Overhead Lifting

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Overhead Lifting

- "Process of lifting that would elevate a freely suspended load to such a position that dropping a load would present a possibility of bodily injury or property damage."








Main constrution parameters (1)

Working Load Limit (W.L.L.) - the MAXIMUM load that shall be applied in direct tension to undamaged straight length of a sling or hoisting equipment,

Design Factor - a ratio of the breaking strength to the working load limit,

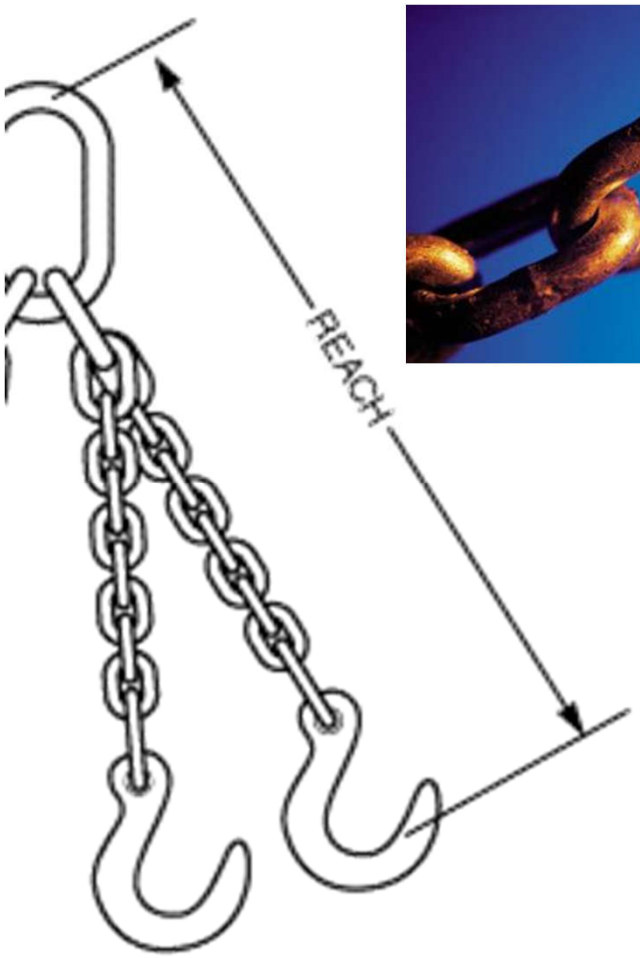
Component	Minimum Design Factor
Nylon rope sling	5:1
Polyester rope sling	5:1
Polypropylene rope sling	5:1
Alloy steel chain sling	4:1
Wire rope sling	5:1
Metal mesh sling	5:1
Synthetic web sling	5:1
Synthetic round sling	5:1

Main constrution parameters (2)

Elongation - the ability of a piece of load bearing material to permanently increase in length before it fails or breaks.

Expressed as a percentage of increase over its original length

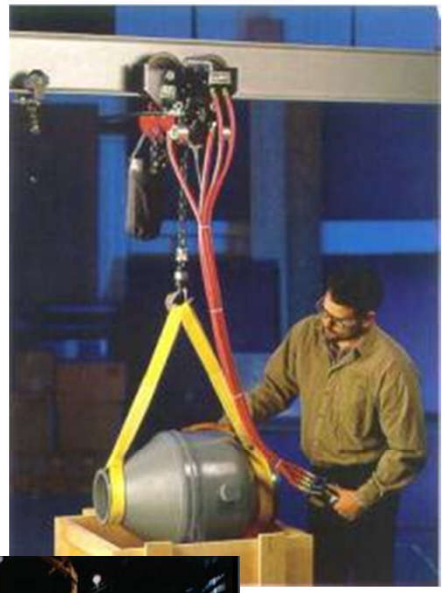
Reach - the distance measured from the top of the master link to the bowl of the load hook.

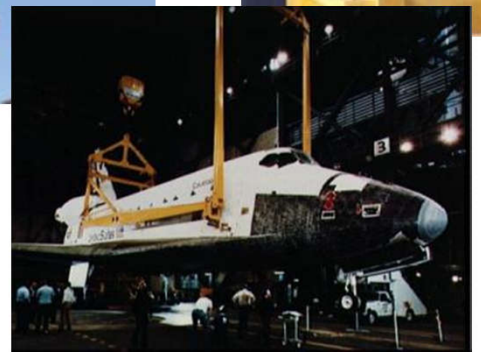


Hoist

hoist (hoist) v. hoist·ed, hoist·ing, hoists

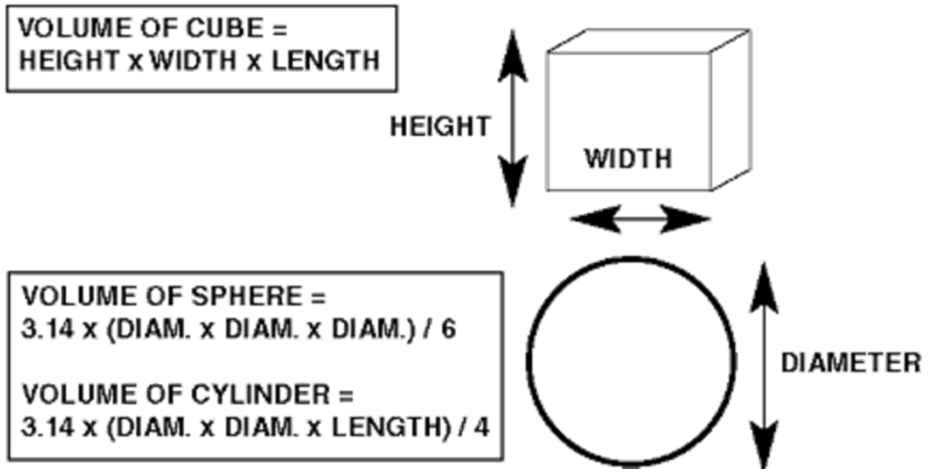
To raise or haul up with or as if with the help of a mechanical apparatus.





Determining Load Weight

- Actual weight obtained from engineering data, shipping papers, catalogs.
- Calculated weight based on common materials.
  - Volume of object
  - Weight of material
  - Reduced for air (voids)



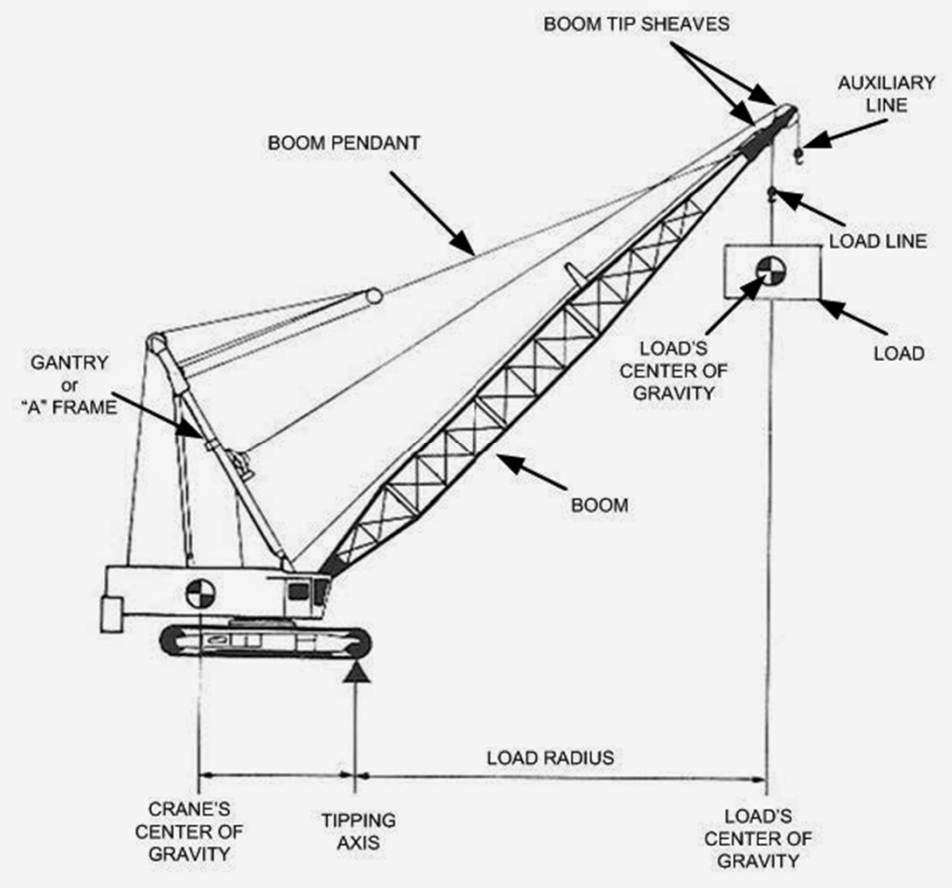
- **Known**
  - **Data plate**
  - **Engineering specifications**
  - **Shipping papers**
  - **"Tribal Knowledge"**
- **Estimated**
  - **Volume of object**
  - **Density of materials**
  - **Adjusted for voids (air)**

Crane Operating Capacity (1)

- Manufacturer's operating notes supplied with the machine contain important information concerning load handling capacities of cranes.
- Mistakes in calculating capacity can cause accidents.
- Several factors to be considered when calculating a cranes load capacity, including the following:
  - Load Radius: the horizontal distance between the center of the crane rotation to center of the load.
  - Boom length: including the jib, swing away extension or any other attachments that may increase length of the boom.
  - Quadrant of operation: the area of operation that the lift is being made in; note different quadrants usually have lower lifting capacities.

