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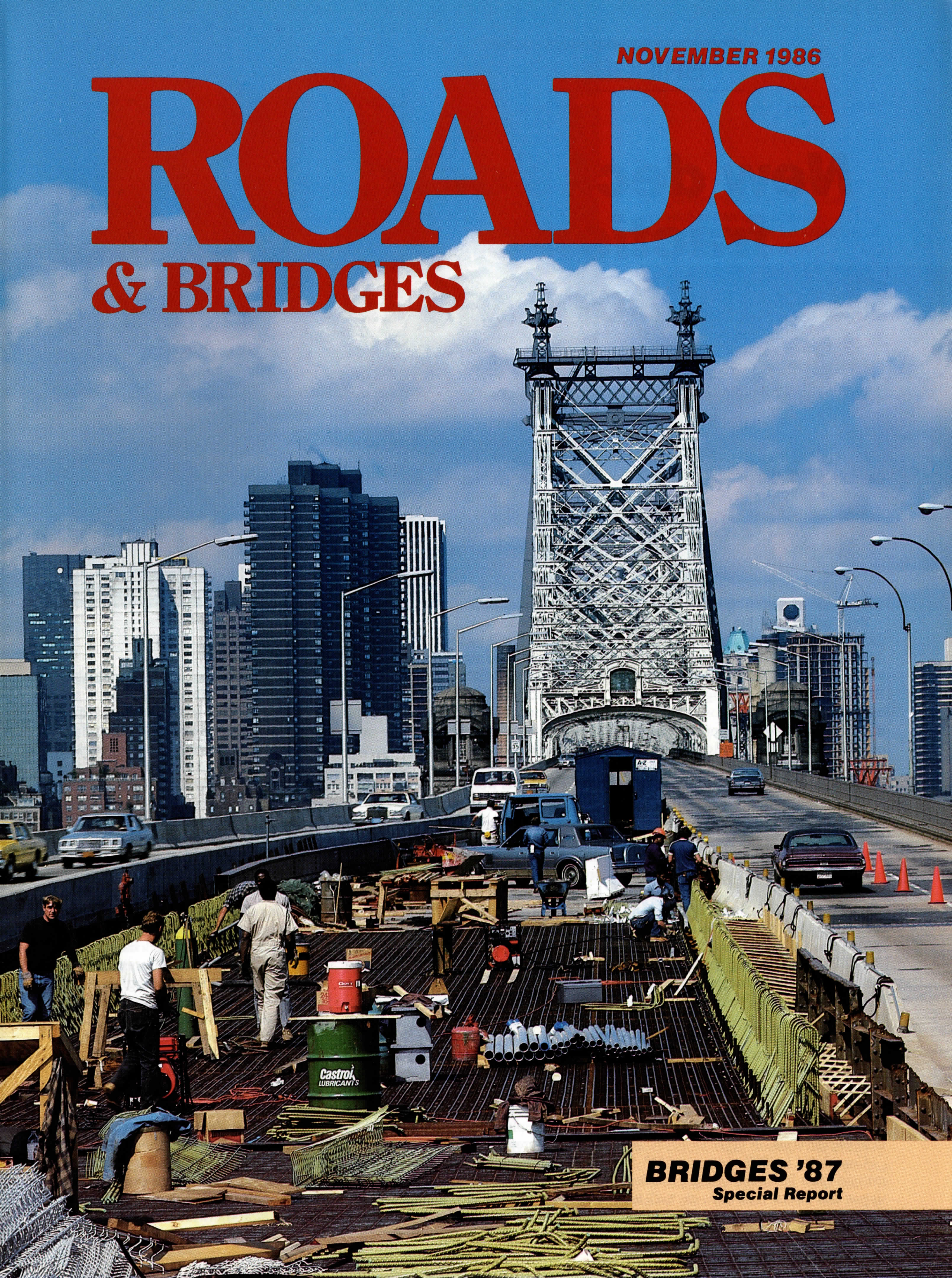
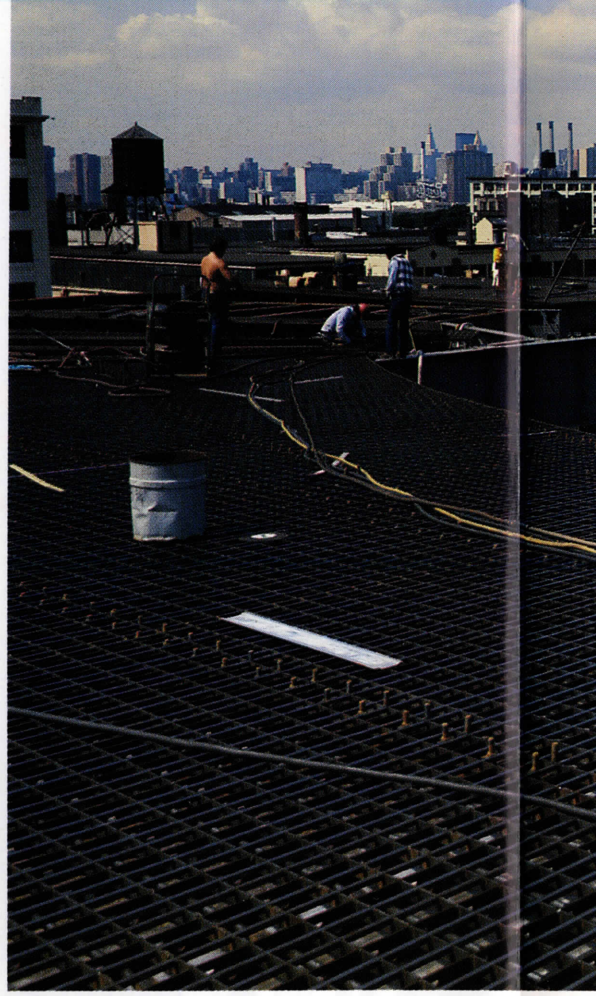
ROADS & BRIDGES



