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Effects of Sodium Chloride on Bond Strength between Steel and Concrete

Prof.Muralidhar K

Assistant Professor, Dept. of Civil Engineering, Sinhgad Institute of Technology and Science, Narhe, Pune, India

Vijay K, Viral S, Rushikesh A, Kranti M, Ritvik L.

UG Students, Dept. of Civil Engineering, Sinhgad Institute of Technology and Science, Narhe, Pune, India

ABSTRACT: This paper investigates the influence of sodium chloride (NaCl), commonly known as table salt, on the bond strength between steel reinforcement and concrete. Understanding this effect is crucial for ensuring the durability of reinforced concrete structures exposed to saltwater environments or de-icing chemicals.

KEYWORDS: Sodium Chloride, Bond Strength, Steel, Concrete, Corrosion, Durability.

I.INTRODUCTION

Tremendous increase in demand for resources and acute shortage of the same is like a double edged sword. Codes and construction practices are emphasizing durability to cope with the situation. One of the most important concerns with reinforced concrete construction is deterioration due to reinforcement corrosion. Corrosion effects on structures cannot be ignored and replaced. Corrosion is defined as the destruction or deterioration of a material because of its reaction with the environment. In case of corrosion formation, an oxide of iron due to oxidation of the iron atoms in solid solution is a well-known example of electrochemical corrosion, commonly known as rusting. These oxides are usually weaker than steel. Chloride ingress into the concrete is a major cause of steel corrosion. Presence of chloride ions at the rebar level leads to the breakdown of passive film thin film layer and consequently initiates the corrosion (Pradhan and Bhattacharjee, 2009). Rust produced as a result of corrosion increases its volume 2 to 6 times than that of original steel; it causes an increase in volume of tensile stresses in concrete (Bhaskar et al. 2010). The process of corrosion is initially slow and later it progresses exponentially. Corrosion initiation process in RC structures depends on the atmospheric conditions, thickness of cover, quality of concrete present at the cover depth, stress levels of corrosion in rebar, cracking effect etc. Macro corrosion cell-both the anodic and cathodic reactions frequently take place in different places with some distance apart (Browne, 1975). Physical model for steel corrosion in concrete sea structures is proposed by Bazant, (1979).

II. PROCEDURE

1. Determine the mean target strength f_t from the specified characteristic compressive strength at 28-day f_{ck} and the level of quality control. $f_t = f_{ck} + 1.65S$
2. Where S is the standard deviation obtained from the table of contents given after the design mix.
3. Obtain the water cement ratio for the desired mean target using the empirical relationship between compressive strength and water cement ratio so chosen is checked against the limiting water cement ration. The water cement ratio so chosen is checked against the limiting water cement ratio for the requirements of durability given in table and adopts the lower of the two values.
4. Estimate the amount of entrapped air for maximum nominal size of the aggregate from the table.
5. Select the water content, for the required workability and maximum size of aggregates (for aggregates in saturated surface dry condition) from table.
6. Determine the percentage of fine aggregate in total aggregate by absolute volume from table for the concrete using crushed coarse aggregates.
7. Adjust the values of water content and percentage of sand as provided in the table for any difference in workability, water cement ratio, grading of fine aggregate and for rounded aggregate the values are given in table.
8. Calculate the cement content from the water-cement ratio and the final water content as arrived after adjustment. Check the cement against the minimum cement content from the requirements of the durability, and greater of the two values is adopted.

9. From the quantities of water and cement per unit volume of concrete and the percentage of sand already determined in steps 6 and 7 above, calculate the content of coarse and fine aggregates per unit volume of concrete.
10. Determine the concrete mix proportions for the first trial mix. xii. Prepare the concrete using the calculated proportions and cast three cubes of 150mm size and test them wet after 28 days moist curing and check for the strength.
11. Prepare trial mixes with suitable adjustments till the final mix proportions are arrived at.

III.MATERIALS

- 1.Cement: OPC 43 cement shall conform to IS:8112-1989 and the designed strength of 28 days shall be minimum 43 MPa or 430 kg/sqcm. Even though 43 Grade cements early strength is less as compared to that of 53 Grade, with time it will attain the same ultimate strength as that of 53 Grade cement.
2. Aggregates: Aggregates are inert granular materials such as sand, gravel, or crushed stone that, along with water and portland cement, are an essential ingredient in concrete. Aggregates strongly influence concrete's freshly mixed and hardened properties, mixture proportions, and the economy.
3. Fine Aggregate: Fine aggregate is the essential ingredient in concrete that consists of natural sand or crushed stone. The quality and fine aggregate density strongly influence the hardened properties of the concrete.
4. Fly ash : The use of fly ash in portland cement concrete (PCC) has many benefits and improves concrete performance in both the fresh and hardened state. Fly ash use in concrete improves the workability of plastic concrete, and the strength and durability of hardened concrete.
5. Super plasticizers: When superplasticizer is used, concrete tends to lose workability rapidly. High strength concrete containing such materials must therefore be transported, placed, and finished before they lose their workability.
6. Steel bar: Reinforcement for concrete is provided by embedding deformed steel bars or welded wire fabric within freshly made concrete at the time of casting.
7. Water : Generally, water that is suitable for drinking is satisfactory for use in concrete. Water from lakes and streams that contain marine life also usually is suitable. When water is obtained from sources mentioned above, no sampling is necessary.