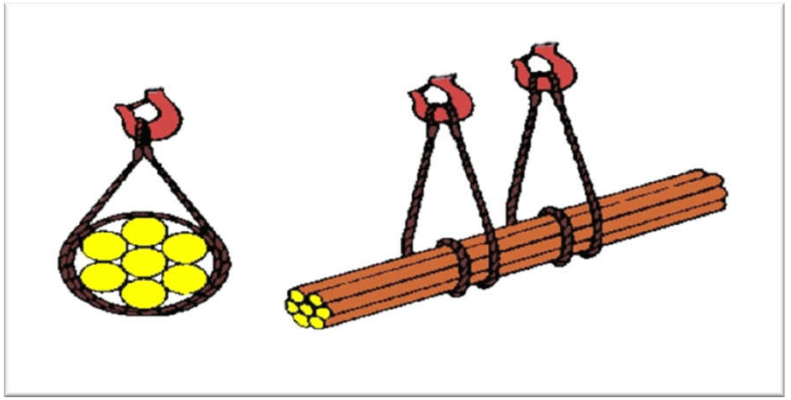
Crane Operating Capacity (2)

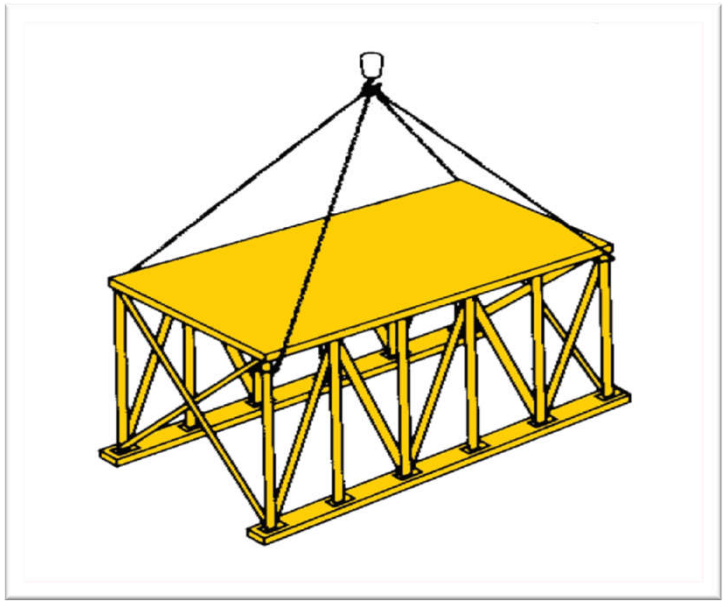
- Boom angle: the angle formed between the horizontal plane of rotation and center line of the boom.
- Weight of any attachments: jib, lattice extension or auxiliary boom point.
- Weight of handling devices: ball, block, and/or any necessary rigging.



Sling Capacity

- Load bearing material
  - Alloy chain
  - Wire rope
  - Synthetic
  - Metal mesh
- Upper and Lower End Attachments





Alloy Chain Slings

Advantages

- Flexible
- Impact resistant
- Easy to inspect
- Can be used at relatively high temperatures
- Completely repairable
- Minimum elongation
- Corrosion resistant
- Durable

Disadvantages

- Heavy
- Moderate initial cost

Reduction of Working Load Limit

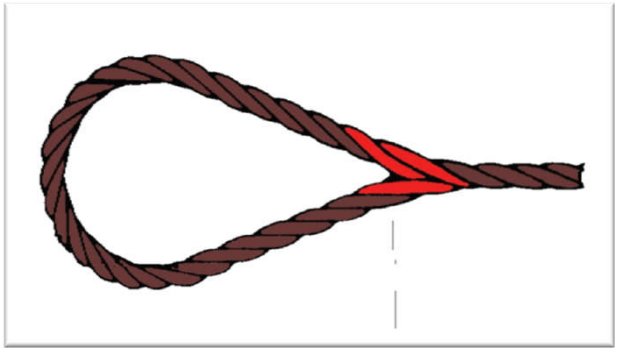
- Chains should not be used outside of the -40 °C to 204 °C temperature range without consulting the chain manufacturer.

Temperature		Grade Of Chain			
		Grade 80		Grade 100	
°F	°C	While At Temperature	After Exposure	While At Temperature	After Exposure
<400	<204	None	None	None	None
400	204	10%	None	15%	None
500	260	15%	None	25%	5%
600	316	20%	5%	30%	15%
700	371	30%	10%	40%	20%
800	427	40%	15%	50%	25%
900	482	50%	20%	60%	30%
1,000	538	60%	25%	70%	35%
>1,000	>538	OSHA 1910.184 requires all slings exposed to temperatures over 1000° F to be removed from service			

Wire Rope Slings

Advantages

- Low initial cost
- Lighter weight than alloy chain



Hand Tucked Splice

Mechanical splice

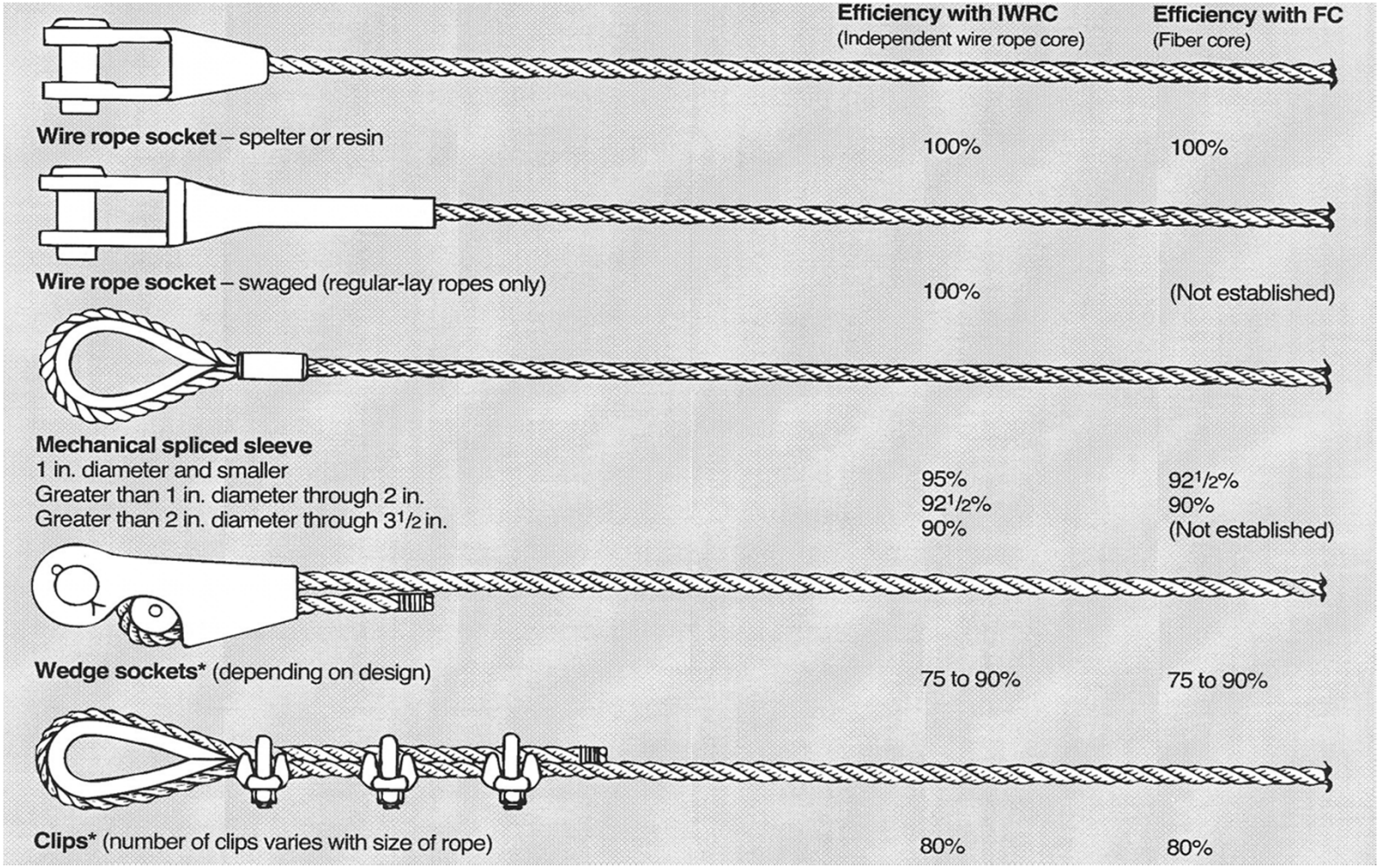
Disadvantages

- Low strength to weight ratio
- Difficult to inspect
- Easily kinked
- Internal corrosion
- Not repairable

