WIND STUDY

Wind Study is intended for grades 5-8 and 8-11
Questions posted on: Monday Answers posted on: Friday
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2023Q7 RIGGING

Hello and welcome to another Wind Study! This week we are talking about rigging! Rigging refers to the engineered hardware, tools, and materials used to secure a load before that load is lifted by a crane.

When using any type of rigging, safety is always the number one priority. Proper inspection of all the cables, straps, hooks, and ropes should be done before each use to ensure the rigging is safe. Minimum PPE (personal protective equipment) requirements include gloves, safety glasses, steel toe boots, high-visibility reflective clothing, and a hard hat when working with rigging and loads.

It is important to always be aware of your surroundings. NEVER walk below an object being lifted or put your hands in potential pinch points (places where they could get smashed). During a lift, it is also important to communicate effectively with everyone involved. When using rigging in critical applications, every aspect of the lift should be meticulously planned and organized to keep everyone involved safe.

When it comes to the rigging itself, each piece of equipment is standardized to certain ratings. One rating that is required for all hardware used in rigging is the *Safety Factor.* The **Safety Factor** is the ratio of the **Minimum Breaking Strength (MBS)** to the permissible **Working Load Limit (WLL)**. MBS indicates the force at which the material will fail, while WLL refers to the maximum allowed force that a piece of rigging can handle safely under normal conditions. Anything used in rigging typically has a **Safety Factor** of 5:1, meaning that the rigging can hold 5 times the rated working load before failure.

$$Working\ Load\ Limit = \frac{minimum\ breaking\ strength}{safety\ factor}$$

Another important point is that the material and shape of the object can significantly impact how it is rigged up. As seen in the photos below, our wind turbine components require different types of rigging. In the left photo, the wind turbine rotor assembly, weighing almost 100,000 lbs., is rigged using what we call a "double basket" configuration. The photo on the right is a wind turbine generator weighing 103,000 lbs. and is rigged using two vertical slings. Observe the differences between the rigging of the two components. Most common rigging set ups include the vertical, basket, or choke configurations, and each configuration will have a different corresponding WLL.

Rotor assembly being lifted using a double-basket configuration.

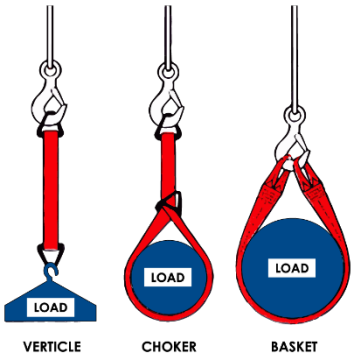
Turbine Generator being lifted using two vertical slings.

Level 1a: You are given rigging straps with a rating tag that lists the following information:

Vertical WLL: 55,000 lbs.

Choke WLL: 44,000 lbs.

Basket WLL: 110,000 lbs



With a safety rating of 5, what would be the Minimum Breaking Strength of the red straps for each configuration style?

Level 1b: You have a concrete cube with a side length of 4.5ft. Using the unit weights table below, find out if one strap (from 1a) in a vertical hitch orientation would be rated high enough to lift the cube.

UNIT WEIGHTS FOR COMMON MATERIALS						
Material	Steel	Aluminum	Concrete	Wood	Sand and Gravel	Copper
lbs./ft^3	490	165	150	50	120	560

Level 2: You need to lift a cube with a side length of 10ft off a flatbed truck and onto the ground. You have a rigging setup with a WLL of 200,000 lbs. Refer to the table from the previous question. What materials could the cube be made of that would allow you to stay within your WLL? What materials would make this task impossible?