EXPERIMENTAL FEATURES CONSTRUCTION-REPORT

SERB GUARDRAIL
IN-SERVICE EVALUATION
OR 88-02

S. Ashland to California State Line
F.A.P. IR-5-1(113)00
Jackson County

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ABSTRACT

This report covers the installation of two Self-Restoring Barrier (SERB) guardrails on Interstate-5 south of Ashland Oregon. The SERB design was developed to reduce repair cost and increase safety when compared to conventional barriers. This is accomplished by a design that allows the rail to deflect up and back on impact. This allows the vehicle to be redirected smoothly and minimizes rail damage.

The installations were performed by contract and all work was inspected by ODOT personnel. The contractor did not have any major problems with the installation but found the SERB rail to be heavy and cumbersome to work with.

Ongoing evaluation will determine the cost-effectiveness and safety of the design. Part of the cost issue is concerned with the ease and cost of repair. As a preliminary evaluation, it appears that the internal splice design will make the rail difficult to repair. The manufacturer (SYRO Steel) recommends that future installations use a "lap-splice" design to improve the SERB's repairability.

ACKNOWLEDGEMENTS

The authors wish to thank Ronald V. Busey, Project Manager and his crew for their construction documentation and Video Tape of the installation.

DISCLAIMER

The contents of this report reflect the views of the authors who are solely responsible for the facts and accuracy of the data presented herein. The contents of this report do not necessarily reflect the views or policies of the Oregon Department of Transportation or the Federal Highway Administration. This report does not constitute a standard, specification, or regulation.

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1.0 INTRODUCTION

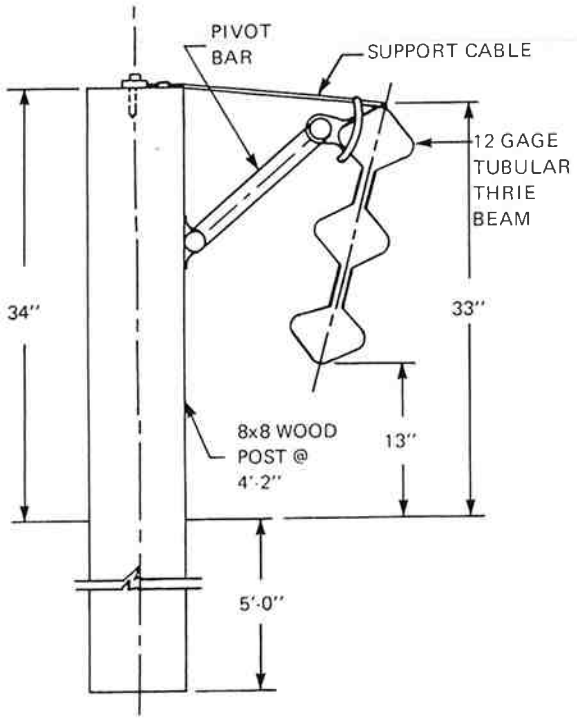
The Self-Restoring Barrier (SERB) guardrail was developed by the FHWA to contain and redirect a wide range of vehicle sizes. The initial crash test of the SERB rail failed when a school bus rolled over the rail during the test. A design modification was made to the SERB rail and additional FHWA crash tests were made. These test showed that the rails flexibility allows for most shallow angle impact forces to be absorbed or attenuated.[1],[2] Based on the SERB's ability to absorb these impacts, it is expected to be cost effective when compared to conventional longitudinal barriers by reducing repair cost in less severe impacts.

To evaluate these qualities, two installations were made in Jackson County, Oregon in the Northbound direction of Interstate-5. The first section was installed in October, 1988 between MP. 5.99 and MP. 6.23. The second section was installed in June, 1989 between MP. 5.19 and MP. 5.22. Both of these areas are within the South Ashland Interchange - California State Line Paving Project and were chosen because they have a history of frequent rail impacts, often requiring repair.

