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Roadside Safety Research Program
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Guardrail Posts in Mowing Pads

INTRODUCTION

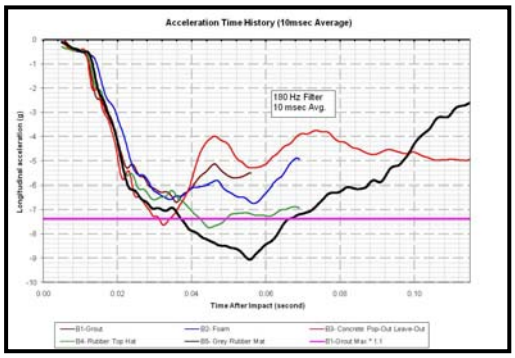
The objective of this project was to identify alternative backfill materials for the low strength two-sack grout mix currently used to fill the voids around posts in guardrail mow strips. In order to maintain impact performance, a candidate material should have a compressive strength comparable to the grout that was successfully crash tested in a mow strip application. The material should be able to retard vegetation growth around the guardrail posts without restricting its motion in an impact event.

RESEARCH APPROACH

Static laboratory and dynamic bogie impact testing was conducted to evaluate several products for use around guardrail posts encased in a pavement mow strip. A two-sack grout mixture that had been successfully crash tested under a previous research study was used as a baseline reference for acceptable impact performance. The basis of the evaluation was that if a candidate product offered resistance to post movement in the leave out section that was equal to or less than that of the two-sack grout, it could be considered an acceptable alternative without the need for further crash testing.

The products that were investigated include a two-part urethane foam, a molded rubber product that has an insert fabricated to match the size of the leaveout, a flat recycled rubber mat that rests on top of a leave out backfilled with soil, and a new pop-out concrete wedge conceived under this project.

All of the products except the flat rubber mat are considered to have acceptable impact performance. The acceleration levels associated with the flat rubber mat significantly exceeded the baseline threshold established from the test results of the two-sack grout mixture (see graph). It should be noted that the thin mat itself does not provide any significant resistance to post movement and is not responsible for the high acceleration. Rather, it is the soil confined within the leaveout. To support the flat mat, the standard soil was compacted to the top of the leaveout without any void space. The added height and confinement of the soil led to acceleration levels that exceeded those of the baseline two-sack grout mixture as the soil was compressed between the post and the back face of the leaveout.



10 msec average acceleration-time histories from bogie impact test

The other tested products are considered to be acceptable alternatives to the standard two-sack grout mix from an impact performance and vegetation control standpoint. However, they each have their own advantages and disadvantages in regard to installation and inspection.

Two-Part Urethane Foam

Two-part urethane foams are readily available from several manufacturers. These foams can be pre-packaged as a two part chemical solution to achieve a desired volume with a specified density and strength. Because it is closed cell, the foam is essentially impermeable to water. Inhibitors should be specified to provide resistance to degradation from ultraviolet (UV) light.

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The installation of the foam can be somewhat cumbersome. Once the two parts are mixed, it must be quickly poured into place before is begins to expand. Further, it is difficult to obtain uniform, unconfined expansion of the foam. Therefore, since any voids or low spots below the grade of the pavement mow strip can collect dirt and possibly lead to some future vegetation growth, it may be necessary to overfill the leave out cavity and later cut the foam level with the ground surface for aesthetic purposes. While the foam is relatively easy to cut using any type of saw blade, the shape of a steel guardrail post can make this task more difficult.

Alternatively, a temporary form can be placed across the top of the leave out to confine and produce more even expansion of the foam. However, the temporary form would need to be treated with a bond release agent to prevent adherence of the foam, be properly secured to the pavement mow strip or otherwise weighted down, and have some vent holes to permit the release of foam in the event the leaveout cavity is significantly overfilled.

Rubber Mat with Insert

The rubber mat with insert, known as the TopHat™, is available from Welch Products, Inc. It is molded from recycled crumb rubber and is designed to be used as a permanent form around the guardrail post. It can reportedly be manufactured in a variety of colors. The lower portion of the TopHat™ has an insert that is molded to fit inside the perimeter of the leave out. The area inside the insert should be left as void space with no soil backfill.

The upper portion of the TopHat™ consists of a 3/8-inch thick mat that extends over the edges of the leaveout to prevent vegetation growth. The mat can be manufactured with a cutout that matches the shape of a particular post (e.g. W6x8.5 steel or 6x8 wood). Alternatively, scribe lines for different post shapes can be incorporated into the mat to facilitate cutting in the field. In either case, the size of the upper mat should be sufficient to overlap onto the pavement mow strip while providing some tolerance for post placement in the leaveout section.

Because the TopHat™ is molded in one piece, it must be slid into position over the installed guardrail post, or the post must be driven through it after the TopHat™ is placed in the leaveout. A silicone sealant or other suitable adhesive should be used to help seal the perimeter of the mat to the post and pavement mow strip.

Pop-Out Wedge Concrete

The pop-out concrete wedge permits the use of conventional concrete as a backfill material in the leaveout section around the post. The leaveout is constructed with a modified geometry that provides an opportunity for the concrete to displace or "pop-out" of the leaveout during an impact. The two sides and rear edge of the leaveout are chamfered at a 45 deg angle to allow the concrete wedge to be pushed up and out of the leaveout upon loading from the post. The post is then free to rotate within the leaveout without any further resistance from the backfill material.

Note that a bond breaking material must be applied to all of the internal faces of the leaveout to permit the backfill material to readily release from the pavement mow strip. In the bogie test, roofing tar paper was used as a bond breaker and conventional concrete was used as the backfill material.

The use of conventional strength concrete eliminates the difficulty associated with the quality control and inspection of the two-sack grout mixture. However, it does require that the leaveout be inspected prior to placement of the concrete backfill to verify proper geometry and application of a bond breaker.

RECOMMENDATIONS

The two-part urethane foam, rubber mat with molded insert, and pop-out concrete wedge are all considered suitable for implementation based on an evaluation of their impact performance. Each of these products has its own advantages and disadvantages in terms of cost, availability, ease of inspection, and installation. It is recommended that some field experience be gained with one or more of these products to better assess which would provide the most cost-effective solution for a particular user agency.

It should be noted that the durability of these products was not evaluated. Field experience is necessary to assess their long-term durability in the highway environment.

Two-Part Urethane Foam after Test

TopHat™ recycled rubber mat after test

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