



# Highway Bridge Pier Column Emergency Repair

Using AQUAPREG<sup>®</sup> 22-71  
GLASS COMPOSITE SYSTEM  
Bridge No. 7012680 and 7012690

New York State Department of Transportation  
District #6

Report No. AIR LOGISTICS CORP. 00-01-04

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## *Introduction*

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The New York State Department of Transportation, District #6 (NYSDOT), operating under an emergency repair contract, effected repairs on Bridge No. 7012680 and 7012690 on Rt. 17 in Painted Post, New York.

The bridge, built in 1952 is structurally sound but was exhibiting serious spalling on the columns. This bridge supports the Norfolk Southern Railroad over Rt. 17 in Painted Post, NY.

NYSDOT elected to use AQUAPREG<sup>®</sup> 22-71 Concrete Repair System to perform the repair to the four spalled columns. The material was applied by C.P. Ward, Scottsville, New York.



## *Acknowledgment*

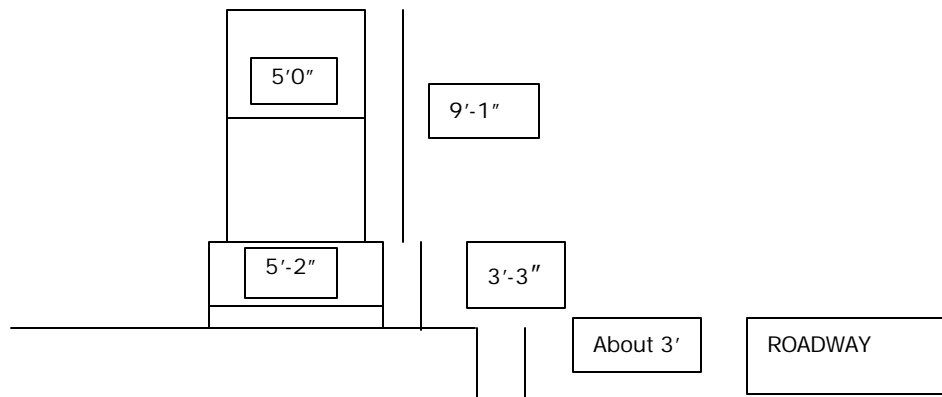
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This project was a good example of different organizations working as a team. AIR LOGISTICS CORP. acknowledges the job carried out by Mr. Jerry O'Connor of the NYSDOT for his vision in using advanced materials as an alternative technology on New York Bridges. Thanks also to Mr. John Murphy, Construction Supervisor, NYSDOT and Mr. Chuck Houser, Bridge Safety Assurance, NYSDOT for their support during the project. AIR LOGISTICS CORP. acknowledges the effort of Mr. Theodore Gilbert, C.P. Ward, as the system applicator, for his efforts under less than ideal conditions. Thanks also to Mr. Franz Worth, Air Logistics Corp., Pasadena, CA for his support in the field.



**Bridge No. 7012680 and 7012690**

The project consisted of four columns, two on Bridge No. 7012680 and two columns on Bridge No. 7012690. The original condition of the columns is pictured above. The columns are approximately 5 feet in diameter and a height of 12 feet.



**Figure 1 (Not To Scale)**

The deteriorated condition of the columns is primarily due to weathering, freeze / thaw cycling, and the use of salt in winter conditions. Not all of the four columns exhibited the same amount of degradation. The column pictured on Page 2 shows the “worst case” situation.

## *AQUAPREG® 22-71 System Components*

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AQUAPREG® 22-71 Concrete Repair System consists of three components: AQUAPREG® 22-71 Structural Adhesive, AQUAPREG® 22-71 Structural Prepreg Cloth, and AQUAPREG® 22-71 Veil Prepreg Cloth.

AQUAPREG® 22-71 Structural Adhesive is a two part bonding material designed to produce a bond between the AQUAPREG® 22-71 Structural Prepreg Cloth and the concrete substrate.



AQUAPREG® 22-71 Structural Prepreg Cloth is the main structural component of the repair system. This is a woven roving material impregnated with a water cured resin system. The material comes packaged in moisture-tight packaging.





AQUAPREG® 22-71 Veil Prepreg Cloth is a tight-woven glass cloth impregnated with the same water cured resin system used in the AQUAPREG® 22-71 Structural Prepreg Cloth. The material is also packaged in the same manner as the AQUAPREG® 22-71 Structural Prepreg Cloth.

### *Column Repair*

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The procedure for repairing the spalled columns consisted of the following:

- Remove spalled concrete from column.
- Clean column surface.
- Repair spalled areas with HD-25 Vertical and Overhead patch material.
- Apply the AQUAPREG® 22-71 Structural Prepreg Cloth.
- Apply the AQUAPREG® 22-71 Veil Prepreg Cloth.
- Allow the AQUAPREG® 22-71 System to cure.
- Paint the surface with a system compatible polyurethane paint.

