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Strengthening and Repair of a Precast Reinforced Concrete Residential Building

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Abstract

The deterioration or ageing of the existing infrastructures coupled with increased safety requirements necessitate immediate strengthening. Developing long lasting and cost effective repair techniques and materials continue to capture the attention of concrete professionals worldwide. The main purpose of this investigation was to extend the life span of a multi-storey precast reinforced concrete structure built in Riyadh 40 years ago. The condition assessments relied on analytical tools, visual, field and laboratory experiments for core samples collected from the building. The analytical checks of the building revealed considerable deflections of some slabs because of design error. The field and chemical analysis tests performed, confirmed the occurrence of durability defects as a result of poor workmanship during the construction stage. Several state-of-the-art repair techniques and materials were used for enhancing the service life of the structure at a minimum cost. The Repair strategy implemented included, removal of the deteriorated concrete, pouring a bonding agent on the surface of the damage, followed by injecting high strength cementitious grouts, supporting the deflected slabs using I-section steel beams, using cathodic protection to prevent corrosion, strengthening the columns and beams using carbon fiber reinforced polymer (CFRP) sheets, and steel jackets.

Keywords: Steel Corrosion; Precast Concrete; Cement Grout; Repair; Cracks; Buildings.

1. Introduction

Usually concrete structures show different types of defects during their lifetime starting from fine plastic shrinkage cracks to deflection problems that may lead to collapse in some cases. Despite the precautions and safety factors taken during the design stage, execution process, and usage of the facility, defects continue to appear in many parts of the structure. Once the diagnosis and the root causes of those defects are defined clearly, they are more likely to be prevented by choosing the most appropriate repair techniques available. ACI committee 546 [1] proposed the following steps for maximizing the service life of deteriorated concrete structures: condition evaluation, determination of the causes of deterioration, selecting repair methods and materials, preparation of drawings and specifications, execution of the work. The emphasis of material selection for structural repair has shifted towards inhibiting renewed corrosion of steel in the repair patch and preventing initial corrosion, [2]. The corrosion of reinforced concrete (RC) has always been an issue of great concern for concrete practitioners and researchers worldwide. Reinforced concrete structures are corroded due to several environmental factors, such as chloride, carbonation and temperature. Reinforcement corrosion is one of the most serious durability problems that requires urgent solutions throughout the world. In United States, approximately 15% of the nation's bridges are structurally deficient due to steel corrosion. In North Africa, and in the Middle East, some buildings have been destroyed because of steel reinforcement corrosion,

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