Composite Arch Bridge System

Inspection and Maintenance Manual
I. INTRODUCTION

The purpose of this manual is to provide a guide for the inspection and maintenance of the components of the Composite Arch Bridge system. It will describe what to expect when conducting a bridge inspection on this system, how to identify maintenance concerns and also provide guidance for developing a plan to address possible maintenance issues.

The intended use of this document is to supplement existing agency or owner inspection and maintenance procedures for bridges. The frequency of routine inspection and reporting requirements of the Composite Arch Bridge system components should be consistent with existing agency requirements for bridges, but can be less frequent if approved by FHWA. Special inspections may be warranted after extreme natural occurrences, such as major flooding or severe earthquakes.

A. Scope

The scope of this guide is limited to the Composite Arch Bridge components supplied by Advanced Infrastructure Technologies:

- Arches
- Decking
- AIT supplied Headwalls and wingwalls

B. Inspection Overview

The basic inspection sequence is:

- Visual examination
- Physical examination
- Non-Destructive Evaluation (NDE)

The first inspection method is a thorough and systematic visual inspection of each component. This will identify areas for further investigation. General photographs of the structure should be taken to document the overall condition. Closeups of typical arch, decking and wall surface condition should be taken initially for future comparison over time.

If areas of concern are identified a physical examination can be undertaken. This can include feeling the suspected area by hand or with a probe and/or tapping to determine potential damage from sound.

In cases where structural damage is suspected, but unable to be detected or definitively determined by visual or physical methods, NDE methods can be employed. AIT recommends ultrasonic examination (UE) or infrared
thermography. Either method requires a trained technician.

II. BLEMISHES AND IMPACT DAMAGE

Durability and corrosion resistance are considered two advantages of FRP materials. However, like most structures they are not immune to impact damage or resin loss over time.

Composites damage to the fibers is of concern while damage to the resin is considered superficial, unless it degrades to the point of fiber exposure.

For additional protection, all AIT arches have an additional polyurethane coating applied at manufacturing that provides long-term protection to the resin. This coating will wear over time and eventually may need to be recoated or touched up to maintain appearance and protection.

A. Blemishes, Irregularities

All AIT arches are delivered with a Quality Assurance Report (QAR) that identifies and characterizes any features of an arch, which may raise concern to an inspector. These features have been identified and considered "non-structural" and purely aesthetic in order for the arch to be approved for use in a bridge. These features may include resin ridges, minor variations in fabric direction, small holes drilled during construction and variations in surface appearance. All fabricated irregularities will be noted in the QAR.

B. Impact Damage

Anticipated in service damage is limited to the following types:
- Composite Fiber Exposure and Abrasion
- Scratches and Lacerations
- Laminate Penetrations and Gouges

III. ARCHES

Inspection reports should reference individual arches. Arches can be referenced by relative location (e.g.: third arch from upstream side).

When conducting the visual examination arches, should be examined for discoloration and abnormal surface features. Some non-uniform surface features are part of the normal arch appearance and should be distinguished from damage. These normal features include resin ridges, areas of thickened surface coating, and minor wrinkles (less than 1/8”).

The following categories of damage are considered repairable. A qualified composites technician should be involved in all repair work. Damage beyond the extent of the following categories shall be considered serious and shall be assessed by a licensed Professional Engineer experienced in composites engineering.

DISCOLORATION AND FADING

Discoloration and fading are not issues themselves because they are related to the protective coating. The coating may be touched up or recoated for aesthetics. Follow manufactures instructions for touchup and recoating when necessary.
COMPOSITE FIBER EXPOSURE AND ABRASION

Abrasion that affects only the protective resin coat with no exposure of fibers is non-structural and can be repaired by recoating with a UV-resistant resin coat.

SCRATCHES AND LACERATIONS

Any damage to the fibers may represent structural damage. Minor scratches are simply recoated with resin, but any damage larger than 1" in size should be inspected closely to determine the extent of damage. Damage affecting an area greater than 5% by circumference of the fibers should be repaired with additional fiber reinforcement. The repair method will depend on the severity and extent of damage to the fibers.

LAMINATE PENETRATIONS AND GOUGES

Large laminate penetrations and gouges that extend into the concrete represent significant damage if greater than 1" in diameter and should be repaired. Any penetration through the entire laminate larger than 1" in diameter should be repaired with additional fiber reinforcement.

If the damage resulted in the loss of concrete the void space must be filled with resin or grout.

IV. DECKING

Each bay between arches should be thoroughly inspected.

AIT custom decking is a pultruded composite product and will have a more consistent surface appearance than the arches. It should be smooth and free of the types of damage listed for arches.

The inspection and repair methods for the pultruded composite decking are the same as for the arches.
V. HEADWALLS

Headwalls should be monitored for creep and excessive deflections. Comments should be recorded about any visually noticeable deviations: bulges, deformations, creep, or settlement. Location and measurements should be recorded if possible. Plumbness can be measured with a digital level and bulges can be measured as deviation from a straight string-line.

The area where the headwall connects to the structure at the base should be examined. Observations regarding the condition of the connection should be recorded and photographed.

There are many headwall types available. The owners inspection and maintenance protocols for the specific headwall should be followed.

VI. REPAIR OPTIONS

Any repair procedures to the arches or decking should be performed by a qualified composites repair technician. The American Composite Manufacturers Association can provide a list of local qualified companies and individuals or you may contact AIT for assistance.

Inspection and maintenance methods in the composite industry are well known and it is expected that most companies in the composite industry would be qualified to perform inspection and maintenance on a Composite Arch Bridge System structure.

VII. Useful Resources


3) Field Inspection of In-Service FRP Bridge Decks, National Cooperative Highway Research Program (NCHRP) Report 564, 2006