



Heartland Science



Ohio's Legacy of Discovery & Innovation



Construction

From Malls to Memorials

Brooklyn Bridge Model

The Covington and Cincinnati Bridge over the Ohio River, designed by John Roebling and built between 1856 and 1867, became a wonder of the 19th century world and was the prototype for Roebling's celebrated Brooklyn Bridge.



The bridge was renamed the Roebling Suspension Bridge after designer John Roebling in 1984. At the time of its completion in 1867, its 1,057-foot span was the longest in the world. It crosses the Ohio River between Covington, Kentucky, and Cincinnati, and remains one of the nation's foremost suspension bridges.

Cincinnati was already a major city in 1850, with a population of over 115,000. It ranked sixth in the U.S. at the time. Its neighbors of Covington and Newport had more than 20,000 residents. The ferries used to cross the river no longer could keep pace with the demand for transport. The new bridge took over a decade to complete due to prior laws restricting piers in the river, budget problems, and the Civil War. It opened in December 1866 at a cost of \$1.8 million. Not only was it the

longest suspension bridge at the time but also the first to incorporate vertical suspenders and diagonal stays in its design.

The bridge charged a toll to those crossing it until the early 1960s. Original charges were 15 cents for a horse and buggy, 25 cents for three horses and a carriage, and a penny for pedestrians.

Roebling later built other suspension bridges in Pittsburgh and Niagara Falls. He died in 1869 as he was selecting a pier site for the Brooklyn Bridge.





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Golden Gate Bridge's Roots

Joseph Strauss, a Cincinnati native, was a noted civil engineer who in 1937 helped design the Golden Gate Bridge in San Francisco. The Golden Gate is a wonderful example of Art Deco design that spans a submerged cleft in the Coastal Mountain



Range called the Golden Gate. It is almost 9,000 feet long (about 2 miles) and joins north San Francisco and Sausalito, California. There were many challenges to bridge designers: rough ocean waters, high winds, the width of the waterway, and the huge expense. Plans for a bridge to span the waterway began in 1916. For the next 15+ years the bridge underwent many design changes on paper. In 1929 Joseph Strauss was appointed as Chief Engineer; he budgeted construction at about \$27,165,000. At the time it was the largest suspension bridge on the globe. The Golden Gate Bridge is the result of the joint effort of Joseph Strauss, Clifford Paine, engineer Charles A. Ellis, and consulting architect Irving F. Morrow. The bridge was



paid for by San Francisco and five north coastal California counties. Construction was relatively speedy, taking only 52 months to complete. It opened May 27, 1937, at a cost of \$27,125,000 - under budget. Strauss was also a pioneer in building safety. He required workers to wear hard hats (an innovation at the time) and undergo daily sobriety tests.

Saving Fort Point

While the original plans for the construction of the Golden Gate Bridge recommended destruction of Fort Point, a civil war-era brick structure, Joseph Strauss insisted on saving the building and designed around it. In doing so, a large portion of the cliff behind the fort was removed, and the cables were anchored there. The fort was used as base offices for construction, and then the building was preserved and today is a popular tourist attraction, and became a National Historic Site on October 16th, 1970.



Find Out More...

- [PBS The American Experience: Golden Gate Bridge](http://www.pbs.org/wgbh/amex/goldengate)
(www.pbs.org/wgbh/amex/goldengate)
- [Golden Gate Bridge Historic Photos](http://www.goldengatebridge.org/photos/history.htm)
(www.goldengatebridge.org/photos/history.htm)
- [Fort Point NHS - Golden Gate Bridge Exhibit](http://www.nps.gov/fopo/exhibits/ggb.htm)
(www.nps.gov/fopo/exhibits/ggb.htm)
- [Golden Gate National Recreation Area](http://www.nps.gov/goga/home.htm)
(www.nps.gov/goga/home.htm)



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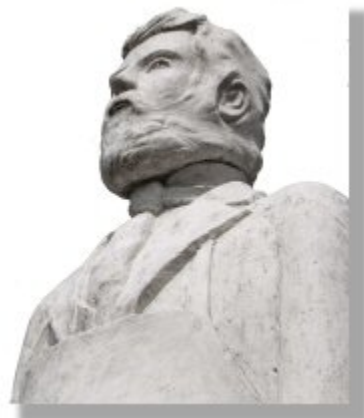
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Street Pavement Pioneers

George W. Bartholomew, of the Buckeye Cement Company, and his contractor William T. G. Snyder, laid the first concrete street in America along Main Street in Bellefontaine in 1891. Their design used results of scientific research on concrete, cement, foundations, and drainage design that were intended to keep the pavement from cracking. Other pavement builders adopted their approach for streets and roads build around the country.



Bartholomew, an engineer, first proposed the idea of concrete pavement to Bellefontaine city officials in 1889. That was 19 years before Ford's Model T, the first mass-produced automobile, began zipping down America's streets. Streets in those days were a mess. Some had crude paving made from logs, wooden planks, or stone. Most, however, were just dirt. Dirt roads served the public well in winter, when everything was frozen solid. In wet weather, however, roads were quagmires of mud, often ankle deep. It splattered pedestrians and trapped horses and horse-drawn wagons. During dry summer weather, traffic kicked up clouds of dust that coated people and buildings.



