

HARDPOINT ASESMENT FOR SUSPENSION BONDAGE

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COURSE GOALS

- Will that hold me?
- Why should you worry?
- How much should you worry?
- Who pays the price of failure?

THINGS TO **AVOID**

- The Two Big Guys Test (TBGT)
- Wire Eye Bolts.
- Long spans with lots of deflection.
- Anything that cannot be explained.
- Anything that makes you nervous.

HOW THINGS FAIL

- Sudden Failure
- Gradual Failure
- Two Big Guys Test

WHAT THE NUMBERS **MEAN**

- Breaking Strength
- Safe Working Load (SWL)
- Tensile Load
- Shear Load

WIRE TURNED EYE BOLTS

- Have very **low** working load limits
- Can only be used in a straight pull
- Load limits are not for dynamic loads
- Can **unscrew** if twisting loads are used.



Eye Bolt Size	SWL
1/4-20	50 lbs
5/16-18	100 lbs
3/8-16	125 lbs
1/2-13	200 lbs

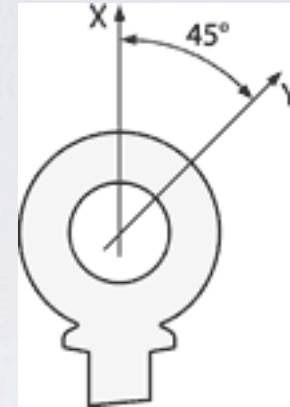
FORGED EYE BOLTS



- Can only be used in a straight pull.
- Can unscrew if twisting loads are used.
- 10 times stronger than a wire eye-bolt.

Eye Bolt Size	SWL
1/4-20	500 lbs
5/16-18	800 lbs
3/8-16	1200 lbs
1/2-13	2200 lbs

MACHINE EYE BOLTS



- Can unscrew if twisting loads are used.
- Can be used at angles up to 45 degrees.
- 45 degree SWL is reduced by 75%

Eye Bolt	SWL	SWL 45
1/4-20	500 lbs	125 lbs
5/16-18	900 lbs	225 lbs
3/8-16	1400 lbs	350 lbs
1/2-13	2400 lbs	600 lbs

BOLT GRADES

- Steel bolt grades are the number of marks plus 2
- Grade 5 and 8 bolts are hardened and more expensive
- Stainless steel bolts are comparable to grade 5 bolts



Grade 2



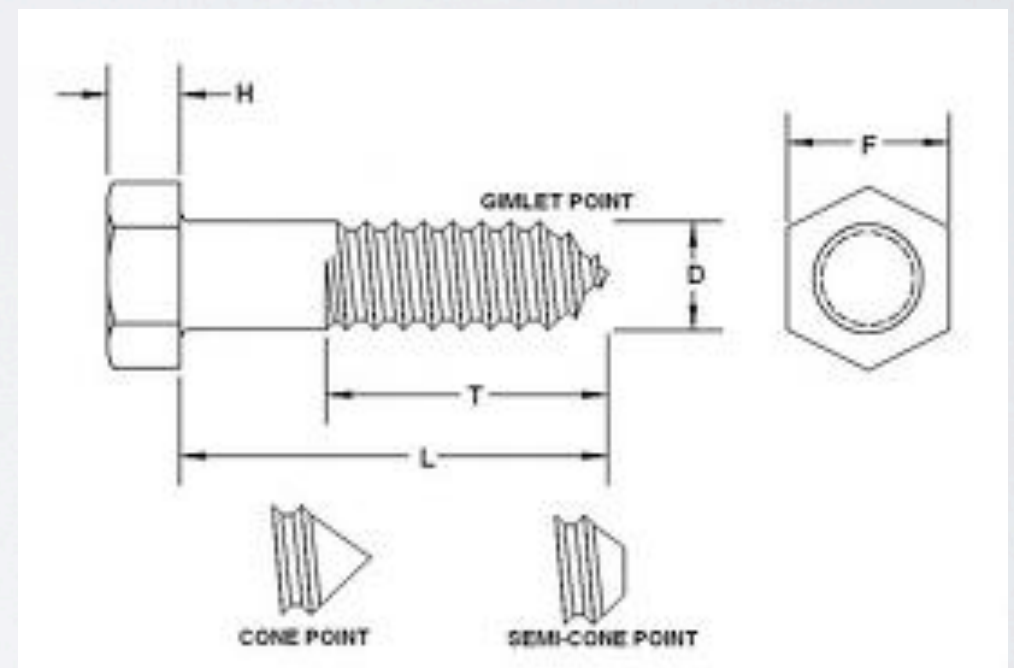
Grade 5



Grade 8

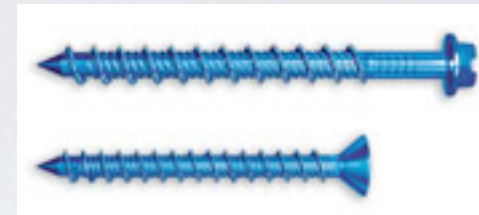
LAG AND CONCRETE FASTENERS

- A **properly** installed lag bolt **should** never pull out of wood.
- A lag bolt 16-20 times its diameter should hold more than its tensile load.