The procedure for repairing the spalled surface that is not in confinement (Bull Nose):

- Remove spalled concrete from column.
- Clean concrete surface.
- Repair spalled areas with HD-25 Vertical and Overhead patch material.
- Apply AQUAPREG® 22-71 Structural Adhesive
- Apply the AQUAPREG® 22-71 Structural Prepreg Cloth.
- Apply the AQUAPREG® 22-71 Veil Prepreg Cloth.
- Allow the AQUAPREG® 22-71 System to cure.
- Paint the surface with a system compatible polyurethane paint.

The following photograph shows the column after the spalled areas have been repaired using HD-25 Vertical and Overhead patch material approved by NYSDOT.



### **Concrete Repair Prior to Application of AQUAPREG® 22-71**

#### **Apply the AQUAPREG® 22-71 Structural Prepreg Cloth**

After the column has been repaired with HP-25 patching material, water is sprayed on the surface of the concrete and the AQUAPREG® 22-71 Structural Prepreg Cloth is applied.

AQUAPREG® 22-71 Structural Prepreg Cloth can be applied in individual layers (as done on this project) or may be wrapped in a spiral pattern. Applied horizontally assures the full use of all the structural strength of the fabric. Applied in a spiral pattern reduces the labor but also has slightly lower mechanical properties. For spall repair the spiral pattern is preferred.





### **AQUAPREG® 22-71 Structural Prepreg Application**

AQUAPREG® 22-71 Structural Prepreg Cloth is applied by wrapping it around the column and onto itself for the second layer. This process is repeated for the entire length of the column. Since the system is a water-cured system, water is sprayed on each layer as the material is applied. This is a confinement application therefore does not require the use of AQUAPREG® 22-71 Structural Adhesive.



### **Additional AQUAPREG® 22-71 Structural Prepreg Application**





**Completing the Structural Layers**

**Apply the AQUAPREG® 22-71 Veil Prepreg Cloth**

After the AQUAPREG® 22-71 Structural Prepreg Cloth has been applied the next step is the application of the AQUAPREG® 22-71 Veil Prepreg Cloth.

Water is sprayed on the surface of the AQUAPREG® 22-71 Structural Prepreg Cloth. The Veil is then applied in a spiral manner around the column. The AQUAPREG® 22-71 Veil Prepreg Cloth is the finish layer.



**Start of Veil Layer**



**Spiral Wrapping in Progress**



**Veil Progress**



**Completed Veil Application**

After the application of AQUAPREG<sup>®</sup> 22-71 the materials were allowed to cure for 24 hours before the application of the protective paint. Cure is usually much faster but due to the low temperatures, curing did take longer than usual.

## *Bull-Nose Repair*

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The lower sections of the columns were attached to one another with a wall approximately three feet, three inches high by 14 inches thick. Because of the location of the wall and its attachment to the column, the confinement technique used on the upper portion of the column could not be used. Since we could not wrap the material onto itself we had to use an adhesive to assure a proper bond to the concrete sub-straight.

### **Apply AQUAPREG® 22-71 Structural Adhesive**

The AQUAPREG® 22-71 Structural Adhesive is a two-part system mixed in a one to one ratio. The adhesive is applied to the sub-straight using a roller or trowel. For this application rollers were used to apply the adhesive.



**Roller Application of Adhesive**

The adhesive was applied and allowed to “tack-off” before the application of the AQUAPREG® 22-71 Structural Prepreg Cloth. By applying the AQUAPREG® 22-71 Structural Prepreg Cloth to the adhesive when it has “tacked-off” adhesion to the concrete sub-straight is assured.

### **Apply the AQUAPREG® 22-71 Structural Prepreg Cloth.**

The AQUAPREG® 22-71 Structural Prepreg Cloth is applied to the bull-nose in the same manner as applied to the columns. The first layer of AQUAPREG® 22-71 Structural Prepreg Cloth is allowed to “tack-off” before the application of the second layer. This again, allows for better bonding.



**Structural Layer over Adhesive**

**Apply the AQUAPREG® 22-71 Veil Prepreg Cloth.**

The AQUAPREG® 22-71 Veil Prepreg Cloth is applied over the structural material. The AQUAPREG® 22-71 Veil Prepreg Cloth is not wrapped in this case. It is applied in the same manner as the structural material.



**Completed Veil Over Bull-Nose**

Once the veil has been applied and allowed to cure, the surface is painted with a system compatible polyurethane paint.



