# POLYMER MODIFIED REINFORCED CONCRETE BEAMS - A REVIEW ON SHEAR BEHAVIOR

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## ABSTRACT

*In this paper a review is made on the study of shear behavior of normal and high strength polymer modified concrete beams. Use of polymers in concrete made a significance development in enhancing the durability criteria and bonding between the aggregates. Polymer like natural rubber latex in concrete improves resistance against carbonation and chloride penetration. This paper presents a comprehensive review on various aspects like need of high strength concrete, crack width, percentage of longitudinal reinforcement, shear reinforcement and spacing of shear reinforcement to be used in the reinforced concrete member.*

***Keywords - Crack Width, High Strength Concrete, Longitudinal Reinforcement, Polymers In Concrete, Shear Reinforcement***

## I. INTRODUCTION

Reinforced concrete is commonly used material in the growth of urbanization. It is largely used in the construction industry. The use of reinforced concrete has increased due to its advantages like low creep, shrinkage and permeability, high modulus of elasticity, and chemical resistance, freeze thaw resistance. Besides these advantages, there exist a number of modes of failure in reinforced concrete structure. One of the most common failures in the concrete beams and other structural components is mainly due to shear. Beams are structural members which are used to carry loads by shears and internal moments. The reinforced concrete beams are initially designed for flexural strength and then for shear strength. In the design of a RC member, flexure is usually considered first, which leads to the size of the member and the arrangement of reinforcement. Beams are then designed for shear.

## II. HIGH STRENGTH CONCRETE

The high strength concrete is comparatively a brittle material as it fails in abrupt manner due to the presence of sound matrix of aggregates and cement paste which provides a smoother shear failure plane. The shear strength of High Strength Concrete does not increase as compressive strength increases. As high strength concrete is commonly used nowadays, many studies were also conducted to study the shear behavior of high strength reinforced concrete members. Increase in shear strength increases the brittleness compared to normal strength concrete. With a stronger interface between the cement paste and the aggregate, the failure surface of high strength concrete is smoother and thus lead to a weaker post-cracking shear resistance due to less aggregate interlock.

## III. POLYMERS IN CONCRETE

Polymer concrete is a concrete which has polymer in it and same ingredients of concrete. During mixing process polymers are added to the concrete and when added they increase the binding properties and adhesion with the aggregates. Polymer possesses a long chemical chain structure, and interns develop bonding in the concrete mix. Cement materials provide short-range structures of bonding. Polymer materials provide superior compressive, flexural and tensile strength to the concrete made of ordinary Portland cement. In addition, they provide good adhesion to other materials as well as resistance to chemical attack and physical damage (abrasion, erosion, and impact). Addition of polymer to conventional concrete could yield composites with excellent physical and mechanical properties. Polymer materials are available in wide ranges and have variations in properties could provide complex properties to polymer-modified concretes.

## IV. Latex Modified Concrete

The latex modified concrete is defined as Portland cement and aggregate combined at the time of mixing with polymers which are dispersed in water. This dispersion is known as latex. A polymer is a material composed of thousands of simple molecules called as monomers. These monomers are combined by a reaction called polymerization. When latex is added with other ingredients the fresh concrete is produced with consistency and workability characteristics slightly different from normal concrete. After curing, the latex-modified concrete (LMC) consists of hydrated cement paste and aggregate which are interconnected by a continuous film of latex. This continuous film imparts the superior physical and chemical properties to latex-modified concrete. A latex generally contains about 50 % by weight of spherical and very small (0.01 to 1 m in diameter) polymer particles which are by surface-active agents in suspension of water. The presence of surface-active agents in the latex tends to incorporate large amounts of entrained air in concrete; therefore, air detraining agents are to be added to commercial latexes.

## V. LITERATURE REVIEW

### 5.1 Modes of Shear Failure

DeWolf [1] concluded Shear failure of a reinforced concrete beam is sudden, brittle and has the potential for catastrophic consequences. Because of the unpredictable nature of shear failures & general guidelines require shear strength to be greater than the flexural strength of a beam in all regions

Three types of shear failure are possible

- Diagonal tension shear failure
- Bond splitting (end anchorage shear failure)
- Crushing of compression strut

### 5.2 Shear Reinforcement

Piyamahant [2] showed that the RC structures should have stirrup reinforcement equal to the minimum requirement specified by the code. The theoretical analysis shows that the amount of stirrup of 0.2% should be provided.

