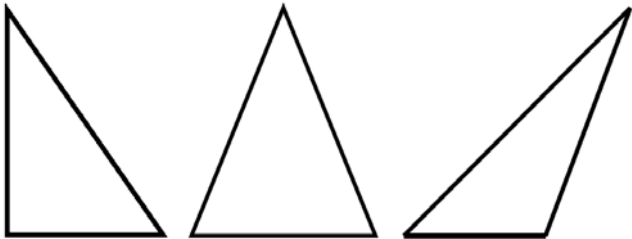
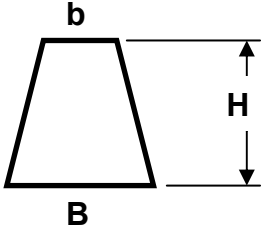
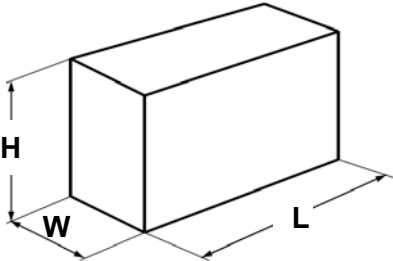
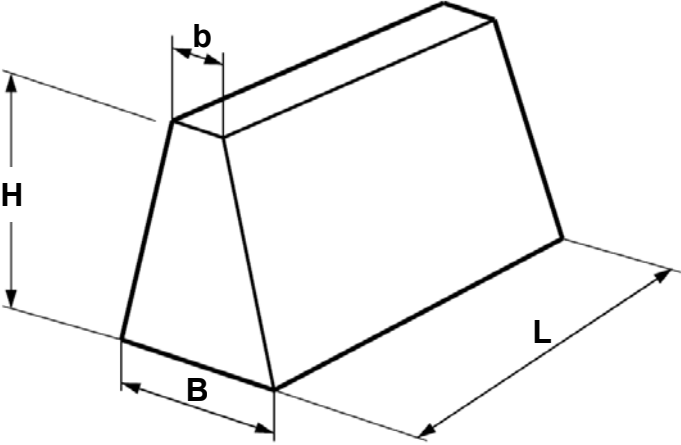


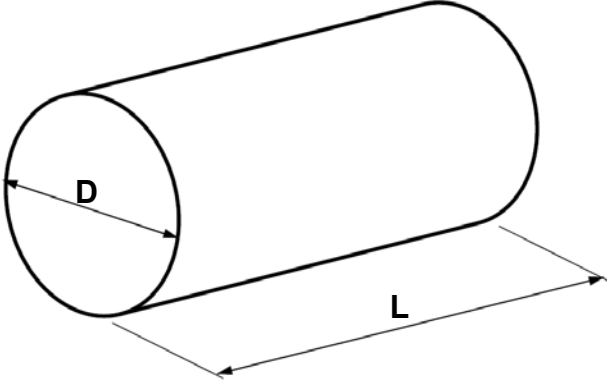
Time	Description	References
8:00-8:15	Introduction, complete paperwork, etc.	Attendance Record, Name Cards, Certificate Forms Optional Slideshow "000 General Intro"
8:15-8:30	Introduce and present Slideshow 001	Slideshow 001 Fighting Time and Steel
8:30-8:35	Introduce and briefly review Student Workbook	Student Workbook Page 1-4
8:35-8:40	H&R Hazards: Line of fire, How rigging accidents may not be reported as such. Discuss briefly the accident case presented in slideshow 001. try not to get into too many war stories, but ask the class if in their lifetime they can recall a near miss that could have been very serious. Make the point that a rigger is a working professional, and that certain knowledge is expected. Introduce Code of Ethics	Student Workbook Page 5-7
8:40-9:00	Procedures and precautions, Common hazards, Working around cranes, the importance of proper handling and rigging procedures, protecting slings, knowing loads imposed, etc. Make the point about knowing the load weight and some of the methods riggers use to determine load weights. : scale tickets? Shipping documents? Notes from previous lifts?	Student Workbook Page 8-14
9:00-9:10	If you haven't already handed out calculators, do so now and give the class a few minutes to answer the Self-Appraisal Quiz Questions Watch your class closely, if everyone is finished with these questions well within the 10 minute time frame, then you might be able to move quickly through or even skip the "Determining Load Weights" section.	Student Workbook Page 15-18
9:10-9:20	Break	
9:20-10:00	Determining Load Weights: The first step in rigging a load is to know the weight. Introduce Rigging Reference Card: Start with area formulas: Rectangles: L x W you can use the example of steel plate on the MSHA fatalgram; fab05m11 or, Make up some of your own Try something like 3-ft x 5-ft = 15-ft² If the 15-ft ² is a steel plate say ½" thick then: 15 x 20-lbs/ft² = 300-lbs. a 5 x 10 x ¾" steel plate would weigh: 5 x 10 x 30-lbs/ft² = 1,500-lbs.	Student Workbook Page 32-35 Rigger's Reference Card: Panel One: Formulas for calculating Load Weights

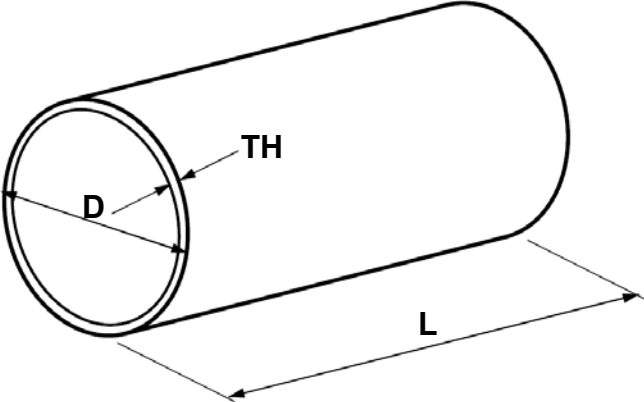
Time	Description	References
<p>9:20-10:00 Continued</p>	<p>Next give an example of a triangle: if you start with the steel plate you've just detailed and simply draw a line diagonally from corner to corner to divide the rectangle into (2) triangles, then it's easy to see why the formula for a triangle is: $L \times H \div 2$, then explain that it doesn't matter what shape the triangle is, the formula is still the same: for example:</p>  <p>$5 \times 10 \div 2 \times 30\text{-lbs/ft}^2 = 750\text{-lbs.}$</p>	<p>Panel One: Formulas for calculating Load Weights Student Workbook Page 32-35</p>
	<p>Area formulas continued: Trapezoid:</p>  <p>$(B + b) \div 2 \times H$</p> <p>You can use feet or inches, however, if you use inches this might be a good time bring up conversions, for example: 1-ft = 12 inches 1-ft² = 144 inches² 1-ft³ = 1,728-inches³ Although the cubic foot conversions should probably wait until you actually cover some volume formulas</p>	<p>Student Workbook Page 32-35 Rigger's Reference Card: Panel One: Formulas for calculating Load Weights</p>

