OHIO DEPARTMENT OF TRANSPORTATION
QUARTERLY RESEARCH REPORT

For Quarter Ending: June 30, 2011

Date Submitted: July 7, 2011

Project Title:	Evaluation of Fiber Reinforced Composite Dowel Bars and Stainless Steel Dowel Bars – TPF-5(188)		
Research Agency:	Applied Pavement Technology, Inc.		
Principal Investigator(s):	Roger M. Larson and Kurt D. Smith		
State Job Number:	134411	**Agreement Number:**	22160
Project Start Date:	October 17, 2008	**Contract Funds Approved:**	$54,000
Project Completion Date:	October 17, 2011	**Spent to Date:**	$40,739
75.4 **% Funds Expended**	80 **% Work Done**	89 **% Time Expired**	

List the Technical Liaisons and Other Individuals Who Should Receive a Copy of This Report:

Roger Green (Office of Pavement – 614-995-5993)

TPF-5(188) Technical Panel Members: Mark Gawedzinski (Illinois); Andy Gisi (Kansas); Barry Paye (Wisconsin); Max Porter (Iowa State University); Dr. Paul Virmani (FHWA)

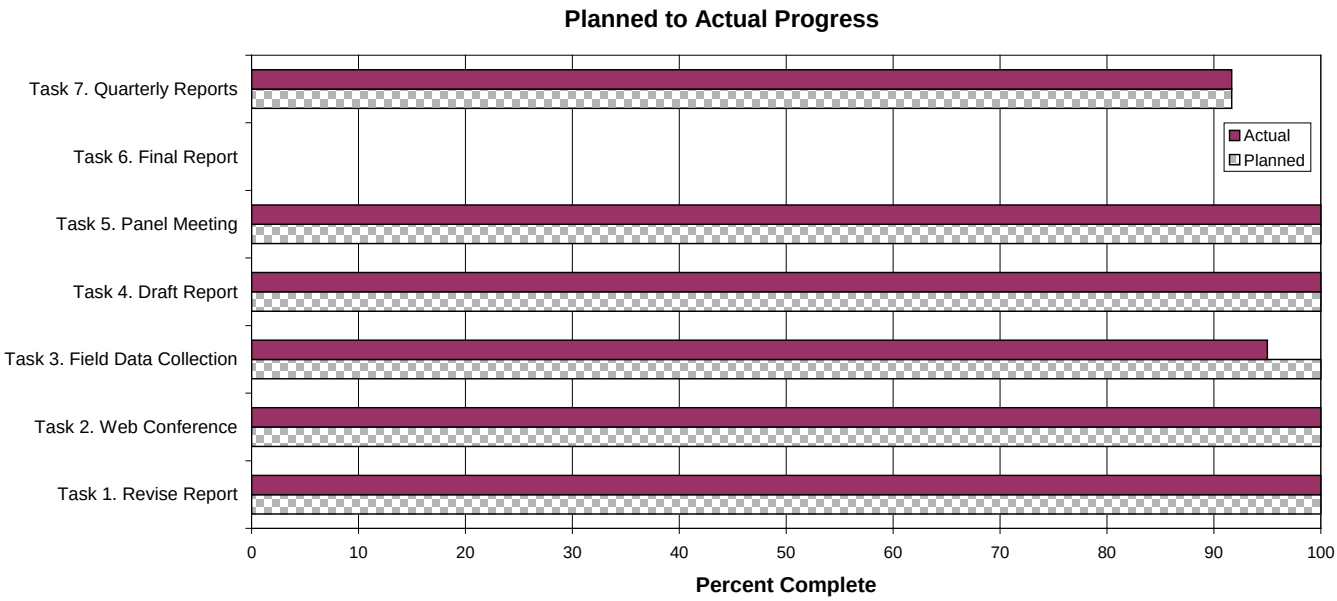
SUMMARY OF PROGRESS FOR QUARTER:

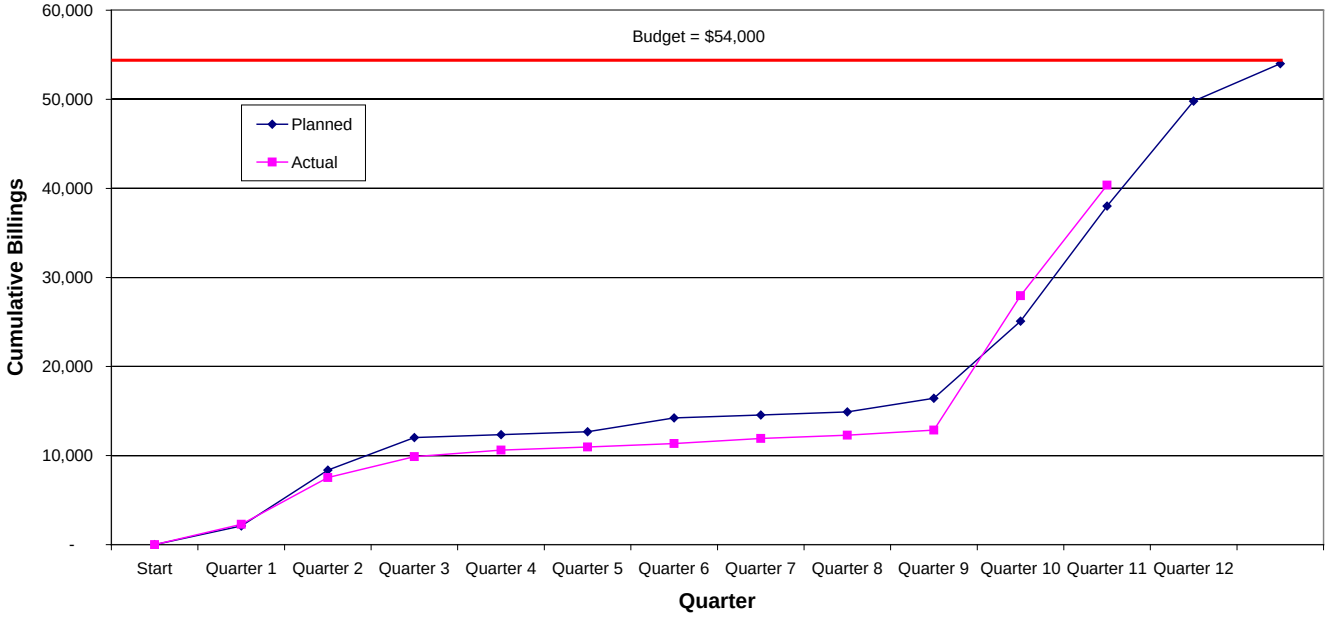
*Attach a progress schedule consisting of graphical information depicting (1) a schedule of research activities tied to **each task** defined in the proposal, (2) a comparative status of actual versus estimated expenditures, (3) a percentage completion of the research, (4) and a brief description of the activities accomplished by **each member** of the research team as listed in the project budget.*

The quarterly progress report for the period ending March 31, 2011 was prepared by Roger Larson and Kurt Smith and submitted on April 20, 2011. A draft version of the project's final report was completed and distributed to the technical advisory panel on June 15, 2011. Comments on the draft Final Report have been requested from the advisory panel by August 19, 2011.

A web conference to discuss the draft Final Report was held with the advisory panel on June 20, 2011 from 10 to 11:30 am EDT. Participants included Vicky Fout, Roger Green, and Eric Morse from ODOT; Barry Paye from Wisconsin DOT; Mark Gawedzinski from Illinois DOT; Max Porter from Iowa State University; and Roger Larson and Kurt Smith of APTech.

The bulk of the data has now been collected for the project. ODOT is trying to extract raw data files for OH2 and Bel 7 to see if we can get IRI and faulting data for the individual test sections. WI was collecting new profile data for WI 2 so they provide updated ride and faulting data also.





PROPOSED WORK FOR NEW QUARTER:

During the next quarter, the Final Report will be prepared. The project panel review comments received by August 19 will be addressed and supplemental data recently furnished by ODOT (final corrosion testing results and OH 2 and Bel 7 roughness data) and the Wisconsin DOT (updated WI 2 roughness data) will be incorporated into the Final Report.

The project wrap-up meeting with the Ohio DOT will be scheduled to be held in Columbus, OH before the October 17, 2011, contract completion date; this will also be made available in a web conference format so that technical advisory members may participate.

IMPLEMENTATION (if any):

No change from the four previous quarters, a review of which is included below:

It is suggested that the States evaluate their epoxy-coated dowel bar specifications to help ensure that best practices are being followed. Report UCPRC-RR-2005-10 (FHWA No. S/CA/RI-2006/27) dated January 2007 provides the following recommendations:

> *It is recommended that: a) Quality control checks to control holidays be implemented, and b) Bar ends should be coated with epoxy, and care must be taken during shipping, storage, and installation. Stainless steel clad, hollow stainless steel, or microcomposite steel dowels should be considered for locations with high risk of chloride exposure.*

This interim guidance is suggested until the results of this research are available. Also, the FHWA TechBrief *Long Life Concrete Pavements,* FHWA-HIF-07-030 (July 2007) includes dowel specifications used by Washington State and Minnesota for their long-life PCC pavements that can be considered if more corrosion-resistant dowels are currently required. A TechBrief on alternative dowel bar coatings is being developed under the FHWA ACPT and should be available in the future.

