lifting Beam or Spreader Bar

- Distribute or spread weight from one to other points

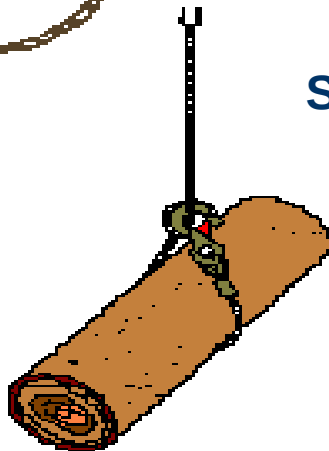
Rigging and Slings



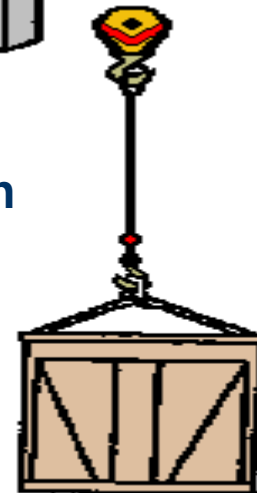
Single Basket Hitch
with Inclined legs



Single Basket Hitch

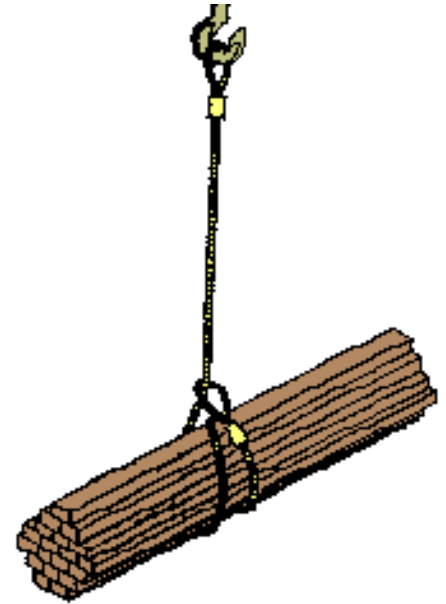
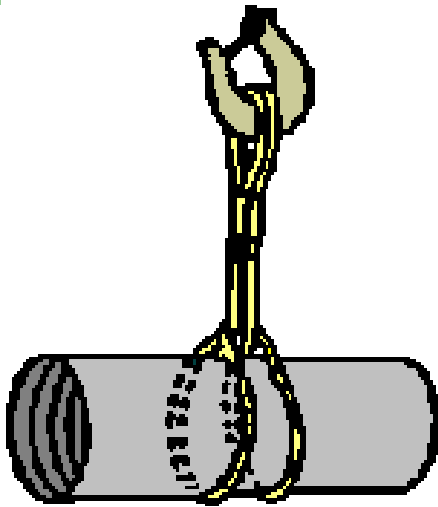


Single Choker Hitch



Single Vertical Hitch
Or Straight pull

Rigging and Slinging

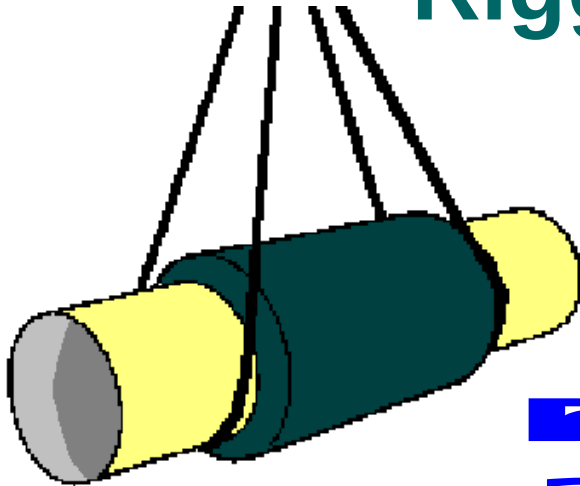


**Single-
Double Wrap
Basket Hitch**

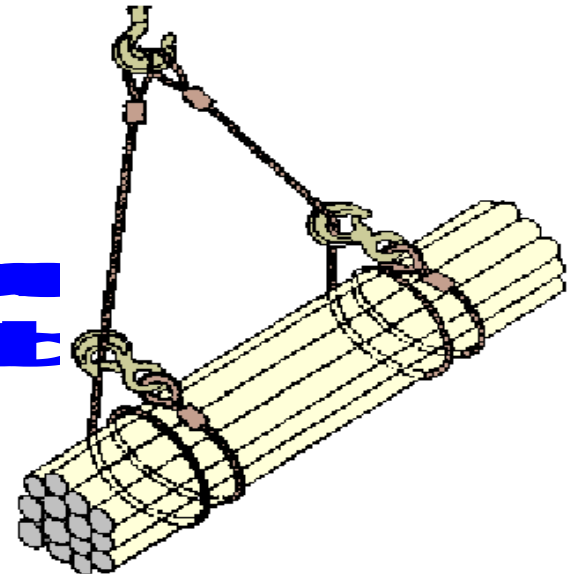


**Single-
Double Wrap
Basket Hitch**

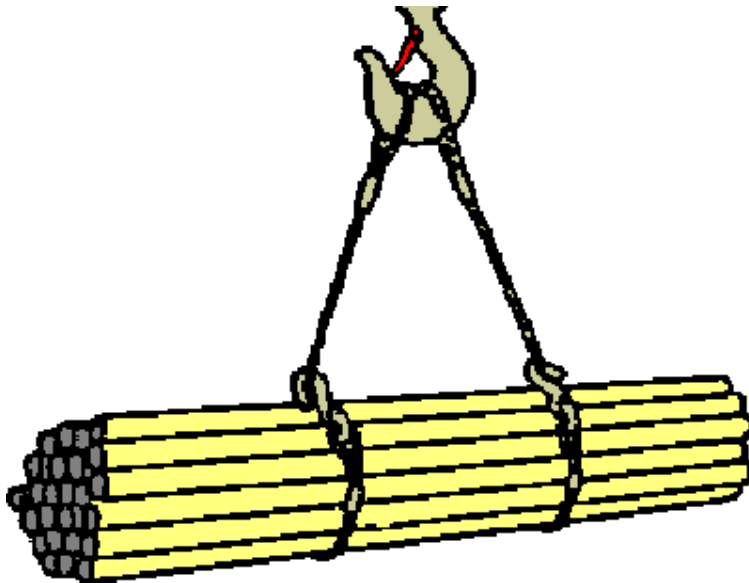
Rigging and Slings



~~Unbalanced load~~
~~Unbalanced load~~

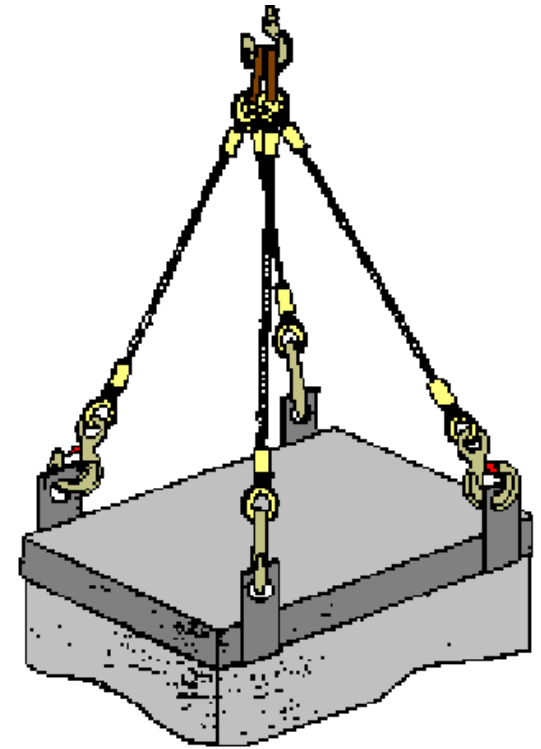
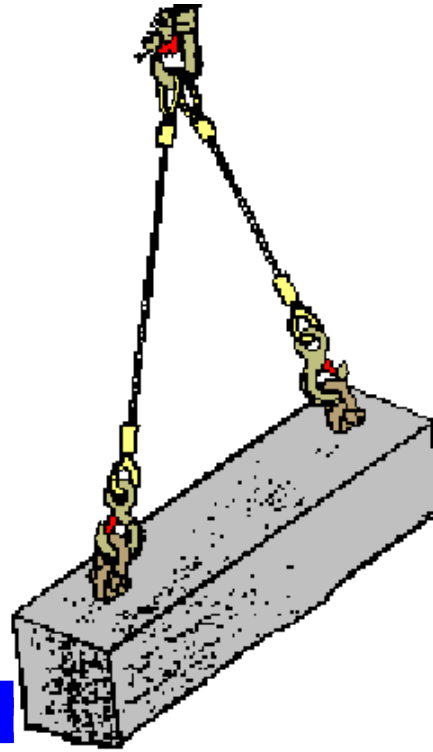
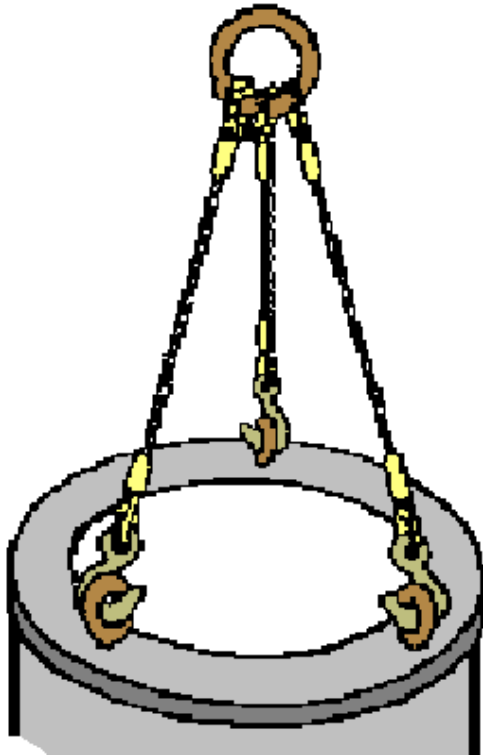


~~Unbalanced load~~
~~Unbalanced load~~



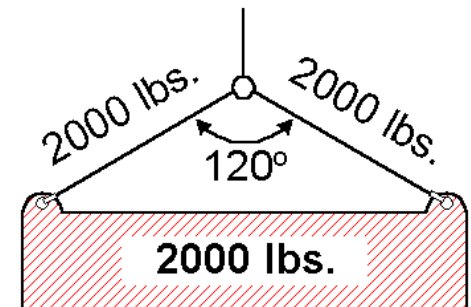
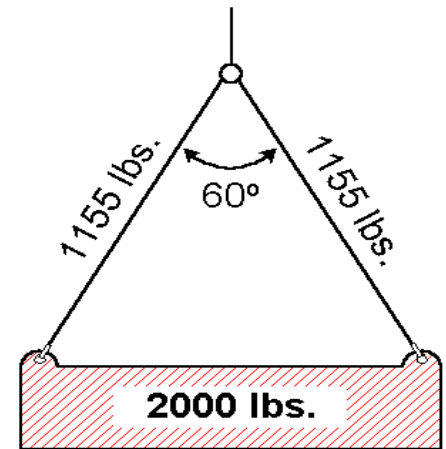
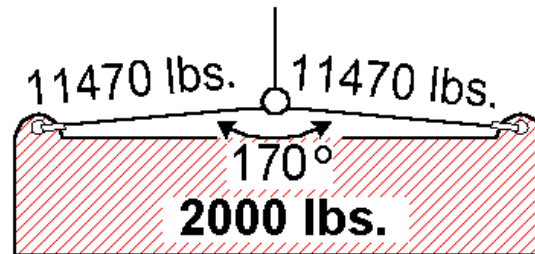
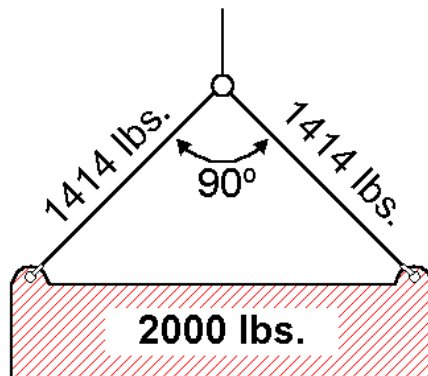
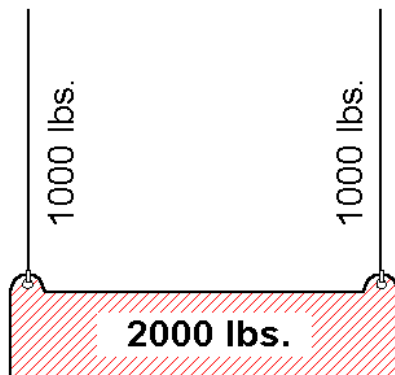
~~Unbalanced load~~
~~Unbalanced load~~

Rigging and Slings



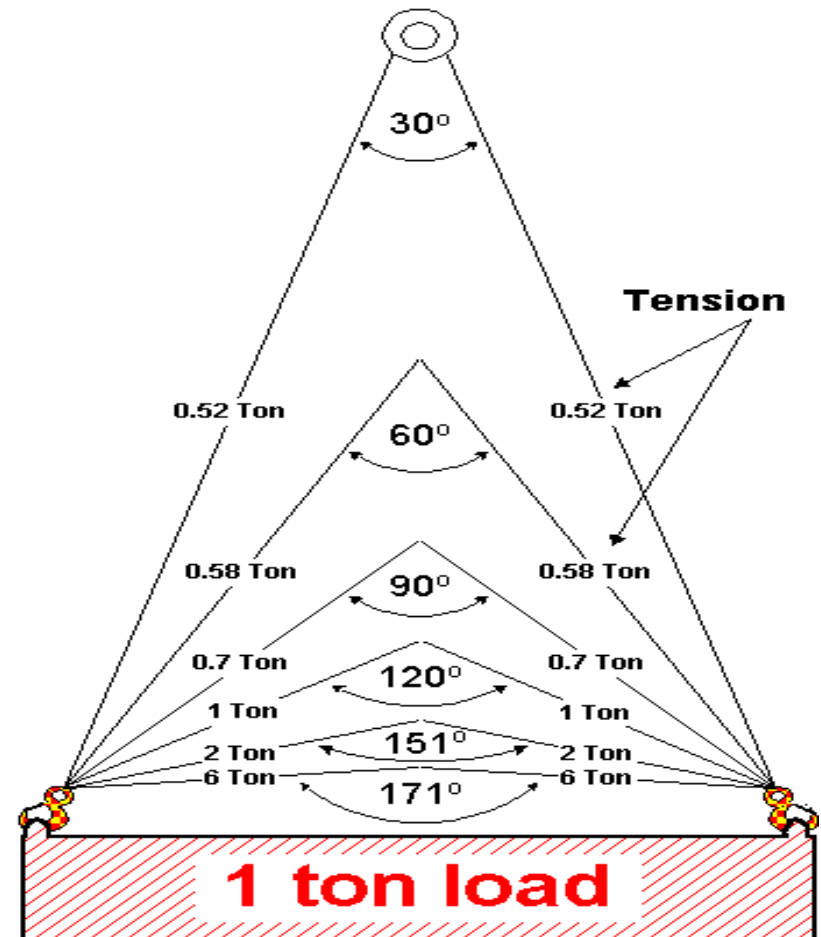
Rigging and Slings

- The tension on sling leg depends on its angle to the load and the weight of the load to be lifted

