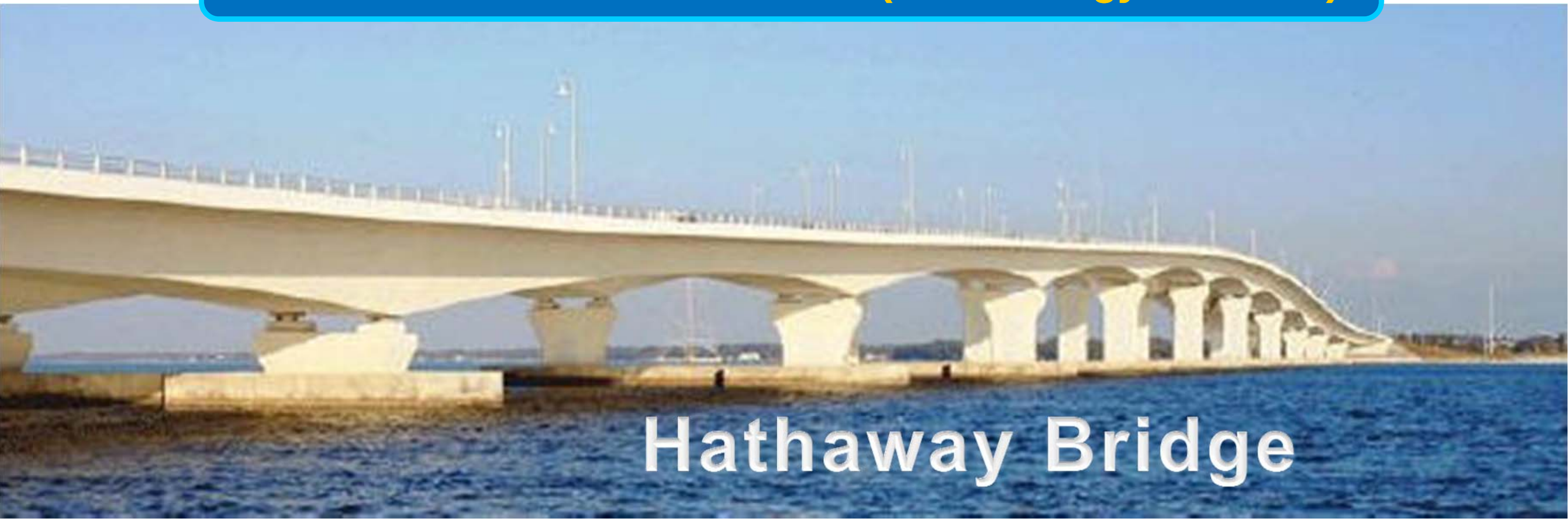
BRUCE HAMMER SUCCESS STORY, BRIDGE PILING

Model SGH-3013 Pile Hammer (Max. Energy 39 ton.m)



The Bruce SGH-3013 successfully completed the pile driving of Hathaway Bridges at Fl, USA

By Florida State University College of Engineering, Fall Semester 2008
A Thesis submitted to the Department of Civil and Environmental Engineering in partial fulfillment of the requirements for the degree of Master of Science and The Office of Graduates Studies has verified and approved.

History of Hathaway Bridge

The First Hathaway Bridge was built in 1929 and was originally known as the St. Andrews Bay Bridge. It was later renamed The Hathaway Bridge after Franz Hathaway,who was Chairman of Florida's State Road Department, the predecessor to the Florida Department of Transportation (FDOT). For its time the St. Andrews Bridge was a remarkable achievement in engineering. It utilized 16 Parker through-truss spans that were 160 to 225 feet in length and 31 to 38 feet high with a 20 foot-wide roadway. To 14 accommodate shipping traffic the bridge encompassed a 200 foot long Warren through truss "swing span" that would open and close as needed. (Bridgepros)

Figure 2 – *Hathaway Bridge 1929*

By the mid 1950's the Bridge was becoming functionally obsolete and structurally deficient. So in 1960 the second Hathaway Bridge was opened to the public, this new bridge was more than three times wider than the original with double the number of lanes on a 62 foot wide roadway, four 13-foot lanes with two in each direction of traffic.

However, like many other bridges built in the 1950's the Hathaway II Bridge as its affectionately known was built with a sense of practicality and economy. It was a utilitarian structure with three foot outside shoulders, a four foot raised center median, no pedestrian access, no dedicated bicycle access, and no "refuge lane" for broken down vehicles. A small accident or a stalled vehicle could create huge traffic snarls and bring traffic to a standstill. (Bridgepros)

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Figure 3 – *Hathaway Bridge 1960*

