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Study on behavior of chlorine effect to the concrete and behavior of bond stress of concrete.

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Abstract
At low concentration, chloride ion has little or no effect on physical stability of concrete of concrete structure but it cause the corrosion of the reinforcement steel in the concrete. But at high concentration especially at low temperature it cause expansion and cracking in the concrete. The Chloride ions content of concrete is usually measured in the laboratory using wet conical analysis Although laboratory testing is the most accurate, it is time consuming and often taken several weeks before result are available as result field test kits has been developed, the Chloride ions content of concrete is using measured in the laboratory using wet chloride analysis although laboratory testing is the most accurate it is time consuming and often takes several weeks before result are available as a result, field test laid have been developed
Permeability is an important property to consider when designing concrete for long service lives but unfortunately requires long-term testing to be accurately measured. Short-term test methods to estimate permeability such as rapid chloride permeability (RCP), bulk resistivity (BR), and surface resistivity (SR) have therefore been developed. In this study, three short-term test methods are performed, and the results compared, RCP testing is performed using accelerated curing to determine whether testing can be shortened, and the effects of SCMs on results are examined. It was observed that all three test methods had strong positive correlations with one another. RCP testing performed on specimens subjected to an accelerated-curing regime for 28 days had a strong positive correlation with specimens that were cured in standard conditions for 91 days. The addition of SCMs improves concrete permeability; the beneficial effect of SCMs increases with the maturity of the concrete.
Keywords: *chloride, penetration, distilled water, concrete*

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INTRODUCTION

I. In this document, a review of the current common methods for determining chloride penetrability of concrete is presented. First, some theoretical background of what influences the penetration of chlorides into concrete is presented in Section 3. The different mechanisms of chloride penetration are presented, followed by a further elaboration of the chloride diffusion theory. The influence of basic properties of concrete on its chloride penetrability is also discussed. In Section 4, individual test procedures are presented. First, the existing long-term procedures are discussed, namely the salt pending (AASHTO T259) test and the Nordtest (NTBuild 443) bulk diffusion test. The existing short-term tests are then presented. For each test, the procedure, the theoretical basis, and any advantages and disadvantages are presented. Also included in this document as an appendix is a glossary of some of the common terms related to chloride ingress testing and measurement the interest of high strength concrete has increased considerably in the last few years. Several research works on this subject have contributed to a better understanding of the material properties and mechanical behavior in structural elements of high strength concrete.

II. Reinforced concrete structures are exposed to harsh environments yet are often expected to last with little or no repair or maintenance for long periods of time (often 100 years or more). To do this, a durable structure needs to be produced. For reinforced concrete bridges, one of the major forms of environmental attack is chloride ingress, which leads to corrosion of the reinforcing steel and a subsequent reduction in the strength, serviceability, and aesthetics of the structure. This may lead to early repair or premature replacement of the structure.

III. A common method of preventing such deterioration is to prevent chlorides from penetrating the structure to the level of the reinforcing steel bar by using relatively impenetrable concrete. The ability of chloride ions to penetrate the concrete must then be known for design as well as quality control purposes. The penetration of the concrete by chloride ions, however, is a slow process. It cannot be determined directly in a time frame that would be useful as a quality control measure. Therefore, in order to assess chloride penetration, a test method that accelerates the process is needed, to allow the determination of diffusion values in a reasonable timeOne subject, which needs some investigation as far as the use of high strength concrete in building construction is conceded, is the prediction of "in situ" concrete strength. It is known that the strength measured on standard specimens, at 28 days and cured in standard conditions, only gives the potential value of the concrete strength, which is useful for quality control purposes and for checking the acceptability of the concrete as it is produced (1, 2). However, this reference strength is normally achieved by the real structure at ages much higher than 28 days, depending on various parameters, mostly associated with curing conditions. On the other hand it is often necessary to know the strength of concrete before 28 days to determine when the forms can be disassembled or to know the structure performance at certain age. As a way of estimating the "in situ" strength for high strength concrete, some techniques, previously used in normal strength concrete, have been adapted and used.

