



## Composite Arch Bridge System

# Installation Handbook

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## I. INTRODUCTION

The purpose of this handbook is to provide a General Contractor an overview of the sequence of operations involved in building the Composite Arch Bridge system.

Although every project will have a unique set of contractual documents with plans, specifications, and testing/ inspection requirements, the intent is to provide a summary of operations and overall requirements for planning work.

Due to a variety of designs for bridge foundations and abutments, the focus of this handbook is limited to the construction operations of: handling and setting arches, installing decking, placing the self consolidating arch concrete, and construction of headwalls.

## II. CONSTRUCTION EQUIPMENT SELECTION

Typically, light equipment is used to set the arches and install the decking. The equipment's reach needs to exceed the center (apex) of the arches so that they can easily be set. The hollow arch weight for a 12" diameter 50 foot span is approximately 200 pounds, and the same arch made out of 15" diameter would weigh 250 lbs. Thus, two men can easily lift and adjust the arches to their final position.

A concrete pump truck with a boom that can reach the apex of the arch may be used to fill the arches with concrete or a traditional concrete bucket.



A loader/forklift/or excavator is needed for unloading the arches from the transport truck, material handling, and leveling equipment work areas.

## III. CRAFT LABOR

The general craft skill requirements of a working crew are: layout foreman, light construction equipment operator, and four construction laborers, although two laborers might be sufficient in some cases. Typically, a working superintendent or foreman will have the skills necessary for layout and operating equipment.

## IV. SCHEDULE DURATIONS

Given a 50 foot wide bridge with geometry of 50 foot span, and 10 foot arch rise (above top of abutment) a representative duration for the following construction activities is listed below:

Arch Setting (12" diameter): 25 arches per eight-hour crew operation with six-person crew.

FRP Deck Installation 30 panels per eight-hour crew operation with six-person crew.

**Arch Embedment Concrete Placement:** four-hour crew operation placement with four-person crew (excluding concrete truck driver and concrete pump operator); plus 18 hour cure time before subsequent operation other than light foot traffic on decking. The arch embedment can be part of a single foundation pour.

**Arch Concrete Placement:** two-four hour crew operation with two-man crew (excluding concrete truck driver and concrete pump operator); plus 2 day cure time before subsequent operations other than light foot traffic on decking.

## V. HANDLING & SETTING ARCHES

Planning receipt of arches should be as close to the installation date as possible to minimize the risk to damage during on-site storage.



Arches are stacked, crated with blocking as a unit (five to seven stacked arches due to transport height limitations) and shipped on a flatbed trailer from the fabricator. The crate can be unloaded, using an excavator or forklift. The full crate can be offloaded as a

whole or broken down and staged on a relatively flat area.



Disassembling arches from the crate is done by hand. Relocating arches to store or set in place by excavator requires one nylon 3" wide sling straps.

The first arch is set into place using a boom truck or excavator with one person at each end to ensure arches are set in vertical and horizontal alignment. The next arch is set and braced from the previous arch to ensure alignment.



Restraining is accomplished by using AIT provided positioning hardware and fixing the arch end to the abutment at the specified location /elevation. For Bevelled end arch



structures, a secondary support will be necessary for temporarily supporting the partial arch sections until the final concrete fill of these arches.



1 x 3 Wooden spacers can be used to maintain the specified arch spacing prior to and during FRP deck installation. **AT THIS POINT all arches should be checked and adjusted for plumbness, horizontal and vertical alignment to be within 1/4" in each orientation of its intended position.**

## VI. ARCH CONCRETE EMBEDMENT

After the arches and the first decking panel have been set at each abutment, the stem wall concrete can be placed. Special care is needed in positioning the first panel level using a transit.



## VII. DECKING

Light equipment may be necessary during deck installation (a deck panel weighs roughly 7 pounds per foot making a 40ft panel weight around 280 pounds) .



The panels are then attached to the arches using provided fasteners along the spine of the arch. A battery drill with clutch is ideal as care should be taken not to strip holes when fastening the deck. Decking can be field cut to dimensions indicated on the contract drawings. Bevell cutting should be laid out with appropriate project control to assure coordination with embankment slope requirements. Please see AIT details

associated with bevel cutting and slope tie ins at our decking.



Work operations on the deck should be limited to workers walking on the deck and arch fill operation until the arch embedment concrete cures to the specified strength.

## VIII. ARCH CONCRETE PLACEMENT

The concrete required in this operation is a self-consolidating concrete (SCC). The SCC mix includes shrinkage compensating admixtures (SCA), viscosity modifying admixtures (VMA), a hydration stabilizer (retarder) and a superplasticizer (high range water reducer). A mix design with proven performance needs to be submitted to the engineer for approval.



Flowability of the SCC mix is field tested by measuring slump flow. Typically slump flow (measured as diameter of the concrete spread) is between 24" and 30".

A trailer mounted grout pump, similar to Schwing Model No. SF 500 with a 2 in ID line, has been used successfully. Concrete Pump Trucks and concrete buckets with trunk lines feeding into a funnel made from a traffic cone have been used successfully as well to facilitate the SCC arch fill. This method allows for flow control and topping off operations, while minimizing concrete overflow and spillage. A maximum of 2 workmen are allowed at the apex of the arch while it is being filled.

Vent holes are located 18"-24" on either side of the arch fill hole and must be unobstructed during concrete filling.

A continuous concrete arch fill operation is required. No partial arch fill between truckload is allowed in an arch fill operation.



After the arch concrete placement, no other work activities are allowed for 24 hours. Only light foot traffic is allowed over the decking until the arches have reached their desired compressive strength.

## **IX. HEADWALL INSTALLATION**

After the arches have cured for 24 hours, the headwall panels may be erected and braced into position. Headwall options vary and details will be project specific.

## **X. BACKFILLING**

Upon attaining min SCC strength, the structure can be backfilled using maximum lifts of 12" with a maximum deviation of equal backfilling of 24". After backfilling is completed to finish grade, work can begin on guardrails and paving.