ESTIMATION OF MARINE SALTS BEHAVIOR AROUND THE BRIDGE STRUCTURES

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The development of chloride penetration models is essential for the assessment of the service life of concrete structures exposed to marine environment. Simple models are derived from Fick's 2nd law of diffusion are at present the best way to predict chloride penetration in practical situations. However these models need to be calibrated with experimental results. This paper presents an experimental study where the parameters used in the penetration model where calibrated to allow the prediction of long term chloride content in concrete. The results showed that the concrete cover and concrete quality requirements stated in the present codes need to be increased so that an acceptable service life can be achieved.

Keywords: M30, Strength, Corrosion

INTRODUCTION

Service life prediction is becoming one of the major tasks in the design of concrete structures. The durability design must be based on consistent models that can describe the deterioration models more accurately.

In marine environment, the service life of reinforced concrete structures depends mainly on deterioration due to reinforcement corrosion. Two stages can be considered in this mechanism; the initiation period corresponding to the critical chloride penetration up to the level of reinforcement and the propagation period related to the reinforcement corrosion and its detrimental effects on the structure.

The high corrosion rates generally observed in marine environment and the difficulty in modeling this mechanism and its effect on the structures led to the usual consideration of service life as the initiation period.

AIM AND SCOPE OF INVESTIGATION

AIM

- In world as consists of more than 70% cover by oceans, river, etc., with salty content.
- Bridge is only way to travel, exchange a goods by land.
- Bridge structure is structural element which are constructed by means of concrete

ingredients in salty water which can easily corrosion in bridge column.

- Which result is reducing strength due to corrosion of reinforcement in column.
- To prevent and overcome the damage by increasing the concrete cover and concrete quality requirements and prevent the corrosion of the reinforcement.
- Additionally it can be used for fixed formwork in column.
- The strength, durability, and compressive strength of column structure element are studied and performed in this project.

MATERIALS

Material investigation is done to test the various materials that are used in making concrete cubes. According to these test results obtained we designed the mix ratios for the materials and prepared the concrete cubes, beams and cylinders. The information are given below,

Cement

OPC of 43 grades in one lot was procured and stored in air tight container. The cement used was fresh, i.e., used within three months of manufacture. It should satisfy the requirement of IS 12262. The properties of cement are determined as per IS 4031:1968 and results are tabulated.

Fine Aggregate

A fine aggregate obtained from the river is used for experimental purpose. The less amount of clay and silt (<3% by weight). The hire from silt, clay, salt and organic material and it was clean and dry. It is of size retained in 1.19 micron sieve.

Table 1: Chemical Composition of Manufactured Sand and Natural Sand

Constituents	Natural Sand (%)	Test Method
SiO_2	80.78	IS: 4032-1968
Al_2O_3	10.52	
Fe_2O_3	1.75	
CaO	3.21	
MgO	0.77	
Na_2O	1.37	
K_2O	1.23	
TiO_2	Nil	
Loss of ignition	0.37	

BULKING OF FINE AGGREGATE

- Table the representative of sample of sand, from the available lot at sight.
- Fill the graduated jar with sand up to certain weight compacting.
- Level the sand surface by gentle motion and note down this height.
- Now pour the water into the graduated jar containing sand till the sample is submerged.
- Cover the jar with the disk and give some motion.
- The tamping rod should be moved through out into sample in the jar, so as to ensure to removed of entrapped air completely.

Table 2: Properties of Natural Sand

S. No.	Properties	Values
1.	Size	Passing through 4.75 mm sieve
2.	Fineness modulus	2.54
3.	Specific gravity	2.78
4.	Water absorption	1.0%

Table 3: Bulking of Fine Aggregate			
S. No.	**Initial Height of Sand**	**Height of Sand After Adding Water**	**Bulking Factor**
1.	600	550	9.09
2.	650	590	10.17
3.	700	650	7.14
Percentage of Bulking			8.8

COARSE AGGREGATE

The coarse aggregate is strongest and porous component of concrete. Presence of coarse aggregate reduces the drying shrinkage and other dimensional changes occurring on account of movement of moisture. The coarse aggregate used passes in 19 mm and retained in 11.4 mm sieve. It is well graded (should of different particle size and maximum dry packing density and minimum voids) and cubical in shape.

