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TRANSMITTAL

TO: Jennifer Fitch, PE Project Manager Vermont Agency of Transportation	DATE	PROJECT NO.
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WE ENCLOSE THE FOLLOWING:

UNDER SEPARATE COVER WE ARE SENDING THE FOLLOWING

COPIES	NUMBER	DESCRIPTION	CODE
1		FRP Field Bonding Procedure	H

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BY:

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Raft Field Bonding Procedure

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Raft Field Bonding Procedure

1.0 Purpose

This procedure documents the process for ensuring that mating pontoons are properly bonded together to resist operational loads and prevent ice buildup between the pontoons.

2.0 Safety

- 2.1 Follow approved lifting and handling procedures when moving and aligning pontoons.
- 2.2 Wear proper PPE when handling chemicals and working around suspended loads.

3.0 Execution

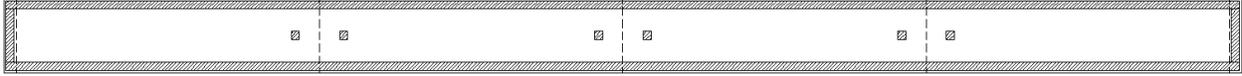
- 3.1 A minimum of 2 jacking assemblies is required (primary and a backup).
- 3.2 Complete dry fitting procedures at the manufacturing facility.
 - 3.2.1 Establish proper position of adjoining pontoons and apply reference marks indicating fore/aft and vertical alignment and spacing (parallel lines shall be placed on each side of the joint a known distance apart so that contact between the pontoons can be confirmed after bonding in the field).
 - 3.2.2 Determine if shims are required near threaded rod bulkheads to maintain desired alignment/gap (minimum 1/32 in.) when tension is applied to rods.
 - 3.2.3 Bond FRP shims as needed to the face of either pontoon and verify alignment.
- 3.3 Ensure the pontoon supports (timber beams) are properly spaced and leveled in the on-site staging area per the lifting and handling procedure. Flat and level supports are essential to successful alignment.
- 3.4 Locate the first pontoon on the support beams by rigging per the lifting and handling procedure.
- 3.5 Locate the second pontoon on the support beams aligned with the first pontoon keeping the mating surfaces approximately 1 ft apart – leave rigging in place.
- 3.6 Pass the threaded rods through the first pontoon and adjust placement of the second pontoon until all three rods can be inserted leaving approximately 2 ft extending beyond the first pontoon.
- 3.7 Dry fit the two pontoons confirming that reference marks can be realigned and the geometric tolerances are met.
 - 3.7.1 Slide the second pontoon to within 6 in. of the first pontoon using the crane then remove the straps.
 - 3.7.2 Use a center hole jack on the middle threaded rod to pull the pontoons together until contact is made.

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- 3.7.3 Pay attention to alignment of the reference marks established at the manufacturing facility.
- 3.7.4 Once reference marks are aligned, determine if adjustments to supports are needed to meet the remaining geometric tolerances and install as needed.
- 3.8 Remove the center hole jack and the threaded rods.
- 3.9 Lift one end of the second pontoon and separate the pontoons a few inches to allow the lifting straps to be installed.
 - 3.9.1 Install two 3/4 in. or 7/8 in. hoist rings or lifting eyes through the bottom flange bolt holes – one on each side of the longitudinal bulkhead closest to the bulkhead. Lifting devices shall be rated for 5,000 lb.
 - 3.9.2 Lifting device shall have a USS washer between the nut and FRP plate.
 - 3.9.3 Once a sufficient gap is established, reset the basket lifting configuration.
- 3.10 Locate the second pontoon on the support beams aligned with the first pontoon with the mating surfaces approximately 3 ft apart – leave rigging in place.
- 3.11 Pass the threaded rods through the first pontoon and adjust placement of the second pontoon until all three rods can be mostly inserted leaving approximately 2 ft extending beyond the first pontoon.
- 3.12 Prepare the MA590 adhesive for mixing in 2-1/2 gal containers.
 - 3.12.1 Have an equal amount of Parts A and B (about 5 lb each) ready to mix.
 - 3.12.2 Total amount required is approximately 27 lb or 3 buckets at 10 lb each.
 - 3.12.3 Use cordless drills and paddle mixers to thoroughly mix each batch.
 - 3.12.4 Do not mix adhesive until all preparations have been made to ensure the maximum amount of working time – about 100 minutes at 74.
Note: Cooler temperatures will significantly increase working time while warmer temperatures will decrease working time.
 - 3.12.5 Temperature of the parts and air shall be a minimum of 55°F. Tenting the area with plastic or tarps and running an indirect heater can be used to achieve and maintain minimum temperature if needed. If warm temperatures are expected, perform the operation in the morning when air and part are below 74°F.
- 3.13 Once all preparations have been made, mix the 3 batches of adhesive at the same time and apply to the perimeter of the mating surface on the first pontoon as shown below.
 - 3.13.1 Use the short side of a 1/4 in. V-notch trowel to spread a *continuous* band of adhesive approximately 4 in. wide along all four edges of the pontoon with the objective of completely sealing the space between pontoons.
Note: Additional thickness may be required along the top edge between bulkheads depending on the as-built straightness of the vertical wall.
 - 3.13.2 Apply a ±4 in. square of adhesive using the V-notch trowel at mid-height approximately 1 ft to each side of the threaded rods.

