

# THE MECHANISM STUDY OF CONCRETE IS ANALYZED COMPREHENSIVELY

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**Abstract:** Polyurethane cement is a new composite material with excellent properties, and its unique molecular structure and physical properties make it have a good enhancement effect in the concrete structure. Compared with traditional concrete materials, polyurethane cement has the advantages of lightweight, high strength, crack resistance and good durability, which can effectively improve the carrying capacity and service life of concrete structure. Therefore, polyurethane cement has been widely used in the construction, bridge, road and other fields. With the continuous development of the construction industry, the limitations of the existing concrete materials in the structural bearing capacity cannot be ignored. As a new composite material, polyurethane cement is widely used in construction, transportation and other industries because of its excellent properties. In recent years, polyurethane cement is favored in the field of concrete structure. Through the analysis of domestic and foreign research status, summarize the research progress of the enhancement mechanism of polyurethane cement in concrete at present, and the enhancement method of the existing polyurethane cement is analyzed, and the development direction is discussed.

**Keywords:** Polyurethane cement composite material; Concrete; Reinforcement mechanism

## 1. INTRODUCTION

In existing building structures, concrete is the most common Building materials [1]. However, due to the long-term exposure of concrete in construction, Exposed to the atmospheric environment and subjected to various loads for a long time, Damage such as cracking will occur, making the original structure unable to meet the load requirements. beg. In order to save money and reduce construction period, it is necessary to study reinforcement technology technology to enhance the bearing capacity of the original structure [2]. At this stage, Reinforcement methods widely used in practical engineering mainly include reinforcement Large-section reinforcement method, pasted steel plate reinforcement method [3-7], although the above Reinforcement methods can increase the load-bearing capacity of the original structure, but because Due to construction technology, reinforcement stability and other reasons, the reinforcement effect is not ideal [8]. Polyurethane appeared in 20 Century 30 years, after nearly 80 Year With the continuous development, it has been widely used in all walks of life. Polyurethane water Mud composite material has high early strength and toughness, suitable for concrete Soil repair and reinforcement [9]. Polyurethane cement because of its own advantages It has developed rapidly due to its performance and has produced great economic benefits. beneficial [10], The emergence of polyurethane cement provides an opportunity for concrete reinforcement Brand new ideas. This article provides an overview of the current polyurethane cement reinforced concrete make a more comprehensive summary of the mechanism of soil and elaborate on the research process some issues and look forward to the development trends of future research. Provide reference for subsequent research.

## 2. CONCRETE REINFORCEMENT RESEARCH

### 2.1 Increasing Section Method

The main principle of increasing section method is to increase the cross-sectional area of the original structure, add steel bars or increase the frame area.

The bearing capacity of the structure [11]. Wei Youliang [12] By increasing the cross section The stone arch bridge was reinforced and subjected to load-bearing capacity verification and cross-section strength verification. Calculation and so on, the conclusion shows that after increasing the cross-section reinforcement, the bridge load-bearing The capacity is improved to meet the load level requirements.

### 2.2 Pasting Carbon Fiber Reinforcement Method

The main principle of pasting carbon fiber reinforcement method is to combine carbon fiber Bonded in the tensile direction of concrete components, making the components shear resistant and Improved bending resistance [13]. Liu Dongkun [14] By pasting carbon fiber cloth to strengthen aging concrete, the conclusion shows that carbon fiber paste reinforcement solid has a positive effect on improving bearing capacity.

### 2.3 Prestressed Reinforcement Method

The main principle of the prestressed reinforcement method refers to the Apply part of the prestress or deformation in advance to reduce or offset Eliminate negative stress and deformation [15]. Hu Junqi [16] Use prestressed reinforcement technology in bridge maintenance and reinforcement, and apply prestressed reinforcement technology to bridge

maintenance and reinforcement. An overall analysis of techniques shows the broad prospects of prestressed reinforcement scenery and good reinforcement effect.

## 2. 4 Composite Reinforcement Method

The main principle of composite reinforcement method is to combine two or more reinforcement methods or combining two high-performance materials Reinforcement methods so that they can take advantage of various reinforcement methods [17].