BRIDGES '87
Special Report

New decks only fraction of Queensboro rehab

Steel and concrete both get overhaul as 75-year-old crossing gets $200 million rehabilitation through 1992; unique deck grid anchoring



by Oliver Witte

Almost any statistic about New York sounds big, even to a jaded native of the city. But when it comes to spending for rehabilitating the Big Apple's big bridges, the numbers reach astronomic proportions.

Few bridges in the world are the focus of more money and reconstruction talent today and during the next few years than the city's Queensboro Bridge, linking the boroughs of Manhattan and Queens across the East River. Current work completed or in progress totals $128 million, with another $92 million expected to be spent by 1994.

The Queensboro Bridge is one of the world's most heavily traveled bridges. It carries an average of 151,000 vehicles a day, ranking it as the second busiest route into Manhattan (after the George Washington Bridge). Also known to residents as the 59th Street Bridge, it is the one made famous as the title of the Simon and Garfunkel song.

Unlike the city's other bridges across the East River, which are all suspension bridges, the Queensboro has no suspended spans. It is a double cantilever truss extending for 7,600 ft including approaches, but excluding off ramps. The two center towers stand on Roosevelt Island. Each channel is spanned by two cantilever arms that are connected at the middle of the channel with vertical rocker arms.

Completed in 1909 at a cost of $13.5 million (plus land), the bridge provides upper and lower roadways as well as two outer roadways. The upper level has four lanes and the lower roadway six lanes. All original rail lines have been removed and their right-of-way converted for vehicular use.

So far, reconstruction has been completed on the south upper roadway, including approach ramps, and the pins holding the vertical rocker arms have been replaced.

New work will include rehabilitation of the lower truss members of the main bridge by replacing the steel lacing bars, which form a shoelace pattern. Broken concrete on the pier caps will be removed and replaced with new concrete. A new drainage system also will be built.

Much of this work will be done from the bridge's newly rebuilt "travelers"—two motorized, enclosed steel platforms for each span, suspended beneath the lower level. They move on tracks to provide access to the bottom of the bridge for inspection, maintenance and repairs. The new travelers will be equipped with navigation lights and safety covers for the motors.

A current contract, for $42 million to the Karl Koch Erecting Co., provides for rehabilitation of the north upper roadway and on-and-off ramps. Work now is under way on Approach A to the north upper roadway. When complete this fall or winter, work will begin on Approach B.

The contract includes removal of old deck and replacement with 300,000 sq ft of concrete-filled steel grating by IKG Greulich. On the main bridge, where weight must be minimized, the new deck will be 3-in. grating filled to the top with concrete and overlaid with a 3/8-in. high-friction, epoxy wearing surface.

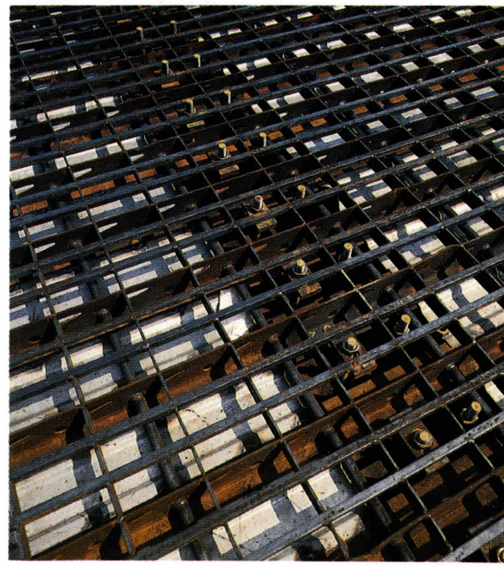
The roadway is being upgraded to meet modern highway design standards. The new ramp will have banked curves, in contrast to the old deck, which was placed flat on floor beams with shear fasteners.

On the ramps, steel fascia beams have been replaced. Most other floor members remain in place and are still sound and reusable.

