MOREnet, MODOT and RoundTrips Present:
Bridge Construction 2: Surface Structure

Date: April 17, 2009
Times: 9:00 a.m. to 9:50 a.m. Central Time and 10:00 a.m. to 10:50 a.m. Central Time
Grade Levels: 5-12
Cost: No Fee

Abstract:
How is the surface structure for a bridge constructed? How is it connected to the bridge support structure? What materials are used? How is quality control ensured? Meet the people constructing the Glasgow Bridge over the Missouri River to find answers to these questions and more about building bridges.

Program Description:

The bridge has been designed, public hearings have been held, and funding has been arranged. Construction is well underway with superstructure built for the bridge's approach ramps and additional superstructure being built over the river itself. Now it is time to begin creating the surface structure. Join us live from the construction site of the new bridge going over the Missouri River at Glasgow, Missouri.

What are the steps in creating the surface structure? What materials are used? How is the structure welded together? How is the surface structure for the bridge connected to the bridge support system? What elements are pre-fabricated and what is created on site? How does the installation occur? What are the careers involved in building a bridge? For the answers to these and other questions, join us for our sixth program in our continuing series of programs produced with the Missouri Department of Transportation as they build a new bridge over the Missouri River at Glasgow, Missouri. Interact with construction personnel as they share how they are bringing the design plans to life.

Program Objectives:

1. The participant will explore the essential elements involved in basic bridge design and construction.

2. The participant will interact with experts involved in planning and executing bridge design and construction and learn about their occupations and work process.

3. The participant will gain knowledge about the engineering and construction of bridges.

Program Format:
The program will focus on the construction of the bridge surface structure. Participants will view construction in progress and interact with professionals building the bridge.

Program Order—The videoconference program will consist of the following segments.

1. Welcome and Introduction—Student groups and experts will be introduced and welcomed to the program. Information will be given on the series of interactive programs that will continue throughout the school year as the new bridge is constructed.

2. Creation of the Surface Structure—Students will interact with construction personnel as they take them through various stages of building the surface structure for the Glasgow Bridge. Examples will include:

a. design, materials and construction processes used in building the surface structure
b. construction done so far on the bridge's approach ramps and span structure
c. forms used to create the roadbed
d. comparisons between building a roadbed on a ground surface and roadbed on a bridge surface

3. Summary and Closing—We'll summarize the major concepts learned today, seek final questions from students, and invite participation in the school year series of programs that will follow the construction of the new bridge.

Featured National Standards: (Science)
From the Center for Science, Mathematics and Engineering Education
6.5 Science and Technology Standards
Grades 9- 12
Abilities of technological design
Understanding about science and technology

Featured State Standards (Missouri):
Schools from across the country are invited to join in the program. Missouri state standards are provided for Missouri schools since funding for this program comes from various Missouri organizations.

Show-Me Knowledge Standards (Science)
In Science, students in Missouri public schools will acquire a solid foundation which includes knowledge of:

2. properties and principles of force and motion

Missouri Grade Level Expectations
Strand 2 Force and Motion
Laws of Motion
Work and Simple Machines
Force, Motion, and Work
Interactions between Energy, Force, and Motion

Participant Preparation:
1. Participants should come to the program with an interest in bridges, engineering, math or science.

2. Participants should utilize preparatory materials provided for the program and other resources of their own to better understand the context of the program's subject and to think in advance of questions they wish to ask the experts. Any questions determined in advance, can be e-mailed to us prior to the program at roundtrips@clayton.k12.mo.us.

3. Participants should have pencil and paper ready to use during the program to jot down ideas and additional questions as they come to mind.

Pre-Program Activity Suggestions:

1. Students should explore the Missouri Department of Transportation website dealing with building the new Glasgow Bridge. That website can be found at http://www.modot.mo.gov/northcentral/glasgowbridgeproject.htm. The site includes information about the original bridge, plans for the new bridge, and a web cam showing current work on the bridge. Students should develop questions about what they read to ask during the program or to send to us in advance of the program at roundtrips@clayton.k12.mo.us. Teachers might want to divide the class into groups and have each group investigate a specific part of the website to explore in depth. Students can then share their learning with the rest of the class and present the questions they have developed to ask of the program's experts.

