FRP-CONCRETE/STEEL INTERFACIAL PERFORMANCE MONITORING WITH DISTRIBUTED ELECTROMAGNETIC PRESSURE TAPES

(NO-COST EXTENSION HAS BEEN REQUESTED)

SUMMARY

Externally-bonded fiber reinforced polymer (FRP) sheets are gaining more acceptance in engineering community for the strengthening of reinforced concrete (RC) members. As needs continue to arise in this direction, it is critically important to make sure that the bonding between an FRP sheet and the surface of the RC member to be strengthened is in good condition during the life span of the strengthened member. Electromagnetic pressure tapes are proposed for the measurement of their interfacial pressure so that the bonding condition between them can be inferred along the pressure tape. Currently the design of two pressure tapes for different measurement ranges is almost completed. Two types of RC beam will be cast and strengthened with externally-bonded FRP sheets. In between the FRP sheets and the beam will be placed a pressure tape, as indicated in Figure 1. Each beam will be tested to study the feasibility and sensitivity of measuring the interfacial pressure.

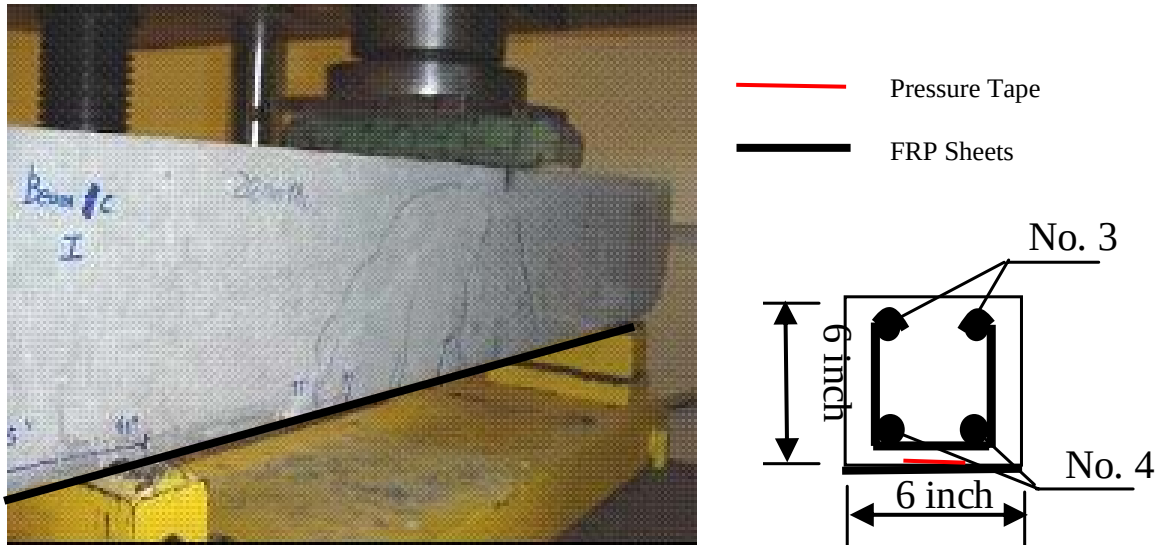

Figure 1. Proposed Test Specimen and Pressure Tape Installation

BACKGROUND

As external FRP-sheet bonding techniques develop for the strengthening of flexural members, as exemplified in Figures 2 and 3, FRP-structure interfacial condition becomes critically important. Therefore, developing an accurate way of measurements to infer the condition is imperative. In this study, pressure tapes are proposed for this purpose.

Figure 2. FRP Wrapping on a Column

Figure 3. Externally-bonded FRP Sheet

To see the feasibility of the pressure tape concept, a simple pressure tape was built using the electromagnetic strip theory. By adding a small weight at one location, the pressure along the tape will change. The maximum change occurs at the location of the weight. The relation between the maximum reflection coefficient change and the pressure difference can be obtained by a series of tests. The results are presented in Figure 4. Considering a noise level of reflection coefficient of 2~3 mrho, the pressure tape can theoretically measure a pressure change of 0.01 psi. This level of sensitivity will be quite accurate for engineering application, but needs to be verified with laboratory testing of small- and large-scale RC members or ultimately with field tests.