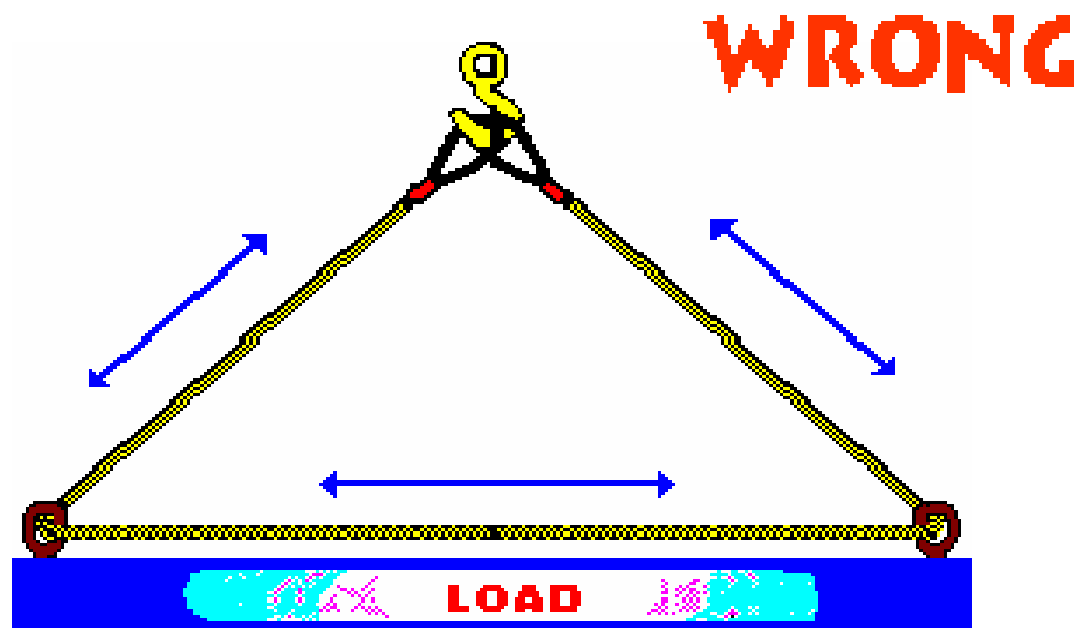


Rigging and Slings

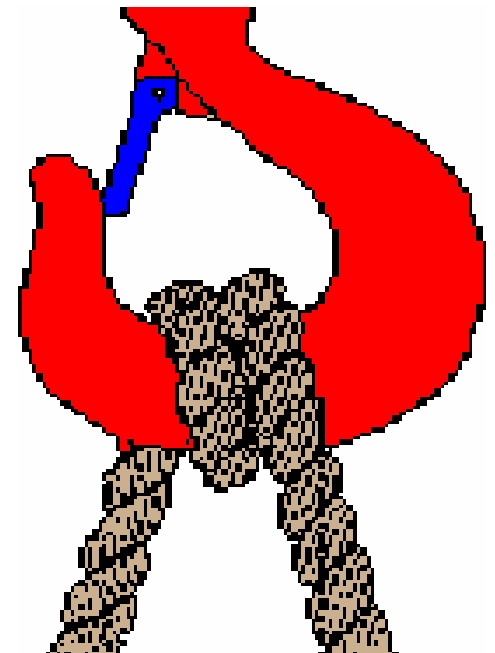
- When a multi leg sling is used with the sling legs at an angle, the load (tension) in the individual slings will increase as the angle between the legs becomes greater



Rigging and Slinging

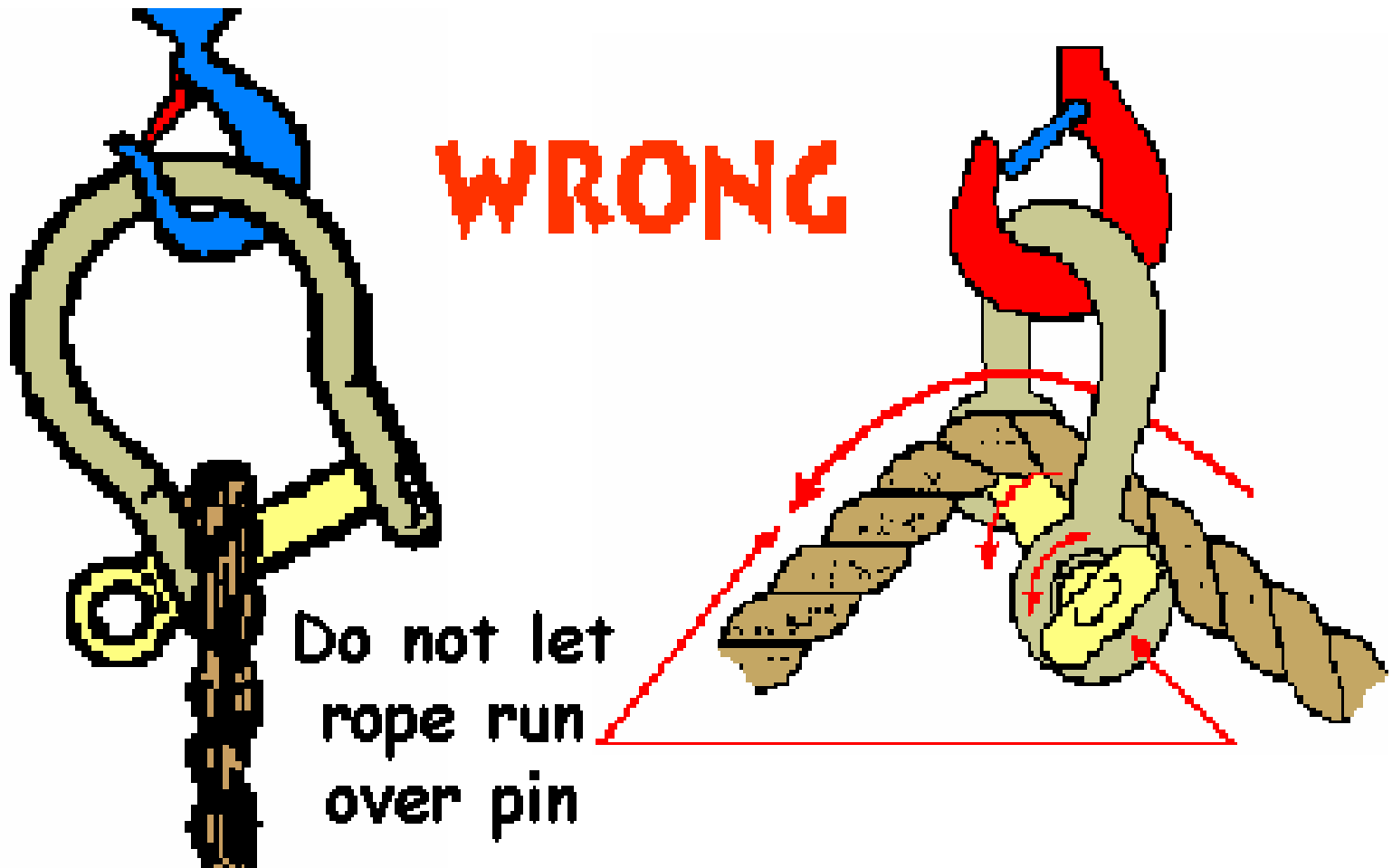


**Never Use a choker
Through the eyebolts**



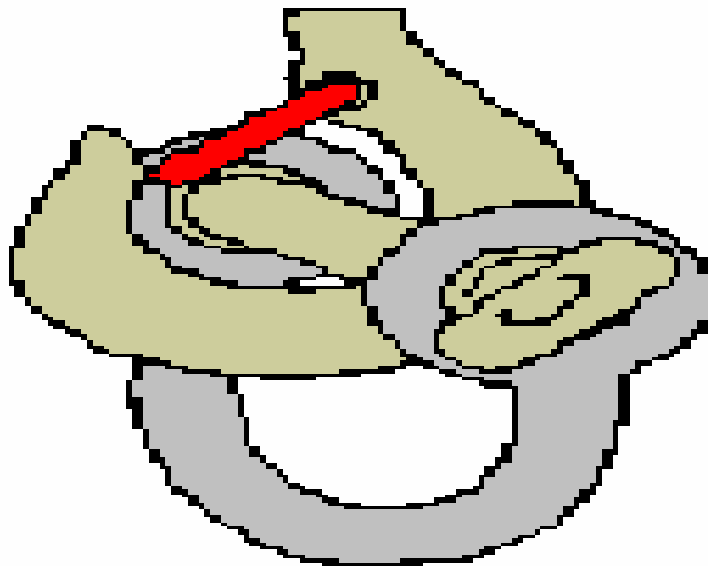
**Never wrap
rope around
the hook**

Rigging and Slings

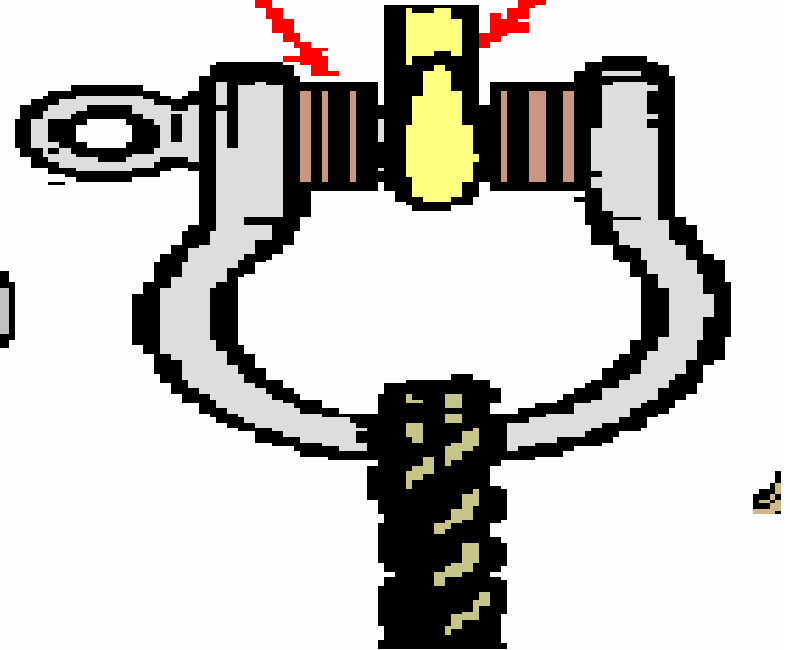


Rigging and Slings

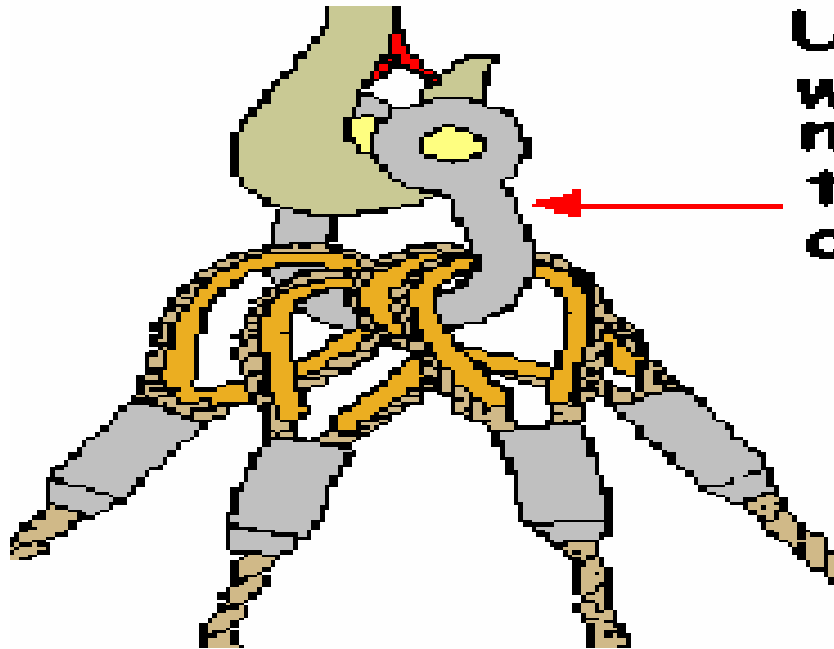
CORRECT



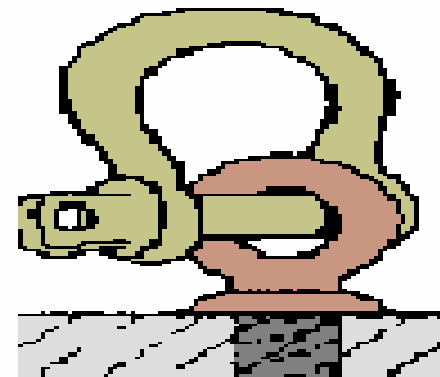
The pin of the shackle must on the hook



Rigging and Slinging

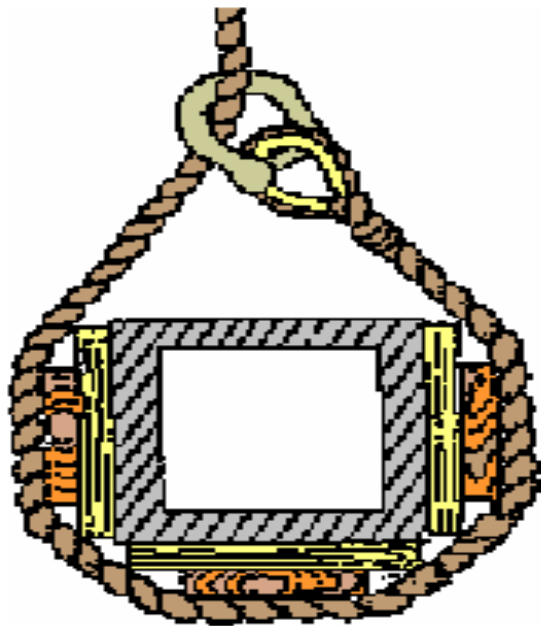


**Use a shackle
whenever 2 or
more ropes are
to be placed
over a hook**



**Use a
Shackle**

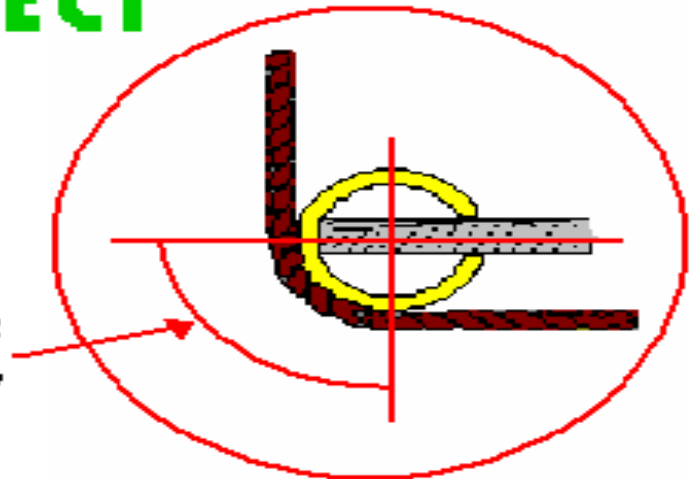
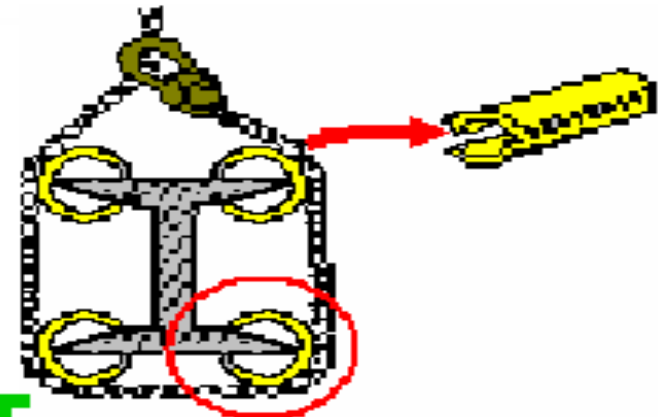
Rigging and Slings



