TRENCH RESCUE TECHNICIAN

N.F.P.A 1006
LEVEL II QUALIFICATION

Load Stabilization
&
Heavy Lifting Systems

OBJECTIVES

- Correctly Identify, Describe, And Demonstrate:
  - The Setup, Operation & Function Of Load Stabilization Systems.
- Discuss, Demonstrate, and Safely Operate Pneumatic Lifting Systems
  - Identify limitations, capacity, and maintenance of pneumatic lifting systems

OBJECTIVES

- Discuss, Demonstrate, identify limitation, and construction various wood cribbing systems.
- Create a stabilization and lifting system for various capabilities.

HIGH-PRESSURE AIR BAGS.

- Outer Shell Is Constructed Of Neoprene / Butyl Rubber.
- The Interior Is Reinforced Steel / Kevlar™.
- Rated Capacity Is Calculated At 1of Lift.
- When Raised To Maximum Height The Usable Capacity Is Reduced To 50% Of The Rated Capacity.
- Identification Label For The Rated Capacity Of The Bag.

HIGH-PRESSURE AIR BAGS

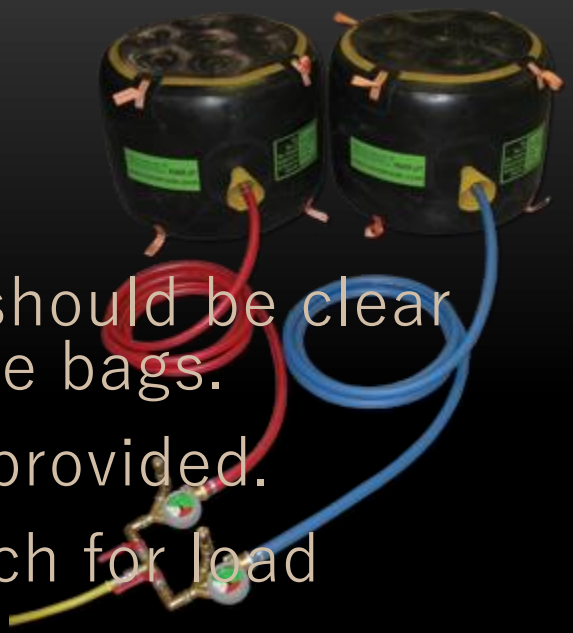
- Are used for lifting and filling in small voids.
- *They should be centered directly under the load.*
- *The higher any bag lifts, the more unstable the lifted object may become.*
- Lifting operation must be closely monitored and halted if there is any indication of instability.
- *No more than two bags should be stacked on top of each other.*

HIGH-PRESSURE AIR BAGS

- *Maximum lifting capacity of the stacked bags is based on the rated capacity of the smallest bag, which should be placed on top of the stack.*
- Make sure the smallest bag has the capacity to lift the load.
- *When using two bags side by side or at two points on a load, the maximum load capacity is based on adding the rated capacity of both bags together.*
- Consider lift height as well as load weight when choosing an air bag.

LOW-PRESSURE AIR BAG

- Used primarily in trench rescue operations for filling voids.
- Can be used for some lifting operations.
- Have a higher lifting range than high pressure bags but cannot lift as much weight.
- The operating pressure ranges from 7-12 psi.
- Low-pressure bag rated for 16 tons can take as much as 250 cubit feet of air to affect a lift.



- The working area under the bags should be clear of any debris that may puncture the bags.
- A solid bearing surface should be provided.
- Pressurize the bag slowly and watch for load shift.
- If the load is uncontrolled, stop the lift and reevaluate.
- Use cribbing, shims and wedges to stabilize the load during the lifting operation.
- Establish safety zones around the working area

LIFTING CAPACITY FORMULA

- Measure the surface area of the object to be lifted and multiply them together, plus calculate the weight of the object.
  - Example: 6”x 6” surface area = 36 square inches of contact surface and the object weighs 6000 pounds.
- Multiple 36 x 120 psi (average operating pressure for high pressure bags) = 4,320 pounds.
- Based on the above formula 4,320 pounds is the maximum amount of weight the contact area can support.
- Based on the above formula can the bag chosen lift the object?

Setup Procedures For High And Low Pressure Bags

CRIBBING FOR LOAD STABILIZATION.

- Preferred wood is Douglas Fir or Southern Pine.
  - This wood tends to crush slowly.
  - provide advanced warning of failure by creaking and cracking.
- Height of cribbing when stabilizing collapsed structures can be up to 3 times of the length of the cribbing piece, based on load resting on all contact points of each crib box.
- When used to stabilize loads to be moved, cribbing height should be no more than 2 times the width.
- ***With the load resting on two contact points of each crib box, keep the height to width ratio to 1 ½:1.***

CRIBBING FOR LOAD STABILIZATION.

