

Research Results

VOLUME 1, ISSUE 1

APRIL 1, 2004

INSIDE THIS ISSUE:

Eleven Research Projects Completed

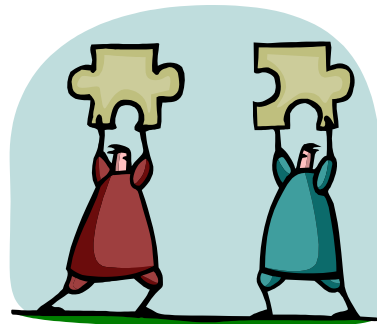
While these eleven research project have been completed—the dividends will not accrue without implementation. Outstanding management, the best scientific analysis and investigation and the finest reports mean nothing, unless a conscientious effort is made to put valid research to work—**implementation**.

Activities during the life of a research project are structured so that we test theories as we go with the involvement of our clients. At the end of the research process we have high confidence that the recommended changes will effectively address the problem with a high probability of success. But this does not mean that all the risk is gone.

Whenever we venture beyond the status quo there is a risk—our aim is to minimize this risk and serve our clients as facilitators of change through the appropriate steps of implementation. We do not cut and run with the completion of the research report.

We work with clients to prepare an implementation plan that sets time-frames and specifies the resources needed along with assignments of responsibility. And we work further to demonstrate the solutions, develop the policies (or specifications), and provide any necessary training, if desired by the client.

A research report can simply collect dust or be the catalyst for needed change through a sound implementation action plan.



Research Yields Dividends: Annual Report 2003

The Kentucky Transportation Center's annual report for 2003 is now available. You can download a PDF copy from the web at www.engr.uky.edu/ktc/ or contact us by telephone at 859 257-4513 extension 234 and we will mail you a hard copy. The report lists the research activity from July, 2002 through June, 2003 and highlights one project from each of the research program areas.

Bridge Cleaning	2
Rock Slope	2
Statewide Landslide	3
ITS Statewide	3
Stop Sign Crashes	4
Welding Processes	4
Constructibility	5
Intersection Crash	5
Lessons Learned	6
Water Quality	6
Pavement Drainage	7

SPECIAL FACTS OF INTEREST:

- *30% of Kentucky's bridges are substandard*
- *1,400 landslides have been inventoried adjacent to Kentucky highways*
- *Kentucky state roads had 953 stop sign crashes with 31 fatalities in the last three years*
- *Seatbelt usage in Kentucky at 65% is surpassed by 75% of the states*

Environmental Impacts of Bridge Cleaning Operations

[KTC-03-03/SPR-224-01-1F]

Purpose: KYTC uses both total removal and over-coating methods for the maintenance painting of steel bridges. There are pros and cons for either method but the issue typically comes down to cost effectiveness and doing what is necessary based on the available funds and being good environmental stewards. This study looked at cleaning operations of bridges with lead paint to determine the resultant contamination and possible solutions.

Objectives:

1. Review existing techniques for filtration and chemical treatment of heavy metals.
2. Analyze lead concentration from current practices and characterize existing paints' potential for releasing lead into wastewater.
3. Test advanced water treatment techniques/systems to determine the amount of lead reduction achieved.
4. Evaluate costs for advanced filtration systems and development of related specifications for field evaluation of over coating.

Conclusion/recommendations:

- **Current practices for removal of contaminants are not as effective as anticipated.**
- A "sand-filter" appears to be a low cost/low tech method of meeting standards.
- Further testing of wastewater on projects should be conducted to determine the presence of other heavy metals.
- Investigate the use of sand filters as a low cost replacement or supplement for existing filter methods.
- Test other chemical or advance filtration methods for their effectiveness and resultant costs.



Highway Rock Slope Management Program

[KTC-03-06/SPR-177-98-1F]

Purpose: The maintenance of highway slopes and clearing of landslides were identified by KYTC as a major problem involving millions of dollars each year. This study established the scope of the problem and a rating system to assist in managing the most critical cases through a statewide database.

Objectives:

1. Establishment of a system for managing the rock slope problem in KY.
2. Development of a geo-technical database.
3. Survey of numerous rock slopes (and landslides) throughout KY's highways.

Conclusions/recommendations:

- All District and Central offices should implement the rock slope and landslide portions of the database. Training on the system would increase the effectiveness of this tool.
- **The database should be kept current by state staff as projects or events take place.**
- A priority list of critical slopes for future repair should be developed and used as a management tool for allocating or programming resources.

Development of a Statewide Landslide Inventory Program

[KTC-03-07/SPR-176-98-1F]

Purpose: The scope of the landslide problem has always been extensive but never fully quantified. This study completed an inventory of approximately 1,400 landslide locations, documented the attributes and accumulated relevant information in the geo-tech database.

Objectives:

1. To develop a system for managing KY landslide information.
2. Survey and categorize the potential landslides and integrate the data into the geo-tech database.
3. Establish links to the database for all District offices and the Central office to optimize the use of geo-tech related information.

