NSBA White Paper

ADVANTAGES OF STEEL OVER CONCRETE FOR BRIDGE DESIGN AND CONSTRUCTION

FIRST cost, life-cycle costs, and environmental effects favor steel as the material of choice for bridges. Aesthetics may also become a factor when the local communities get a chance to weigh in on the material choice, sometimes overruling costs.

First cost

INITIAL cost is greatly affected by design. The industry is now working to help designers and owners achieve the most efficient designs possible. Long spans and curved spans are nearly always steel designs.

- **New High Performance Steels—**Developed specifically for bridges by a collaborative consisting of the Federal Highway Administration, the Navy, and the steel industry, these new steels and weathering steels boast greater toughness and weldability at affordable prices. They have greatly rejuvenated the market for steel bridges, doubling the market since 1995.

- **Decreased Weight—**One of the biggest advantages of steel is weight savings, which means lower erection costs, since the bridge pieces can be handled with lighter equipment. In addition, for the same span and load, a steel girder requires less depth than a concrete girder, which can be helpful when constrained by vertical clearance requirements.
- **Faster Erection—**Steel components are made to closer tolerances, which often translates into faster erection.
- **Lighter Foundations—**If the substructure and superstructure are designed properly, the lighter weight of steel will allow lighter foundations than for concrete.
- **Structural Efficiency—**Generally, it's easier to make spans continuous for both live and dead loads and to develop composite action with steel designs rather than with concrete ones.

Life-cycle cost

MANY factors affect the life of a bridge beyond whether or not the superstructure is comprised of steel or concrete—such as design, type and frequency of traffic, environment, weather, maintenance and changes in usage and conditions over time. In short, each bridge is a unique case reflecting these factors and the state of the art at the time it was built. Life-cycle performance and the long-term durability of steel bridges have been clearly documented. The long-term durability of concrete in bridges remains uncertain.

It's easier to inspect and determine the structural state of a steel bridge where all the components are visible. The long-term durability and cost-effectiveness of steel bridges will be further enhanced by the use of high performance steels with weathering capabilities.

At one time or another, much has also been made of problems with fatigue in steel bridges. Critics, though, forget that many older steel bridges were designed and built before engineers had a full understanding of fatigue behavior. What is often overlooked is that these bridges have been repaired

with simple bolted field splices without reduction in load capacity or service life.

Historically, decks are the most vulnerable part of a bridge. While replacement of a concrete segmental bridge deck is problematical, steel bridge decks are commonly replaced one lane at a time, permitting uninterrupted but reduced traffic flow.

The environment

STEEL is the most environmentally friendly material used in bridge construction.

Recycled Steel—A principal ingredient of the raw material for steel bridges is scrap steel. Rolled shapes and angles are virtually 100% reclaimed steel from scrap. Plates are about 75% recycled steel. New steel bridge construction in the US annually consumes about 350,000 tons of scrap metal. Demand for steel scrap is so high that virtually 100% of it is recycled instead of sent to landfills. Much of the steel collected from the destruction of the World Trade Center, for example, has already been recycled. New steel bridges annually use recycled steel from hundreds of thousands of old cars that would otherwise mar the landscape.

Longer Spans—Steel permits cost-effective longer spans for crossing streams, lakes, wetlands, and environmentally protected areas. The long spans may eliminate or at least minimize environmental impact. In some cases, the long spans possible with a steel bridge can avoid the need for costly environmental impact studies. Longer spans also reduce the number of piers necessary for a crossing, minimizing the number of elements affecting the aesthetics.

Lighter Weight—Construction impact on an environment is lessened because the lighter weight of steel increases a crane's reach. Also for the same span length, the contractor can use smaller cranes and other equipment.

Faster Construction—Steel bridge structures can be erected quickly while habitat creatures are still in hibernation or otherwise dormant.

Aesthetics

BRIDGES are usually significant structures that have the power to add or detract from the landscape. Their beauty or lack of it has less to do with material selection and more to do with overall design in terms of geometry, proportion, structural concept, and integration with the site. When the local community gets to consider bridge design, nostalgia sometimes plays a role in the replacement of old steel bridges.

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