

How do Tower Cranes work?

Tower cranes are a common fixture at any major construction site. They're pretty hard to miss -- they often rise hundreds of feet into the air, and can reach out just as far. The construction crew uses the tower crane to lift [steel](#), concrete, large tools like acetylene torches and generators, and a wide variety of other building materials.

When you look at one of these cranes, what it can do seems nearly impossible: Why doesn't it tip over? How can such a long boom lift so much weight? How is it able to grow taller as the building grows taller? If you have ever wondered about how tower cranes work, then this article is for you. In this article, you'll find out the answers to all of these questions and more!

Parts of a Tower Crane

All tower cranes consist of the same basic parts:

- The **base** is bolted to a large concrete pad that supports the crane.
- The base connects to the **mast** (or **tower**), which gives the tower crane its height.
- Attached to the top of the mast is the **slewing unit** -- the gear and motor -- that allows the crane to rotate:

On top of the **slewing unit** are three parts:

- The long horizontal **jib** (or **working arm**), which is the portion of the crane that carries the load. A trolley runs along the jib to move the load in and out from the crane's center:



- The shorter horizontal **machinery arm**, which contains the crane's motors and electronics as well as the large concrete **counter weights**:



- The **operator's cab**:



The machinery arm contains the [motor](#) that lifts the load, along with the control electronics that drive it and the cable drum, as shown here:



The motors that drive the slewing unit are located above the unit's large [gear](#):



Now let's find out how much weight this equipment can handle.

How Much Weight Can They Lift?

A typical tower crane has the following specifications:

- **Maximum unsupported height** - 265 feet (80 meters) The crane can have a total height much greater than 265 feet if it is tied into the building as the building rises around the crane.
- **Maximum reach** - 230 feet (70 meters)
- **Maximum lifting power** - 19.8 tons (18 metric tons), 300 tonne-meters (metric ton = tonne)
- **Counterweights** - 20 tons (16.3 metric tons)

The maximum load that the crane can lift is 18 metric tons (39,690 pounds), but the crane cannot lift that much weight if the load is positioned at the end of the jib. The closer the load is positioned to the mast, the more weight the crane can lift safely. The **300 tonne-meter** rating tells you the relationship. For example, if the operator positions the load 30 meters (100 feet) from the mast, the crane can lift a maximum of 10.1 tonnes.

The crane uses two **limit switches** to make sure that the operator does not overload the crane:

- The **maximum load** switch monitors the pull on the cable and makes sure that the load does not exceed 18 tonnes.
- The **load moment** switch makes sure that the operator does not exceed the tonne-meter rating of the crane as the load moves out on the jib. A **cat head assembly** in the slewing unit can measure the amount of collapse in the jib and sense when an overload condition occurs.

Now, it would be a pretty big problem if one of these things fell over on a job site. Let's find out what keeps these massive structures standing upright.

Why Don't They Fall Over?

When you look at a tall tower crane, the whole thing seems outrageous -- why don't these structures fall over, especially since they have **no support wires** of any kind?

The first element of the tower crane's stability is a large **concrete pad** that the construction company pours several weeks before the crane arrives. This pad typically measures 30 feet by 30 feet by 4 feet (10 x 10 x 1.3 meters) and weighs 400,000 pounds (182,000 kg) -- these are the pad measurements for the crane shown here. Large **anchor bolts** embedded deep into this pad support the base of the crane:

So these cranes are essentially bolted to the ground to ensure their stability. In the next section, you'll learn how tower cranes "grow."

<http://science.howstuffworks.com/transport/engines-equipment/tower-crane3.htm>