# DETERMINATION OF FLESTURAL STENGHT OF CONCRETE BEAM AND ITS SIGNIFICANCE

**Mohd Muqeem**
Registration No: 28118071
Research Scholar
Dept of Civil Engineering
Shri JJT University, Rajasthan.

**Dr. Anil Achuyt Kunte**
Research Guide
Professor
Dept of Civil Engineering
Shri JJT University, Rajasthan.

**Prof. D Vijaya Kumar,**
Research Co-Guide
Adjunct professor,
Department of Environmental Sciences,
Andhra University, Visakhapatnam.

## ABSTRACT

*In coastal environment reinforcement corrosion is an obvious cause of deterioration of concrete structures which affects the durability and service of reinforced concrete beams. Flexural strength is a measure of resistance against failure in bending and durability is the property of material against weathering action. The main aim of our study is to investigate and compare the flexural strength and theoretically estimated steel loss of corroded and un corroded reinforced concrete beams replaced with 0%, 10%, 20%, 30% fly ash with cement respectively. Accelerated corrosion technique using 5%Nacl and impressed current were adopted to corrode the beam experimentally. The important factors that influence the test results are grade of the concrete and percentage replacement of fly ash. At 10% replacement of fly ash there is a much reduction in the steel loss and as the replacement increases there is a little reduction in steel loss and considerable change in flexural strength.*

***Key words:*** *Corrosion, Flexure Strength, Fly Ash, Grade Of Concrete*

## INTRODUCTION

Flexure or bending is commonly encountered in structural elements such as beam sand slabs which are transversely loaded and the strength is a measure of tensile strength of OPC concrete. Although the probability of the structures being flexure deficient is low, failures have occurred due to a variety of factors: errors in design calculations and improper detailing of reinforcement, construction failures or poor construction practices, changing the function of a structure from a lower service load to a higher service load, seismic and wind action. Corrosion is caused by the destructive attack of chloride ions penetrating by diffusion or other penetration mechanisms from the outside. Carbonation of concrete or penetrations of acidic gases into the concrete causes of reinforcement corrosion. Besides these there are few factors, some related to the concrete quality, such as w/c ratio, cement content, impurities in the concrete ingredients, presence of surface cracking, etc. and others related to the external environment, such as moisture, bacterial attack, stray currents, etc., which will effect the properties of reinforcement corrosion(Castroetal.,1997).

Uncontaminated cover concrete provides a physical barrier that prevents the direct exposure of the steel surface at the outside environment. It also provides a highly alkaline chemical environment that protects steel from corrosion. Corrosion produces expansive products that generate tensile stresses in the concrete surrounding the reinforcing steel, which may cause concrete cracking and can increase the overall tensile strength and stiffness of the concrete structure. Corrosive products are highly porous, weak and often form around reinforcing steel which decreases the bond strength between the reinforcement and concrete. The expected costs of failure for serviceability were significantly higher than the expected costs of failure for ultimate strength limit states. This signifies the need for researching the area of corrosion and inclusion of concept of durability design in our codes with a greater relevance associated to it.

**LITERATURE REVIEW**

**Junjie Jin [2022],** has been receiving a lot of attention in the business of dam construction for hydropower and water resource applications. Improvements in construction techniques and materials have made building RCC dams quicker and cheaper than ever before, but the loss of natural ecosystems has a far bigger effect on the environment. In spite of all the money being poured into hydroelectric projects, there is still a risk of dam collapse as a result of seepage degrading the dam's mechanical features. The potential for dam collapse has not diminished, thus there remains an increased danger here. The primary objective of this study is to elucidate efficient application procedures for joint bonding in an effort to shorten the typically lengthy period of autogenous healing from years to months. To that end, this research delves deeply into how the bonding quality of interlayer joints influences RCC mix performance and how it consolidates RCC layers to withstand shear stress at the interface.

**Karthikeyan Jayakumar's [2021]** In this article, we provide the results of our investigation into the fundamental concepts that underpin many of the prevalent traditional techniques of maturity used to estimate in-place strength of concrete. These concepts are used in concrete strength prediction techniques. It has been discovered that the strength of improved concrete falls in proportion to its maturity before and after treatment, precisely as it does in conventionally cured concrete specimens, when the temperature of the concrete increases by less than a positive amount after the blending procedure. However, this is not always the case due to the fact that rapid heating causes concrete to lose a lot of its strength. There is a well-established correlation between maturity index and strength, allowing for accurate forecasting of in-situ concrete's durability.

