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Review on Experimental Study on Effect of Corrosion In Reinforced Concrete Fly-Ash Beam

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ABSTRACT

In modern days for structures in coastal areas it has been observed that the premature structural failures are occurs due to corrosion of the reinforcements of the designed structural member. The corrosion causes the structural damage which in turn leads to reduction in the bearing capacity of the concerned structural members. The aim of this study was to study the effect of partial replacement of fly ash to minimize the corrosion effect. Beams were designed and corroded by using artificial method known accelerated corrosion method. The beams were then tested for flexural and bond strength. Also the weight loss of the reinforced bars was been determined using electrical resistivity method. The fly ash will replace by 10% and 15%.The strength will calculate at varying percentage of corrosion at 10% and 15%. Beams will cast at M25 grade concrete. The flexural strength will test by using UTM and the bond strength will calculate using pullout test.

Keywords : Fly-Ash, Corrosion, Concrete, Reinforcement.

I. INTRODUCTION

In today's infrastructural world there is a growing use of steel bars for in the form of reinforcements in concrete structures. Thus, the major enormous growing problem of corrosion of these reinforcements. It leads to a major failure of concrete structures. The initiation of corrosion is started by cracking of concrete and breaking of concrete (i.e spalling of concrete). To avoid or minimize such type of failures good quality of concrete is to be used. The corrosion is initialized by the lowering of alkalinity or in some cases it may be also caused by the attack of chloride ions. High quality and durable concrete is necessary in reduction of deterioration of the concrete in these environmental conditions If the reinforcement in these concrete structures start corroding it creates a expansive force due to increase in the volume of steel which in turn ruptures the concrete. Thus,once the cracks are formed it causes the corrosion rate to increase rapidly leading to the failure of the structure. Thus, corrosion is the major problem of the concrete structure induced in embedded bars. Also the second most factor for causing corrosion is the carbonation that is caused due to the reaction of carbon dioxide with cement hydrates. Many times the normal structural element is subjected to early corrosion because of all the above factors. So it created the necessity to find out a way to counteract this corrosion problem.

II. LITERATURE REVIEW

1. Shamsad Ahmad(2009) et.al In this paper, an attempt has been made to firstly describe the

impressed current technique commonly used for accelerating reinforcement corrosion in small- as well as large-sized concrete specimens in the light of state-of-the art information available in the literature. Then the procedure for calculating degree of induced corrosion in percentage by mass and in terms of average corrosion current density using the intensity and duration of the applied current is presented. The effectiveness of the applied current in inducing reinforcement corrosion, guidelines for effectively using the impressed current technique, and some of the alternative techniques for inducing accelerated corrosion of steel in concrete are also described in the paper. Corrosion of steel in concrete is a slow process. Due to the protective nature of concrete, it takes a reasonably long time for initiation and progress of reinforcement corrosion even in the case of severe corrosive exposure conditions.[1]

2. Ahmed K El-Sayed, Raja R Hussain, Ahmed B Shuraim(2016) et.al The effect of stirrups damage due to corrosion on the shear strength and behavior of reinforced concrete beams was experimentally investigated. A total of fourteen full-scale reinforced concrete beams were constructed and tested under four-point bending up to failure. The test beams were 200 mm wide, 350 mm deep, and 2800 mm long. The reinforcing stirrups of nine of the beams were subjected to accelerated corrosion prior to structural testing. The test variables were the corrosion damage level, spacing of stirrups, and shear span to depth ratio. The beams were tested under shear span to depth ratio of 2 or 1 representing short or deep members. The test results indicated that the corroded beams exhibited degradation in stiffness and shear strength in comparison to the uncorroded control specimens. This degradation appeared to increase as the corrosion level increases and as stirrup spacing as well as shear span to depth ratio decreases.[2]