## 3. RESEARCH ON POLYURETHANE CEMENT

Li Xinggui [18] Combine polyurethane modified concrete with ordinary mortar. Doing comparative experiments, it was found that the compressive strength of polyurethane cement The strength, durability and other properties are better than ordinary mortar. Liu Zhimeng [19] The incorporation of water-soluble polymer admixtures can Significantly improve the workability of concrete and effectively increase the strength of concrete strength, durability. Studies have found that polymer modifications incorporating polyurethane The flexural strength and splitting strength of flexible concrete are significantly improved. Hu Guojin [20] Preparation and performance development of water-based polyurethane Research has found that the amount of water-based dispersion polyurethane added to mortar can have an impact on cement properties. And water-based polyurethane is The cement hydration reaction has a certain retarding effect, and it is mixed into cement mortar Appropriate polyurethane can effectively reduce the particle size fraction of cement hydration products. cloth and hole radius, effectively improving cement performance. Wu Yanhua [twenty one] Mercury pressure on polyurethane modified cement mortars conduct research through MIP In the experiment, cement mortar was mixed with poly(polymer) Urethane, it was observed that the pore structure of the cement slurry changed and hardened. The micropore porosity of cement is improved, so polyurethane modified water The anti-permeability and frost resistance of mud mortar have been effectively improved. Chen Hui [twenty two] By comparing two different properties of polyurethane and cement Composite material, water-based polyurethane prepolymerized at the same water-cement ratio Body and cement composite materials have the highest strength. Found through testing, Polyurethane prepolymer promotes the hydration of cement, promotes deep hydration of cement, and thereby improves material strength. Zhang Kexin, Sun Quansheng [twenty three] High toughness polyurethane cement composite Study the mechanical properties of materials. Research has found that concrete and The failure form of polyurethane cement is concrete interface failure, and In the experiment, the failure modes of concrete were all bonded failure, and polyurethane The strong adhesiveness of ester cement was confirmed. Xu Yangnan [24] Experimentally observing the addition of water-based polymers into cement Changes in concrete foundation properties after urethane treatment, research found that water-based After polyurethane is mixed into cement mortar, a certain amount of polyurethane should be added. Under the conditions, the pore structure of cement mortar is effectively improved, and the water Mud density is improved. Zhang Jifeng [25] Compressive and flexural strength of polyurethane cement specimens degree of testing, the study found that the material density and polyurethane cement The relationship between compressive strength and flexural strength of materials. polyurethane water Mud condensation speed Spend Fast, comfortable combine use At quick speed Rob build wait answer urgent work Process. Wu Ruobing [26] Modify cement with water-based polyurethane and research Research has found that when 3% solvent-free self-emulsifying water-based polyurethane is added to cement mortar, 28% of the cement mortar will d Bonding strength reaches peak value, the initial setting time of cement mortar is extended, and the mortar's bending and compression resistance are The intensity has been reduced.

## 4. CLASSIFICATION OF POLYURETHANE CEMENT REINFORCED CONCRETE

### 4.1 MPC Composite Material Reinforcement (Increased Cross-Section Method)

Gudandan [27] Pouring MPC Composite material versus hollow slab bridge The main beam is reinforced, and the transverse alignment is performed at the maximum bending moment in the mid-span. The strengthened main beam is subjected to normal loading and eccentric loading at the maximum bending moment. The deflection was reduced respectively, and the development of original cracks was inhibited. For production, MPC Composite materials play a positive role in concrete reinforcement effect. Wang Jianlin [28] took the bridge reinforcement and maintenance project as an example to MPC The reinforcement of composite materials is studied. MPC composite materials Reinforcement methods can effectively improve the original structure under normal use conditions The ultimate carrying capacity and proposed MPC Under certain conditions, it can be Reinforcement and repair of components without interrupting use. Zhang Lidong [29] Adopt MPC Composite materials versus prestressed concrete The soil hollow slab bridge is reinforced, and the hollow slab bridge is reinforced. The stress of concrete and the stress of rigid strands both decreased, and the hollow slab deflection The strength is significantly reduced, and the crack spacing when damage occurs becomes smaller and appears Evenly distributed. After reinforcement, the yield load and ultimate load of the bridge All have significant improvements. Sun Quansheng [30] For hollow plate beams MPC Reinforce and observe Finite element analysis was performed to observe the load intensity of the components before and after reinforcement. The study found that the load-bearing capacity of the components was significantly improved after reinforcement. Under load, the deflection and maximum strain of the reinforced main beam are both obvious. Significantly reduced. Guo Jiancai [31] Relying on the widening of the Beijing-Kaifeng Expressway bridge, Reinforced reinforced concrete solid slab bridge. After research, it was found that MPC Composite material reinforced bridges can effectively improve the load bearing capacity of concrete bridges. The load is distributed laterally, and the overall stress strength of the bridge is improved. Peng Bo [32] Adopt MPC Composite materials versus void defective steel Tube concrete is reinforced, study finds, using MPC composite material The hollow concrete-filled steel tube short columns

are thickened and the bearing capacity is greatly restored. MPC Both composites and concrete can be used with The peripheral steel pipes produce strong interactions during loading, which in turn causes The bearing capacity and ductility of components are improved.

