COMMUNICATION DOCUMENT

THE ROADSIDE SAFETY RESEARCH GROUP

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Development of a New Guardrail End Treatment SPR-3(043): Self-Restoring Impact Attenuator

***RESULTS:** The intention of this project was to deliver a fully designed and tested self-restoring low-maintenance end treatment at a substantially lower installed cost than existing systems. However, due to intellectual property issues several preliminary designs had to be abandoned. Ultimately, additional lower maintenance crash attenuators became commercially available; however none are within the target cost described in the research project. Due to the long duration of the project and intensive product development remaining to deliver a viable system, the project activities were summarized and the project closed.*

Why We Pursued This Research

In the mid-1990's the Federal Highway Administration (FHWA) issued a memorandum that stated that the Breakaway Cable Terminal (BCT) was no longer acceptable on high-speed, high volume roads on the National Highway System (NHS). The only available non-proprietary alternative design was the Modified Eccentric Loader Terminal (MELT), but it could not be used because it had not met current federal crash worthiness test requirements. Since these two end terminals could not meet the National Cooperative Highway Research Program (NCHRP) Report 350 Test Level 3 requirements, which where the current federal requirement, there was a need for a non-proprietary end treatment.

Figure 1 Breakaway Cable Terminal (BCT)

Initially, this project objective was to produce a non-proprietary guardrail end treatment that provided a high level of safety performance at a reasonable life-cycle cost. In a very short amount of time, the project evolved into developing a non-proprietary self-restoring impact attenuator that would provide a high level of safety performance, would be low maintenance, and would have a low installation cost.

What We Did

Development of the end treatment was to be done through five phases. Phase I was to find and select materials that were to be used in the end treatment. In Phase II the materials would be subject to a series of tests. The data gathered through these tests would be used to develop a prototype design with the use of finite element computer simulations. Phase III would consist of bogie crash tests that would determine the configuration of the final design. In Phase IV a full scale prototype would be developed, fabricated, and tested. Information gathered from these tests and from computer simulations would be used to develop a final working design. Phase V would include the fabrication of the final device and the eight compliance tests required by Report 350.

In Phase I, High Density Polyethylene (HDPE) was selected to be the material that the device would be built around but was later changed to Medium Density Polyethylene (MDPE) as a way to avoid patent infringement issues. Unfortunately, the project never moved past Phase II. Fourteen design concepts were developed but had to be abandoned or shelved because they ether infringed on an existing patent or were cost prohibitive. Also, the project has had three project managers leave and has been shelved on two occasions.

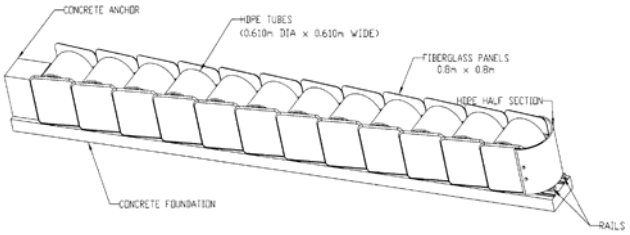

Figure 2 Design Concept #5

Near the end of the project it was decided that work should be done to develop a new testing device. This device was called the High Speed Dynamic Impactor (HSDI) and consisted of a pneumatic piston cylinder device to propel a mass (e.g., a test vehicle) via a pulley and cable system into a test article. It was intended that

the time spent developing this device would be regained by having a quick testing device. Both the HSDI and the fourteenth design concept were in the preliminary stages of development when the third project manager left and no further progress was made.

What Can Be Concluded

As part of a Division-wide efficiency effort this project was deemed unsuccessful and the decision was made to terminate the project. This was because it had grown stagnant from constant hold ups and restarts. Also, due to the amount of time that the project had existed, almost 15 years, the market had changed and new products became available that met the design criteria. At the time this project began there were only two self-restoring crash cushions on the market. Since they were owned by the same company there was no real competition, keeping the systems on the expensive side. Now there are at least five self-restoring systems available that are manufactured by three different companies.

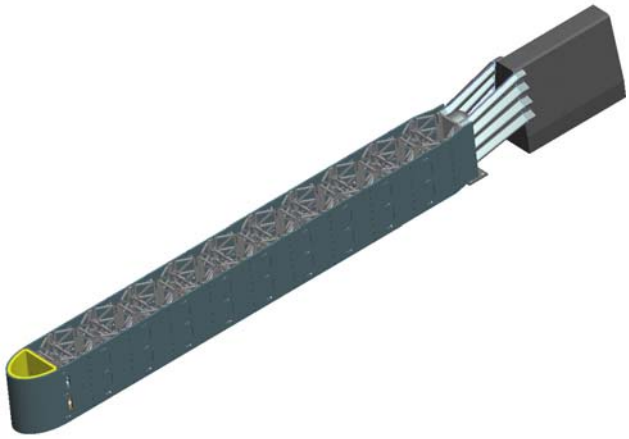

Figure 3 Design Concept #12

The main reason this pooled fund study was unsuccessful was because the original objective was allowed to change. The project was initiated to order to replace the BCT and the MELT systems with an end terminal that would be inexpensive, non-gating, and low-maintenance. The project quickly changed into developing a non-gating, self-restoring crash cushion that was much more complex and would require much more expensive materials. Near the end of the project it became clear that too much time and effort was also being spent on the development of the HSDI. The project was already behind schedule and this testing device should have been a research project by itself.

Another reason why this project was unsuccessful was the amount of time involved. Patent infringement issues plagued this project from the beginning, bringing it to a standstill and in most cases requiring the development of a new concept. The loss of the project manager at three different times also slowed the project. Each time a new manager took charge of the project, months were lost as they were brought up to date.

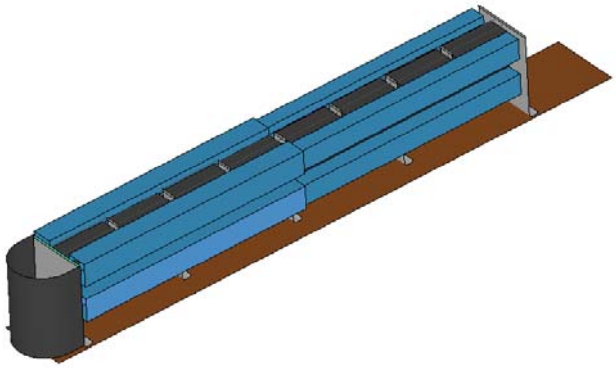

Figure 4 Design Concept #14

The Researchers Recommend

For this study to be successful it should have been broken into three separate projects. The first project would be to find an inexpensive non-gating terminal to replace the BCT and MELT systems that meets the current FHWA roadside hardware criteria. The second project would be to develop a low maintenance, non-gating, self-restoring crash cushion. Before any concepts are developed a thorough patent study should be conducted so that the researchers know which ideas would be off the table. Doing this would save time, money, and prevent frustration. The third project would be for the development of the HSDI.

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