3. Akshatha Shetty, Katta Venkataramana and K. S. Babu Narayan(2014) et.al Corrosion is one of the main causes affecting durability of structures. Corrosion effects on structures cannot be ignored and replaced. To understand the performance of structures there is a need to study the rate at which different corrosion levels occur. Hence the present investigation has been taken up to study the behavior of NBS (National Bureau of Standard) beam specimens made up of Ordinary Portland Cement (OPC) and Portland Pozzolana Cement (PPC) concrete matrix were subjected to accelerated corrosion for different corrosion levels of 2.5 % to 10 % at 2.5 % interval. Results are compared with those for control beam specimen. It is observed that bond stress value decreases with the increase in corrosion levels. Also corrosion leads to the decline of load carrying capacity.[3]

4. Khaldoun N. Rahal(2011) et.al A simple method for predicting the ultimate strength and mode of failure of reinforced concrete beams subjected to pure torsion is presented. This method is an extension of a recently developed method for predicting the strength of membrane elements subjected to pure shear that was also applied to beams subjected to combined shearing forces, bending moments, and axial loads. The torsional strength is related to the amounts of transverse and longitudinal reinforcement and to the concrete strength. To check the adequacy of this simple method, the calculated strength and mode of failure are checked against the experimental results of 66 beam tests available in the literature, and good agreement is found. The simplicity of the method is illustrated by an example. [4]

5. Naga Chaitanya , Vamsi Krishna(2014) et.al Reinforced concrete beams are normally designed as under reinforced to provide ductile behavior such as the tensile moment of resistance. In coastal

environment reinforcement corrosion is an obvious cause of deterioration of concrete structure, which affects the durability and service of reinforced concrete structure. Structural stability is majorly influenced by strength of concrete. Flexural strength is a measure of the tensile strength of concrete, in other words it is a measure of a resistance against failure in bending. The main aim of this study is to analyze the strength, experimentally; of corroded beams using Ordinary Portland cement. Accelerated corrosion technique was adopted to corrode the beam experimentally. The corrosion was measured using Applied Corrosion monitoring instrument. Beam specimens are prepared using M20 grade concrete for OPC. Beam specimens casted are tested as vertical cantilever beam in specially prepared loading setup and load deflection behavior is studied.[5]

6. A. Aryanto & Y. Shinohara(2012) et.al Bond is one of the main keys to assess the performance of reinforced concrete (RC) structure against seismic load. In this paper, the bond behavior including bond stress, crack propagation, crack spacing and tension stiffening of tension RC members was experimentally investigated under certain levels of corrosion of reinforcing steel. Seven cylindrical specimens having 19mm bar diameter and 2.8 cover to bar diameter ratio were prepared and tested under simulated corrosive environment. The corrosion level was ranging from 0% to 4% in mass loss. In low level corrosion up to 1% of corrosion level, the bond stress increases causing a decrease in average crack spacing. For higher corrosion levels the decrease of average crack spacing is attributed to the decreasing of concrete tensile strength caused by cracks around corroded bar. A simple analytical formula has been proposed to predict the mean crack spacing of corroded tension members. [6]

7. Mohammad Rashidi, Hana Takhtfiroozeh(2016) et.al Many structural elements in building and bridge construction are subjected to significant torsional moments that affect the design. A simple experiment for the evaluation of the torsional strength of reinforced concrete beams as a one of this structural elements is presented in this research. The objective of this experiments would be the role of transverse and longitudinal reinforcement on torsion strength. Four beam test samples has been tested with the same length and concrete mix design. Due to the fact that the goal of this experiment is to determine the effect of reinforcement type on torsion strength of concrete beams; therefore, bars with different types in each beam have been applied. It was observed that the ductility factor increases with increasing percentage reinforcement from the test results. It should be also noted that transverse bars or longitudinal bars lonely would not able to increase the torsional strength of RC beams and both of them can be essential for having a good torsional behaviour in reinforced concrete beams.[7]

8.Needa Marwan Lingga(2016) et.al Severe premature deterioration has been reported in a large number of reinforced concrete (RC) structures in corrosive environments. Many concrete structures built in the past few decades are already showing signs of deterioration due to the corrosion of steel reinforcement. This premature deterioration can diminish structural integrity and safety of the structure. There are several options available for retrofitting the structural members of existing reinforced concrete (RC) structures. Basics of corrosion and accelerated corrosion technique are mentioned in details in this research. [8]

