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Delam Tool History

The need for an accurate method for non-destructive testing for delaminations in reinforced concrete has led to the development of rotary percussion. Now included in ASTM standard D 4580-86, rotary percussion is a method which uses non-destructive percussion similar to that of hammer tapping, but designed to cover large areas, including vertical and overhead structural elements, more easily and with a greater degree of accuracy. Rotary percussion was developed out of a need to perform non-destructive sounding studies on overhead structural elements. The device and process is patented and is used to detect delaminated concrete in large top slab applications and in overhead surveys with greater speed and increased accuracy.

Until now, the chain drag has been the universally accepted method for detecting delaminations in steel reinforced suspended concrete structures. Listening for the characteristic hollow sound produced by dragging a chain across a delaminated surface, an experienced technician can detect a damaged area. Obviously, this method is suitable for horizontal, top slab surfaces only. The chain drag method is not as effective in detecting smaller delaminations. These smaller areas are typically found by tapping with a small hammer. The chain drag as described in ASTM D 4580-86 is useful for initial delamination detection on large, flat surfaces, such as bridge and parking decks, and some concrete highway slabs. The advantage of this technique is its speed. The subjectivity of relying on the experienced ear of the operator limits the method to the location of gross surface delaminations where breakdowns have occurred to a considerable extent.

In order for the engineer or technician to sample any vertical or overhead structural element, it is necessary to first gain access to the area, and second, tap the surface with a hammer or similar hard object. Clearly, there are limitations inherent in the use of the current “technology” used to detect delaminated concrete. It is important to make an accurate assessment of the extent of damaged area not only to maintain structural integrity, but also for the engineer to produce an accurate cost estimate for repair. On structural repair projects the line item most likely to exceed estimated costs is the repair of delaminated concrete due to underestimation of total delaminated areas.

Accessories

A set of companion tools which are used with the Delam Tool make the process of detecting, marking, measuring and documenting delaminated areas easier, faster and with greater accuracy. When a defective area is identified, a crayon marker attached to the tool head is used immediately to mark the area. Once the top slab and the overhead structural elements are

delineated for delaminations and marked with the attached crayon, the defective areas can be clearly marked with the spray paint tool attachment. After the area has been paint-marked for repair, a measuring wheel can be attached to the extension pole and a precise measurement taken to document the size of the repair area. In applications where ambient noise is a problem, a wireless microphone attachment can be used with headphones so that even the slightest sound variation can be detected.

Field test Results

Two separate field test examples are presented to demonstrate the effectiveness of rotary percussion when compared to traditional methods of detecting delaminations. The first example is a delamination study conducted on a parking facility in Baltimore, Maryland and shows how rotary percussion exceeds the performance of chain dragging, both in speed and accuracy. The second example was a comparative study on the effectiveness of rotary percussion on a uniquely designed facility with exposed cast-in-place beams,
multi level columns and elevated pedestrian walkways connecting a cluster of buildings. This example demonstrates the effective use of rotary percussion on typically out of reach vertical and overhead structural elements.

Case # 1

During a typical building evaluation in Baltimore, Maryland, the rotary percussion tool and attachments were used to test and clearly mark the extent of delaminated concrete in both the top slab and the overhead structures. The study was confined to the parking structure on the first two levels of the building, plus one below grade level, designated as P-1. The street level of the garage, designated as P-2, is the level on which cars enter the garage. The below grade deck is slab-on-grade and was omitted from the study. The overhead slab at the P-1 level supported the soffit for P-1 and the top slab for P-2. Once the cars entered the garage on the P-2 level, a ramp could carry the cars either down to P-1 or up one level to P-3. The garage measured 40 feet wide and 100 feet deep. Therefore, the study area consisted of 20,000 square feet: the overhead portion of P-1 (4000 square feet); the floor slab and overhead slab of P-2 (8000 square feet); and the floor slab and overhead slab of P-3 (8000 square feet). The bays were divided into two, twenty-foot bays in width and three, thirty-foot bays in depth. Each level had 12 main columns and associated beams. The structure was cast-in-place and built in 1976. The study was ordered because spalling was visually observed throughout the garage, particularly on the drive lanes and the two ramps. Approximately 2000 square feet of P-2 had a bonded overlay material, which was installed in 1980.

Two delamination studies were planned for the same building. One study was planned using the traditional chain drag method on floor slab, with overhead examinations using ladders and hammers for tapping. The second study was planned using the Delam Tool
with the marking and measuring attachments for both the floor slabs and overhead structural elements. Two separate field teams were used to conduct the studies so that each team would gather independent data. The results of each team were compared for time spent and size of delaminated areas found. It is important to note that the spray paint marking was completed after each set of data was gathered.

Method 1 Results:
Chain Drag

Time To Conduct Study……5.5 Hours
Delaminations Found……1.09% (218 square feet)
Bond Failure Found……51 square feet

Method 2 Results:
Delam Tool
Rotary Percussion

Time to Conduct Study……45 Minutes
Delaminations Found……...1.36% (272 Square feet)
Bond Failure Found……..66 square feet

Case # 2

Just South of Washington, D.C. on Route 7 is the Xerox University campus. Built in the 1970's, the facility is a beautifully designed group of interconnecting buildings set in rural Virginia, and houses the training operation for the Xerox Corporation. Natural wood and cast-in-place concrete gives the campus a sprawling contemporary feel.

In 1996 the buildings underwent a 10-day structural investigation focusing on observed structural defects in the exposed concrete structural elements such as beams columns and pedestrian bridges. A visual survey was taken on the overhead areas and spalls and cracks were documented. The lower level concrete was subjected to hammer tapping to detect delaminations and documented accordingly. The repair quantities specified in the 1996 study were based in large part on extrapolations taken from the lower test areas where actual delamination testing was conducted. A set of repair documents was generated and the project was put out to bid. It was difficult to establish a fixed contract price because the line item for delamination repair was designated as a variable and contingent upon the quantity of damaged areas found and repaired.

In 1999 the structural delamination study was reordered using the Delam Tool rotary percussion and 100% of the exposed concrete was tested. The engineering team was allowed 14 days to complete the survey. The survey was completed in 3 days. The data from the survey is currently being used to generate revised repair documents.

Conclusion

The results indicate that using the rotary percussion method to conduct delamination surveys represents a 500% savings in time. The rotary percussion method identified more defective areas, therefore adding to the accuracy in testing. The membrane overlay area was tested with rotary percussion and this method was found to be effective in distinguishing between bond failure and delaminated substrate. Detailed product information can be found at www.soundingtech.com.