IV. One of those techniques consists on calibrating a relationship between the compressive strength of a given concrete and its resistance to penetration by a steel probe fired into the concrete surface. This test, generally known as Windsor Probe Test System, has only shown its applicability in concretes in which strengths are no more than 50 MPa (measured in cubes of 150 mm). In an attempt to use Windsor Probe Test System in high strength concrete, performed by the authors, it was found that the available probes and/or the power level are unsuitable; probes didn't penetrate the concrete surface. It means that probably a new probe and/or a new power level has to be provided by manufacturer in order to be possible its use in high strength concrete.

V. On the present investigation the possibility of using an alternative firing apparatus to the traditional Windsor Probe Test System was evaluated for the range of concrete compressive strength varying from 50 MPa to 90 MPa. A previous study, comparing the reliability of both apparatus, is also presented for the range of concrete compressive strength up to 50 MPa. In an environment exposed to seawater, chloride-induced corrosion of reinforcing steel is the most important deterioration mechanism of reinforced concrete structures. Under chloride attack, the reinforcing steel corrodes more easily The volume of the corrosion products is about four to six times larger than the steel This volume increase would induce internal tensile stresses in the cover concrete, resulting in cracking, de lamination and spelling. Therefore, in the durability design of these structures, the most important factor that determines their service life is the chloride transport properties of the concrete. (Mehta and Monteiro, 2006).Extensive studies have been conducted over the past decades to study the chloride transport properties of concrete. Most of the studies were carried out on sound and un cracked concrete (Zhang and Gjorv, 1996; Wang etal., 2005; Song etal., 2008; Pack etal., 2010). However, in most cases, cracks (micro cracks) may exist in reinforced concrete structures for different reasons. A restrained volume change is one of the most common causes of cracks in concrete. Concrete will shrink during the hydration process. If the shrinkage is restrained, tensile stress will develop. Once the stresses exceed the tensile strength of the concrete, cracks will occur (Carino and Clifton, 1995).. Durability problems also can lead to cracks, such as freezethaw action, alkali-aggregate reaction, sulfate ingress, and corrosion of reinforcement. Other reasons for concrete cracking could lie in poor construction practices, construction over load errors in design and externally applied loads (ACI 224.1R-07, 2007). Several studies have focused on the effect of cracks on the chloride transport properties of concrete using both experiments. Permeation is yet another mechanism by which penetration of chloride ions can occur which is driven by pressure gradients. Consider a closed volume made of concrete whose inside bottom face is under hydrostatic pressure caused due to a liquid and if the same also contain chloride ion then permeation would occur. Absorption through capillary is yet another mechanism through which chloride ingress occurs. Concrete surfaces that are exposed to alternate wetting & drying conditions often undergo chloride ingress by this mechanism. In such conditions, where concrete comes in contact with water containing chlorides then, as mentioned above, due to a moisture gradient capillary suction pressure develops and absorption of chloride ions through the pores occurs. Interesting here would be to note that unless the concrete quality is very poor the absorption of chloride ions by this mechanism would not reach the reinforcing steel because the depth of drying is usually quite small. Though still it does assist in bringing the chlorides inside concrete and reducing the distance that needs to be covered to reach the steel [Thomas, et al., 1995]

VI. Reinforced concrete structures are exposed to harsh environments yet is often expected to last with little or no repair or maintenance for long periods of time (often 100 years or more). To do this, a durable structure needs to be produced. For reinforced concrete bridges, one of the major forms of environmental attack is chloride ingress, which leads to corrosion of the reinforcing steel and a subsequent reduction in the strength, serviceability, and aesthetics of the structure. This may lead to early repair or premature replacement of the structure. A common method of preventing such deterioration is to prevent chlorides from penetrating the structure to the level of the reinforcing steel bar by using relatively impenetrable concrete. The ability of chloride ions to penetrate the concrete must then be known for design as well as quality control purposes. The penetration of the concrete by chloride ions, however, is a slow process. It cannot be determined directly in a time frame that would be useful as a quality control measure. Therefore, in order to assess chloride penetration, a test method that accelerates the process is needed, to allow the determination of diffusion values in a reasonable time.

