STATEMENT OF NEED:
According to the Federal Highway Administration’s 1999 annual report titled “Status of the Nation’s Highways, Bridges, and Transit” an estimated 29% of the nation’s bridges need to be either rehabilitated or replaced. Aging highway infrastructure, increasing traffic loads and the high cost of rehabilitation have combined to make novel repair methodologies increasingly attractive to transportation officials. Several new products now receiving attention in bridge rehabilitation are comprised of composite components, which, because of their high strength and stiffness to weight ratios and durability, are logical substitutes for conventional highway materials.

RESEARCH OBJECTIVES:
The rehabilitation method being studied in the current project consists of attaching composite rods to an existing concrete bridge. After the rods are affixed to the bridge, each rod is loaded to a design tension. The design tension is intended to improve the capacity of the bridge by changing the mean stress in its principal structural members. There are several advantages to this rehabilitation technique; the stiffening members can be applied with little or no traffic interruption, scaffolding and site preparation may be minimized, and tendons and anchors can be prefabricated to reduce work in the field. The study bridge is SCI-23-0.96 in Scioto County, is located just north of Portsmouth on US Route 23 in Scioto County. This bridge has four spans (50.5’, 63’, 56’, and 43’) with ten continuous steel girders and reinforced concrete deck and superstructure. Four lanes of traffic are supported by the bridge as it crosses over railroad tracks and a two-lane street. The bridge is skewed at an angle of 30°32’04”. The purpose of post-tensioning this bridge was to increase load capacity by reducing the maximum negative moment. The focus of this study is on measuring the effects of the attachment of carbon fiber tension rods to an existing steel bridge subjected to various types of static and dynamic traffic loads and environmental conditions.

RESEARCH TASKS:
The Ohio State University (OSU) was selected to observe the installation of external post-tensioned fiber reinforced polymer rods on the Bridge SCI-23-0096 in Scioto County and perform any testing and analysis sufficient to evaluate the effectiveness of the reinforcement. Fiber Reinforced Systems, Ltd. of Columbus, Ohio (FRS) was selected to design and install the reinforcing rods. Typical instrumentation installed by OSU consisted of strain gauges placed in locations where high stresses were anticipated, displacement devices at the center of spans, and load cells on selected rods. The research tasks are as follows:
1. Evaluate the material and structural properties of the carbon fiber reinforcing rods in laboratory tests by performing tests on representative small-scale specimens.

2. Instrument the bridge with monitoring devices to evaluate structural response to traffic loads and environmental conditions.

3. Begin taking measurements that should lead to an evaluation of the effects of environmental factors on the performance of the reinforcing rods.

4. Use the data collected to assist ODOT in the development of standard guidelines for the use of composites in bridge repair in Ohio.

5. Evaluate the material and structural properties of the carbon fiber reinforcing rods in laboratory tests by performing tests on representative small-scale specimens.

**RESEARCH DELIVERABLES:**
The Final Report of research findings and recommendations.

**RESEARCH RECOMMENDATIONS:**

1. The deflection results suggest a small (4%) decrease in the maximum mid-span deflection, after the installation and tensioning of the composite rods. However, this decrease is less than the variability that should be expected in the readings.

2. Further the strain results suggest no improvement.

3. Results from the Portsmouth Bridge suggest the rods were unloaded during the time between the post-tensioning of the rods and the following tests. Therefore, no improvement was shown in the stiffness of this bridge.

4. Monthly load readings for the composite rods show the rods have not maintained their initial tension.

**PROJECT PANEL COMMENTS:**
*Tim Keller:* No implementation is anticipated.

*Omar Abu-Hajar:* This research didn’t show any significant advantage in installing the exterior post tensioning rods. The structural performance of the study bridge didn’t improve after such installation. Consequently, it shall not be used in Ohio.

**IMPLEMENTATION STEPS & TIME FRAME:**
No steps shall be taken to implement

**EXPECTED BENEFITS:**
N.A.

**EXPECTED RISKS, OBSTACLES, & STRATEGIES TO OVERCOME THEM:**
N.A.
OTHER ODOT OFFICES AFFECTED BY THE CHANGE:
N.A.

PROGRESS REPORTING & TIME FRAME:
N.A.

TECHNOLOGY TRANSFER METHODS TO BE USED:
N.A.

IMPLEMENTATION COST & SOURCE OF FUNDING:
N.A.

Approved By: (attached additional sheets if necessary)

Office Administrator(s):
Signature: Tim Keller Office: OSE Date: 8/5/2005

Division Deputy Director(s):
Signature: Tony Vogel Division: DHO Date: 8/8/2005