Study of Bond Strength in Different Corrosion Condition.

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Abstract- The reinforcing steel corrosion is an important issue of construction industry as corrosion is one of the major cause of structure failure. Furthermore, it has turn out to be financial trouble to many government agencies aslot of public money is wasted due to this corrosion. From the literature present, we know that the iron in the steel has natural affinity to revert sooner or later to its most stable oxide state, so once initiated, it becomes complicated to completely dispose of the corrosion .The adaptation of corrosion defense procedures in new construction such as use of superior design and construction practices, enough concrete cover depth, low permeable concrete and coated reinforcing steel, use of pozzolanic materials such as fly ash in concrete, proper water cement ratio and coated reinforcing steel helps in avoidance of steel reinforcing corrosion to huge extend. In this paper review of various papers is presented, steel corrosion can be tested by various methods it can be physical or chemical different research work used different methods to detect cause and extent of corrosion. When corrosion of steel reinforcement is studied properties and composition of concrete is unavoidable as steel has to remain in contact with concrete ingredients. Early recognition of the corrosion process could facilitate limit the location and extent of required repairs or replacement, as well as reduce the cost related with remedial work..

Keywords- Corrosion, Reinforced Concrete, Reinforcement Bars, Impermiability, w/c Ratio, Moisture content, Cracks, Damage, Potential.

I. INTRODUCTION

Concrete is basically the most important material concerning with the construction and infrastructural procedure , for which it should be of good strength and durability. Now a days large and complicated structures are being constructed and advancement are made for their construction And maintenance failure of building became a worst issue faced by the civil engineers.the failure of reinforced concrete (RCC). Structure may be due to primaril deterioration of the bond. Many experiments and development had made to maintain proper bond between steel and concrete .The main idea of this study is to evaluate the bond strength for reinforcing Concrete with corrosion that it can damaging R.C bond. Pullout tests carried out to evaluate the effects of corrosion on bond for that purpose a series of specimens with varying reinforcement corrosion levels tested.We are use different corrosive rods in concrete to get bond strength by pullout test .

II. LITERATURE SURVEY

1. Yousif A , Mansoor The shape of bond strength curves for bothcorroded and control specimens are similar: the bond strength initially increases up to a maximum value, but eventually decreases for greater levels of corrosion. Also, the bond strengths of corroded specimens are less than those of post-corrodedspecimens.For deformed bars, bond strength was very sensitive to corrosion levels and generally decreased with the corrosion level. Bond strength decreased rapidly as the corrosion level increased; bond strength at 2% corrosion was only one third of that of control specimens. The exception is that when the corrosion level was very low, when bondstrength increased as the corrosion level increased. For deformed bars with confinement, corrosion had no substantial influence on the bond strength. For steel bar, bond strength increased as corrosion level increased, up to a relatively high degree of corrosion. The increase in bond strength could be observed even at a corrosion level of more than 5%.For C30-10 results show there are reduction with bond strength around 22% for 4 days corrosion, 25% for 6 days corrosion and 31% for 8 days corrosion. While for C30-14 results show there are reduction with bond strength around 19% for 4 days corrosion, 23% for 6 days corrosion and 28% for 8 days corrosion.The measured failure load was generallylowerthan the control ones. The difference in resultsindicates that the corrosion rate reduced the bond

strength for steel bar with concrete.There are three failure types observed in a pullout test. The first failure occurred when the test bar reaches a peak load and then proceeds to pull out from the block without splitting any face of the concrete. Second failure, a splitting failure was occurring when the bar reaches a maximum load, and then a crack opens parallel to the applied force on the front face of the block as the bar pulls out. This splitting can happen suddenly or gradually (both observed). The last type of failure is bar yielding, when the bar reaches a load higher than the load required to cause yielding. While technically a yielding bar is not a failed specimen, in most cases if a bar was visibly yielding the test would be cut off to prevent damage to the system that was possible with bar fracture. Because of this, the peak load must be considered separately from splitting or pullout type failures. The results show the steel bar diameter had linear impact on the load displacement behavior with different corrosion duration. Corrosion can reduce both the elongation and the ratio of yield to ultimate strength of the reinforcement at maximum load. These reductions can be leaded to premature fracture of the bar before yield is reached for that there are no general relationships for this situation.

2. Ganesh Mahalle , Shabnam Khan The maximum bond stress of concrete after replacing cement with lime sludge was found to be 8.09 N/mm2 and 12.26 N/mm2 for 7 and 28 days respectively.The optimum workability of concrete was found to be at 2%.The waste product form by BGPPL i.e. lime sludge can be used in concrete which can reduce soil pollutionThe use of plastic fibers helps to reduce the bleeding and segregation of concrete.The use of this waste can enable for low cost construction works.