Wire Rope Slings

Mechanical Splice Slings – Single Part Body – IPS – 6 x 19 IWRC RATED CAPACITY (lbs.)					
			Basket Hitch – Sling Angle		
Size (in.)	Vertical	Choker	90°	60°	45°
1 / 4	1,120	820	2,200	1,940	1,580
3 / 8	2,400	1,840	4,800	4,200	3,400
1 / 2	4,400	3,200	8,800	7,600	6,200
5 / 8	6,800	5,000	13,600	11,800	9,600
3 / 4	9,800	7,200	19,600	17,000	13,800
7 / 8	13,200	9,600	26,000	22,000	18,600
1	17,000	12,600	34,000	30,000	24,000
1 – 1 / 8	20,000	15,800	40,000	34,000	28,000
			D / d ratio is 20 or greater		

Wire Rope Slings



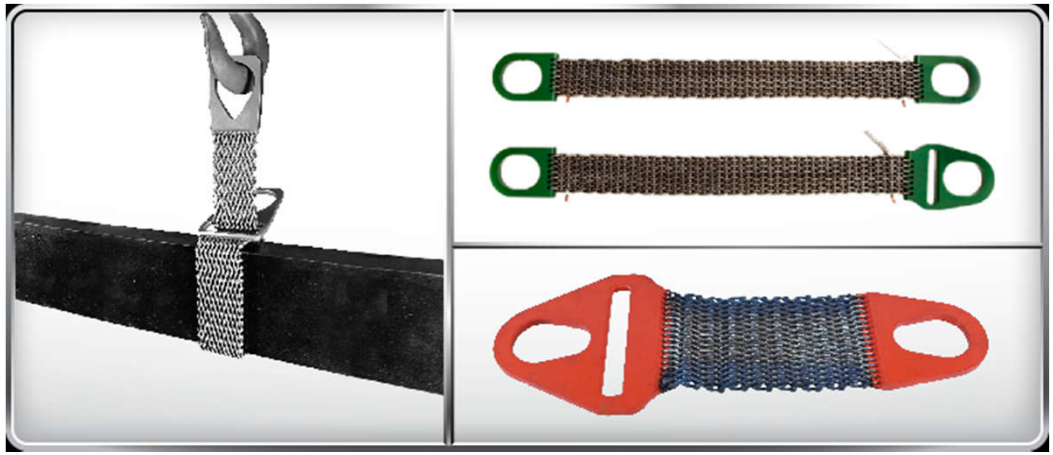
Metal Mesh Slings

Advantages

- Flexibility
- Wide bearing surface
- Resists abrasion and cutting
- Resists corrosion

Disadvantages

- Subject to crushing
- Any broken wire is cause for removal from service



Synthetic Slings

Advantages

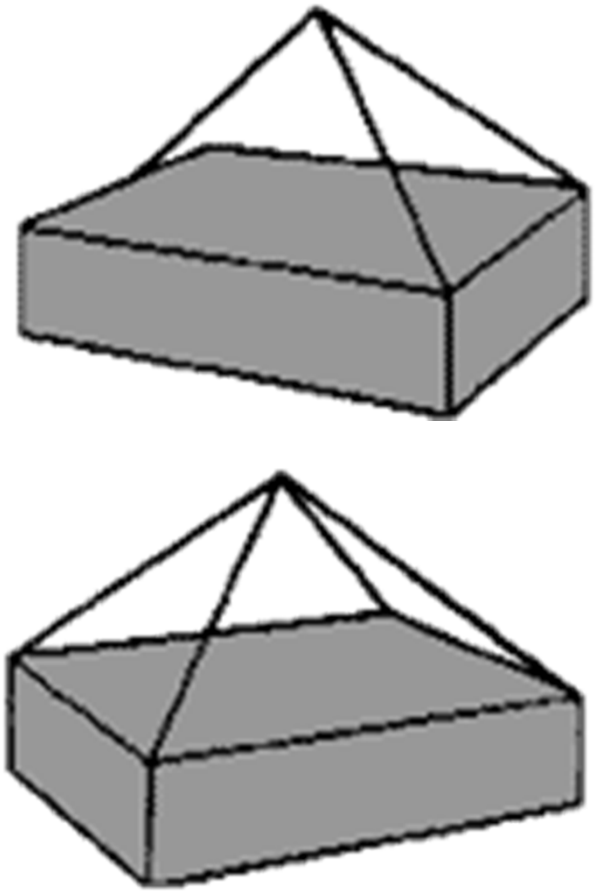
- Light weight
- Easy to rig
- Low initial cost
- Reduced load damage

Disadvantages

- Low heat resistance
- Subject to cuts and abrasion
- Subject to chemicals and UV
- Cannot be repaired

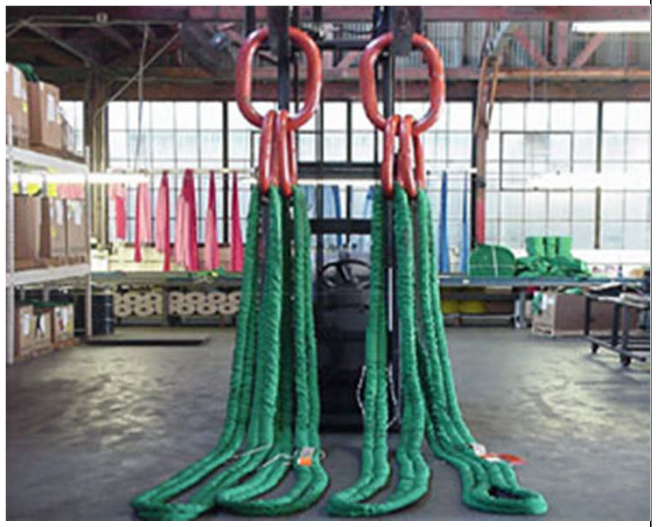
Number of Attachment Points

- Double leg slings share the load equally,
- Triple leg slings have 50% more capacity than double leg slings,
- Quad leg slings rely on the fourth leg for stability only, not additional lift capacity.



Polyester Round Slings

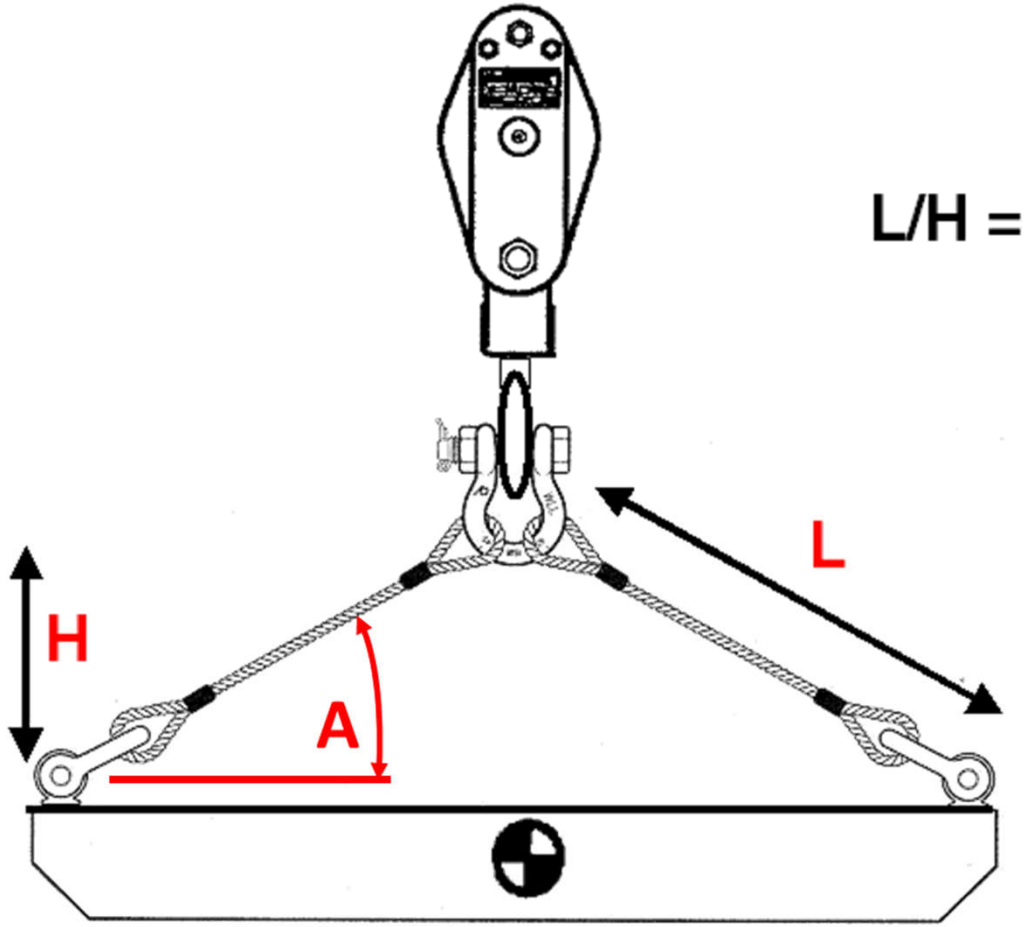
Width (In.)	Color	Rated Capacity (Lbs.)		
		Vertical	Choker	Basket
2	Purple	3,000	2,400	6,000
	Black	4,500	3,600	9,000
	Green	6,000	4,800	12,000
	Yellow	9,000	7,200	18,000
3	Gray	12,000	9,600	24,000
	Red	14,000	11,200	28,000
	Brown	17,000	13,600	34,000
	Blue	22,000	17,600	44,000
4	Orange	26,000	20,800	52,000
		32,000	25,600	64,000
5		50,000	40,000	100,000
		60,000	48,000	120,000



