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A Experimental Study on Strength Parameter of RCC Beam Under Accelerated Corrosion Using TMT Steel and Teflon Coated Steel.

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ABSTRACT

Corrosion effect on reinforced concrete is one of major issue in construction industry. Reinforced concrete is widely used in construction industry due to its extensive accessibility. The outcome of steel corrosion includes damages cross section of steel area, cracks in concrete due to increasing expansive pressure, In coastal region due to effect of chloride deterioration of steel is cause which resulting into reinforcement corrosion which affects service and life of RCC structure. The bond strength between the steel reinforcing bar and concrete is thus reduced and the strength of the structure deteriorates. The objective of this study is to investigate the effect of corrosion on flexural strength and shear strength of reinforced concrete beams. We will be using accelerated corrosion technique to induced corrosion on reinforced concrete experimentally in laboratory. Using TMT steel and Teflon coated steel with ordinary Portland cement, beam specimens are casted. Universal testing machine (UTM) will be used for flexural and shear strength behavior analysis. Specially prepared setup will be used for accelerated corrosion method

Keywords: Thermo Mechanically Treated (TMT), universal testing machine (UTM).

Introduction: -

Reinforced concrete (RC) is the foremost wide used building component due to its extensive accessibility. Reinforced materials are embedded within the concrete in such a way that the two materials resist the applied forces along. The compressive strength of concrete and the tensile strength of steel form a powerful bond to resist these stresses over a protracted span. Plain concrete is not appropriate for many constructions works, as a result of it cannot simply face up to the stresses generated by vibrations, wind, or alternative forces. Its utilized in completely different engineering applications worldwide like buildings, bridges, dams, and newly as a foundation system for wind turbine towers. Because of the wide variety of reinforced concrete applications, RC structures are subjected to a range of different environmental exposures as well as marine, industrial, nuclear, and other extreme environments.

Literature Review: -

For this project different papers have been referred and review this paper are from journals related to study about corrosion of reinforcement and flexural strength.

Shamsad Ahmad (2009): 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. It is difficult to achieve a significant degree of reinforcement corrosion in a limited duration available for performing research studies evaluating (i) the loss of bond and loss of load- bearing capacity of corroding reinforced concrete members, (ii) the effect of mineral admixtures in reducing reinforcement corrosion, (iii) the performance of coated or alloyed reinforcing bars against reinforcement corrosion.

Ahmed K El-Sayed, Raja R Hussain, Ahmed B Shuraim (2016): 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.

Adheena Thomas, Afia S Hameed (2017): When the load was acting away from the resultant force from the shear centre 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, torque- twist response have been taken of those specimens. Objective of study is to study the combined flexural and torsional behaviour of RC beams experimentally.

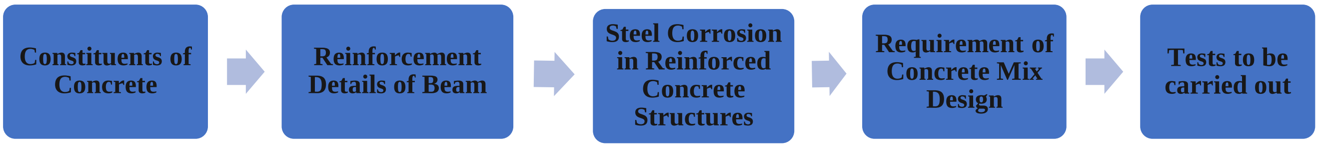
Needa Marwan Lingga(2016): Severe premature deterioration has been reported in a large number of reinforced concrete (RC) structures in corrosive environments. Many concrete structures built in the past few decades are already showing signs of deterioration due to thecorrosion of steel reinforcement. 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. Basic of corrosion including causes of corrosion, process of corrosion, effects of corrosion and retrofitting techniques etc., are referred from this paper. The steel in RCbeams were assumed to be fully corroded, resulting in the most severe loss in steel cross- section and strength.

