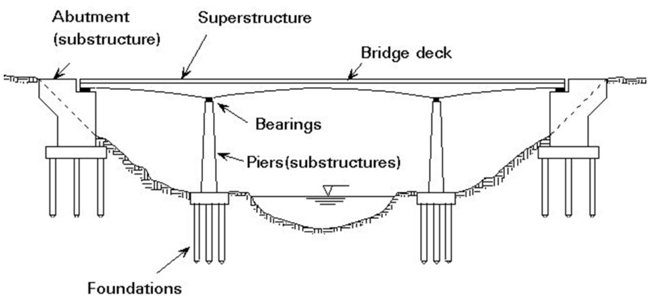
Fall 2016

PORTSMOUTH PROJECT PRESS

A “Simple” Span Bridge



A simple span bridge is by no means a simple structure. From design through construction, a lot of time and effort are required to construct a bridge. A simple span bridge consists of three major components: foundation, substructure and superstructure. This type of structure usually includes abutments and/or piers with beams spanning in between and a cast-in-place deck on top of the beams, as depicted in the diagram to the left. The specific features of the bridge depend primarily upon its intended use; however, the geography, the geologic conditions, construction timeframes, and duration of use all have an influence in its design, construction and cost.

Foundations are the first aspect involved in building a simple span bridge. The geologic studies and exploration will dictate the type of foundations used on the structure, with emphasis placed on the location of competent load bearing soils and bedrock. Common types of foundations include caissons, piling, and footings. Caissons are comprised of cast-in-place concrete columns with steel reinforcement (rebar) placed within. A caisson is excavated with a vertical drill rig using various auger bits to contend with different soil or rock types encountered during excavation. Caissons are usually anchored or socketed into rock at the bottom of the excavated caisson shaft. A rebar cage is then lowered into the vertical excavation and concrete is placed, completing the caisson installation process. Steel piling is another option for foundation placement on bridges. The steel piling is driven into the ground by means of a vertical pile driver or hammer. The pile driver will pound or push the piling into the ground until refusal is met. This can mean one of two things: that the pile has encountered competent bedrock, or the friction of the earth along the pile is adequate enough to bear the required load. The last of the common foundation types is the footing, used when a good load bearing material is close to the surface. A footing, excavated using heavy machinery, is followed by forming a temporary containment of ready-mixed concrete placed to envelop the rebar which hardens before the formwork is removed.

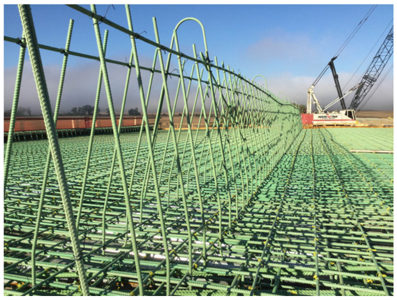
Piles driven for foundation work

Pier and pier cap formation

The second component of a simple span bridge is the substructure. The type of substructure utilized is dependent upon several features including, the type of foundations used, the length of the bridge span, and the height of the bridge above what it spans. Substructure elements can include the following: abutments, piers, pier caps, and wing walls. Abutments are placed on top of either footings or piling and act as the resting place for the end of the beams. The abutment is typically constructed using formwork and rebar, with concrete being cast in the formwork. Piers are constructed when a bridge is required to have multiple spans between abutments, acting as a load bearing structure in conjunction with the pier cap to carry the end of the bridge beams. It, too, is usually constructed using formwork, rebar and concrete. The pier cap is the next item to follow when piers are required in the construction of a bridge. It is placed on the top of a row of piers, acting as a seat for the end of the bridge beams, and transferring the load of the bridge superstructure to the piers below. The pier cap is constructed using formwork, rebar, with concrete being placed in the forms. The last major substructure component are the wing walls, which are placed on each side of the bridge abutments and serve to retain the backfill and materials that are used to construct the roadway and approach slab leading up to the bridge span. The wing walls are typically built using formwork, rebar, and concrete.

After completion of the substructure, the third component of a simple span bridge may be built. The superstructure is made up of bridge beams, bridge deck, parapet walls and median barrier. Bridge beams are next placed on the abutments and depending on the length of

Continued on Page 2



Reinforced steel for bridge deck and parapet walls

Simple Span Bridges

continued

the bridge, piers and pier caps as well. The bridge beams for a simple span structure are typically constructed from steel girders or pre-cast concrete beams. The type of beam used on a project can depend on many variables, including the span of the bridge, the location of the bridge, the load to be carried, and the structure design life.

