

Shotcrete Repair in Paper Mill

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This article describes three successful shotcrete applications that were conducted by the authors and their team in June 2001, March 2002, and May 2002. Work was conducted inside process vessels in a pulp mill by the specialized lining contractor, Canadians Stebbins Engineering Ltd., and the shotcrete contractor, Béton Projeté M.A.H. Due to operational constraints and significant costs involved with downtime, the contractors' primary goal was to perform a repair that would provide long-term reliability within the shortest construction period possible.

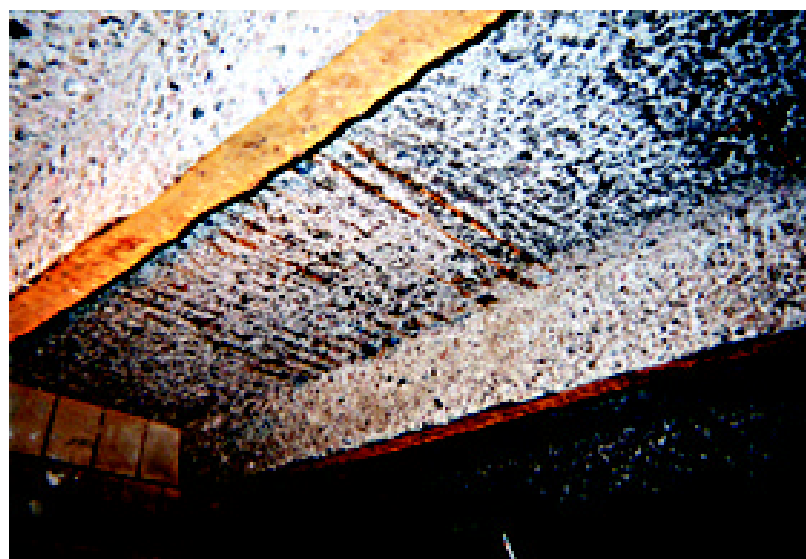


Figure 1: Unidirectional beam and slab roof system before maintenance.



Figure 2: Prepared surface prior to shooting.

Project Description

Concrete ceilings inside paper mill process vessels are often subjected to high temperatures and a highly corrosive environment. Typical repairs of this type of ceiling require 5 to 6 days of production downtime. For Abitibi-Consolidated (La Baie, Quebec, Canada), this period was too long, given that the overall plant shutdown was only 4 days. The conventional repair sequence consisted of cleaning the concrete surface with high-pressure water-blasting, followed by troweling of a cementitious repair mortar onto the surface 13 mm (0.5 in.) thick. Depending on the repair dimensions involved, this single operation normally required a 72-hour window during a mill shutdown. In comparison, the cleaning of the surface, mesh placement, shotcreting, finishing operations, and application of a protective coating required only about half of this time. The area in need of repair for each vessel was approximately 93 m² (1000 ft²). All surfaces to be repaired were overhead and located at 6 m (20 ft) above the ground. Figure 1 shows one of the damaged ceilings before repairs were performed.

Construction

When the Béton Projeté M.A.H. and Canadian Stebbins Engineering Ltd. team first inspected the vessel in June 2001, the concrete ceiling was in major need of repair. Chemical attack of the cement binder and corrosion of the reinforcing steel had reached critical levels. The lower flange of the steel I-beam was also seriously corroded. The contractor proposed to proceed by first removing the damaged concrete, cleaning or replacing rebars, and placing a hot, galvanized 50 mm (2 in.) square wire mesh with L-shaped anchors positioned 400 mm (16 in.) apart. Finally, a 50 mm (2 in.) layer of dry-mix silica-fume shotcrete was applied. Figure 2 shows the prepared concrete surface prior to shooting, and Figure 3 shows the final appearance of the repaired surface. A smooth finish was required so that a special epoxy coating could be applied to the shotcrete surface to provide long-term protection against corrosion in this hot, steamy, and acidic environment.

The mixture considered for this project was a prebagged material typically used for repairs in the province of Quebec. It consisted of an ASTM Type I portland cement, silica fume, sand, and 5 mm (1/4 in.) maximum-size coarse aggregates. From

previous experience with this mixture design, the contractor used silica fume and coarse aggregates to obtain an application with very low rebound, excellent reinforcement encapsulation, and easier finishing.

On subsequent visits in March and May of 2002, the five-man shotcrete team (one nozzleman, one nozzleman's helper, one gun operator, and two finishers) managed to complete the work in less than half the time normally required using the classic repair method. The success of these jobs can be attributed to three important factors: a proven construction method, careful planning of the project, and the individual effort put in by skilled team members. Generally, for this type of application, the costs related to

the use of shotcrete are similar to the costs of hand-applied repair materials. In this particular case, however, the ability of the contractor to perform the work using shotcrete in less time than required for hand-applied repairs provided the client with the best value.

Conclusions

The use of shotcrete for concrete ceiling repairs in this paper mill project allowed an impressive reduction in repair execution time. The indisputable success of this project can be attributed to the use of the advantageous shotcrete placement method, combined with quality work conducted by a well-organized and skilled shotcrete team.



Figure 3: View of the finished surface.

Marc Ferland is the co-owner of Béton Projeté M.A.H. With more than 18 years of experience as a shotcrete finisher, he and his company are involved in work in numerous shotcrete-related fields such as architectural and repair shotcrete.

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Figure 4: Two happy workers! The nozzleman and his helper after completing the vessel's ceiling in less than half the normal time.