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**TecBond™ Permeation
Injection Repair Process**

is

*An Improved Method of ReNewal
for Delaminated Topping Slabs*

**Report of
Identification and Rebonding
Delaminated Topping Slab To
Precast Double T Panels With
Vacuum Technology.**

*Industrial Warehouse Facility
College Park, Maryland*



TECVAC, Inc.
1999

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Background

The second story of a warehouse facility was used to store and distribute aluminum siding, windows, kitchen equipment and other items incidental to residential construction. The floors of the facility were constructed of a three-inch-thick topping slab installed in composite over precast concrete double T's.

Because of the transient nature of the materials, a great deal of heavy forklift traffic was required to move the materials in and out of the warehouse. When large chunks of concrete began to fall from the bottom of the precast panels, the topping slab was discovered to be delaminated.

Although arguable, it was preliminarily determined that the tenant had exceeded the designed weight restrictions and had overloaded the floor. This had caused the topping slab to ripple across the double T's and delaminate. This condition, in turn, imposed forces on the double T's and caused cracking and delaminations of the T's and stems. Representative areas of floor were chain dragged and confirmed to be delaminated. Initial recommendations indicated the only method to restore the composite action of the floor was to entirely remove and recast the topping slab; over 120,000sf. This repair endeavor would necessitate the temporary displacement of the tenant, but more disruptive, it would also require the temporary displacement of the tenants below. Needless to say, no one was happy with this situation, including the owners of the property who were ultimately responsible for what was deemed to be an unsafe condition.

It was agreed that the floor was not totally debonded. There were areas where the topping maintained its original design. However, to facilitate even partial removal, all of the tenants would have to be displaced. It was surmised that if the tenants had to be displaced, then the entire topping would have to be removed and replaced. Using only light weight hammers this would not only be a gruesomely slow operation but, at the very least, would also put the double T's at risk during the demolition. Moreover, this was to be an incredibly expensive ordeal, as suggested by the consulting engineers. 250,000sf of new warehouse space would have to be secured, the contents of 6-7 light commercial businesses would have to be moved, the work would have to be completed and finally, the tenants would have to be moved back into their original spaces. Hence the positioning for responsibility and liability and the entertainment of alternative methods of repair.

Epoxy injection of the delamination was suggested, but this method is not totally effective. Pressure used to install the epoxy resin actually tends to extend the delamination process as it moves the materials along. Iowa DOT testing of topped bridge structures revealed some effectiveness with this method. However, the one thing no one wanted was to risk massive disruptions with no resolve, or only temporary resolve, of the problems.

The Work

Impact-Echo testing is a method of non-destructive testing of concrete, masonry and stone. While this method of testing will reveal many internal defects, including honeycombing, linear fractures and crack depths, in this instance, there was a necessity to identify the void areas between the topping slab and the double T's. This method, unlike common chain dragging, would precisely map the areas of delamination throughout the warehouse with little disruption to the tenant.

First, a 3'x3' grid pattern was laid out on the warehouse floor and transferred to the original floor plan drawings. At each of the grid points, a "shot" was taken with the Impact-Echo equipment and identified as sound or deficient. When all of the grid points were tested, the information was produced as a color-coded diagram of the entire floor. Unlike the area anticipated, the Impact-Echo testing revealed under 35,000sf as delaminated. The testing team also suggested an effective method of repair; a method that could be performed in-situ and would not require the displacement of tenants. With proper load testing confirmation, vacuum permeation, rather than removal and replacement or pressure injection, could prove a real value. This method, coupled with extremely thin acrylic repair resins would produce an effective method of repair, able to withstand confirmation testing.

With the areas of delamination identified, the double T panels were inspected from below. Areas where the repair resin was suspected to leak were sealed and cracks within the deck and stems were identified for repair.

When the areas beneath the delaminations were secured, tiny holes were drilled into the topping to intersect the delamination fracture zone. Vacuum was applied to the sealed zone and the repair material was introduced. The vacuum power was used to draw the materials into the fracture and along the zone to the perimeter of the areas. Spot core drilling was performed to confirm the rebonding and completeness of filling. Later, load testing by an independent testing agency confirmed the restored composite action of the topping and double T's within the entire area.

Conclusion

The power of vacuum forces have been known since the mid 1600's. Otto von Grericke pumped the air from two fitted brass hemispheres and harnessed it between two teams of eight horses on either side. Riders kicked and whipped the teams, but could not part the vacuum secured hemispheres. Tecvac, Inc. has harnessed this powerful force in the repair and restoration of concrete, masonry and stone.

In most cases, the work can be performed with little disruption or intrusiveness. The work was performed during off-hours at night with no disruption to the tenants daily operations. Some of the stored materials required moving to another area of the warehouse while the work was performed, but required no displacement. Nor were the tenants below displaced and the entire work was completed within 45 days.