ROADSIDE SAFETY HARDWARE INSTALLATION/MAINTENANCE EXPERIENCE IN INDIANA

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FOREWORD

The Indiana Department of Transportation (INDOT) requires training and certification for State and contractor employees who are responsible for the installation, maintenance, and repair of proprietary roadside safety devices.

BACKGROUND

During the 1960s and 1970s, the Indiana State Highway Commission (ISHC) used turned down terminals to replace blunt W-beam guardrail ends that were exposed to oncoming traffic. With its end firmly fastened to a buried concrete dead man, the turned down terminal provided the necessary guardrail anchoring while not threatening to spear vehicles that approached along the post line. In the late 1970s, ISHC turned to the breakaway cable terminal (BCT), in hopes that it would neither spear oncoming vehicles, as blunt ends can, nor vault or roll them as turned down terminals can. By 1982, disappointment with the BCT on narrow rights-of-way led the reorganized Indiana Department of Highways (IDOH) to resume using the turned down terminal on most W-beam runs.

In 1986, IDOH installed four of Energy Absorption Systems, Inc.'s Sentre guardrail end treatments on I-70, east of Indianapolis, in a federally funded Experimental Project No. 7. The Sentre received praise in the construction report, which also noted its high unit cost compared to "conventional end treatments" - that is, the turned down and the BCT. During the study period, one Sentre was hit end-on. The pickup truck was redirected satisfactorily, the victim was not seriously injured, and the terminal was deemed to have performed as intended. Whether because of the small number of units deployed or their high cost, this study did not result in an immediate move toward the Sentre in Indiana.

In 1987, IDOH began a new effort to evaluate safety guardrail terminals in hopes of establishing the viability of competitive products. IDOH decided to deploy the Vehicle Attenuating Terminal (VAT), manufactured by Syro Steel Company, and the Sentre in large-enough numbers to obtain reliable data regarding accident performance and ease and costs of installation, maintenance, and repair. At that time, the FHWA classified these products as "experimental" shoulder guardrail terminals. The first VATs were installed in late 1988, and new Sentres began to be placed in late 1989. In Spring, 1989, the FHWA upgraded the Sentre to "operational" on the basis of several states' experiences with them. Syro's Crash Cushion/Attenuating Terminal (CAT), which became eligible for placement both in the median and along the shoulder, superseded the VAT, was added to the study plan, and was first installed here in 1989. In Spring, 1990, the FHWA also upgraded the CAT to operational status. Around that time, IDOH was merged with several other state agencies to form the Indiana Department of Transportation (INDOT).

SOME CONCERNS

After the Sentre and CAT upgrades, the FHWA changed some policies regarding guardrail termination on federal aid highway contracts. In 1990, turned down terminals were strongly advised against for upstream-end installation on high speed, high volume highways. In 1991, new terminals which meet crash test criteria became immediately eligible for deployment. Field evaluation was still recommended, but an experimental study period is no longer required. These accelerated moves toward the growing generation of safety terminals and crash cushions have heightened the States' imperative to develop and implement roadside safety management systems. For economic reasons and because they are not all suited to every application for which they may be placed, consideration of where safety terminals are most apt to perform well is due. Routine accident investigation and performance evaluation should replace the former experimental evaluation process.

The new terminals are more complex than their predecessors. Training on their design, intended performance, proper location, assembly, inspection, maintenance and repair is necessary. Because they can be disabled by nuisance hits and are expended in accidents, more timely repair is necessary for most of these terminals. This increases manpower needs and requires quicker damage detection. Tools and spare parts must be stocked. Because they are complex and because significant design changes have sometimes been

effected, it seems advisable to employ at least one person in each District who can stay informed about each optional terminal's designs to direct both construction and maintenance workers during inspection or repair, as needed. This person may also be assigned to perform routine accident investigation and to funnel accident performance data to a central office. Executive level support is necessary for such a comprehensive new program to succeed.

ENSURING EFFECTIVENESS

Roadside safety hardware designers strive to achieve ease of product location, assembly, and repair. Manufacturers would like to say "it's impossible to install this terminal improperly," and highway officials would like to believe it. However, recognizing that safety terminals were becoming complicated and design changes were occurring faster than field personnel could stay informed, INDOT attempted to ensure their proper installation by including the following Special Provision in certain contracts: "The (device) shall be as manufactured by (manufacturer). Assembly and installation shall be in accordance with the manufacturer's recommendations at the location(s) as shown in the plans."

Regardless, INDOT experienced recurring difficulties related to product design; inappropriate locations, inadequate site preparation, and unsafe construction time frames; parts substitution, omission, or addition; and out-of-spec assembly. Installers and inspectors were not given complete and up-to-date plans and instructions; or had them, but did not understand or follow them. Serious installation and repair errors were made by both novice and experienced workers. Therefore, INDOT now requires that all proprietary terminals' assembly and installation "shall be supervised or performed at all times by an installer trained and certified by the unit's manufacturer, and shall be in accordance with the manufacturer's recommendations at the locations shown on the plans. A copy of the installer's certificate shall be presented to the Engineer prior to the start of work. Grading requirements for each location shall be as shown on the plans." INDOT has not yet required training on non-proprietary devices.

Syro Steel Co. and Energy Absorption Systems, Inc., in cooperation with INDOT, held training classes in March, 1992. Several Federal, State, and local highway personnel attended with the contractors' employees. Manuals, slides, videos, and actual product displays augmented the oral presentations. Each product was presented individually, and a written exam specific to it was administered immediately afterward. Exam questions covered the important aspects of each device and were intended to be straightforward. Both companies expressed their intention to follow up failing test scores with local visits, as necessary, to clear up any misunderstandings. A certificate specific to the product was mailed to participants who passed its exam. It is our mutual hope that training will increase the incidence of correct installations.

BENEFIT/COST

The primary benefits of safety terminals - reduced injury severity and mortality - should more than offset their increased complexity and costs. Concern about the turned down terminal's performance may have driven the development of these higher-type end treatments, but benefit/cost is still an important issue. Other terminals now on the market vary in cost by at least a factor of six, with the least expensive costing about $1000, installed, in Indiana.

One would prefer to apply the cheapest safe product in any given location. If several terminals each find separate niches where they perform best, it may be economical to identify their preferred uses. INDOT has found that, given training and motivation, state employees and contractors can install, inspect and repair the new safety terminals. But as the number of options grows and as design changes are effected, there is concern about workers' ability to remain familiar with and stock parts for several different alternatives. State DOTs for awhile may have to manage a confusingly large array of safety terminals.

INSTALLATION REVISITED

Guardrail is often one of the last jobs done on INDOT's resurfacing and reconstruction contracts. Meanwhile, contractors and District, Area, and Project Engineers may be trying to wrap up other unfinished work against a deadline. To these busy people, including some dedicated roadbuilders, safety terminals may seem to be a dubious investment of highway money. Inspectors, who receive little motivation from their superiors in this small part of their jobs, cannot observe all important details as each terminal is erected. This scenario is not conducive to the correct installation of these complicated devices, nor to their proper response during "crunch times."
These products of intense development efforts include no frivolous features. That is not to say they are perfect, but merely that every part and specification was considered necessary to the purpose for which they were designed. Although not every installation error will prove

fatal or serious in every impact to a device, there are accidents for which each design feature is critical. Safety terminals must be installed properly for their deployment to result in improved roadside safety.