VII. Corrosion of Steel reinforcement is a civilian Concrete durability problem in New Zealand. It is caused by the depth or quality of Cover Concrete being insufficient to prevent

VIII. Moisture and air penetrating the Concrete Surface and migrating the reinforcement and is exacerbated when the Concrete Contains Chloride ions. In addition to increasing the risk of reinforcement Corrosion after construction. Chloride affect ·Concrete s the 145 Seating behavior of fresh Subsequent Strength. Reinforced Canes he Structures are exposed to harsh environments yet ark Expected to last with little of maintenance of Len offer no Foe loony Periods of time 100 years one attack of the major is Cloned forms often vhommental ingress A common method A common method deled orally is to the of Pac venting prevent chlorides from to the level the Reinforcing steel ban by using relatively impenetrable Concisely Such

IX. Cannot be dele, mined disquietly in a Frame Control -that would be

X. Corrosion of steel reinforcement is a significant concrete durability problem in new Zealand . It is caused by the depth or quality of cover concrete being insufficient to prevent moisture and air penetrating the concrete surface and migration to the reinforcement and is exacerbated when the concrete contain chloride ions

XI. In addition to increasing the risk of reinforcement corrosion after construction chlorides can affect the seating behavior of fresh concrete and its subsequent strength Reinforcement concrete structures are expected to harsh environments yet are expected to last with little or no repair maintenance for long periods of time often 100 years or more one of the major forms of entertain mental attack is chloride ingress. A common method of preventing such deterioration is to prevent chloride from penetrating the structure to the level of the reinforcing steel bar by using relatively impenetrable concrete .It cannot be determined directly in a time. Frame that would be useful as a quality control measures In general concrete is a heterogeneous mixture used is most of the construction works concrete has a complex nature in that it's properties in its fresh and hardened state are different This pores in the concrete pave way to water absorption and chloride ions penetration from the atmosphere which in turn leads to reinforcement corrosion but cementations composites are multiphase and multi - scaled material in nature with time variant characters annexing more complexities this has led to other studies focusing on the effect of Nano sized cementations composites on concrete. Chloride ions are among the primary cause of steel corrosion in reinforced concrete structures determination of the evaluating risk of corrosion the drawbacks of conventional techniques for determination chloride content call for reliable techniques. The performance of embedded chloride sensor in cementitious material depends on the physical condition of the interfaces at the sensor's surface as well as the fore solution compositions. The presence of different ions in the pore. Channels of this layer, subsequently affects the sensor’s response this is mainly in view of pore solution composition and compactness of hydration products at the interface between sensor and cementations materials.

1.3 Advantages

1. It is relatively quick- can be used for quality control
2. Has simple and convenient set up and procedures
3. Provides results that are easy to interpret

1.4 Disadvantages

1. May not represents the true permeability for concrete that contains supplementary Cementations material or chemical admixtures.
2. May allow measurements before a steady state is achieved
3. Can cause physical and chemical changes in the specimen , result in unrealistic values
4. Has low inherent repeatability and productivity

1.5 The objectives of Phase B are

1. Propose chloride limits on the basis of total cementations materials; and

2. Evaluate the validity of current chloride limits for reinforced concrete stated in ACI 318. This report summarizes the findings in Phase A of the project.

