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Experimental Analysis on Vulnerability of RCC Members Due to Floods

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ABSTRACT

This projects gives the remedial measures for the buildings that is severely affected by floods. The buildings in the flood prone areas of Chennai city is mapped using ArcGIS. Mapping of these areas helps to make immediate strategies on those areas during flood. Various techniques are incorporated to reduce the vulnerability of the building, Crystalline admixture has been used to turn the normal ordinary Portland cement to hydrophobic cement which makes it has highly water repellent and Epoxy resin is applied has a coating to the reinforced bars to make it corrosion resistant and helps it to fight against sulphate attack. These techniques is also applicable during the construction of coastal buildings with very low vulnerability. Using of these techniques in buildings helps the structure to gain more durability and sustainability especially during the time of flood.

KEYWORDS: *Hydrophobic concrete, ARC GIS, Corrosion resistance*

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1. INTRODUCTION

Due to the flood the vulnerability of buildings in flood prone areas are extremely high. Because of this the durability and sustainability of the buildings are reduced greatly. To stop this we are incorporating techniques like epoxy resin and Hydrophobic cement which decreases the vulnerability of the buildings. Application of Epoxy resin to reinforcement bars helps the bar to withstand sulphate and corrosion attack. During the time of flood the stagnant water around the buildings infiltrate into the concrete and affects the bars to reduce this epoxy resin is used. Hydrophobic cement are majorly used in the construction of water structures like dams, spillways and etc. Due to the unavailability of Hydrophobic cement, crystalline powder is added to cement which helps the normal OPC cement to turn as hydrophobic cement which is extremely water repellent.

2. MAPPING OF FLOOD PRONE AREAS USING ArcGIS

The mapping of flood prone areas in Chennai city is done, for incorporating various flood mitigation techniques to save the lives of people and to reduce the vulnerability of the buildings. Also the affected areas of Chennai city during the December 2, 2015 is mapped and shown in the below figures.

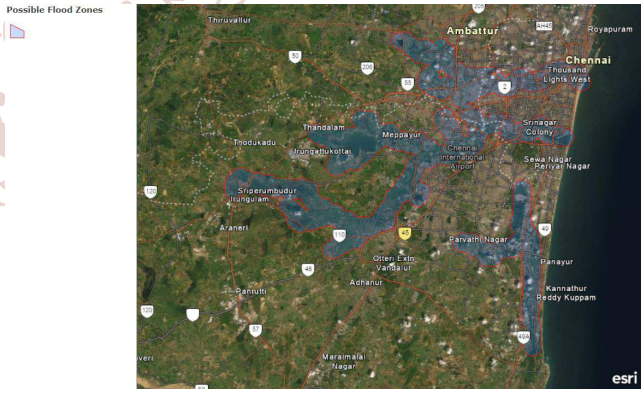

Fig 1 Possible flood prone areas of Chennai

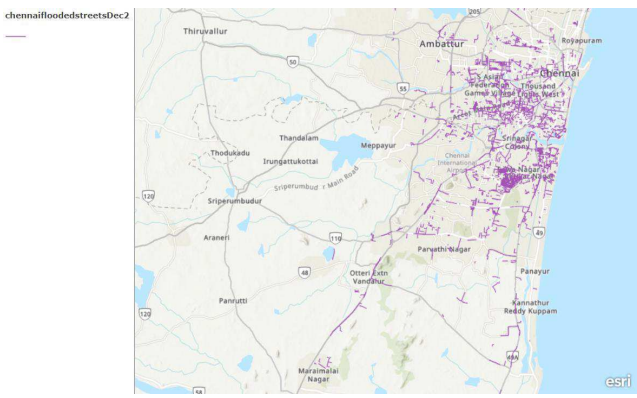

Fig 2 Affected areas of Chennai during December flood

3. HYDROPHOBIC CONCRETE

The hydrophobic concrete is produced based on the technology used in Crystalline waterproofing is manufactured in the form of a dry powder compound which comprises of Portland cement, very fine treated silica sand, and proprietary chemicals. It's applied as a coating material, admixture and dry shake. Crystalline Waterproofing Technology enhances the durability of concrete structures by pore-blocking mechanism, where in the pores, capillaries and micro-cracks in the concrete are blocked with a non-soluble, crystalline formation. The crystalline waterproofing admixture can be supplemented to concrete at the time of batching as well as at the site immediately before pouring of the concrete which then forms part of concrete and helps in making it dense and watertight.

4. EXPERIMENTAL TESTS

Since the study mainly aims the study of corrosive properties of the hydrophobic concrete designed, only the basic compressive test is done for the primary achievements. Hence 18 cubes of M20 grade concrete specimens dimensions 150mm ×150mm were casted. 9 cubes were casted as conventional concrete (Control concrete) and 9 cubes were casted as un-conventional concrete (crystalline admixture mixed concrete) and to study the corrosive properties of hydrophobic concrete half-cell potential meter test was conducted for four cylinders of 150 mm diameter cylinders, 2 cylinders for conventional and 2 cylinders for un-conventional concrete

4.1. COMPRESSIVE STRENGTH TEST

Compressive strength test was conducted for 7, 14 and 28 days for both conventional and un-conventional concrete and results were obtained as follows, an average of 3 cubes were tested for one particular day test

Table 1 - Average compressive strength test of conventional concrete cubes

Days	7th day	14th day	28th day
Average compressive strength	13.17 N/mm²	15.83 N/mm²	23.49 N/mm²

Table 2 - Average compressive strength test of un-conventional concrete cubes

Days	7th day	14th day	28th day
Average compressive strength	21.97 N/mm²	26.33 N/mm²	27.2 N/mm²

Fig1. Compressive strength test of concrete specimen

4.2. HALF CELL POTENTIOMETER TEST

The method of half-cell potential measurements normally involves measuring the potential of an embedded reinforcing bar relative to a reference half-cell placed on the concrete surface. The half-cell is usually a copper/copper sulphate or silver/silver chloride cell but other combinations are used. The concrete functions as an electrolyte and the risk of corrosion of the reinforcement in the immediate region of the test location may be related empirically to the measured potential difference. In some circumstances, useful measurements can be obtained between two half-cells on the concrete surface. ASTM C876 - 91 gives a Standard Test Method for Half-Cell Potentials of Uncoated Reinforcing Steel in Concrete.

