

Tire Bale
Slope Failure Repair
Summary Detail

November, 2002

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TxDOT's Fort Worth District embarked upon a recycling mission in 2001 to find a way to use baled scrap tires. Taking up the Texas Legislature's mandate to increase the use of scrap vehicle tires in highway applications, the District's Construction and Maintenance Recycling Coordinator, Richard Williammee, P.E., accepted the challenge by investigating the use of tire bales previously used for channel erosion and as a roadbed foundation as a possible repair method for failed slopes that occurred in the District due to a higher than normal amount of rain in the area.

In the Spring of 2001, he was approached by a local firm, Mr. James Glendening of Touché International, to see if there was a need for tire bales. After some thought as to where these might be applicable in the highway system and remembering that they needed to add "engineering value", Mr. Williammee considered the possibility of using them as building blocks within a roadway slope, especially one that had failed in typical mudflow failure. Several recent ones had occurred and it was just a matter of selling the concept to the District staff and the lucky Maintenance Supervisor whose failed slope would be selected to be repaired. Mr. Glendening had some photographs of his horizontal baled tires which he shared with Mr. Williammee. Mr. Williammee then approached the District Maintenance Engineer, Mr. Glenn Elliott, to discuss the possibility of doing an experimental project. The District Engineer, Mr. Steve Simmons, happened to be meeting with Mr. Elliott and became involved in the discussion. After presenting the concept, it was decided that the request was reasonable and a location was suggested. Mr. Williammee investigated the location with a Maintenance Supervisor and quickly learned that the site was already under repair and no longer available. Another inquiry with Mr. Elliott led to the selected site on IH30 approximately 3 miles east of downtown Fort Worth. The Maintenance Supervisor, Mr. Bobby Etheredge, was notified and stopped the repair work on this slope that would have used steel I-beams and metal beam guard fence sections placed together to form a wall, placed in the middle of the slope, that extended below the potential failure plane. This wall would become buried within the slope repair.

In the meantime, Mr. Williammee contacted the Department's Tire Recycling Coordinator, Dr. Rebecca Davio, to investigate possible vendors in possession of tire bales. Touché International only had 40 bales made and was not receptive to hiring people to bale any more unless TxDOT was willing to pay to do so. We were not so inclined but were willing to haul the 40 bales from his site near Whitesboro in northern Texas along the Red River at our cost. They were interested in getting rid of what they had due to the Texas Natural Resources Conservation Commission (TNRCC) being after them to clean up their site or face fines. Other vendor inquiries yielded a variety of costs from \$5. to \$100. per bale plus freight. This immediately was a cause for concern as Maintenance did not have money appropriated to pay this much for tire bales. One call to a vendor led to an offer to come to Texas and do a free demo of a vertical tire baler. This was very enticing in that substantial money could be saved. A gentleman's agreement was made

with Mr. Ed Drews of Encore Systems in Minnesota to bring his vertical baler to Texas and make and donate 200 tire bales using only Texas tires.

But prior to Mr. Drews' arrival and in a conversation with Dr. Davio in November 2001, she mentioned that any donations had to be approved by the Texas Transportation Commission. Also, approval for the baling site had to be acquired from the TNRCC. Working collectively, Mr. Williammee enlisted Dr. Davio's assistance in preparing the document to be presented to the Commissioners at their December meeting. It was prepared, presented, and approved without incident in mid-December. Meanwhile, Mr. Williammee was working with Ms. Cynthia Hackathorn at the local TNRCC office in Fort Worth to prepare the request for approval of the TxDOT Arlington Maintenance yard in which to bale and store the tires. Additionally, the Arlington Fire Department had to be notified as to our intent and a pre-baling fire prevention plan submitted which included a diagram of the yard, emergency entrances, and the location of the nearest fire hydrants. The final forms were completed and turned into Ms. Hackathorn who immediately began processing the paperwork and was able to obtain approval for the tire baling in less than a week. This was a great effort in partnership between two agency giants.

Mr. Drews arrived in Arlington, Texas in late January 2002 and spent about a week making the 200 bales. These were briefly stored until the Maintenance office could schedule the equipment and manpower to transport and construct the slope. This was accomplished in mid-February. Placement started with using the 40 horizontal, larger bales. The original plan was to leave a 6"-8" gap between each bale to encapsulate it with soil against potential combustion creating an underground fire as had been created in 3 shredded tire sites in Washington and Colorado. The spacing did not happen as Maintenance pushed the bales tightly together. As the first layer was progressing, the Maintenance Supervisor realized that he should have placed a rock drainage layer along the slope backwall to intercept groundwater coming out. Initially, this was likely the cause of the slide. After placing the 240 donated bales, only 2 of the projected 3 layers of tire bales were completed. We miscalculated the quantity needed. Some of the bales were moved from the second layer and placed on a third layer to give everyone an idea of what it would eventually look like. Additional players came onto the scene promising to buy a vertical baler from Encore Systems but after 5 months of waiting, it never materialized. Mr. Williammee went again in search of tire bales and procured 120 from Dearth Bros. in Houston, Texas. These were hauled to the Arlington Maintenance yard where they were offloaded for storage until Maintenance could get to the slope. An unloading problem occurred and damage was inflicted to a truck when one of the bales fell off of the truck, bounced, and hit the fiberglass body of the truck. It was quickly realized that dunnage separating each layer of bales would have made unloading much easier. The vendor was notified of this incident and the remedy for future use.

Periodic visits during the 5 month layoff found no movement of the bales even though 25"+ of rain had dropped on the area since the original placement. Groundwater was also observed coming through the second tire layer and outfalling onto the slope face. This was considered a good thing as it showed that the groundwater was flowing through and outfalling potentially reducing the potential for a future failure.

Maintenance forces got back to the project in early August and placed the 120 bales in 2 days. The second layer was completed and it was quickly realized that additional bales were needed.

More would have been purchased except for the fact that the District Maintenance Engineer had ordered that the slope be completed immediately. So only one layer of bales was placed along the back part of the slope the entire length of the opening. The slope was completely covered up and shaped on the third day. A company was hired to supply and spread compost and seed and vegetation continues to grow to minimize surface slope erosion.

An additional site visit in mid-October revealed some small cracks developing along the top ridge of the slope. This area has received almost 50" of rain since the first placement of the tire bales in mid-February 2002. A Geotechnical Engineer under contract to the Fort Worth office was hired to perform a preliminary slope stability analysis of the final product. Initial analysis revealed that the slope Factor of Safety was improved 2-3 times from using the tire bales instead of the original soil. Additional work was performed to sample and test the in-place soil and determine the properties of the tire bales to use in the final slope analysis calculations.

In April 2003, a Geotechnical report was submitted to TxDOT by the Geotechnical Engineer. The slope was analyzed using the UTEXAS2 software program created by the University of Texas at Austin. Final Factor of Safety calculations resulted in a F.S. = 1.7. A F.S. = 1 considers a slope to be in equilibrium but any changes such as additional water intrusion or loading on the slope can quickly lower this value and cause a failure. With this information, the Geotechnical Engineer and this office concur that this process is a viable "Engineered function" giving value to tire bales as a remediation tool for slope failures. Full vegetative growth has been established and the District to this point considers the repair a success.