NEW PRODUCTS CURRENTLY USED BY THE KENTUCKY TRANSPORTATION CABINET

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INTRODUCTION

It is the Transportation Cabinet’s responsibility to provide safe and effective transportation systems in the most cost-effective manner possible. Obviously, a significant element in accomplishing this goal is for the Cabinet to take advantage of advances made in the industry. After any product or technique has undergone an initial literature review and controlled testing, the product’s expected performance is proven through field testing in a real-world environment. Normally, this is accomplished by the selective use of a product or technique in actual highway improvement projects. We try to place products in situations in which they can be easily monitored and in which a variety of situations will be encountered.

Current activities that involve the Division of Design can be loosely grouped into three broad categories: drainage, roadside safety, and pavement. Since innovations in pavement have been addressed, I will focus primarily on the first two items. In the area of drainage, the Cabinet is currently evaluating plastic pipe, aluminized pipe, metal pipe end sections, metal box culverts and aluminum pipe arches, new applications for slotted drain pipe, structural steel grates, and erosion control blankets. Within the context of roadside safety, we are working with the Transportation Center to evaluate guardrail end treatments and crash cushions. Specific items under evaluation include a new end treatment at median piers, the CAT Crash Cushion, and the Brakemaster Crash Cushion. There also has been an evaluation of flexible delineator posts and guardrail delineators. Finally, I would like to discuss a couple of innovations...

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relating to pavements. These include a one-step pavement sealant for bridge decks, self-leveling silicone sealant, and the use of geogrids.

DRAINAGE

Many suppliers in the drainage field have been aggressively pursuing innovations designed to give them a competitive edge. Their goal is to provide a product that meets our needs at a reduced cost. The challenge of the Cabinet is to encourage this competition while insuring that our needs are met.

Plastic Pipe

There have been a number of innovations in the plastic, polyethylene, and polyvinyl pipe industry that has increased the hydraulic efficiency of these pipes. This development and increased testing relating to the strength of plastic pipe have led us to accept plastic pipe as an alternate to traditional concrete and metal pipes for use as an entrance pipe. We also have allowed a number of cross-drain installations as an experimental product. Generally speaking, plastic pipe has the advantage of lower cost and greater ease of installation. However, it is not without its disadvantages. We know that the plastic tends to deteriorate and become brittle when exposed to sunlight. While laboratory testing shows good results from strength tests, there are still some questions relating to the long-term durability and strength of this product.

Aluminized Pipe

One of the problems we have encountered in the field is the corrosive effects of acidic soils on metal pipes. In order to combat this shortcoming and to allow a metal pipe alternative in adverse conditions, aluminized pipe has been developed. This process provides for a coating of aluminum to be applied over normal steel pipe. This coating is intended to protect against corrosion while maintaining the required strength at a price that would be competitive with allowable concrete alternates. This process is working fairly well.

Metal Pipe End Treatments

Metal pipe end treatments address concerns in both the drainage and the roadside safety areas. In the past, side slopes were often steepened to 2:1 and short sections of pipes with vertical concrete headwalls were used to reduce project cost. Short sections of guardrail were used to protect vehicles from impact with these headwalls. With additional roadside safety research, it has become apparent that the guardrail itself represents a hazard. Many rehabilitation projects have included the extension
of pipes to provide an adequate clear-zone and eliminate the need for guardrail.

The first attempts to improve this situation were changes in headwall design to provide sloped headwalls that better matched 4:1 or flatter side slope conditions. While this eliminated the headwall itself as an obstacle, a significant hole was left on larger pipes that could result in severe accidents if a vehicle ran over a headwall installation. The safety grate was then added to the design to allow vehicles to travel over a headwall installation without damage. While these designs effectively addressed the safety issue, they proved to be costly, and they were very difficult to maintain. Debris would be trapped by the grates resulting in a loss of hydraulic efficiency.

Recent research by FHWA has shown that vehicles can safely negotiate openings as wide as 36" without major problems. This research has led to acceptance of metal pipe sections as an experimental product. Several of these pipe end sections of various sizes have been installed on the West Kentucky Parkway for evaluation. We are currently preparing standard detail sheets to allow for broader application of this product, if they perform as expected.

