New bridge's alloy boasts allies in the steel industry

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By Dan Gibbard
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Innovation can be a hard sell in the rigid world of steel, experts say, but a bridge that opened this month in a northern suburb uses a new alloy that state officials believe could become an industry benchmark.

Hailed as stronger, cheaper and more durable, the new steel was developed more than a decade ago at Northwestern University. But it was used to build an entire structure for the first time in a 430-foot span on Illinois Highway 83, just north of Illinois Highway 132 in Lake Villa, which opened at the end of August.

Engineers with the Illinois Department of Transportation decided to use the new steel after it passed a series of industrial tests. It was first used several years ago to shore up a bridge over the Mississippi River near St. Louis.

"I just could see that this was the steel of the future," said Chris Hahin, an IDOT engineer in charge of structural materials and bridge investigations.

Northwestern professors Morris Fine and Semyon Vaynman began working on the metal in 1990, experimenting with a process called precipitation hardening, which Fine helped refine in the 1960s.

They hit on a formula that mixes iron with copper and nickel instead of high amounts of carbon. The steel is rolled into plates at high temperatures, and when it cools the copper helps form a tough structure of interlocking atoms.

The resulting alloy is not only stronger but much easier to weld than high-carbon steel, and it weathers the elements so well it never needs to be painted, leaving it a perpetual rusty-brown color.

The steel costs a little more--an extra 6 to 10 cents a pound, Hahin said--as much as $100,000 for a 500-ton project like the Lake Villa bridge. But the state saved $300,000 in initial painting costs for the $5.75 million project, he said, and bridges often need to be repainted several times over the decades.

Being engineers, Fine and his colleagues speak of their accomplishments in obscure terms: nano-size precipitates; Charpy impact tests; ultimate tensile strength.

The bottom line: "This is strong stuff," says Mario Biondolillo, a resident engineer for IDOT who oversaw the Lake Villa project.

The old bridge over Metra's North Central Service tracks was held up by eight sets of columns, called piers. The new bridge uses only two piers, particularly impressive because of the sharp angle over which the girders cross the piers, Biondolillo said. Without the new steel's resistance to flexing, that might not have been possible, he said.

Also, it can be made in just about any steel factory, including the mini-mills that are increasingly popular in the steel industry, because they can start with scrap metal instead of iron ore.

Yet for all the advantages the steel's advocates claim, it's unclear what the future holds for the alloy, known officially as ASTM A710 Grade B high-performance structural steel.

From bridges to buildings to ships to military vehicle armor, A710 has numerous potential applications, Hahin said, but it's unclear when or if any of them might happen.

"The engineering and construction community is very conservative," Hahin said. "This steel is becoming a mainstream steel, it just takes a long time."

Northwestern did not patent the copper precipitate formula, so Fine and Vaynman don't stand to profit if it becomes popular. But it's still their baby, and they want to see it succeed.

"We're not marketing people," Fine said. "It's the pride of seeing something you've done being used and being useful.

"We developed the steel, and if it's any good it should be used. We've done our part."

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