TRAFFIC & SAFETY
Jerry G. Pigman, Program Manager

Ken Agent	Research Engineer
Eric Green	Research Engineer
Adam Kirk	Research Engineer
Nithin Agarwal	Research Engineer
David Cain	Technical Analyst
Neil Tollner	Programmer/Analyst
Tony Fields	Research Analyst
Nick Stamatiadis	CE Professor
Mei Chen	CE Professor
Reg Souleyrette	CE Professor

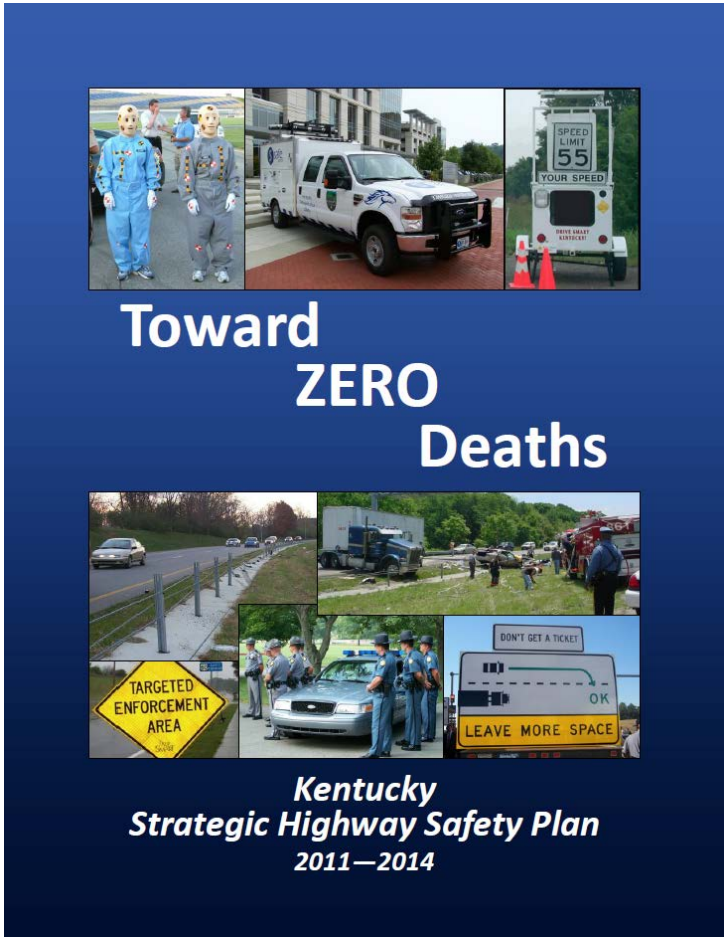
5 Undergraduate Students

Program Topics

- Evaluation of Highway Safety Features
- Crash Data Analysis
- Evaluation of Traffic Control Devices
- Traffic Data Analysis
- Evaluation of Geometric Design Elements
- Traffic Modeling and Simulation

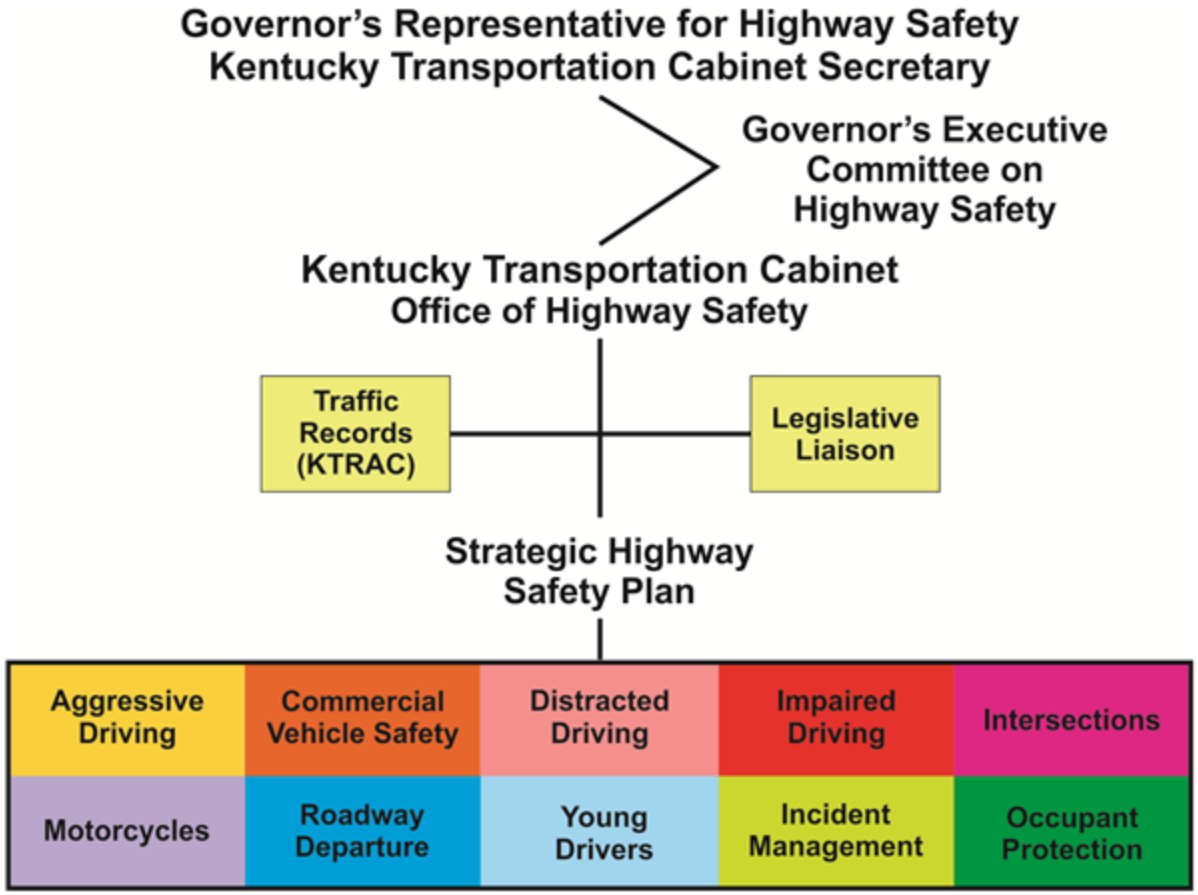
Traffic and Safety Research Activities

Strategic Highway Safety Plan



Areas of Research

STRATEGIC HIGHWAY SAFETY PLAN



TECHNICAL SUPPORT FOR HIGHWAY SAFETY IMPROVEMENT PROGRAM

Areas of Research

HIGHWAY SAFETY IMPROVEMENT PROGRAM

- HSIP is a "Core FHWA Program" to Reduce Fatalities and Serious Injuries
- $40+ Million Provided to Kentucky for Current FY
- KTC Provides Data Analysis to Support Prioritization
- Application of HSM Methodologies

Areas of Research

PRIMARY ACCOMPLISHMENTS

- Identification of Sites and Evaluation of Rumble Strips/Stripes
- Database Development
- Intersection Improvement Plan
- High-Friction Surface Evaluation
- Identification of Sites and Evaluation of Cable Barriers
- Preparation of Three Annual Reports

Areas of Research

CENTERLINE RUMBLE STRIPES AND MILLED SHOULDER RUMBLE STRIPS

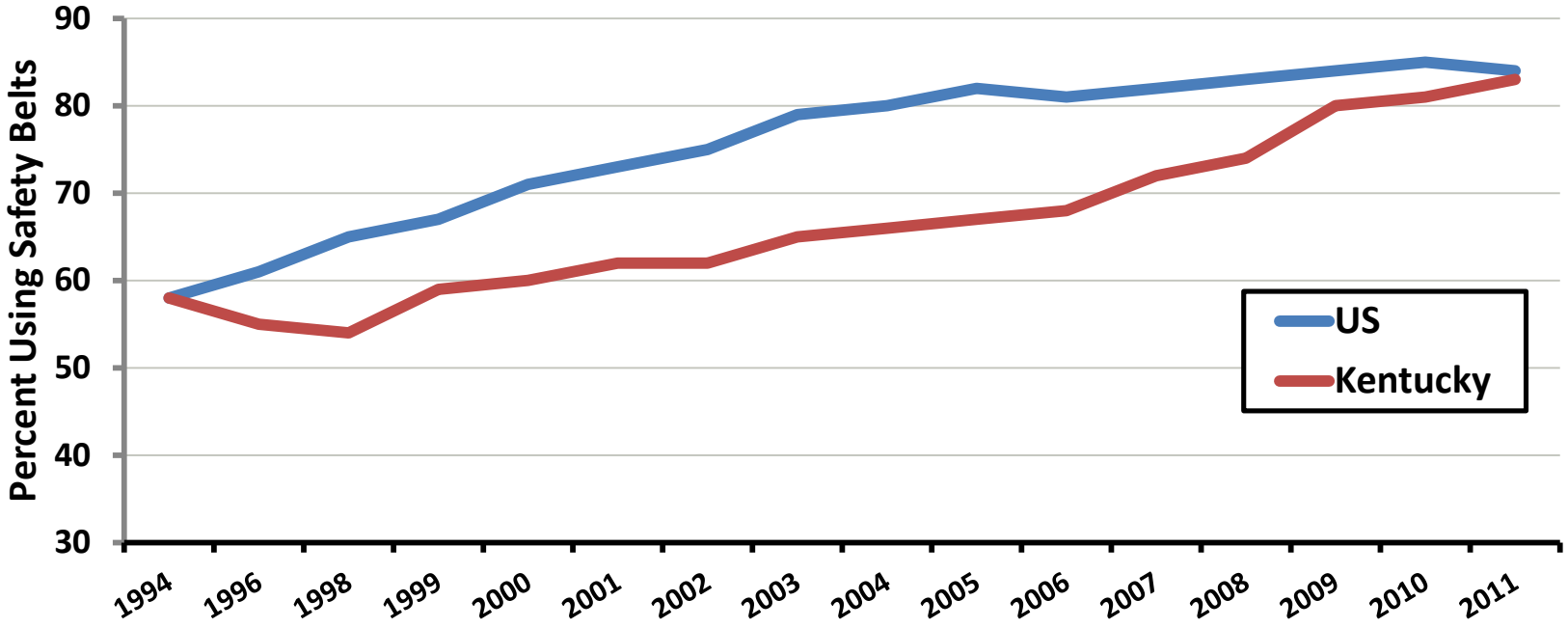
Rumble Stripe

Figure A-13. Rumble Stripe (Dry, Nighttime Condition) (Garrard County).

Rumble Stripe

Figure A-14. Rumble Stripe (Wet, Nighttime Condition) (Garrard County).

Safety Belt Usage Rates
(US vs. Kentucky)