3. Ganesh Mahalle □ The maximum compressive strength of concrete after replacing cement with lime sludge was found to be 9.91 N/mm2 for 7 days and 29.46 N/mm2 for 28 days at proportion of 10%.The maximum compressive strength of concrete after replacing water with Pulp Black Liquor was found to be 23.00 N/mm2 for 7 days and 45.69 N/mm2 for 28 days at proportion of 4%. The maximum compressive strength of concrete after replacing cement with lime sludge and use Pulp Black Liquor as admixture was found to be 17.75 N/mm2 for 7 days and 39.29 N/mm2 for 28 days at 10% lime replacement and 1% PBL as admixture.The optimum workability of the concrete was found to be at 10%.The waste products i.e. lime sludge and PBL can be used in concrete which can reduce soil pollution.The use of this waste in concrete can enable for low cost construction works.

4. **Y. Zhao, H. Lin** In the past several decades, a great deal of research effort has been devoted to the understanding of the deterioration of bond behavior due to reinforcement corrosion. As a result, numerous experimental investigations have been conducted by researchers worldwide. This paper has presented a comprehensive review of the existing studies regarding the bond deterioration of specimens subjected to monotonic or repeated loading, where the influence parameters have been discussed and the empirical models for bond strength or bond sliprelationship have been summarized. Based on this study, the following conclusions can be drawn:- The deterioration of bond strength is closely related to the confinements, the corrosion conditions of stirrups and the corrosion rate. However, none of the current models for bond strength can well reflect the influence of the parameters, except the one proposed by the authors. Further studies are still needed with respect to the deterioration of bond strength under different corrosion current densities or natural corrosion. Although several empirical models that bridge the surface crack width with bond strength of corroded reinforcement have been developed by researchers, more bond tests are still needed to further improve and validate the effectiveness of these models.Researchers have contradictory findings on the bond-slip relationship of corroded reinforcement. More bond tests are required to further explore the influence of corrosion on bond-slip mechanism, bond stiffness, rupture slip and frictional bond stress. Repeated loading can worsen the bond deterioration induced by corrosion, which is characterized by the progressive formation of residual slip. Models for bond-slip relationship and bond fatigue life have been developed by the authors, but these models should be further improved to consider the influence of more factors such as the confinements, the bond length and the loading scenarios.

5. **Adel A. Elbusaefi** The compressive strength and splitting strength of concrete for all concrete mixes were affected by the cement replacement material, this is also confirmed by Megat Johari et al. (2011) and the influence of further cement hydration on the concrete strength increase with curing age.The corrosion levels of the steel bar in different concrete mixes appear to follow a similar trend, where an increase in corrosion level was observed with increasing corrosion exposure time, as said by Abosrra et al. (2011) and the magnitude of increase in corrosion level for the SF and PFA mixes was less than the other concrete mixes due to a more dense concrete and high electrical resistivity.It was found that the bond strength of the corroded specimens depended on the corrosion level and the concrete strength. The higher the compressive strength, the higher the bond strength and there was no significant influence of the presence of cement replacement materials on the bond strength as confirmed by Fang et al. (2006).

6. **Engg. Charles Kennedy** Experimental resultsshowed the following conclusions:Lower percentile values were recorded in corroded while control and artocarpus altilis exudates/ resinscoated specimens have higher values, especially in coated members. Results vindicated the negative andpositive effects of corrosion on the strength capacity of corroded and coated members.Summarized results showed higher values of pullout bond strength in control and exudates/ resins coatedto corroded specimensiv.Bond test results showed, bond stresses experienced exudates /resins coated reinforcements are higher compared to the controlled specimens.

7. **Ashutosh S. Trivedi, Arpit Singh Bhadoriya, Manoj Sharma** This paper provides the overview on corrosion of steel reinforced structures. In result of study of various papers it is observed that steel has high affinity towards corrosion if steel comes in contact with moisture various chemically active substances present in concrete also play great role in corrosion of steel embedded in concrete and extent of it these substances can be oxides of different metals. Chloride content of concrete also plays significant role in rebars corrosion. Various properties of concrete like porosity, w/c ratio, pH value, compaction, curing, cement content etc. also affects corrosion in reinforced concrete hence these parameters can be studied in detail so that their relation with reinforcement bars corrosion can be examined in detail which can help in controlling the corrosion damage of RCC structures.