The instrument measures the potential and the electrical resistance between the reinforcement and the surface to evaluate the corrosion activity as well as the actual condition of the cover layer during testing. The electrical activity of the steel reinforcement and the concrete leads them to be considered as one half of weak battery cell with the steel acting as one electrode and the concrete as the electrolyte. The electrical potential of a point on the surface of steel reinforcing bar can be measured comparing its potential with that of copper – copper sulphate reference electrode on the surface. Practically this achieved by connecting a wire from one terminal of a voltmeter to the reinforcement and another wire to the copper sulphate reference electrode.

Table 3 – Corrosion test results

Trial number	Specimen details	Readings	Probability of corrosion
1	Conventional cylinder	-384	High probability of corrosion
2	Crystalline Admixture and Epoxy resin in reinforcement	-281	Uncertainty of corrosion

Less than 200 - 10% of corrosion
Between 200 to 350 - 50% of corrosion (Uncertain)
Above 350 - 90% of corrosion

Fig 3. Half-Cell Potentiometer Test Equipment

Fig.4 Test specimen

5. RESULTS AND DISCUSSION

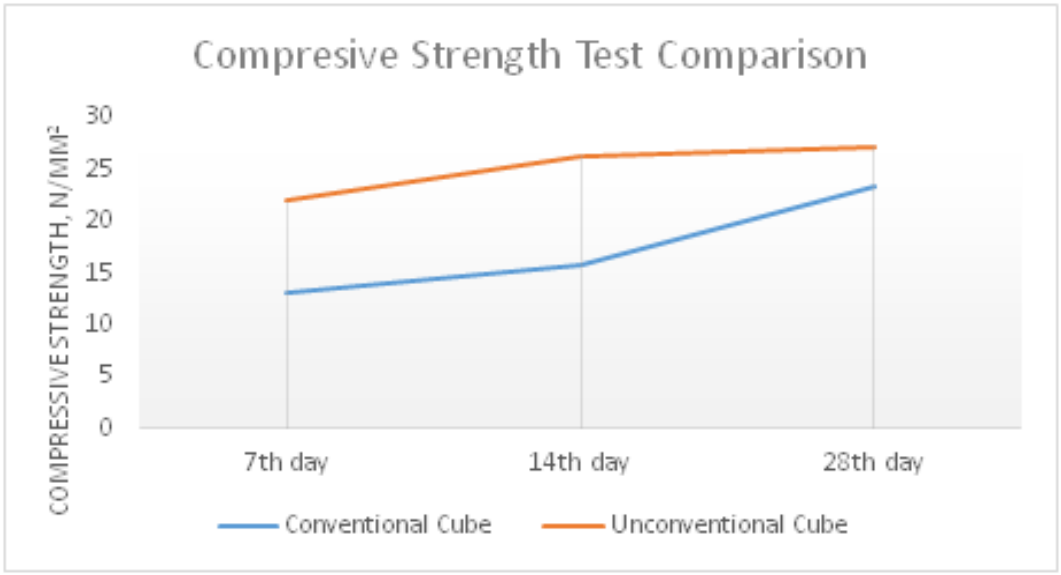

Fig 5. Comparison of Compressive strength test between Conventional and Un-Conventional test

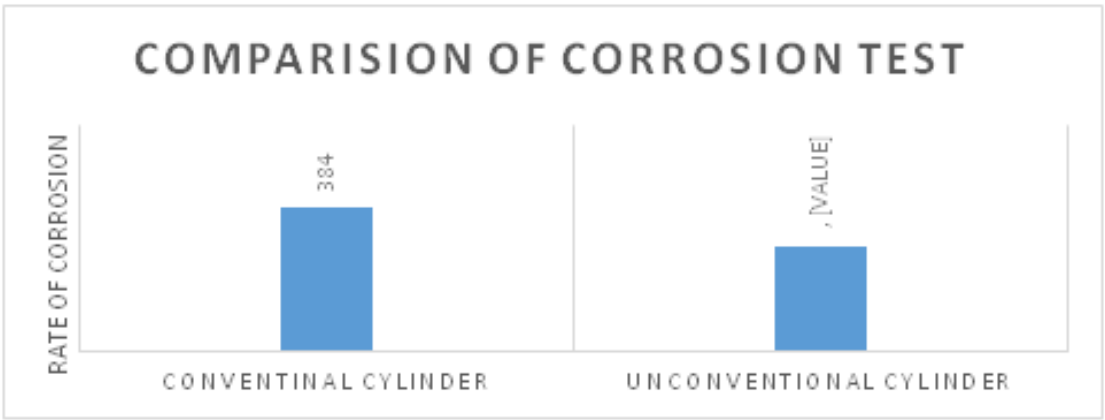

Fig 6. Comparison of Corrosion test between Conventional and Un-Conventional test

6. CONCLUSION

Thus the remedies for reducing the vulnerability of buildings in flood prone areas have been discussed and it has been proved that, using of crystalline admixture in Cement makes it has water repellent and increased the compressive strength of concrete considerably. And the coating of epoxy resin in reinforcement bars helps it to withstand the sulphate and corrosion attack. So these techniques can be incorporated in flood and coastal areas to increase the sustainability and durability of buildings.

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