Bartholomew thought that concrete paving could clean up the mess, and speed the flow of traffic in all kinds of weather.

Laying large slabs of concrete, however, required solving a number of problems. Concrete slabs need a firm foundation, for instance, to prevent cracking. It must be built in a way that allows water to drain without washing away the foundation material.

After experimenting with different construction methods, Bartholomew was ready to build pavement that would last. The first 8-foot-wide strip of concrete went down on Main Street along the side of Bellefontaine's Courthouse Square. In 1893 and 1894, city officials paved Court Avenue, Columbus Avenue, Opera Street, and more of Main Street. Some of the original pavement still remains. Bellefontaine has converted the area into a pedestrian mall with a monument to Bartholomew.



Did You Know?

- The first concrete highway in the United States was a 24-mile long, nine-foot-wide, five-inch-thick strip of concrete pavement built near Pine Bluff, AK,, in 1913.
- President Woodrow Wilson in 1916 signed the first Federal Aid Highway Act, which allowed the federal government to help states pay the costs of road building.

- In 1919, Oregon became the first state to put a fuel tax on gasoline to pay for road construction.
- Federal and state excise taxes on each gallon of gasoline and diesel fuel still build and maintain American's roads. In 2004, the Federal gasoline tax was 18.3 cents per gallon. State taxes added up to 30 cents a gallon more.
- The Pennsylvania Turnpike, built in the 1930s, was the first major intercity turnpike, or tollroad, completed in the U.S.
- According to the National Scenic Byways Program, Ohio's historic National Road paved the way west through the newly formed states of Ohio, Indiana, and Illinois and provided a direct connection to the mercantile and political centers of the east coast that helped to secure the influence and viability of these new settlements. As much as the road's boom times during the early- and mid-nineteenth century signified its importance to national commerce and expansion, its decline during the late-nineteenth and early-twentieth centuries reveal the meteoric rise of the railroad as the primary means of transport and trade across the nation. Likewise, the renaissance of the National Road in the early twentieth century reflects the growing popularity of the automobile.

Find Out More...

- [Pennsylvania Turnpike History](http://www.pahighways.com/toll/PATurnpike.html)
(<http://www.pahighways.com/toll/PATurnpike.html>)
- [Why Concrete Pavement?](http://www.ne.pavement.com/why.html)
(<http://www.ne.pavement.com/why.html>)



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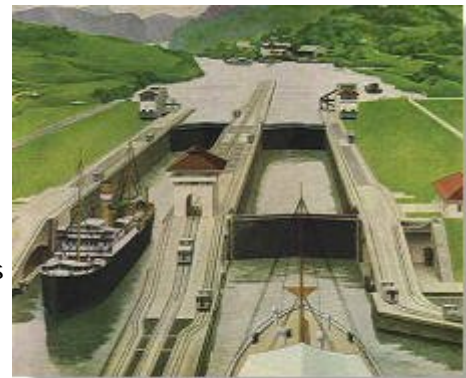
From Malls to Memorials

Moving the Earth

Edward Huber in 1884 founded a factory that developed world-renowned steam shovels and other earth-moving equipment in Marion, Ohio. The Marion Power Shovel Company's powerful machines -- steam shovels, dipper and elevator dredges, ballast unloaders, railroad ditchers, log loaders, and other machinery -- helped build the Panama Canal, Boulder dam, highways, bridges, tunnels, pipelines, and thousands of other ambitious construction projects. Marion's steam shovels also dug coal that fueled electric power plants and factories. In the 1960s, NASA called on Marion to build the world's biggest land vehicles for transporting fully assembled Saturn V rockets.



Steam shovels were invented in the 1830s and had been used in construction and mining since the 1840s. However, Marion engineer Henry M. Barnhart introduced improvements in design that made steam shovels more efficient and reliable. They are earth-moving machines with a hinged bucket on the end of a long boom. The operator digs by scooping up material into the bucket. Steam shovels got that name because the first ones were operated by steam. Today's machines have diesel engines and are sometimes called power shovels.



Marion, now owned by Bucyrus International, supplied 24 of the steam shovels used in the digging of the Panama Canal. In May of 1912, one of Marion's 3.8 cubic meter (five cubic yard) machines, set a world record by moving 4,247 cubic meters (5,554 cubic yards) of material.