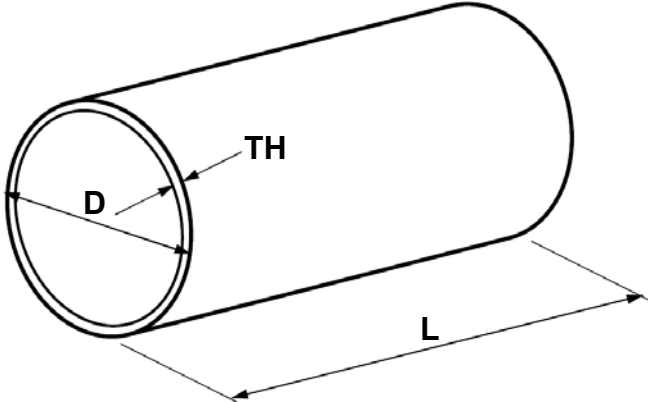
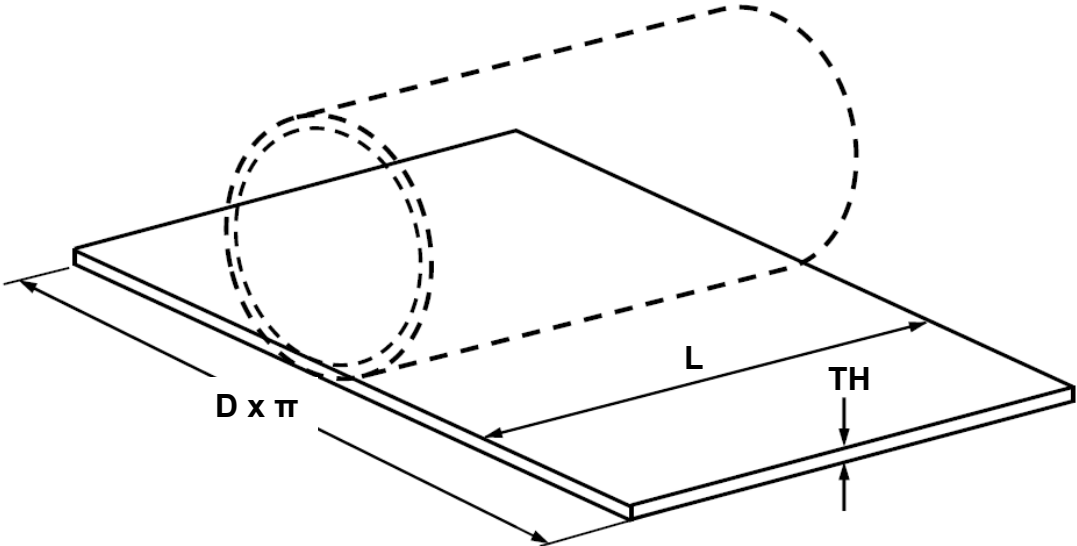
Time	Description	References
9:20-10:00 Continued	<p>Area formulas continued: Next cover the formula for the area of a circle. Ask the class if anyone remembers the formula? usually at least one will remember the πR^2 formula. Write the formula longhand, (i.e.): $\pi \times R \times R$</p> <div data-bbox="576 457 938 821" data-label="Image"> <p>The diagram shows a circle with three key measurements labeled: 'Circumference' is indicated by a curved arrow along the top outer edge; 'Radius' is a line segment from the center to the outer edge; and 'Diameter' is a horizontal line segment passing through the center from one side to the other.</p> </div> <p>Now draw a circle and explain the difference between Diameter and Radius $R = \frac{D}{2}$ or $R = D \div 2$</p> <p>Then explain that the R (in the formula) is a variable depending on the size of the circle, but that π is a constant used in mathematics. Pi (π) is defined on the rigger's card as "Pi = 3.14159" but for this program you could abbreviate to 3.14</p>	Student Workbook Page 32-35 Rigger's Reference Card: Panel One: Formulas for calculating Load Weights

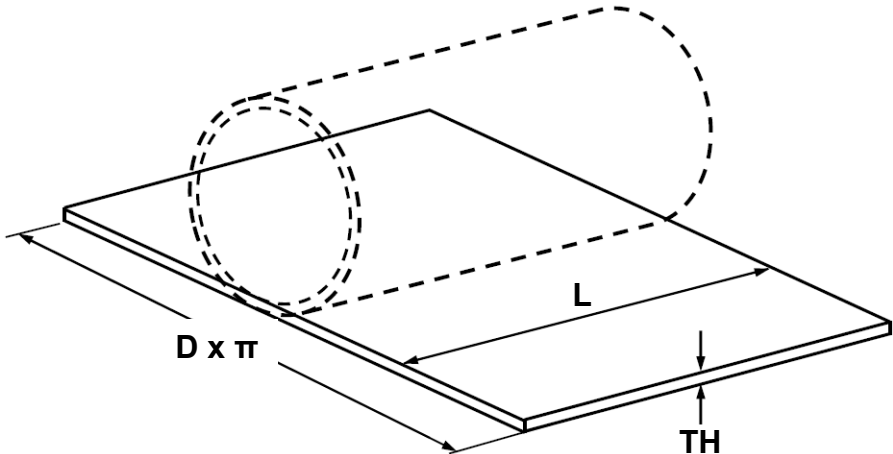
Time	Description	References
9:20-10:00 Continued	<p><u>Volume formulas:</u> Start with the volume of a cube: L x W x H Illustrate a box and dimension it for example:</p>  <p>Start with even dimensions like: 5' x 2' x 3' = 30-ft³ Then try to equate this to some type of common material like concrete. Concrete = 150-lbs/ft³ 30-ft³ x 150-lbs/ft³ = 4,500-lbs. Now try using dimensions like: 45" x 28" x 41" = 51,660-inches³ If you want to figure this as another concrete block then you have to either convert the volume to cubic feet, or determine what a cubic inch of concrete weighs. There are several ways to do this: <u>Method 1:</u> $\frac{45 \times 28 \times 41}{12 \times 12 \times 12} = 29.896\text{-ft}^3$ So you could convert each dimension to feet by dividing by 12, or you could divide the whole equation by the cube of 12 (12³) <u>Method 2:</u> $\frac{45 \times 28 \times 41}{1,728} = 29.896\text{-ft}^3$ Another method is to convert the weight of a cubic foot of material to the weight of a cubic inch of material, using concrete you'd have: $\frac{150}{1,728} = .0868\text{-lbs/in}^3$ So if you have a volume of 51,660-in³ <u>Method 3:</u> 51,660-in³ x .0868-lbs/in³ = 4,484-lbs. Or back to Method 1: <u>Method 1:</u> $\frac{45 \times 28 \times 41}{12 \times 12 \times 12} \times 150\text{-lbs/ft}^3 = 4,484\text{-lbs.}$</p>	Student Workbook Page 32-35 Rigger's Reference Card: Panel One: Formulas for calculating Load Weights