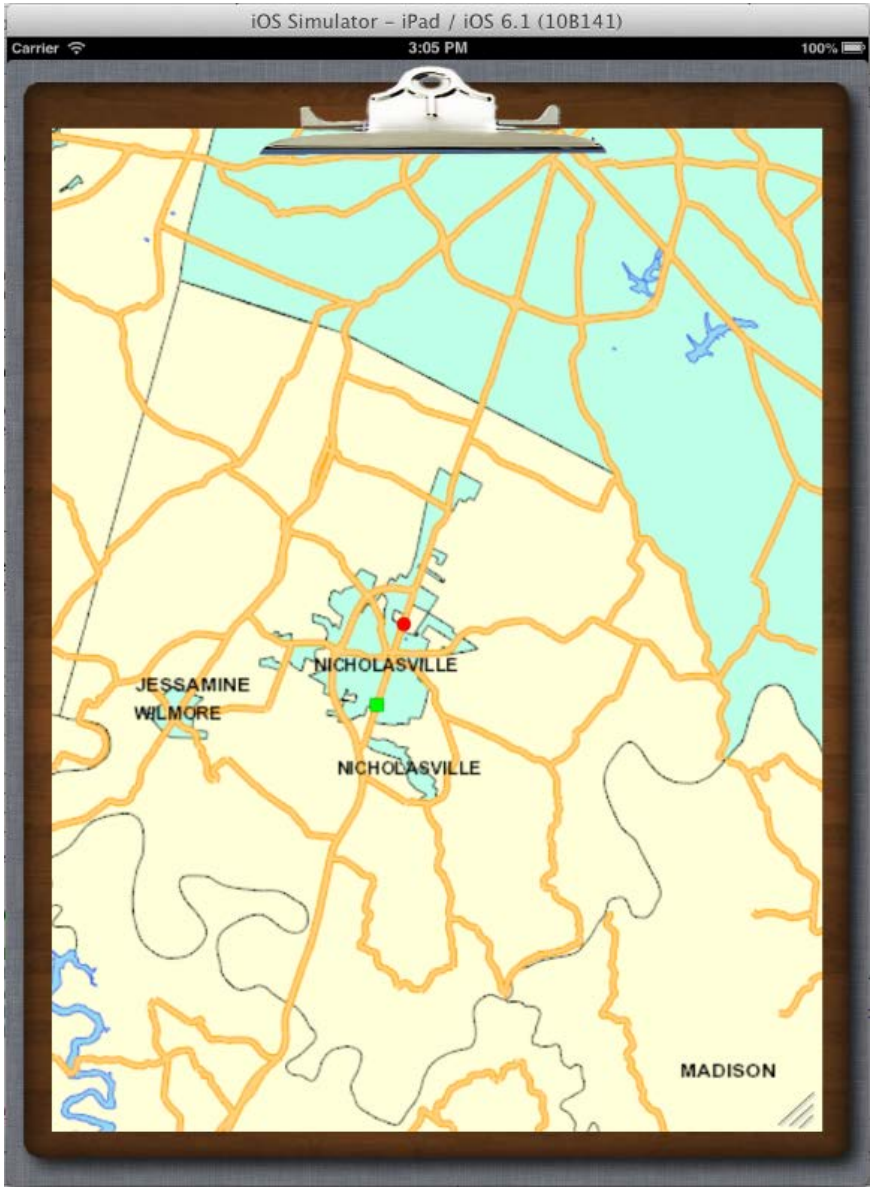


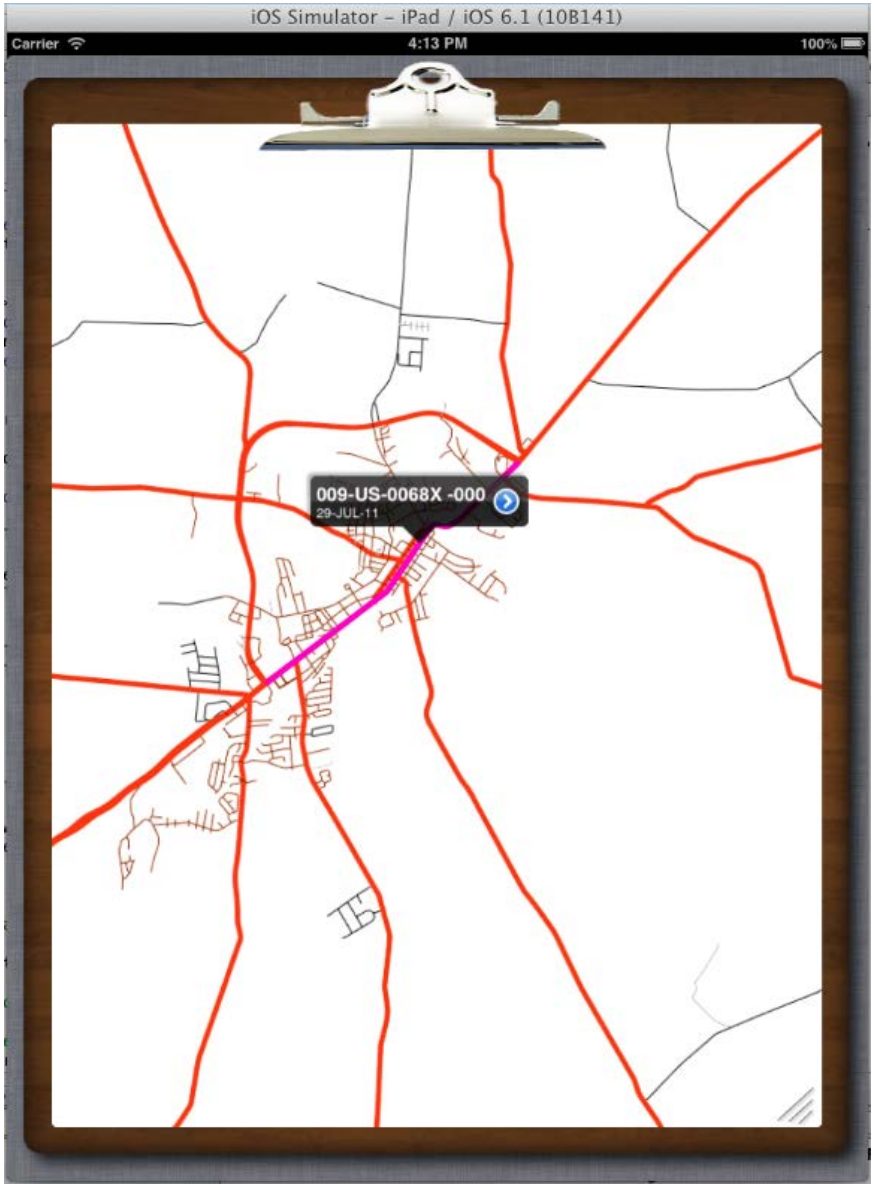
Trend In Motorcycle Helmet Usage

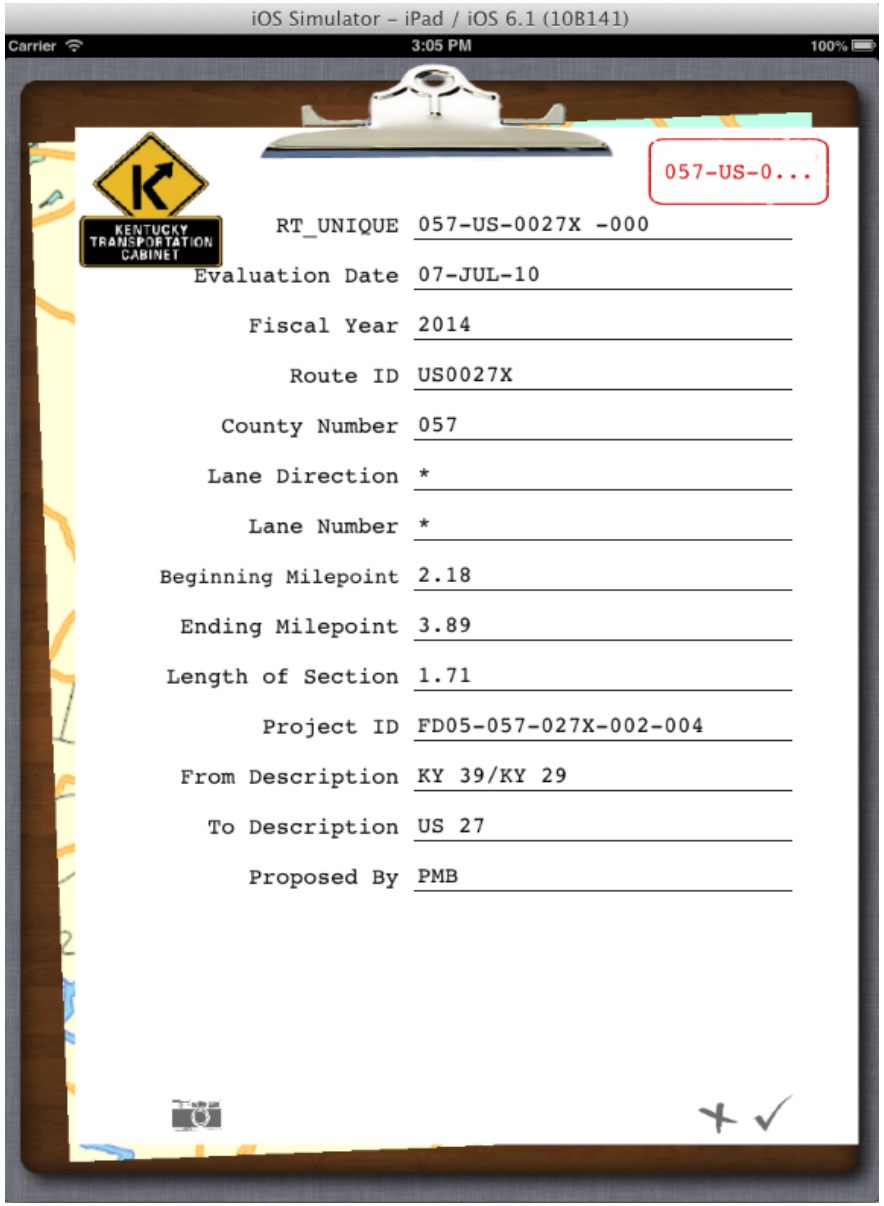
(PERCENT USING HELMET)

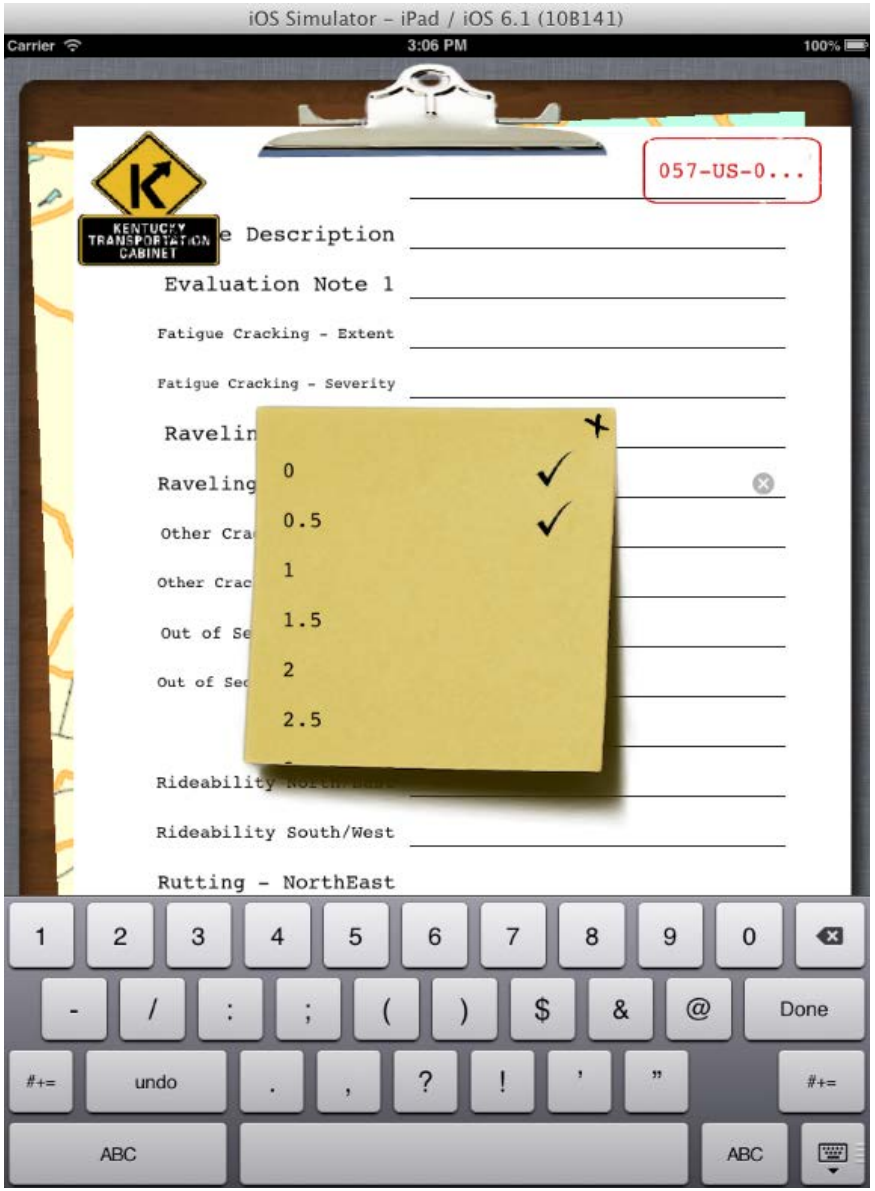
YEAR	PERCENT USAGE
1999	65
2000	70
2001	56
2002	57
2003	56
2004	58
2005	59
2006	60
2007	56
2008	58
2009	64
2010	50
2011	52
2012	53

iOS App for Pavement Rating

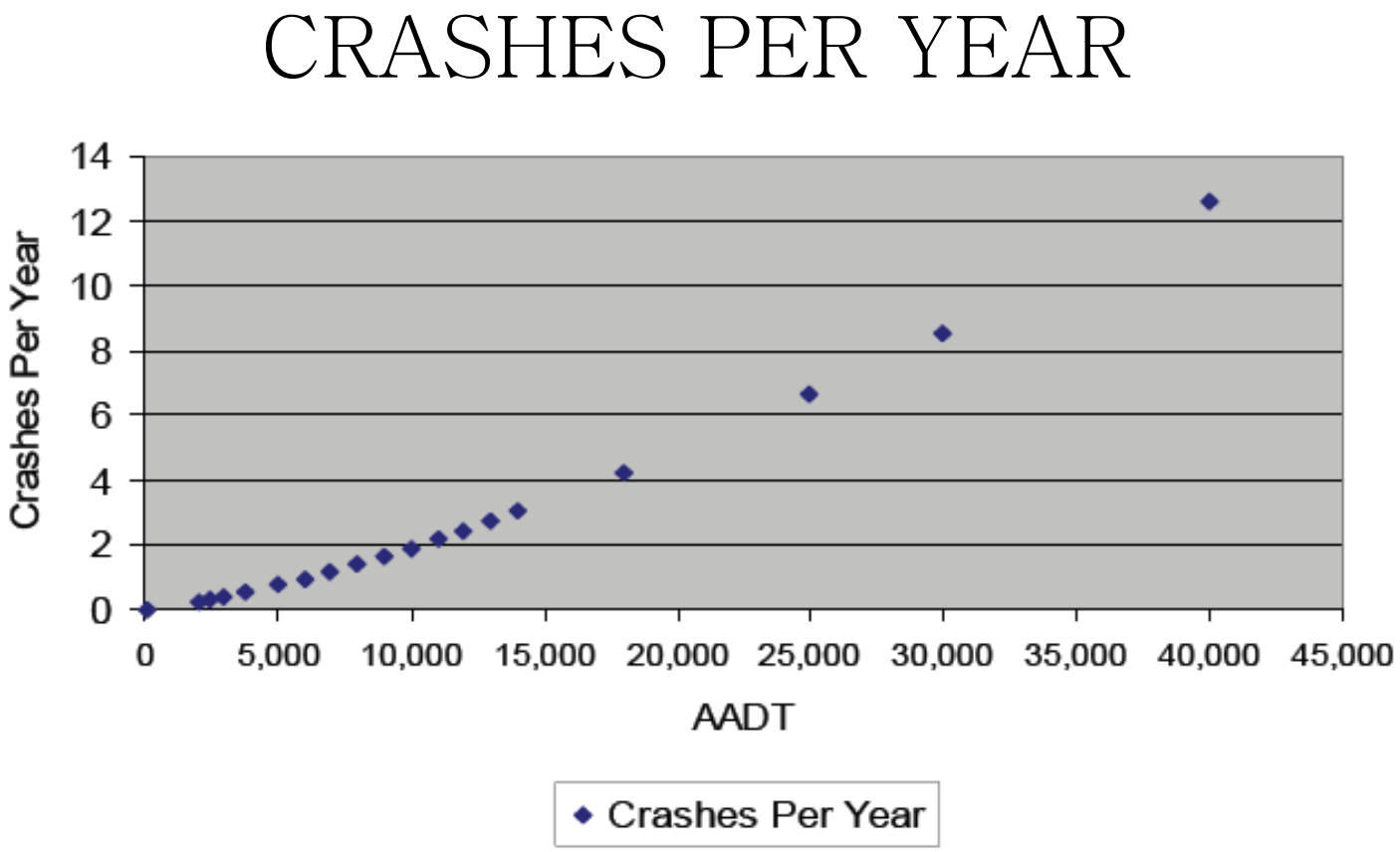

iOS Simulator – iPad / iOS 6.1 (10B141)
Carrier
3:05 PM
100%
JESSAMINE
WILMORE
NICHOLASVILLE
NICHOLASVILLE
MADISON


iOS Simulator – iPad / iOS 6.1 (10B141)
Carrier
4:13 PM
100%
009-US-0068X -000
29-JUL-11