**Brindha Dharmar (2020)** hypothesises that the superior quality of natural fibres may explain why they have been so widely used in building in recent decades. The effects of static and dynamic loads on basalt fibre reinforced concrete are described in this research. By incorporating basalt fibres of varied sizes and shapes (including chopped fibres, minibars, rebars, and meshes) into the concrete, the researchers want to showcase the material's physical and mechanical capabilities. Using basalt fibre in concrete and subjecting it to a variety of stresses is the subject of the proposed review research, which gathers the available literature on the issue. Static and dynamic loads in concrete are examined and assessed in relation to fibre size and volume%.

**Heather Brown [2016]**the properties of conventional concrete, roller compacted concrete (RCC), and flowable fill were examined. Wood ash was successfully used as a cement and sand substitute in all three applications. The primary objective was to gain insight into how wood ash altered the fundamental characteristics of these materials throughout the manufacturing process and after they had hardened. The use of wood ash as a replacement for some of the cement in traditional concrete mixes was shown. Improved compaction and reduced segregation are only two of the many advantages of using wood ash into RCC.

**Use Flexural Strength**

Beam field specimens must be meticulously prepared. Concrete pavements often sag anywhere from half an inch to two and a half inches. Upon more reflection, you'll see that it's not quite as easy as first seems. If the moulds are tapped to remove trapped air, then spaded around the edges after rodding, the result will be even more sagging. Maintain a constant moisture level on the beam surfaces. Wait at least 20 hours for the limewater to become green.

While creating standards and analysing ostensibly low strengths, the larger variety in flexural strength values should be taken into account. Flexural strengths of concrete may be controlled to within a range of 40 to 80 psi (0.3 and 0.6 MPa) for strengths up to 800 psi (5.5 MPa). If the standard deviation is more than 100 psi (0.7 MPa), there may be issues with the testing. Weakness in a beam may result from insufficient testing or from moisture changes within the beam as a result of early drying.

**Design for Flexure**

- Sectional design and member details are two essential parts of designing reinforced concrete components for flexure. Cross-sectional geometry and the necessary ACI 318-05 longitudinal reinforcement are both part of the sectional design process. The development, splice, and anchoring length criteria given in ACI 318-05 regulate the calculation of bar lengths, cut-off point positions, and reinforcing details for members. This addresses the use of ACI 318-05's Strength Design Method for sectional member design in flexure.
- Reinforcement and concrete strains are proportional to the angular displacement from the neutral axis. This indicates that strains vary linearly over the segment and that unknown values may be calculated from known strain
- concrete sections are said to have reached their flexural capacities, and the stress in the reinforcement increases linearly with strain up to the specified yield strength. After this point, further increases in strains have no effect on the stress level. In other words, we are ignoring the effect of strain on steel's hardness.
- Lack of attention paid to concrete's tensile strength.

**Design of rectangular reinforced concrete Beam**

Beams made of reinforced concrete are structural components that are meant to support external transverse loads. Torsion, shear, and bending moments are all transmitted down their length as a result of the stresses. Plus, concrete is excellent in compression but terrible in tension. Consequently, tensile stresses in reinforced concrete beams were previously absorbed by steel reinforcement. Beams may also be continuous, self-supporting, or cantilevered. Shapes like rectangles, squares, Ts, and Ls are all possible. Beams may have one or two layers of reinforcement. If the beam depth is limited, the latter option should be utilised.

**Flexural of Reinforced Concrete Beams**

These components may be anything from joists to girders to spandrels to lintels in a contemporary building. However, regardless of the circumstances, their actions remain consistent. Unless otherwise indicated, beams will be used to describe flexural members throughout this solution. Strength, ductility, serviceability, and constructability requirements for beams according to ACI 318 are summarised and shown below.

**Strength**

In order for a flexural design to be valid, there must be a minimum strength of.

Mu ≤ ØMn

Mu is the bending moment of the factored loads, and Mn is the member's nominal moment strength. One steel-reinforced concrete beam may set you back $3.6 million.

A steel rectangular beam at its highest stress point is the simplest example of this idea.