MATERIALS AND MIXTURE PROPORTIONS

The following materials were used for the concrete mixtures:

- ASTM C150 Type II portland cement (II) with C3A = 6.6% (Bogue)/4.0% (QXRD)*

- ASTM C150 Type V portland cement (V) with C3A = 2.9% (Bogue)/2.6% (QXRD)
- ASTM C989 slag cement (SL)
- ASTM C618 Class F fly ash (FF)
- ASTM C618 Class C fly ash (CF)
- ASTM C1240 silica fume (SF
- ASTM C33 No. 57 crushed coarse aggregate with high chloride from Illinois (IL)
- Powdered Calcium chloride (97.1% purity) * C3A calculated from Bogue equations is relevant to ASTM C150. The cement supplier also reported the C3A from direct phase determination by quantitative X-ray diffraction (QXRD) using the Riveted method. Table 2 summarizes the chemical characteristics of the cementations materials used in this project as reported by the supplier. The measured chloride content of the materials used for the concrete mixtures are reported in Table 3. The acid-soluble and water-soluble chloride contents of the different material ingredients were measured by ASTM C1152 and ASTM C1218, respectively.

RESULT AND DISCUSSION

A-I STIPULATIONS FOR PROPORTIONING

I) Grade designation : M20
II) Type of cement : OPC 43 grade conforming to IS 8112
c) Maximum nominal size of aggregate : 20mm
d) Minimum cement content : 300 kg/m'
e) Maximum water-cement ratio : 0.55
f) Workability : 100 mm (slump)
g) Exposure condition : Mild (RCC IS 456:2000 Table No. 5)
h) Method of concrete placing : Pumping
j) Degree of supervision : Good
k) Type of aggregate : Crushed angular aggregate
m) Maximum cement content : 450 kg/m?

3.5 Preliminary investigation of natural aggregates

Various tests were carried out natural aggregates to study different physical properties there of

3.5.1. Fine aggregates (sand):

Locally available fine aggregates i.e. sand obtained from the nearby river of NASHIK was used.
The following necessary and important tests were carried out on sand

a) Specific gravity
b) Water absorption
c) Sieve analysis and fineness modulus.

These tests were carried out as per the relevant IS code of practice. The test result indicated that, the sand was satisfying the requirement according IS code.The salt content and clay lumps were within the limits. Same sand was used throughout all concrete mix.

3.5.2. Coarse aggregate:

Coarse aggregate (natural aggregate) used was a crushed volcanic basalt rock. The following tests were carried out for the both natural and recycled coarse aggregates as per the procedure given is relevant IS code of practice

a) Sieve analysis and fineness modules
b) Specific gravity
c) Water absorption
d) Mechanical properties
e) The test result is described in the Table No. 2.2 and Table No. 2.3

Natural Aggregates:

Table 2.1: Properties of natural aggregates

Test	Result
Specific gravity	2.7
Water absorption	3.06%
Fineness modulus	3.09%
Aggregate crushing value	11.26%
Aggregate impact value	11.11%

3.6 Existing test methods for chloride penetration test:
(1) AASHTO T259 (Salt Pounding Test)
(2) Bulk Diffusion Test (Nordtest NTBuild 443)
(3) AASHTO T277 (Rapid Chloride Permeability Test)
(4) Electrical Migration Techniques
(5) Rapid Migration Test (CTH Test)
(6) Resistivity Techniques
(7) Pressure Penetration Techniques
(8) Indirect Measurement Techniques
(9) Sorptivity

3.7 Testing for accurate M20 Grade concrete Mixture

For accurate m20 grade concrete admixture we need to 3 test (T1, T2, T3) every test we have to cast 3 cubes of concert. The size of cube is 150x150x150mm and the ratio of cement, fine and coarse aggregate we used is as per the calculations of the following ratio.