The purpose of this study is to determine if the SERB guardrail reduces the maintenance costs for replacing damaged rail. This is to be accomplished by comparing past maintenance cost of the old type rail to the newly installed SERB rail. It is expected that repair will be required less frequently. The cost for each repair, however, is expected to be higher.

2.0 SERB DESCRIPTION

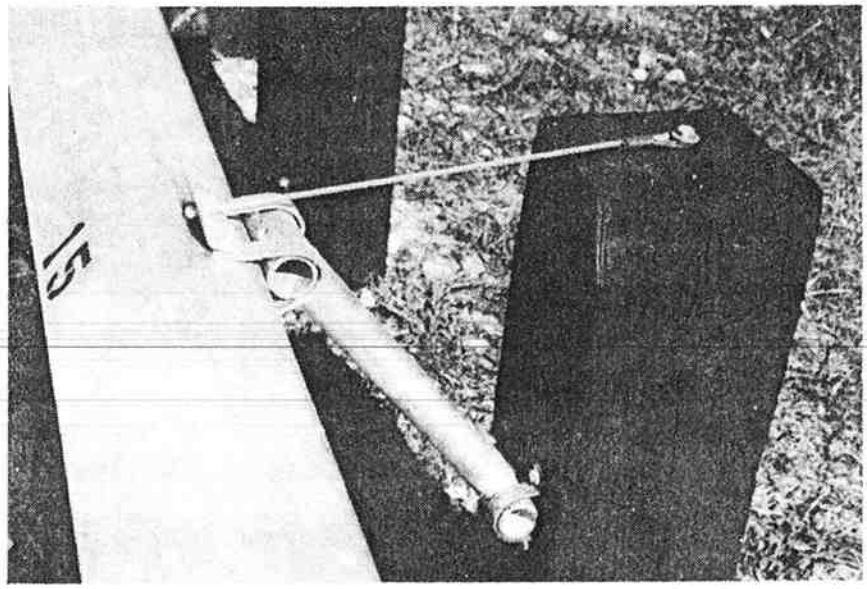
The SERB guardrail is fabricated out of 12 gauge steel. It consists of two tubular thrie-beam sections connected back-to-back forming three hollow tubes. Diagram 1 is a design description of the rail used at this test installation. Photo 1 is of the SERB rail mounted in place.



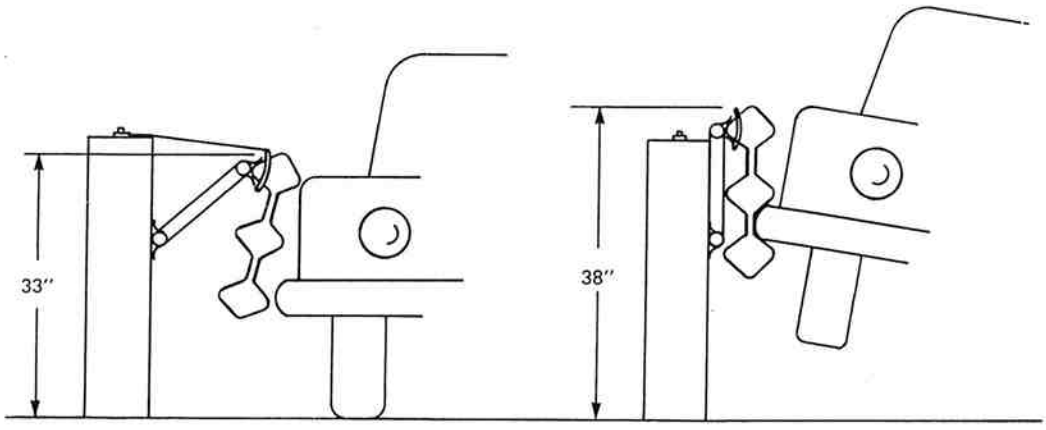
(Diagram 1, SERB Design)

(Photo 1, SERB Rail in place)

Pivot bars and support cables (as shown in photo no. 2) attach the SERB rail to ground mounted wooden posts. The pivot bars and support cables allow the rail to deflect backward and upward, and then return to its original position. This allows the vehicle to follow the upward motion and provides for a smooth redirection as shown in diagram two.



