

**Department of Civil and Environmental Engineering
University of South Florida – Tampa, Florida 33620**

Date: November 12, 2009

To: FDOT Research Center c/o Sandra Bell
From: A. Sagüés, Principal Investigator (PI) Project BDK84 977-08
cc.: Sastry Putcha, FDOT technical coordinator
Mario Paredes, FDOT State Materials Office



Subject: **Quarterly Progress Report - 1st Quarter: 7/1/09 - 9/30/09**
Project BDK84 977-06: "Reinforced Concrete Pipe Cracks -Acceptance Criteria"
(USF # 2104112600).

Note: the technical content of this report was conveyed to the technical Project Manager on 10/2/09.

1) Activities performed this quarter:

Teleconferences:

Kickoff meeting on 06/25/2009, follow-up meetings on 08/3 and 09/18

Literature review

- 1- Reviewed over 20 papers on autogenous healing and pipe crack issues and over 40 papers on localized corrosion in reinforced concrete.
- 2- Contacted over 8 sources (RC pipe users, manufacturers and professionals) on US and abroad (e.g. California, Texas, UK, Australia and Libya)
- 3- We are continuing the review and expecting additional information from a survey of other agencies through a State Materials Office questionnaire.

Preliminary findings

Survey to date revealed the following existing State / User agency standards.

Ohio DOT:

Supplemental Specification 802, Post Construction Inspection of Storm Sewers and Drainage Structures, April 15, 2005, supplemental to Construction and Material Specifications, 2008.
(Section 802.10, Table 802.10. A)

The specification calls for a crack width of 0.075 inch maximum, based on their assuming that autogenous healing is likely.

Caltrans, AASHTO:

Construction manual, Chapter 4, section 65-reinforced concrete pipe, Caltrans.

AASHTO LFRD Bridge Construction Specification, American Association of State Highway and Transportation Officials Standards, 2006. Section 27, Concrete Culverts, Clause (27.4.1)

Both Caltrans and AASHTO specifications call for a crack width of 0.1 inch maximum in specified less aggressive conditions (pH= 5.5 or greater, Chloride concentration =500 ppm or less), and 0.01 inch maximum in more corrosive environments. The specs are based on the report "Diamond Bar Culvert, A study of corrosion of the steel reinforcement relative to crack widths in reinforced concrete pipe", prepared by the technical committee of the California Precast Concrete Association, February,1976. The study indicated that examination of cracks disclosed no evidence of autogenous healing but no corrosion of steel reinforcement was observed at crack widths up to 0.1 inch in less aggressive environments where slabbing of the pipe wall had not occurred. The study however calls for further investigations to study crack/corrosion/serviceability relationships.

Pipe Manufacturers have proposed more or less formally the following

(American Concrete Pipe Association) ACPA

RC pipes with 0.02 inch maximum wide cracks that are not penetrating the pipe wall and having at least 1 inch concrete cover would provide the same durability as uncracked pipes cover in aggressive environments.

Ontario Concrete Pipe Association (OCPA)

RC pipes with up to 0.01 inch wide cracks are acceptable in aggressive environments. OCPA calls for consideration to be given to 0.02 inch crack width.

Concrete Pipe Association of Australasia (CPAA)

Up to 0.5 mm (0.0196") circumferential cracks and / or 0.15 mm (0.005") longitudinal cracks are acceptable in RC pipes with 25 mm (1 inch) concrete cover.

2) Activities Planned for Next Quarter:

As stated during teleconferences with the project manager, the PI would expect that the starting point for developing our standard will be to consider a 0.02 inch max acceptance criterion, with possible provisions for a somewhat more relaxed specification for benign service conditions, and a more conservative limit for aggressive conditions (if those are not already ruled out anyway by the current FDOT environmental limits for RC pipe).

The PI will define more precisely the proposed starting point when the results from the SMO survey start arriving. If response to the questionnaire is sparse we will contact agencies directly. An experimental testing plan will be prepared accordingly.