Test No	Concrete	Super plaster	Admixture
1	1	2.73	3.71
2	1	2.65	3.75
3	1	2.83	3.70

Calculations
1: 2.73: 3.71
1 + 2.73 +3.71= 7.44
3 x (0.15)3 x 2580 = 26.12
Cement = 1 /7.44 x 26.12 = 3.5 x 1.15 = 4 kg
Fine aggregate = 4 x 2.73 = 10.92 kg
Coarse aggregate = 3.71 x 4 = 14.84 kg
Chemical admixture = 3 /100 x 4 = 0.12 kg
Water = 4 /0.58 = 6.80 kg

1: 2.65: 3.75
1 + 2.65 + 3.75 = 7.4
3 x (0.15)3 x 2580 = 26.12
Cement = 1 /7.4 x 26.12 = 3.52 x 1.15 = 4.128 kg
Fine aggregate = 4.128 x 2.65 = 10.93 kg
Coarse aggregate = 3.75 x 4.128 = 15.22 kg
Chemical admixture = 3 /100 x 4 = 0.12 kg
Water content = 4 /0.52 = 7.70 kg

1: 2.65: 3.75
1 + 2.65 + 3.75 = 7.4
3 x (0.15)3 x 2580 = 26.12
Cement = 1 /7.4 x 26.12 = 3.52 x 1.15 = 4.128 kg
Fine aggregate = 4.128 x 2.65 = 10.93 kg
Coarse aggregate = 3.75 x 4.128 = 15.22 kg
Chemical admixture = 3 /100 x 4 = 0.12 kg
Water content = 4 /0.52 = 7.70 kg

3.8 Testing for accurate M30 Grade concrete Mixture

As like m20 grade of concrete, for accurate m30 grade concrete admixture we need to 3 test (T1, T2, T3) every test we have to cast 3 cubes of concert. The size of cube is 150x150x150mm and the ratio of cement, fine and coarse aggregate we used is as per the calculations of the following ratio.

Test No.	Concrete	Super plaster	Admixture
1	1	2.36	3.45
2	1	2.45	3.60
3	1	2.30	3.40

Calculations

1. 1: 2.36: 3.45
1 + 2.36 + 3.45 = 6.81
3 x $(0.15)^3$ x 2580 = 26.12
Cement = $^1/_{6.81}$ x 26.12 = 3.83 x 1.15 = 4.5 kg
Fine aggregate = 4.5 x 2.36 = 10.60 kg
Coarse aggregate = 3.45 x 4.5 = 15.5 kg
Chemical admixture = $^3/_{100}$ x 4.5 = 0.135 kg
Water content = $^{4.5}/_{0.45}$ = 10 kg

2. 1: 2.45: 3.60
1 + 2.45 + 3.60 = 7.05
3 x $(0.15)^3$ x 2580 = 26.12
Cement = $^1/_{7.05}$ x 26.12 = 3.70 x 1.15 = 4.5 kg
Fine aggregate = 4.5 x 2.45 = 11.05 kg
Coarse aggregate = 4.5 x 3.60 = 16.2 kg
Chemical admixture = $^3/_{100}$ x 4.5 = 0.135 kg
Water content = $^{4.5}/_{0.42}$ = 10.71 kg

3. 1: 2.30: 3.40
1 + 2.30 + 3.40 = 6.7
3 x $(0.15)^3$ x 2580 = 26.12
Cement = $^1/_{6.7}$ x 26.12 = 3.89 rt6g7h 8jik\][poiuytre43w2q1`x 1.15 = 4.5 kg
Fine aggregate = 4.5 x 2.36 = 10.60 kg
Coarse aggregate = 3.45 x 4.5 = 15.5 kg
Chemical admixture = $^3/_{100}$ x 4.5 = 0.135 kg
Water content = $^{4.5}/_{0.45}$ = 10 kg

- **Amount of Material we used for accurate amount and ratio od m20 and m30 gradeof concrete**

1) Cement = 26 kg x 4 = 104 kg
2) Fine aggregate = 67 kg x 4 = 268 kg
3) Coarse aggregate = 92 x 4 = 368 kg
4) Chemical Admixture (Super plasticizer) = 0.765 kg x 4 = Approx 10 kg
5) Water content (distilled water) = 56 kg