Operating Limitations

- Crane Capacity Charts
  - Mobile Crane
    - Boom angle
    - Boom extension
  - Overhead Crane
  - Static versus Dynamic loads
- Slings and Hardware
  - Vertical capacity
  - Basket capacity
  - Choker capacity
  - Bridle capacity

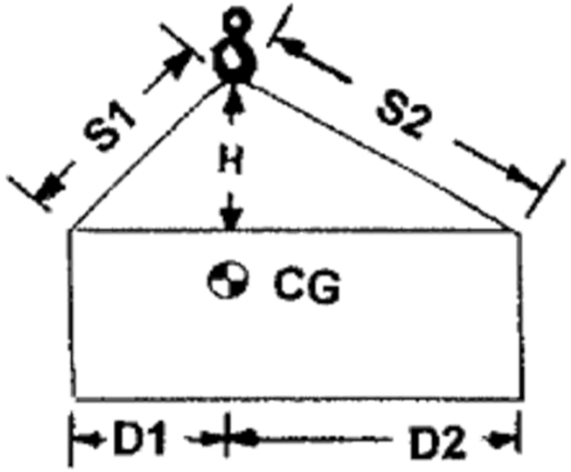
Sling Angle Factor (1)



L/H = LOAD MULTIPLIER

SLING ANGLE CHART	
Angle from Horizontal [A]	S.A.F. [L ÷ H]
90°	1.000
60°	1.155
45°	1.415
30°	2.000

Sling Angle – Unequal Legs



LOAD ON SLING CALCULATED
TENSION 1 = LOAD X D2 X S1/(H(D1+D2))
TENSION 2 = LOAD X D1 X S2/(H(D1+D2))

Sling 1

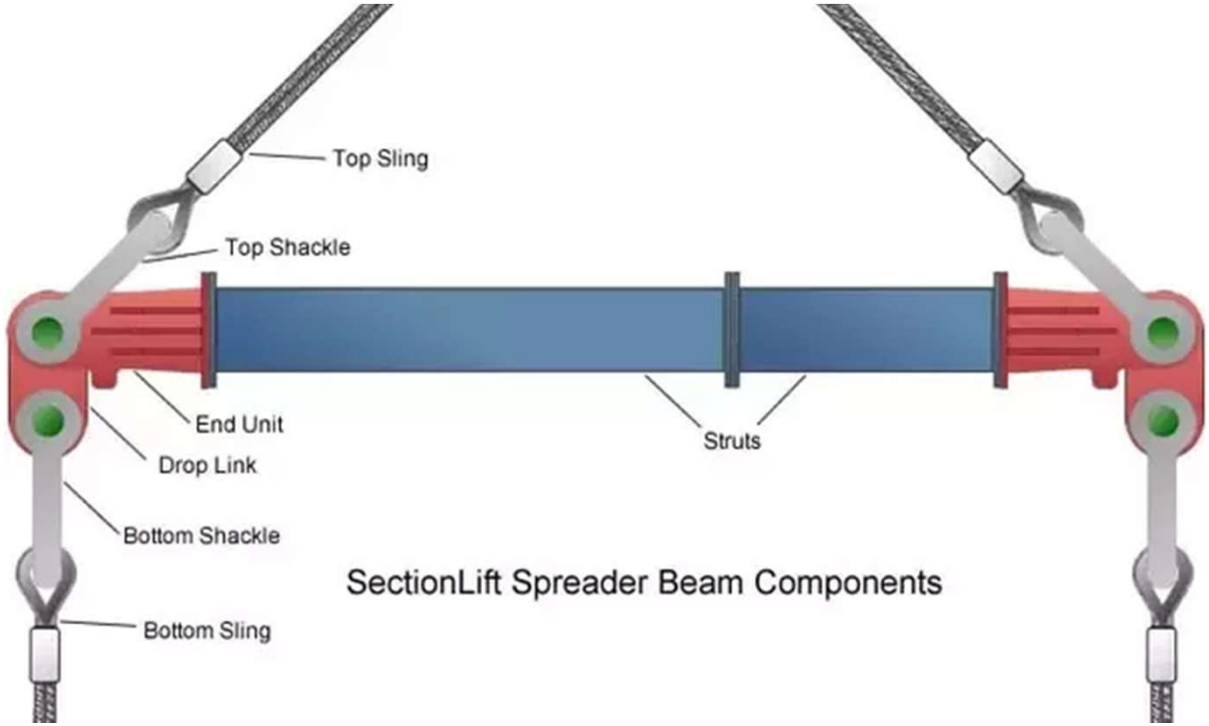
- Tension = Load x D2 x S1/(H(D1 + D2))
- Tension = 1,000 x 7 x 5/(4(3+7))
- Tension = 1,000 x 7 x 5/40
- Tension = 1,000 x 7 x 0.125
- Tension = 875#

Sling 2

- Tension = Load x D1 x S2/(H(D1 + D2))
- Tension = 1,000 x 3 x 8/(4(3+7))
- Tension = 1,000 x 3 x 8/40
- Tension = 1,000 x 3 x 0.2
- Tension = 600#

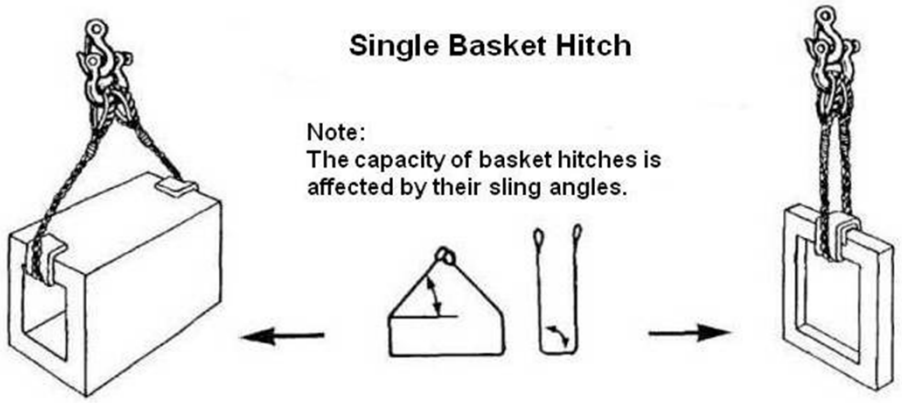
Sling Angle – Spreader Beam

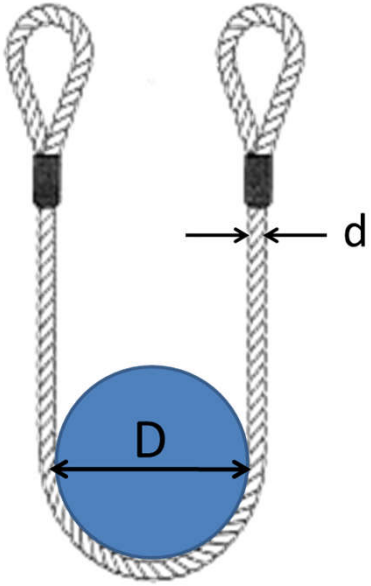
- Distributes load evenly without excessive sling angles
- Requires greater headroom clearance

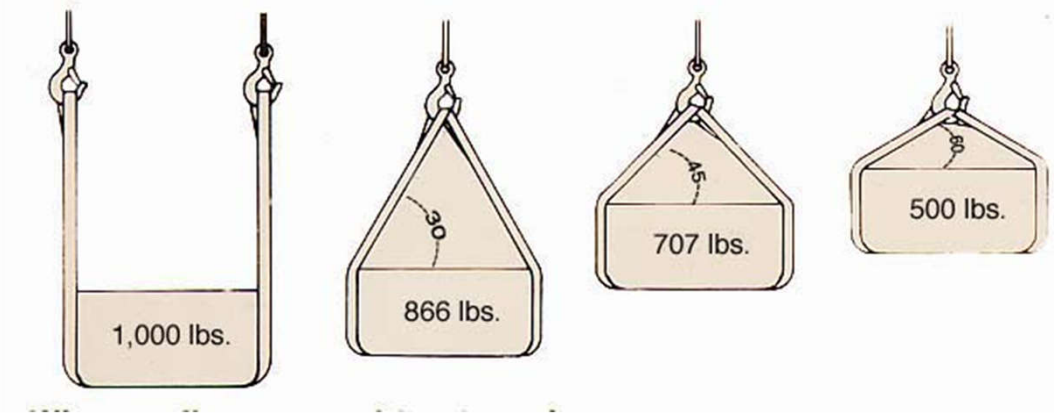


Vertical Basket Hitch

- Two times the single leg capacity
- Legs must be vertical to within 5 degrees
- D/d must be greater than 20/1