The next step after beam placement is the construction of the bridge deck. The bottom of the bridge deck is formed between the bridge beams, as well as the ends of the deck. Rebar is then placed on the deck form, and concrete is placed, creating the finished bridge deck. Parapet walls, which act as the safety barrier on the outside edge of the bridge deck, are placed using formwork, rebar and concrete. The median barrier, if required, is placed in the same manner as the parapet wall and serves as a divider between traffic traveling in opposite directions.

Upon completion of the superstructure, the main components of a simple span bridge are in place. Items such as the concrete approach slab, concrete sealants, roadway striping and lighting may then be required to reach the full completion of the project.

The term “simple span bridge” is deceiving. Such structures require countless hours of design and construction to attain a quality, finished product – making them not so ‘simple’ after all.

Bridge Construction Under Way!

Shown here are just some of the 22 bridges in progress

Pictured are Bridges 1a & 1b - Ramp B over U.S. 52 and Ohio River Road - and **Bridge 2 -** Ramp A over Ohio River Road.

At right is Bridge 8, Shumway Hollow Road over S.R. 823. Below left depicts **Bridge 13** over Morris Lane and at the right **Bridge 14** at Flatwood Fallen Timber Road.

At left is Bridge 19, Ramp B, over the Norfolk-Southern Railroad. Below left is **Bridge 16** over Fairground Road and below right is **Bridge 20**, Ramp A/D over the NSRR and U.S. 23.

Dozer grading slope
Seg 1/2a

Hitachi 1200 loading CAT 773 along mainline
Seg. 2b/3a

Construction of haul road along the mainline
Seg. 3b

Drilling rig drilling blast holes for production blast
Seg. 4

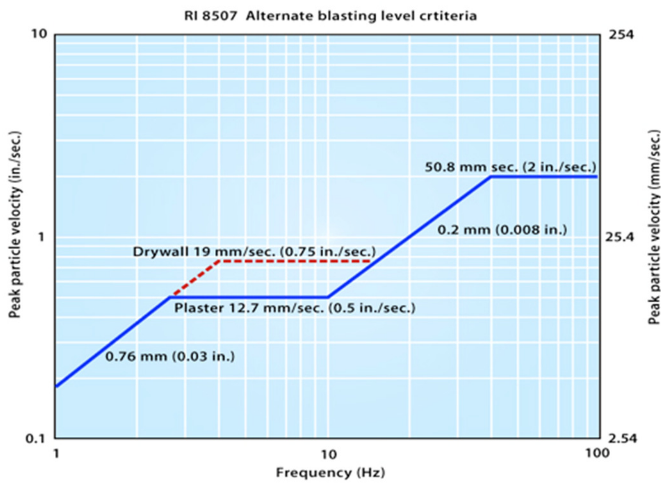
Controlled Blasting – Ground Vibrations Limits

Limits are set for ground vibrations as a preventive measure to avoid property damage, and these limits are rooted in decades of research. There is not one limit in use everywhere; however, one common set of recommended limits was derived from research conducted by the United States Bureau of Mines (USBM). Though the USBM was closed in the 1990s due to budget cuts, the research conducted in the 50 years prior still holds relevant today, with current research still supporting the findings.

The USBM conducted numerous studies over the term of existence, as in USBM RI 8507 recommending frequency (the number of complete waves that pass by in one second) based limits. USBM RI 8485 focused on the affects of an air blast resulting from blasting activities on structures. For air vibrations, the standard is a function of pressure most often reported in decibels (dB), with a common limit of 133 dB (equivalent to 20 mph wind). Recommended ground and air vibration limits are based on scaled distance (a number based on the explosive charge weight and distance from a blast used to evaluate vibration levels); peak particle velocity (PPV, the maximum measurement of the intensity of ground vibrating, specifically the velocity of motion of the ground particles as they are excited by the wave energy); air pressure (the pressure exerted by the atmosphere), and frequency.

Vibration standards are usually plotted graphically, using log (logarithmic or non-linear) scales in both the horizontal and vertical directions. The vibration intensity (PPV in inches/second) on the vertical scale and vibration frequency (Hertz) is on the horizontal scale. Vibrations deemed “allowable” in these standards fall below the central lines; “non-allowable” vibrations lie above the lines. Since not all vibrations felt by people are damaging to structures, the vibrations standards attempt to separate those vibration intensities and frequencies which are potentially damaging to structures from those which may be concerning to people but pose relatively little damage probability. Thus, for a given single blasting-caused vibration lasting less than a few seconds, with ground movement frequency components and velocities below the dividing line, 95 percent of essentially intact residential houses of typical dimensions on firm foundations will not be damaged by that vibration. Using the recommended limits in USBM RI 8507 are for the prevention of cosmetic damage in the most susceptible of materials such as plaster and sheetrock. Other materials including masonry, concrete block and mass concrete can withstand much higher levels of vibration without damage.