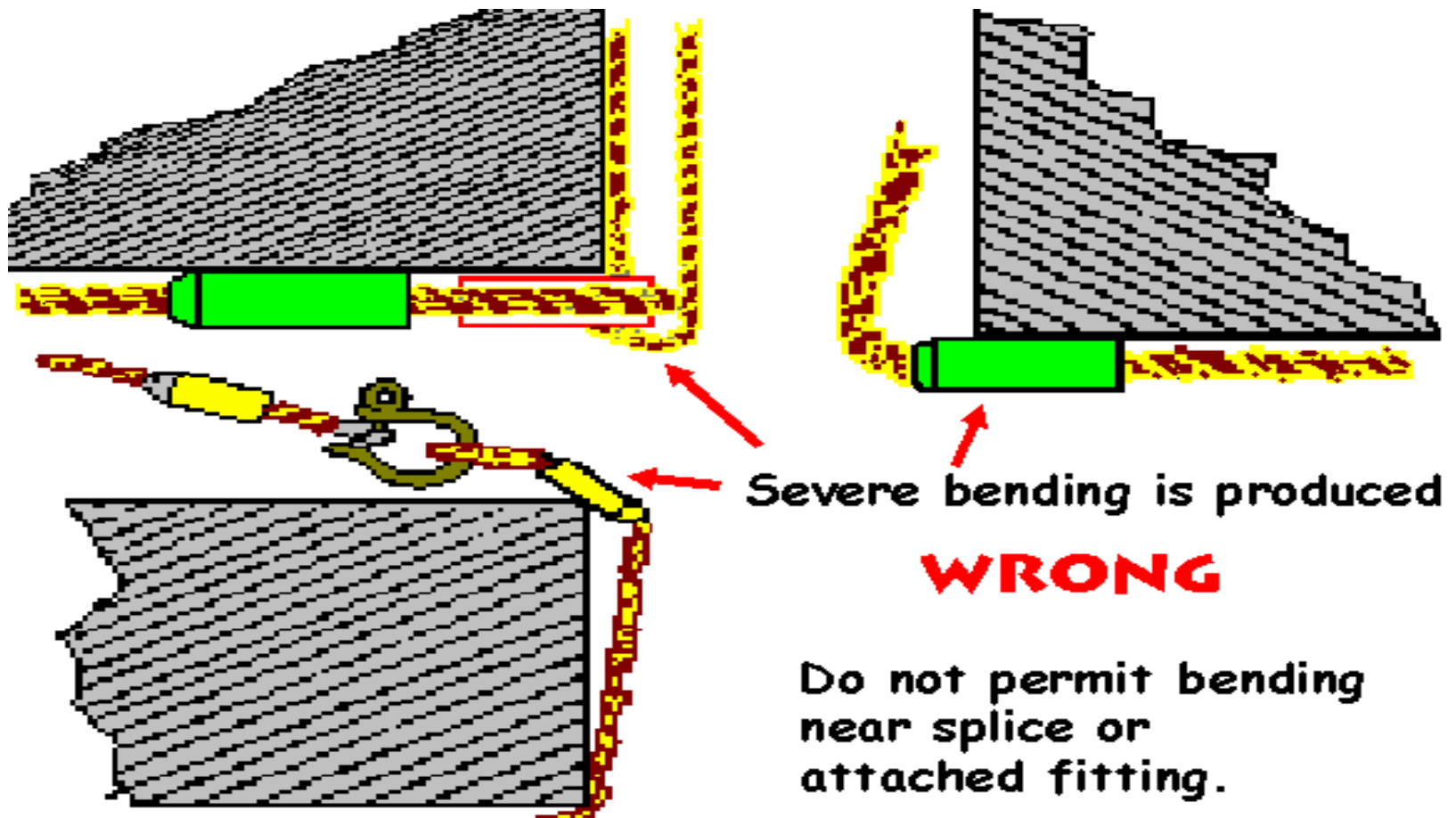
All sharp corners must be covered by pads or softeners

CORRECT

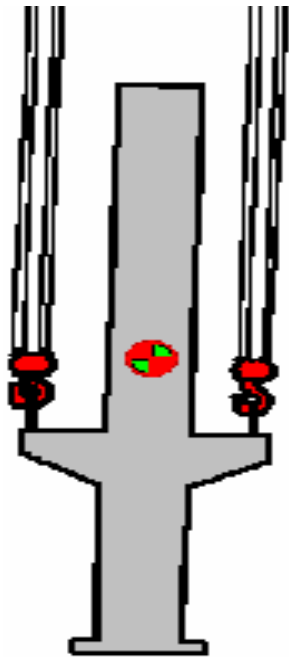
Contact radius must be equal to one rope lay



Rigging and Slings



Rigging and Slinging



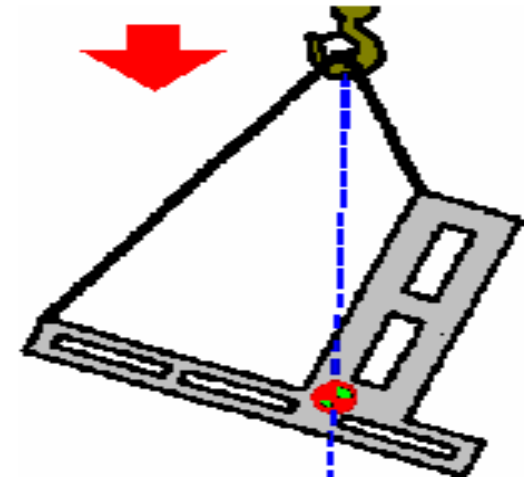
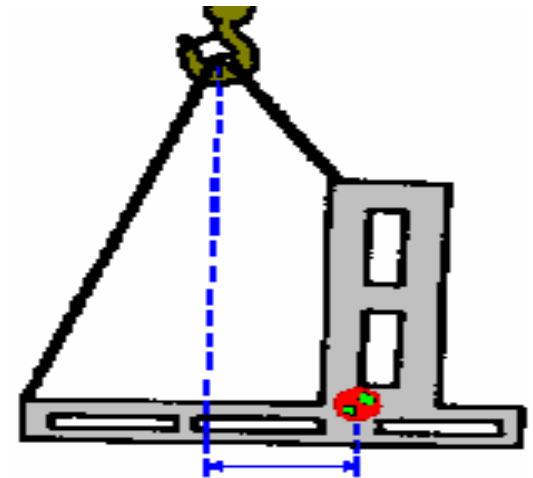
UNSTABLE
Center of Gravity is above lift point.

UNSTABLE

The Hook is NOT over the Center of Gravity

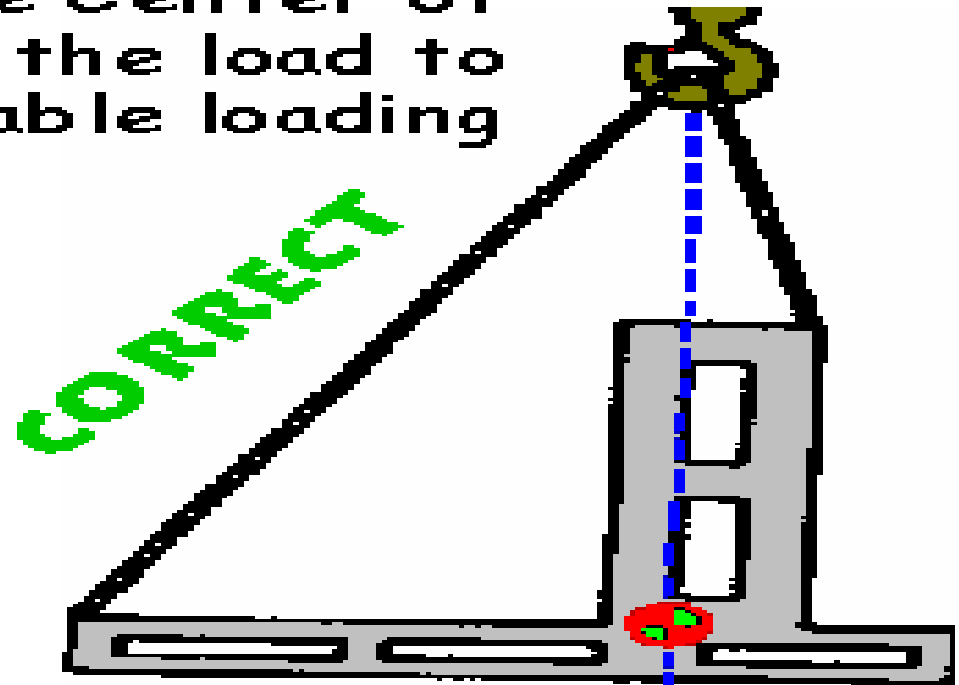
WRONG

The load will shift until the center of gravity is below the hook



Rigging and Slinging

The crane hook must be **OVER** the Center of Gravity of the load to have a stable loading



STABLE - Hook is over the Center of Gravity

Rigging and Slinging



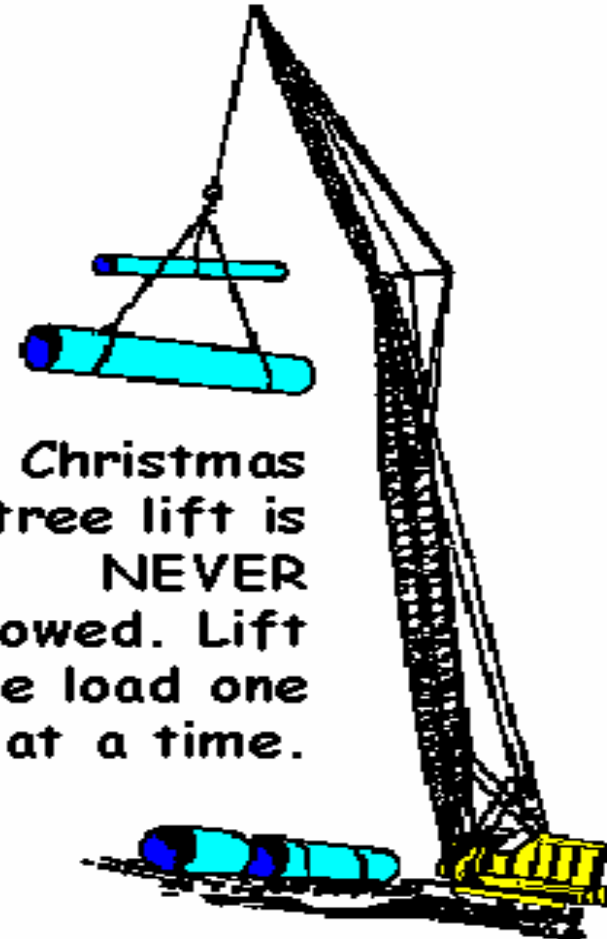
Keep away from the load while slings are being pulled out.

WRONG



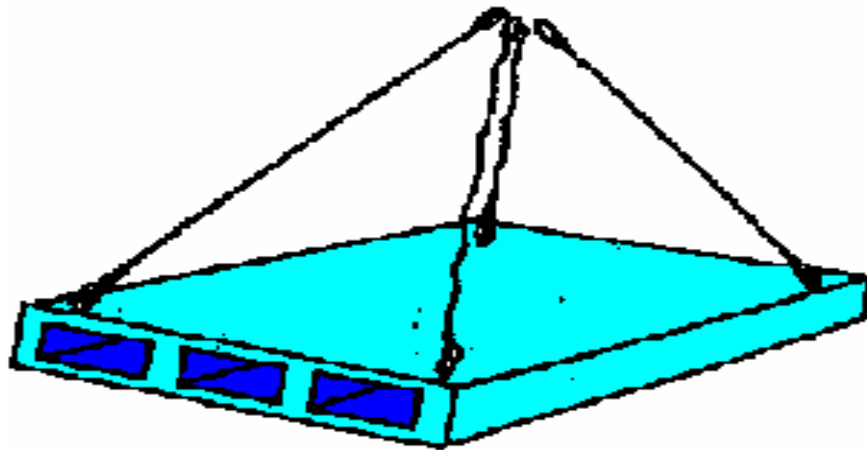
OK

Use clove hitch in fastening a rope.



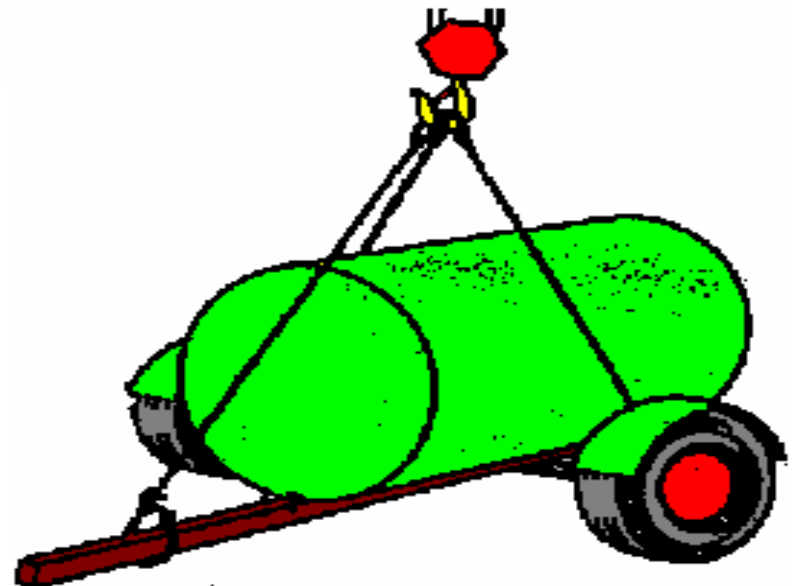
Christmas tree lift is NEVER allowed. Lift the load one at a time.

Rigging and Slings



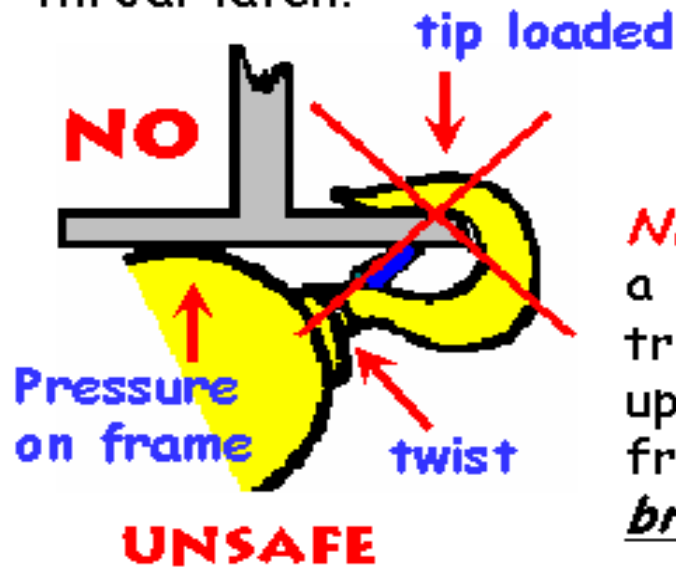
On a rigid object being hoisted with a 4-leg (or 3-leg) bridle hitch, it is possible that only 2 legs carry the total weight and the other leg(s) only serve to balance the load.