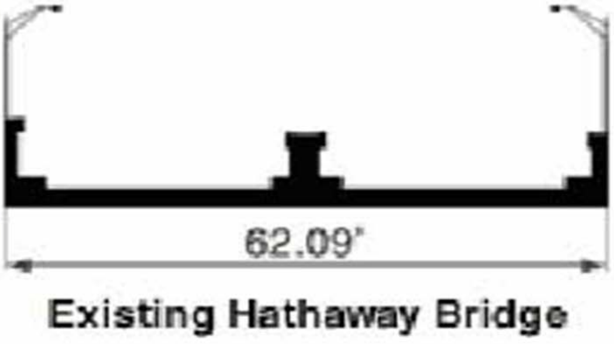


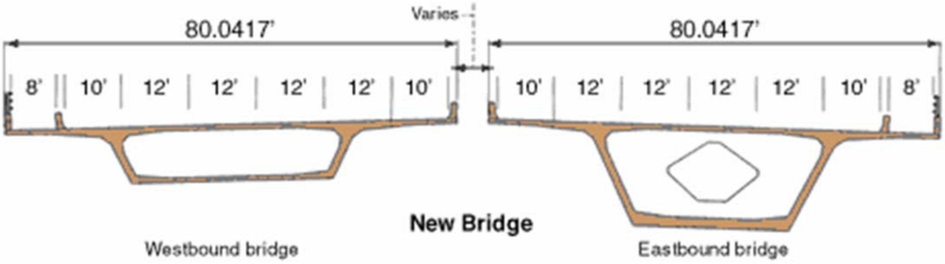
Figure 4 – Old Hathaway Bridge Width

With the population boom in Florida after 1960 the Hathaway II would become obsolete by the 1980's. In 1970, an average 15,600 vehicles were crossing the bridge 15 each day. The number doubled by 1982 and approached 57,000 by 1998 By the late 1990's after many failed efforts to alleviate the traffic with trolleys and ferry boats, Panama City wanted to attach a bicycle and pedestrian structure to the bridge but when the price tag jumped $3 million to $8 million dollars the idea was dropped. So in 1997 the Bay County Bridge Authority, the Panama City Metropolitan Planning Organization and the Bay County Tourist Development Council all voted to support the construction of a new bridge. In 1999 the third Hathaway Bridge came to life as the Florida State Legislature appropriated over $80 million dollars for the construction of the new bridge.
By 2020 an estimated 97,700 vehicles will be using the bridge daily.(Bridgepros)

The New Bridges

The new Hathaway Bridge consists of twin, 80-ft-wide segmental concrete box girders. These precast, single-cell bridges have haunched main spans of 330 ft with shorter (approximately 200-ft), constant-depth approach spans. The new bridge is actually two bridges, which will both carry three lanes of traffic, one auxiliary lane and one pedestrian/bicycle lane in a single direction. The new bridges will be built just north of the existing bridge and within existing state right-of-way. No additional property was required for the new bridges, and environmental impacts would be minimal.

Figure 5 – New Bridge Alignment



- Two separate bridges, each consisting of an 80-foot wide bridge deck
- Four 12-foot wide lanes of traffic in each direction
- 10-foot inside and outside shoulders
- 8-foot lane for pedestrian/bicycle traffic on the outer edge, separated from traffic by a concrete "Jersey style" barrier
- One lane in each direction to be used as a auxiliary lane, providing a "refuge lane" for disabled vehicles
- Total Bridge Length: approximately 3800 feet
- Vertical Navigational Clearance: 65 feet (meets minimum navigational height for the Intercoastal Waterway)

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Design Process

The first step the preliminary design team had to develop was the alignment and profile of the bridge. This was developed electronically within an electronic right-of-way limit provided by the design surveyor. This alignment and profile was then used to lay the bridge out and achieve required vertical clearances. Early on when the design team decided that both bridges would be put on the north side of the existing bridge they knew that they would have tight control requirements. Once the Granite ream realized they would be very close to the project right-of-way limit they hired DRMP, who had performed the original survey for the FDOT to confirm that they were in fact within the ROW limits. And in fact they were.

Given the nature of the Design/Build approach, the Granite team had freedom with the design that allowed for much flexibility. They poured over numerous options that included asking the coast guard if they could use a shorter channel span, and also contemplated constructing just one combined bridge.

Once the alignment had been finalized they had a clearly defined design process that would require the development of geotechnical and scour assumptions that were used to design a preliminary foundation system for the bridge that could be quantified.

Simultaneously, superstructure designs using different span lengths were developed so they too could be quantified. To find the best combination of superstructure and substructure design both elements were looked at iteratively. The solutions the design team came up with were then sent to the construction side of the team for input and modification.
This phase of the Design/Build process is why many believe it has huge advantages over the traditional design-bid-build methodology. As this is when there can be a free flowing exchange of ideas about the planning and design between both those on the construction side as well as the design.

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Selection of Pile Hammer & Alternatives Considered

The only parameters given to the Granite team restricted its use of steel girders so they considered many different concrete solutions but focused mainly on segmental boxes and girders. Based on span length, aesthetics, and erection several variations of each choice was considered. Early on in the process the team decided that a combination of both girders and boxes would not be aesthetically pleasing to the public so they turned their attention to the segmental box solution.