Water

Ordinary drinking water available in the construction laboratory was used for casting all specimens of this investigation. Water helps in dispersing the cement even, so that every particle of the aggregate is coated with it and brought into ultimate contact with the ingredients.

It reacts chemically with cement and brings about setting and hardening of cement. It lubricates the mix and compact property. Potable water, free from impurities such as oil, alkalis, acids, salts, sugar and organic materials were used. The quality of water was found to satisfy the requirement if IS: 456-2000.

MIX DESIGN

General

Mix design can be defined as the process of selecting suitable ingredients of concrete and determining their relative proportions with the object of producing concrete of certain minimum strength and durability as economically as possible. The main objective is to stipulate the minimum strength and durability. It also reveals the relation between aggregate and paste. The other conditions being equal, for workable mixes the strength of concrete varies as an inverse function of the water/cement ratio. Since the quantity of water depend upon the amount of paste, it is important that as little paste as possible should be used and hence the importance of grading.

1:1:2.18

Casting and Curing

The mould specification, preparation of mould the method of casting and curing are discussed in following.

Casting Mould Preparation

The PVC mould dia 180 mm, 600 mm height was placed in position on an even surface. All the interior faces and sides were coated with mud oil to prevent the sticking of concrete to the mould.

Mixing

The concrete using grade M30 (1:1:2.18) with water cement ratio 0.37 were used. Concrete is mixed in roller type of mixing machine.

Figure 1: Concrete Mixing

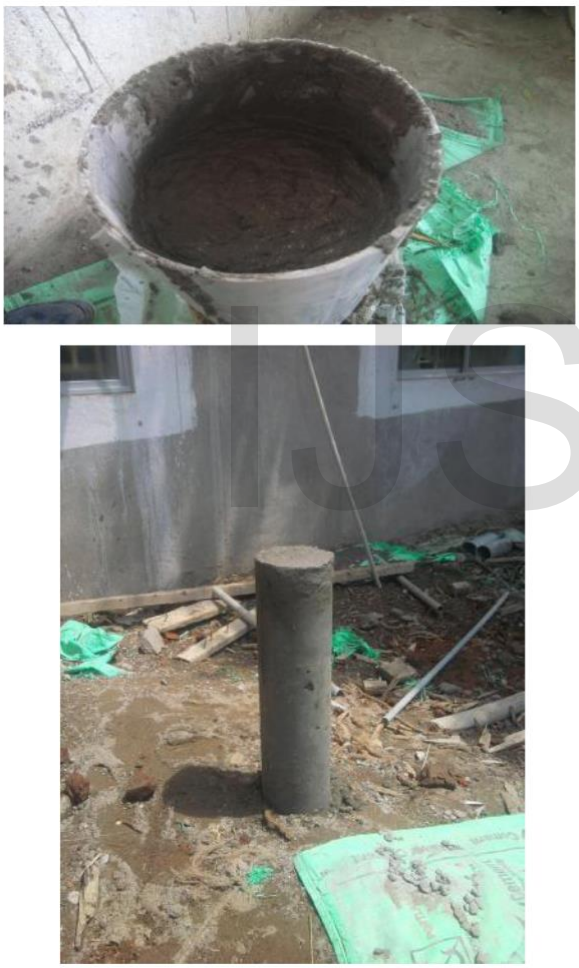
Placing

Concrete is properly placed beneath and along the sides of the mould with help of trowel.

Compaction

Hand compaction was done for all the cubes used in the test. The damping mild steel rods having point ends were used to poke the concrete and it is placed in vibrating table to make compaction complete.

Figure 2: Casting of Column



Curing

The specimen is striped after 24 hours. The test cubes were cured for duration of 28 days in a curing tank. With chloride content.