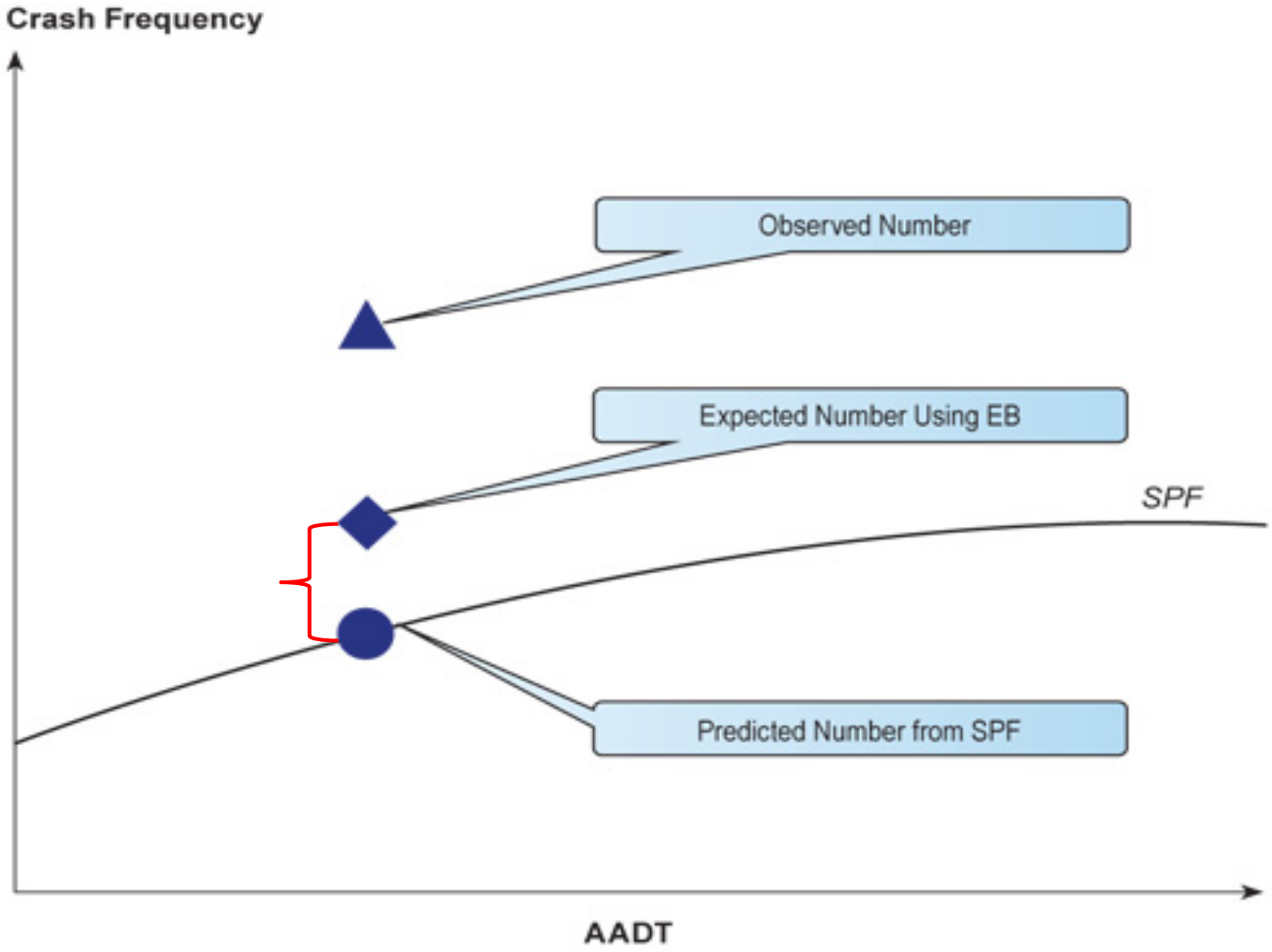

iOS Simulator - iPad / iOS 6.1 (10B141)
Carrier
3:05 PM
100%
KENTUCKY TRANSPORTATION CABINET
057-US-0...
RT_UNIQUE 057-US-0027X -000
Evaluation Date 07-JUL-10
Fiscal Year 2014
Route ID US0027X
County Number 057
Lane Direction *
Lane Number *
Beginning Milepoint 2.18
Ending Milepoint 3.89
Length of Section 1.71
Project ID FD05-057-027X-002-004
From Description KY 39/KY 29
To Description US 27
Proposed By PMB


iOS Simulator – iPad / iOS 6.1 (10B141)
Carrier
3:06 PM
100%
057-US-0...
KENTUCKY TRANSPORTATION CABINET
Description
Evaluation Note 1
Fatigue Cracking - Extent
Fatigue Cracking - Severity
Raveling
Other Cra
Other Crac
Out of Se
Out of Sec
0
0.5
1
1.5
2
2.5
Rideability South/West
Rutting - NorthEast
1 2 3 4 5 6 7 8 9 0
- / : ; ( ) $ & @ Done
#+= undo . , ? ! ' " #+=
ABC
ABC

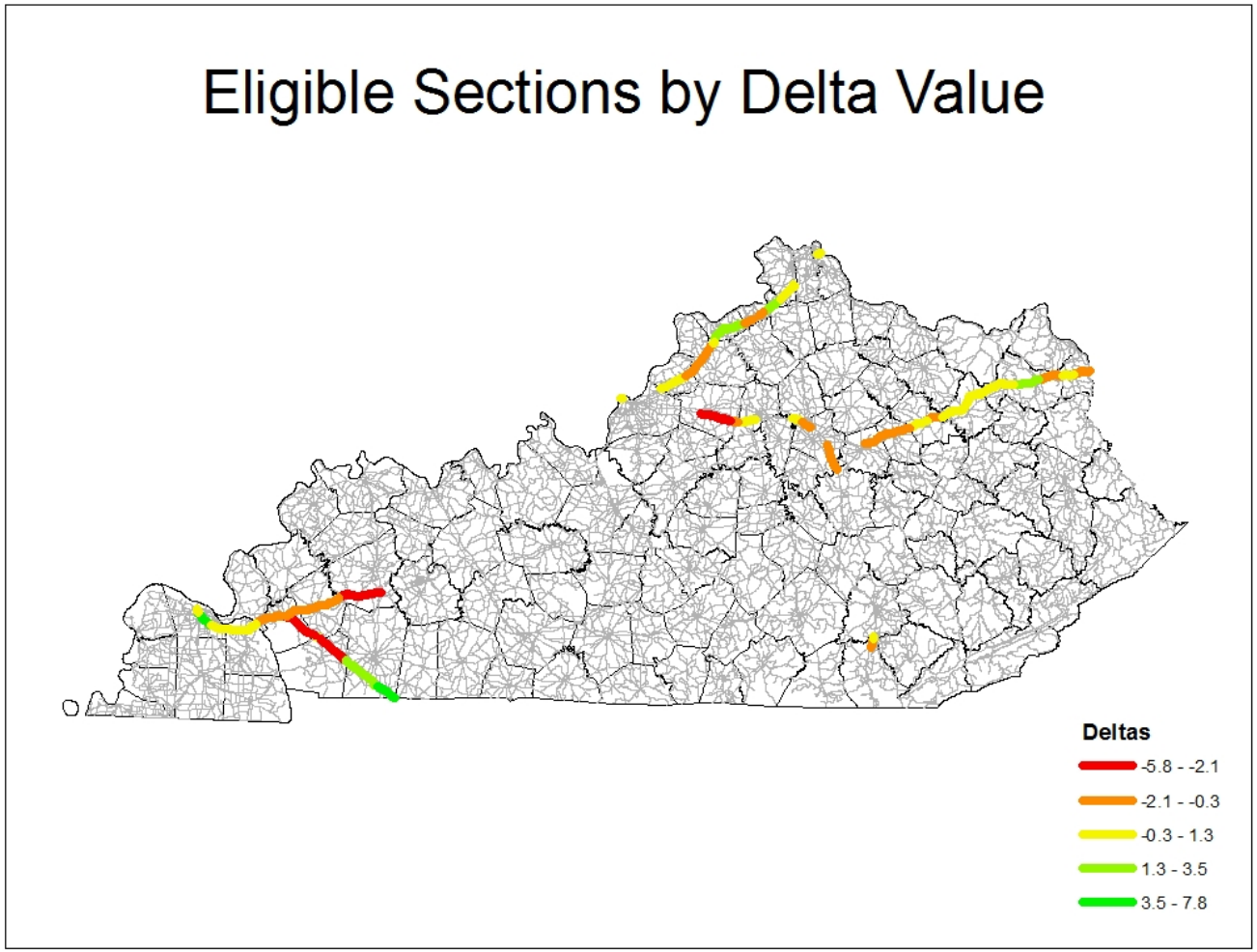
Example SPF


CRASHES PER YEAR
Crashes Per Year
14
12
10
8
6
4
2
0
0
5,000
10,000
15,000
20,000
25,000
30,000
35,000
40,000
45,000
AADT
Crashes Per Year

Delta


Crash Frequency
Observed Number
Expected Number Using EB
SPF
Predicted Number from SPF
AADT

Delta Map

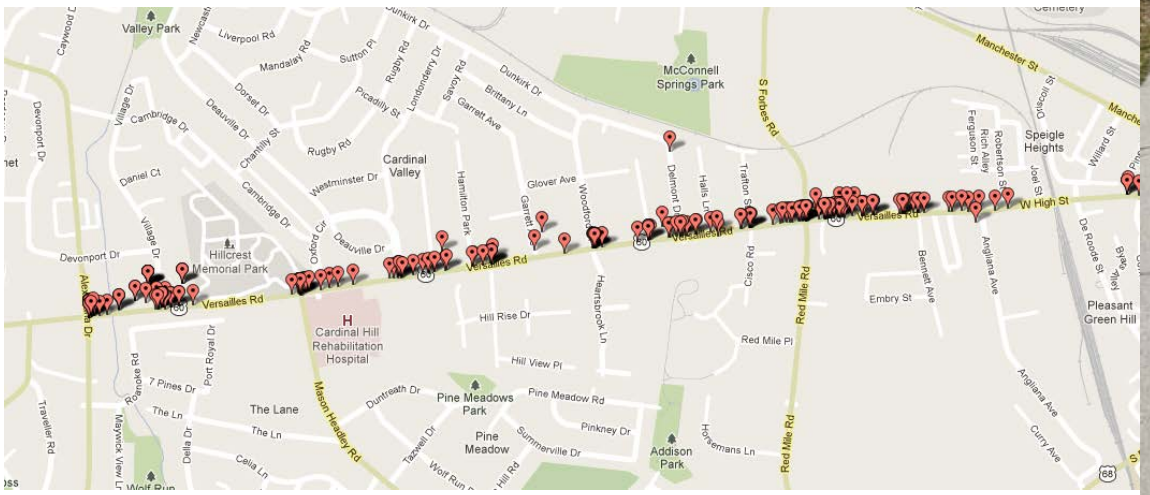

Eligible Sections by Delta Value
Deltas
-5.8 - -2.1
-2.1 - -0.3
-0.3 - 1.3
1.3 - 3.5
3.5 - 7.8

Versailles Road Multimodal Corridor Study

- Travel Survey
- Alternative Analysis
- Crash Analysis
- Recommended Countermeasures

						Total
15	12	14	12	15		68
		Existing				

Bike					Bike		Total
5	11.5	11.5	12	11.5	11.5	5	68
			Proposed				

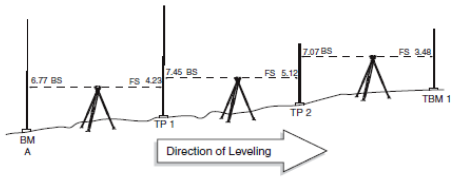


Technical Training

- Signal Technician
- Signal Timing
- Basic Geometric Design Training
- Advanced Geometric Design Training (Intersections)
- Survey Training
- Policy Training for KYTC Pr

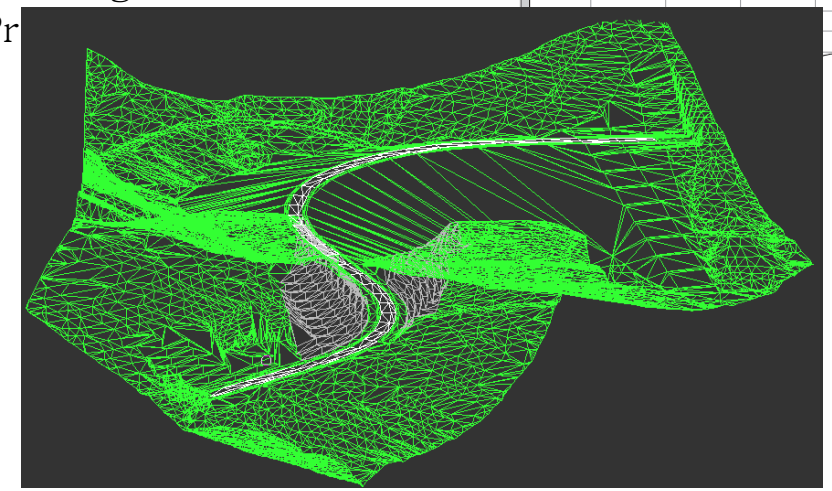
SAMPLE NOTES FOR A TYPICAL LEVEL LOOP

Going from BM A to TBM 1

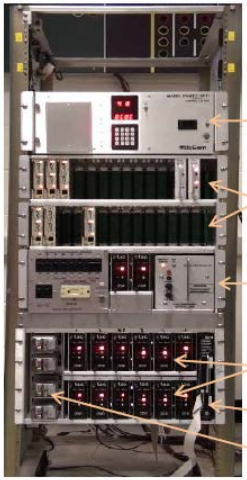


BM. A. TO TBM. 1

POINT	BS	HI	FS	SS	ELEVATION
BM. A					5280.00
INST. 1	6.77	5286.77			
TP. 1			4.23		5282.54
INST. 2	7.45	5289.99			
TP. 2			5.12		
INST. 3	7.07	5291.94			
TBM. 1			3.48		



TRAFFIC CONTORL EQUIPMENT
Model 332 Cabinet



Pavement Materials and Geotech

Clark Graves – Program Manager
Brad Rister – Research Engineer
Charlie Sun – Research Engineer
David Hunsucker – Research Engineer
Kean Ashurst – Research Engineer
David Allen – Research Engineer (part-time)

6 Research Engineers

Tim Scully – Research Investigator

1 Research Investigator

Dan Eaton – Engineering Technician
Jamie Creech – Engineering Technician
Tim Jones – Engineering Technician
Levi McIntosh – Engineering Technician
Richard Reitenour – Engineering Technician (part-time)

5 Engineering Techs

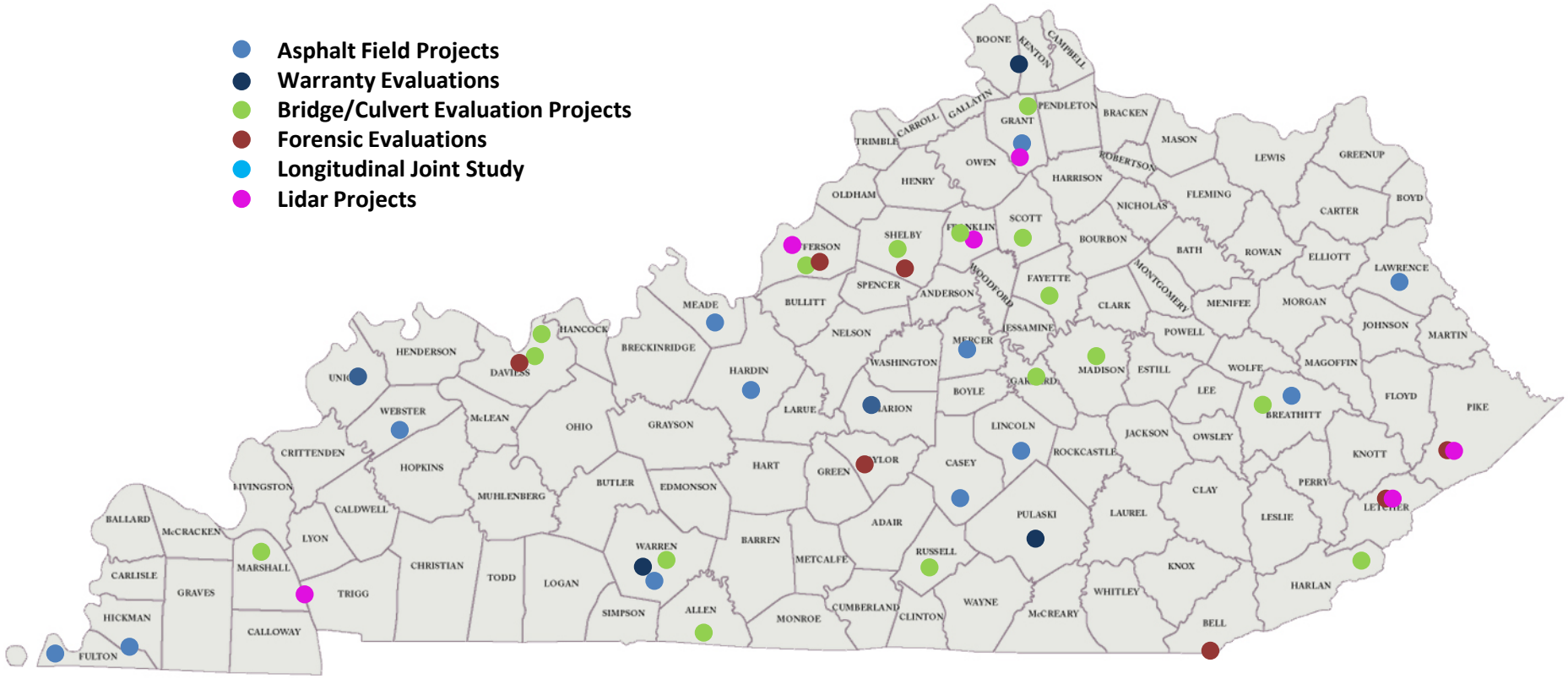
Joe Whelan – Graduate Student

1 Graduate Student

Areas of Research

- Pavement Design and Construction
- Forensic Studies
- Materials
- Highway Drainage
- Traffic Loading
- Structural Instrumentation Testing
- Geotechnical Evaluations
- Utilization of LiDAR
- Evaluation of High Friction Surfaces
- Bridge Instrumentation
- Ground Penetrating Radar (GPR) Evaluations

Where Are We Working?