For the foundation system for the bridge much research and investigation went into evaluating alternatives. Shaft foundations were cost prohibitive for the soil conditions at the site and steel piles while a good engineering solution were not economical, so they were both ruled out. So they swayed towards the pre-stressed concrete piles, which there were many options.

Again with this being a DB project the team wanted to utilize this freedom and come up with a unique solution for the pre-stressed piles. Granite is based in California so it comes as no surprise that they found the answer to their problem in their own back yard. Because California's seismic requirements are extremely restrictive they only allow a certain type of pile. One type they do allow are pre-cast cylinder piles that are similar to standard square piles and are cast using long-line methods. They are 60 inches in diameter and the Granite team found a manufacturer in Tampa, Fl who can produce them to the required lengths for the foundation without any splicing whatsoever.

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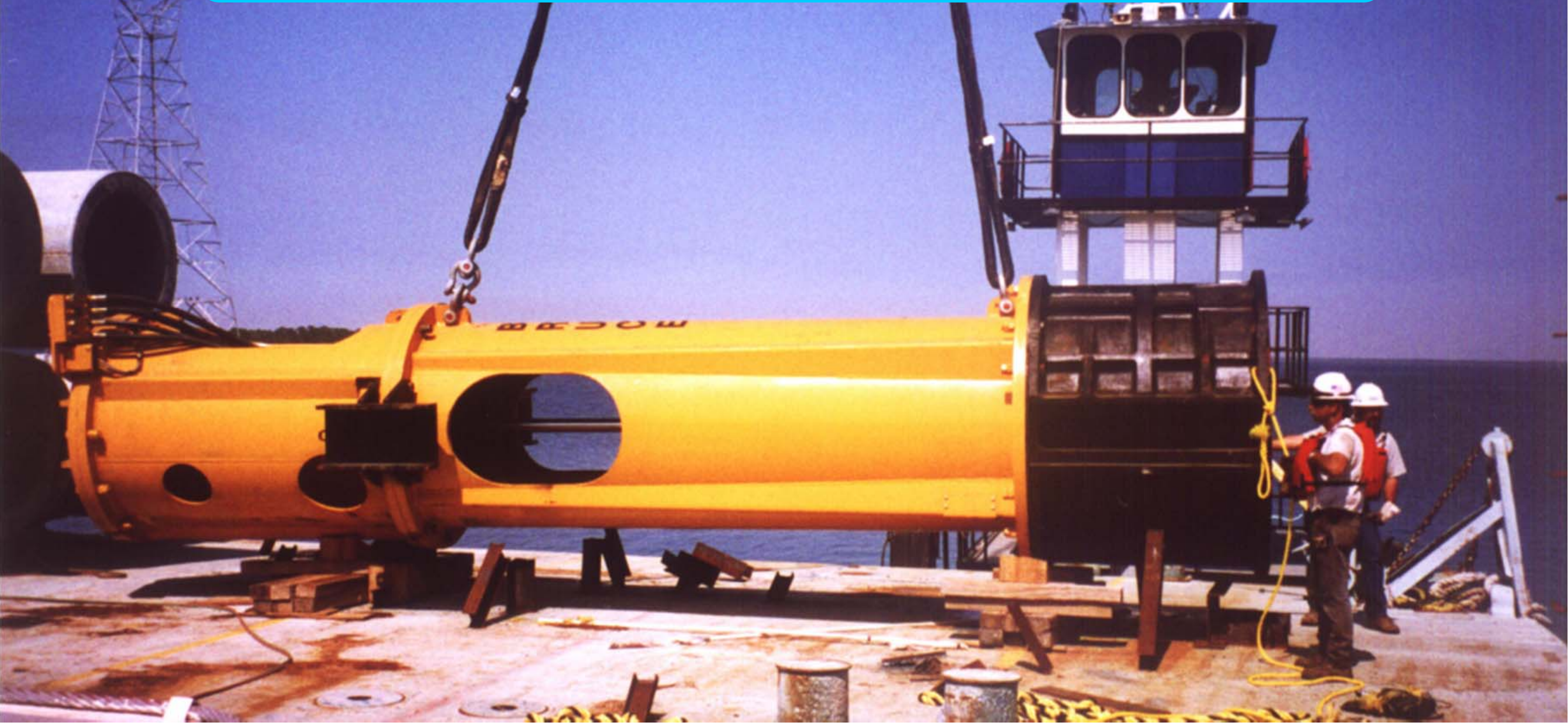

Selection of Pile Hammer & Alternatives Considered

These piles will become one of the highlights of the project. Because of their size, it will reduce the number of piles that have to be driven by a substantial number.

According to Tony there is only two known hammers in the world that can drive these massive piles and one was shipped in from South Korea. The hammer is called the Bruce SGH 3013 for driving 60 inch concrete cylinder pile in the picture below.