Reviewed By:
Milan W. Lawson, P.E.
Materials & Research
Engineer

Prepared By:
Peter C. Winters
December 20, 1989

RESEARCH UPDATE

NUMBER U89-2

REPAIR OF CONTROLLED RELEASING TERMINAL

REFERENCE:

Updates 88-3, 88-13

HISTORY:

Two controlled releasing terminal (CRT) guardrail ends were installed in 1986 as experimental features, in conjunction with the Colchester-Highgate IR 809-3(57) project, at a cost of $1600.00 each. In comparison, breakaway cable terminals were bid at $650.00 each. The design, installation, and first winter's performance were reported in Update U88-3 in January of 1988. In the Winter of 1987/1988, neither of the CRT installations had been struck but the rails had "fallen off" both installations. It was assumed that this occurred due to snow load from winter maintenance activity. Repair of the CRT was accomplished with off-the-shelf lock washers of a heavier gauge than the manufacturer supplied retaining rings.

During the weekend of April 16-18, 1988 an unidentified vehicle struck one of the CRT installations. The damage was reported in Update U88-13. The amount of damage to the installation suggested that the vehicle may have been a large truck which would have had the bumper strength, weight and momentum to break twelve wooden posts, bend six steel posts and yet sustain a sufficiently small amount of damage to continue unassisted. It was observed at that time that many of the retaining rings were split but a determination was not made whether they were split on installation.

Because the installation is experimental, the manufacturer did not have replacement parts in stock and repair was delayed until December of 1988. The cost of repair at that time was: materials $1078.00; labor $758.00; equipment $339.00; total $2175.00. Minor patching of the asphalt island around the reset posts was done in the Spring.

On December 20, 1988, maintenance personnel discovered that one of the rails had fallen down again. The retaining rings supplied with the replacement parts had split. There had been no significant snowfall to load the rail and there was no similar problem with the other CRT which was not damaged in April and still had off-the-shelf rings.

Since it was theorized that the retaining rings, supplied by the manufacturer at $5.00 each, might be inadequate to perform their intended role of supporting the rail, this Agency attempted, unsuccessfully, to locate a source of retaining rings similar to those installed in late 1987.

Another theory advanced was that the shafts of the bendaway attachments might be oversized due to the process of galvanizing.

With the cooperation of the U.S. D.O.T., FHWA Research and Development Center, and the manufacturer, Syro Steel, retaining rings of the original type were obtained. It was also determined that the recommended "pull-off" strength was 500 lbs.

When an attempt was made to install the "original" rings on randomly selected attachments, the rings were found to break or split, usually between fingers. Measurements were made of the selected attachments. It was found that most of the shafts were oversized up to .069".

The Materials and Research Division conducted "pull-off" testing of the original retaining rings and of two grades of retaining rings made by a competing manufacturer. Each ring was installed, either singly or in pairs, on the shaft of a bendaway attachment which had been machined to the specified 0.062". The attachment with ring(s) was inserted into a device which allowed the rings to be pulled off with 360° contact with the ring. This device was placed in a Tinius-Olsen testing machine and the force in lbs necessary to cause the ring(s) to pull off was measured.

The original rings were installed in pairs, as specified, and a pull off strength of 160 lbs was measured. A retest of another pair of rings produced a pull off strength of 245 lbs. Light and heavy grade substitute rings were tested. A single "light"ring failed at 480 lbs. A pair of "light" rings failed at 1165 lbs. A single "heavy" ring failed at 1155 lbs. A pair of heavy rings failed at 2080 lbs. Testing was stopped due to a lack of undamaged machined attachments.

The original rings failed at approximately 40% of the recommended pull off strength. They did not split but were slightly flattened. The substitute rings did not split but were flattened and deformed. Only the single "light" ring failed at approximately the specified 500 lb. pull-off strength.

Concurrently with the pull-off testing the manufacturer produced a set of bendaway attachments which were not galvanized but coated with a 50% zinc paint. Before these could be installed, another vehicle impact occurred.

SECOND ACCIDENT

On the weekend of July 17, 1989 a vehicle impacted the rail. The bolt attaching the first bendaway to the post was broken. The rail released as it was designed to do. No metal posts were

damaged. The 3rd and 4th wooden posts were split vertically and one block out device was bent.

A bumper end, marked VW and made in Canada, was found at the scene. No accident report was filed and the operator and vehicle were not identified. It thus appears that the terminal performed its design function of minimizing vehicle damage.

REINSTALLATION

The rail was reinstalled on July 25, 1989. The broken posts were replaced and some other posts were restored to a vertical position. The first 10 posts had the "new" bendaway attachments installed. The retaining rings used were the substitute rings which were on-hand. The attachment at the first post, and the last four of the twelve posts were installed with "heavy" rings. The other seven had "light" rings installed. During the installation, some of the rings were split. This was in contrast to comments by the workmen that, during previous repair activities, many rings had split. None of the split rings were left in place.

FOLLOW UP

Preliminary indications are that using the substitute rings will produce the desired pull off strengths and assist in solving the problem of split rings.

The reinstalled CRT will be observed until valid conclusions can be drawn as to its effectiveness and life cycle cost.

Dist A,B,C,D,E