**Metal Box Culverts and Aluminum Pipe Arches**

One other area where the industry has presented the possibility of some interesting alternatives deals with culvert situations. Traditionally, when it is felt that a box culvert is needed in a given location, the Department has looked to cast-in-place or precast concrete box culverts. Two alternatives have been identified: metal box culverts and aluminum pipe arches. There is no doubt that these alternatives can be designed to meet the hydraulic needs of a given site. Remaining questions relate to strength and long-term durability. For the most part, properly installed metal culverts seem to be performing well. Additional time will be needed before the durability questions can be answered.

**Slotted Drain Pipe**

Slotted drain pipe certainly isn't a new product; however, it is being used by the Cabinet in a number of new ways in an attempt to solve previously identified drainage problems. Slotted drain pipe is being used to replace flumes due to erosion problems that have been identified with flume installations. Slotted drain pipes have been used as bridge end drainage, and they have been used in conjunction with a Type 16 box in very flat areas as additional insurance against ponding. It also has been used in pavement where no curbs existed to prevent runoff from entering the road surface. Slotted drain pipe is very versatile; however, it does have its share of problems—the installation must be well-maintained, the
narrow openings are susceptible to clogging, and proper installation is important. If improperly placed, it would be very easy for most of the water to bypass the slotted drain installation.

**Structural Steel Grates**

Structural steel grates are a developing product that have recently been accepted as an equal alternate to iron castings for our Type 13 and Type 16 drop-box inlets. Initially, it was the attitude of the Cabinet that castings would be necessary to maintain adequate levels of strength. The first innovation in grate design was the implementation of a vane grate design to improve the hydraulic efficiency of our grates. A couple of years ago, a manufacturer submitted a structural steel alternative for consideration. The design was evaluated for structural strength and a modification was suggested. The modified design was manufactured and submitted for testing. This process eventually led to a decision that a structural steel alternative that was functionally equivalent to the castings could be accepted. A number of these grates have been installed on US 23 in Floyd and Pike Counties. We have been monitoring them carefully to determine if any additional modifications are necessary. So far the performance has been very good.

**Erosion Control Blankets**

One final product area that is quite active at this time deals with erosion control or drainage blankets. There are a wide variety of options available. Generally, straw or some other biodegradable material is woven into a nylon or synthetic webbing. This blanket is used to hold the side slope or ditch line until the natural vegetation is established. Some of these materials are made with seeding included in the drainage blanket and others have been manufactured to act as permanent installations in lieu of channel lining. Our predominant experimental installation so far has been as a substitute for sodding in medians. We have used Excelsior Mats on I-265 and I-65 in Jefferson County with favorable results.

**ROADSIDE SAFETY**

I would like to change gears a little at this point and discuss some changes that deal primarily with features of roadside safety. FHWA's acceptance of the AASHTO Roadside Design Guide has caused us to re-evaluate many of our policies relating to end treatments and crash cushions. One of the more significant changes has been the recommendation to eliminate Median Breakaway Cable Terminals (MBCT). This recommendation was reinforced by an interim report issued by the Transportation Center relating to its ongoing research effort on end treatments and crash cushions.
In order to implement this change, we took advantage of the ROAD­SIDE computer program to evaluate a number of possible alternative strategies. The MBCT is no longer used as a median protection at bridge piers. In wider medians, this design has been replaced with a modified design developed by Georgia DOT. This design uses standard BCT (Type 4) end treatments and a modified BCT (Type 5) to provide, what we hope will be, a more forgiving end treatment. In narrower median situations, we would be using a crash cushion instead of the old Type 6 end treatment. For a number of years, the Type VI crash cushion (basically Energy Absorption's GREAT Crash Cushion) has been the Department's standard. While the performance of this system is generally accepted as being excellent, it is an expensive device and it is fairly difficult to maintain. A series of crash tests has been conducted on a variety of crash cushions to determine performance against national standards. Two of the systems that have been successfully tested are being evaluated in the field as a part of the ongoing research effort being conducted by the Center.

**CAT Crash Cushion**

SYRO Steel worked with the Cabinet and other states to develop a less expensive alternative to the GREAT Crash Cushion. The result of that effort was the CAT Crash Cushion. The CAT has been installed in over 100 locations on the West Kentucky Parkway and the Mountain Parkway. To date, 11 impacts have been documented. In general, the system appears to be performing as designed although the translation in the system has not been quite what we expected. The system has proven to be easy to install and easy to maintain.

