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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Hope you're ready forrrrrr… a Wind Study! This week we'll be talking about something foundational to wind turbine construction: the concrete foundation! The concrete foundation is an important step in wind turbine construction as it is essential to the structural stability of the wind turbine.

Concrete foundations generally have two components, concrete (as I'm sure you could guess) and rebar. Concrete is a composite material made of aggregate rock and a binding paste consisting of cement and water. Concrete starts out as a malleable mixture, but once it hardens it becomes durable and strong, making for a great foundation component for a wind turbine.

Rebar are steel rods that are used to improve the strength and durability of the concrete. Concrete itself has high compression strength, meaning it withstands pushing forces, but a low tensile strength, meaning it is not as resilient against pulling forces. Rebar rods improve the tensile strength of the concrete, helping to improve its overall strength.
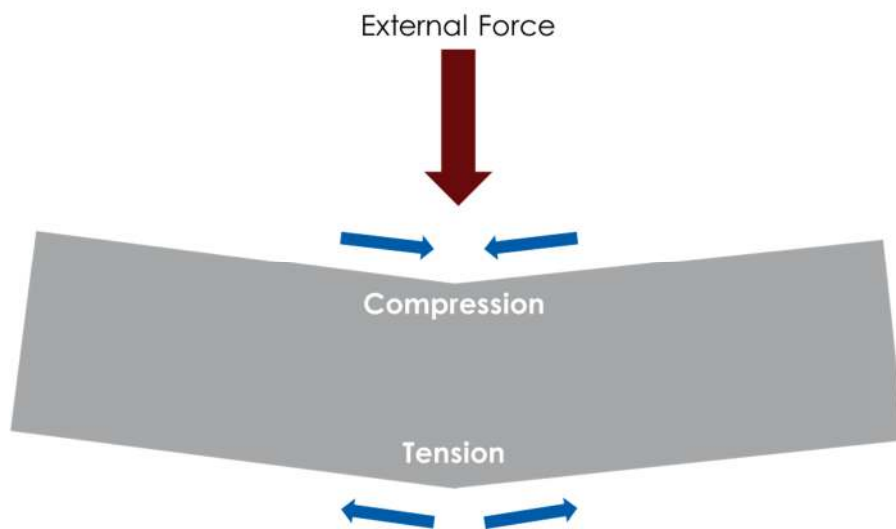

Figure 1: Concrete block under compression and tension when an external force is applied

Rebar rods are usually set up as a grid over which the concrete is poured. Once the concrete hardens, the foundation is set. The size of the foundation will vary based on the dimensions of the turbine. The turbines One Energy constructs are all the same size, so all of the foundations are roughly the same size.

Now that we have a better grasp on a wind turbine foundation and its components, let's dive into this week's questions!

Level 1: We want to fill a turbine foundation with concrete using concrete trucks. The foundation is 6 feet deep and 40 feet in diameter; the rebar takes up about 5% of the volume of the foundation. If each concrete truck holds 10 cubic yards of concrete, how many trucks will be needed to fill the turbine foundation? Assume the foundation is cylindrical in shape.

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Level 2: If each concrete truck pours concrete into the foundation at a rate of 4 gallons per second and it takes 10 minutes to switch between empty and full trucks, how much time (in hours) will it take to fill the foundation with concrete? Assume the same foundation and concrete truck volume from the previous question.