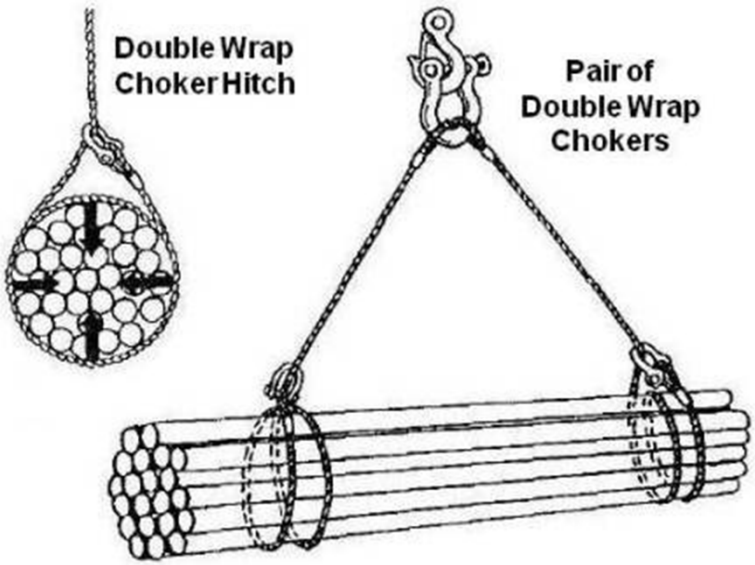


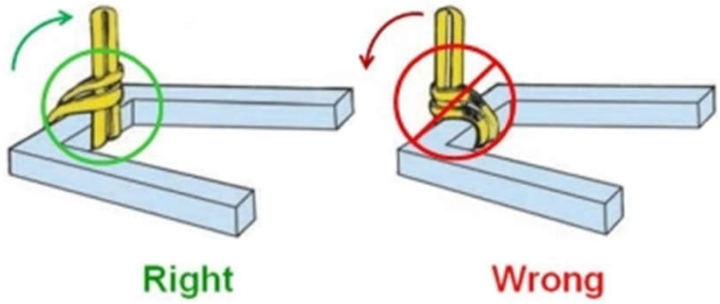




Double Wrap Basket Hitch

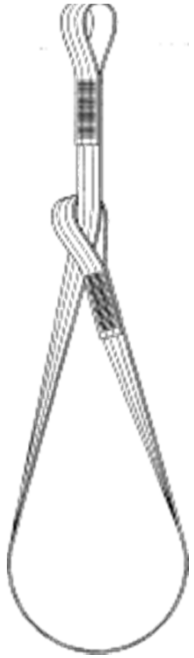
- Excellent load control for loose materials and good grip on smooth surfaces.
- Twice the single leg capacity.
- Sling wrap must be lay side by side
- Do not overlap at bottom of load
- Adjust sling as slack is taken up

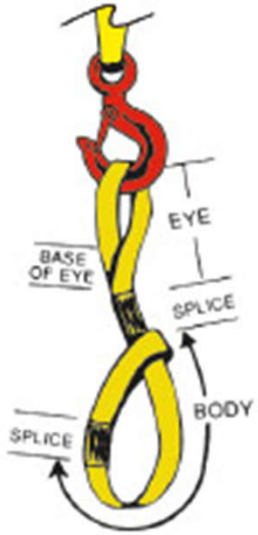




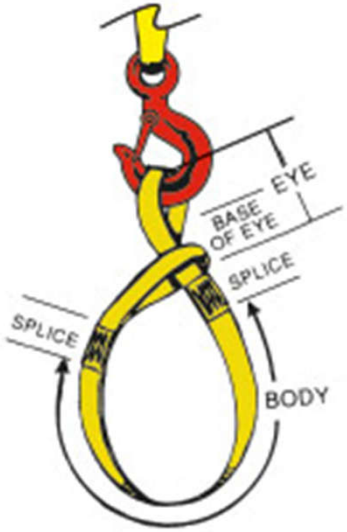
Choker Hitch

- 75-80% of single leg capacity
- Angle of choke must be greater than 120 degrees

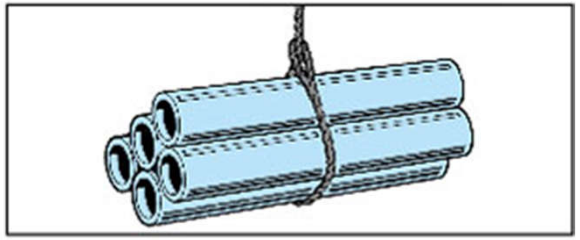




Right

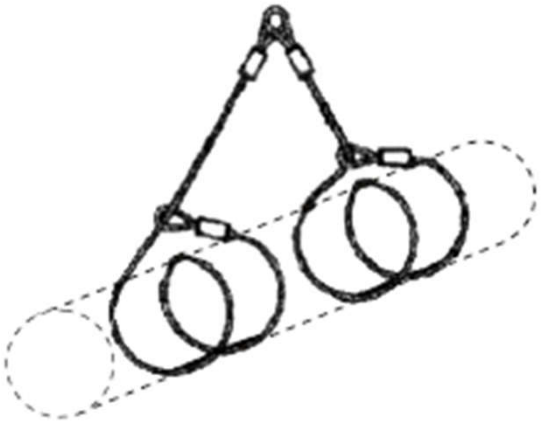


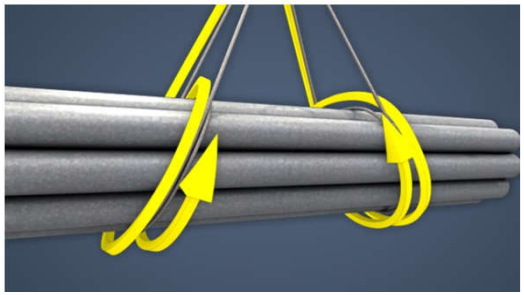
Wrong

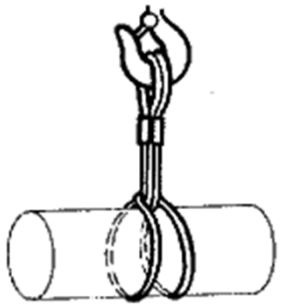


Double Wrap Choker Hitches

- Excellent load control for loose materials and grip on smooth surfaces
- 75-80% of single leg capacity
- Angle of choke must be greater than 120 degrees
- Sling wrap must lay side by side
- Do not overlap at bottom of load