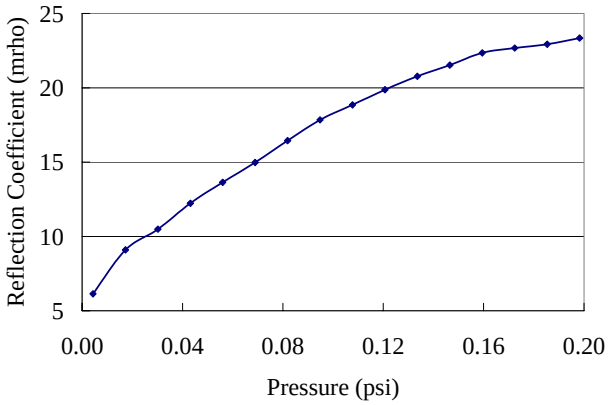

Figure 4. Sensitivity of a Pressure Tape

OBJECTIVE

This project is aimed to develop electromagnetic pressure tapes for the monitoring of interfacial behavior of FRP-retrofitted beams or columns, and study the effect of embedded pressure tapes on the strength of externally FRP-bonded beams.

SPECIMENS

Pressure tapes will be made of copper foils and dielectric materials such as rubber and calibrated for different ranges of pressure measurements. After having been calibrated, pressure tapes will be installed between a RC beam and the FRP sheets used to strengthen the beam with external bonding. A total of six beams will be cast for validation of the pressure tape sensors. They

are divided into two types with different reinforcement as shown in Figure 5, which will be detailed in Table 1.

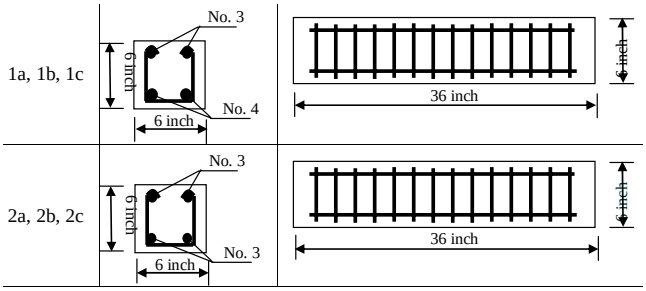

Figure 5. Beam Design and Rebar Details

TEST SETUP

Two types of RC beams will be tested under three-point loading as shown in Figure 1.

INSTRUMENTATION AND TEST PLAN

Displacement transducers will be instrumented on each beam to measure the displacement distribution from which the interfacial pressure may be inferred. The test matrix of six beams is given in Table 1.

Table 1 Test Matrix

Specimen	Retrofit Scheme
1A	Control Unit w/o Retrofit
1B	Externally-bonded FRP Strengthened Beam w/o Pressure Tape
1C	Externally-bonded FRP Strengthened Beam with Pressure Tape
2A	Control Unit w/o Retrofit
2B	Externally-bonded FRP Strengthened Beam w/o Pressure Tape
2C	Externally-bonded FRP Strengthened Beam with Pressure Tape

RESULTS AND DISCUSSIONS

Results will be presented in the final report.

CONCLUSIONS

Conclusions will be drawn in the final report.

WANT MORE INFORMATION?

Details on this research project and additional information will be available in the final report.

CONTACTS

Eric Pilger
Graduate Research Assistant
University of Missouri Rolla
TEL (573) 341-7516
FAX (573) 341-4729
E-mail: epilger@umr.edu

Dr. Genda Chen, P.E.
Associate Professor of Civil Engineering
University of Missouri Rolla
TEL (573) 341-4462
FAX (573) 341-4729
E-mail: gchen@umr.edu