**METHODOLOGY**

Experiment & numerical modelling are the research methods used in the present research. The experimental research is divided in to two different parts which include the study of the behavior of simply supported & continuous beams along crimped & hooked end steel fibers under monotonic & cyclic loading. Initially, the materials used in the current research are tested for their properties. Two types of beams, namely HPC & HPFRC, have been cast & tested under cyclic loading as well as monotonic loading. Two conventional concrete beams are cast as HPC beam & three types of HPFRC beams are cast, namely hooked end fiber reinforced HPC beam, crimped fiber reinforced HPC beam & hybrid fiber reinforced HPC beam. For each mix, two specimens are cast. In the case of hooked end & crimped fiber reinforced concrete beam, the beams are incorporated into hooked end fibers & crimped fibers respectively. In hybrid fiber reinforced concrete beam, the specimen is incorporated along 70% of hooked end & 30% of crimped fibers through volume of total fraction of 1.5%. Then the eight beams are subjected to cyclic loading. Similarly, the other eight beams are cast & subjected to monotonic loading. The load is applied along the help of screw jack & the deflection is measured through means of deflector meter

**RESULTS**

**Flexural Strength Test Results**

Table 1 and image 4.19 show the binary and ternary combination mixes' flexural strengths after 28 days of curing 4.9, respectively.

**Table 1 Flexural Strength Results for Binary and Ternary Mixes**

| Sl. No. | Mix Designation | Flexural Strength (MPa) | |
|---|---|---|---|
| | | Experimental Flexural Strength | Theoretical flexural strength($0.7\sqrt{f_{ck}}$) |
| 1 | CC | 7.11 | 3.84 |
| 2 | SFBAC | 7.80 | 3.95 |
| 3 | SFSSAC | 8.15 | 4.29 |
| 4 | BASSAC | 7.90 | 4.23 |
| 5 | SFBASSAC | 7.49 | 3.73 |

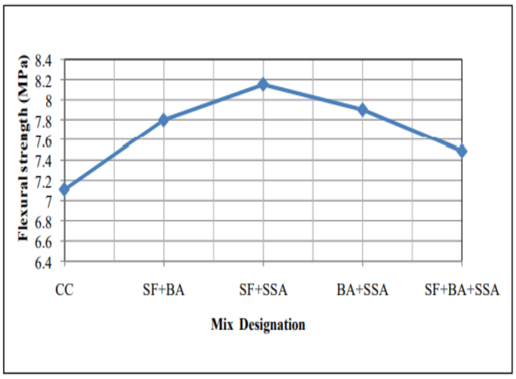


**Figure. 1 Flexural Strength test Results for Binary and Ternary Mixes**

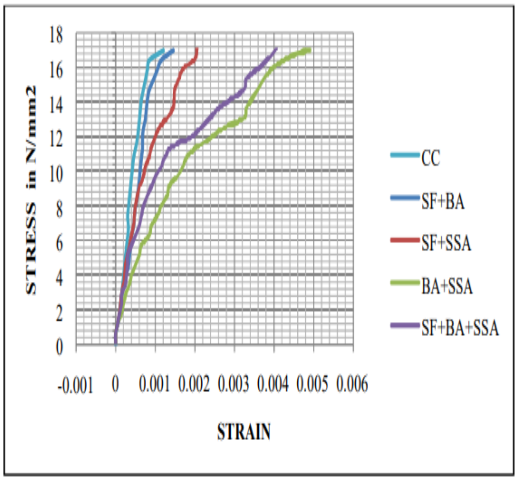
Flexural strength varies relatively little across the board with the exception of the SFSSAC/BASSAC combo. It has also been noted that HPC blends have greater flexural strength compared to CC. Increases in flexural strength of 8.84 percent, 12.76 percent, 10 percent, and 5.07 percent were also reported relative to CC. Flexural strength was improved across the board as compared to regular concrete, regardless of whether it was a binary or ternary mix.

**Test Results for Modulus of Bounciness**

Except for the combination of SFBAC and SFSSAC, the modulus of elasticity showed relatively little variance across the board. It was also discovered that, with the exception of the BASSAC mix, the modulus of elasticity of HPC mixtures rises with regard to the CC. It was also determined that the modulus of elasticity rose by 21.97%, 65.68%, and 4.19% for the SFBAC, SFSSAC, and SFBASSAC mixtures, respectively, when compared to the CC. When compared to CC, the BASSAC mix saw a 3.91 percentage point drop in value.

**Table 2 Results for Modulus of Elasticity**

| Sl. No. | Mix Name | Modulus of Elasticity | |
|---|---|---|---|
| | | periment al Modulus of Elasticit y(E) | Theoretic al Modulus of Elasticity( E) |
| 1 | CC | 21168 | 27459 |
| 2 | SFBAC | 23381 | 28279 |
| 3 | SFSSAC | 31759 | 30655 |
| 4 | BASSAC | 18417 | 20383 |
| 5 | SFBASSAC | 24972 | 26683 |




**CONCLUSION**

From the flexural strength and theoretically estimated steel loss values we can conclude that flexural strength mainly depends upon the grade of the concrete whereas the estimated steel loss depends upon the replacement of fly ash. As the grade of concrete increases, the flexural strength¬ of concrete increases and steel loss decreases. When the percentage of fly ash is increased there is a¬ little change in the flexural strength and considerable reduction in the steel loss. The beams replaced with 10%fly ash is considered as¬ optimistic because in flexure test there is no much difference between conventional and replaced and in steel loss test there is considerable change from conventional and replaced one.