(Photo 2, pivot bars and support cables)



(Diagram 2, SERB Flex upward and backward)

3.0 FIELD INSTALLATION

The alignments used for the old type guardrails were also used for both of the SERB installations. No shoulder widening or alterations in the fogline striping were made. Some SERB rail features that are different from the old type 2A and 3 rail include the post spacing and post face location. The post spacing is changed from 6'3" to 4'2" and the post face is 6" farther from the travel lanes. In place of guardrail blocks, a cable and pivot bar assembly is attached to every other post.

Each SERB rail section is 24', 11 1/2" long. An internal splice, (a 24" piece of rail that slides inside each sections end) is used to connect these sections. Photo number 3 shows the internal splice and how it fits inside of the thriebeam rail.

(Photo 3 internal splice)

To install the splice the rail ends are wedged apart and slipped over the splice plates. Once over the splice the two rail sides come together and meet at the splice midsection as shown in photo number 4. Here they are fastened using six round fastening holes, three on the top and three on the bottom.

(Photo 4, rail slipped over the splice plates)

When securing the rail to the 8" x 8" x 8' treated post, the rail is positioned and held so that the pivot bar and cable can be bolted to the post. This position is slightly closer and higher on the post than the rails final hanging point.

It was necessary to use both of the northbound travel lanes to maneuver the large SERB rail sections during the installation. This was not a problem at this site because the section of highway was closed to travel due to paving. If future installations are made, lane closure and traffic control may be necessary.

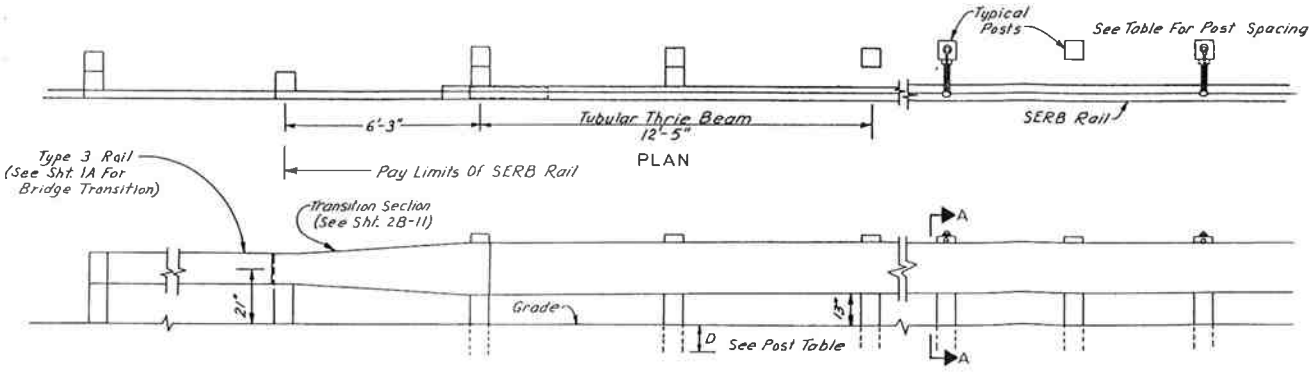
The equipment used to install the SERB rail included a forklift and a truck. The forklift was used to move and position the heavy SERB rail sections. The pick-up truck was used to haul miscellaneous materials and small tools and a guard rail punch was needed to place the posts.

The workers performing this installation found the SERB rail to be heavy and cumbersome to work with. Often the internal splice section had to be hammered into position. To prevent the galvanizing from being damaged extra care was required.