When designing for a proper size of sling for 3 or 4 leg bridle hitch, assume that the load is carried only by 2 slings.



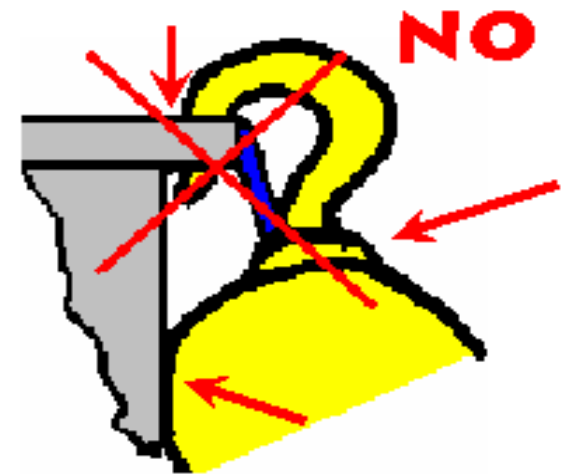
Rigging and Slings

NEVER point load the hook by placing it in a bolt hole. *This could cause the hook to be spread or the tip could shear off under the stress!* This also bypasses the function of the throat latch.



UNSAFE

NEVER hook the hoist over the lip of a beam, angle or plate. This causes a tremendous twisting force against the upper hook retaining area of the frame. *The entire hook could be broken out of the frame.*



REMEMBER – If you lose the upper hook, you also lose the load !!

Rigging and Slings

All hoist must be rigged or hung in such a manner that the hoist is solidly held in the uppermost part of the hook arc. If rigged in this manner, it will be found that the hook support is directly in line with the hook shank



When loading the lower hook, the same procedure is followed and again the loaded portion of the hook support is directly in line with the hook shank. When your hoist is loaded in this manner, the load chain will make a straight line from the shank to hook shank.

Rigging and Slinging

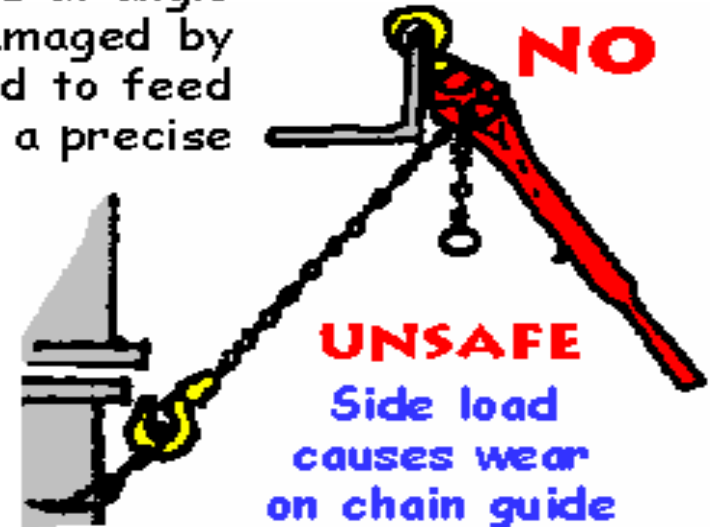
NEVER use the hoist to pull a load that is at angle to the hoist. The chain guide will be damaged by angle pulling. The chain guide is designed to feed the chain over the lift wheel or dogs in a precise manner.

NEVER use the load chain as a sling. A twist may be produced in the chain when the lower hook block and load chain are being used as a sling. This prevents the lower hook from swiveling and re-leaving the twist.

NO



Twisted chain causes wear on chain guide

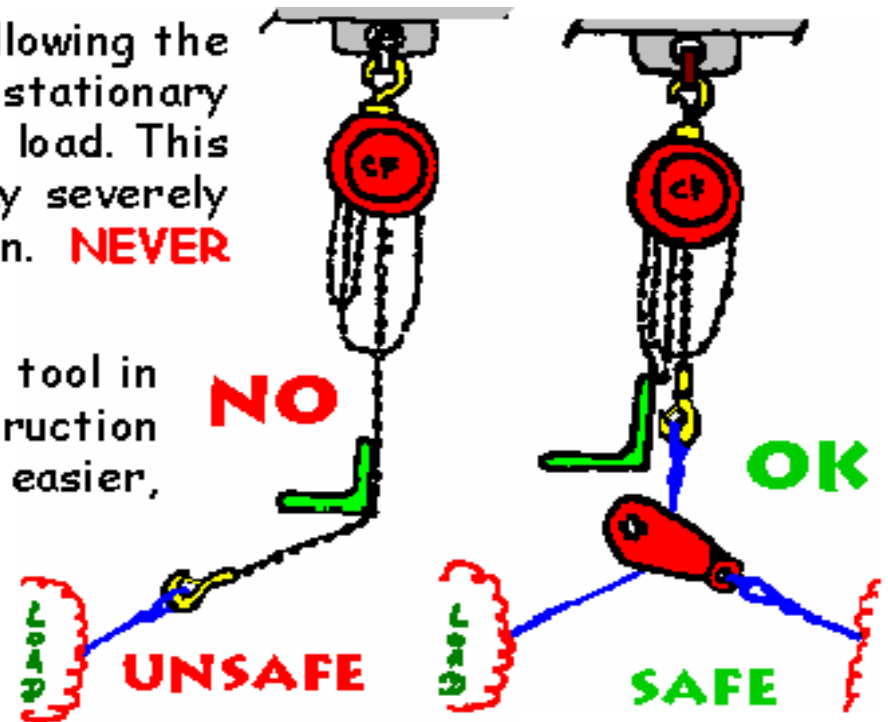


If the chain guide is damaged, it can no longer align the chain. This will result in the rapid wear of the chain and lift wheel. Eventually, this will cause the chain to slip or bind on the lift wheel resulting in a broken chain.

Rigging and Slings

Another unsafe practice is allowing the load chain to contact a stationary object between the hoist and load. This causes excessive wear or may severely damage and break the chain. **NEVER** allow this to happen!

Hoist are essential and useful tool in the maintenance and construction fields. They make our work easier, better and safer when used in the proper manner. When misused or abused, they can cause many problems, the hoist may wear out quickly or fall suddenly.



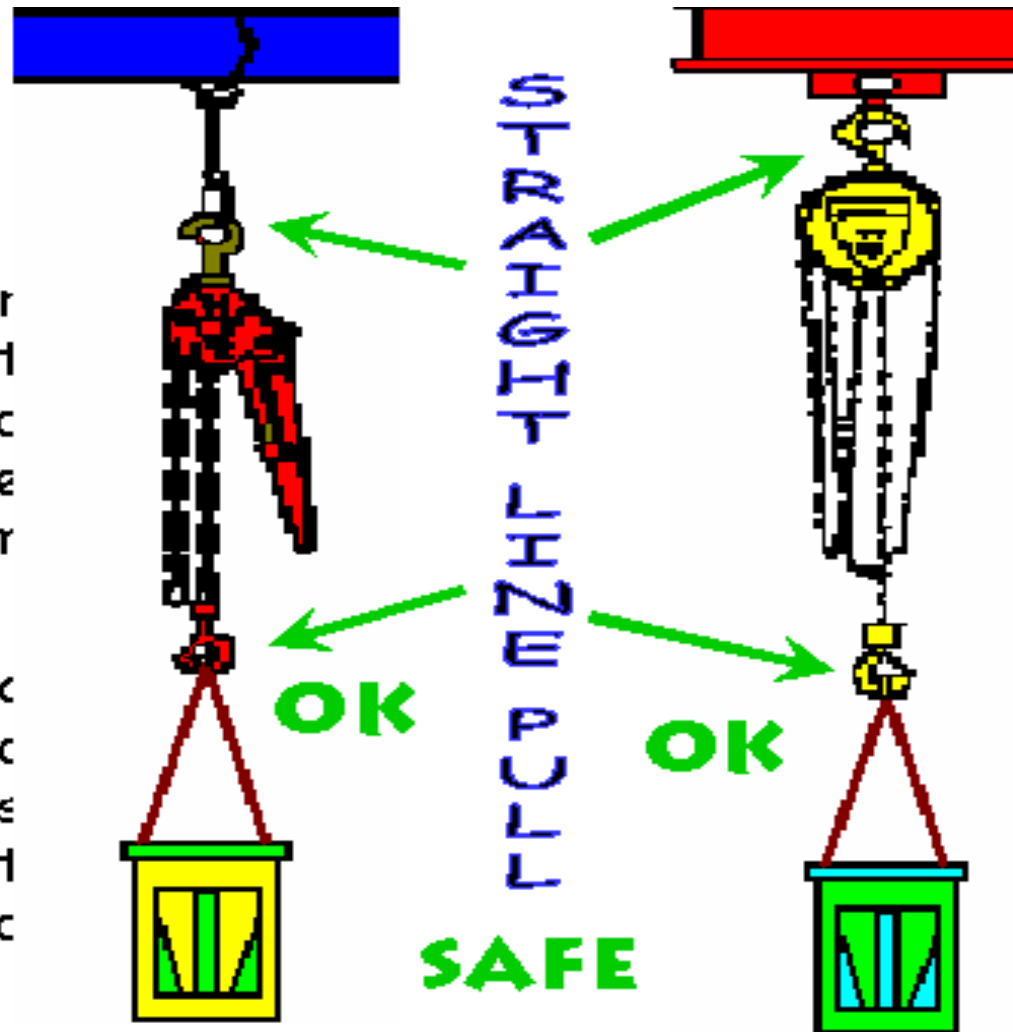
It is very important that these tools be utilized safely! The tools are expensive to replace; the property damage caused by their failure could be catastrophic and the ***fingers, toes, hands, feet, arms, legs or lives lost by their failure could not be replaced!***

Rigging and Slings

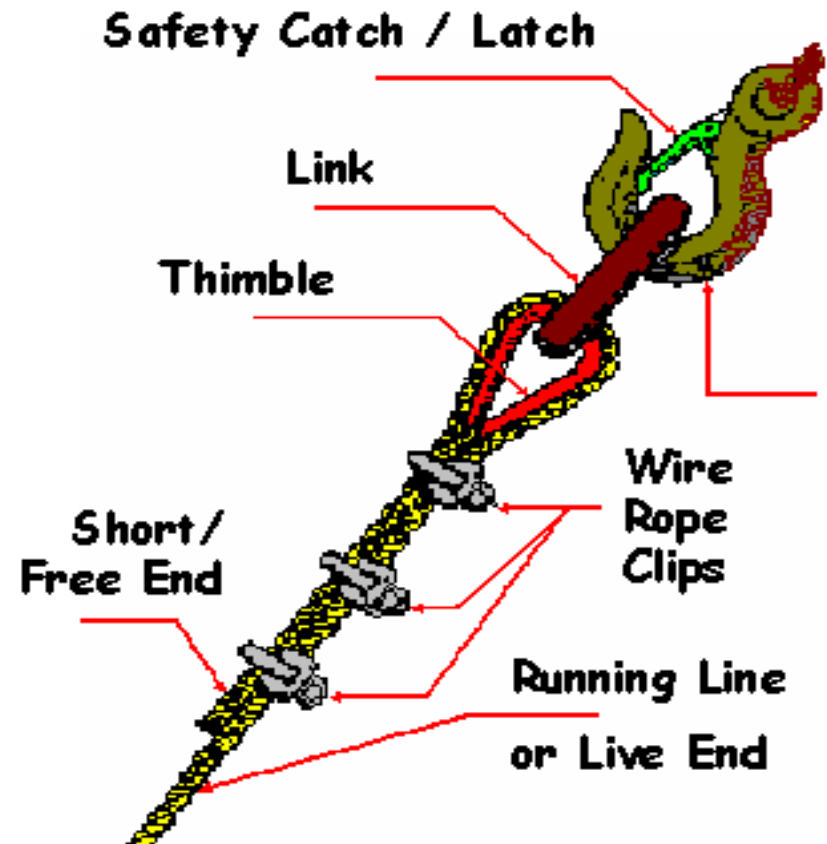
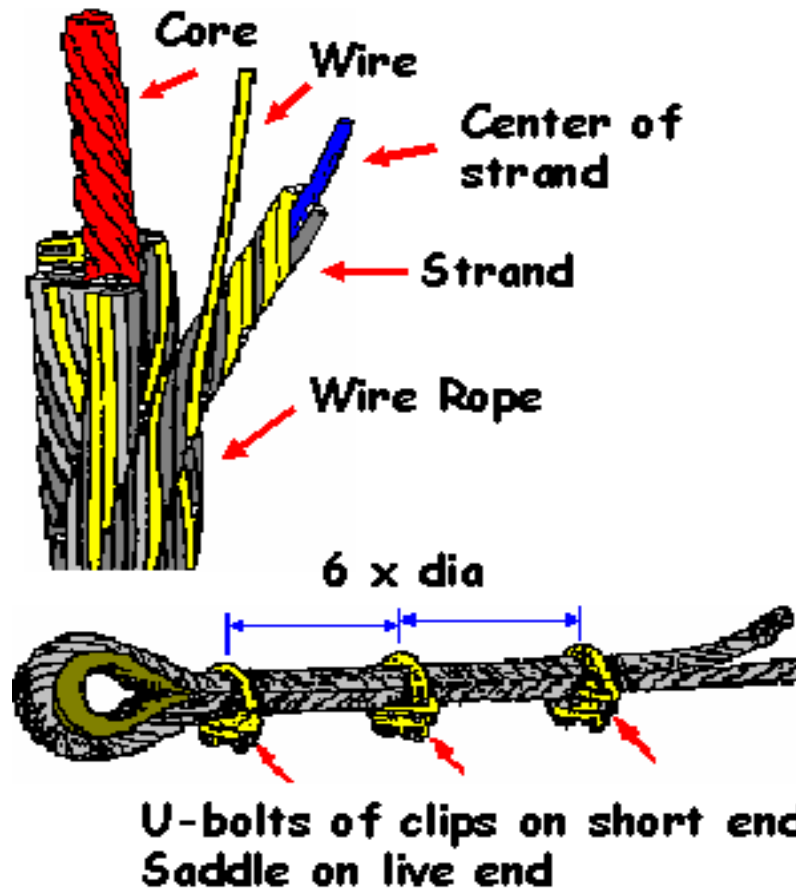
Come-A-Longs and Chainfalls

A properly rigged lever or chain operated hoist must always be loaded so that a straight line pull can be drawn from hook to hook.

When rigged in a straight line, no additional stress is placed on the unit other than the load itself.

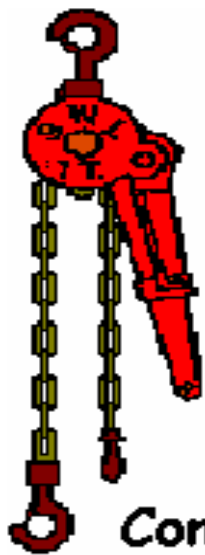


Rigging and Slings

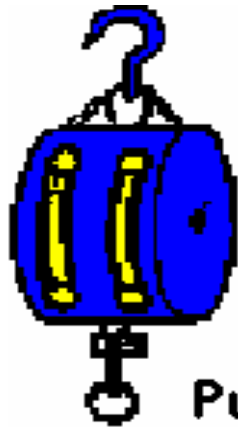


No. of Clips Required = $(\text{dia} \times 3) + 1$ (rounded off to the nearest whole no.)