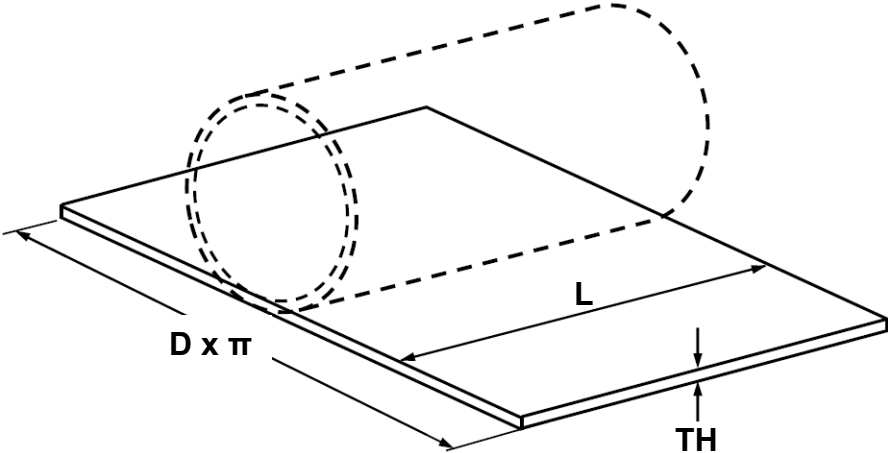
Time	Description	References
9:20-10:00 Continued	<p><u>Volume formulas cont'd:</u> Or...</p> <p><u>Method 2:</u> $\frac{45 \times 28 \times 41}{1,728} \times 150\text{-lbs/ft}^3 = 4,484\text{-lbs.}$</p> <p>Next try the volume of a trapezoid section You could use a concrete jersey barrier as an example:</p>  <p>$V = (B + b) \div 2 \times H \times L$</p> <p>Try these dimensions: $V = (18 + 4) \div 2 \times 30 \times 72 \text{ (using inches)}$</p> <p><u>Method 1:</u> $(18 + 4) \div \frac{2}{12} \times \frac{30}{12} \times \frac{72}{12} \times 150\text{-lbs/ft}^3 = 2,062\text{-lbs}$</p> <p>Or... $(18 + 4) \div \frac{2}{12} \times \frac{30}{12} \times \frac{72}{12} = 13.75\text{-ft}^3$ $13.75\text{-ft}^3 \times 150\text{-lbs/ft}^3 = 2,062\text{-lbs}$</p> <p><u>Method 2:</u> $\frac{(18 + 4) \div 2 \times 30 \times 72}{1,728} \times 150\text{-lbs/ft}^3 = 2,062\text{-lbs}$</p> <p>Or... $\frac{(18 + 4) \div 2 \times 30 \times 72}{1,728} = 13.75\text{-ft}^3$ $13.75\text{-ft}^3 \times 150\text{-lbs/ft}^3 = 2,062\text{-lbs}$</p> <p><u>Method 3:</u> $(18 + 4) \div 2 \times 30 \times 72 = 23,760\text{-in}^3$ $(18+4) \div 2 \times 30 \times 72 \times .0868\text{-lbs/in}^3 = 2,062\text{-lbs}$</p>	Student Workbook Page 32-35 Rigger's Reference Card: Panel One: Formulas for calculating Load Weights

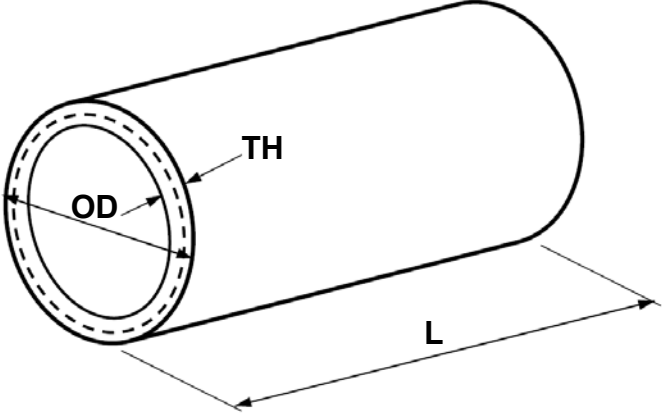
Time	Description	References
9:20-10:00 Continued	<p><u>Volume formulas cont'd:</u> Next give an example of a cylinder:</p>  <p>$V = \pi \times R \times R \times L$ Try these dimensions: Diameter = 6-inches, Length = 30-inches $3.14 \times 3 \times 3 \times 30 = 847.8\text{-in}^3$ Let's use steel round bar as an example: Method 1: $3.14 \times \frac{3}{12} \times \frac{3}{12} \times \frac{30}{12} \times 490\text{-lbs/ft}^3 = 240\text{-lbs}$ Method 2: $\frac{3.14 \times 3 \times 3 \times 30}{1,728} \times 490\text{-lbs/ft}^3 = 240\text{-lbs}$ Method 3: $3.14 \times 3 \times 3 \times 30 \times .2835\text{-lbs/in}^3 = 240\text{-lbs}$</p>	Student Workbook Page 32-35 Rigger's Reference Card: Panel One: Formulas for calculating Load Weights
10:00-10:10	Break	