Figure 3: Curing of Column

Test of Specimen and Result Analysis

Testing of concrete plays an important role in controlling and confirming the quality of cement concrete. Conventional column are tested for its strength characteristics.

Testing of Specimen

Compression Test

The cubes of size 150 x 150 x 150 mm are placed in the machine such that load is applied on the opposite side of the cubes as casted. Align carefully and load is applied, till the specimen breaks. The formula used for calculation.

Figure 4: Compression Test

Compressive Strength = Total Failure Load/ Area of the Cube

Split Tensile Test

The test is carried out by placing cylinder specimen of dimension 150 mm diameter and 300 mm length, horizontally between the loading surface of compression testing machine and the load is applied until failure of the cylinder along the vertical diameter. The failure load of the specimen is noted.

The failure load of tensile strength of cylinder is calculated by using the formula

Tensile strength = 2P/3.14 DL6.2.2

where,

P – Failure of the specimen

D – Diameter of the specimen

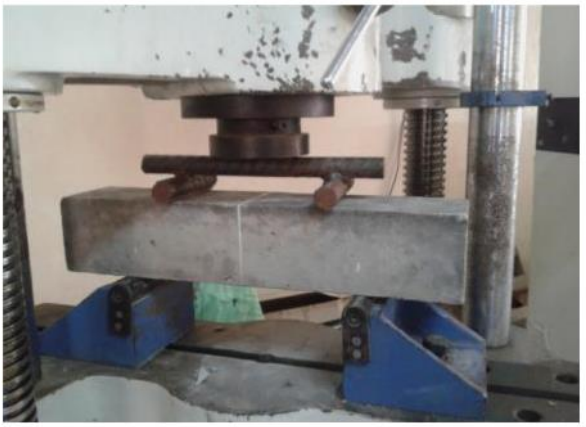
L – Length of the specimen

Figure 5: Split Tensile Test

Flexural Test

The test is carried out to find the flexural strength of the prism of dimension 100 x 100 x 500 mm. The prism is then placed in the machine in such manner that the load is applied to the uppermost surface as cast in the mould. Two

Figure 6: Flexural Test



points loading adopted on an effective span of 400 mm while testing the prism. The load is applied until the failure of the prism. By using the failure load of prism.

Flexural strength = Pl/bd^2 P –

Failure load of the prism l –

Length of the prism b –

Breadth of the prism d – Depth

of the prism

Table 4: Test Results

S. No.	Speciman	Compressive Strength N/mm^2	
	Cube	**7 days**	**28 days**
1.	1	16.89	29.01
	2	17.10	29.15
	Cylinder	**Split Tensile N/mm^2**	
2.	1	0.95	2.35
	2	0.98	2.40
	Prism	**Flexural Test N/mm^2**	
3.	1	4.09	6.40
	2	4.01	6.17

Test Setup

Column has been tested in loading frame with proper procedure. The axial load is applied

gradually and the strain readings were taken at regular intervals of loading. The loading is continued up to the ultimate load level and the failure pattern has been studied.

Apparatus

RC column,

Loading frame,

Load Po = □ccAg + (□SC□CC)ASC

Figure 7: Testing of Column

Table 5: Column Resullt

Initial Crack	184 KN
Maximum Load	211 KN
No of Cycle(s)	355

CONCLUSION

- The non use of concrete proves to be more effective penetration in concrete column.
- May increase of concrete cover in column to achieve good axial compressive strength, penetration control and corrosion.
- Compressive strength is decreased due to curing in salty solution.
- Total ultimate load carrying capacity of the specimen is devastatingly low. Since the load carried is about 240 kN whereas the ordinary is about only 109 kN.

SUGGESTION FOR FUTURE WORK

- Use various sizes of cover for column with different Mix of column specimen with various loading.
- Investigation of production of various sizes of Cover for column with different curing 28 days, 54 days, and 84 days.
- Experimental Investigation of water permeability test after testing of column.

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