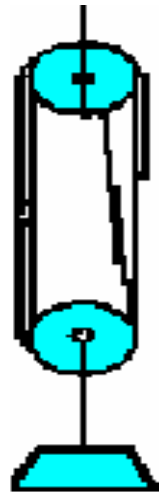
Lifting Equipments



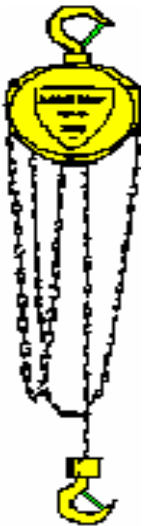
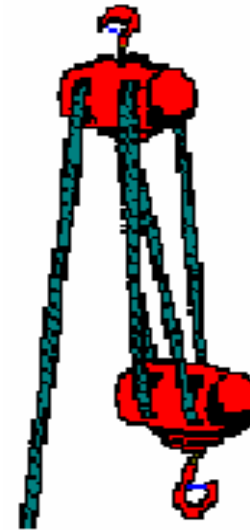
Come-A-Long



Pulley



Block & Tackle



Mouse Hook



Turnbuckles

Clevis

Eye

Lifting Equipments



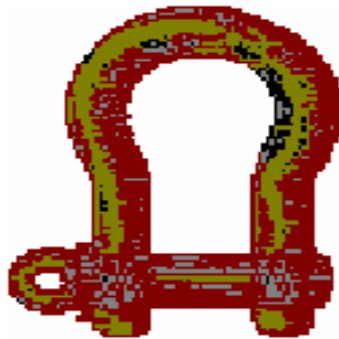
Standard
Eye Bolt



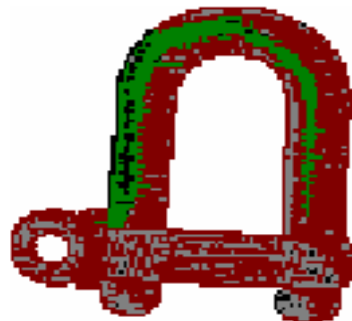
Standard
Eye Bolt
with Link



Chain
Sling



Bow Shackle



D-Shackle

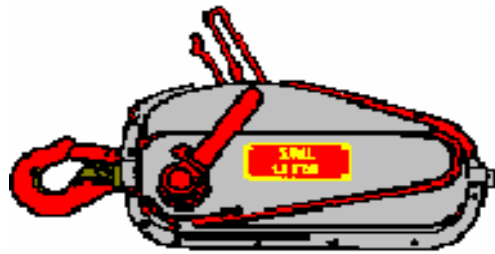


Hook with Rocker
type Safety Catch

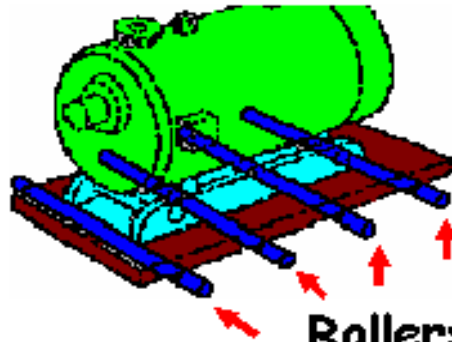


C-Hook

Lifting Equipments



Tirfur or Hand
Operated Winch



Rollers

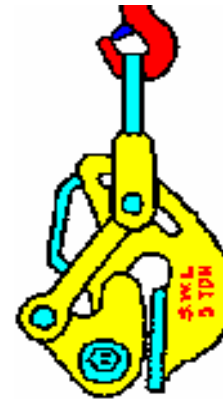
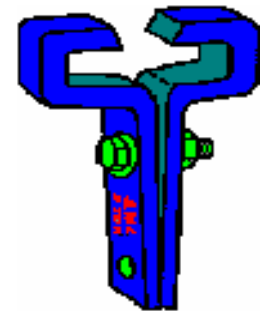
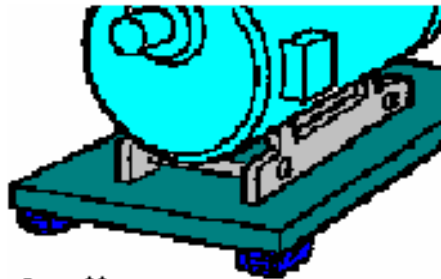


Plate Clamp



Beam
Clamp



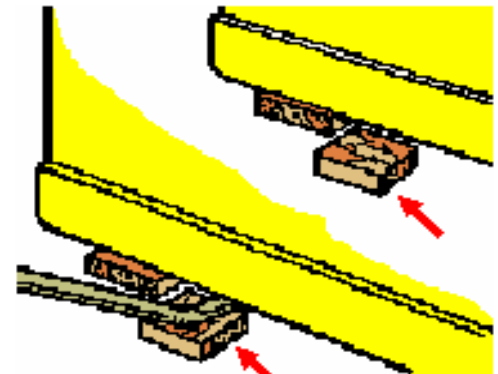
Dolly



Pinch Bar



Skid



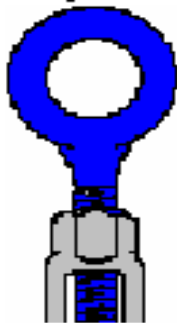
Wooden Blocks



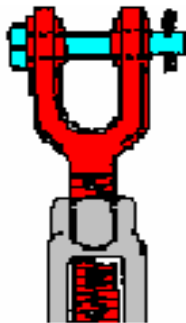
Lifting Equipments

Turnbuckle End Fittings

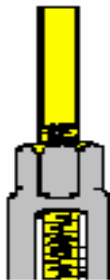
Eye



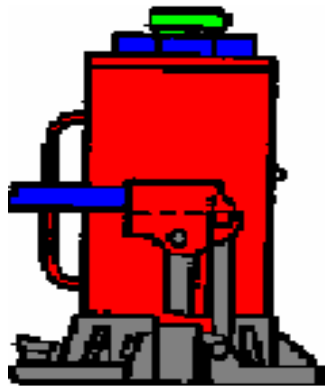
Clevis



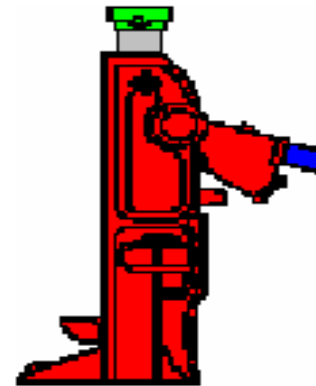
Stub



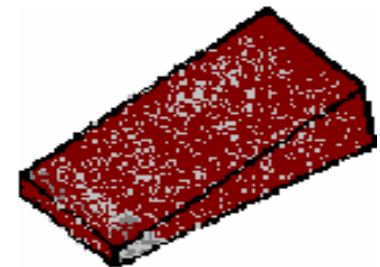
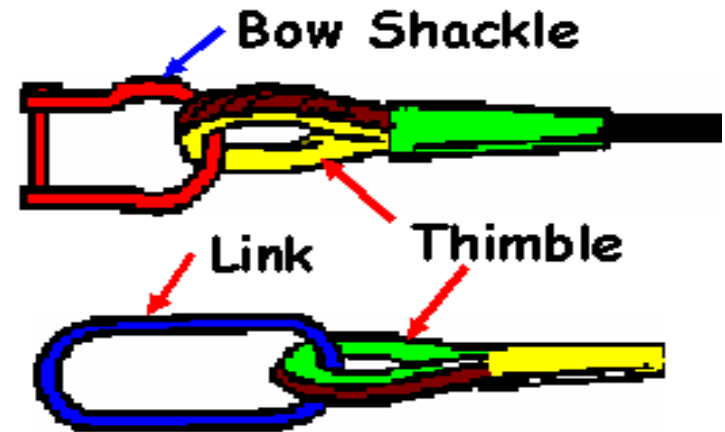
Hook



Screw Jack



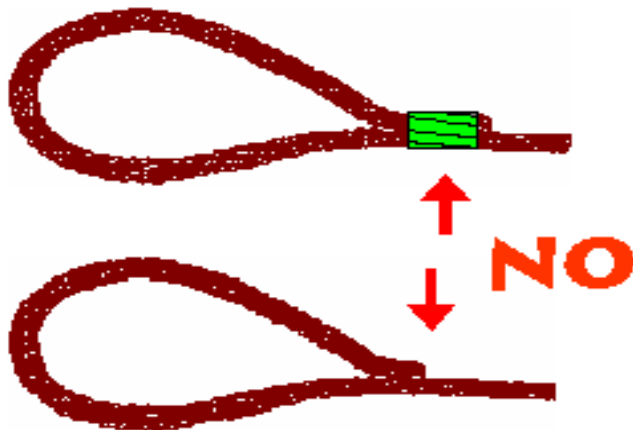
Step Jack



Wedge

Lifting Equipments

Aluminum Ferrule Sling



Endless

Steel Ferrule Sling

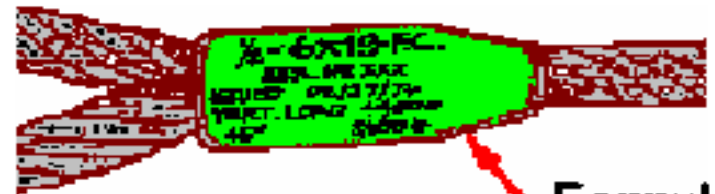


Flat Belt Sling

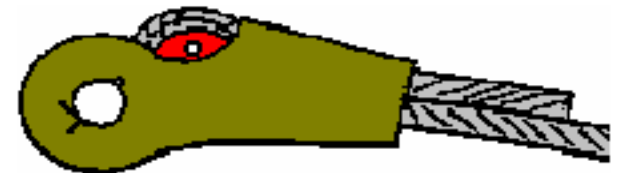
Seizing Wires



Lifting Equipments



6 x 19 means: Ferrule
6 strands with 19 wires
per strand

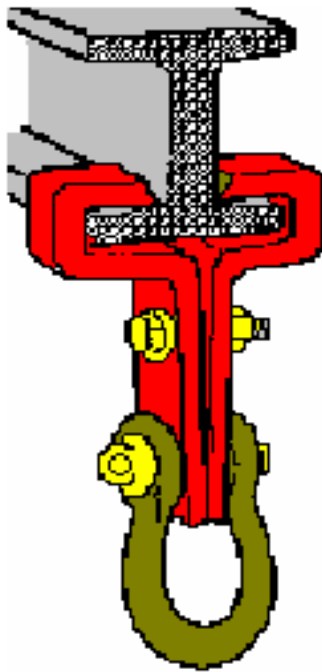


Becket

Open Socket



Lifting Equipments



Beam Clamp

- Temporary overhead support
- Straight lifts

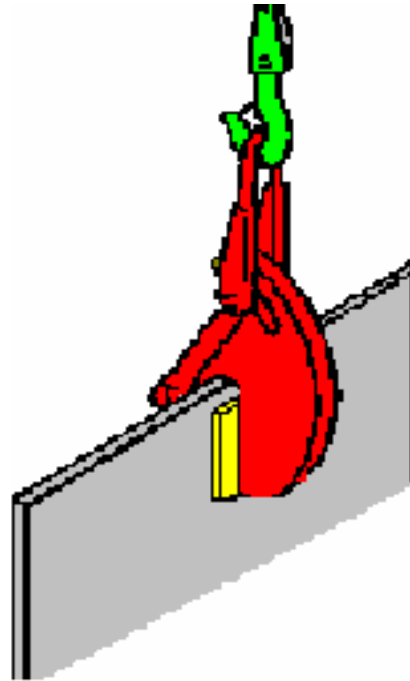


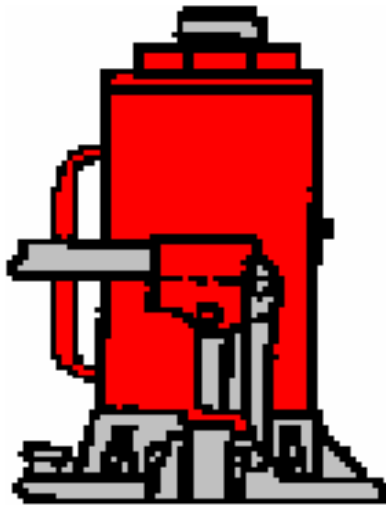
Plate Clamp

- To lift plates

Lifting Equipments

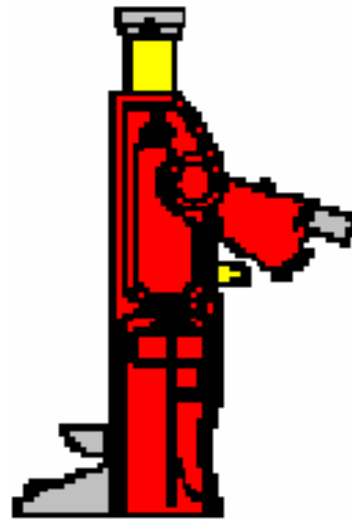
Jacks

- Raise or lower load
- Where cranes and hoist can't be used



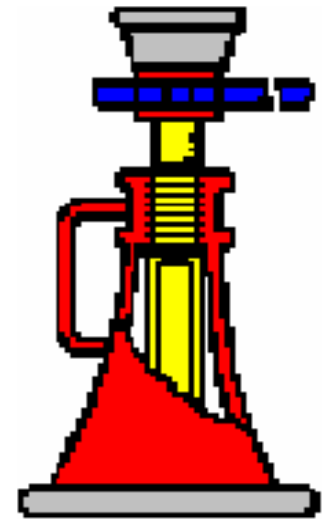
Hydraulic Jack

- Raise / lower heavy load



Step Jack

- Raise up to 24 tons



Screw Jack

- Raise up to 24 tons

Wear & Damage of Rigging Equipment

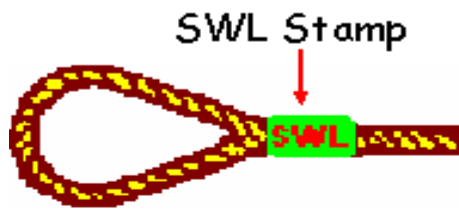
Removal from service of Wire Rope Sling

29 CFR Part 1910.184 (OSHA): Wire rope slings shall be immediately removed from service if any of the following conditions are present.

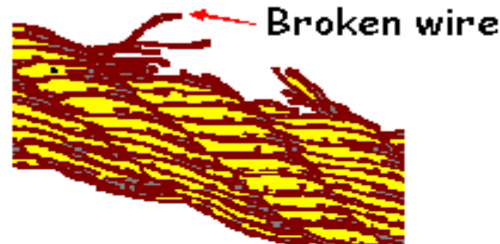
- Ten randomly distributed broken wires in one rope lay, or five broken wires in one strand in one rope lay.
- Wear or scraping of one-third ($1/3$) the original diameter of outside individual wires.
- Kinking, crushing, bird caging or any other damage resulting in distortion of the wire rope structure.
- Evidence of heat damage
- End attachments that are cracked, deformed or worn.
- Hooks that have been opened more than 15% of the normal throat opening measured at the narrowest point or twisted more than 10 deg. from the plane of the unbent hook.
- Corrosion of the rope or end attachments.