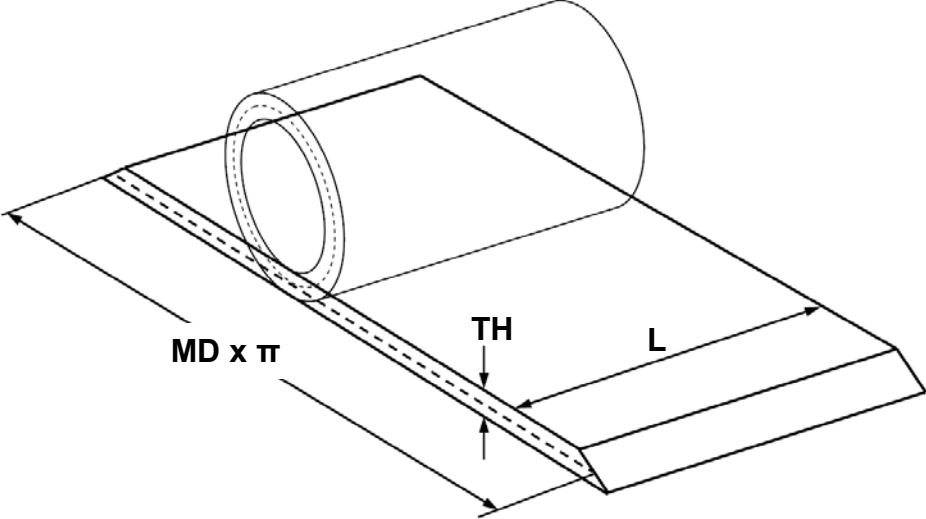
Time	Description	References
10:10-11:00	<p><u>Volume formulas cont'd:</u> Now try a pipe shape:</p>  <p>$V = \pi \times R \times R \times L$ Try these dimensions: Diameter = 20-inches, Length = 72-inches Wall Thickness = 1/2-inch Let's use steel pipe as an example: <u>Method 1:</u> $3.14 \times \frac{10}{12} \times \frac{10}{12} \times \frac{72}{12} \times 490\text{-lbs/ft}^3 = 6,411\text{-lbs}$ Minus $3.14 \times \frac{9\frac{1}{2}}{12} \times \frac{9\frac{1}{2}}{12} \times \frac{72}{12} \times 490\text{-lbs/ft}^3 = 5,786\text{-lbs}$ = 625-lbs <u>Method 2:</u> $\frac{3.14 \times 10 \times 10 \times 72}{1,728} \times 490\text{-lbs/ft}^3 = 6,411\text{-lbs}$ Minus $\frac{3.14 \times 9\frac{1}{2} \times 9\frac{1}{2} \times 72}{1,728} \times 490\text{-lbs/ft}^3 = 5,786\text{-lbs}$ = 625-lbs <u>Method 3:</u> $3.14 \times 10 \times 10 \times 72 \times .2835\text{-lbs/in}^3 = 6,411\text{-lbs}$ Minus $3.14 \times 9\frac{1}{2} \times 9\frac{1}{2} \times 72 \times .2835\text{-lbs/in}^3 = 5,786\text{-lbs}$ = 625-lbs</p>	Student Workbook Page 32-35 Rigger's Reference Card: Panel One: Formulas for calculating Load Weights

Time	Description	References
<p>10:10-11:00 Continued</p>	<p>Determining Load Weights (cont'd): Using the same pipe shape and dimensions there is another method that is quicker:</p>  <p>Diameter = 20-inches, Length = 72-inches Wall Thickness = 1/2-inch</p> <p><u>New Method 1:</u> Try to visualize cutting the pipe and rolling it out flat</p>  <p>Remember that Pi(π) is the ratio of the circle's diameter and it's circumference, So to get the dimension of the circumference you could either measure all the way around the pipe, or mathematically multiply the diameter by π:</p> <p>$D \times \pi$ Next multiply that width by the length and the wall thickness becomes the height. The complete formula becomes: $D \times \pi \times L \times TH$</p>	<p>Student Workbook Page 32-35 Rigger's Reference Card: Panel One: Formulas for calculating Load Weights</p>

Time	Description	References
10:10-11:00 Continued	<p>Determining Load Weights (cont'd):</p>  <p>Method 1: $D \times \pi \times L \times TH$ $\frac{20}{12} \times 3.14 \times \frac{72}{12} \times \frac{.5}{12} \times 490\text{-lbs/ft}^3 = 641\text{-lbs}$</p> <p>Notice the weight is slightly higher using this method. The reason is that we used the outside diameter rather than the mean diameter. Using the mean diameter would have resulted in the exact same weight as our previous methods</p> <p>Method 2: $20 \times 3.14 \times 72 \times .5 \times 490\text{-lbs/ft}^3 = 641\text{-lbs}$ 1,728</p> <p>Method 3: $20 \times 3.14 \times 72 \times .5 \times .2835\text{-lbs/in}^3 = 641\text{-lbs}$</p> <p>You could also simplify this further by just using the plate dimensions and substitute 1/2 plate weight. 1/2-inch steel plate is usually considered to be 20-lbs/ft²</p> <p>Method 1a: $D \times \pi \times L \times UW$ $\frac{20}{12} \times 3.14 \times \frac{72}{12} \times 20\text{-lbs/in}^2 = 628\text{-lbs}$</p> <p>This method actually comes closer to the actual weight of 625-lbs (at least in this case) this stems from the way steel plate weight was averaged and rounded in the first place</p>	<p>Student Workbook Page 32-35 Rigger's Reference Card: Panel One: Formulas for calculating Load Weights</p>
	<p><i>Actual weight of a cubic foot of steel is: 489.5424-lbs. Rounded to 490-lbs. the actual weight of a square foot of 1-inch plate is 40.7952-lbs. rounded would be 41-lbs/ft², but when trying to work the values for fractions of an inch it's more convenient to use 40-lbs so most books and references use the 40-lbs/ft²</i></p>	

Time	Description	References
10:10-11:00 Continued	<p>Determining Load Weights (cont'd):</p>  <p>Method 2a: $D \times \pi \times L \times MW$ $\frac{20 \times 3.14 \times 72 \times 20\text{-lbs/in}^2}{144} = 628\text{-lbs}$</p> <p>Method 3a: $D \times \pi \times L \times MW$ $20 \times 3.14 \times 72 \times \frac{20\text{-lbs/in}^2}{144} = 628\text{-lbs}$</p> <p>Methods 2a and 3a simply use the square of 12 rather than dividing by 12 twice, $12^2 = 144$ Also referred to as 12 raised to the second power Notice these methods are really only using 2 dimensions (hence the power of 2), if we were using 3 dimensions we would be using 12 to the third power (12^3) or 12 cubed = 1,728 as we did previously Additionally, methods 1a thru 3a start to err on heavy side as the wall thickness increases. We recommend not using the plate weight system if the wall thickness is greater than 1-inch.</p>	<p>Student Workbook Page 32-35 Rigger's Reference Card: Panel One: Formulas for calculating Load Weights</p>