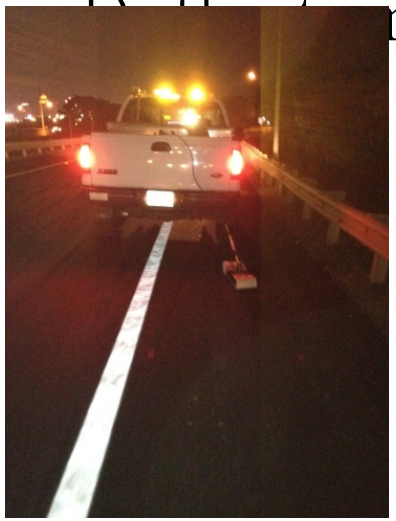


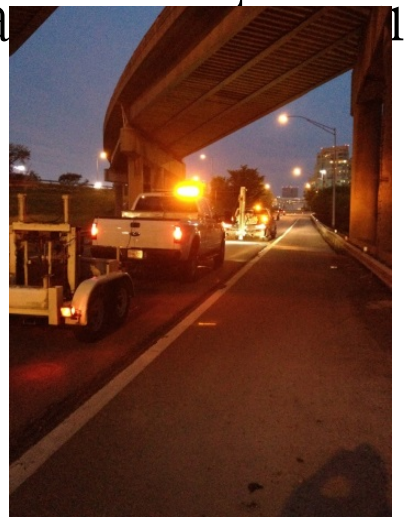
Project Highlights

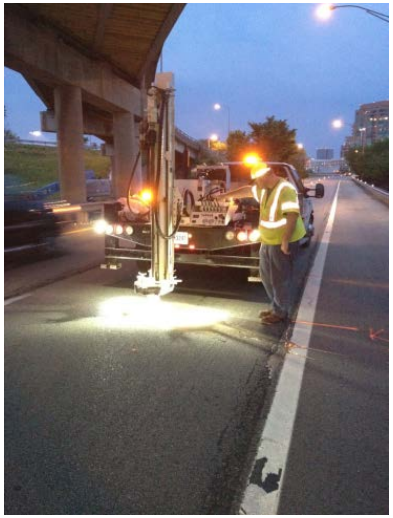
- Forensic Evaluations
- High Friction Surface Materials
- Culvert Inspection and Evaluation
- Use of LiDAR

Forensic Evaluations

- Subsurface Pavement Evaluations, Louisville Southern Indiana Ohio River Bridges (LSIORB)
- Determine in-situ conditions for use by design-build teams
- Ground Penetrating Radar, Falling Weight D[illegible]meter, Pa[illegible]ing

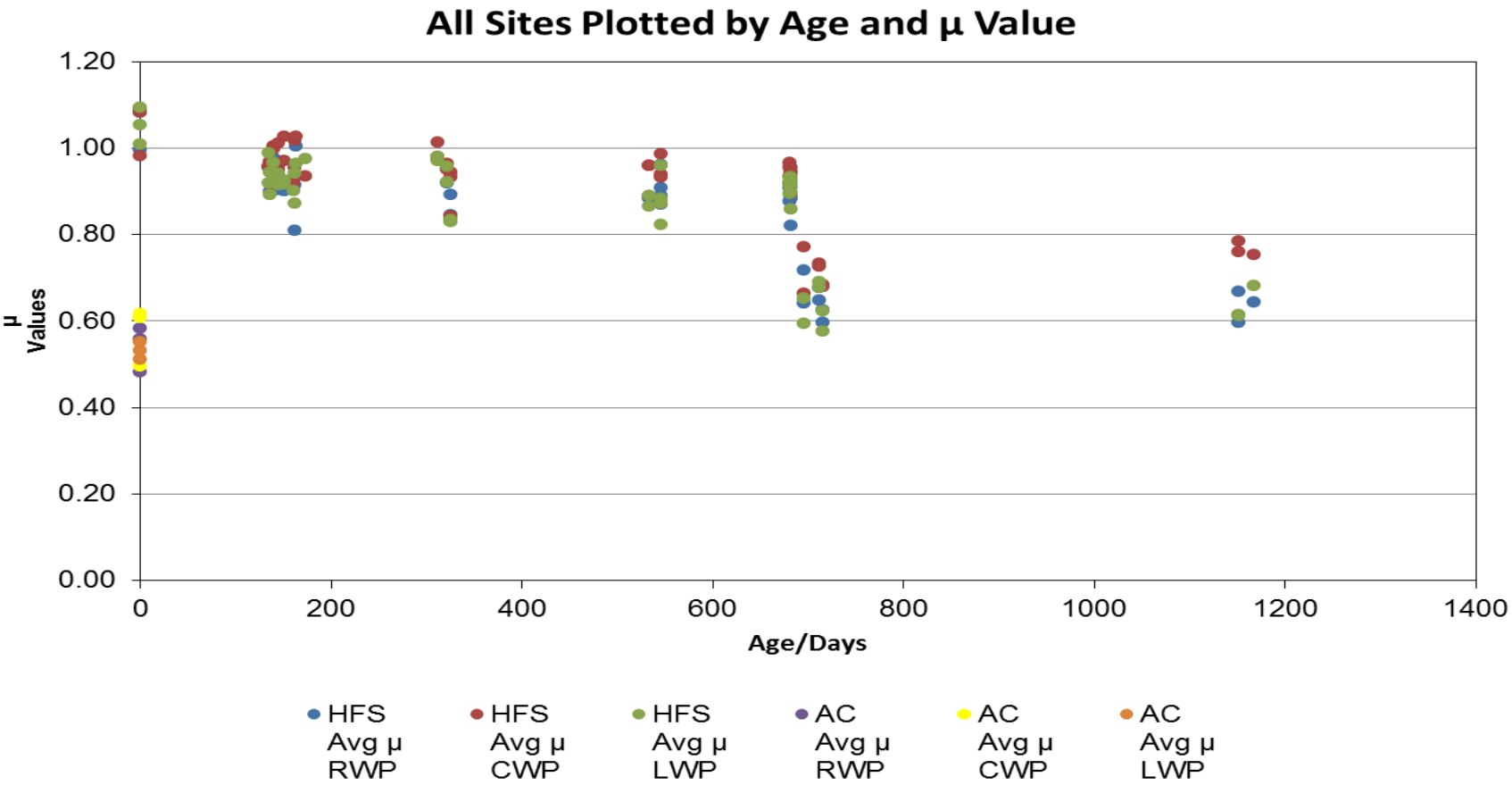






High Friction Surface (HFS)

Friction Results

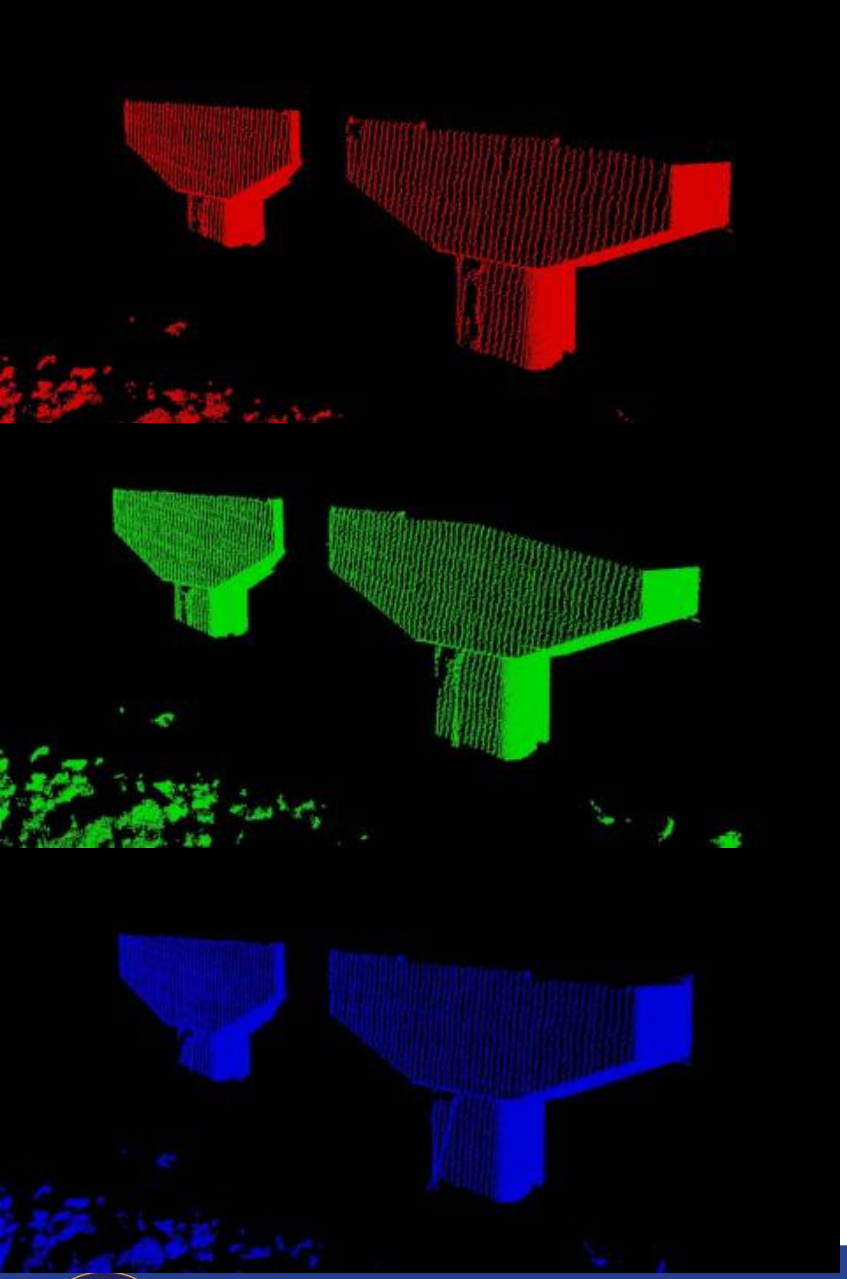


Pipe Inspection Certification Program

- Purpose is to ensure consistent results among contractors
- Consistent reporting format
- Set up a “test track” with flexible and rigid pipe
- Distress pipe with in situ like conditions
- Contractor is to come in and video and laser inspect pipe and submit report
- KTC to determine compliance with KYTC specs

Applications of LiDAR

- Monitor bridge piers (stationary LiDAR)
- Check bridge clearance heights (mobile LiDAR)
- Determination of existing pavement profile (mobile LiDAR)