Wear & Damage of Rigging Equipment

Wire Rope Sling



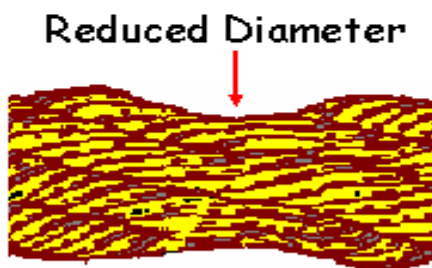
➤ SWL Stamp



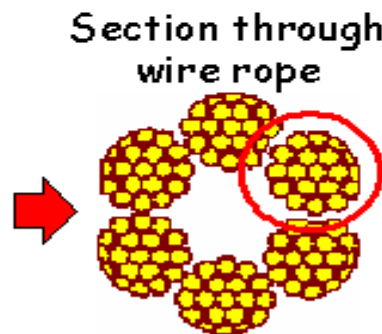
➤ Broken Wires



➤ Kinks

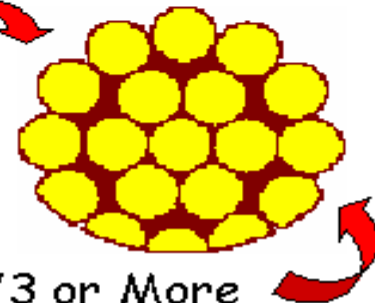


Reduced Diameter



Section through
wire rope

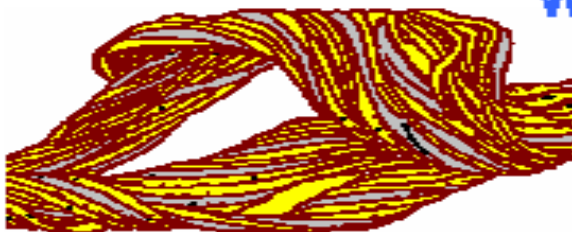
View of single strand



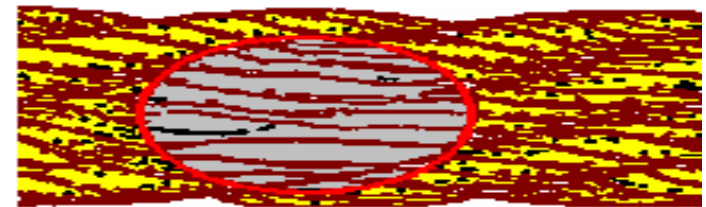
Replace Rope if Wire Wear is 1/3 or More

Wear & Damage of Rigging Equipment

Wire Rope Sling



- Unraveling or Bird Caging

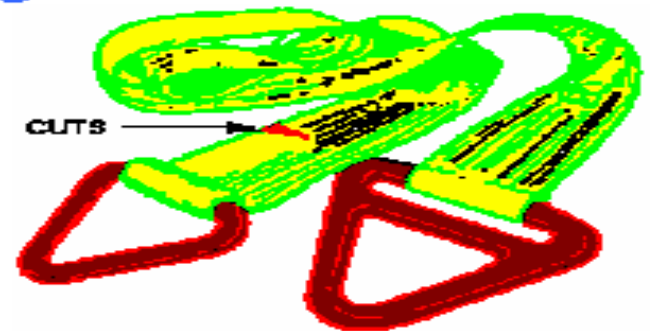


- Excessive Wear

Belt Sling



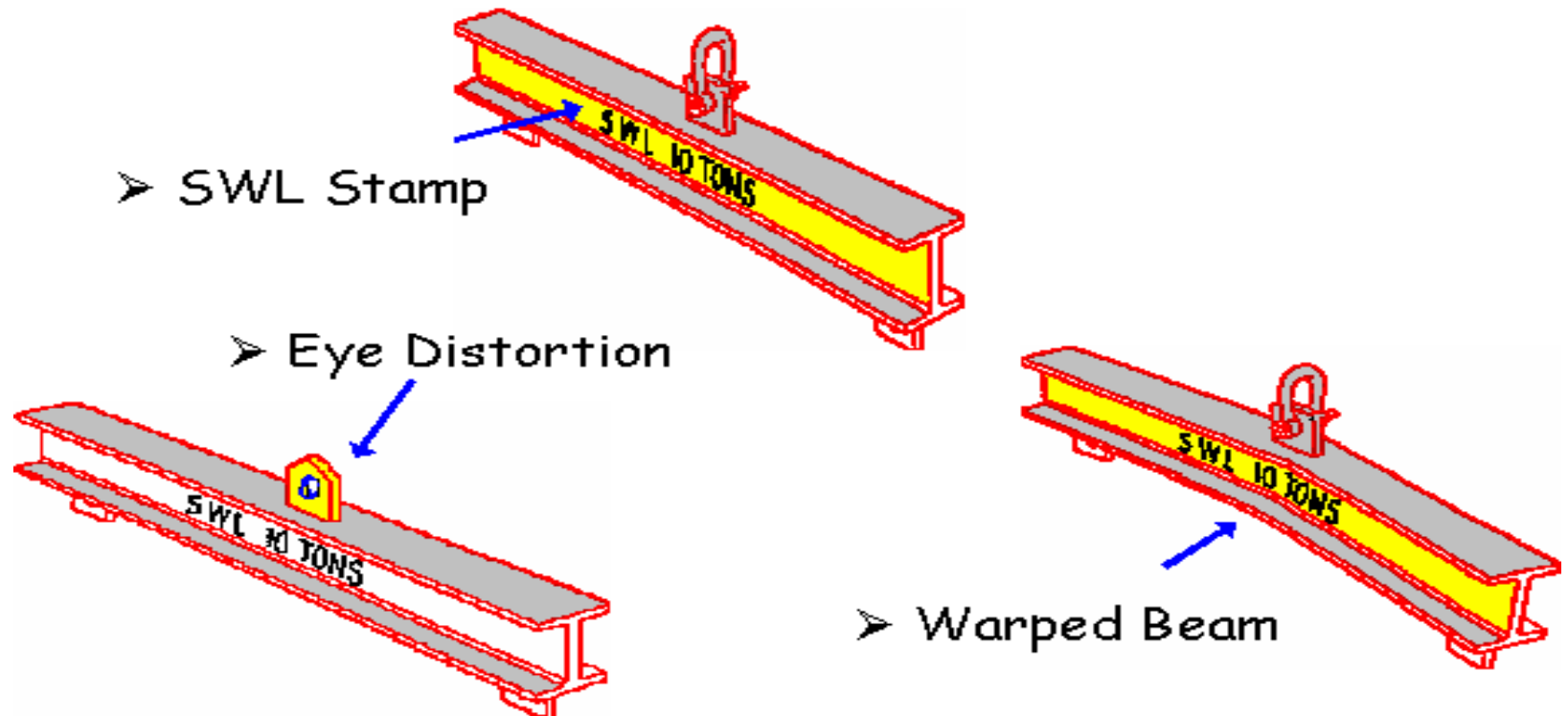
- SWL Tag



- Cuts or Broken Stitches

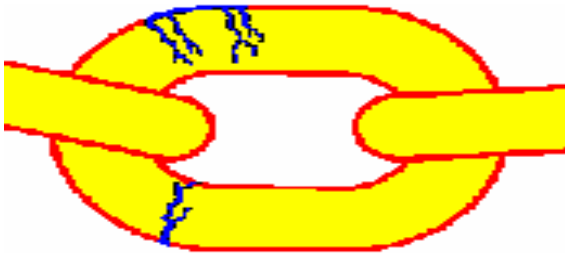
Wear & Damage of Rigging Equipment

Spreader Bar or Lifting Beam



Wear & Damage of Rigging Equipment

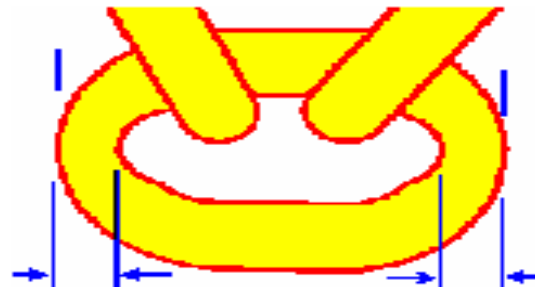
Chain Sling



➤ Broken Welds



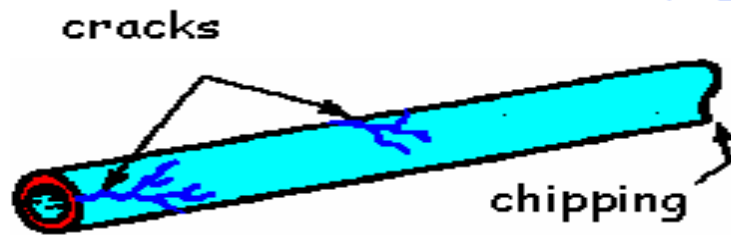
➤ Cracks



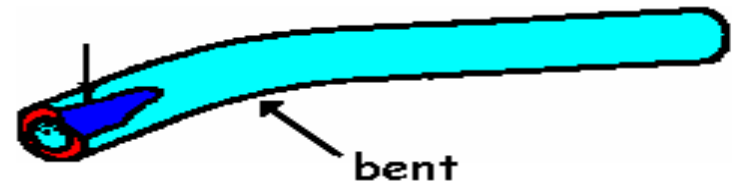
➤ Excessive Wear

Wear & Damage of Rigging Equipment

Rollers

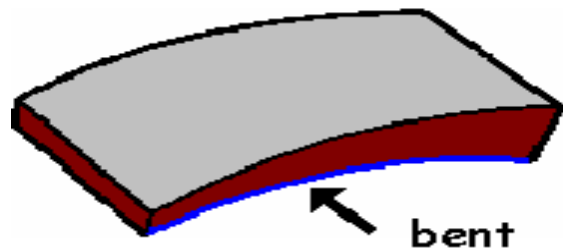


- Cracks & Chipping

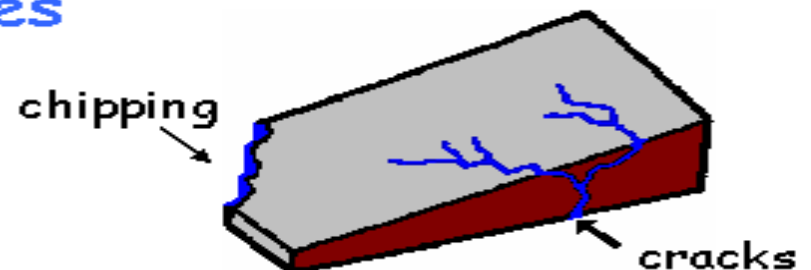


- Bends and Flat Spots

Wedges



- Distortion



- Cracks & Chipping

Wear & Damage of Rigging Equipment

Hooks

- Throat Spreading

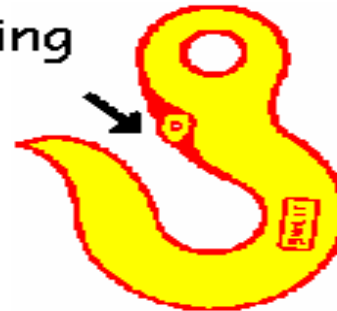


- Excessive Wear on Hook



- SWL

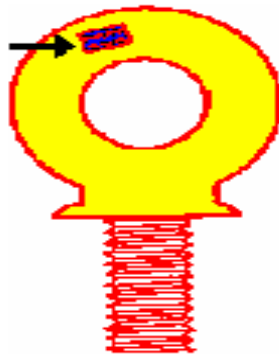
- Missing latch



- Cracks

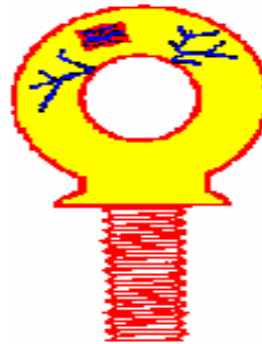
Wear & Damage of Rigging Equipment

➤ SWL

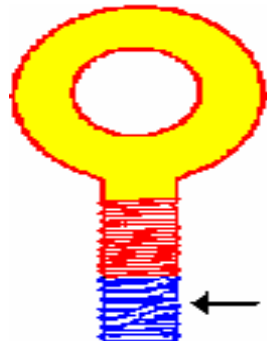
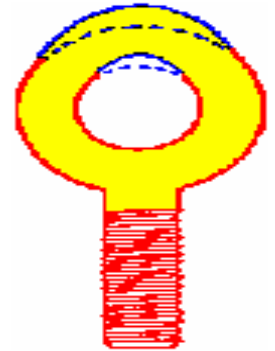


Eye Bolt

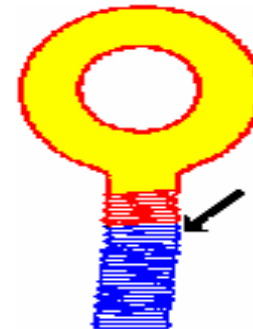
➤ Cracks



➤ Eye Distortion



➤ Stripped and Damaged Thread



➤ Bent Shank

Wear & Damage of Rigging Equipment

Wire Rope Clips

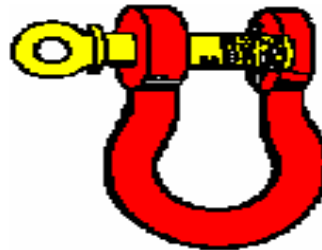


- Stripped Thread

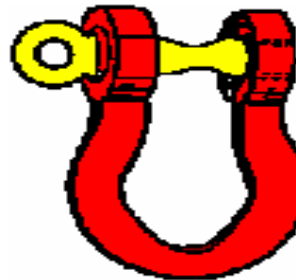


- Corrosion

Shackle

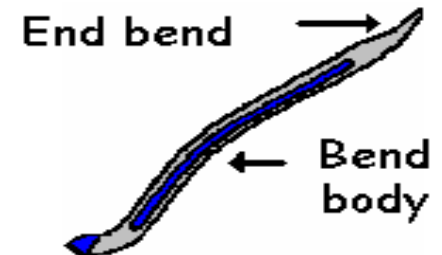


- Damaged thread on pin and shackle

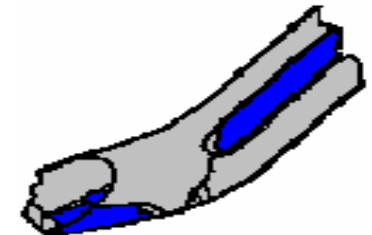


- Worn Pin & Body

Pinch Bar



- Bends and Distortion

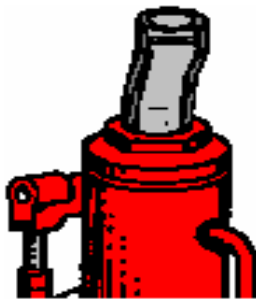


- Cracking & Chipping

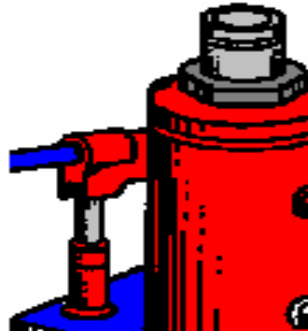
Wear & Damage of Rigging Equipment

Hydraulic Jacks

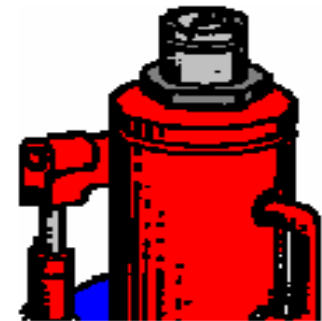
- Bent Ram



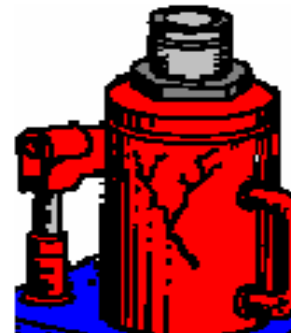
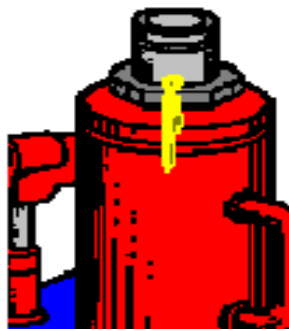
- Loose bolts / rivets



