RESEARCH PAYS OFF

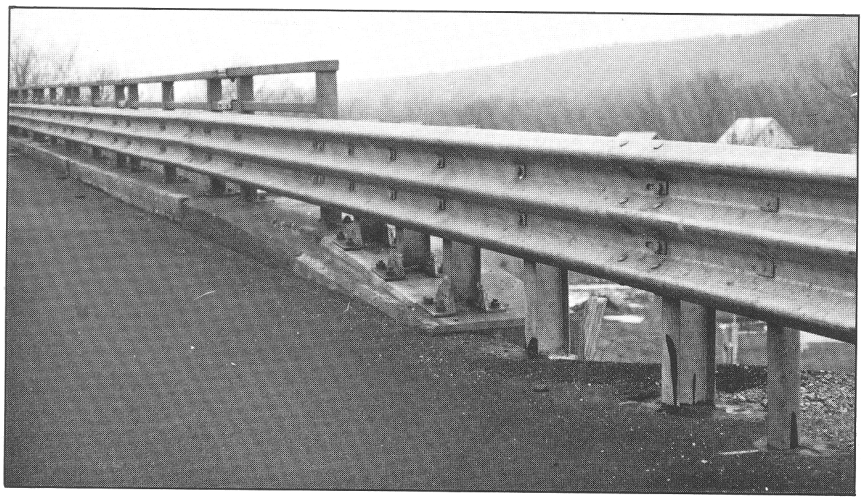
New York Retrofits Railings and Saves Money

A good example of the impact of improved highway design criteria can be seen in the Interstate System, which has consistently experienced fatality rates half that of other federal-aid routes. Evolving safety design criteria have been relatively easy to incorporate in such new construction. But the question of upgrading many thousand miles of existing highways to current safety standards presents an entirely different problem. This is particularly true when it comes to upgrading bridges. It took a $135,000 research investment by the New York State Department of Transportation to develop bridge rail upgradings. However, the work paid off in savings of more than triple that amount in just 2 years.

Problem Almost all bridge railing designs use steel, aluminum, or concrete connected to concrete bridge decks. Many older bridges were designed with concrete safety curbs and parapets. Railing systems are necessary to contain and redirect passenger vehicles when they are hit at the speeds and angles that can reasonably be expected to occur. Although systems designed by NYSDOT since the mid-1960s meet the safety performance criteria recommended by AASHTO, many systems still in service on thousands of older bridges do not. Commonly used procedures for replacing the older systems with modern designs required costly and time-consuming alterations to the bridge deck. In addition, roadway geometry and other factors frequently made it impossible to install modern designs on older bridges.

Solution In 1978 NYSDOT set out to develop a family of schemes for upgrading bridge rail systems that would be adaptable for use on bridges not otherwise amenable to the installation of new modern systems. The department initiated FHWA-funded research projects to develop, evaluate, and crash test systems to meet the state's needs. Through the joint efforts of the department's designers and researchers, upgrading systems are now available to retrofit several existing railing conditions.

When bridge geometry and strength of the old railing permit, the upgrading is attached directly to the face of the existing railing system. In other cases, new steel posts are bolted to the deck or safety walk in front of the old railing. The new rails consist of 10-gauge triple-corrugated steel—thrie beam—and 6 by 6 by 3/16 in. or 8 by 6 by 1/4 in. steel tube—box-beam. Each system is designed to make the transition smoothly into W-beam or box-beam guide rail on the bridge approach, thus providing continuous protection to vehicles approaching and crossing the structure. These new systems meet AASHTO recommended performance criteria in terms of structural adequacy, occupant risk, and vehicle trajectory.



Application In accordance with department policy, railing safety must be considered whenever an existing structure is scheduled for repair or rehabilitation. Bridge rail upgradings are routinely used in the state of New York to improve the safety of existing structures, because their costs are much lower than those of installing new railings. Engineering instructions were prepared to assist designers in deciding when upgrading systems should be used. Standard design sheets show the details of each upgrading system, and the existing conditions where they may be applied. These standard drawings include the systems actually crash-tested, plus similar designs derived from them. Standard railing, post, and connection components were used to the greatest extent possible to simplify detailing and reduce construction and repair costs.

The systems now in use are designed to safely contain and redirect a wide variety of passenger vehicles, ranging from 1,800-lb subcompact cars to 4,500-lb sedans. Although tests were not conducted with larger vehicles, research performed elsewhere indicates these systems also provide a measure of protection for buses and trucks. Between early 1982 and mid-1983, nearly 20,000 ft of upgradings were let to contract. With more than 7,000 bridges on the state highway network and even more on the local system, almost all with old railings, the potential use is great.

Benefits Depending on the type specified, the average cost of new railing systems in the state of New York in 1982 and 1983 ranged from $48 to $78 per lineal foot. On existing structures, the additional cost to remove the old railing and prepare the concrete deck for installation of the new railing increased these costs by another $10 per ft. In contrast to these costs, bridge rail upgradings over the same period averaged between $20 and $43 per lineal foot, which included deck preparation. Based on the differential between the actual cost of the upgradings and the lowest-cost new railing, the installation of 20,000 ft of rail upgradings in the state of New York in 1982 and 1983 resulted in savings of at least $500,000. The total research costs were approximately $135,000. Because there are more than 5,000 structures on the state highway system and up to 10,000 on local systems that may benefit from this research, savings from implementing the results of the research will eventually total several millions of dollars.

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