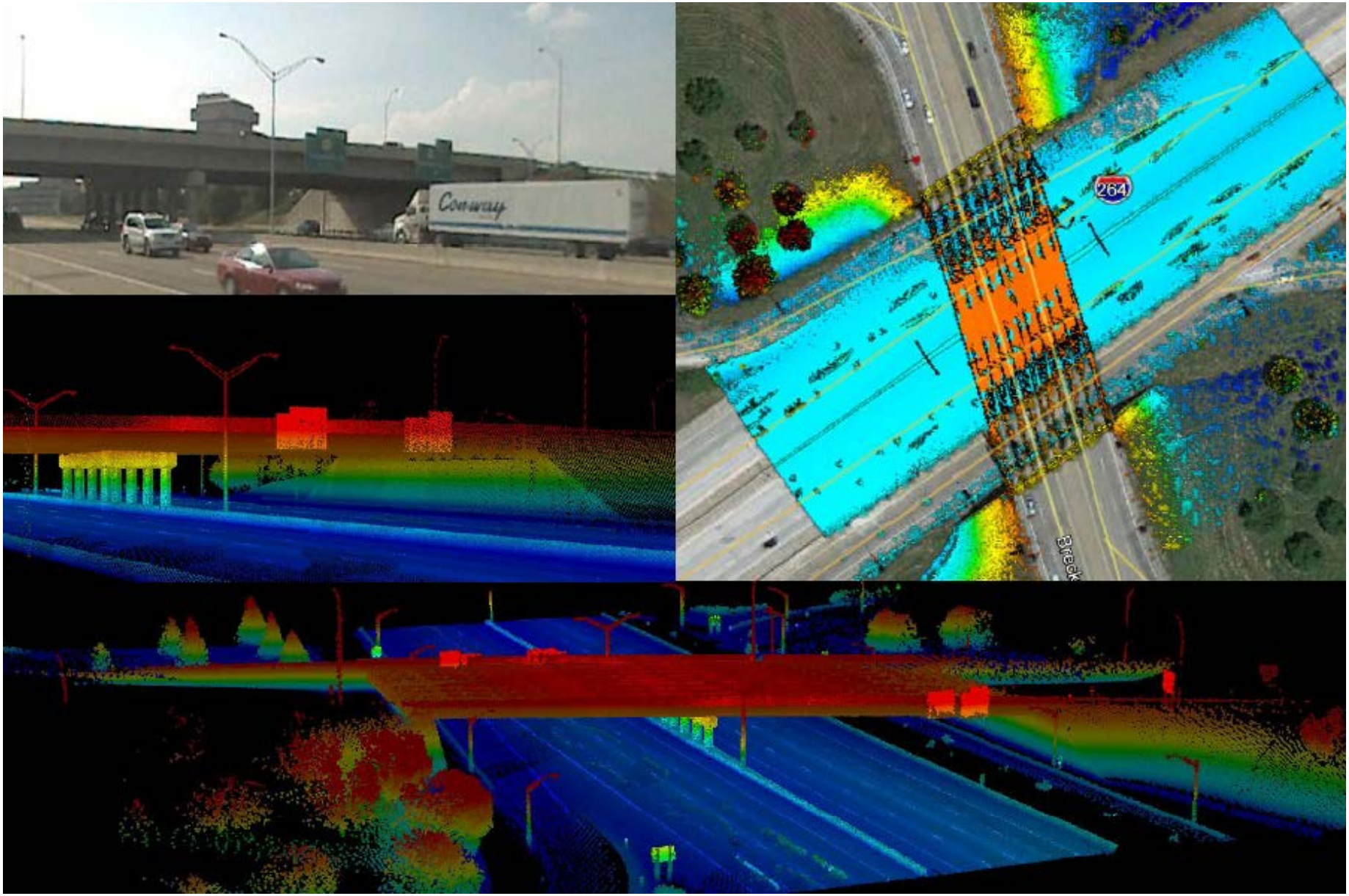


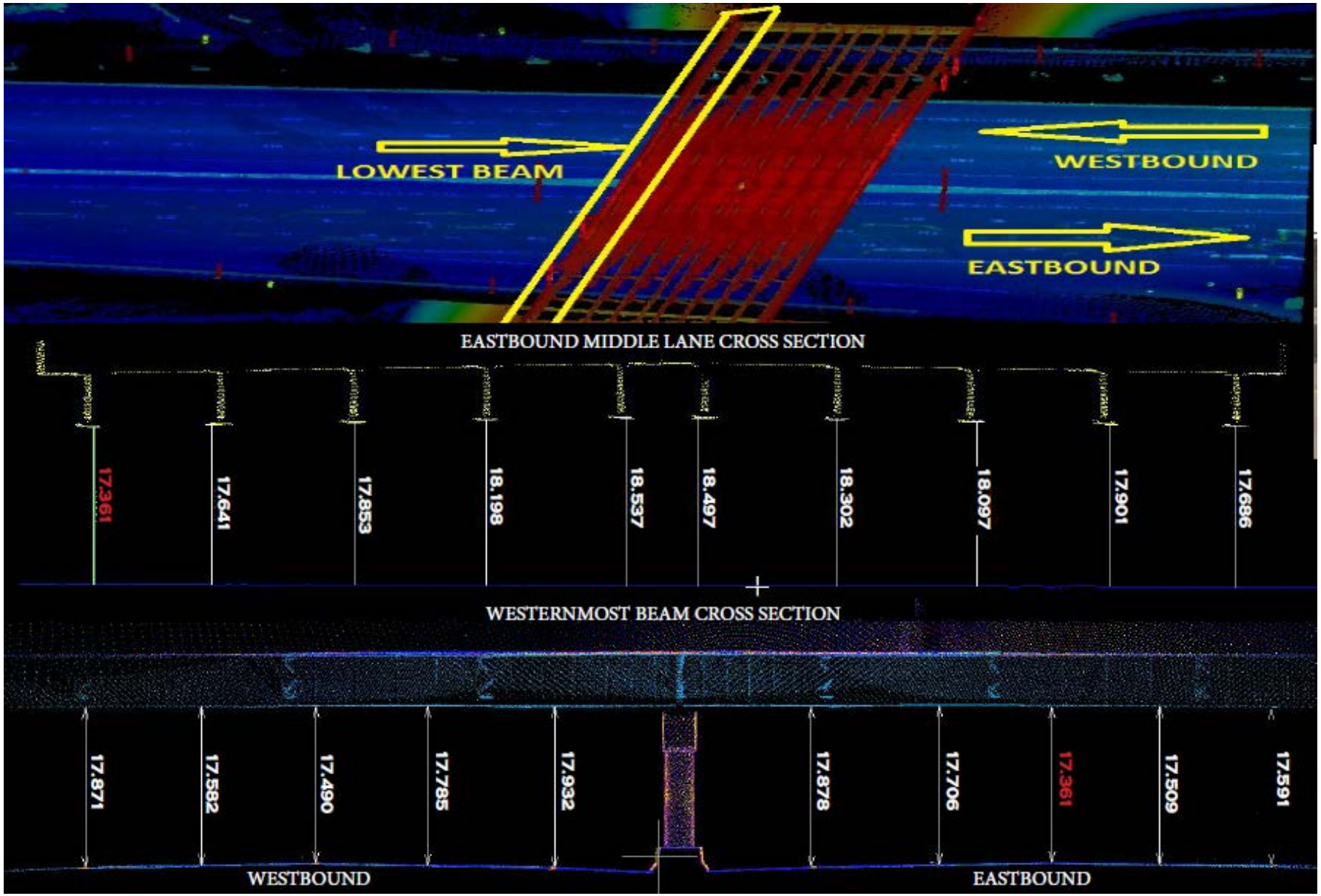
Data example from Pier A scanned on:

12/11/2012

12/19/2012

1/9/2013


Conway
264


LOWEST BEAM
WESTBOUND
EASTBOUND
EASTBOUND MIDDLE LANE CROSS SECTION
17.361
17.641
17.853
18.198
18.537
18.497
18.302
18.097
17.901
17.686
WESTERNMOST BEAM CROSS SECTION
17.871
17.582
17.490
17.785
17.932
17.878
17.706
17.361
17.509
17.591
WESTBOUND
EASTBOUND

Summary

- Develop or apply emerging technologies/applications
- Evaluation of innovative materials and technologies
- Provide savings for design, construction, and maintenance projects
- Help improve the industry

KTC Program Name: Structures
Program Manager: I.E. Harik

- Current Employees
  - Full-Time: Dr. A. Peiris
  - Ph.D. Student: Mr. A. Jawdhari
  - U.G. Student: Mr. B. Benifield
  - U.G. Student: Mr. T. Blair
  - U.G. Student: Mr. M. Crossley

Program Topics

High Performance Materials

APPLYING COMPOSITES

Edited by Karen Lindsay

The Clear Creek Bridge demonstration project: a photo essay

Visitors to Kentucky's Daniel Boone National Forest now have a high-tech link to a major hiking trail. A 60-ft. long composite bridge provides access from the Clear Creek Furnace picnic area to the Sheltowee Trace National Recreation Trail. Installed on November 14, 1996, the bridge's main load-carrying members are 24-in.-deep pultruded composite I-beams (glass-fiber-reinforced vinyl ester with carbon fiber in the flanges to increase stiffness).

"As with most composites, strength did not control the design," says Issam Harik, professor at the University of Kentucky's Department of Civil Engineering. "In fact, the beam without the carbon would have been several times stronger than what was required. Limiting deflection of the bridge under normal foot traffic was the characteristic that controlled the design." Adding carbon fibers to the section more than doubled the stiffness of the beam (*CDA* Fall '96, 7). But doubling the stiffness of the beam was not enough to allow a two-girder, 6-ft.-wide bridge to span 60 ft. With a design load of 85 lb./sq. ft., the total load used for the design was 30,600 lb., which caused 7 in. of deflection under the full design load. The goal was to limit the midspan deflection to 4 in. under full design load. To achieve desired stiffness, pultruded composite sucker rods were anchored to the abutments to support the bridge girders 10 ft. from each end. To maintain low-profile appearance, the sloping portion of the rods were limited to a relatively flat angle.

All components were delivered to the bridge site in a single-axle truck. Each of the two girders consisted of three beam segments which were shored on temporary scaffolding and then field spliced. Stainless steel splice plates and bolts were used to maintain corrosion resistance. Composite panels were attached to the top flange of the beams and serve as the bridge deck. Handrail posts and internal cross bracing are connected to the I-beams' webs at 5-ft. intervals along the bridge. All assembly of the bridge was accomplished with common hand tools. Total construction time with three workers was approximately three days.

➤ *1. Clear Creek Bridge site (before). [Photo, University of Kentucky]*

➤ *2. Clear Creek Bridge (after). Designers (l-r): Brad Robson, Issam Harik, and Pete Szak. [Photo, University of Kentucky]*

Largest in the World

Johnson County Plastic Bridge Deck

By Steve McNally, CCT • Director of Industry Affairs, Composites Fabricators Association

The residents of the community of River in Johnson County, Kentucky are the beneficiaries of the longest plastic bridge deck in the world. (The second longest is in Scotland). The deck of the 420-foot footbridge, over the Levisa Fork of the Big Sandy River, is made of FRP composite materials.

Dr. Issam Harik, professor of civil engineering, read of the plight of the residents of River in 1994 in an article in the Lexington Herald-Leader. An existing wood footbridge, built in the 1930s, had fallen into disrepair. "It looked like something Indiana Jones would have to cross," said Freddie Goble, project manager for the Big Sandy Area Development District.

The wooden bridge deck had numerous holes and all four primary cables were rusted, one to the point of having broken. Many residents continued to use the old bridge, however, saving themselves an hour round-trip by car. Without the footbridge, residents would be forced to drive 13 miles up the river to an automobile bridge and then 7 miles back down to the other side of the footbridge. On the other side lies the local post office, River United Baptist Church, and friends and family.

Dr. Harik is considered a pre-eminent authority on the use of composite materials in structures. He saw this project as a good fit for composite materials. Harik and his research team began the project independently of any government agency. Brad Robson and Michael Whitney (graduate students working with Dr. Harik at the time) worked on the design and analysis of an all FRP bridge as a possible replacement of the River bridge as a project in a graduate course. Once their design and analysis was completed, Harik contacted the Kentucky Transportation Cabinet (KyTC) and the Johnson County Judge who were already working on securing funds to replace or retrofit the bridge.

It was determined that the entire structure was in such disrepair, it would all need replacing. The cost of this extensive replacement project far exceeded the funds which were originally allocated the initial plan, which involved repair of non structural portions of the bridge.

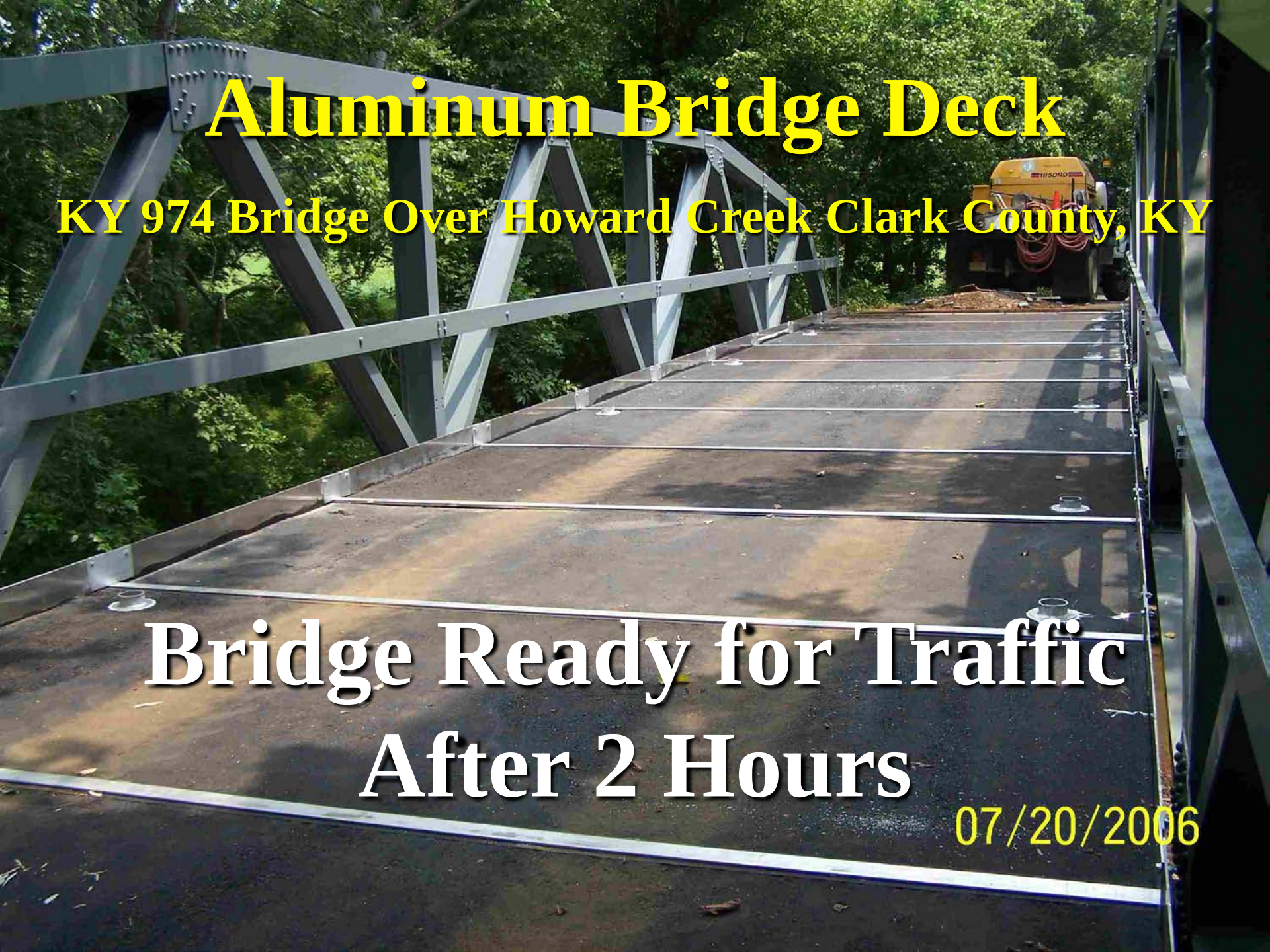
Over the next three years, the $527,560 needed to complete the bridge was procured from the Federal Highway Administration, the Kentucky Transportation Cabinet and from R. B. Preston, a Johnson County native and private citizen. Once funding was secured, construction began in November 1998 with completion in April 1999.