**Brakemaster Crash Cushion**

In response to competitive pressure from SYRO and other vendors, Energy Absorption has developed a new system designed to dissipate energy through translation. This system is called a “Brakemaster System.” Twenty of these systems were installed on US-23 between Prestonsburg and Pikeville. To date, there have been only two documented impacts on this system. One of these impacts was a severe head-on collision. The system was judged to have performed as expected. Based on the experience in other states, we expected the unit bid prices for these systems to be cost comparable with the CAT systems. The actual bid price for these units was much higher than we expected. The system is fairly easy to install, but proper tensioning in the cable is important and our experience, so far, indicates that seasonal adjustments may be necessary. Repair has not proven to be a very difficult prospect.
Delineator Posts and Delineators

The Department also has worked with the Center to evaluate the potential use of flexible delineator posts. A number of manufacturers has developed flexible posts that are meant to survive impacts. While these posts are generally between two-to-three times more expensive than traditional metal posts, it was felt that this expense could be offset by increased survivability. Some of these were installed on I-64 between Frankfort and Shelbyville. Three different systems were evaluated in the field. The general conclusion of the report was that the long-term durability of these products was not good enough to offset the additional costs and an increased use of flexible delineator posts was not encouraged. The New Products Committee has approved the use of guardrail delineators as an operational product. This delineator is simply a piece of galvanized steel shaped to fit into the center of the rail, it is attached to the rail at the post. The delineator is covered with a Type-1 Reflex-Reflective sheeting that meets the necessary reflectivity requirements. This product may be called for by the designer if the shoulder widths are 6' or less or if the guardrail leads into a horizontal curve of less than 950’ radius. It should be noted that these devices are to be used solely as delineators, they should not be considered warning devices. The use of standard curve warning devices should not be affected by the use of guardrail delineators.

PAVEMENT RELATED PRODUCTS

Certainly, the most significant issues dealing with pavement innovations have already been addressed here today by Mr. Blake and Mr. McChord. I want to touch on a couple of minor issues in which the New Products Committee has been involved.

One-Step Waterproofing and Reflective Crack Suppressant was approved by the Committee for use several years ago. The product, which is basically an impermeable black membrane, is used to seal an existing bridge deck. The membrane consists of a sheet of fiberglass with a polymer coating on the bottom and the top. Once the One-Step material is in place, it is possible to place a bituminous overlay on the bridge deck without leakage or pronounced reflective cracking. Maintenance personnel in District 2 have used this product on several occasions and indicated that they have had very good success with this process.

Self-Leveling Silicone Sealant

Dow and Crane have each produced self-leveling versions of their silicone sealant products. The concept is to reduce manpower and, hopefully, the overall costs of silicone sealants by eliminating the need to hand-tool the joint seal. The Department has agreed to try this product in

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the field. It was used on the recently completed Cedar Cove Hill project on US 127, just north of Frankfort. In spite of some early problems placing the sealant on steep grades, revisions in the extrusion process were all that were needed to solve the problem. It is still too early to determine its long-term performance.

**Geogrids**

One final area dealing with pavements is in the application of geogrids. There are a number of manufacturers in the geogrid area. Geogrids are basically plastic grids that are used to strengthen soils in much the same way reinforcing bars are used to strengthen concrete. They have been used for subgrade and slope stabilization. Recent proposals have been made in which we consider using geogrids to steepen side slopes and bid these systems as alternates to traditional or MSE retaining wall systems. Currently, only Tensar has submitted its product through the New Products Committee and they are the only approved manufacturer. Geogrids are generally only used when called for by the designer. In the future, a generic specification will be adopted and an approved products list generated. Given the versatility of this product, it is possible that a significant expansion in the use of geogrids will occur in the near future.

**FUTURE EMPHASIS**

Most of the product areas identified in this report will continue to be important to us in the near future. One new area that promises to offer significant challenges is the use of recyclable and recycled products. There is a national emphasis on the environment that demands that we in the transportation industry use our resources responsibly. The introduction of this social priority into the formula will further complicate the equation. When we consider which new products will be accepted for broader application, we will not be able to base our decisions solely on cost and functionality. The policy directive to expand the use of these products will almost certainly result in increased development of recycled products. The emphasis on increased safety will certainly continue. This emphasis will result in continually updated research that will require modification of policy and product use. In addition, the roadside hardware market is very competitive. It will be an ongoing challenge to monitor developments in the field and implement progressive changes in a systematic manner. The implementation of these changes will require a certain amount of education relative to the intended purpose of safety hardware. There also will be a greater need for design, construction and maintenance to communicate and coordinate the evaluation process.