Axial Confinement of Concrete Columns with Carbon Wrap

Case Study – HJ3 CS200906

Introduction:

The Refinery discussed in this case study processes a wide variety of petroleum products. Reinforced concrete columns and beams support extensive process piping throughout the plant. Overtime, exposure to the freeze thaw cycle and vibration caused extensive cracking of the concrete columns, delamination of the concrete and corrosion of the reinforcing steel rebar causing OSHA to tag the columns.

Problem:

During a plant survey it was shown that reinforcing rebar within the column had deteriorated up to 25% as much of the rebar was completely exposed to the external environment. The resulting damage of the columns and beams compromised the structures fire rating, endangering plant operations and worker safety. Given the extent of the damage, the plant considered three alternatives: replacement, resurfacing of concrete and reinforcement with HJ3's Composite System, and only resurfacing the concrete. The plant chose to resurface the structures with a cement based grout to reestablish the fire rating of the structure and then strengthened the patched area with HJ3's Composite System. The use of HJ3's Composite System was selected to handle shear forces from thermal expansion and contraction and continued vibration that caused the initial damage to the columns

Installation

The columns were first wire brushed and cleaned of all loose concrete material. Corroded rebar were then cleaned and treated to prevent further corrosion. Then a 6000-psi grout was used to resurface the columns back to their original shape. After surface preparation, the columns were primed with 10 mils of the HJ3 PC-100 Primer Coat. Then two layers of HJ3's carbon fabric were saturated with SR-400 Saturating Resin and wrapped to the columns.

Conclusion:

In total seventeen columns and four beams were repaired and strengthened with the HJ3 Carbon Composite System. The total installation was completed in eight days and resulted in 70% cost savings for the client when downtime and fines were considered. The main advantages of the HJ3 Carbon Composite System were as follows:

- 10 x Tensile Strength of Steel
- Corrosion Resistant
- Speed of installation
- Minimized Downtime Cost
- 70% to 80% Cost Savings over alternatives – Including Replacement
- Columns are 20% stronger than initial design

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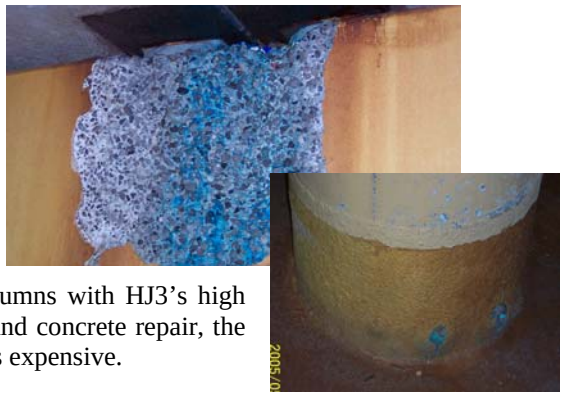
Axial Confinement of Concrete Columns with Carbon Wrap

Case Study – HJ3 CS200912

Introduction:

The Copper Mine discussed in this case study utilizes an electrowinning process to extract high end copper from iron-ore. The electrolyte that is used to extract the copper is highly corrosive and acidic. Over 1,000 electrolytic tanks that hold the electrolyte are supported by concrete beams and columns in the basement of the SX/EW plant. The columns are reinforced with #9 steel bar spaced 6-inch on center around the circumference of the column.

Problem:



During a plant survey extensive corrosion to both reinforced concrete columns and beams was noted. The problem stems from electrolyte attack of steel re-bar. As the tanks over flow electrolyte floods the basement and pools at the base of the columns. The electrolyte also leaks through the floor of the tanks and pools in the concrete beams. Over time the the steel reinforcement will lose 50% to 75% of its strength causing risk of failure The mine considered two options (1) Re-core new #9 bar 6-inch on center into the existing columns and re-pour concrete to rebuild the columns, or (2) wrapping the columns with HJ3's high strength s-glass system. After attempting the traditional steel and concrete repair, the plant determined that the carbon fiber would be 75% to 80% less expensive.

Installation

The columns were first abrasive blasted to remove lose particles and clean the substrate. Corroded rebar were cleaned and treated to prevent further corrosion. Then a 6000-psi grout was used to resurface the columns back to their original shape. After surface preparation, the columns were primed with 10 mils of the HJ3 PC-100 Primer Coat. Then two layers of HJ3's s-glass fabric were saturated with SR-400 Saturating Resin and wrapped around the columns.

Conclusion:

In total over 150 columns were repaired and strengthened with the HJ3 Carbon Composite System. The total installation resulted in 75% to 80% cost savings over the traditional steel and concrete repair. The main advantages of the HJ3 Carbon Composite System were as follows:

- 10 x Tensile Strength of Steel
- Chemical Resistance to Electrolyte
- 3-Year Warranty
- No Downtime Costs
- 75% to 80% Cost Savings over alternatives

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Axial Confinement of Concrete Columns and Beams with Composite Wrap

Case Study – HJ3 CS200913

Introduction:

The Copper Mine discussed in this case study utilizes an electrowinning process to extract high end copper from iron-ore. The electrolyte that is used to extract the copper is highly corrosive and acidic. Over 260 electrolytic tanks that hold the electrolyte are supported by concrete beams and columns in the basement of the SX/EW plant. The columns are reinforced with #6 steel bar spaced 12-inch on center around the circumference of the column.

Problem:

During a plant survey, extensive corrosion to both reinforced concrete columns and beams was noted. The problem stems from electrolyte attack of steel re-bar. As the tanks over flow electrolyte floods the basement and pools at the base of the columns. The electrolyte also leaks through the floor of the tanks and pools in the concrete beams. Over time the steel reinforcement will lose 50% to 75% of its strength causing risk of structural failure. At this facility, the electrolyte penetrated deep within the pours of the concrete surface of both the columns and the beams.

Installation:

The columns were first abrasive blasted to remove lose particles and clean the substrate down to rough aggregate to thoroughly clean all contaminants out of the concrete substrate. The steel rebar were also cleaned and treated to prevent further corrosion. Next, a quick set 6000-psi grout was used to resurface the columns back to their original shape. After surface preparation and patching, the columns were primed with 10 mils of the HJ3 PC-100 Primer Coat. Then one layer of HJ3's s-glass fabric was saturated with SR-400 Saturating Resin and wrapped around the columns. A final coat of HJ3 HCRC- 511 Epoxy Novolac was installed over the HJ3 reinforcing system.

Conclusion:

In total over 20 columns and beams were repaired and strengthened with the HJ3 Composite System. The total installation resulted in 75% to 80% cost savings over the traditional steel and concrete repair. The main advantages of the HJ3 Carbon Composite System were as follows:

- 10 x Tensile Strength of Steel
- Chemical Resistance to Electrolyte
- 3-Year Warranty
- No Downtime Costs
- 75% to 80% Cost Savings over alternative repairs

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