For which the accurate M20 grade is used for final testing is when the ratio of load carried by the cube of concrete and strength is up to the 26.6 and for the M30 grade is to be close to the 38.25

All the cubes which are cast by the ratio and proper admixtures are placed under water for next28 days curing in water to get maximum strength there were 3 cubes of test 1 M20, 3 are test 2M20 and 3 cubes are of test 3 M20 as well there are more 3 cubes are of test 1 M30 and 3 are test 2 of M30 and 3 cubes are more of test 3 M30

M20		
Test 1	Test 2	Test 3
Cube 1	Cube 1	Cube 1
Cube 2	Cube 2	Cube 2
Cube 1	Cube 1	Cube 1

M30		
Test 1	Test 2	Test 3
Cube 1	Cube 1	Cube 1
Cube 2	Cube 2	Cube 2
Cube 3	Cube 3	Cube 3

After 28 days of curing the cubes are placed under sunlight for up to the 2 hours until total wateris evaporated. Weight all the cubes on weight machine, note down all the weight in book.

After that to calculate the actual strength of the cube the (UTM) Universal Testing Machine is used. The cubes are placed in the machinery one by one and put pressure on it until the cubes getting cracks on surface, note down the strength of cube in KN this is used to calculate the ratioof load carried by the cube and strength of cube.

Grade	M20		
Test No.	Test 1	Test 2	Test 3
Cube 1	413 KN	477 KN	698 KN
Cube 2	450 KN	415 KN	570 KN
Cube 3	368 KN	341 KN	376 KN

Garde	M30		
Test No.	Test 1	Test 2	Test 3
Cube 1	1047 KN	403 KN	616 KN
Cube 2	774 KN	368 KN	829 KN
Cube 3	973 KN	410 KN	882 KN

Get the average of the weight of all cube of test 1, test 2 and test 3 of both m20 and 30 gradecubes

$$\frac{413+450+368}{3}$$

M20		
Test 1	Test 2	Test 3
410.33 KN	411 KN	548 KN

M30		
Test 1	Test 2	Test 3
931.33 KN	393.66 KN	775.67 KN

To calculate the accurate M20 grade and M30 grade the average weight or load is divided bythe size of the cube

$$\frac{410.33}{0.150 \times 0.150 \times 0.150}$$

After calculating all the load the nearest to 26.6 and 38.25 is accurate grade of M20 and M30respectively

- **Calculations**
- **For M20**

I. **410.33/0.150X0.150X0.150 = 61.5495 KN/M^2**
II. 411/0.150X0.150X0.150 = 61.54 KN/M^2
III. 548/0.150X0.150X0.150 = 82.22 KN/M^2

- **Calculations**
- **For M30**

I. 931.33/0.150X0.150X0.150 = 139.69 KN/M^2
II. **393.66/0.150X0.150X0.150 = 59.04 KN/M^2**

III. 775.67/0.150X0.150X0.150 = 116.35 KN/M^2

All above calculations conclude that for penetration test on concrete **Test 1** of m20 grade cubemixture is use and for m30 **Test 2** cube mixture is use.

CONCLUSION

First of all I chose a topic and it was called Study on behavior of chlorine effect to the concrete and behavior of bond sress of concrete. I have studied all the research papers related to that topic. I took the help of IS Code-14959 Part 2 (2001) and 10262 (2009) to check the concrete.

A lot of information was obtained from it, which was useful for me to do my project. I was using some chemicals to test the concrete; I bought those chemicals from the market. With the help of those chemicals I was perform the test on concrete through which I am come to a conclusion.

The conclusion is 1)Higher the grade of concrete and mixture higher the strength and durability of concrete in construction and vise versa

2) Sometimes chloride ions cause corrosion in steel which are used in construction as material with the concrete to prevent this chloride penetration test we done

3) High-volume fly ash replacing cement helps to improve the fluidity, volume stability, durability, and economy of concrete.

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