1988 Installation

A total of 1290 lineal feet of SERB rail was installed in 1988 on a descending Siskiyou Mountain Pass that has a 5.53% grade. The north end of the rail is connected to the south end of the "Special Barrier" constructed for the upper Truck Escape Ramp. Alignment ranged from tangent to a 7 degree curve with superelevation rates from .02 to .1. Typical sections show a paved 6' median, two 12' travel lanes, and a 10' shoulder. This lane configuration and the location of the barrier are both essentially the same as previously with the conventional barrier.

Transition back to the Type 2A and 3 rail and a bridge connection required some adjustments to fit smoothly. The concrete bridge rail that the thrie rail was to be bolted to was not high enough. So a Type 3 terminal connector was bolted to the bridge rail. It was then transitioned to the thrie rail and then to the SERB rail. Post placement also had to be tapered between SERB and Type 2A and 3 rail. This was necessary because the SERB rail posts are placed 6" farther, from the travel lanes, than the old type rail post.



(Diagram 3 Rail Transition)

1989 Installation

An additional 500 lineal feet of rail was installed in July 1989. This installation was also installed on a descending Siskiyou Mountain Pass with a grade of 5.53%. Its' alignment is tangent and typical sections show a paved 6' median, two 12' travel lanes, and a 10' shoulder. This lane configuration and the location of the barrier are both essentially the same as previously with the conventional barrier.

4.0 INSTALLATION COST INFORMATION

Actual costs for manpower and equipment is only available for the first installation of SERB rail. The subcontractors' bid price was $54.00 per / lineal foot. Actual cost was calculated out to be $37.98 per / lineal foot.

These costs are as follow:

Labor	$ 7,240.40
Equipment	6,923.29
Materials	34,830.00
Total	$48,993.69 / 1290 L.F. = $37.98/ft.

5.0 MAINTENANCE AND REPAIR

One major concern is how to repair damaged sections of the SERB. Maintenance personnel see the internal splice design as a problem. In order to replace a section of the thriebeam rail, the complete rail may have to be unbolted section by section for several hundred feet on both sides of the damaged area. Another problem is that Maintenance does not have the right equipment to replace the 24', 11-1/2" long sections which are heavy a cumbersome to maneuver. It is believed that handling would be easier if 12'5" manufactured sections were used. In addition, the thriebeam sections are a specialty item and cost significantly more than conventional barrier rail.

The FHWA Experimental Project Branch, Demonstration Projects Division, agrees that maintenance repairs on the SERB rail are difficult. They suggest the use of a LAPP-SPLICE or STRAP STEEL PLATES. The later is placed in the depression areas of the tubular thriebeam rail. It is not known, however, how well either one of these will withstand repeated hits when used as a retrofit.

The LAPP-SPLICE design is intended for use with new construction and has not been tested as a retrofit. Syro Steel representative, Chuck Norton, does not recommend using this design as a retrofit, although he says that it could be accomplished with some field fabrication. A diagram of this Lap Assembly Splice can be found in Appendix A. During repair the splice should be lapped in the direction of travel to minimize snagging.

All new SERB barriers provided by SYRO are now constructed with the LAPP-SPLICE. This design, when used as original construction, has been crash tested and approved.

Other States Experiences

Oregon is not the only state that has found the SERB rail to be cumbersome to work with and to have difficulty with the internal splice during installation. According to the FHWA, Demonstration Project Division, other states who have installed the SERB rail have had these same experiences. This is because of the rail is stiff and heavy which makes if difficult to wedge apart to slip in the splice piece.

Two other states that have installed the SERB rail are Illinois and Colorado. The Illinois DOT installed a section of the SERB rail on a tight exit ramp in Chicago. The rail received so many hits that the Illinois DOT decided to remove the SERB rail rather than repair it.

The Colorado DOT installed a section of the SERB rail on a mountain pass West of Denver. The rail was damaged when two Army Ducers went over the rail. Rather than attempt repairs, the Colorado DOT placed a concrete safety barrier in front of the interior run of the SERB rail.

