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Repair Techniques in RCC Structures

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ABSTRACT

This paper reviews works on repairing techniques of deteriorated reinforced concrete structures. Cement concrete reinforced with steel bars is widely popular construction material. One major flaw, namely its sensitivity to environmental attack, can severely reduce the strength and life of these structures. These structures will provide speed, quality and economy in site construction. In RCC structures, we have freedom of design, quality and final appearance. Every structure is made/designed for a specific type of loading and different types of environments. Hence after some time these structures gets deteriorated and needs repairs in order to get their strength [1]. In this paper, we focused on various types of materials and techniques used for repairing of RCC structures such as Grouting, Guniting, mortar, concrete spraying (shotcrete), epoxy, Ferro cement mixed with mortar.

Keywords- *Deteriorated, epoxy resin, mortar, repairing, reinforced concrete structures, shotcrete.*

I.INTRODUCTION

RCC stand for Reinforced Cement Concrete. RCC is a concrete that contains steel bars, called reinforcement bars, or rebar. This combination is highly effective, as concrete is very strong in compression, easy to produce at site and inexpensive while on the other side steel is very very strong in tension. RCC structures gets deteriorated during its lifetime. Every year thousands of successful RCC structures are constructed worldwide but even though some structures fail due to inadequate design, construction, quality of material used, overloading, chemical attacks, rebar corrosion, settlement of foundation, natural disasters, etc. Hence it is essential to restore the strength of concrete structures by assessing and repairing of damages and defects. The success of repair activity depends on the identification of the root cause of the collapse of the concrete structures. Construction chemicals/Polymers came into existence in the world of concrete during the late Sixties.If this cause of deterioration is properly identified, satisfactory repairs techniques can be used for the improvement of strength and durability, thus extending the life of the structure, is not difficult to achieve. Many countries are trying to find new techniques of repairing to save money and increase safety, even for historic monuments.

FACTORS AFFECTING THE RCC STRUCTURES

RCC structures get deteriorated during its lifetime which somehow decrease the strength of the structure which leads to the loss of life & economy. The various causes for such damages or defects or deterioration can be many such as

Site selection and site development errors

Site should be selected after studying factors like seismic activities, coastal region and flood plains. Some other site problems are related to soil condition such as expansive of soil or permafrost in cold region [2]. Failures may occur if proper investigation is not done on the site before starting the construction.

Design errors

Many structuresfail due to error in their design concept. Some failure includes error in concept, incorrect load calculation, types of load, material durability, bad quality of material used, lack of structural redundancy, calculation errors, insufficient knowledge of computer software and inadequate specifications for materials.

Material deficiences

Most problems with material are due to human errors. It involves lack of knowledge of material, lack of testing knowledge, not following the proper mixture of the material, which effects the serviceability of the structures [2].

Construction errors

Construction errors arises due to excavation and equipment accidents, removal of formwork before time, excessive construction loads, improper temporary support to the formwork. All these constructions errors will affect the structure properties hence needs repair to meet the given requirements.

REPAIR TECHNIQUES FOR RCC STRUCTURES

Every structure is designed with proper calculation and designing requirements given in IS code. Even though due to some errors or damages, these structure needs repairs as reconstruction of new structure is very costlier process and also time consuming. Hence various repair techniques are used to repair the deteriorated structure that is economical to meet the designing requirements. These techniques are discussed below:

EPOXY INJECTION

This method is suitable for repairing of cracks that are narrower than 0.002 inch (0.05mm). Cracks in concrete are bonded by the process of injection in which epoxy bonding compound is injected under pressure. Epoxies have higher dimensional stability. Epoxies does not melt i.e. they have thermosetting properties [3]. This method is used to repair of cracks in building, bridge, dams and tunnels. Wet cracks are injected by using moisture tolerant materials. This technique requires high skilled labour with high tech instruments.

GROUTING

Grouting is a process of filling the cracks or voids under pressure in concrete or masonry structural member to change its physical characteristics. Grout is a flow able plastic material with negligible shrinkage to fill the voids completely. In this technique Grouting machine, mixture (cement, sand, water) are used to fill the cracks and voids in the structure. Grouting is suitable where soil permeability creates a very heavy demand on pumping [4]. Various methods for grouting are:

- ***Compaction grouting***

  Compaction Grouting is also known as Low Mobility Grouting. Compaction Grouting involves injection of low mobility grout with the help of drill casings that are drilled or driven to pre-set depths. The grout, usually consists of cement, sand, fly ash and water, is placed from the bottom-up with pressure-based

criteria [2]. After each consecutive stage, the drill casing is lifted upwards to the point till it is entirely taken out.

- ***Permeation grouting***

  Permeation grouting which is also known as penetration grouting. It is the most common and conventional grouting method to repair the deteriorated structure. It involves filling of any cracks, joints or voids in rock, concrete, soil and other porous materials. The objective is to avoid without displacing the formation or creating any change in volume or configuration in the medium. This is typically useful to strengthen the existing formation, creating an impermeable water barrier or both.

- ***Fracture grouting***

  Fracture grouting also known as compensation grouting. In Fracture grouting, a low viscosity grout that splits through the ground by hydraulic fracturing is used which penetrates into the fractures. The insitu soils are displaced and soil immediately next to the fractures are densified, but to a lesser extent as compare to the compaction grouting.

JACKETING

Jacketing is the most popular method used for strengthening of columns. Jacketing consist of adding concrete with transverse and longitudinal reinforcement around the existing column. It helps in providing strength to column. Jacketing increases the seismic capacity of column. Frame is added around the existing column and then is poured with concrete. The grout used is having a cement-sand ratio by volume, between 1:2 and 1:3.

ROUTING & SEALING

Routing and sealing of cracks in concrete can be used for dormant cracks not involving the restoration of tensile strength of the structure. In this method the crack is expanded along its exposed face to form a V-shaped groove up to a minimum width of 6 mm and a depth of 6 to 25 mm and sealing it with a joint sealant. This method is commonly used for both fine pattern cracks as well as large isolated cracks but dormant cracks. [5]

SHOTCRETE

Shotcrete is high performance concrete sprayed on a surface under suitable pressure through a hose at high velocity. Shotcrete is used in repair work of various structures such as bridges, buildings, tunnels and marine structures. It is primarily used for beam repairs of variable depths, abutments, damage caused by fire or earthquakes.

II.CONCLUSION

The repair of RCC structures is very challenging work. It can be concluded that if proper care and supervision is taken then the formation of cracks can be prevented and if the formation still occurs then proper suitable repair technique is taken into action. Epoxy injection technique is one of the suitable and best techniques used. If properly used to treat cracks then epoxy treatment serves well as compare to other techniques to repair the damaged parts. To modify or improve the properties of concrete, a large number of different

polymers/admixtures have been tried and tested and extensively used in other countries. After analyzing the different types of damages or defects in building, we can apply the appropriate repair methods which are described above i.e. Guniting, Routing and Epoxy Injection, Shotcrete, Jacketing. Honey combing and bug hole like surface defects requires immediate repairs.

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