9. Suresh Bhalgamiya, Govind Tivadi, Mehul Jethva(2018) et.al Concrete durability is an important design criterion, which must be assessed for every type of structure. Reinforcement corrosion has widely reported in literature over last two Decades. It is one of the major durability problems, mainly when

rebar in concrete is exposed to the chloride either contributed from the concrete ingredients or penetrated from surrounding chloride bearing environment. Corrosion of steel in concrete is a slow process. Due to the protective nature of concrete, it takes a reasonably long time for initiation and progress. The assessment of causes and extent of corrosion is carried out using accelerated corrosion techniques. The diffusion of chlorides is recognized as one of major responsible of corrosion phenomenon start. This report presents study on the mechanism of reinforcement corrosion, different Corrosion test utilized to monitor reinforcement corrosion. Methodology that utilized for assessment of Rate of corrosion is discussed. In this report, an attempt has been made to firstly describe commonly used accelerating reinforcement corrosion test and corrosion development of reinforcement bar in concrete by employing accelerated corrosion test, causes of reinforcement corrosion is discussed including carbonation and chloride ingress.[9]

10. Chhabirani Tudu(2012) et.al Fiber Reinforced Polymer (FRP) as an external reinforcement is used extensively to deal with the strength requirements related to flexure and shear in structural systems. But the strengthening of members subjected to torsion is explored only recently. Torsion failure is an undesirable brittle form of failure which should be avoided specially in the earthquake prone areas. In the present work, the behavior and performance of rectangular reinforced concrete beams strengthened with externally bonded Glass Fiber Reinforced Polymer (GFRP) fabrics subjected to combined flexure and torsion is studied experimentally. Rectangular RC beams externally bonded with GFRP fabrics were tested to failure using an arrangement which transfer torque to the central part of the beam through two opposite cantilevers called moment arms. Each arm is subjected to equal static loading during the experiment. Total nine RC beams were cast and tested for the study. All the beams were designed to fail in torsion.[10]

11. Adheena Thomas, Afia S Hameed(2017) et.al When the load was acting away from the resultant force from the shear center axis, combined action of bending and torsions occurs . The present investigation aims to study the combined action of flexure and torsion for which two beams are casted. The test set up is specially fabricated for applying combined torsion and bending. For the study, Crack pattern, load- deflection characteristics, torquetwist response have been taken of those specimens. Objective of study is to study the combined flexural and torsional behavior of RC beams experimentally.[11]

12.C.D.Atis(2013) et.al The fly ash mix proportions at various levels have been provided in this paper. Fly-ash as an corrosion reducer agent is been promoted. The paper gives the idea about the changes brought about by the mixing of fly ash in the mix.[12]

13.Ashutosh S.Trivedi, R.P.Sharma, Sarvesh K Jain, S.S.Bhadauria, Abhishek Tiwari(2017) et.al This paper examines various aspects of corrosion of reinforcement embedded in concrete by various factors like moisture, permeability pH and temperature etc and also their corrosion control methods.[13]

14. P. R. Wankhede et.al experimentally studied that the exploration finishes up the examination on the impact of fly fiery debris on the properties of concrete for ostensible blend of M25 evaluation of cement. Droop loss of solid increments with increment in w/c proportion of concrete.[14]

III. CONCLUSION

- By studying above research papers it is observed that The steel reinforcement may be corrode faster than sand used concrete samples.
- It is subjected to different curing condition such as sea water and portable water.
- The steel reinforcement in the concrete sample subject to sea water curing corroded faster than portable water curing and also in the basis of percentage of fly ash used in different curing condition.
- Manufactured sand is good as fine aggregate for fly ash replacement reinforced concrete.
- The partial replacement by fly ash increases the compressive strength for 10% and 15% fly ash replacement respectively.

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