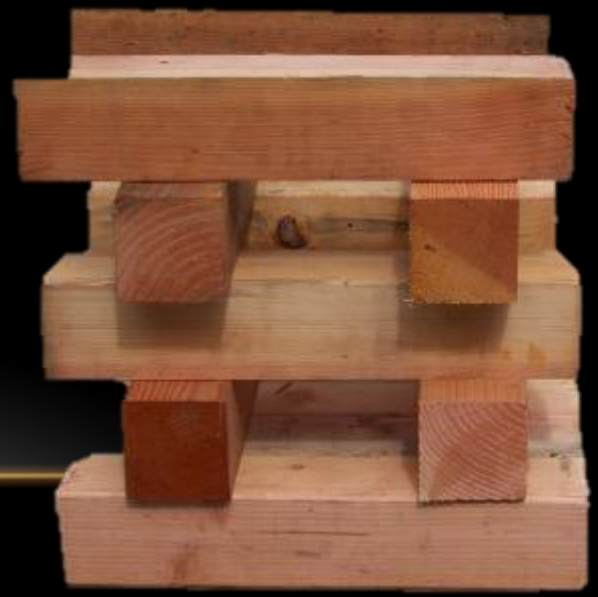
- *With the load resting on one contact point of each crib box, keep the height to width ratio to 1:1.*
- Overlap the corners by at least the width of the cribbing to ensure slow crushing failure.
- To provide lateral resistance in addition to friction, cribbing should be notched to minimize slippage.
- Heavily loaded cribbing can crush so that it will lose from 10% to 20% of height.
- The load capacity is determined by the number of contact points between the load and each box crib.

FORMULA TO DETERMINE LOAD CAPACITIES (4”X4”)

- Cribbing strength is determined by figuring the surface area at each point of contact and multiplying by the wood strength.
- 500psi for Douglas fir, lower for softer woods.
- The nominal dimension of a 4 X 4”timber is actually 3.5”.
- 3.5 X 3.5 = 12.25 X 500 psi = 6,125 pounds.
- Round off to ***6000 pounds per contact point***.

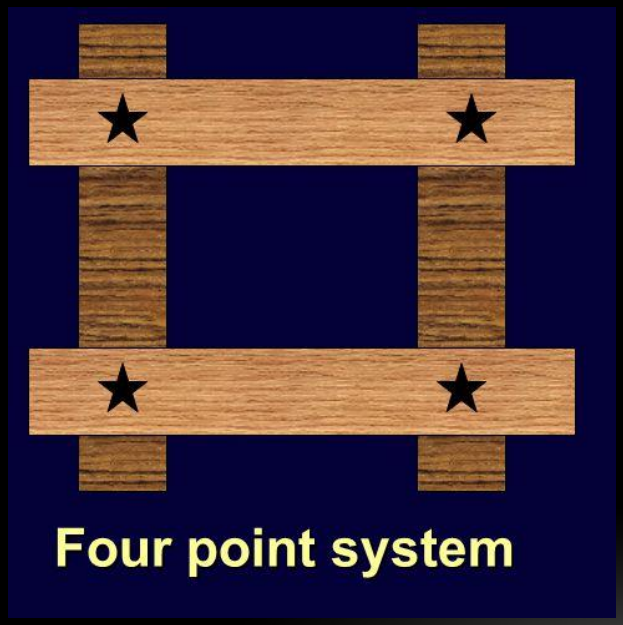
FORMULA TO DETERMINE LOAD CAPACITIES (6"X 6")

- The nominal dimension of a 6 X 6 timber is actually 5.5.
- 5.5 X 5.5 = 30.25 X 500 psi =15,125 pounds.
- Round off to ***15,000 pounds per contact point***.



