WHAT LIES BENEATH - PLANT ROOM SLAB CORROSION

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Synopsis: This paper discusses mechanisms of corrosion found in plant rooms as published in the project profile "Problems with Plant Rooms" in the October 2010 issue of Corrosion & Materials with additional details of the electropotential surveys and other case materials. Plant room slabs can experience sheet-style delamination as a first sign that maintenance is required. This issue relates to their purpose, housing a concentrated array of mechanical/electrical and plumbing fittings, in combination with aggressive conditions relating to use of cooling tower chemicals. Common mechanisms of corrosion initiation include the leakage and "windage losses" of treatment chemicals and brackish water concentrates sprayed onto the slab and surrounding metal items. Copper pipes in direct contact with slabs subject to wetting are also a cause of aggressive galvanic corrosion with reinforcement donating electrons to copper. Diagnosis of the extent of corrosion is explored in a case study using electro-potential mapping, with the finding that a 50% corrosion probability related to in-situ corrosion confirmed during breakout. A repair case study and the rationale behind it from a structural perspective is given. The inadvisability of relying on patch repair strategies is discussed. Given the likelihood of future maintenance well within the 50 year lifespan of the building, some observations are made on the placement of plant room slabs enabling maintenance inspections.

Keywords: cooling tower, plant room, corrosion, slab

1. Introduction

Plant rooms containing cooling towers can be open to the elements or enclosed for soundproofing and house other items such as generators and electrical cabinetry. These are often accommodated on a suspended slab at roof or podium level above other facilities such as kitchens and bathrooms. This configuration enables shared ducting for plumbing and electricity, and facilitates ducting of cooled air back through the building. The plant room is often centrally located near the lift core.

The corrosion scientist Tutti[1] has highlighted the exponential nature of damage over time from corrosion of reinforcement, classifying the limit states as being T1 initiation of corrosion, T2 initiation of first cracking, T3 loss of concrete section, T4 loss of steel section and T5 loss of structural integrity.

Two highly trafficked areas affected by large spalls which have been investigated recently include a kitchen of an office building (case study 1) and the public toilets in a shopping complex (case study 3). Case study 2 examples how windage losses have contributed to slab contamination, rusting affixed metal plant. In cases 1 and 3, disguised by a ceiling and apparently in good condition on the top side, the first evidence that the overhead floor required maintenance was larger sheet-style delaminations (T3) beneath, with mass loss of slab reinforcement (T4). Apart from risk to occupants, immediate loss of amenity was experienced.

From a capital investment perspective such areas represent the most expensively fitted out square meterage of the building. The visual impact of propped concrete causes stress to tenants with resulting pressure on rental returns. This article highlights aspects of diagnosis and repair, with some comments on preventative strategies in design.

2. Diagnostics

Case study 1 concerns an outdoor cooling tower room of pit dimensions 2.9 x 4.7 metres (Figure 1), the first symptom of an issue for building managers was a spalled piece of concrete found in the ceiling cavity. Preliminary inspection from the soffit side found that the slab had cracked along its length, and apart from the original spall, a piece of size approximately 1.8 x 0.9 m was loose. The area was immediately cordoned off and the soffit propped by the conclusion of the inspection (Figure 2).