6.0 EVALUATION

Rail Damage

This is not an evaluation report. However some preliminary evaluation is possible at this time. It appears the flexible design of SERB may be beneficial at this particular installation. The SERB rail does show some scrapes but has not received any major damage to date. In the past, truck drivers with brake problems used the old rail to slow themselves down on the steep grade. This may explain why 90% of the hits on the old rail were truck related. This type of hit has not yet occurred on the SERB barrier.

One possible explanation for this is the size of the SERB barrier. Because the SERB rail looks different and is bigger than the old type of guard rail, the driver may perceive it as something to avoid hitting.

Maintenance

An attempt was made to locate repair cost data for the original conventional barrier at the same locations as the SERB. This information would be useful as a baseline for comparison. However maintenance information is not available in a useful form. The final evaluation of repair cost s for both the SERB and the conventional barriers will be performed by using cost estimates by the Section Foreman.

The following is a list of damage reported by the Section Foreman, Curtis Yocum. Thus far, the damage has not been severe enough to require immediate repair. So no repair costs have yet been incurred.

Date of Contact	Reported Damage
1988	No damage, a berm of snow protected the rail.
12-24-89	No damage reported.
01-25-90	No damage reported, but the first rail installation is starting to sag.
02-26-90	A snow plow tore the rail on the second installation during snow removal. This was reported to have happened on 2/23/90.

7.0 RECOMMENDATIONS

The Project Manager recommends that the support cable be mounted to the back of the post with a notched plate to hold the cable. Presently the lag screw is mounted in the top center of the post and will come loose if the post cracks.

It is believed that handling and maintenance would be easier if the 12'5" sections were used.

All future installations should use the LAPP-SPLICE design as part of the original construction.

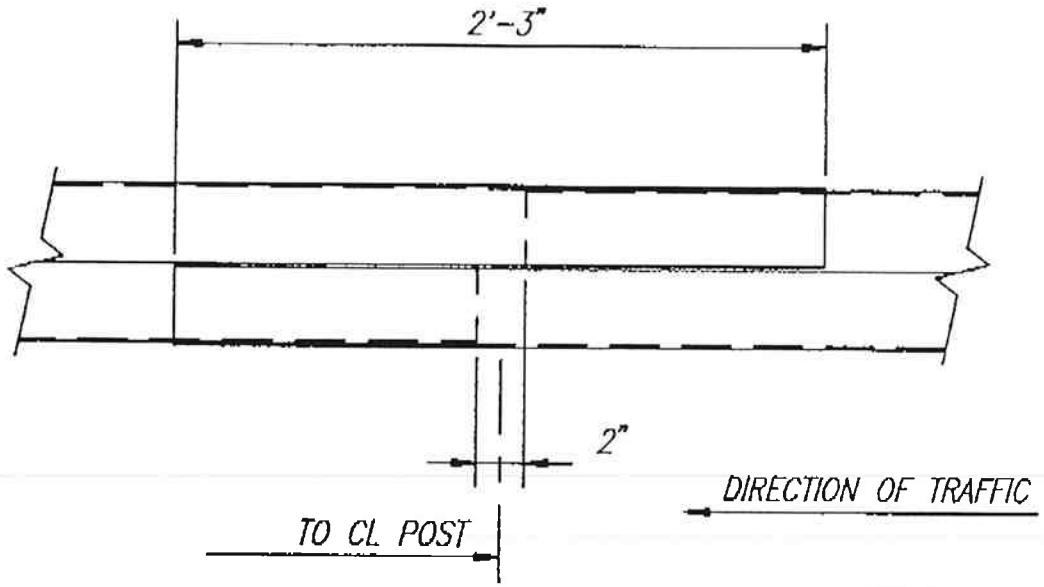
If repair costs become prohibitive or unreasonable, then the Experimental Feature status of this barrier may allow federal funding for complete replacement of the SERB with either conventional barrier or another SERB with a LAPP-SPLICE design. If this SERB design is determined to be inadequate, then this course of action may be considered.