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Steel Construction Pioneer

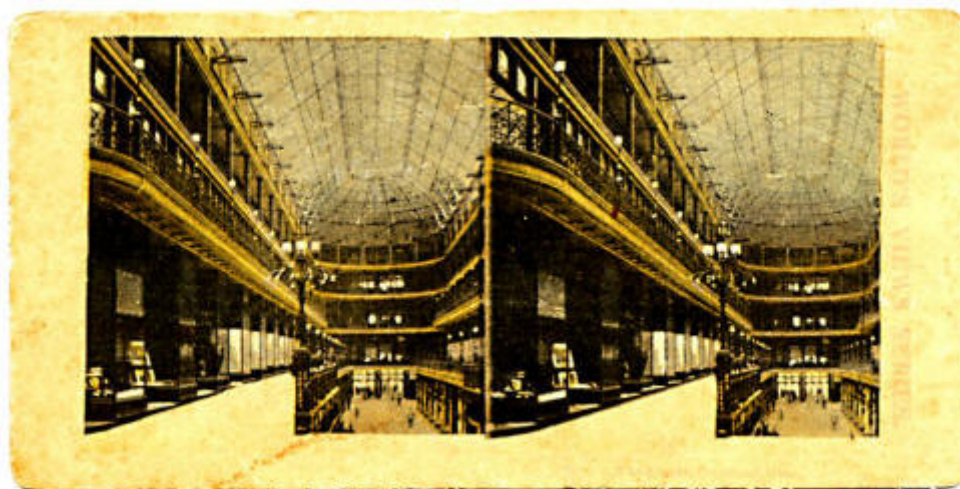
John Eisenmann (1851-1924) pioneered structural steel construction in the United States in the late 1800s. It substituted metal beams and other metal supporting material for the wooden beams that had been used in the past. With structural steel, buildings could rise higher and take on new architectural shapes, while being extremely strong. Eisenmann also drafted the nation's first comprehensive building code, which was for the city of Cleveland. Building codes are regulations that control design and construction of buildings and the kinds of materials that can be used in them. They have played a major role in making all kinds of buildings – from single-story homes to the highest skyscrapers – safer and more pleasant. Eisenmann, the first professor of civil engineering at the Case School of Applied Science, co-designed the "Arcade," which was the first commercial building in Ohio to be designated as an historic landmark in architecture.



Eisenmann was instrumental in helping to erect a famous memorial to Oliver Hazard Perry. In 1813, Perry had commanded an American fleet that defeated the British at the Battle of Lake Erie. Eisenmann thought a memorial appropriate and developed a watercolor proposal. He also selected a spot on the Lake Erie Islands for construction. While another design was ultimately selected for the monument, Eisenmann's suggested location of South Bass Island was where the Perry memorial was erected in 1912.



Eisenmann also designed the Ohio State Flag in 1902. It is unique in the United States – the only birgee, or pennant shaped state flag.



"Early stereopticon photo card view of Cleveland Arcade"

Visit the Arcade

Located at 401 Euclid Ave, Cleveland OH 44114, The Arcade was the first Cleveland building added to the National Register of Historic Places.

Find out more...

- [Cleveland Arcade History and Photos](http://www.clevelandskyscrapers.com/cleveland/arcade.html)
(<http://www.clevelandskyscrapers.com/cleveland/arcade.html>)
- [Ohio State Flag](http://www.50states.com/flag/ohflag.htm)
(<http://www.50states.com/flag/ohflag.htm>)
- [A Monument to Perry](http://www.nps.gov/pevi/HTML/monument.html)
(<http://www.nps.gov/pevi/HTML/monument.html>)
- [History of the Stereopticon](http://www.bitwise.net/~ken-bill/stereo.htm)
(<http://www.bitwise.net/~ken-bill/stereo.htm>)



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Vietnam Veterans Memorial

Maya Ying Lin, a native of Athens, Ohio, designed the Vietnam Veterans Memorial in Washington D.C. Sometimes called "The Wall," the famous tribute lists the names of more than 58,235 men and women who died in the nation's least-popular war. Its goal was to honor the 2.7 million veterans who served in the war, while separating the issue of their sacrifices from the U.S. policy in the war. One of the most popular tourist attractions in the nation's capitol, it attracts more than 4.5 million visitors each year.



Ling was an undergraduate architecture student at Yale University in 1959, when a nonprofit group called the Vietnam Veterans Memorial Fund, Inc. (VVMF) announced a nationwide competition to design a memorial. She entered the contest, along with 1,420 other individuals. A jury of eight internationally recognized artists and designers judged the entries, and picked Ling's design as the winner. She also served as a consultant during construction of the Memorial.



What was Ling's vision?

"I saw the Vietnam Veterans Memorial not as an object placed into the earth but as a cut in the earth that has then been polished, like a geode," she recalled. "Interest in the land and concern about how we are polluting the air and water of the planet are what make me want to travel back in geologic time to witness the shaping of the earth before man."

She wanted to create a quiet, protected place within Constitution Gardens, the area bordering Constitution Avenue in downtown Washington that would be the memorial's site – a park within a park. The dedication, which took place on November 13, 1982 during a four-day salute to Vietnam veterans, revealed a simple yet stunning panorama: polished black granite walls with a mirror-like surface stretch into the distance toward the Washington Monument to the east and the Lincoln Memorial to the west. As visitors draw nearer, what appear to be white lines on the wall surface come into focus as words, and then the words become names – thousands upon thousands almost without end.

Families and friends of those listed on the memorial often make rubbings of the names on the wall. They find a specific name by consulting index books available at each end of the wall. Ling's name appears on a panel on the memorial, along with those of the officers of the Vietnam Veterans Memorial Fund, architects, and others who helped make it a reality.