IV. SECURITY

Spectrum sensing: Detecting unused spectrum and sharing it, without harmful interference to other users; an important requirement of the cognitive-radio network to sense empty spectrum. Detecting primary users is the most efficient way to detect empty spectrum. Spectrum-sensing techniques may be grouped into three categories:

Transmitter detection: Cognitive radios must have the capability to determine if a signal from a primary transmitter is locally present in a certain spectrum. There are several proposed approaches to transmitter detection:

1. Cooperative detection: Refers to spectrum-sensing methods where information from multiple cognitive-radio users is incorporated for primary-user detection.
2. Interference-based detection.

Since primary user networks have no requirement to change their infrastructure for spectrum sharing, the task falls to CRs as secondary users to detect the presence of primary users through continuous spectrum sensing. Spectrum sensing by CRs can be conducted either individually or cooperatively. Recently, the efficacy of cooperative spectrum sensing has gained a great deal of attention. There are several advantages offered by cooperative spectrum sensing over the non-cooperative methods. However, due to the randomness of the appearance of PUs, it is extremely difficult to achieve fast and smooth spectrum transition leading to limited interference to PUs and performance degradation of SUs. Locally collected and exchanged spectrum sensing information is used to construct a perceived environment that will impact CR behaviour. This opens opportunities to malicious attackers. In cooperative spectrum sensing a group of secondary users perform spectrum sensing by collaboratively exchanging locally collected information. Malicious secondary users may take advantage of cooperative spectrum sensing and launch attacks by sending false local spectrum sensing results to others, resulting in a wrong spectrum sensing decision. Two known security threats in CRs are Selfish Primary User Emulation (SPUE) and Malicious Primary User Emulation (MPUE) attack. These types of attacks emulate signals with the characteristics of incumbent primary users to fool other secondary users.

SPUE: In this attack, an attacker's objective is to maximize its own spectrum usage. When selfish attackers detect a vacant spectrum band, they prevent other secondary users from competing for that band by transmitting signals that emulate the signal characteristics of primary user signals. This attack is mostly carried out by two selfish secondary users.



MPUE: In this attack, the objective is to obstruct the DSA process of SUs- i.e., prevent SUs from detecting and using vacant licensed spectrum bands, causing denial of service.

Using the Trust-Worthy algorithm it defines a threshold value to the SUs to overcome the PUE attacks. It enables CR-Networks nodes to efficiently utilize the available spectrum channels. Nodes, which can easily find various licensed channel opportunities without interfering the primary system increases. This reveals that it has a potential to be able to convert the various network conditions into a performance improvement.

V. RESULT AND DISCUSSION

Table 1: Cubes cured in normal water

Sr. No.	Parameters/ Cubes	Cube 1	Cube 2	Cube 3	Cube 4	Cube 5	Cube 6
1	Failure load	32.3 KN	29.1 KN	30 KN	31.1 KN	30 KN	30.4KN
2	Bond Strength	12.85 N/mm ²	11.578 N/mm ²	11.936 N/mm ²	12.374 N/mm ²	11.936 N/mm ²	12.095 N/mm ²
3	Stress in bar	642.58 N/mm ²	578.92 N/mm ²	596.83 N/mm ²	618.71 N/mm ²	596.83 N/mm ²	604.788 N/mm ²
4	Development length	100.012 mm	100.003 mm	100.005 mm	100.001 mm	100.005 mm	100.006 mm
5	Development Length by using IS Code	422.75 mm	380.86 mm	392.65mm	407.04mm	392.65mm	397.88mm

VI. CONCLUSION

In this project The bond strength for every cube is varying in the range 11.50 N/mm² to 12N/mm² and as per IS 456-2000 The bond strength for deformed bar and for M40 grade of concrete it is 3.04 N/mm², so the actual bond strength between steel and concrete is conservative by approximately 4 by factor of safety. Similarly in the case of development length, The development length provided is 100mm and As per IS 456:2000, After doing of calculation the development should be in the range of 350mm-425mm, But As we have provided the development length of 100mm, Then Also the bond strength is in the range of 11.50 N/mm² to 12N/mm² which is grater than As per IS 456:2000 provisions. So, Here the bond strength and development length is safe side or conservative by factor of safety of 4.

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