- Damaged Load Cap

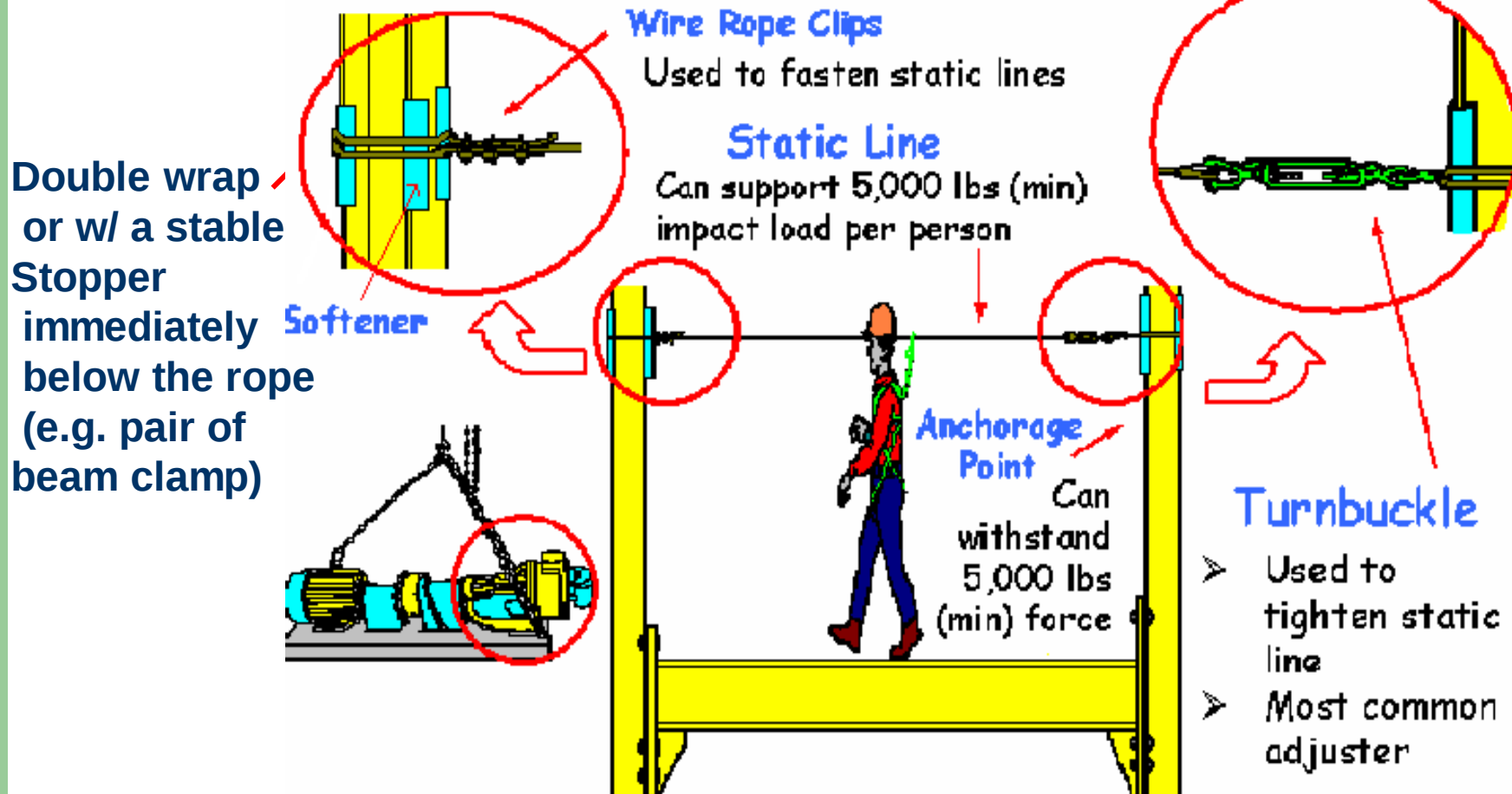


- Leakage around the RAM (sign of overloading or excessive worn seals)



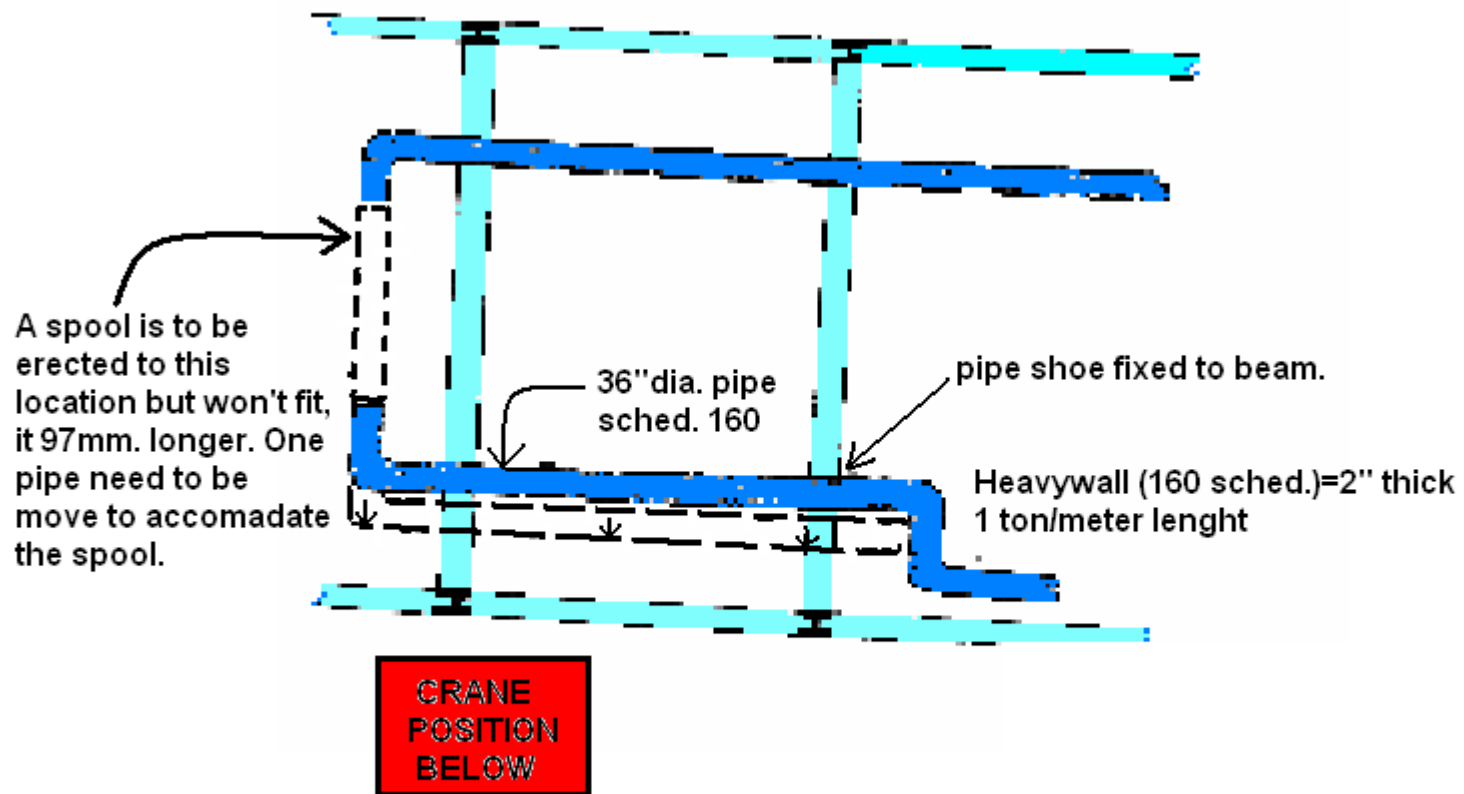
- Cracked and damaged casing (result of overloading & misused)