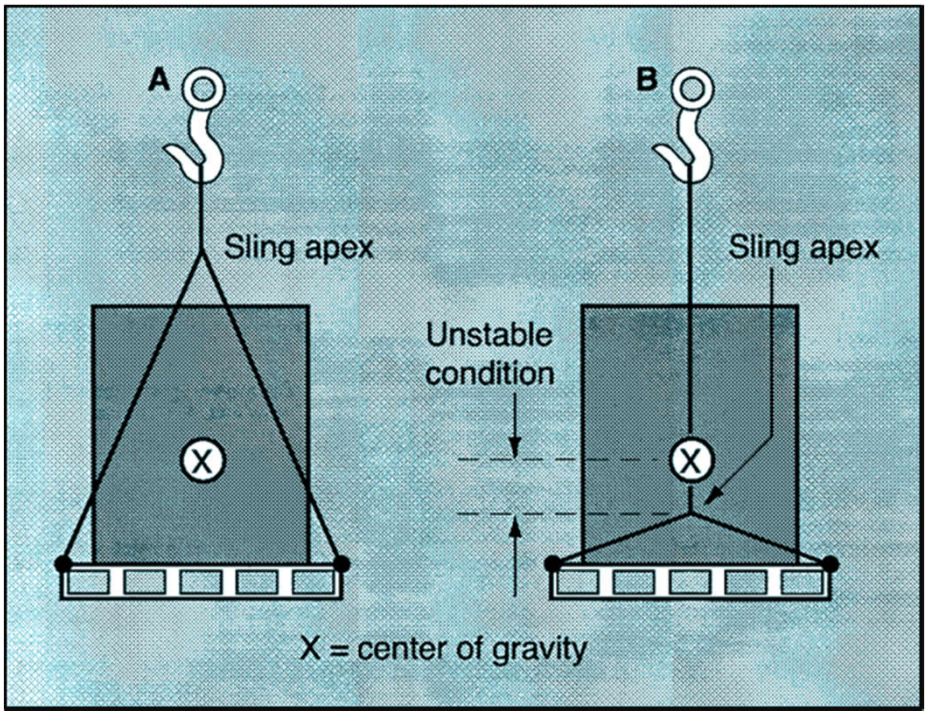




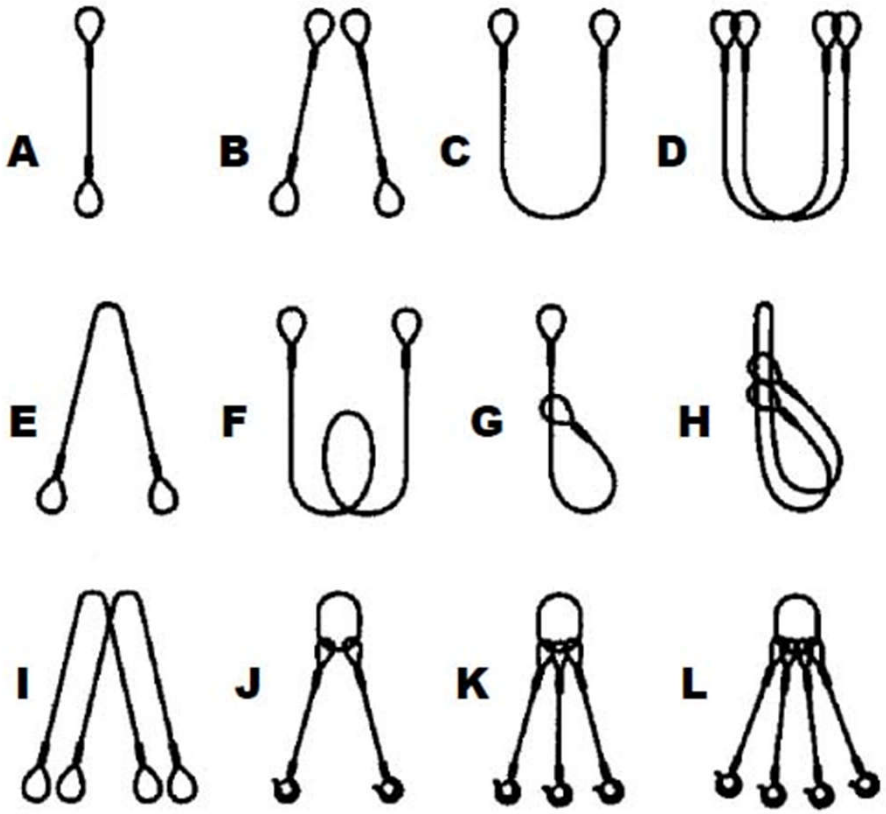


Load Stability

- Capture the Center-of-Gravity
- When suspended an object will always center itself under the lift point
- Center the lift above the center of gravity, not the physical center of the object
- Calculating the C.G.



Summary



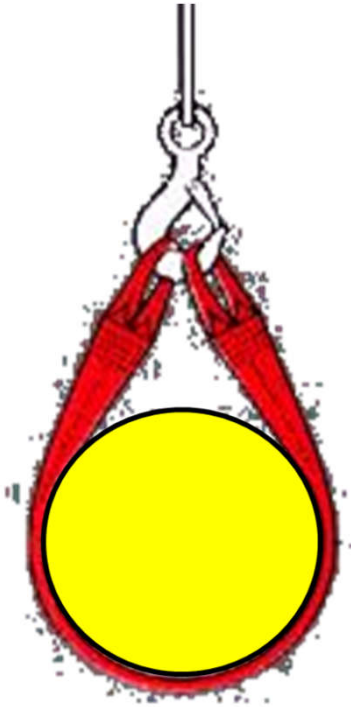
A. Vertical Hitch
B. Two Leg Vertical Hitch
C. Basket Hitch
D. Double Basket Hitch
E. Inverted Basket Hitch
F. Double Wrap Basket Hitch
G. Choker Hitch
H. Double Wrap Choker Hitch
I. Double Inverted Basket Hitch
J. Two Leg Bridle
K. Three Leg Bridle
L. Four Leg Bridle

