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Telephone 561-775-7151

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8211 Needles Drive, Palm Beach Gardens, Florida 33418

DROPS FROM ABOVE, BUT NOT HEAVEN

By Bob Cusumano

A new classroom building was constructed at a southern university. The atrium area of the building had an exposed steel ceiling composed of galvanized three inch vented ceiling deck with structural steel supporting members (photo 1). Light weight insulating concrete was placed on top of the steel deck thus becoming part of the roofing system. The steel beams and angles were to be shop cleaned and shop primed with an alkyd resin rust inhibitive primer. The galvanized deck and support steel were finish painted with an acrylic dryfall material. Within two years of completion, it was noted that areas of the supporting steel had rusted and delamination of the paint was evident.



Photo 1



Photo 2

Accessible areas of the exposed ceiling were visually examined and defects were noted. The 12 inch beams in the ceiling appeared to be the most severely affected surfaces, as delaminating paint and corrosion were evident (photo 2). The slotted areas of the corrugated deck were also corroded and discolored. The tops of the 30 inch beams had some corrosion, but none was noticed on the face or bottoms of these beams. Only minute areas of discoloration were noted on pipes in the ceiling area.

Upon closer inspection, it was noticed that where the deck was vented corrosion was present on the steel below as shown by the red arrows in photo 3. However, the blue arrows in that photo point to areas where no rust occurs on the beams where a solid rib is above. Small, highly alkaline stalactites were present at slots in the deck.

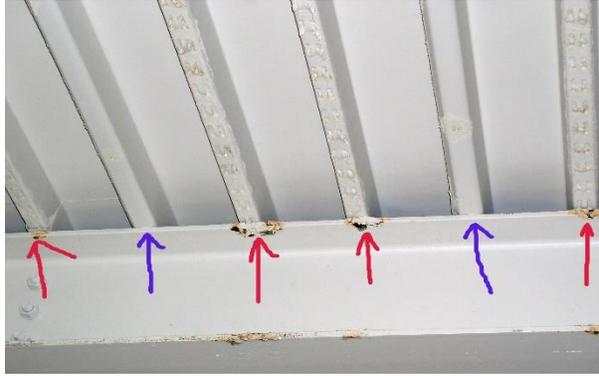


Photo 3

The adhesion of the paint to its substrate was tested in accordance with ASTM standard D3359, Adhesion by Tape Test. Incisions were made through the coating in a grid pattern. The specified adhesive tape was firmly applied to the area and then sharply removed. The adhesion of the coating was then evaluated by the amount of paint that was removed. The adhesion of the paint was found to be "poor" at locations immediately adjacent to visible delamination and discoloration. However, the adhesion of the paint and primer were found to be "good" at other locations where defects were not noted. In fact, the paint could hardly be scraped off with a knife blade.

The pH on the surface of the paint was measured by marking the area with a pH pencil, moistening the area with distilled water, and comparing the color to the pH chart. The pH of the substrate immediately beneath the painted surface was determined in the same manner after carefully removing the paint. The pH was found to be highly alkaline (readings of 12 and 13) at areas of paint delamination. The high pH readings were present both on the surface of the delaminating paint and beneath it. At locations where no delamination was present and the adhesion of the paint was "good", the pH readings were in the normal range of 7 to 8.

Delaminated paint chips were examined with a microscope. It was found that the rust inhibitive primer had become very friable and easily disintegrated (photo 4).



Photo 4



Photo 5

An area of unpainted ceiling deck above an acoustical tile ceiling was also examined. As shown in photo 5, corrosion was apparent at slotted portions of the corrugated ribs at these unpainted areas.

A wet sample of rust inhibitive primer and the delaminated paint chips were tested to determine if the cause of the degradation of the primer was saponification. Saponification is the chemical degradation of a coating due to high alkalinity and moisture. The coating becomes "sticky", then brittle when dried and loses its adhesion. The testing confirmed that saponification of the primer had occurred.

The cause of the saponification was highly alkaline salts that were dripped onto the support steel through slots in the deck and at junctures where two pieces of deck overlap. Alkyd resins such as that used in the rust inhibitive primer are particularly subject to saponification. The degradation of the primer resulted in spontaneous paint delamination and corrosion.

It was not determined whether this excess moisture was due to roof leaks or retained moisture in the concrete above the deck. Prior to repainting with a high performance system, it was necessary to determine that the concrete above the deck had sufficiently dried out and that the alkalinity was neutralized.