Static Line



DW-HSE-TM036

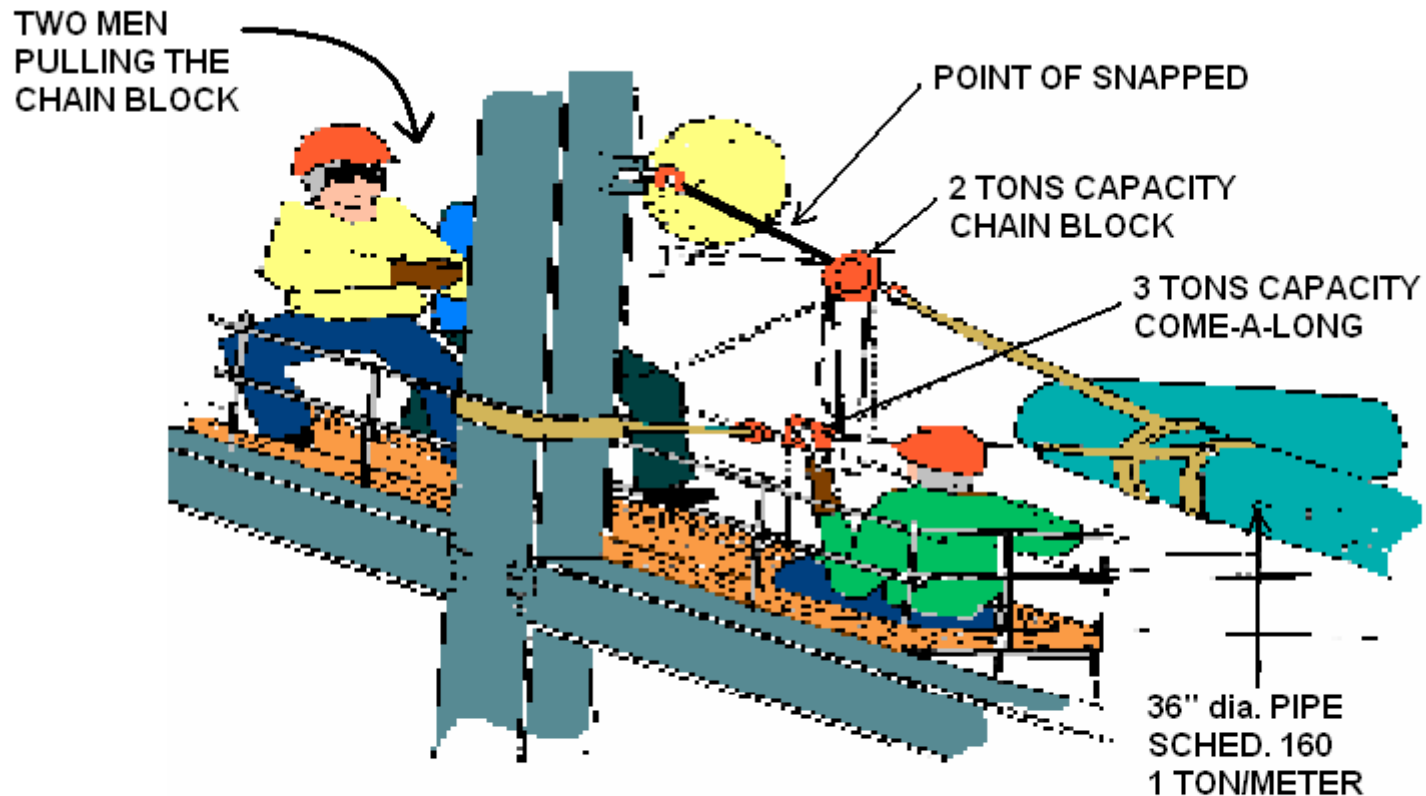
Pipe Rigging Incident - 1



SIMPLIFIED PLOT PLAN OF PIPES

FIG. 1

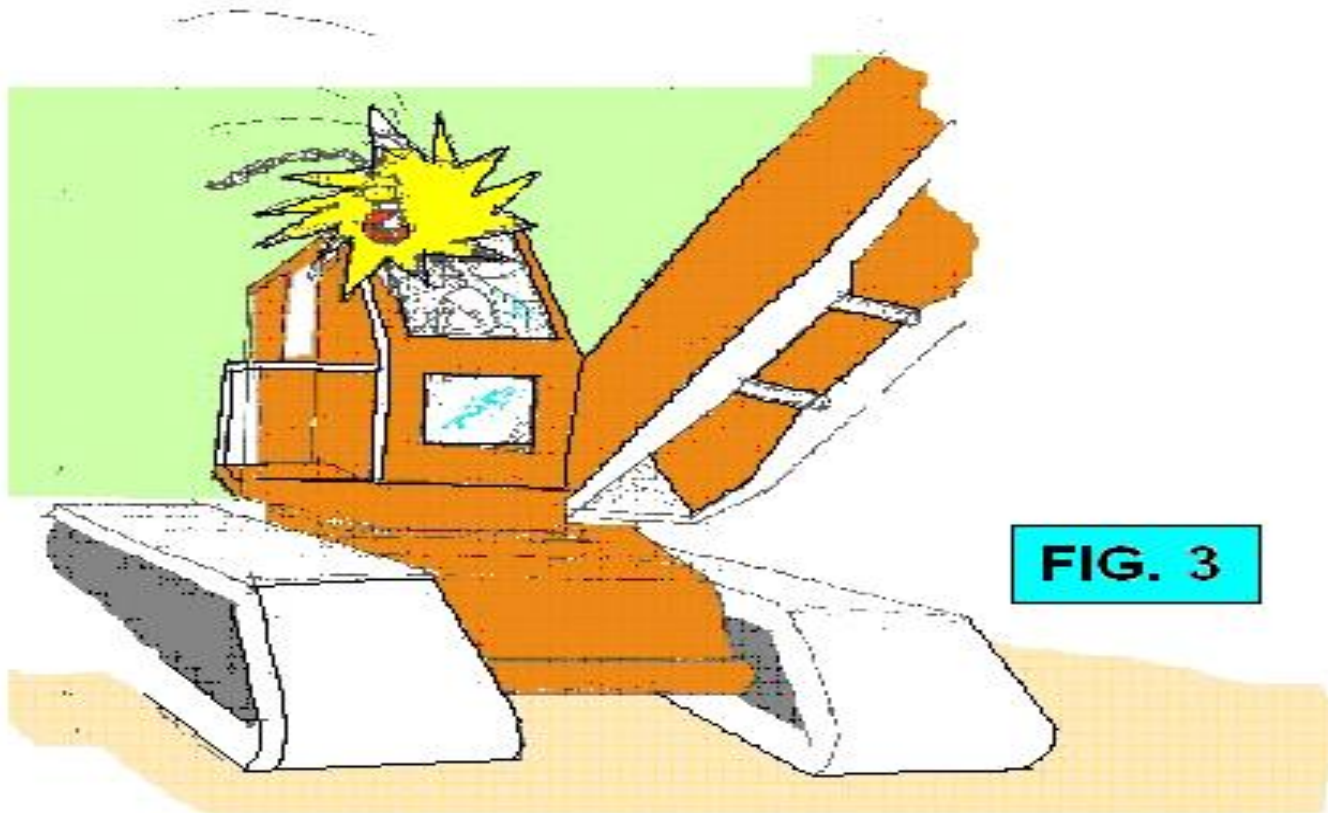
Pipe Rigging Incident - 1



**SIMPLIFIED DRAWING OF PULLING THE
36" DIA. PIPE**

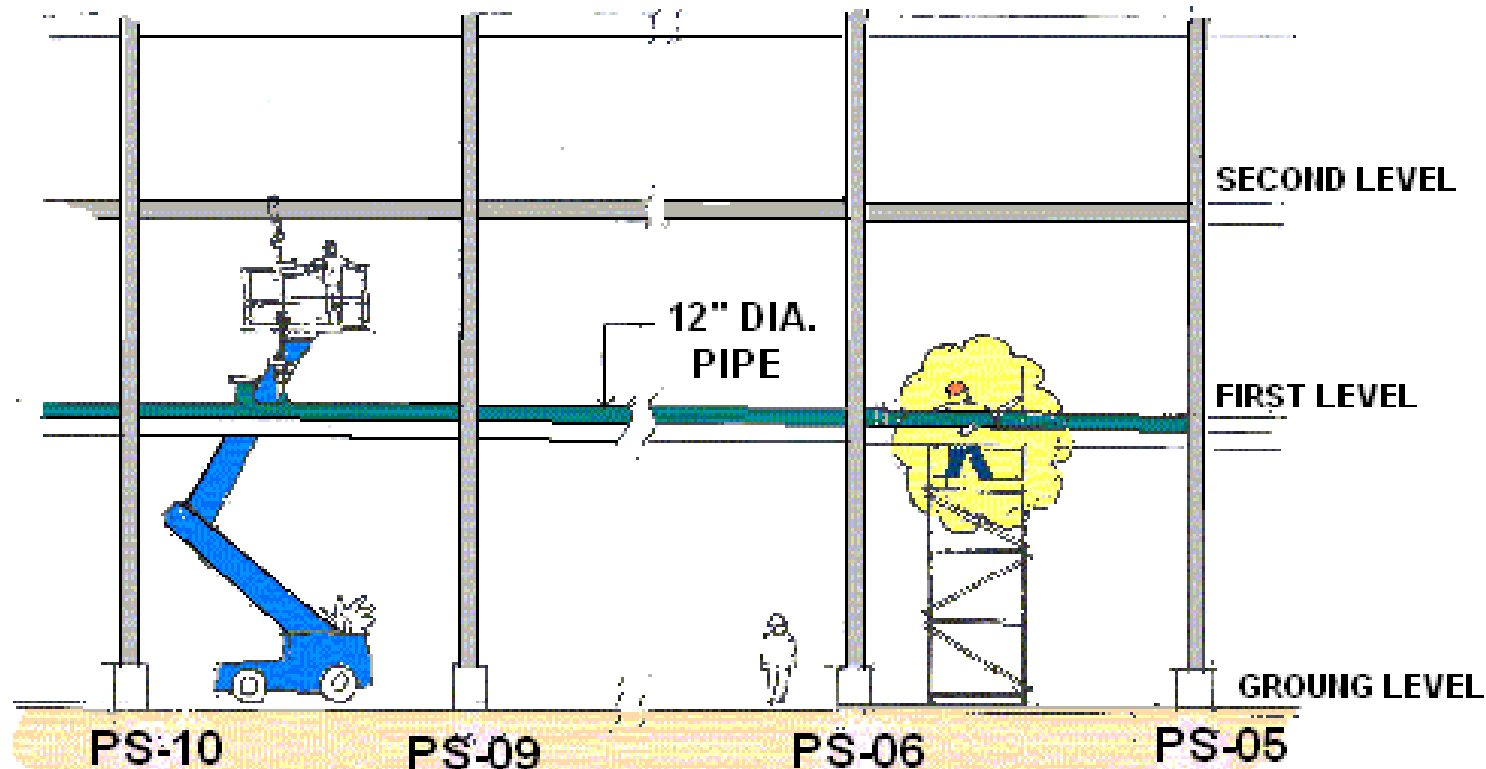
FIG. 2

Pipe Rigging Incident - 1



**THE CHAIN WITH HOOK HIT THE
WINDSHIELD OF CC-19**

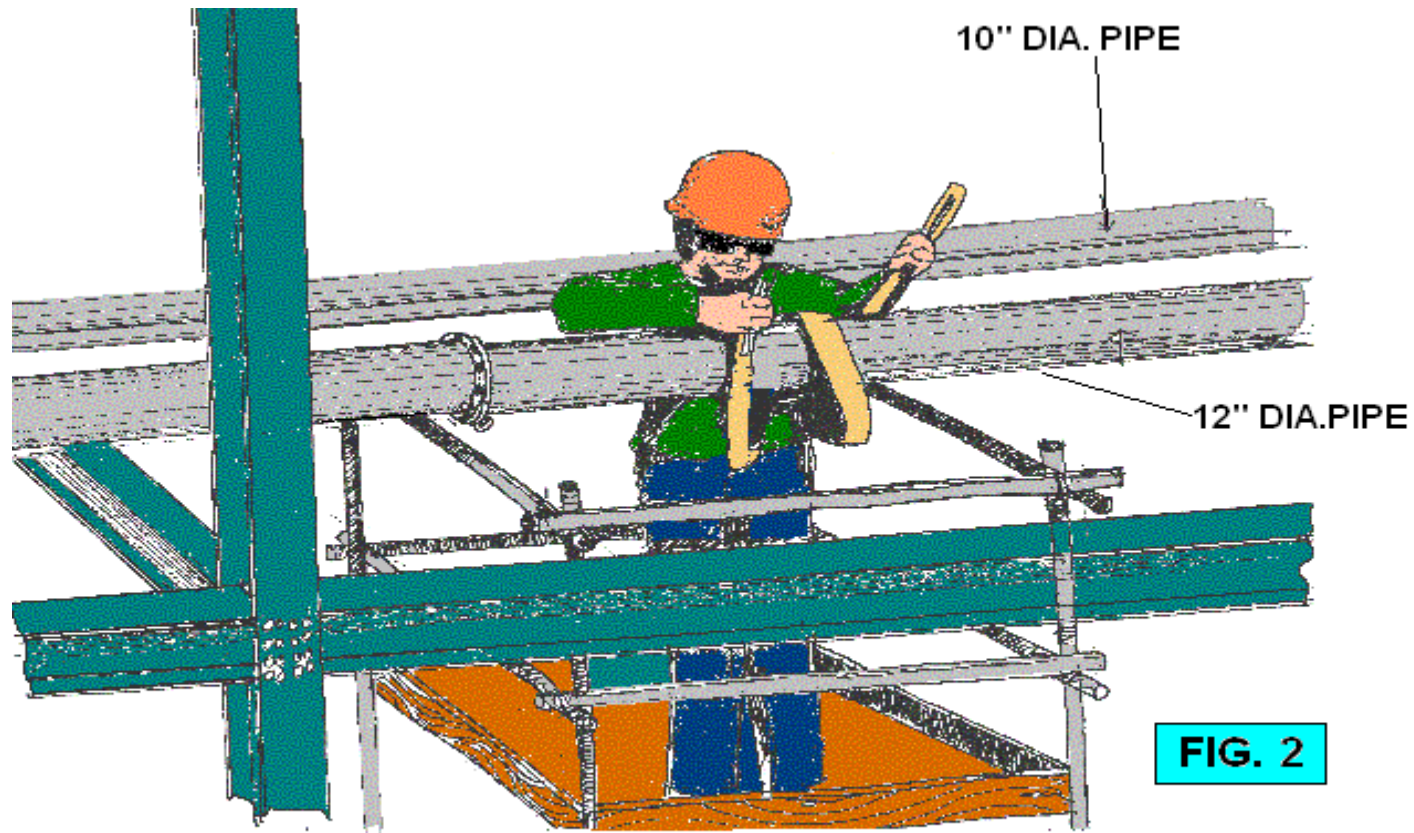
Pipe Rigging Incident - 2



**SET UP OF ACTIVITY @ PR
70-01 FROM PS-05 TO PS-10**

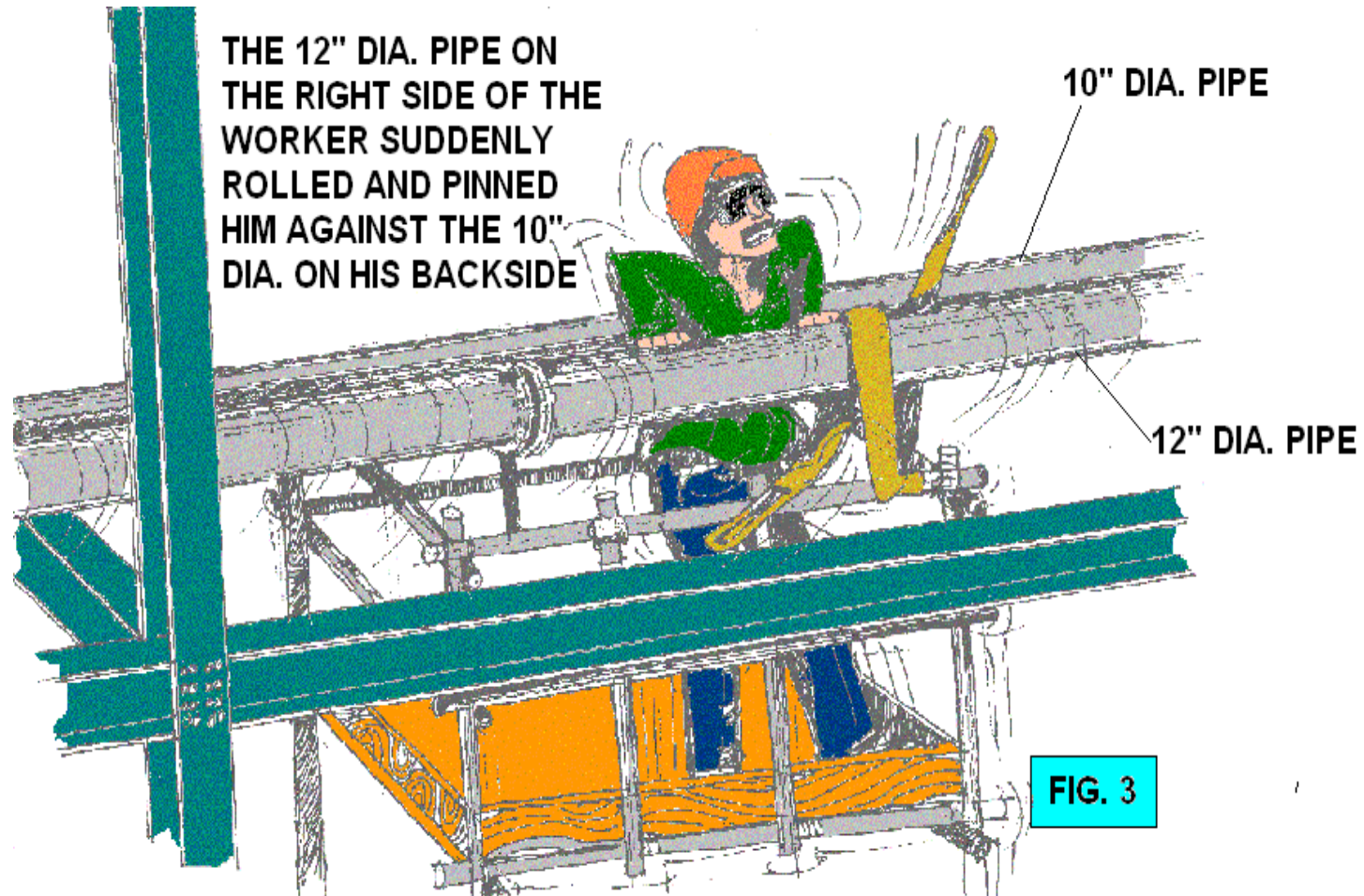
FIG. 1

Pipe Rigging Incident - 2

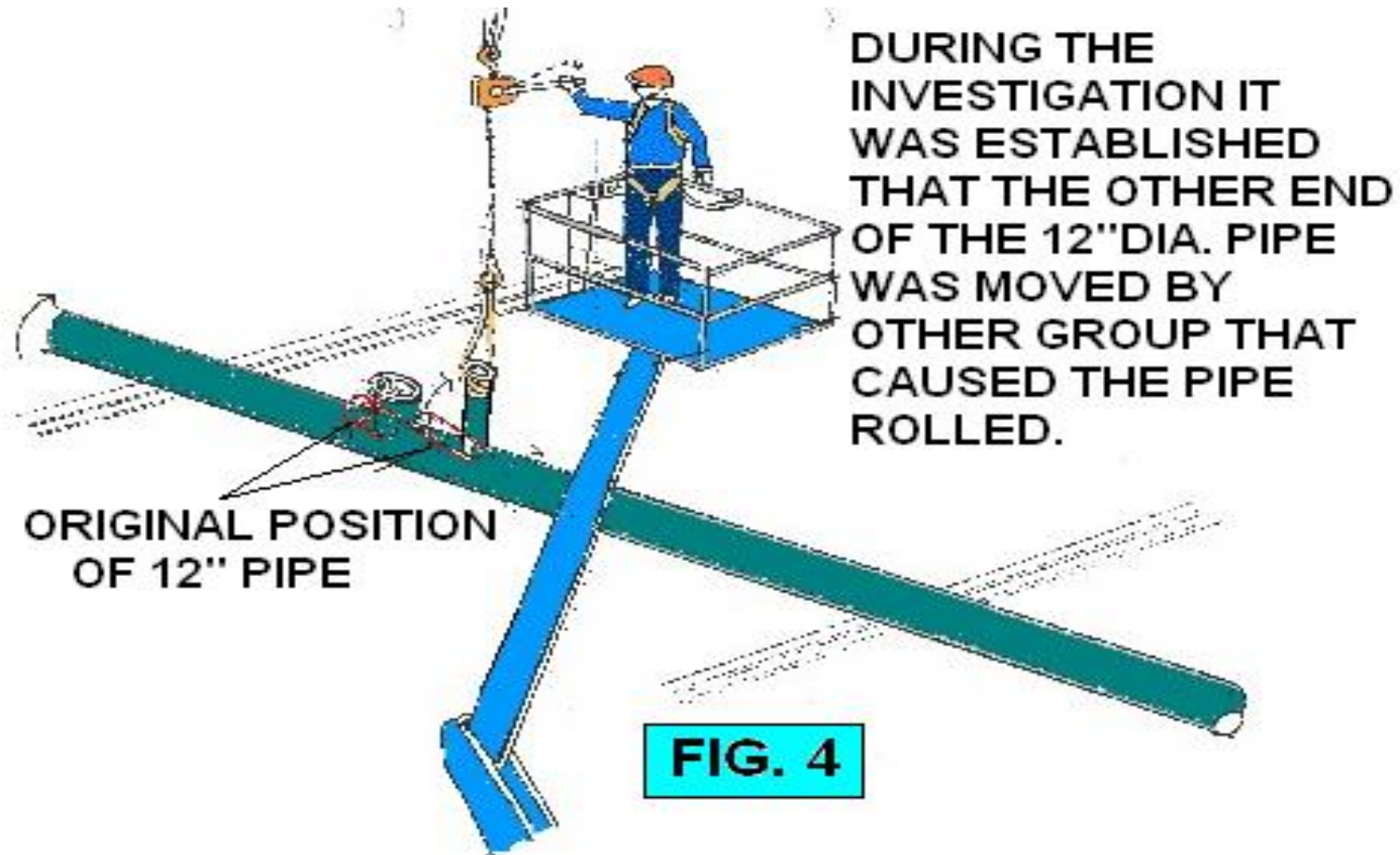


**WORKER PLACING THE NYLON SLING ON
TO A 12" DIA. PIPE.**

Pipe Rigging Incident - 2



Pipe Rigging Incident - 2



Summary

Prior to any lifting operation taking place the following must be performed

- Assess the lifting task to identify and reduce the risk that may be inherent in the operation
- Where possible, eliminate the need to carry out the manual handling operation and resort to mechanical lifting operation
- Where risk is identified, implement mitigation measure to reduce the risk
- Consideration must be given to weight of the load, location of lifting area, equipments to be use and personnel competency