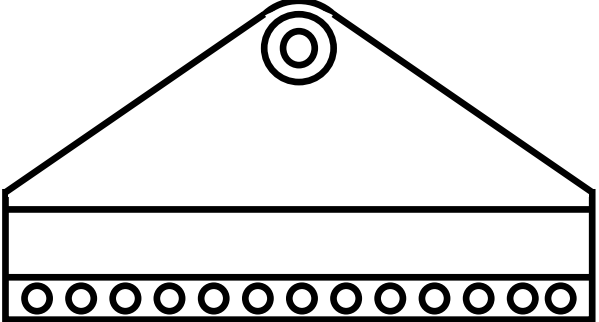
Time	Description	References
<p>10:10-11:00 Continued</p>	<p><u>Determining Load Weights cont'd.:</u> Mean Diameter: Mean is just another word for average. The textbook method is to take the sum of the Outside Dia. plus the Inside Dia. and divide by 2, thus averaging the 2 dimensions Mean Diameter = (O.D. + I.D.) ÷ 2 But there is an easier way to obtain Mean Diameter and that is to either take the Outside Diameter minus the wall thickness, or the Inside Diameter plus the wall thickness, Since we're showing the O.D. dimension here let's use: O.D. – TH</p>  <p>For this example let's use a heavy wall concrete pipe. When the wall thickness is thicker than 1-inch it's a good idea to use either mean diameter or one of the first (3) method(s) we used for pipe. The tradeoff is that the Mean Dia. method is much quicker to use, but more difficult to teach. Here goes: Outside Diameter = 48-inches, Wall Thickness = 4-inches, (Inside Diameter would be 40-inches), Length = 60-inches $(48 + 40) \div 2 = 44$-inches or,... $48 - 4 = 44$-inches M.D. x π x L x TH x MW = Pipe Weight $\frac{44 \times 3.14}{12} \times \frac{60}{12} \times \frac{4}{12} \times 150\text{-lbs/ft}^3 = 2,878\text{-lbs}$</p>	<p>Student Workbook Page 32-35 Rigger's Reference Card: Panel One: Formulas for calculating Load Weights</p>

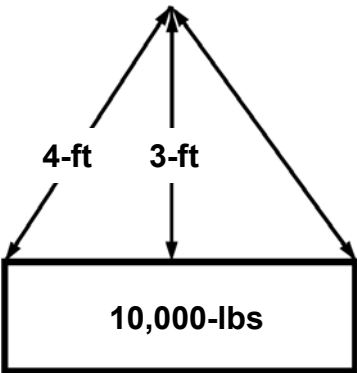
Time	Description	References
10:10-11:00 Continued	<p>Mean Diameter method continued:</p>  <p>We're now back to using essentially L x W x H, the MD x π becomes our Width, and the Wall Thickness (TH) becomes our height because remember we're visualizing rolling this shape out flat like a plate</p> <p>Also remember that since we're using inches for our dimensions, and our material weight (MW) is referenced as 150-lbs/ft³ at some point we have to make a conversion, in the last example we divided by 12 three times, but we could also divide by 12 cubed (12³) 1,728. we could either divide our volume by 1,728, or we could divide the 150-lbs/ft³ by 1,728 to get the material weight down to the weight per cubic inch.</p> <p>Method 2: M.D. x π x L x TH x MW = Pipe Weight $\frac{44 \times 3.14 \times 60 \times 4 \times 150\text{-lbs/ft}^3}{1,728} = 2,878\text{-lbs.}$</p> <p>Method 3: M.D. x π x L x TH x MW = Pipe Weight $44 \times 3.14 \times 60 \times 4 \times .0868\text{-lbs/in}^3 = 2,878\text{-lbs.}$</p>	<p>Student Workbook Page 32-35 Rigger's Reference Card: Panel One: Formulas for calculating Load Weights</p>
11:00-11:10	Break	

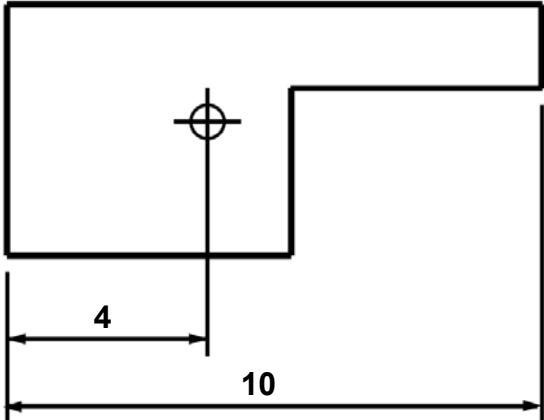
Time	Description	References
11:10 – 11:25	<u>Basic Rigging Hitches:</u> Cover all 3 basic hitches and rules for each Also show video 001 Rigging Basics	Student Workbook Page 19-21 Video “001 Rigging Basics”
11:25 – 12:00	<u>Video “002 Precision Machine”:</u> Introduce and show video. Then very briefly identify common types of wire rope and properties such as: Terminology, design, reasons for different lays, wear, fatigue, grades of steel, cores, and types of failures.	Video “Precision Machine”
12:00-12:30	Lunch	
12:30 – 12:50	<u>Video “003 Mechanical Splice”:</u> Introduce and show video. Then very briefly identify common types of wire rope used for the fabrication of slings. (6 x 19, 6 x 37, Cable Laid) Also cover when fiber core vs IWRC cores are used, the various common end fittings used in the production of slings, and the additional rules and restrictions if using hand-tucked slings.	Video: “003 Mechanical Splice”
12:50 – 01:35	<u>Slideshow “003 Rigging Card”:</u> Use the slideshow presentation to explain the panels on the card column by column. Explain the terms and how to use the sling weight calculator The first example references a 1-inch sling by 10-feet long. The minimum length for a 1-inch sling is approximately 4-feet, so 10-ft minus 4-ft means we have 6 additional feet times 1.85-lbs per foot, plus the original 21-lbs of the min. 4-ft length sling. (this includes the amount of rope required to form the eyes and the carbon steel sleeves that finish the eyes.	Slideshow “Rigging Card”
	For rigging hardware weights explain that the anchor shackle weights were taken from the safety anchor shackle (that is: the type with a separate pin and nut) the regular screw pin type would be slightly less weight. The numbers under the “Jaw and Eye Turnbuckles” are the weight in pounds followed by the nominal size (Nominal Diameter by Length (in inches)) since turnbuckles come in differing lengths, it is necessary to specify the length. Next cover the terms used on the “Rigging Hardware Capacities” panel	