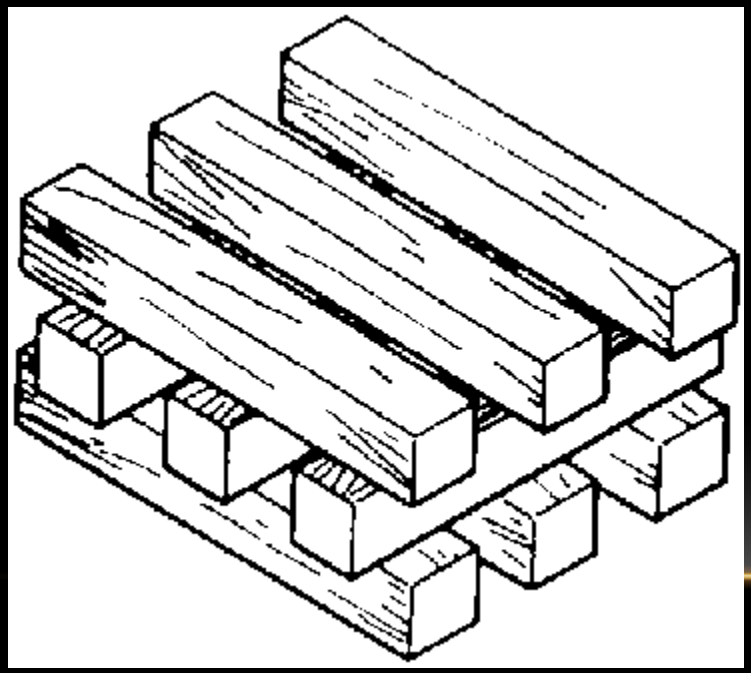
BOX CRIB 2X2

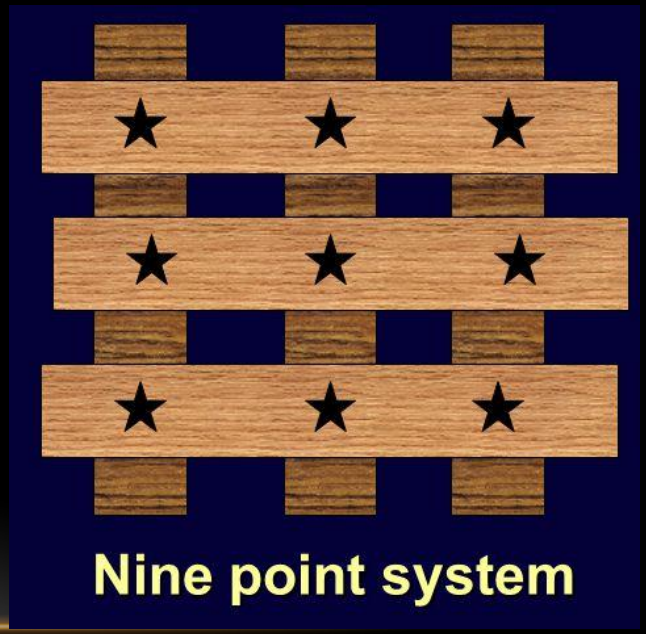
(4x4) 4 contact points X 6000 pounds = 24,000 pounds.
(6x6) 4 contact points X 15000 pounds = 60,000 pounds.