Conclusions/recommendations:

- KYTC should fully implement the database system relating to landslides.

- Entry of data by trained Cabinet staff is critical to the long-term benefits of the system.



Intelligent Transportation System Statewide Architecture

[KTC-03-08/SPR-188-98-2F]

Purpose: The project provides a description of KY's ITS architecture. In 1997 a strategic plan for ITS activities was developed followed by a business plan. The business plan took the goals identified in the strategic plan and identified specific project recommendations. As these various plans were developed it was determined that an overall ITS architecture should be developed to define how all the ITS components fit together and optimize their effectiveness for KY.

Objectives:

1. Identify and interview stakeholders to assist in defining the scope and detail of ITS projects.

2. Prepare market packages to match project descriptions. (Market packages are discrete, useful ITS services identified through the national ITS architecture such as traffic management, WIM, and emergency routing.
3. Create project architecture based on the individual market packages.

Conclusions:

The statewide architecture is an essential tool for the management of ITS projects and prerequisite for the receipt of future ITS funds. It acts as an enabler for ensuring that all ITS projects are in conformance with current and future standards.

Traffic Control at Stop Sign Approaches

[KTC-03-09/SPR-258-03-11]

Purpose: Disregarding stop signs at intersections has the potential for generating extremely severe crashes. This study was to analyze these types of crashes and offer suggestions for reducing the numbers.

Objectives:

1. Determine the numbers of crashes in KY involving a driver disregarding a stop sign and the locations of these events.
2. Determine the characteristics of these types of crashes.
3. Investigate locations with high numbers of these crashes.
4. Make recommendations to reduce the probability of a driver disregarding a stop sign.

Conclusions/recommendations:

- **About 0.07% of all crashes involved a driver disregarding a stop sign, compared to about 1.46% of all fatal crashes.**
- KYTC should have a standard policy concerning installation and maintenance of stop signs at intersections of county and city roads with state maintained roads.
- There should be an expanded use of stop bars on stop approaches, with the stop bar placed where the driver will have a clear view of approaching traffic.
- It is preferable to maintain a minimum size for stop signs of 30"X30".
- There should be more use of rumble strips at approaches where the sight distance is limited.

Survey of Welding Processes

[KTC-03-16/SPR-269-03-1F]

Purpose: Welding processes impact steel fabrication costs and current specifications may be too restrictive. This study reviewed state and national practices in welding in order to determine the state of the practice.

Objectives:

1. Review current welding process prohibitions/restrictions under AWS/AASHTO codes and KYTC special provisions.
2. Determine best practices and welding process trends and identify which those that would represent the state of the art and be the most cost effective.
3. Seek sources of training for KYTC design and construction staff.

Conclusions/recommendations:

- Eliminate KYTC special provision number 4- Welding steel bridges.

- Incorporate in current KYTC specification for steel bridges that fabrication will be per AWS D1.5 (current edition), except welding processes (ESW) and (EGW) must be approved by the Department and engineers. Also process (FCAW) maybe used on secondary members but must be approved by the Department and engineers for main members.
- Actively participate in AASHTO to seek incorporation of important exceptions into the bridge welding code.



Constructibility Issues on KYTC Projects

[KTC-03-17/SPR-236-02-1F]

Purpose: Constructibility is a process that utilizes construction personnel with extensive knowledge, early in the design stage, to ensure that projects are buildable, cost effective, biddable and maintainable. This project demonstrates that an effective construction review during the design process can lead to better project performance.

Objectives:

1. Identify the constructability practices currently being used by other DOT's.
2. Identify the primary constructability issues on KYTC construction projects.
3. Identify practices to alleviate or minimize the impact of major constructability issues.
4. Evaluate the development of a Lessons Learned System that can be effectively implemented.
5. Recommend guidelines for implementation of the constructability review process for KYTC construction projects.

Crash Rates at Intersections

[KTC-03-21/SPR-258-03-2I]

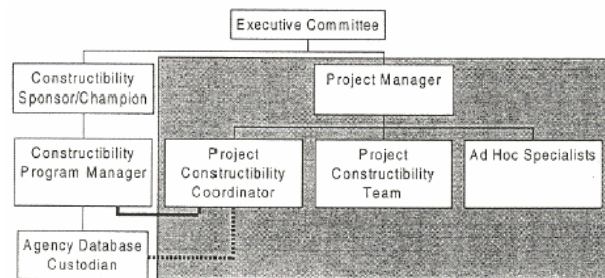
Purpose: Crash rates (CR) in KY are calculated for highway sections (crashes per 100 million vehicle miles) and for spot improvements (crashes per million vehicles). Due to the high incidence of crashes at intersections (35%) KYTC desired to update the methodology for identifying crashes at intersections.

Objectives:

1. Develop a database of intersections.
2. Match crashes to the noted intersections
3. Calculate CR by specific type of intersection.
4. Identify intersections with the highest crash rates.