CONCRETE ANCHORS

- A **properly** installed concrete anchor **should** never pull out of concrete.
- Proper concrete anchor installation involves training and certification.
- Concrete anchors fail with no notice.





- The type of concrete construction is very important
- Architects and/or engineers are needed in most cases

1/2 inch Drop In Anchor	Tensile Load
Hi PSI Concrete	4400 lbs
Concrete over Metal Deck	1135 lbs

MOUNTAIN CLIMBING BOLT HANGERS

- Load rating is in all directions
- Load ratings with suspended humans in mind
- Over 20 KN
- Still has twisting load problem



MARINE PAD-EYE

- 3000 lb SWL
- No twisting problem
- SWL calculated with long term hostile environment



CLIMBING SLINGS

- Lightweight and compact
- Will hold well over 20 KN
- Easily cut
- Not for uses without easy inspection



ROUND SLINGS

- Durable
- Designed with long term use in mind
- Low cost
- Variety of sizes
- Typical SWL over 4000 lbs
- Bulky



WOOD STRUCTURES

- Grades of lumber.
- Can you see the wood structure?
- The purpose of the structure.



STRENGTH OF WOOD BEAMS

	3'	4'	6'	8'
2x4	1021	766	510	382
4x4	2382	1786	1190	893
2x6	2521	1891	1260	945
2x8	-	3285	2190	1752
4x6	5882	4411	2941	2352

Assumes Douglas Fir Structural Select, halve numbers for Stud Grade. Assumes beams are on edge. These are long term working loads. Architectural engineering standard is to double these numbers for short term loads < 7 days.



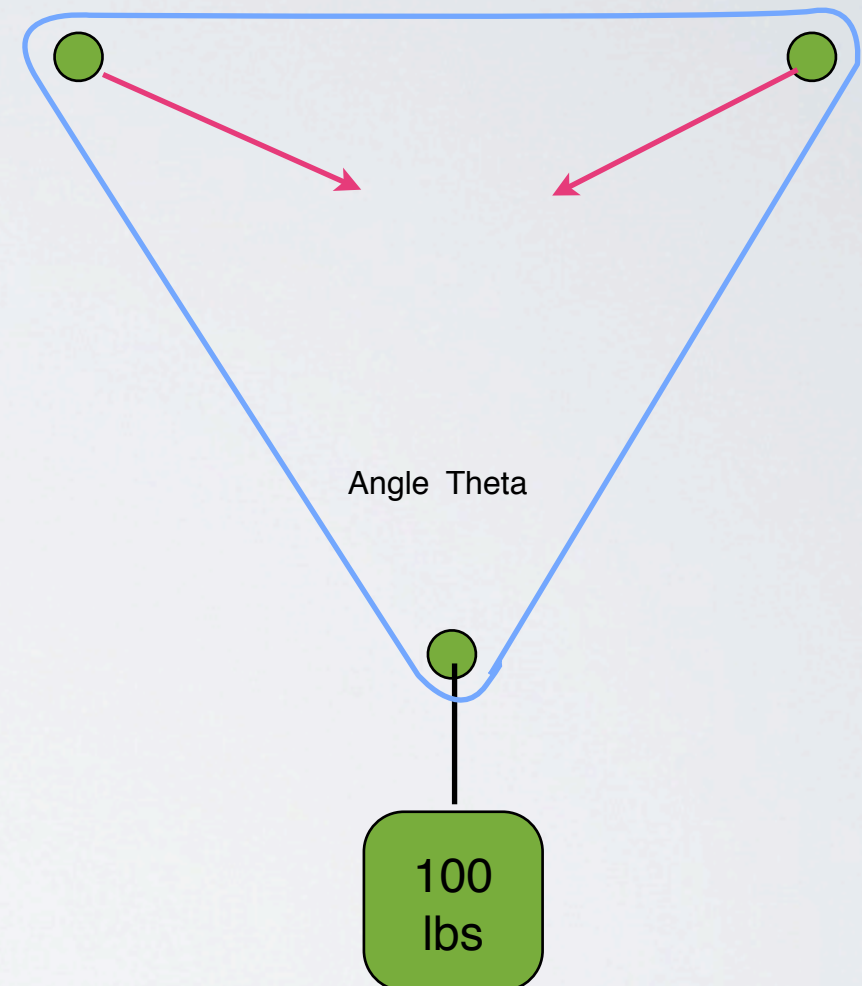
Structural Select



Stud Grade

TRIANGLE OF DEATH

- Wrapping a sling around two hard points actually magnifies the load instead of reducing it.
- The greater the angle Theta the greater the magnification.