3) Summary of Requested Modifications:

None at present

4) Progress Schedule:

- See next page.

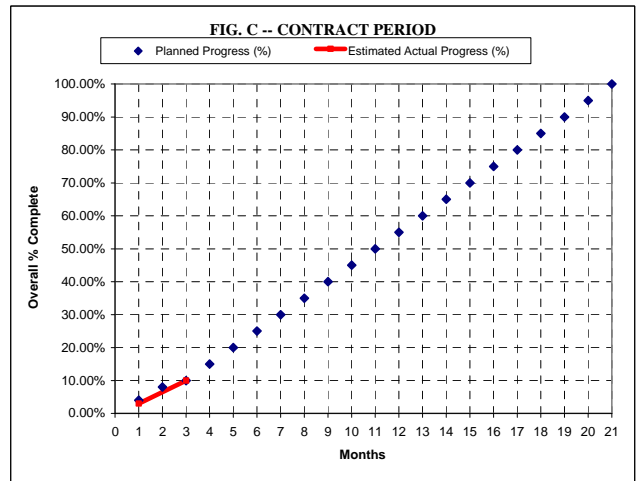
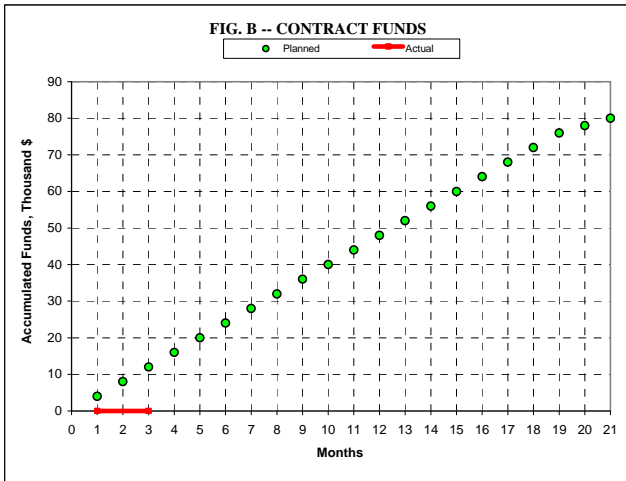
FLORIDA DEPARTMENT OF TRANSPORTATION
RESEARCH CENTER

PROJECT SCHEDULE

Project Title Reinforced Concrete Pipe Cracks - Acceptance Criteria
 FDOT Project No. BDK84 977-06 FY 2008-9 Month 3
 Research Agency University of South Florida
 Principal Investigator Dr. Alberto A. Sagues

RESEARCH TASK	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	ESTIMATED % COMPLETION	
Task 1 Lit. Rev.	33	66	100																				90%
Task 2 Final approach				100																			0%
Task 3 Conduct Rsch.					10	20	25	30	40	50	60	70	75	80	85	90	95	100					0%
Task 4 Maximum Width									25	50	75	100											0%
Task 5 Draft Specifcation															25	50	75	100					0%
Final Report																			33	66	100		0%
Overall % Complete Projected	4%	8%	10%	15%	20%	25%	30%	35%	40%	45%	50%	55%	6.0	6.65	7.0	7.75	8.0	8.85	9.0	9.66	10.0		
Overall % Complete Actual			10%																				10%

FIG. A -- OVERALL PROJECT SCHEDULE



Funds Expended	% 0	*Only direct costs are listed as expenses. Indirect cost is budgeted to reach \$14,675 by the end of the contract. Listed balance does not include that eventual reduction.	Time expended	%
Contract Amount	\$ 80,000		Starting Date	07/01/09
Expended This Quarter	\$ 0		Completion Date	3/31/2011
Total Exp. to Date	\$ 0 *			
Balance	\$ 80,000		*Pending expenditures can delay posting to subsequent quarters.	