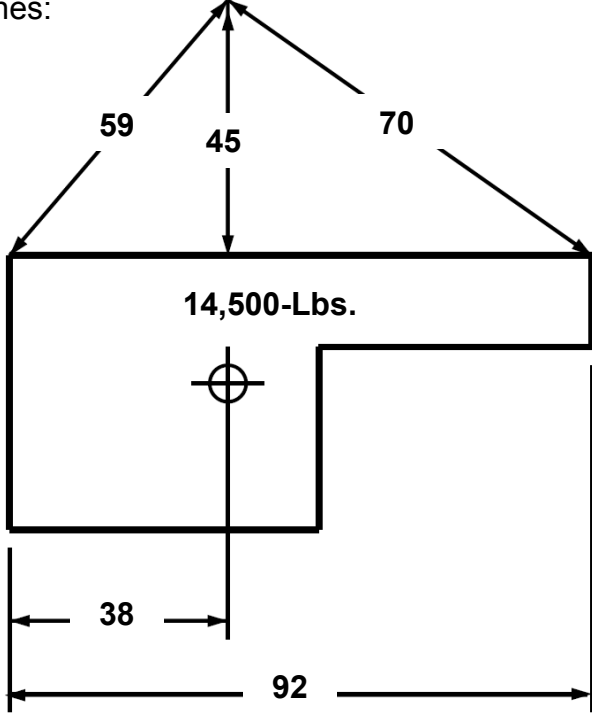
Time	Description	References
12:50 – 01:35	<p><u>Slideshow “003 Rigging Card” (continued):</u> Explain the different types of eyebolts and that if anything other than a straight line pull, that the shoulder type must be used. Then explain that even if a shoulder type is used, the capacity listed is based on the straight line pull, that pulling at an angle results in significant reductions from these capacities. (This instruction has proved to be one of the biggest life savers over the years, if your company or employees even consider using eyebolts, you must emphasize this point, if you believe it may not have been adequately covered, do not hesitate to bring it up later).</p>	Slideshow “003 Rigging Card”
	<p>For example: at only about 15-degrees deviation from the straight line pull, the capacity is reduced to only 55-percent of the original listed capacity. At 45-degrees, the capacity is reduced to only 25-percent of the original listed capacity. So the example of a 5,000-lb load at a 45-degree angle, you would need a shouldered eyebolt at least 4-times more capacity (or a minimum of 20,000-lbs) the first eyebolt we see that has sufficient capacity for this load turns out to be the 1-1/4 size at a capacity of 21,000-lbs.</p>	
	<p>Then explain the swivel eyebolt capacities (and that these type are rated at the listed capacity any angle you pull, up to 90-degrees deviation from the straight line pull)</p>	
	<p>Next explain the terms used on the wire rope sling capacities panel Such as: 6 x 19, usually standard slings are made from wire constructed of 6 x 19 class rope up to and including 1-1/8-inch diameter. (That is: 6 strands made up of 19 wires), then usually larger sizes switch to the 6 x 37 class, so that the slings still have some flexibility. Explain the MS (Mechanical Splice) Cover the other terms, such as diameter and the basic hitches. Also make clear the rules and restrictions associated with each hitch (especially the choker and basket hitches)</p>	
	<p>Next explain the 2-leg bridle capacities and the difference between horizontal and vertical angle references. This card (as well as most modern references) refers to the horizontal angle, some earlier cards referenced the angle off the vertical.</p>	

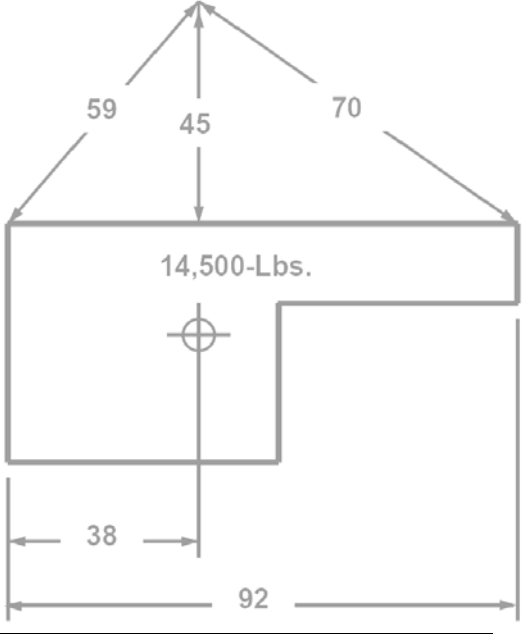
Time	Description	References
12:50 – 01:35	<p>Explain how to determine if a bridle’s horizontal angle is 60-degees (or higher) and how to determine if the horizontal angle is 45-degrees (or higher) If the angle is somewhere in between the 60 and 45-degree angles, then reference the lower (45-degree) angle.</p> <p>Also encourage students to use this 2-leg bridle chart even if rigging a 3-leg or 4-leg bridle.</p>	Slideshow “003 Rigging Card”
1:35-1:45	Break	
1:45- 2:20	<p><u>Types of Slings:</u> Introduce some of the other sling types (Chain, Metal Mesh, Synthetic types, webbing, roundslings, nylon vs poly) etc.</p>	Student Workbook Page 22 Sling Samples
2:20-2:50	<p><u>Sling inspection:</u> Introduce and show video, then review inspection criteria for each sling type. For each type start with the information given on the sling tag, and why it’s important. Point out the differences in the information as you progress from one type to the next. Discuss the requirements of OSHA and the ASME B30.9</p>	Student Workbook Page 23-24 Optional Video: “Inspection Care and Storage of Slings”, Sling Samples: Run time approx. 17-minutes.
2:50-3:00	Break	
3:00-3:20	<p><u>Rigging Hardware inspection:</u> Cover inspection points for rigging hardware. Keep it simple, explain that the basic inspection points should be about the same regardless of the hardware, with the exception being shackle inspection. That shackle’s must have their capacity identified rather than just identifying diameter (for example) since there may be many shackles available which are not load rated. Other than that the basics are:</p> <ol style="list-style-type: none"> 1. Wear: 5-10% 2. Damage: 0% 3. Deformation: no significant 4. Modification: no heating, no welding, no bending, no substitution. <p>Use several samples as examples, or if onsite a visit to the toolroom, rigging rack, or gear loft to inspect some of the rigging (slings and hardware) currently in use.</p>	Student Workbook Page 25 Samples, Whiteboard and Video: “003 Hook Overload”,

