

On December 15, 1967, the Silver Bridge of Point Pleasant, West Virginia, collapsed into the Ohio River. The accident killed 46 people. Had it occurred during a busier time, there could have been many more fatalities.

In response to this accident, the nation's attention was focused on bridge safety, inspection, and maintenance. The Federal Highway Act of 1968 demanded national standards for bridge safety. It also called for a new program to train bridge inspectors.

Why are bridges subject to failure? If a bridge is stable during the first few months of its use, why doesn't it continue that way? The answer involves the forces and stresses on the bridge, and the materials that are used to construct the bridge.

Until the mid-1800s, most bridges were made of wood, stone, or brick. Then engineers began using steel in bridges. Steel is a mixture of iron and other metals, and it includes carbon. Steel is extremely strong and stiff, and it makes long bridge spans possible. Today, all major highway, railroad, and pedestrian bridges are made of steel.

Although steel can last a long time, it is not permanent. The iron in steel will combine with oxygen in the air to form iron oxide, a substance also known as rust. Rust is soft and crumbly, making it a poor building material. The greater the extent of rust on a bridge, the weaker the bridge becomes.

A simple way to prevent rust is by painting the steel. The paint acts as a barrier between the iron in the steel and the oxygen in the air, so rust cannot form. At the Golden Gate Bridge, a team



The steel of the Golden Gate Bridge is covered in orange paint. Why is the paint important?

of 28 painters have the continuous job of painting any rusted metal that they find.

Inspectors try to pay special attention to the places where steel beams or cables are joined together. If rust weakens these joints, the parts could move as vehicles cross the bridge. A moving beam or cable could in turn apply stress to other parts of the bridge, causing further damage.

All bridges are subject to a variety of forces. These forces include the weight of the bridge itself, called the dead load, and the weight of bridge traffic, called the live load. Weather, especially severe storms that can result in both high winds and fast-moving water, also apply forces to a bridge. Sometimes a sudden force strikes a bridge, such as an earthquake or a collision of a vehicle with the bridge structure.

When forces are applied to a bridge day after day, and year after year, the structure of the bridge can change in subtle ways. Bolts can gradually loosen and weaken. Cables can fray at their edges. Beams can bend or sag. Tiny cracks can form in the steel due to stress, rust, and other factors.

There might not be any obvious change to the structure of a bridge over time because these changes happen so slowly. Yet as time passes, the changes could worsen and accelerate. If uncorrected, the bridge could fail suddenly and without warning.

Today, bridges throughout the country are inspected regularly. Inspectors may recommend preventive maintenance, which is designed to stop problems before they occur. Inspectors may also demand corrective maintenance, which is the fixing of a problem. In some cases, especially as a bridge ages, the inspectors may recommend that the bridge be closed at some future date.

What bridges are important in your community? Choose one of these bridges and research its history. Find out when it was built, what needs it meets, and how it is maintained.