Concrete made with SFBAC, SFSSAC, BASSAC, and SFBASSAC had a high RN value before being submerged in a 3% sodium chloride solution. During the salt resistance test, the rebound values were in the 29–39 range before immersion and the 22–28 range thereafter. The concrete made with the BASSAC mix seems to be more resistant to acid and of higher quality overall.

Before being subjected to a 3% salt chloride solution, UPV readings for SFBAC, SFSSAC, BASSAC, and SFBASSAC concrete were all rather high. Salt resistance was evaluated both before and after immersion using ultrasonic pulses with velocity of 4.0 to 4.4 km/sec for the former and 3.5 to 3.9 km/sec for the latter.

All four types of concrete (SFBAC, SFSSAC, BASSAC, and SFBASSAC) had a rather high RN value before being immersed in a 5% sodium sulphate solution. Before being immersed, the rebound values were in the 30–40 range, but after being subjected to the sulphate resistance test, they dropped to the 20–28 range. The concrete made with the SFBAC combination seems to be more resistant to acid and of higher quality overall.

Concrete made using SFBAC, SFSSAC, BASSAC, and SFBASSAC had a high UPV before being submerged in a 3% sodium chloride solution. For the sulphate resistance test, the ultrasonic pulse velocity was between 4.0 and 4.4 km/s just before immersion, and between 3.4 and 3.9 km/s just after. High-quality, acid-resistant concrete was produced using the SFBASSAC mixture.

Unlike CC pictures, SEM photographs of silica fume concrete may provide a more accurate depiction of the adhesive's hydration.

## BIBLIOGRAPHY


1. *Arezki Adjrad (2016),"Prediction of the Rupture of Circular Sections of Reinforced Concrete and Fiber Reinforced Concrete", International Journal of Concrete Structures and Materials, ISSNno:2234-1315, Vol.10(3), DOI:10.1007/s40069-016-0137-8*
2. *Arul Siva (2018),"A Review on Self Compacting Concrete", International Journal of ChemTech Research, ISSNno:2455-9555, Vol.10(11), Pages.62-68.*
3. *Aurelio Muttoni (2015),"Design versus Assessment of Concrete Structures Using Stress Fields and Strut-and-Tie Models", Aci Structural Journal, ISSNno:0889-3241, Vol.112(5), Pages.605-616.DOI:10.14359/51687710*
4. *Avin Pillay (2010),"Tracking chloride and metal diffusion in proofed and unproofed concrete matrices using ablative laser technology (ICP-MS)", Natural Science, ISSN no:2150-4105, Vol.2, No.8, Pages.809-816.*
5. *Biranchi Panda (2018),"Experimental study on mix proportion and fresh properties of fly ash based geopolymer for 3D concrete printing", Ceramics International, ISSNno: 1873-3956, Vol.44, Issue.9, Pages.10258-10265.https://doi.org/10.1016/j.ceramint.2018.03.031*
6. *Brindha Dharmar (2020),"Influence of basalt fibers in the mechanical behavior of concrete—A review", Structural Concrete, ISSNno:1751-7648,Vol.22(2),DOI:10.1002 /suco.201900086*
7. *C.D. Atiş (2005),"Influence of dry and wet curing conditions on compressive strength of silica fume concrete", Building and Environment, ISSN no:0360-1323, Vol.40, Issue. 12, Pages.1678-1683.https://doi.org/10.1016/j.buildenv.2004.12.005*
8. *Caijun Shi (2015),"A review on mixture design methods for self-compacting concrete", Construction and Building Materials, ISSNno:0950-0618, Vol.84, Pages.387-398.https://doi.org/10.1016/j.conbuildmat.2015.03.079*
9. *D. V. Phillips (1993),"Direct tension tests on notched and unotched plain concrete specimens", Magazine of Concrete Research, ISSNno:1751-763X, Vol.45(162), Pages. 25-35.DOI:10.1680/macr.1993.45.162.25*
10. *D.Y. Gao (2009),"Experimental study on axial compressive strain-stress relationship of plastic concrete", Shuili Xuebao/Journal of Hydraulic Engineering, ISSNno:0559-9350, Vol.40(1), Pages.82-87.*