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3.13.3 The goal is to have all adhesive in place within 20 minutes of mixing.



Note: This results in 5,200 in² of adhesive prior to clamping. After clamping (squeeze out), the anticipated coverage area is about 2X or 10,400 in².

- 3.14 Lift the second pontoon enough to slide it closer to the first pontoon leaving just enough room to remove the lifting straps without disturbing the adhesive.
- 3.15 Pass the threaded rods entirely through the second pontoon and prepare for clamping.
- 3.15.1 Secure a bearing plate, washer, and nut on each end.
- 3.15.2 Mount a center hole jack on the middle threaded rod.
- 3.15.3 The goal is to have the jack in place within 40 minutes of mixing.
- 3.16 Slowly apply tension to the threaded rod drawing the two pontoons together.
- 3.16.1 Pay attention to alignment of the reference marks established at the manufacturing facility.
- 3.16.2 Once desired alignment is achieved, continue loading the jack until a value of 15,000 lb is reached then snug the nut under the jacking chair.
- 3.16.3 Repeat the tensioning process on the two outer threaded rods to 15,000 lb.
- 3.16.4 The goal is to have the pontoons joined within 65 minutes of mixing.
- 3.17 Allow the adhesive to spread under pressure for 5 minutes.
- 3.17.1 While waiting, scrape off squeeze out from the perimeter and reapply this adhesive to sections that are missing enough adhesive to cause squeeze out.
- 3.18 Starting at the middle threaded rod, load the jack until a value of 15,000 lb is restored then snug the nut under the jacking chair. Repeat for the other two rods.
- 3.19 The goal is to have the second tensioning complete within 85 minutes of mixing.
- 3.20 Confirm that hard contact has been made between the pontoons by verifying the pre-established distance exists between the gap reference marks.
- 3.20.1 If the gap has not been closed, apply an additional 10,000 lb to each jack until the desired gap is achieved up to a load of 55,000 lb.
- 3.20.2 The goal is to have the raft in final clamped position within 100 minutes of mixing.
- 3.21 Scrape clean any additional squeeze out that occurs.
- 3.22 Leave the bonded raft in place for at least 12 hours. Maintain a minimum temperature of 55°F for 5 hours after the adhesive was mixed.

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4.0 Supporting Calculations

The special provision specification requires that a shear key be designed for a distributed, factored shear force of 0.75 kip/ft. The following calculation demonstrates that the adhesive applied as described above will provide the required shear strength.

$$\begin{array}{ll} V_u = 0.75 \text{ kip/ft} & V_n = F_s h \\ F_s = 1.60 \text{ ksi} & h = 8 \text{ in. (uncompressed}^1 \text{ height of adhesive = 4'' + 4'')} \\ \lambda = 0.9 & \phi = 0.5 \quad C_m = 0.85 \end{array}$$

$$C_m F_s h \lambda \phi = 58.75 \text{ kip/ft} \gg 0.75 \text{ kip/ft}$$

As noted in the previously submitted technical data sheet, Plexus MA 590 is commonly used to bond fiberglass material used in marine construction. It is resistant to water and solvents and has excellent impact resistance and flexibility even at low temperatures.

¹ Actual height of adhesive after it's compressed between the pontoons is greater than 8 in. Therefore, use of the uncompressed height is conservative.