("Plastic Bridge" continued on p. 42)

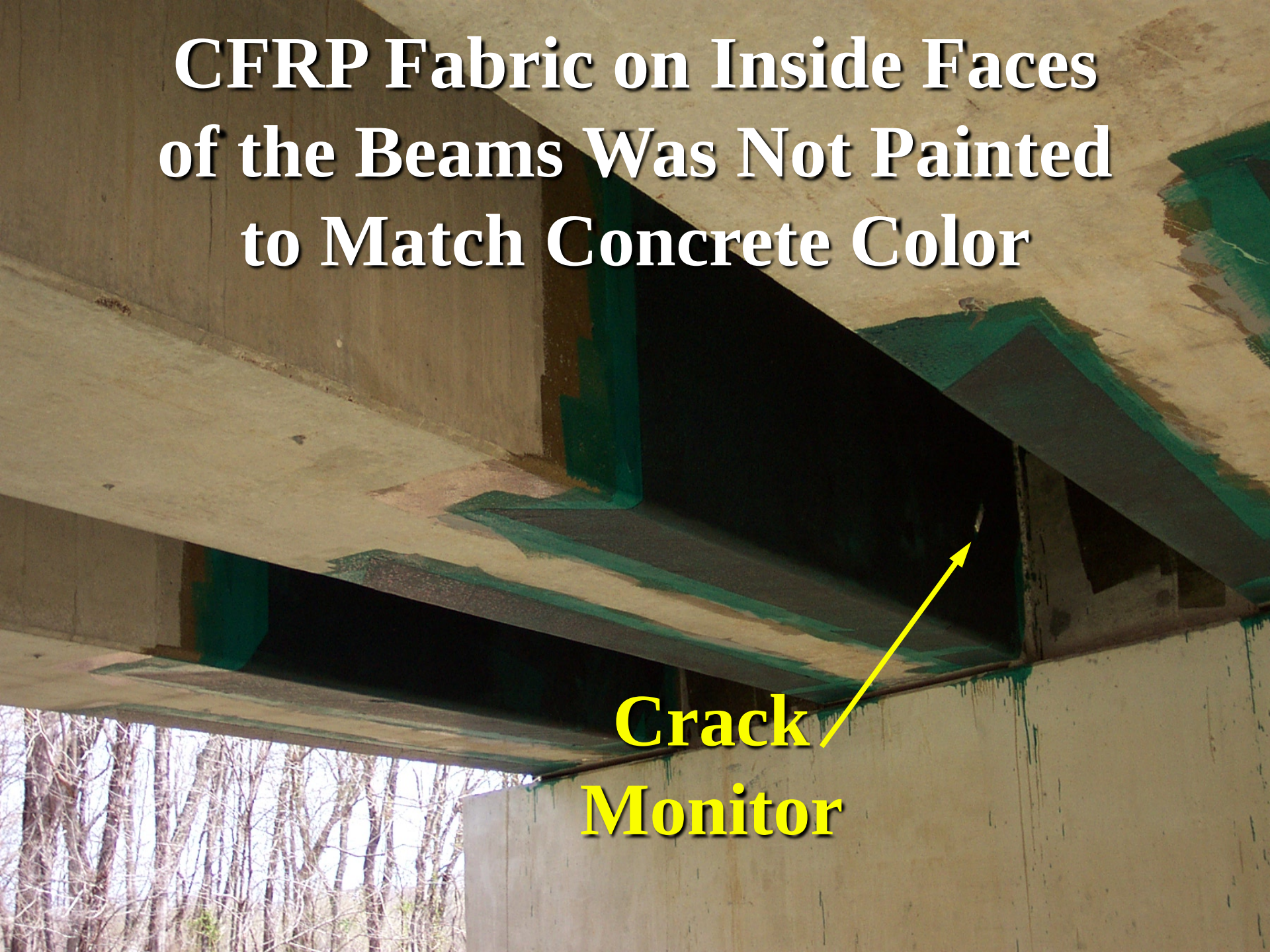
Glass FRP Rebars

Roger's Creek Deck, Kentucky - 1997

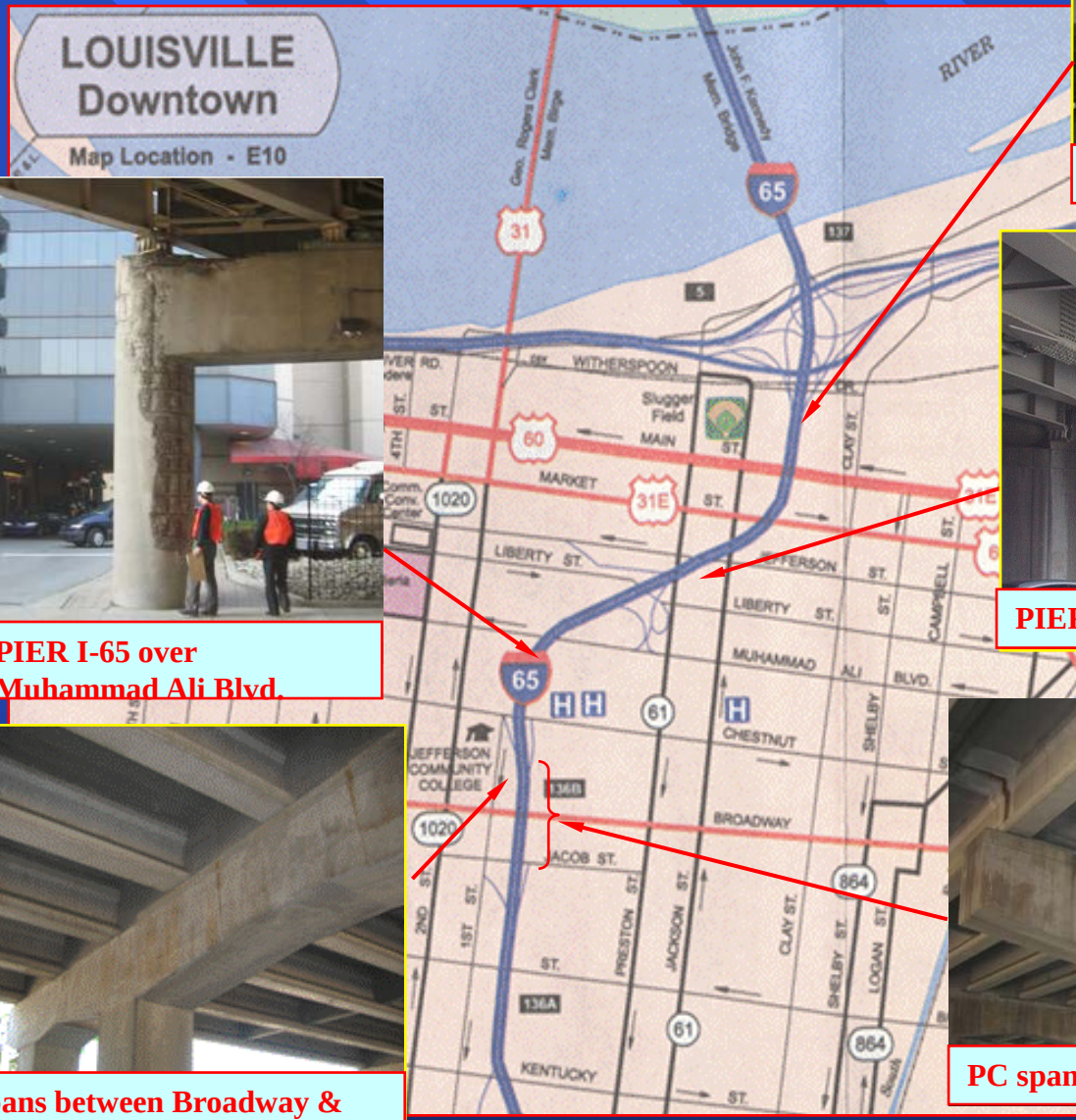

Carbon FRP Rebars
First Bridge in the US
With CFRP Bars
Clark County Bridge, Kentucky - 2002


Aluminum Bridge Deck
KY 974 Bridge Over Howard Creek Clark County, KY
Bridge Ready for Traffic
After 2 Hours
07/20/2006

Bridge on KY 3297 over Little Sandy River
Carter County, Kentucky


CFRP Fabric on Inside Faces of the Beams Was Not Painted to Match Concrete Color
Crack Monitor

I-65 in Louisville



PIER 6 at Main & Hancock ST

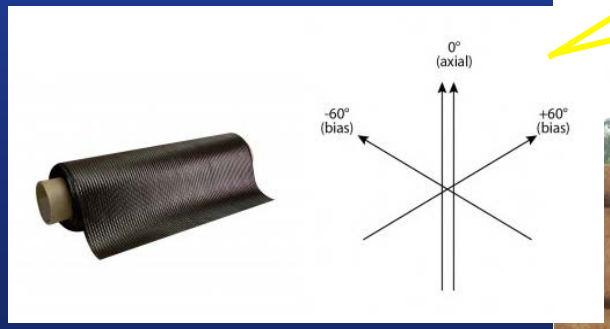
PIER I-65 over Muhammad Ali Blvd.

PIER 4 at Jefferson & Preston ST

PC spans between Broadway & Chestnut

PC spans between Jacob & Gray ST

First Application of Triaxial Fabric on Bridges



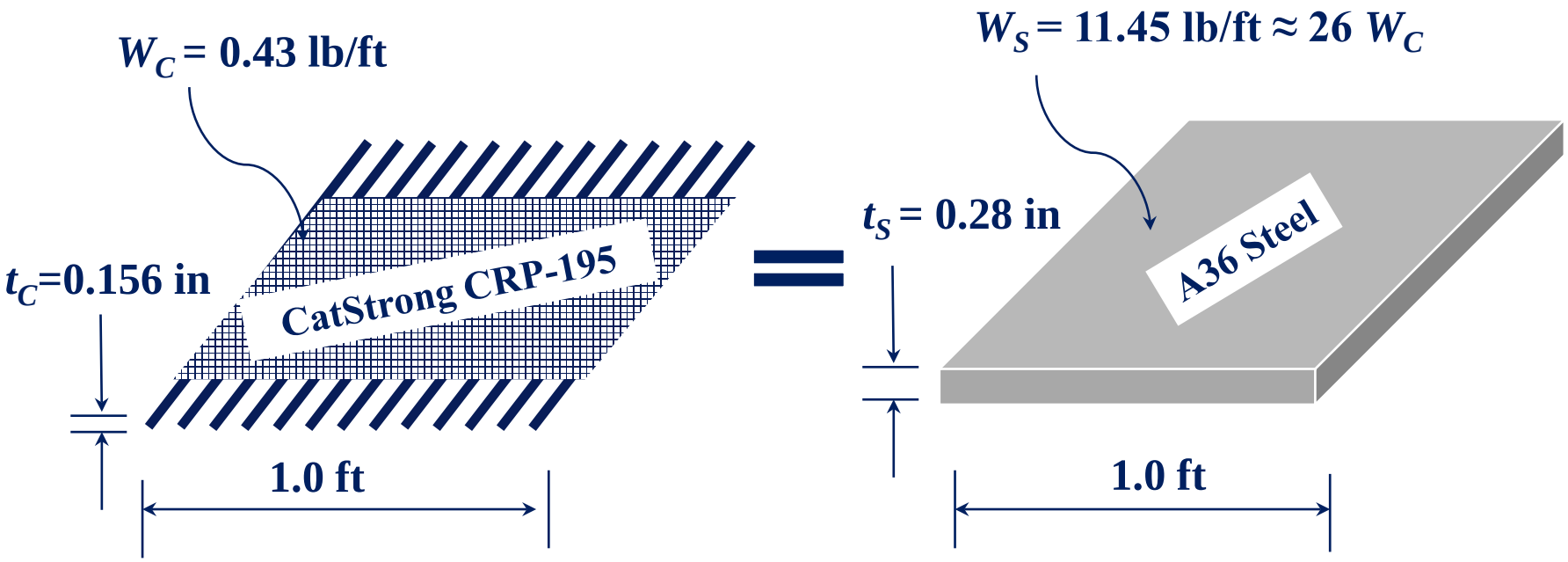
Simpson County, KY


Second Bridge in the World
With UHM CFRP Laminates
KY 32 Bridge
Scott County, KY

CatStrong

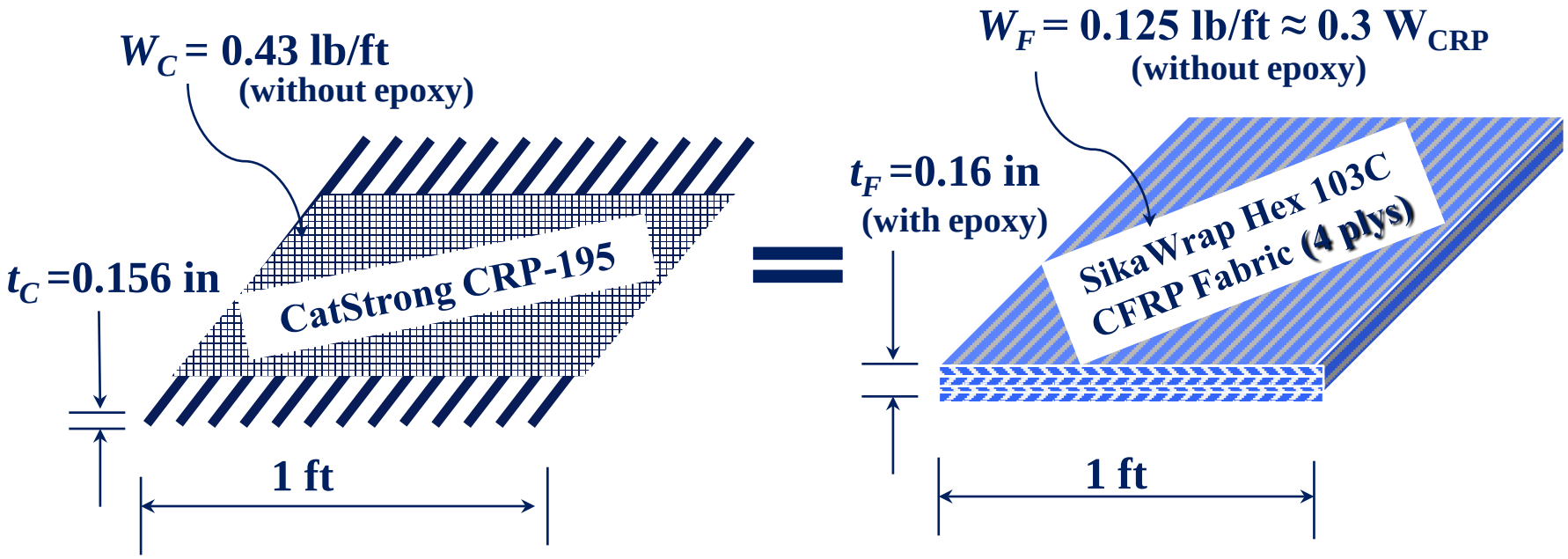
CFRP Rod Panels Developed at U. of KY

CRP-195 vs. Steel



Ultimate Load = 195 kip

CRP-195 vs. CFRP Fabric

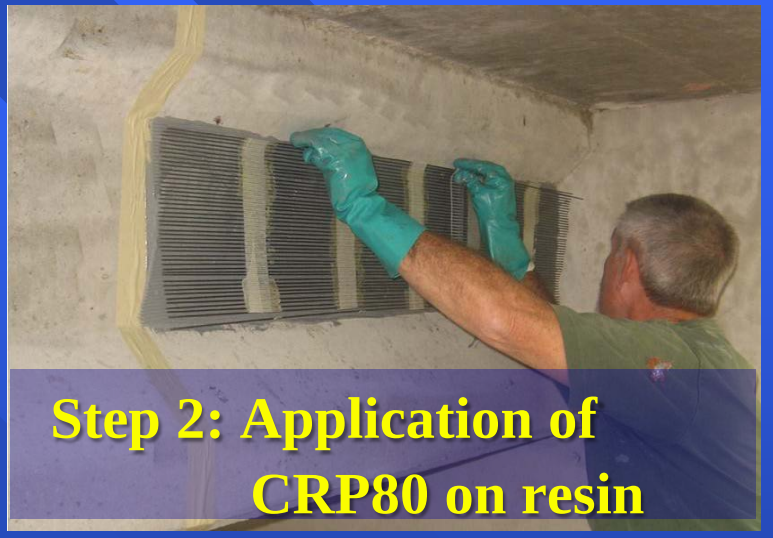


Ultimate Load = 195 kip

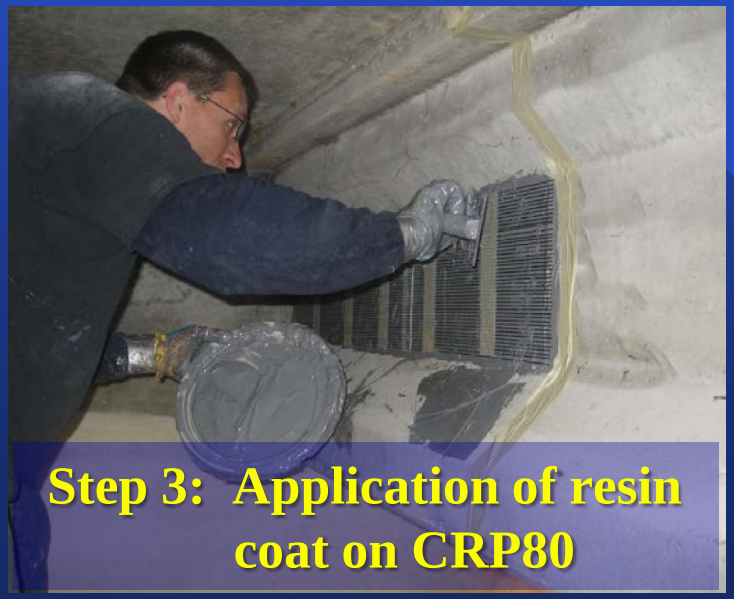
Repair of the KY218 Bridge Over Blue Springs Creek, Hart County, KY