2. Have students explore the PBS website http://www.pbs.org/wgbh/nova/bridge/build.html and play the game to build the bridge they believe is best for the locations shown. What questions do they have for the program's based on this experience?

3. View videos of bridges being built, their infrastructure and more at the How Stuff Works website ttp://videos.howstuffworks.com/tlc/28828-understanding-history-of-bridge-construction-video.htm. Students could split into small groups to view different videos and share what they have learned with each other. What questions do the students how that they would now like to ask the experts involved in the videoconference?

Post-Program Activity Suggestions:

1. As a follow up to this program and as a lead in to the other programs in the upcoming series, have students create a list of questions they have about "what happens next" in the construction of the new bridge. Send those questions to us at roundtrips@clayton.k12.mo.us for MODOT experts to answer and reply to your students.

2. Have students share what they found most interesting and potentially frustrating about the careers they saw today. What would they like or dislike about being an engineer or bridge builder?

3. Have students check out the wide variety of weblinks at the About.com site on Architecture of bridges. Here they'll find tutorials on the basics of how bridges work, can participate in a bridge building challenge, learn about bridge coating materials and more. The website is http://architecture.about.com/od/bridgegallery/Bridge_Construction_and_Engineering.htm.

Vocabulary:

Live Load--The force exerted on a bridge as a result of the traffic moving across the bridge.

Dead Load--The force exerted by a bridge as a result of its own weight.

Dynamic Load--The force exerted on a bridge as a result of unusual environmental factors, such as earthquakes or strong gusts of wind.

Truss--A structure that consists of a number of triangles joined to each other.

Substructure--The understructure support of the bridge including foundation, piers, bents, caps, columns, footings, etc.

Abutment-- Point of contact between two objects or parts

Tension—In physics, tension is the magnitude of the pulling force exerted by a string, cable, chain, or similar object on another object.

Compression—Physical compression is the result of the subjection of a material to compressive stress, resulting in reduction of volume. The opposite of compression is tension.

Bending—In engineering mechanics, bending (also known as flexure) characterizes the behavior of a structural element subjected to an external load applied perpendicular to the axis of the element. A structural element subjected to bending is known as a beam. A closet rod sagging under the weight of clothes on clothes hangers is an example of a beam experiencing bending.

Torsion—In solid mechanics, torsion is the twisting of an object due to an applied torque.

Shear—A shear stress is defined as a stress that is applied parallel or tangential to a face of a material, as opposed to a normal stress which is applied perpendicularly. In other words, considering that weight is a force, hanging something from a wall creates a shear stress on the wall, since the weight of the object is acting parallel to the wall, as opposed to hanging something from the ceiling which creates a normal stress on the ceiling, since the weight is acting perpendicular to the ceiling.

Arch Bridge--The main supporting structure in an arch bridge is one or more curved elements. The dead and live forces that act on the arch bridge are transmitted along the curved line of the arch into abutments or supporting structures at either end. These abutments are sunk deep into the ground, into bedrock if at all possible.

Beam Bridge--The simplest type of bridge consists of a single piece of material that stretches from one side of a barrier to the other side. That piece of material—called a beam or girder—rests directly on the ground on each side or is supported on heavy foundations known as piers.

Suspension Bridge--In a suspension bridge, thick wire cables run across the top of at least two towers and are anchored to the shorelines within heavy abutments. In some cases, the roadway is supported directly by suspenders from the cables. In other cases, the suspenders are attached to a truss, on top of which the roadway is laid. In either case, the dead and live loads of the bridge are transmitted to the cables, which, in turn, exert stress on the abutments. That stress is counteracted by attaching the abutments to bedrock.

Cable-Stayed Bridge—A cable-stayed bridge is a bridge that consists of one or more columns (normally referred to as towers or pylons), with cables supporting the bridge deck.

Series Information:

This program is the seventh of a ten part series of programs dealing with the Missouri Department of Transportation building a new bridge over the Missouri River at Glasgow, Missouri. Schools may sign up for one program or any combination thereof. More information about the entire series of programs, including archived versions of previous programs in the series can be found at: http://mobridge.more.net.