PhD engineer Mariusz Hetmanczyk

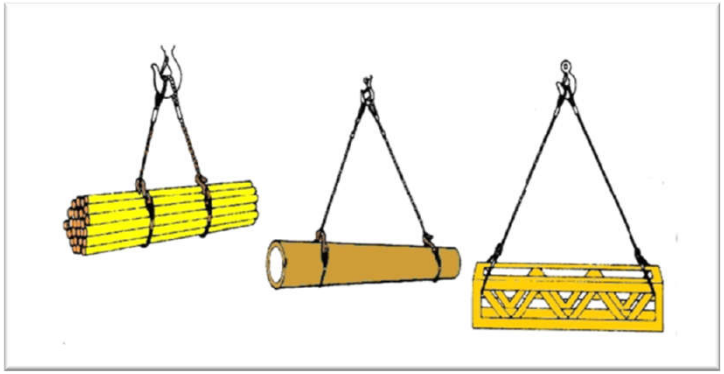
Sling Hitches

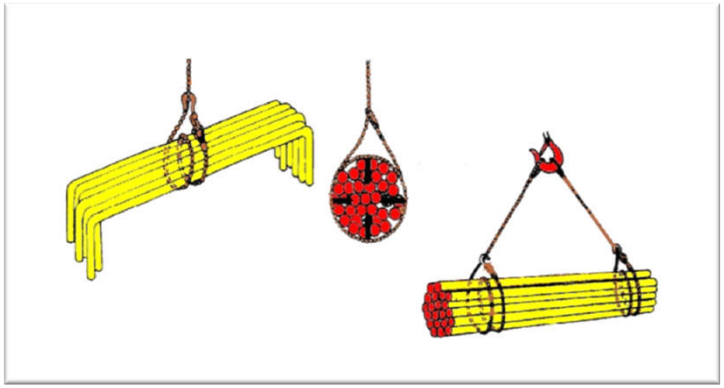
Vertical

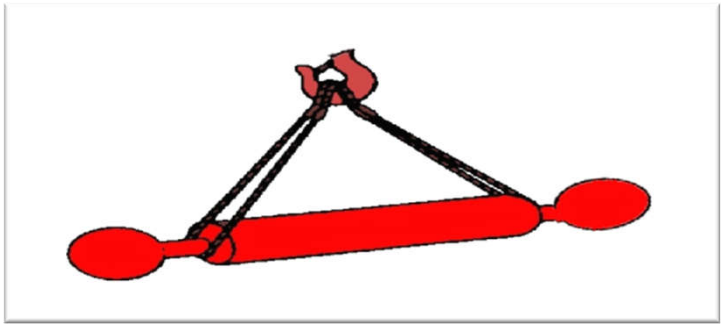
Choker

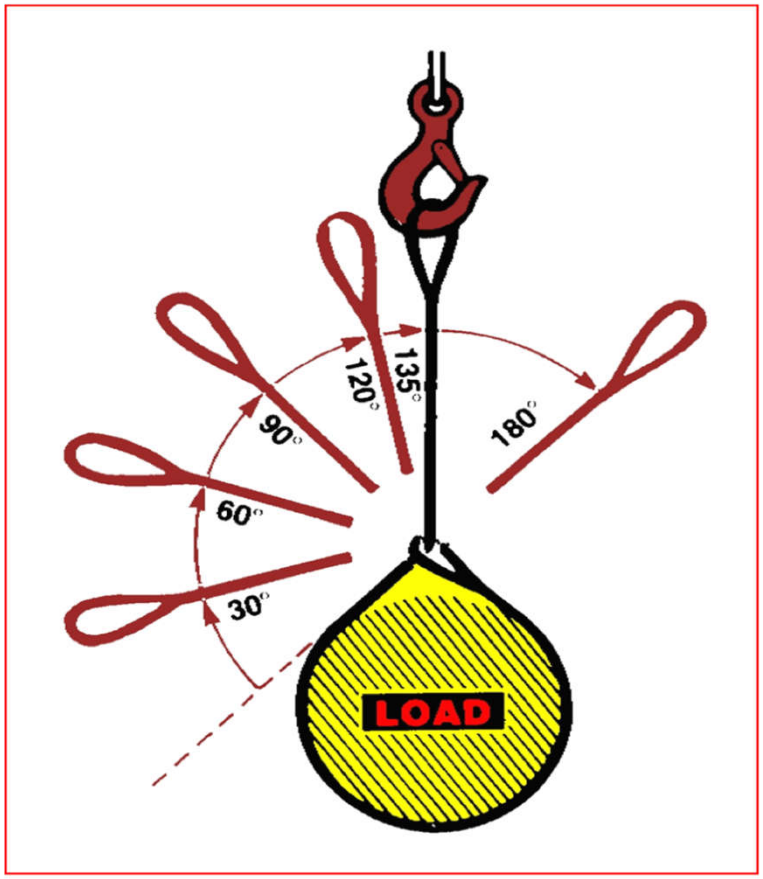


Basket

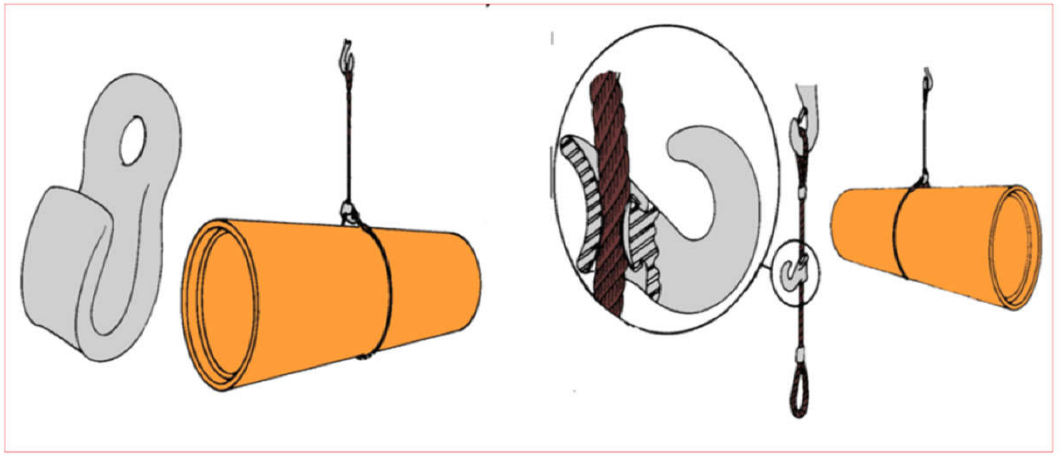




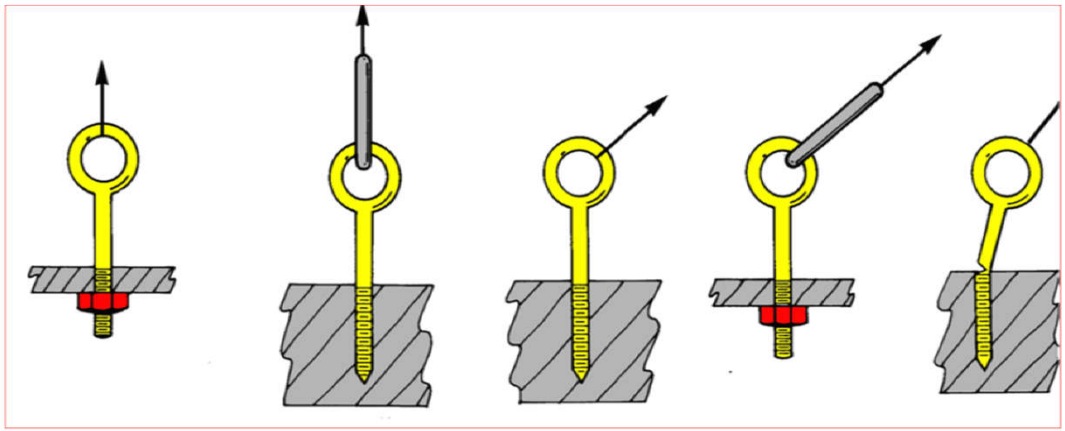




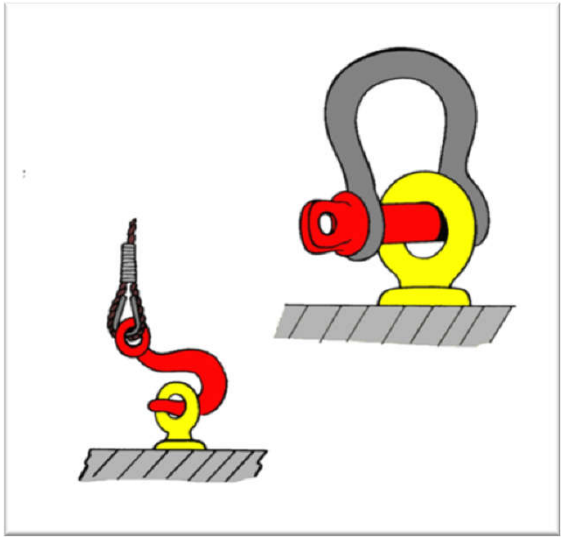
Choker Angles



Choker Hooks

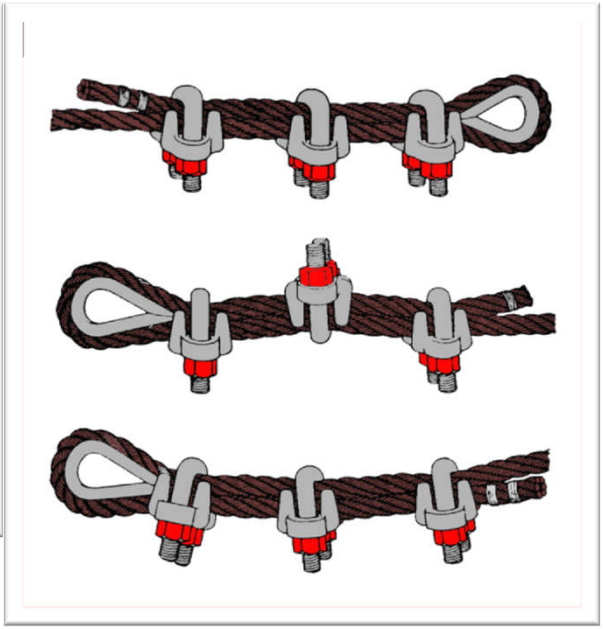


Eye Bolts