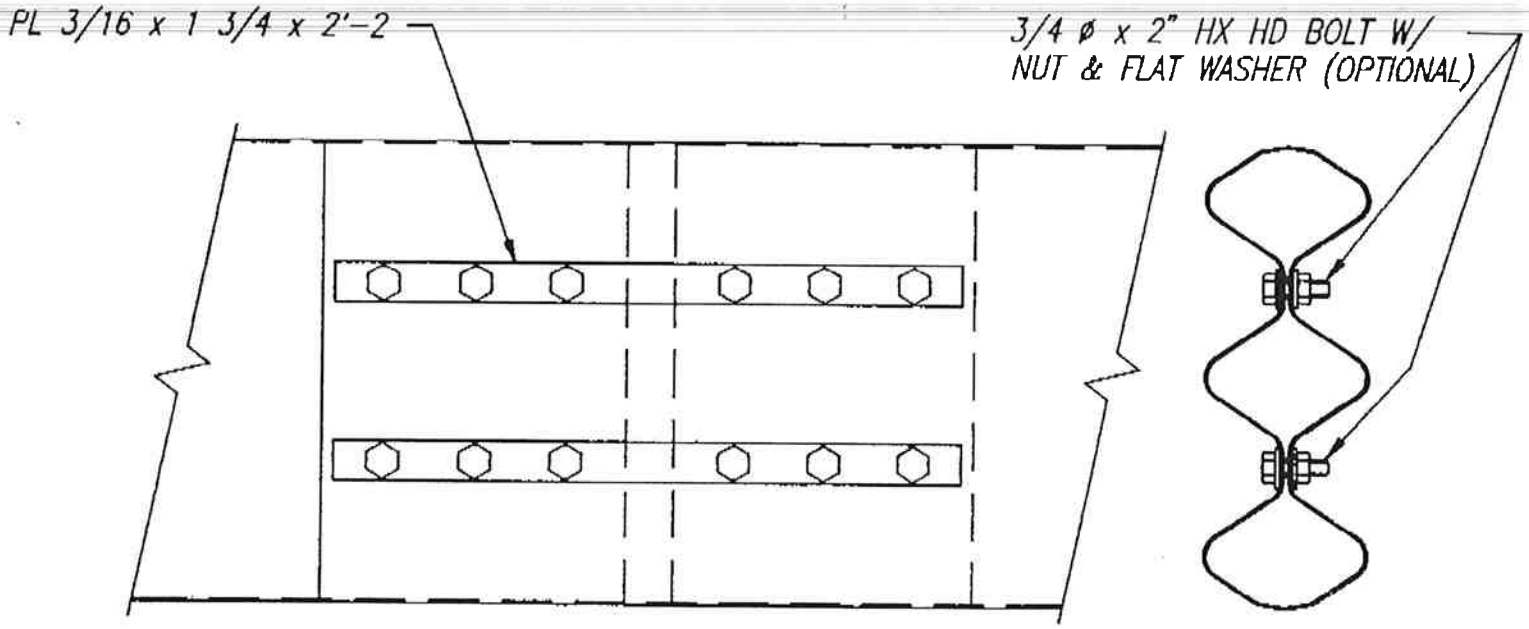
REFERENCES

1) C.E. Kimball, Jr. and G.W., Deel, "Test Evaluation of Self Restoring Guardrails," Federal Highway Administration, Washington, DC, September 1980.

2) M.E Bronstad, C.E Kimball, Jr., Southwest Research Institute and C.F. McDevitt, Federal Highway Administration, "SERB - A New High Performance Self-Restoring Traffic Barrier"

APPENDIX A





LAP ASSEMBLY
(TUBULAR THRIE BEAM)

SYRO