Santosh Kumar Karri ,G.V.Rama Rao, P. Markandeya Raju (2015): Concrete is probably the most extensively used construction material in the world with about six billion tones being produced every year. It is only next to water in terms of per-capita consumption. However, environmental sustainability is at stake both in terms of damage caused by the extraction of raw material and CO2 emission during cement manufacture. This brought pressures on researchers for the reduction of cement consumption by partial replacement of cement by supplementary materials. These materials may be naturally occurring, industrial wastes or byproducts that are less energy intensive. These materials (called pozzalonas) when combined with calcium hydroxide, exhibits cementetious properties. Most commonly used pozzalonas are fly ash, silica fume, metakaolin, ground granulated blast furnace slag (GGBS)

Gap Finding

- From the literature it was evident that all the studies and test were conducted on concrete with nominal mix design . Considering the present scenario the design mix are upgraded with repalcement of cement with waste by product possessing pozzolanic properties and GGBS is a relatively new approach.
- The behaviour of beams under corrosion studied in the years are reinforced with normal TMT bar so there are lack of study report on beam reinforced with Epoxy coated steel bar.

Methodology



Ground granulated blast furnace slag (GGBS)

Properties of Ground Granulated Blast Furnace Slag IS:16714 (2018

Properties	Result	Required
Fineness	381	320(min)
Specfic Gravity	2.90	2.85
Moisture content	0.028%	1%

GGBS

Cement

Properties of 53 grade ordinary Portland Cement (OPC)as per IS 12269 : 2013

Properties	Result	Required
Standard Consistency	28%	25% to 35%
Initial Setting Time	170 min	60min
final Setting Time	265 min	600min
Fineness of cement	1.18%	10%
Soundness of Cement	1mm	10mm

Compression test results

Compressive Strength of OPC Concrete M 25 Grade cube

Sr.no	Days	Cube 1 (N/mm2)	Cube II (N/mm2)	Cube III (N/mm2)	Average of cubes (N/mm2)	Strength % As per IS 456: 2000
1	7 Days	16.4	17.10	16.60	16.7	65%
2	14 Days	21.7	23.4	23.3	22.8	90%
3	28 Days	26.7	24.8	26.2	25.9	100%

Compressive Strength of GGBS Concrete M 25 Grade

Sr.no	Days	Cube 1 (N/mm2)	Cube II (N/mm2)	Cube III (N/mm2)	Average of cubes (N/mm2)	Strength % As per IS 456: 2000
1	7 Days	17.4	14.8	15.5	15.9	65%
2	14 Days	21.90	24.50	25.30	23.9	90%
3	28 Days	29.10	28.60	27.50	28.4	100%

Three Point Bending Test Results

The normal flexure at 0% corrosionis tested and calculated.. The results obtained are as follows:

Type of specimen	Ultimate Load (KN)	Average Ultimate Load(KN)	Deflection (mm)	Average Deflection(mm)
TMT steel reinforced beam	221.5	216	12.7	12.2
	225.3		11.8	
	201.2		12.1	
Epoxy coated steel reinforced beam	233.4	234	11.1	10.02
	241.5		9.4	
	227.1		9.56	

Bending Moment and Shear Force of 0%corrosion

Type of specimen	**BendingMoment (KNm)**	**ShearForce (KN)**
TMT steel reinforced beam	9.72	108
Epoxy coated steel reinforced beam	10.53	117

The beamsfor further testing are corroded to 15% .The resultsobtained are as follows

Type of specimen	**Ultimate Load(KN)**	**Average Ultimate Load (KN)**	**Deflection(mm)**	**Average Deflection(mm)**
TMT steel reinforced beam	144.2	143.6	8.1	8.2
	145.7		7.9	
	140.9		8.6	
Epoxy coated steel reinforced beam	162.3	160.5	7.9	7.8
	161.8		8.0	
	157.4		7.5	

Bending Moment and Shear Force of 15% corrosion.

Type of specimen	**Bending Moment(KNm)**	**ShearForce (KN)**
TMT steel reinforced beam	6.46	71.8
Epoxy coated steel reinforced beam	7.22	80.25

Conclusion

1. The replacement of cement by GGBS in concrete mix increases the compressive strength by 10% .
2. Bending moment at 0% corrosion increases by 8.3 % after casting specimen with Epoxy coated steel over TMT steel.
3. Bending moment at 10% corrosion increases by 7.39 % after casting specimen with Epoxy coated steel over TMT steel.
4. Bending moment at 15% corrosion increases by 11.76 % after casting specimen with Epoxy coated steel over TMT steel.
5. The maximum load bearing capacity at 0% corrosion in three point bending test is increases by 8.3% after casting specimen with Epoxy coated steel over TMT steel.
6. The maximum load bearing capacity at 10% corrosion in three point bending test is increases by 7.5 % after casting specimen with Epoxy coated steel over TMT steel.
7. The maximum load bearing capacity at 15% corrosion in three point bending test is increases by 11.8 % after casting specimen with Epoxy coated steel over TMT steel.

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