In the construction of Southern Ohio Veterans Memorial Highway these limits are adhered to ensure the least likelihood of damage to the properties in proximity of the project.



Who We Are

CH2M, Inc, provides Quality Assurance oversight as a subcontractor to ODOT. The staff of CH2M serve as an extension of ODOT to ensure adherence to the Public Private Agreement (PPA) by all parties associated with the project.

CH2M was founded in 1946 as Cornell, Howland, Hayes, & Merryfield by three Oregon State University graduates, Holly Cornell, Jim Howland, Burke Hayes, and their engineering professor, Fred Merryfield. From their education to their service during World War II, they learned the importance of honesty, integrity, hard work and giving back to their communities, and these values were the guiding principles of the new company from the start.

CH2M is prevalent in many arenas and employs specialists in areas of government, cities, transportation, water, environment, nuclear energy and industry. The company's dedicated staff work in many aspects of design-build, consulting, project management, program management, operations management, construction management and design. A leading infrastructure consulting firm, CH2M has worked throughout the United States, as well as the world. Last year alone CH2M served more than 5,000 clients worldwide.

Continuing in the tradition of the company's founders, CH2M's guiding principles today are focused on safety, ethics and sustainability.

Most Valuable Portsmouth Project Player (MVP3)

PGG congratulates Dan Engelhart – the Fall 2016 recipient of the MVP3 award for the hard work he contributes to the project.

Dan Engelhart serves Beaver Excavating as the project's structures manager. Dan oversees all 23 bridges structures, which includes making sure that more than 900 individual piles and more than 400,000 square feet of mechanically stabilizing earth (MSE) walls are constructed on time and according to plan.

Dan's construction career began at the age of 16 when he began placing concrete driveways. As a young adult, he continued working in the trades, and eventually grew into a supervisory role. Dan's career of more than 20 years has produced some of the most complex and esthetically pleasing works within the structures realm.

Dan says one of the keys to his success is doing things right the first time and taking pride in his work. Dan still drives over bridges he was a part of building many years ago, and he is still in awe. Dan also says that keeping up with the ever-changing construction industry has helped him to continue to be successful.

Dan joined the Southern Ohio Veterans Memorial Highway team in January 2016 and quickly worked to shorten the construction schedule. In his short time with the project, Dan has been able to build an efficient team of 70 to 80 people and continue his legacy of building lasting value. The Portsmouth Gateway Group recognizes Dan as the Most Valuable Portsmouth Project Player (MVP3) for the fall quarter for his talents toward the success of the project.

Dan, his wife Monica, and their three children reside in his hometown of Hartville, Ohio, which is northeast of Canton. In his time off, he enjoys hunting and fishing.

Big Rigs of the Project

Bid-Well 4800

A bid-well machine is used for the placement of concrete on the bridge decks that can be found throughout the project. The idea for the machine came about in the 1960s, and allowing for wider and longer bridge decks, the machine has revolutionized how bridge deck pours are accomplished.

The bid-well consists of a large truss structure that runs on rails placed on the outside edge of the bridge deck. It has one engine that moves the machine along the rails and another engine that operates a powered concrete screed and finishing head. One operator sits atop the truss structure controlling all the machines operations. Concrete is placed in front of the machine by a concrete pump truck, and laborers and concrete finishers tend the concrete in front of the machine, ensuring an even spread for the machine to screed and finish.

The bid-well first uses an auger system to evenly distribute concrete at the front of the finishing head. The next part of a finishing head involves two sets of vibrating rollers that float the concrete out, forcing aggregates lower in the slurry and bringing a cement/sand paste to the top for a smooth finish. The optional third part of the finishing head is a concrete finishing float and a brush or set of tines to provide the desired finish. If this option is not used, concrete finishers follow the machine and manually provide the finish required for the slab surface.

The bid-well provides a much more consistent and smooth product with fewer construction joints. It also reduces the amount of labor and time needed to place a concrete bridge deck.

Project Trivia Fact

There is more than 5,300 feet in bridge span from rear abutment to forward abutment in the construction of the Southern Ohio Veterans Memorial Highway