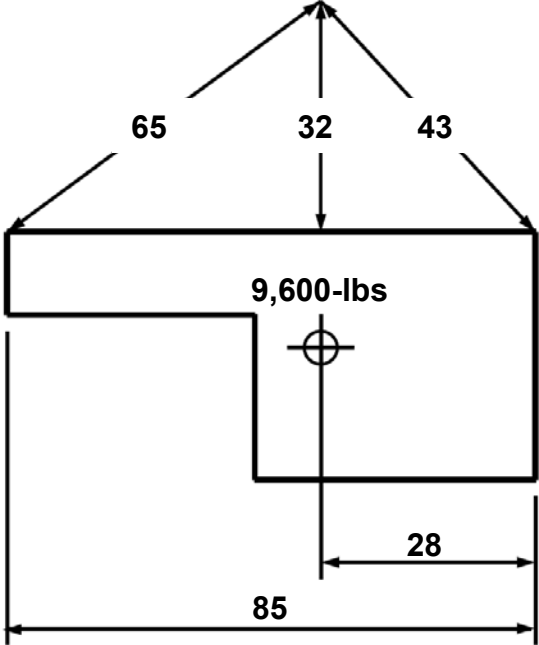
Time	Description	References
3:20-3:50	<p><u>Use and Inspection of Below the hook Rigging Devices:</u> Identify the types of devices your company uses and any special limitations or considerations Explain that additional training may be required before operating some of these devices Explain the differences and limitations of various types of spreader bars.</p> <div style="text-align: center;">  <p>Bridle Bar</p>  <p>Panel Bar</p> </div>	Rigging Gear Book Section 7 Use whiteboard or any addition manufacturer information for the devices you wish to cover
3:50-4:00	Break	
4:00-4:30	<p><u>Communications & Signaling:</u> Cover importance of proper communications. Demonstrate hand signals as required. Use appropriate hand signal workshop Use Slideshow 004 Communications If desired</p>	Student Workbook Page 26 Slideshow “004 Communications” Mobile Crane or Overhead Crane Hand Signals Workshop (or both if appropriate)

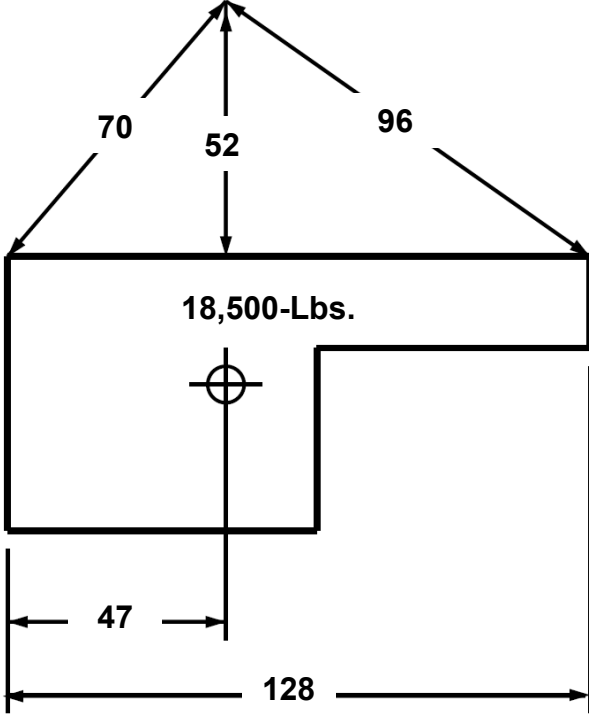
Time	Description	References
<p>Day Two: 8:00-8:15</p>	<p>Sign in and Topic Review: Ensure everyone initials the sign in sheet <u>Today's Topics:</u> Bridles Sling Angular Stress Balanced Loads Unbalanced Loads Center of Gravity Basic Knots (for Rigger Certification) Written Exam Begin Practical Exams</p>	
<p>8:15-9:00</p>	<p>Sling Angle Stress: Cover basic formulas: LAF x W x LWD and L/H x W x LWD Start with very easy numbers like a single sling on a 10,000-lb load, followed by 2 slings on a 10,000-lb load, followed by 2 slings at a 60-degree angle on a 10,000-lb load. Use the examples on the rigging card as a guide Redraw using a sling angle of 45-degrees: 1.414 x 10,000 x 50% = 7,070-lbs. Then redraw using a sling angle of 30-degrees: 2.000 x 10,000 x 50% = 10,000-lbs. Use 2 slings (of the same length) to demonstrate how to determine the 60-degree and 45-degree sling angles without even needing a tape measure. Next reiterate that the stress doubled at 30-degrees, and to try to stay away from the lower angles whenever possible. $\frac{L}{H} \times W \times LWD$ H</p>  <p>$\frac{4}{3} \times 10,000 \times 50\% = 6,667\text{-lbs}$</p>	<p>Student Workbook Page 27 Rigger's Reference Card: Panel Seven: Sling Angle – Load Angle Factors Workshop handout: “Sling Angle 001”</p>

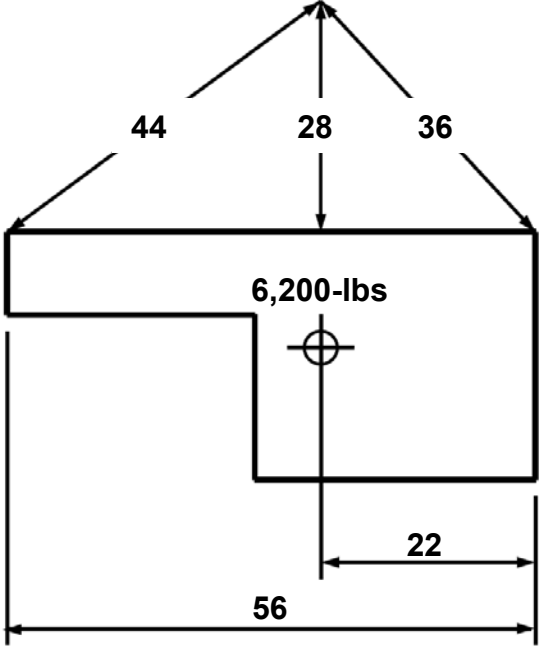
Time	Description	References
8:15-9:00	<p><u>Sling Angle Stress (cont'd):</u> <u>Try a few more examples before handing out the workshop, here are a few, or you can make up your own:</u></p> $\frac{7}{5} \times 6,800 \times 50\% = 4,760\text{-lbs}$ $\frac{6}{4} \times 8,500 \times 50\% = 6,375\text{-lbs}$ $\frac{12}{9} \times 9,000 \times 50\% = 6,000\text{-lbs}$ <p>After finishing the workshop handout ask if there was any confusion regarding number 6 Number 6 from workshop handout is as follows: $\frac{15}{4} \times 8,000 \times 50\% = 15,000\text{-lbs}$</p> <p>Sometimes students are confused that the load angle factor can increase the stress that much above the actual load weight. In any case it's a good point to make riggers aware of</p>	Workshop Handout: "Sling Angle 001"
9:00-9:10	Break	
9:10-10:10	<p>Offset Center of Gravity Loads: Cover how to determine LWD, then modify the formula from L/H x W x LWD. Replace LWD with OL/TL</p>  <p>Start with very easy numbers to illustrate the point of how to determine LWD percentages In this case the percentage of the distance to the center of gravity shown is: $4 \div 10 = .4$ (40%) So if the 4-feet equates to 40% of the distance to the center of gravity from the left side, ask the class, looking at this load, where would it make sense for 40% of the load weight to be distributed?</p>	Workshop handout: "Sling Angle 002"