B.K.Kolhapure [3] concluded that, the strength of the concrete, longitudinal reinforcement ratio, shear span to depth ratio value and depth of the beam are the most influencing parameters in the deformational and shear behavior of the high strength concrete beams with web reinforcement. As the spacing of shear reinforcement increased to 225mm and 300mm the load carrying capacity decreased. As the spacing of shear reinforcement decreases to75 mm the load carrying capacity increases. Shear failure is characterized by small deflection lack of ductility and catastrophic failure.

Dr .WaleedAwadWaryosh[4] said that when transverse steel ratio is stepwise increased from zero to 0.00377, 0.00502 and 0.00754, shear reinforcement contribution is increased by 47.7% and 136% respectively.

Attaullah Shah[5]found that the failure in most of the beams has been caused due to diagonal tension cracking. For beams without web reinforcement and having large values of longitudinal steel (ρ=1% and 1.5%), the shear failure is more brittle and sudden, giving no sufficient warning.

Khairy Hassan Abdel Kareem [6] concluded that increasing the amount of shear reinforcement leads to an increase in the beam ductility, so the minimum amount of shear reinforcement must be increased for high strength concrete.

### 5.3 Longitudinal Reinforcement

Wassim M. Ghannoum[7]found that increasing the amount of longitudinal steel reinforcement increases the shear stress at failure in both the normal-strength and high-strength concrete beams

R.S. Londhe[8] observed that the addition of longitudinal beyond 1.80% and transverse steel beyond 1.25% improves the shear response of the transfer beams by increasing the failure shear strength and a higher ductile response.

B.K.Kolhapure [3] concluded that as the percentage of longitudinal steel increases from 1%, 1.8% and 2.8% the load carrying capacity of the beam increases.

### 5.4 Crack Width

ArunaMunikrishna[9] confirms that the measured shear crack widths for all beams reinforced with high-strength stirrups designed with a yield strength of 80 and 100 ksi (552 and 690 MPa) were within the allowable limit recommended by ACI 318-08.10.

Tarek K. Hassan [10] concluded that direct replacement of the conventional steel stirrups by a similar amount of HS steel stirrups increases the shear capacity of concrete beams, increases their stiffness and reduces the shear crack width due to the better bond characteristics of the HS steel.

### 5.5 Influence of Rubber Latex

OhamaY[11] found that hardened latex-modified concretes developed good strength, adhesion, pore structure, impermeability and durability (freeze thaw resistance, chloride penetration resistance, carbonation resistance and weather ability).

Dr. Vaishali.G.Ghorpade [12] observed that at 0.5 % of rubber latex, the decrease in the compaction factor. Also these mixes are quite cohesive even at lower water-cement ratio of 0.325 because of the polymer (Natural Rubber Latex) used in the mix. The 28-day compressive strength increases with increase in percentage of Rubber latex up to 0.5%. It can further be observed that the maximum compressive strength of 103.67 MPa is achieved at 0.5 % dosage of natural rubber latex and 1.0 % of steel fiber at water cement ratio of 0.325.

## VI. CONCLUSION

1. The longitudinal reinforcement ratio, strength of the concrete, shear span to depth ratio value and depth of the beam are the most influencing parameters in the deformational and shear behavior of the High Strength Beams.
2. Increase in percentage of longitudinal reinforcement increases the shear strength and ductility of the beam.
3. Minimum shear reinforcement should be provided in the beam to avoid the sudden failure.
4. Decrease in the spacing of shear reinforcement increases resistance against shear and reduces the crack width.
5. Stirrups which are made of high strength steel reduce the width of the cracks and increase the stiffness of the member.
6. Use of natural rubber latex in concrete improves adhesion property, impermeability, durability, imparts strength, and makes concrete cohesive at low water to cement ratio.

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