

Bridges and Tunnels can be Safe

By Gil Woolley

Loss of life is the obvious reason to be concerned about the collapse of an Interstate bridge in Minneapolis, a falling slab of concrete in a Central Artery tunnel and other recent failures of bridges and tunnels in the US. There is also a serious environmental issue. All large structures incorporate enormous investments of energy; to make the cement and steel, to transport materials to the site and to prepare the site for construction. This energy is wasted when the structure fails, and more energy is used to remove the debris and replace the structure.

These are more than sufficient reasons to make bridges and tunnels more durable. The Romans knew how to do it. The Pont du Gard in Provence, France, was built in AD 17 and is still in usable condition. This bridge is built of stone, but all over the world there are road and rail bridges made of iron and steel, some two hundred years old that are still in use. These include the first bridge made of iron, built in 1779 at Coalbrookdale, England. Many functioning old railroad bridges are over saltwater estuaries, making them more likely to rust than in Minneapolis. New York City has several old rail and highway bridges that are still in use, including the Brooklyn Bridge, built in 1870.

I think that the “secret” is that the builders built as well as they knew how. But the current practice of leaving a lot of the design to the contractors, and awarding the contract to the lowest bidder, doesn’t encourage adding additional material to make the structures stronger and safer. And the cost of rebuilding or replacing the structure falls on the next generation, not on the contractor who was responsible for the failure. I believe that the only way to get safer and more durable public structures is for the contracting government agencies to take more responsibility for the design of bridges and tunnels. In the computer industry, where I once worked as a Reliability Engineer, field failures are also very costly. We did not rely on suppliers of materials and components to meet our reliability requirements, but used our own experience and judgment to require suppliers to make purchased materials and products reliable.

Today there are computer programs that allow quick analysis of the design of structures like bridge trusses and tunnel shells. But good engineering judgment is also required. For example, having heavy slabs of concrete, located over travel lanes, supported solely by bolts retained by epoxy, is not acceptable practice.

There is hope, however. “In October, the Federal Highway Administration will begin enforcing new rules for bridge design, meant to make new structures more efficient, more reliable, safer and longer lasting” (New York Times, August 7, 2007). Even if, initially, they are inadequate, they can be enhanced. These rules should be tightened up based on experience.

In the long run, rust is the enemy. Rust reduces the cross section of steel members and, consequently, their strength. Iron and steel structures must be prevented from rusting. At least once a year the structural members must be inspected, any trace of

rust removed and rust resistant paint applied. Look at any steel structures in Massachusetts, and you will probably see rust.

In reinforced concrete structures, water must be prevented from reaching the steel reinforcing rods (“rebar”). This means regularly sealing any cracks in the concrete.

Why doesn't the state maintain its bridges and tunnels? Perhaps the most important reason is that maintenance comes out of state funds, while federal funds are available for replacement and major rebuilding. Another is that maintenance has to compete for funding with new bridges, tunnels and highways. In the Legislature, new will always prevail. The US should provide positive incentives to encourage maintenance instead of neglect. It should be mandatory to allocate some significant percentage of the capital budget for maintenance,

Until this is done, states will continue to neglect bridges until they fall down, and chunks of concrete will continue to fall into tunnels. Hopefully the publicity given to recent failures will overcome resistance to change.

Gil Woolley is a retired engineer and longtime member of the Sierra Club