First Application of CatSrong CRP80 (week of September 19, 2011)

Step 1: Application of resin on concrete girder



Step 2: Application of CRP80 on resin



Step 3: Application of resin coat on CRP80

Girder strengthened with CRP80


Caldwell Road over Blue Grass Parkway
10/07/2011

Sunnyside-Gotts Road over I-65

CatStrong CRP 195 Application

KY 81 Bridge, McLean County, KY

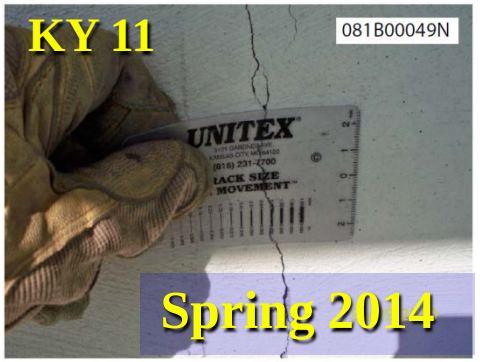

Beam After Repair (9/18/12)
(Repaired beam is stronger than the original beam when the bridge was first opened to traffic)

Results that have benefited KYTC

Results that have benefited KYTC

Repair With Carbon FRP by District Personnel


KY 55 Bridge
June 2013


KY 11
081B00049N
UNITEX
Spring 2014

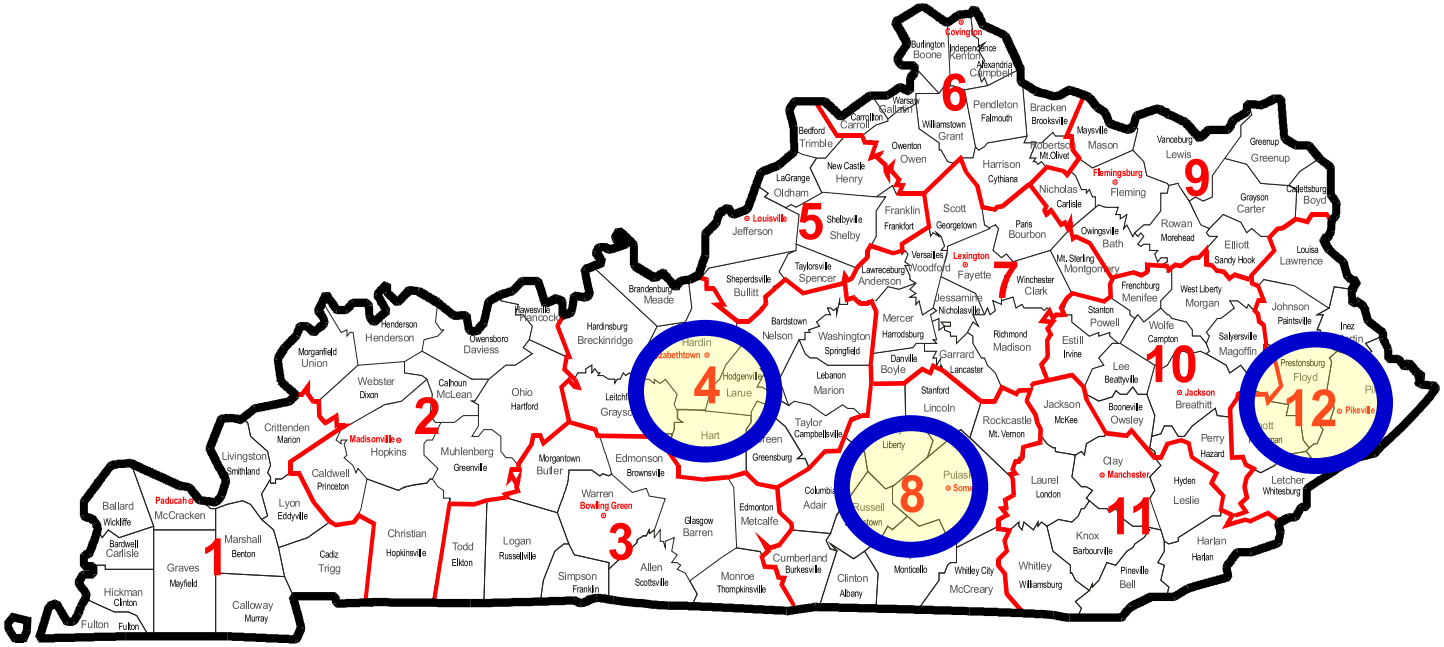

I-64 Over River Road
Spring 2014

1
2
3
4
5
6
7
8
9
10
11
12
Louisville
Jefferson
Lexington
Fayette
Covington
Bowling Green
Madisonville
Paducah
Elizabethtown
Somerset
Flemingsburg
Manchester
Jackson
Pikeville


KY 80 Over I-69
EXIT 21
SOUTH
Fulton
RIGHT 1/2 MILE
August 2013


KY 80
September 2013


KY 72, Harlan
Fall 2013


1
2
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11
12
Paducah
Madisonville
Bowling Green
Hopkinsville
Owensboro
Henderson
Morganfield
Union
Webster
Dixon
Calhoun
McLean
Ohio
Hartford
Hawesville
Hancock
Brandenburg
Meade
Hardinsburg
Breckinridge
Leitchfield
Grayson
Elizabethtown
Hardin
Hodgenville
Larue
Hart
Louisville
Jefferson
Sheperdsville
Bullitt
Taylorsville
Spencer
Shelbyville
Shelby
Bardstown
Nelson
Springfield
Washington
Lebanon
Marion
Campbellsville
Taylor
Greensburg
Green
Columbia
Adair
Edmonton
Metcalfe
Glasgow
Barren
Edmonson
Brownsville
Morgantown
Butler
Muhlenberg
Greenville
Caldwell
Princeton
Crittenden
Marion
Livingston
Smithland
Lyon
Eddyville
Marshall
Benton
Calloway
Murray
Graves
Mayfield
Hickman
Clinton
Fulton
Ballard
Wickliffe
Bardwell
Carlisle
McCracken
Christian
Hopkinsville
Todd
Elkton
Logan
Russellville
Simpson
Franklin
Warren
Allen
Scottsville
Monroe
Tompkinsville
Cumberland
Burkesville
Clinton
Albany
Russell
Liberty
Pulaski
Somerset
Monticello
Whitley City
McCreary
Stanford
Lincoln
Danville
Boyle
Harrodsburg
Mercer
Jessamine
Nicholasville
Versailles
Woodford
Lexington
Fayette
Lawrenceburg
Anderson
Frankfort
Franklin
Georgetown
Scott
Harrison
Cynthiana
Williamstown
Grant
Pendleton
Falmouth
Carrollton
Carroll
Warsaw
Gallatin
Bedford
Trimble
New Castle
Henry
LaGrange
Oldham
Owenton
Owen
Burlington
Boone
Covington
Independence
Kenton
Alexandria
Campbell
Bracken
Brooksville
Maysville
Mason
Robertson
Mt.Olivet
Nicholas
Carlisle
Paris
Bourbon
Winchester
Clark
Mt. Sterling
Montgomery
Owingsville
Bath
Flemingsburg
Fleming
Vanceburg
Lewis
Greenup
Rowan
Morehead
Elliott
Sandy Hook
Grayson
Carter
Cattlettsburg
Boyd
Louisa
Lawrence
Frenchburg
Menifee
Stanton
Powell
Estill
Irvine
Lee
Beattyville
Jackson
McKee
Booneville
Owsley
Rockcastle
Mt. Vernon
Laurel
London
Clay
Manchester
Knox
Barbourville
Whitley
Williamsburg
Pineville
Bell
Harlan
Hyden
Leslie
Letcher
Whitesburg
Perry
Hazard
Breathitt
Jackson
Wolfe
Campton
Morgan
West Liberty
Johnson
Paintsville
Inez
Sallyersville
Magoffin
Prestonsburg
Floyd
Pikeville

Intelligent Transportation Systems
Jennifer Walton

- Current Employees
  - Andrew Martin, Research Associate
  - Mark Spellman, Research Associate
  - Jerry Kissick, Research Engineer
  - Mark Bell, Research Associate/Advisor
  - Valerie Keathley, PhD Candidate
  - Daniel Schwendeman, Undergraduate Student
  - Zack Palumbo, Undergraduate Student

Program Topics

- Policy and Tax Issues Related to the Motor Carrier Industry

Program Topics

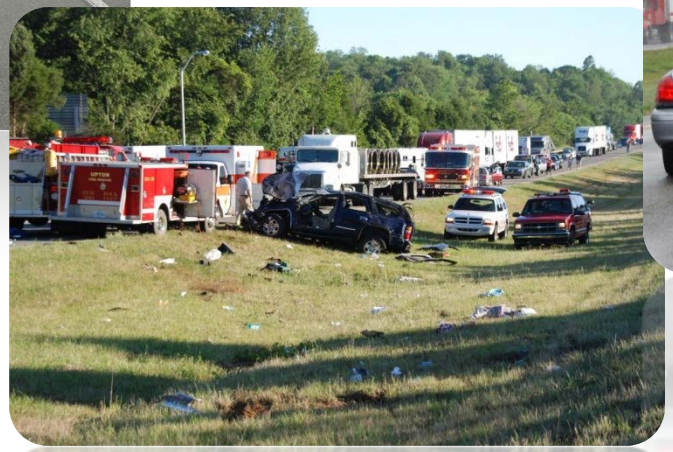
- Support of Kentucky's Commercial Vehicle Information Systems and Networks (CVISN) & Performance Registration Information Systems Manag ms