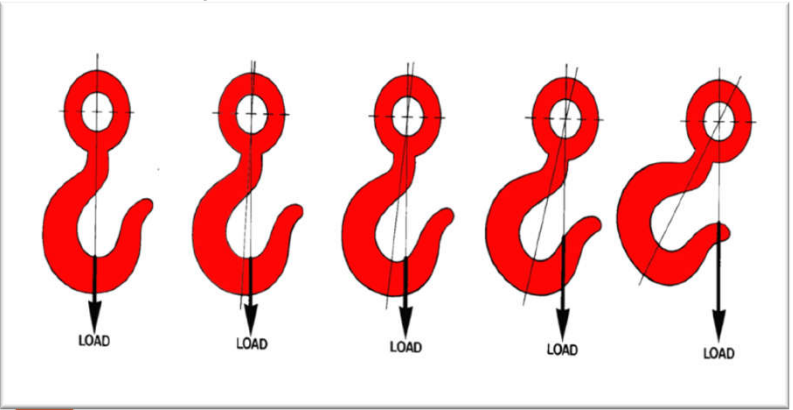


Eye Bolts

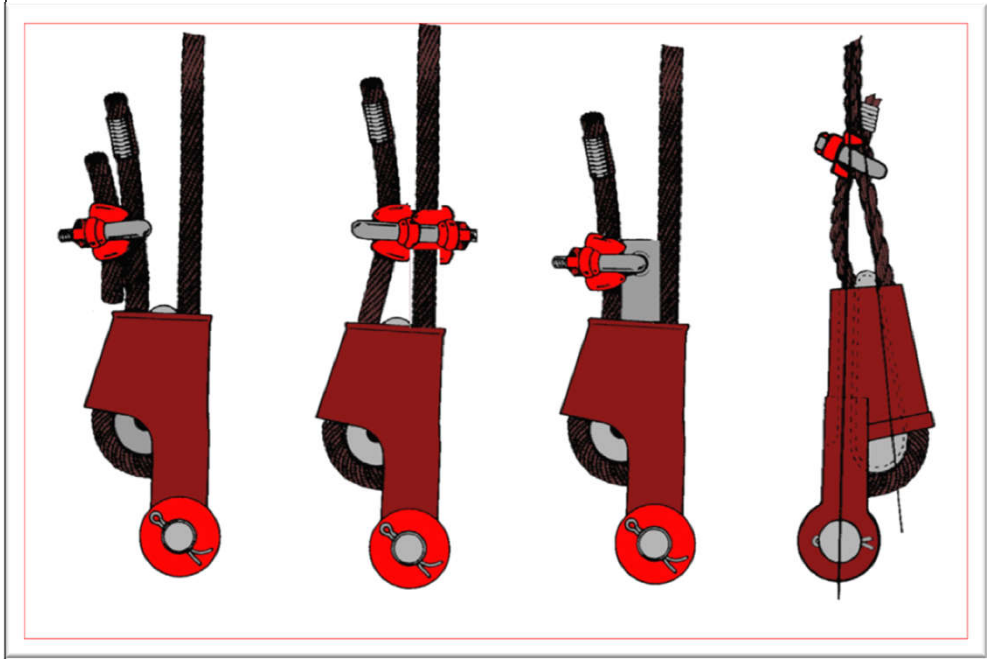
Shackle Types



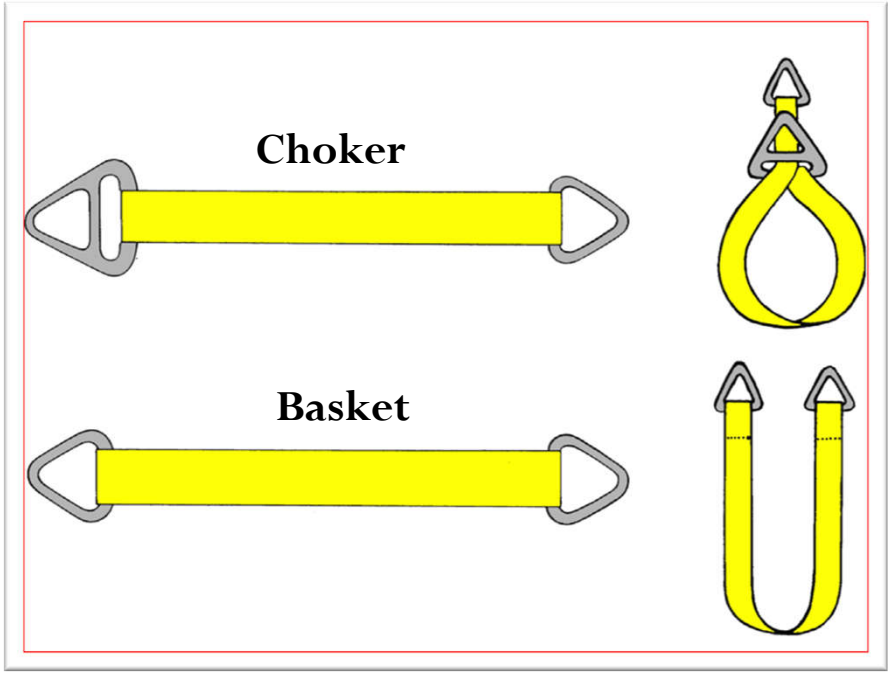
Cable Clips



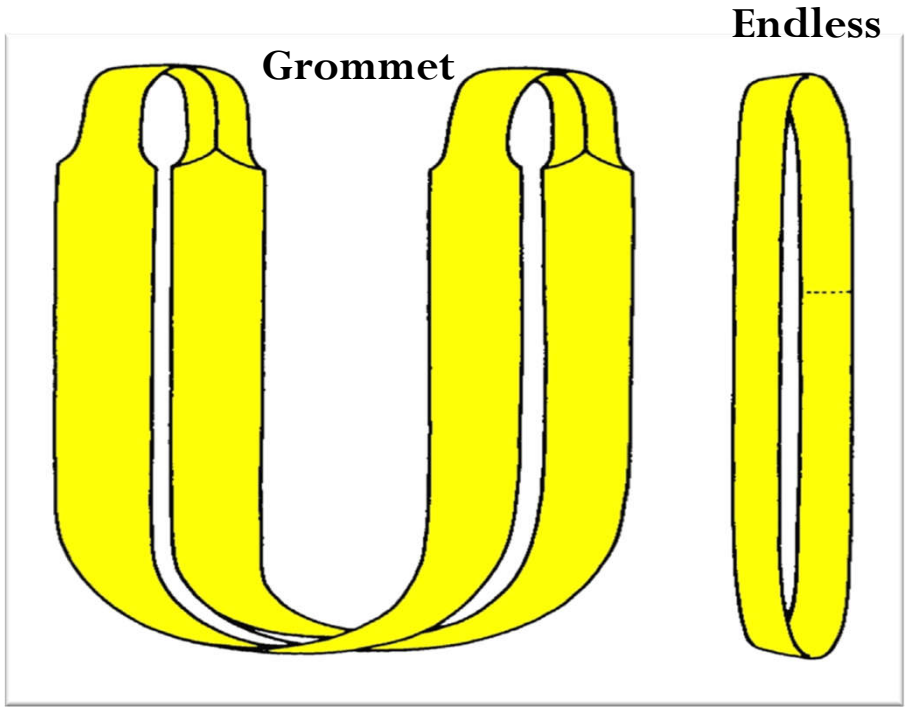
Hook Capacities



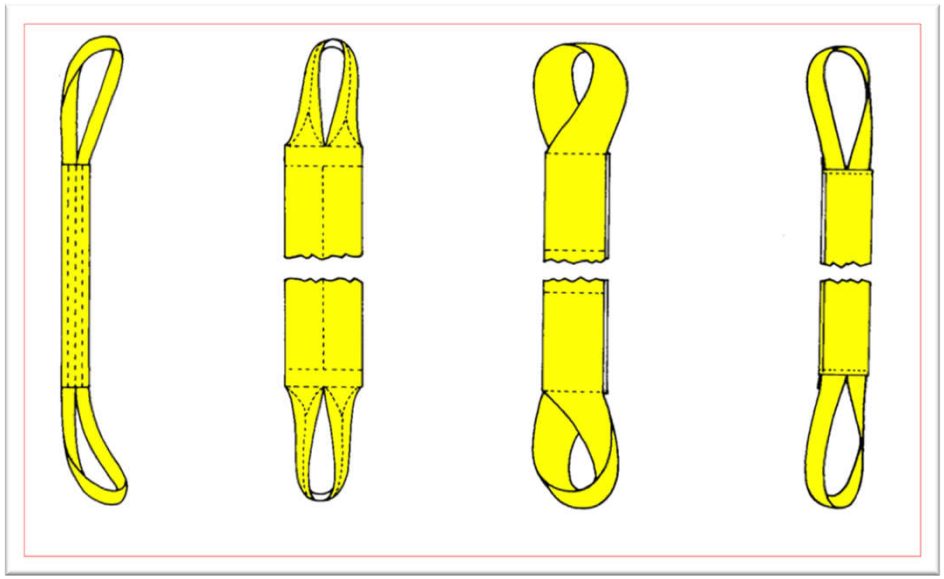
Wedge Sockets



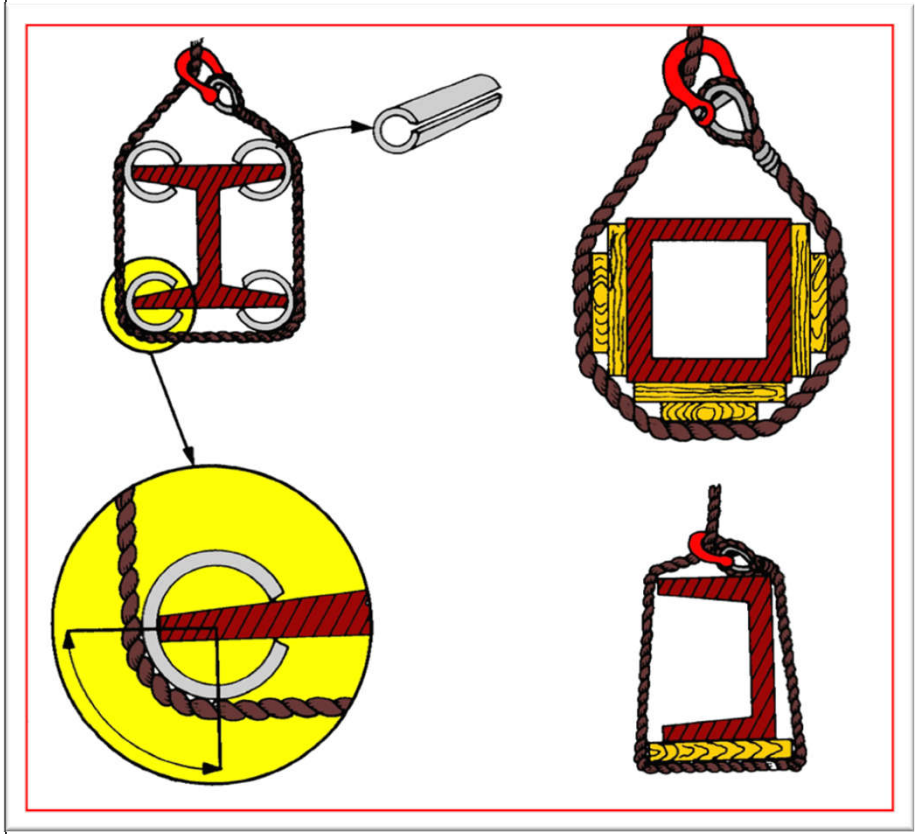
Synthetic Web Metal End Slings



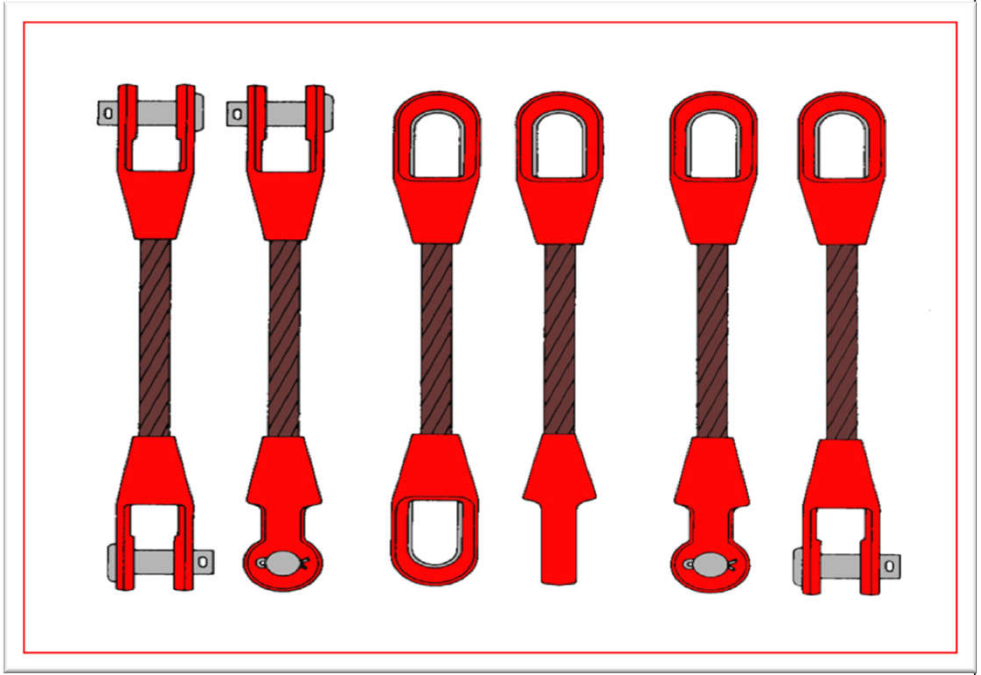
Synthetic Web Slings



Synthetic Web Slings



Softeners



Swaged Splice