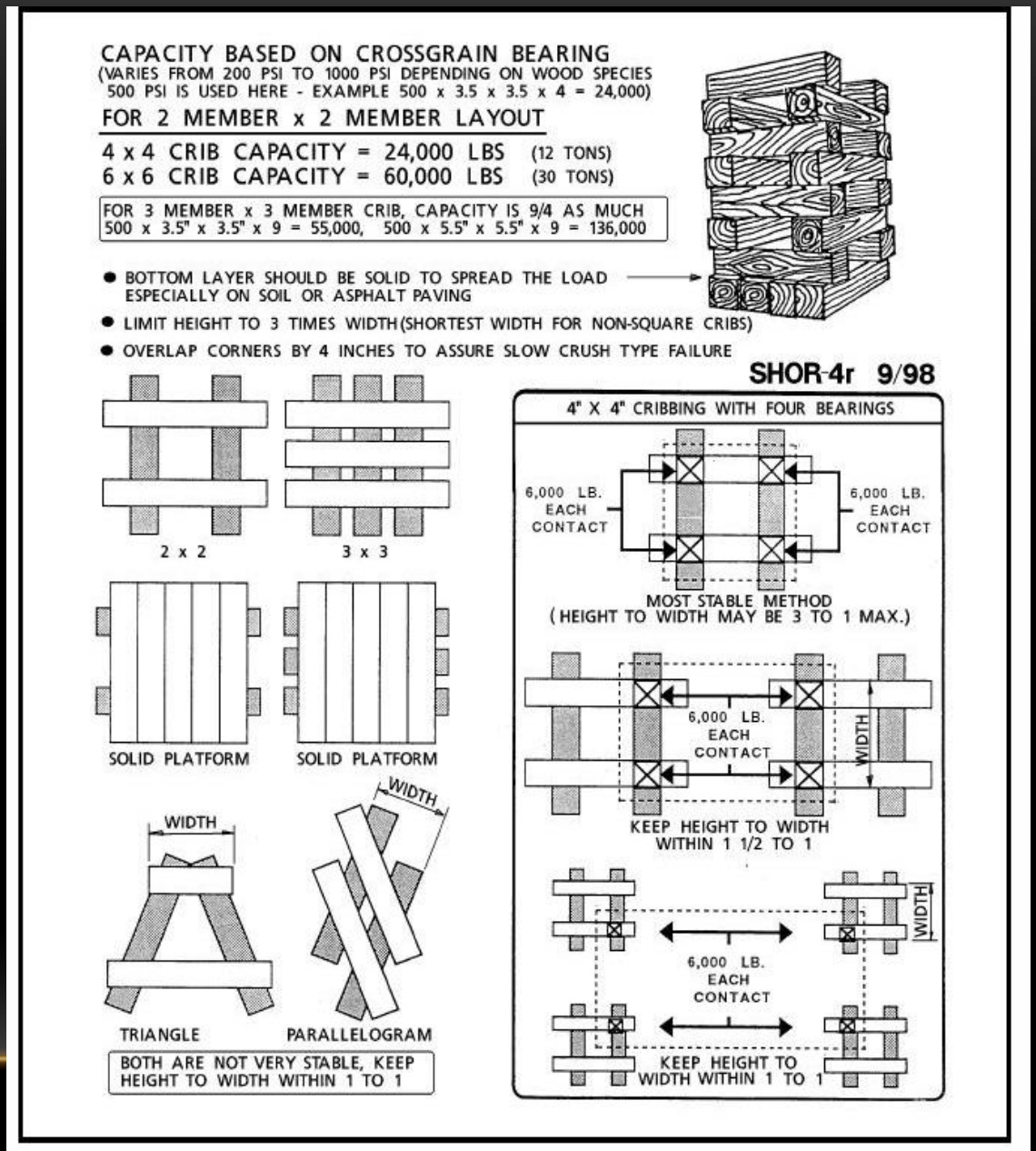
3 X 3 BOX CRIB

- (4x4) 9 contact points X 6000 pounds =54,000 lbs.
- (6x6) 9 contact points X 15000 pounds =135,000 lbs.





USAR FOG


CAPACITY BASED ON CROSSGRAIN BEARING
(VARIES FROM 200 PSI TO 1000 PSI DEPENDING ON WOOD SPECIES
500 PSI IS USED HERE - EXAMPLE 500 x 3.5 x 3.5 x 4 = 24,000)
FOR 2 MEMBER x 2 MEMBER LAYOUT
4 x 4 CRIB CAPACITY = 24,000 LBS (12 TONS)
6 x 6 CRIB CAPACITY = 60,000 LBS (30 TONS)
FOR 3 MEMBER x 3 MEMBER CRIB, CAPACITY IS 9/4 AS MUCH
500 x 3.5" x 3.5" x 9 = 55,000, 500 x 5.5" x 5.5" x 9 = 136,000
BOTTOM LAYER SHOULD BE SOLID TO SPREAD THE LOAD ESPECIALLY ON SOIL OR ASPHALT PAVING
LIMIT HEIGHT TO 3 TIMES WIDTH (SHORTEST WIDTH FOR NON-SQUARE CRIBS)
OVERLAP CORNERS BY 4 INCHES TO ASSURE SLOW CRUSH TYPE FAILURE
SHOR-4r 9/98
2 x 2
3 x 3
SOLID PLATFORM
SOLID PLATFORM
WIDTH
WIDTH
TRIANGLE
PARALLELOGRAM
BOTH ARE NOT VERY STABLE, KEEP HEIGHT TO WIDTH WITHIN 1 TO 1
4" X 4" CRIBBING WITH FOUR BEARINGS
6,000 LB. EACH CONTACT
6,000 LB. EACH CONTACT
MOST STABLE METHOD
(HEIGHT TO WIDTH MAY BE 3 TO 1 MAX.)
6,000 LB. EACH CONTACT
WIDTH
KEEP HEIGHT TO WIDTH WITHIN 1 1/2 TO 1
WIDTH
6,000 LB. EACH CONTACT
KEEP HEIGHT TO WIDTH WITHIN 1 TO 1

CRIBBING TYPES

- Crosstie Crib (3x3 Crib)
- Solid Crib (entire surface area contact).
- Box Crib = 4 contact points
- 6 x 6 timber, X 15,000 pounds = 60,000 pounds.
- 3 x 3 Crib = 9 contact points X 15,000 pounds=
- 135,000 pounds.

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EQUIPMENT (CONT'D.)

Skills/Procedures 5-1 Airbag operation

EQUIPMENT (CONT'D.)

Skills/Procedures 5-2 Low and medium pressure airbag operation in void spaces