Program Topics

- Commercial Vehicle Electronic Sc

Program Topics

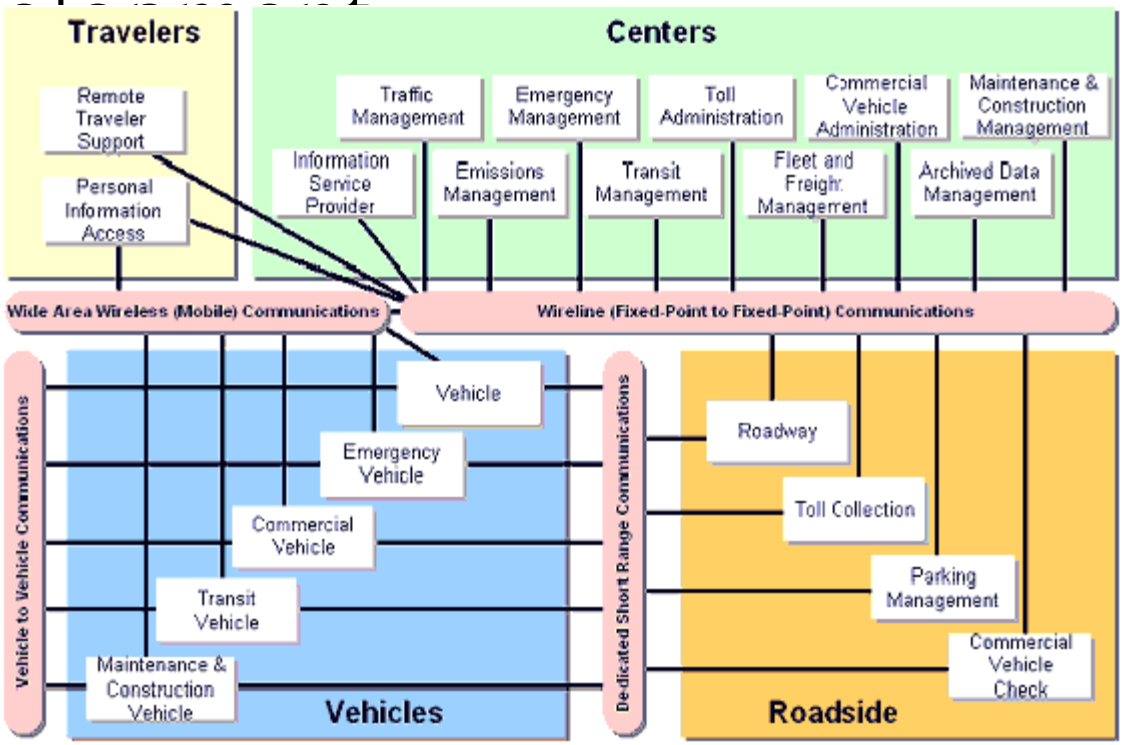
- Traffic Incident Manageme



Pictures provided by Code 3 Images

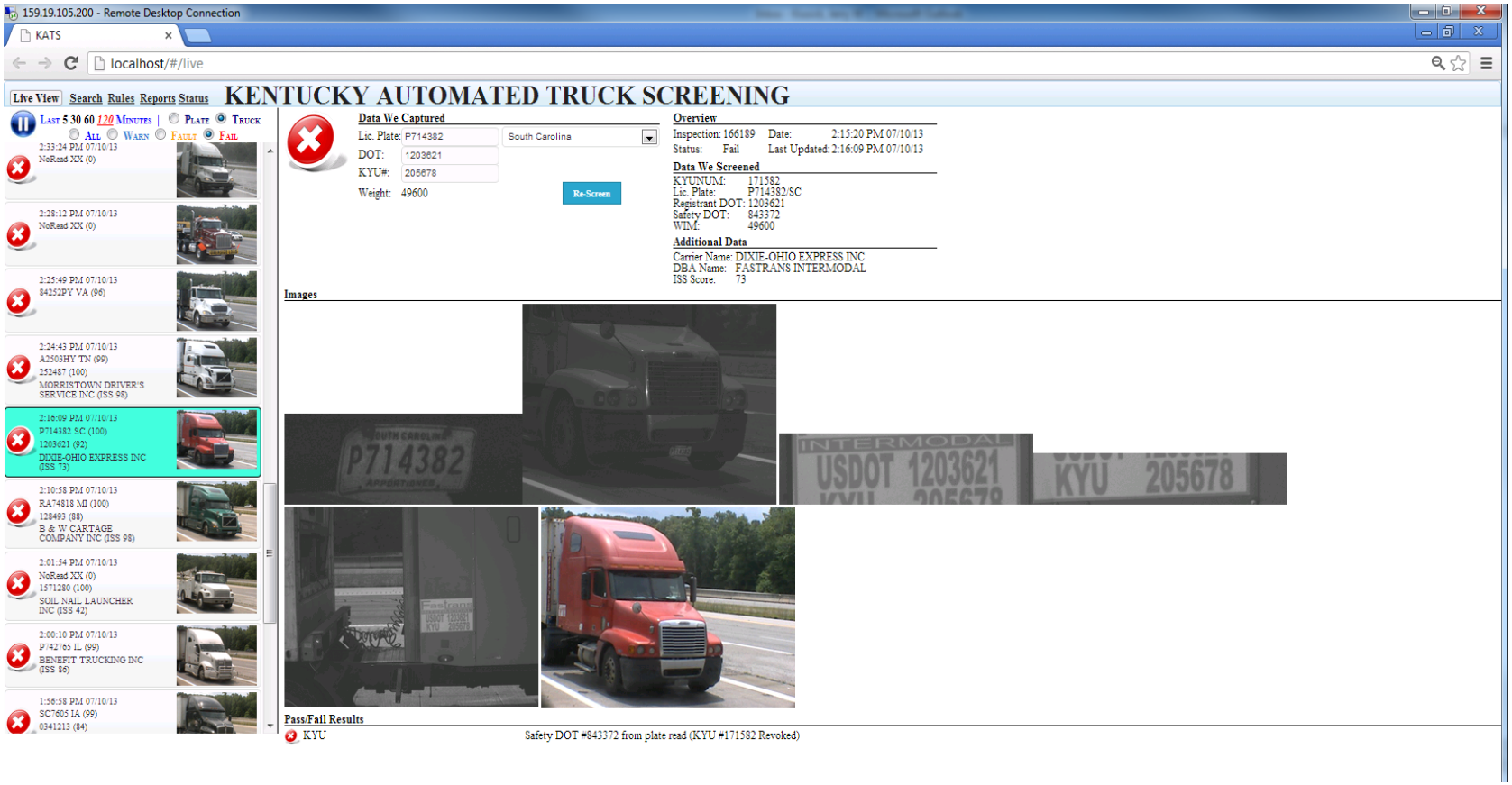
Program Topics

- ITS Planning and Architecture Development



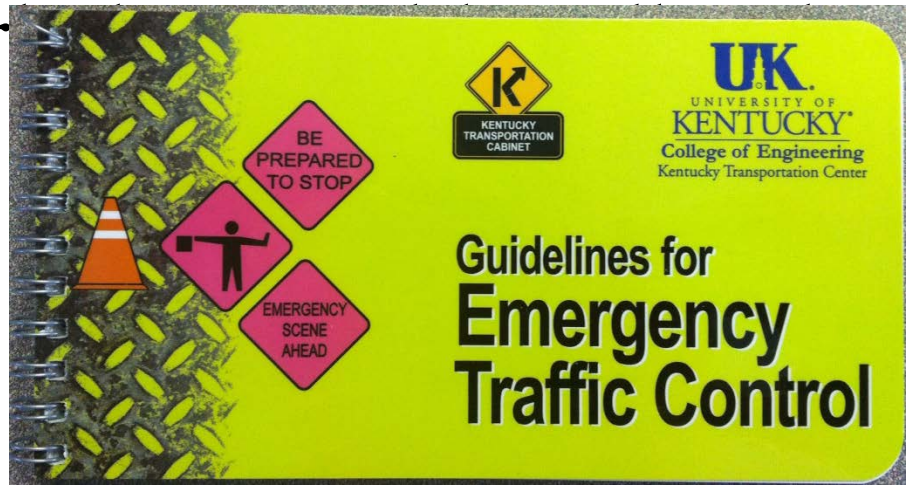
Commercial Vehicle Related – Results

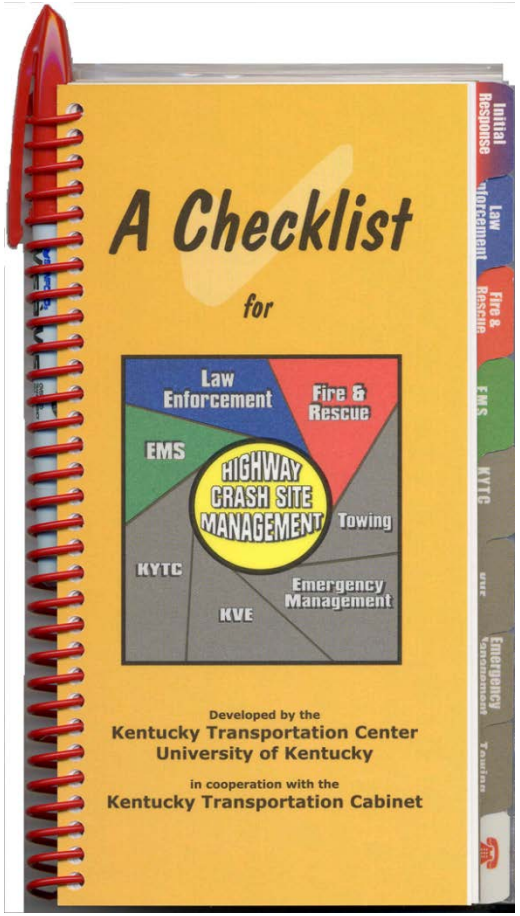
- London NB Weigh Station Ramp



Incident Management Related – Results

- Highway Crash Site Management Workshop and Handbook
- Emergency Traffic Control Wor





Bridge Preservation Program Overview

Sudhir Palle, P.E.

Program Mission:

Conduct research and investigations on technologies to extend the lives of bridges

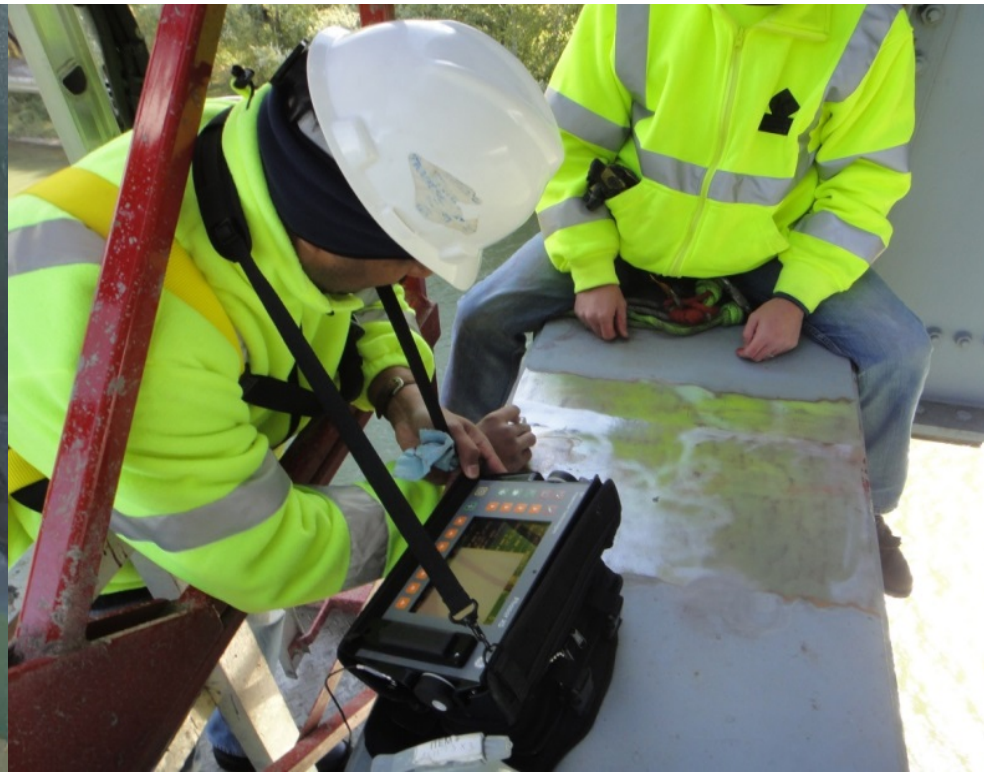
Program Composition:

Five full-time and two temporary employees located at the Whalen Building

Bridge Preservation Program Facilities

Monitoring Experimental KYTC Bridge Projects

Nondestructive Evaluation of Bridges



Addressing Major Bridge Concerns

Construction Engineering & Project Management

- Program Manager
  - Tim Taylor, P.E., Ph.D.

- Research Engineer
  - Roy Sturgill, P.E.

Topic Areas

The section focuses on integrating construction knowledge into ***project planning and design*** in order to improve a project's cost, schedule, quality, and safety performance.

- Cost Estimating
- Scheduling
- Project Delivery
- Contract Administration
- Quality Control/Assuranc
- Safety

High Value Project for Highway Design

- Updating the Kentucky Contract Time Determination System
  - Different methods per project type & contract schedule goals
  - Existing system out-of-date and had a 233% mean variance in analysis (predominant model across U.S.)
  - Created a new regression method tool for contract time estimation (52% mean variance) while also revising existing system for

Previous Method (223% Mean Variance)

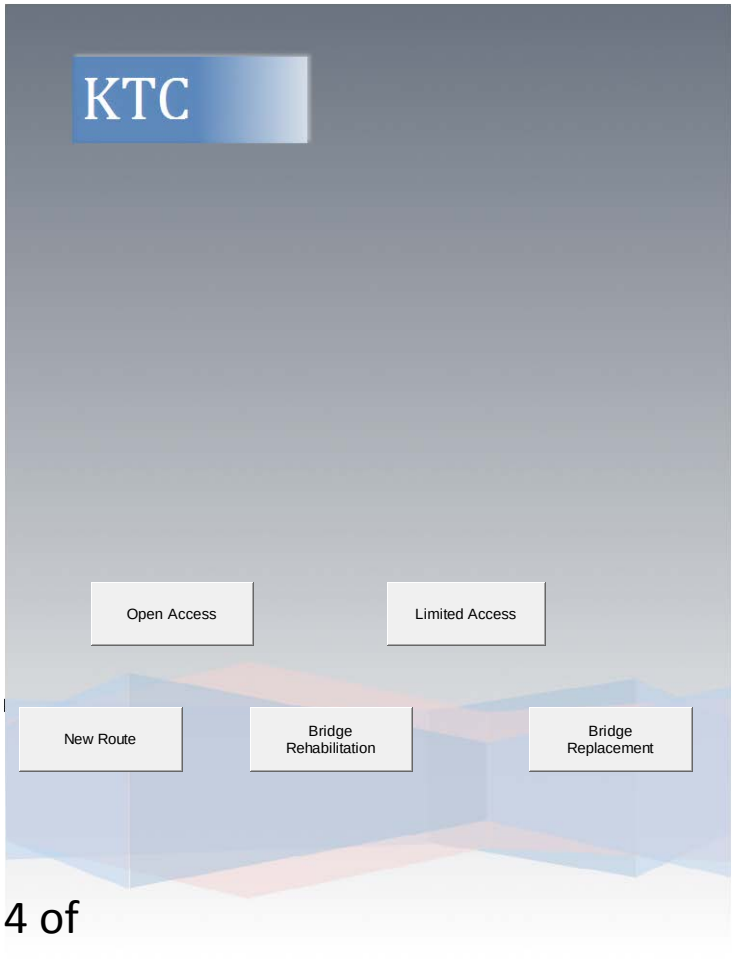
NEW ROUTE			Input Design Quantity	Default Production Rate, Unit/Day	Default Activity Duration, Days	Production Rate Override, Unit/Day	Activity Duration Override, Days	Calculated Activity Duration, Days	Comments
Item No	Activity	Unit							
1	Initial Traffic Control	Days		1	2			2	
2	Clearing & Grubbing	Acres		3	0	3		0	
3	Diversion (By-Pass Detour)	Days		1	6			6	
4	Roadway Excavation	CY		5,000	0	5,000		0	
5	Embankment in Place	CY		4,000	0	4,000		0	
6	Drainage Pipe	LF		200	0	200		0	

NEW ROUTE			Input Design Quantity	Default Production Rate, Unit/Day	Default Activity Duration, Days	Production Rate Override, Unit/Day	Activity Duration Override, Days	Calculated Activity Duration, Days
Item No	Activity	Unit						
1	Initial Traffic Control	Days		1	2			2
2	Clearing & Grubbing	Acres		3	0	3		0
3	Diversion (By-Pass Detour)	Days		1	6			6
4	Roadway Excavation	CY		5,000	0	5,000		0
5	Embankment in Place	CY		4,000	0	4,000		0

26	Asphalt Repair	Ton		50	0	50		0	
27	Concrete Repair	SY		30	0	30		0	
28	Concrete Paving	SY		4,000	0	4,000		0	
29	Asphalt Surface	Ton		1,000	0	1,000		0	
30	Sheet Signs	Ea		30	0	30		0	
31	Panel Signs	Ea		1	0	1		0	
32	Major Traffic Signals	No of Intersection		15	15			15	
33	Lighting,Total Installation Luminaires	Ea		2	0	2		0	
34	Guardrail	LF		1,500	0	1,500		0	
35	Finish Seeding	SY		4,000	0	4,000		0	
36	Pavement Marking	LF		10,000	0	10,000		0	
37	Final Clean-Up	Days		1	10			10	
38	Phasing Allowance	No of Phase		1	3			3	

New Method (52% Mean Variance*)

- Two Methods for Determining Contract Time
  - Projects >$1million
    - 5 Project Types
    - Regression Driven Spreadsheets
  - Projects <$1million
    - Develop full schedule or use seasons



*This was the overall average for the five types; 4 of the 5 models were less than 40%

Large Project Example

Project ID# 11-1025	Limited Access Duration				
Year of Bid Awarded:	2011	Cost Index	0.900580092	Range	
Construciton Type	Activity	Input Value	Mean Duration (Days)	Lower Duration (Days)	Upper Duration (Days)
Limited Access (>$1 million)	Engineers Estimate (2005 Dollars)	2400000	192	91	293
	DirtWork_Roadway Excv. (CY)	180			
	Storm Sewer (LF)	1100			

This Calculation is for Limited Access Only!

Print

Project Status

- Currently Available
- Implementation Guide is Under Review
- Additional Guidance/Training is in Development
  - Instructional Videos
  - Possible Onsite Visits