8. **Hakan Yalciner, Khaled Marar** An experimental study was performed using an accelerated corro-sion method and pull-out tests. The developed models were used to predict the bond strength of uncorroded and corroded concrete specimens as a function of concrete cover depths, strength levels, and two different geometries of reinforcement bars. The test results showed the following:- In the case of the uncorroded specimens, there were no signifi- cant increases in the bond strength with increasing concrete cover depth due to the provided confinement effect of hooked reinforcement bars. At the same concrete cover depth, the bond-strength values for HKS were less than the obtained bond-strength values for HK. The development length of HKS increased the forces on the concrete, resulting in longitudinal and radial crack components.Increases in bond strength due to the corrosion of HK and HKS were approximately 0.55% of the corrosion level for the lower strength level of concrete. The cracking of concrete of two geometries of reinforcement bars (HK and HKS) was greater than that of conrete with reinforce- ment bars without hooks. This was due to the increased radial stress on the concrete surfaces by hooked reinforcement bars. Reduction in the bond strength due to corrosion was greater for HKS concrete specimens compared with HK concrete specimens. The crack width of the higher strength level of concrete due to corrosion was greater than that of the lower strength level of concrete with a higher corrosion level. At the same concrete cover depths, increases in the bond strength occurred at lower levels of corrosion for the lower strength level of concrete. This was due to the confined corrosion products by the higher strength level of concrete.

9. **Konstantinos Koulouris and Charis Apostolopoulos** In the current manuscript, an extensive experimental study was conducted on RC elements,where the influence of steel bar's corrosion damage and stirrups spacing on bond behavior between steel and concrete was investigated, in function with the average width of surface concrete cracking.Corrosion of the main steel bar causes surface concrete cracking, the width of which is closely related to the existence and densification of stirrups. The increased density of stirrups, on the one hand, contributes to the reduction in the range of surface cracking and on the other hand, to the reduction in the bond loss rate in corrosion conditions.In non-corroded conditions, the use of wide stirrups (Φ8/240 mm) enhances the bond strength, in uncorroded conditions, by about 36% in comparison with a group of specimens without stirrups. However, in corrosion conditions, an 8.5% mass loss of reinforcing bar leads to about a 60% reduction in bond strength compared to those of uncorroded specimens.Specimens with quite dense stirrups (Φ8/120 mm) indicated higher bond strength values in non-corroded specimens, and bond strength degrades by about 32% due to an 8.5% mass loss.Dense stirrups spacing, specimens with Φ8/60 mm, ensure a high level of bond behavior, either in terms of bond strength or of residual bond stress, both in uncorroded and corroded conditions.

10. Sachin M Jose, Kavitha P E Accelerated corrosion technique could be used as a feasible method to estimate the rate of mass loss of a steel bar embedded in concrete. The bond stress reduces with increase in the level of corrosion. The reduction in bond stress increases from 18% to 75% when the corrosion level was increased from 15% to 25%.The bond stress increases with the increase in the compressive strength of the concrete. As the corrosion level increases from 15% to 25%, the bond stress increases 7%-19% with the increase in compressive strength from M20 to M40.The finite element software ANSYS could be effectively used to study the variation of bond stress with the change in corrosion levels. The suggested multivariable regression equation could be used to determine the bond stress of the specimens with grades of concrete from M20 to M40 subjected to reinforcement corrosion levels upto 25% with 1-9% variation from the analytical results.

III. OBJECTIVE

The objective of project are as follows:

- To undertake bond test in order to investigate the influence of range of corrosion level on the bond strength of reinforcement concrete manufactured with different cement replacement materials.
- To investigate the effect of the concrete composition and micro-structure, as chaaracterised by the gas relative permeability test on the corrosion resistance and bond strength of RC structure.
- To investigate the relatoinship between the rate of corrosion of reinforcemcent steel and the intrinsic permeability of the concrete.
- To know the bond detorioration due to steel reinforcement corrosion is the most importnt parameter in the loss of bond strength between the steel and the surrounding concrete.

III. METHODOLOGY

1) **Testing on material**
   - CEMENT
     - i. Fineness Test
     - ii. Consistency Test
     - iii. Initial Setting Time
     - iv. Final Setting Time
     - v. Specific Gravity
   - SAND
     - i. Fineness Modulus of Sand
     - ii. Specific Gravity
   - AGGREGATE
     - i. Fineness Modulus
     - ii. Specific Gravity
     - iii. Abrasion Test
     - iv. Impact Test
     - v. Flakiness Index
     - vi. Elongation Index

2) **Mix design proportion. (As per IS:10262-2000)**

3) **Prepare a Mix & Casting.**

4) **Curing.**

5) **Testing of Specimen by Pull Out Test.**

IV.REFRENCES

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