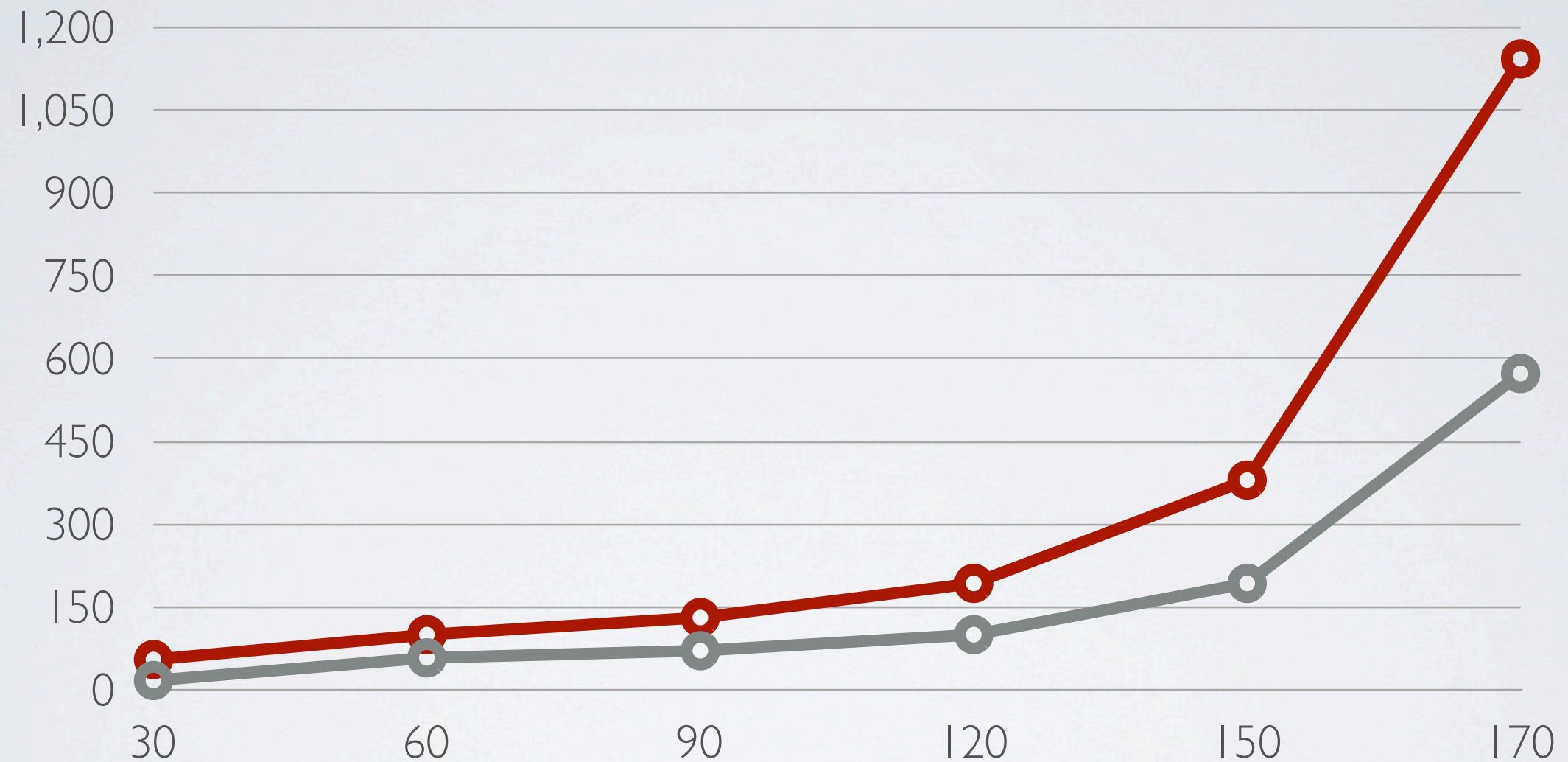


V VS. TRIANGLE

- As you can see from the numbers increasing Theta greatly increases your load.
- Even in a V, keeping angles less than 60 deg is recommended.

Theta	V	Triangle
30.00	52	82
60.00	58	100
70.00	61	108
90.00	71	131
120.00	100	193
150.00	193	383
170.00	574	1,146

TRIANGLE OF DEATH



ASSESSMENT STEPS

- Look up
- Ask questions
- Look for redundancy
- Use your judgement
- Beware false security
- Play

RESOURCES

- <http://www.softwood.org>
- Western Wood Products Assoc. <http://www.wwpa.org>
- West Marine <http://www.westmarine.com>
- <http://www.boltdepot.com>
- Wood Structural Design Data. Washington DC: National Forest Products Association, 1970
- Architectural Graphic Standards 9th Edition. Ramsey, Sleeper. New York NY: J. Wiley, 1994
- On Rope. Smith, Padgett. Huntsville, AL: National Speleological Society, 1996
- REI <http://www.rei.com/>
- Fastenal <http://www.fastenal.com>