A TRB Webinar on *Improved Practices for Dowel Bars in Concrete Pavement* was held February 16, 2011. FHWA is currently updating a Technical Advisory on Concrete Pavement Joints which will include a discussion of alternative materials. Also, a Task Force on Joints under the FHWA ACPT program will meet in 2011. The Ministry of Transport of Quebec is reviewing a proposal to allow 0.25-in larger vinylester composite dowels as an alternate to epoxy-coated steel dowels. GFRP dowels with polyester resin are not proposed to be allowed due to poor performance on the moisture absorption test. Mateen dowels have provided a proposed specification for vinylester composite dowels and have installed their dowels of 16 miles in one roadway of a project in Idaho. These efforts should help to provide improved guidance on the use of alternate materials for dowel bars in transverse joints of PCC pavements.

PROBLEMS & RECOMMENDED SOLUTIONS (if applicable):

(Describe any problems encountered or anticipated that might affect the completion of the project within the time, scope, and fiscal constraints set forth in the contract, along with recommended solutions to those problems. NOTING DIFFICULTIES IN THIS SECTION DOES ***NOT*** *CONSTITUTE A REQUEST TO MODIFY THE PROJECT. Requests for additional time, money, or scope revisions must be submitted in a separate letter to the Office of R&D Administrator.)*

A revised evaluation plan has previously been prepared with recommended testing by the states to complete the evaluation of the various alternative dowel bar material projects that were constructed in 1997-1998. FWD testing, coring, and profile evaluation of field projects by the states in calendar years 2009 and 2010 was recommended.

The revised Evaluation Plan also recommended taking cores of epoxy-coated dowels in 15 to 30^{+}-year-old concrete pavements to help evaluate their condition and long-term performance so the relative cost effectiveness of either FRP dowels or stainless steel dowels can be evaluated. No project funding for the chloride testing of the concrete cores taken for the experimental dowels or for the coring and chloride testing of the older epoxy-coated dowel projects is available. This work would have to be conducted by the participating States. Wisconsin and Ohio are collecting this type of data.

As previously noted, more recent evaluation data will only be available from Ohio and Wisconsin. The amount of data actually collected during 2009, 2010, and 2011 (three older Ohio epoxy-coated dowel projects and coring the Type 316 stainless steel clad dowels installed in 1998 in the adjacent roadway on OH 2) will affect the evaluation of the data planned for this project. Results from accelerated load testing on composite dowel joints in KS and CA and other available research data will be considered in making the final recommendations for this project.

The major recommendations in the draft Final Report include:

- The revised evaluation plan based on coring selected joints rather than laboratory testing of extracted dowels appears to be a satisfactory evaluation approach. The testing provided a considerable amount of performance data and it is recommended additional states consider this approach.
- Polyester resin and e-glass fiber composite have not performed satisfactorily and should not be used. Vinylester resin and ECR-glass is recommended when fiber composite dowels are used.
- For strong support conditions, i.e. unbonded concrete overlays, FRP dowels 0.25-in larger than epoxy coated dowels are recommended and for standard support conditions, FRP dowels 0.50-in larger are recommended for longer life pavements (due to their higher initial cost). FRP dowels performance is affected more by poor support conditions than standard epoxy coated dowels. If FRP dowels are used, improved concrete quality must be provided to obtain the expected longer service life.
- Due to the short evaluation period, no definite conclusions on the life expectancy of Type 304 stainless steel solid dowels or mortar filled pipes or tubes can be made at this time. Results of accelerated laboratory testing by others should be reviewed for guidance in this area.

EQUIPMENT PURCHASED (if any): None.

CONTACTS & MEETINGS:

Roger Green has provided a wealth of information on various dowel bar projects in Ohio in addition to the OH 2 project data. In particular, supplemental information on the Belmont 7 project constructed in 1983 (and evaluated in detail in 1998) was provided due to the much improved performance of the 1.25-in vinylester resin dowels on that project compared to the poorer performance of 1.5-in polyester resin dowels on the OH 2 project.

Barry Paye provided information on the base type on the projects where epoxy coated dowels were cored and provided some photos of the condition of the pavement surface at the joints that were cored. Wisconsin was also collecting current roughness data on the WI 2 experimental sections in June 2011 which is expected to be provided shortly.

As noted, the draft Final Report was submitted to the panel on June 14 and the updated WI report was furnished to the panel after the June 20 web conference. The web conference was held on June 20.