**Painted Column Bull-Nose**



**Wall Column Interface**



**Completed Project**

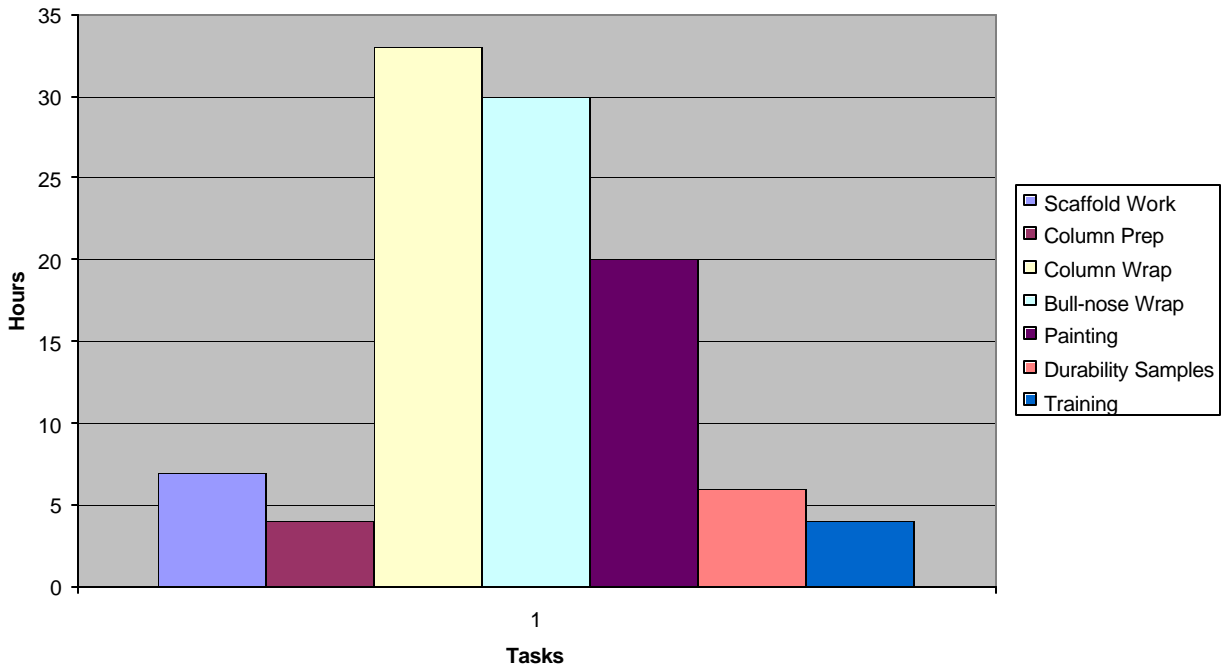
*Labor and Labor Analysis*

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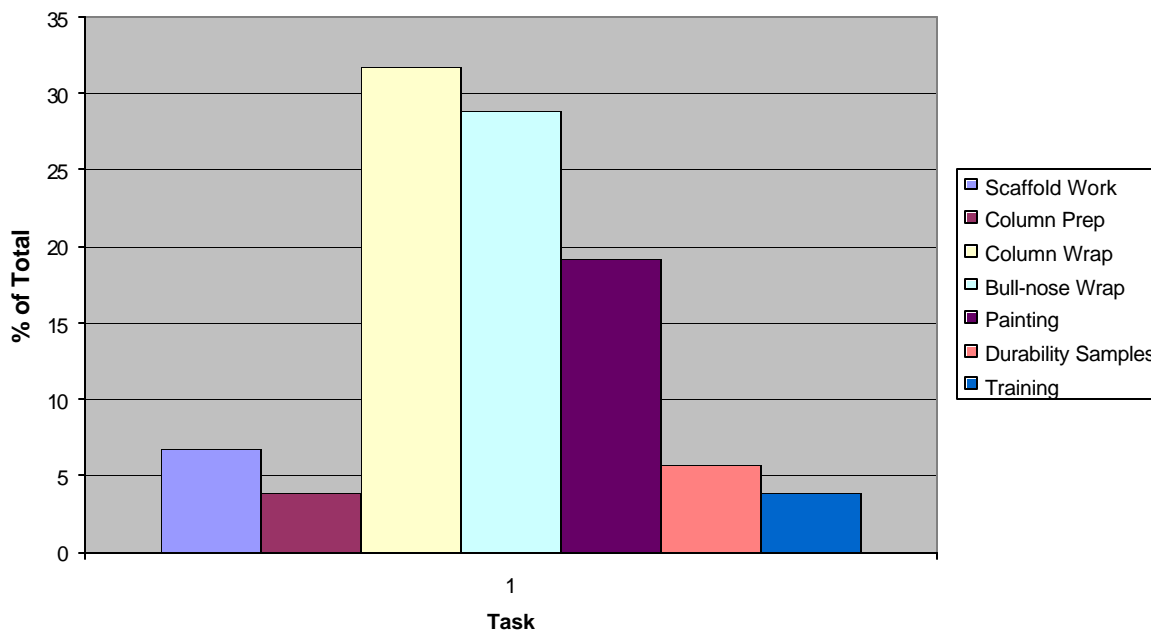
The man-hours used, the labor analysis by hour and by a percentage of the total are given in the charts below.