Time	Description	References
9:10-10:10	<p>Offset Center of Gravity Loads (cont'd):</p> <p>This opposite relationship is the toughest point to get across when teaching this concept.</p> <p>Almost invariably at least one of the students will apply the lighter percentage to the heavier side, when working the whole formula:</p> $\frac{L}{H} \times W \times \frac{OL}{TL} = \sigma$ <p>Note: σ = Stress (the Greek letter Sigma is usually used to represent stress, in this case sling stress)</p>	Workshop handout: "Sling Angle 002"
	<p>In most of our examples we've been using weight in pounds for the variable "W" but we could also be using Tons, Kips, Kilograms, etc. whatever we use for "W" is what we'll wind up with for our answer. Since our sling capacities are normally listed in pounds it works out making sense to use pounds for our load weights</p> <p>For our lengths we could use feet, inches, centimeters, etc. Let's try an example using inches:</p>  <p>Notice that with datum dimensioning we wind up having to do the math in our heads to come up with the opposite partial length for the left sling</p> $92 - 38 = 54$	

Time	Description	References
9:10-10:10	<p><u>Offset Center of Gravity Loads (cont'd):</u></p>  <p>So for the left sling stress σ_L:</p> $\frac{59}{45} \times 14,500 \times \frac{54}{92} = 11,159\text{-lbs}$ <p>And for the right sling σ_R:</p> $\frac{70}{45} \times 14,500 \times \frac{38}{92} = 9,316\text{-lbs}$ <p>So the horizontal stress in this case seems to make a certain amount of sense in that, the sling on the heavier side has the heavier stress level. If anyone wound up with a heavier stress on the lighter side then they most likely used the wrong side to calculate their "Load Weight Distribution" LWD. That is: they used the adjacent rather than the opposite.</p>	Workshop handout: "Sling Angle 002"

Time	Description	References
9:10-10:10	<p><u>Sling Angle Stress (cont'd):</u> <u>Let's try another example, again using inches:</u></p>  <p>Here are the numbers for the left sling: $\frac{65 \times 9,600 \times 28}{32 \times 85} = 6,424\text{-lbs}$ And then the right sling: $\frac{43 \times 9,600 \times 57}{32 \times 85} = 8,651\text{-lbs}$ Again it seems to make sense, the sling on the heavy side carries the heavier load If coming up with these examples on the fly, it's important to make sure that your triangles are square. Use the <u>Pythagorean Theorem</u>: The basic theorem that the square of the hypotenuse is equal to the sum of the squares of the 2 adjacent sides. <u>So for example:</u> $43^2 = (32^2 + 28^2)$ and $65^2 = (32^2 + 57^2)$ So if you arbitrarily name a couple of dimensions like 32 and 28, to come up with a length that makes sense for these numbers, square each number, add them together and find the square root. Using a calculator this is easy because almost all calculators have a square root key. $(32^2 + 28^2) = (1024 + 784) = 1808$, $\sqrt{1808} = 42.52$ (rounded to 43), this gives you the appropriate length for the right side, you would have to repeat this for the left side</p>	Workshop handout: "Sling Angle 002"

Time	Description	References
9:10-10:10	<p><u>Sling Angle Stress (cont'd):</u> Let's try another example:</p>  <p>Here are the numbers for the left sling: $\frac{70}{52} \times 18,500 \times \frac{81}{128} = 15,759\text{-lbs}$ And then the right sling: $\frac{96}{52} \times 18,500 \times \frac{47}{128} = 12,541\text{-lbs}$ Notice also that our formula doesn't require any feet to inches conversions. Earlier when calculating load weights it was sometimes necessary to make these conversions because often our dimensions were shown in inches, but our reference weights were all listed in cubic feet. For the above formula, it really doesn't matter which unit of measure we use, as long as we don't mix units in the same variable. That is, we could measure our sling length and height in inches, and our load lengths in feet and it wouldn't matter. Try 4-ft divided by 3-ft, and 48-inches divided by 36-inches and you'll get the same result. The same "Load Angle Factor" from the same rigging.</p>	Workshop handout: "Sling Angle 002"

Time	Description	References
9:10-10:10	<p><u>Sling Angle Stress (cont'd):</u> Here's one more example, for more you can use the workshop "Sling Stress 002":</p>  <p>Here are the numbers for the left sling: $\frac{44}{28} \times 6,200 \times \frac{22}{56} = 3,828\text{-lbs}$ And then the right sling: $\frac{36}{28} \times 6,200 \times \frac{34}{56} = 4,840\text{-lbs}$</p>	Workshop handout: "Sling Angle 002"
10:10-10:20	Break	
10:20-10:45	<p><u>Sling Stress (cont'd):</u> Continue with the offset Center of Gravity formula and the workshop handout. Keep an eye out for any students that need additional help</p>	Workshop handout: "Sling Stress 002"
10:45-11:20	<p><u>Finding Center of Gravity:</u> Cover basic methods of finding Center of Gravity</p>	Student Workbook Page 28-29 Workshop: "Center of Gravity 001" thru 003 or... "Center of Gravity 004"
11:20-11:30	Break	

Time	Description	References
11:30-11:50	Give hands on presentation of the basic knots that will be used on the practical exam	Supplemental Training Materials Folder
11:50-12:00	<p>Course Review: Briefly review what has been covered and explain the rules for the written exam to be administered after lunch</p> <p>Rules: No cheating No talking during the test If you have a question raise your hand and the instructor will talk to you outside the room After you complete your exam bring the exam and the data card to the instructor for grading, then leave the room Do not re-enter the room until all tests have been completed</p>	
12:00-12:30	Lunch	
12:30-1:15	<p>Written Exam: Reiterate the rules as you pass out the exams and data cards</p>	
1:30-2:30	<p>Hands on Exercises: Provide guidance for appropriate hands on training and exercises.</p>	<p>Student Workbook Page 28-29 Workshop: "Center of Gravity 001" thru 003 or... "Center of Gravity 004"</p>
2:30-4:30	<p>Practical Exams: Schedule times around shift workers Use basic practical exam outline and scoresheets</p>	<p>Rigger Basic Practical Exam Outline Certified Rigger Performance Evaluation Scoresheet</p>