Bridge Wonders

INDIAN RIVER INLET BRIDGE

For more information and to see construction photographs and view live webcams visit www.irib.deldot.gov

Q: What is the first step in building a bridge?

A: First the bridge builder completes a test pile driving program, where very long square concrete columns known as piles are driven into the ground using big hammers. This provides the bridge builder with information such as the soil conditions, how deep the piles should go into the soil, the weight they can support, etc. Next, they drive the real piles that hold up the bridge. Approximately 291 piles have been completed in the pile driving program, which was just completed this month (Nov. 2009). These piles provide a stable base within the soil for the pylon towers to be built upon, and therefore are very important to the rest of the bridge.

Q: What will the new Indian River Inlet Bridge look like, and what's the big deal?

A: The bridge will look like this. It is a Cable Stay bridge that will span the Inlet without any supports (piers) in the water. It's a big deal because not many bridges of this size and magnitude are built in our generation. It takes great skill and ability to build a bridge like this. It is awesome to see it being built. You find yourself asking, how do they do that?

How will engineers build this bridge?

They start with driving individual concrete piles and then build a cap (footing) to cover each pile group. The pylon towers, which are the main vertical structures that hold up the bridge, are then built on top of the footing, and are where the bridge gets its stability and strength. The pylon towers cannot be constructed all at once, so engineers use climbing steel and wooden forms to work as they move up the pylon tower.

The green bars that you see sticking up above the forms are steel reinforcing bars (rebar) providing the "skeleton" that will eventually be encased in concrete. The pylon towers are not solid; they are hollow inside so that workers can inspect the inside in the future. There will be four towers, two on each side of the Inlet, reaching almost 250 feet in the air. Each pylon tower has almost 800 cubic yards of concrete, and about 280,000 pounds of rebar. You can see a long way up and down the Coast when you're on top of a 250-foot tall pylon.

How do they make sure the two sides of the bridge will line up? Mainly surveying and re-surveying. Surveying is measuring distances and points within the construction zone. As the bridge is built, surveyors continuously measure to ensure they are building the bridge in the right spot. They also do a lot of mathematical equations, read construction plans, and they use their experience – both good and bad – from previous bridge-building projects. Construction bridges is a challenge!

But how does the bridge get off the ground? Once the pylon towers are finished, the horizontal part of the bridge (*superstructure*) is built. This is the part that you drive, bike or walk on, and is sometimes called the bridge deck. The new IRIB will be built using concrete. The concrete is put into forms that are supported from the ground on temporary steel bridges called *shoring or falsework* (pictured at right). The shoring is made of unpainted steel, which is why it looks rusty. Next, forms will be built on top of the shoring. More rebar will be put inside of the forms (remember the skeleton?) and also long wire cables called *post-tensioning* strands. Section-by-section, fresh concrete will be put inside of the forms, just like chocolate inside of a mold. Once the concrete hardens or *cures*, the section of the bridge is attached to *cable stays*. These cables are pulled and attached at the other end to the pylon, forming a diagonal arrangement between the vertical pylon tower and the horizontal bridge superstructure. Once these operations are finished, the shoring is removed.

How much will it cost to build the bridge?

Approximately $150 million

How much does the average engineer make in salary per year?

Salary range for an engineer with less than one year of experience is from $43,700 to $53,400. An engineer with over 20 years experience can make over $100,000.

How much schooling does an engineer need?

Becoming an engineer requires at least a Bachelors of Science Degree in Engineering. To further their career, engineers need additional years of schooling or work experience in a particular type of engineering. Many employers require the engineer to obtain a Professional Engineer's license which requires study, taking and passing a two-day test!

How do they build the center portion of the bridge over the Inlet? During construction of the center part of the bridge deck the bridge builder must construct what is called a *form traveler*. It is a movable form that will hold the rebar and fresh concrete to make the superstructure piece-by-piece. The form traveler weighs 250 tons, and takes 2 weeks to assemble. It is placed on the bridge by a tower crane, attached to the bridge, and supported by one of the cable stays. The form travelers will support the fresh concrete while it cures even while you are fishing underneath it!

How does all of the heavy equipment and materials get moved into position?

The builder uses two *tower cranes* to help with the operations around the bridge site (see photo). Sometimes the tower crane lifts buckets of fresh concrete to the forms. The operator has to stay up in the driver's cab all day since it takes so long to go up and down. How would you like to be working on this crane or the form traveler high above the water?

So what keeps the bridge from falling into the inlet? The Cable Stay strand system looks like a blue pipe on the outside, but don't let that fool you! Inside each pipe are 19 to 59 strands of *high-strength wire* that together make a cable that provides strength needed to balance and hold-up or support the bridge. Each cable is pulled (*tensioned*) according to the amount of load it holds. Interestingly enough, a bridge builder can remove and repair one strand within the cable without disrupting the rest! Think of it as a doctor doing surgery.

How do you make sure the cable stays are strong enough? The cables are put through 2 million cycles of **S—T—R—E—T—C—H—I—N--G** to ensure they can withstand the force that would be exerted on them during a hurricane. Afterwards, a leak test is performed to ensure there was no cracking or damage to the cable stay that might allow water to get in. Water might damage or *corrode* the cables!

AND DID YOU KNOW….

The center part of the pylon tower is hollow and contains only a ladder system, and that someone will have to climb up 249 feet to perform maintenance on the navigational lights on the bridge. **Would you like to be the person doing that job?**

There will be sensors built into to the bridge to tell DelDOT how the bridge is doing in a hurricane. If the bridge sways too much, DelDOT will close the bridge to traffic.

And, last but not least…..

This is truly a worldwide bridge: Cable stays are being tested in **Germany**; wind studies are being done in **Canada**; the traveler form comes from **Norway**; Traveler form is manufactured in **China**; our erection engineering team is from **Hong Kong**; the cable-stay supplier working with the bridge builder is from **France**. This presents challenges such as language, cultures, and time differences. Can you imagine trying to schedule a meeting with everyone?

Other Resources/Links You Can Check Online:
West Point Bridge Project – www.bridgecontest.usma.edu
Skanska.com - (Skanska USA Civil Southeast is the bridge builder of the IRIB)
Largest Cable-Stay Bridges – http://en.wikipedia.org/wiki/List_of_largest_cable-stayed_bridges