Man-hour Breakdown					
Date/Task	12/7/99	12/8/99	12/9/99	12/10/99	Total
Scaffold Work	2	2	2	1	7
Column Prep	1	1	1	1	4
Column Wrap	15	15	3		33
Bull-nose Wrap			15	15	30
Painting		4	8	8	20
Durability Samples				6	6
Training	4				4
Total	22	22	29	31	104

**Man Hours Per Task**



**Labor % by Task**



### *Material and Material Analysis*

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AIR LOGISTICS CORP. was the material supplier for this project. The materials supplied for the project were:

- AQUAPREG® 22-71 Structural Adhesive
- AQUAPREG® 22-71 Structural Prepreg Cloth.
- AQUAPREG® 22-71 Veil Prepreg Cloth.

In addition to the materials supplied by AIR LOGISTICS CORP., C. P. Ward supplied the labor for the installation.

The following chart gives a breakdown of the materials and their usage.



MATERIALS	Price	Rolls/Column	Sq. Ft. / Column	Rolls/ Bull-Nose	Sq. Ft. / Bull-Nose	Gallons
<b>Adhesive</b>						
AQUAPREG® 22-71 Structural Adhesive						0.5
Price per gallon	\$56.76					
<b>Structural Material</b>						
AQUAPREG® 22-71 Structural Prepreg Cloth		17.5	396.90	3	68.04	
Price per roll	\$120.25					
<b>Veil Material</b>						
AQUAPREG® 22-71 Veil Prepreg Cloth		3.25	242.78	1	74.7	
Price per roll	\$269.65					

Material	Per Column	Per Bull-Nose
Structural Material	\$2,104.38	\$360.75
Veil Material	\$876.36	\$269.65
Adhesive		\$28.38
Total	\$2,980.74	\$658.78
Sq. Ft. Cost		
Structural Material	\$5.30	\$5.30
Veil Material	\$3.61	\$3.61
Adhesive		\$0.76
Total per Sq. Ft.	\$8.91	\$9.67

Prior to the repair process, NYSDOT had the columns prepared for the wrap. This included rebuilding the surfaces of the column and bull-nose.

## *Tools Used*

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The following tools were used during the project:

Project plans  
Safety gear  
Hard hats  
Safety glasses  
Safety shoes  
Vest with reflective markings  
Water  
MSDS and certificates of all materials  
Generator  
Mixing equipment for adhesive (drill and mixing blades)  
Cutting tool  
Neoprene latex gloves (XL)  
Paint pails  
Acetone  
Squeegees with handles  
Mixing buckets  
Flat sticks to mix/scoop adhesive from buckets  
Trowels to apply adhesive  
Garden trowels to scoop adhesive from buckets  
Scissors  
Knives  
Wire brushes  
Rags  
Extension cords  
Tape measure  
Garden sprayer

## **SAFETY**

Reiterate safety procedures to everyone. Assign people for each column: Mixer, Resin applicator, Adhesive, Safety officer/Supervisor/Quality assurance.

Safety meetings were held at the beginning of each shift. Each project leader was responsible for the safety of his crew.

Temperature	12/7/99	12/8/99	12/9/99	12/10/99
	36 °F Clear	45 °F Clear	45 °F Clear	39 °F Rain

In order to ascertain the long-term durability of the AQUAPREG® 22-71 system, a durability sample was made on the structure. Enough material was put down on the structure to pull a sample each year and do mechanical tests.



**Preparation of Surface for Durability Samples**



**Laying-up Durability Samples**

## **CONCLUSION**

The repair of the Painted Post Bridge was accomplished in a timely manner. There was little waste of material and time. The process of repair using composite materials has been demonstrated many times in NY, each time increasing the knowledge base for the introduction of this new technology.

In this case, the viability of composites from a constructability standpoint has been successfully demonstrated. In this particular application, the use of the water cured prepreg material proved to be very valuable. The quality of the impregnation was improved from the typical wet lay-up method. The impregnation of the fabric was complete and there was no evidence of dry fibers.

AQUAPREG® 22-71 System made this job successful even at the low temperatures we encountered during the installation.

For all rectangular or square columns or areas where the fabric can't be wrapped around itself it is suggested that the adhesive layer be applied to the surface prior to the application of any composite wrap. This will lessen the chances for the formation of voids and assures a good concrete / composite bond which is vital in transferring the loads from the concrete to the composite.