Conclusions/recommendations:

- **KYTC should formally implement constructibility reviews and post construction reviews on all projects.**
- KYTC should measure the performance of the constructibility review process as a means of continuous improvement.
- Each District should have a person responsible for constructibility reviews and a uniform practice should be established for all Districts.
- Significant construction review findings should be included in the lessons learned database.



Conclusions/recommendations:

- **Approximately 7,000 intersections identified with 19,000+/- crashes over a 3-year period (2000-2002).**
- 428 intersections had a CR factor greater than 1, and 36 had a CR factor greater than 2
- CR was highest for 4 lane undivided in both urban and rural areas and lowest for 4 lane divided.
- A spreadsheet for all intersections of 2 or more state maintained roads was developed. The spreadsheet has provided information to identify high crash intersections for central office and highway districts. **THIS IS CONSIDERED FULLY IMPLEMENTED.**

Lessons Learned System for KYTC Projects

[KTC-03-25/SPR-262-03-1F]

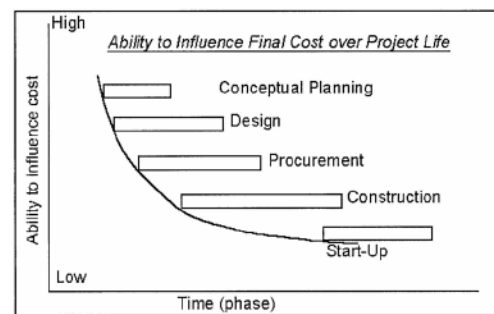
Purpose: A critical component for today's complex transportation system is the ability to collect, archive and disseminate lessons learned that have resulted from our design and construction processes. This project examined the possibility of such a system and how it could be put to use throughout the Cabinet. A working prototype was developed.

Objectives:

1. Identify systems that have been put into practice in other states or organizations.
2. Define the functional capabilities of a lessons learned system (LLS) for KYTC.
3. Develop a system design for LLS.
4. Recommendations for integrating LLS within KYTC construction/design process.

Conclusions/recommendations:

- A web-based system will greatly improve the effectiveness of LLS by making it widely available to all relevant staff within the Cabinet.
- It is essential to have an appropriate quantity, quality, and diversity of data stored in the system and mechanism put in place to keep this information current.



Evaluation of Method to Protect Water Quality in Karst Areas

[KTC-03-30/SPR-237-01-1F]

Purpose: This study included a literature review on what has been previously learned about highway runoff in relation to karst aquifers. A karst highway site was designated in KY that can be used to evaluate a variety of Best Management Practices (BMP). Future widening of I-65 through a karst environment was one of the reasons for undertaking this work.

Objectives:

1. To identify the possible impacts of highway runoff to karst areas.
2. Offer suggestions for BMP when traversing sensitive areas.

Conclusions/recommendations:

- Studies found no strong or definitive relationship between average daily traffic and pollutant levels.
- The greatest influencing factor on pollutant loads is the surrounding land use and in particular atmospheric quality.

- Groundwater in karst areas is more susceptible to contaminants, consequently preventing contamination from entering the aquifers within the cave systems are the only ways to ensure protection. Peat filters have been found successful.
- The BMP for highway runoff in any terrain are vegetative controls such as swales and buffer strips.



Evaluation and Analysis of Highway Pavement Drainage

[KTC-03-32/SPR-207-00-1F]

Purpose: Pavement drainage plays an important role in the overall performance of the pavement structure and long-term investment of our highway system. Over the years KY has used a variety of measures to promote pavement drainage (edge drains, drainage blankets, etc). This study was designed to quantify the drainage characteristics of several construction practices in the state.

Objectives:

Study and quantify drainage characteristics of some key construction practices:

1. Break and seat concrete layers covered with superpave asphalt layer.
2. Effect of a central collection pipe under pavements.
3. Effect of HMA surface permeability.
4. Effect of pavement geometry and pavement types.
5. Effect of cracks on pavement surface.
6. Effect of drainage blankets and its slope.

Conclusions/recommendations:

- Broken and seated PCCP works as an effective drainage layer.
- Superpave surfaces reduce the water quantity that goes through the sides of the pavement.
- Superpave surfaces have a higher permeability, which must be handled by subsurface drainage.
- All break and seat pavements should have positive drainage provided by longitudinal edge drains
- On Interstate widening projects a longitudinal drain should be placed at the interface between the old pavement and the new pavement.
- Stabilized drainage blankets with longitudinal edge drains should be provided on all new construction and major rehabilitation.
- On new construction or major rehab it is recommended that each succeeding layer have a higher permeability than the layer above.



Kentucky Transportation Center

College of Engineering
176 Raymond Building
Lexington, KY 40506-0281

Phone: 859 257-4513
Fax: 859 257-1815
Web: www.engr.uky.edu/ktc

*Innovation and
Service Beyond
Expectation*