Perhaps the most technically demanding part of the job will be the replacement of 14 bearings on Approach B. The lifting and locking of the hydraulic jacks must be completed in one night for each bearing so as to permit the roadway to reopen every day. The job will be done by lifting the structural member on falsework of steel bents.

Jacking forces will be huge. The system is designed to apply a lifting force of 2,000 kips. The existing roller bearings are frozen—solidly packed with rust. When the truss is jacked up—only half an inch is required—the contractor can remove the existing bearing, casting and rollers so he can install Teflon bearing with a stainless steel

Left: Workers install grid on eastern approach to lower deck. Below: Anchoring design calls for welded shear studs that are fully threaded.



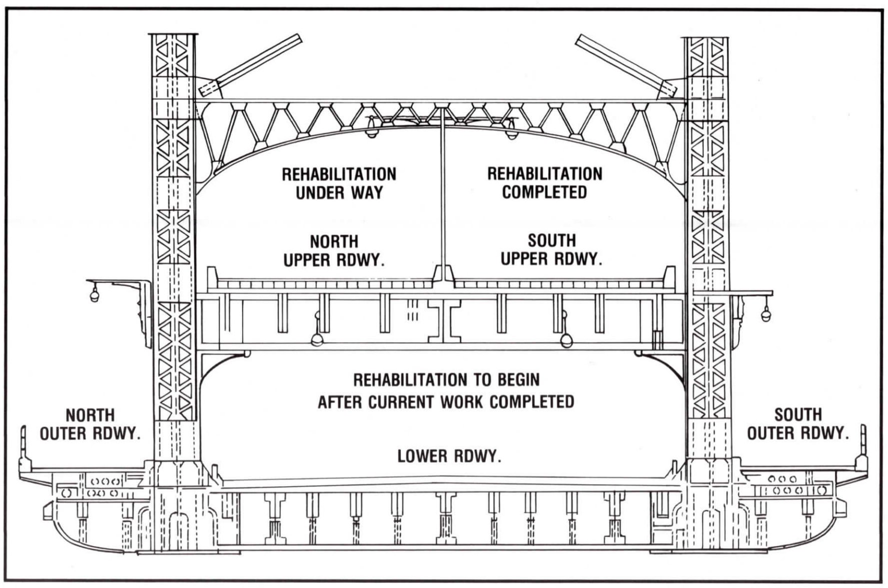
soleplate. Rollers are being eliminated as an outdated method of providing expansion.

When the contract is complete, the upper roadway will be capable of carrying bus and truck traffic. The upper portion has deteriorated too much to carry heavy traffic. Then lanes on the lower level can be closed so rehabilitation can begin there.

Design work on the bridge since 1978 has been done by the engineering firm of Steinman, Boynton, Gronquist and Birdsall, New York City.

The firm has developed an interesting method of attaching the steel grating to the steel bearing members below it. Previously, steel decks normally were set down directly on the steel stringers or cross-beams. Often the contractor would have to push them down forcibly to bear on the steel because the deck had spring in it and the stringers were not at equal heights. Then workmen would weld the grating to the steel, creating a bit of waviness in the grating.

Problems arose because gratings that were forced down tended to act compositely. Occasionally, there wasn't enough weld to make the deck stay put.



Typical cross section, Queensboro Bridge

But the deck didn't know it hadn't been designed to be composite, so it would shear off the welds and the deck would pop up off the steel.

The Steinman design called for welded shear studs that are threaded. This is a standard item, like a normal Nelson stud, but it is fully threaded. Koch, which pioneered the construction technique, lays the grid down in its location on the steel. Then workmen locate the spaces between the members of the grid and shoot the studs into the steel below, right through the grids.

Small jacking devices lift the grating over the studs again. A steel plate is placed over the stud with a nut below. Then the grating is set back on the steel plates. Workmen use the nuts to adjust the height of the steel plate as precisely as desired, and the grating cross bar rests on the steel plate.

Peter Sluszka, project manager for Steinman, describes the process this way:

"Let's say we erect a span of new steel stringers. They're erected, in place, under their own weight. The contractor surveys the elevation of the steel and we provide in the contract drawing what are called haunch tables. He enters in that table the elevation that he measured on that steel stringer. The haunch table predicts how much that stringer will deflect downward when we put the final deck on. We also tell him the final elevation we want the bottom of the deck.

"Using those numbers, he can compute how high above the steel he wants to set the steel grating. At that point, he can set the height of these steel plates. When he pours the concrete into the grating, it also fills in a haunch between the grating and the steel supporting it, so these studs get buried within the haunch.

"You wind up with a composite deck that's attached to the stringers with shear studs just like a conventional reinforced concrete deck. The entire grating is embedded in concrete. When we use the 2-in. monolithic overfill, you never know there's a grating there at all."

Future work will include rehabilitation of the lower roadway and approaches along with approach towers and columns, wind bracing and plazas. The lower outer roadways also will be rebuilt, with one roadway converted to a bicycle and pedestrian path. □