#### 4.2 Polyurethane Coating Reinforcement

Zhang Jingjing et al [33-37] Research has found that high-strength High-temperature, high-strain composite materials improve the mechanical properties of the original components. Effective improvement. The principle is to spray paint on the surface of the original structure High-performance material, which forms a film-like structure after spraying. Can effectively improve the load bearing capacity of the original structure. And polyurethane Ester materials have superior properties such as high flexibility and elasticity. Composite spray Coating material characteristics, and polyurethane has strong bonding ability to concrete and Can be cured quickly, so by spraying polyurethane composites Reinforcement of concrete has attracted much attention. Lei Bo, Huang Xianbin [38] Spray polyurethane on the surface of concrete components ester composite materials and verify the mechanical properties of sprayed concrete components. Studies have found that the location of polyurethane spraying can affect the reinforcement effect impact, concrete members bear static loads and impact loads capabilities have been improved, as the thickness of polyurethane spraying increases With increasing pressure, the maximum strain and cumulative strain of concrete members gradually Increase. Tian Ying et al. [39] Clay brickwork coated with spray polyurethane elastomer The performance of the body wall model was studied, and the study found that through polyurethane Hysteretic properties of clay brick masonry walls improved by elastomer spraying The load-bearing capacity and deformation capacity of the wall after coating reinforcement are improved. Single- and double-sided spray coating of polyurethane elastomer and polyurethane- reinforced walls of different thicknesses show similar hysteretic properties. Adding When the reinforcement thickness is the same, the load-bearing capacity of the surface-reinforced wall is stronger, while Single-sided reinforcement is more conducive to improving the deformation ability of the wall. overall Generally speaking, the overall damage to the wall through the spraying of polyurethane elastomer Power performance is significantly improved. Zhang Cheng et al. [40] Polyurethane Coatings for Concrete Durability The impact was studied. By studying the chloride ion permeability coefficient The study found that the diffusion coefficient of chloride ions in polyurethane-coated concrete components was significantly improved compared with the blank group. Polyurethane coating available Effectively prevents the penetration of chloride ions. Preventing the penetration of chloride ions can prevent mixing. Durability degradation such as rust swelling and peeling of the concrete protective layer. Polyurethane Coatings play an active role in improving the durability of concrete.

#### 4.3 Polyurethane Cement Mixed with Polymer Reinforcement

The principle of polymer modified concrete is to combine cement and aggregate Mixed and dispersed in water or can be dispersed in water organic A composite material produced by combining polymer materials. The resulting composite material may be called polymer modified concrete. At present, most polymer-modified concrete methods mainly include the following two methods: one The polymer is first dispersed in water and then added in the form of emulsion or polymer aqueous solution. The polymer latex is added during the hydration process of concrete. Affects the hydration process of concrete and the structure of concrete, thereby improving the performance of concrete. The other is to first aggregate Pre-disperse the material with cement or other dispersion media, and use the dispersed material in the form of dry-mixed mortar. When water is mixed with mixed ingredients When mixed with water, the polymer forms an emulsion. During the setting and hardening process of concrete, the emulsion dehydrates and forms a solid polymer structure. this In addition, polymers can also be in the form of fibers or fiber-reinforced plastics exist, changing the properties of concrete through polymers, in concrete It has been widely used in [41-45], modified concrete by polyurethane The strength of concrete is increased and more people can see it. Sun Nan and Sun Quansheng [46] studied carbon fiber polyurethane cement (CPUC) The mechanical properties of composite materials are studied through normal Cross-experiment was conducted to analyze the effects of carbon fiber and silica fume under different ash collection ratios. Compare CPUC 7d compressive strength, 28d Effect of compressive strength And get the optimal ratio of materials. CPUC The strength is mainly composed of poly The bonding strength of the interface between urethane, polyurethane and cement, and the bonding strength of the interface between carbon fiber and polyurethane are jointly determined. use After silica fume replaces cement, since the diameter of silica fume particles is larger than that of cement particles, Small, it can effectively fill the voids of cement particles and form good grades. allocation, so that CPUC The void ratio decreases and the compactness and compressive strength are reduced. improve. Because carbon fiber has a high elastic modulus and crack-resistant effect, response, so when a certain amount of carbon fiber is incorporated, the resistance of the material The folding strength and splitting strength are significantly improved. Li Jin [47] The mechanical properties of the test block were tested by using a triple test membrane with different volume ratios of carbon fiber, PVA fiber, and rigid fiber. Studies have found that the flexural strength of polyurethane cement composites increases with fiber The dimensional doping ratio first increases and then decreases. Polyurethane cement composite material The principle of energy reinforcement is that fibers exist in a randomly distributed form Inside the test block, as the fiber content increases, the distance between the fiber and the test block increases. The connection is tighter and the integrity is stronger, and the stress strength of the test block is improved. to enhance. However, adding too much fiber will make it difficult to separate the fiber. Scattered, weakening the flexural strength of the test block. Incorporating an appropriate amount of carbon fiber can make The overall strength of the specimen was improved.

#### 4.4 Polyurethane Cement Composite Reinforcement Method

Guan Zebin [48] Polyurethane cement composite via steel wire rope Reinforce damaged hollow plate beams and test the strength of the reinforced hollow plate beams Mechanical properties. Under the same load, the deflection of the reinforced rear beam Spend Down down 22.81%, beam body Bit shift extend sex Tie number superior Lift 57.14%, the overall durability of the beam is improved; the maximum crack of the reinforced beam is reduced by 52. 73%, the measured load-bearing strength and ultimate load of the reinforced beam have been significantly improved. Sun Quansheng [49] The T-beam bridge was reinforced with polyurethane cement wire ropes, and the bending load-bearing capacity of the reinforced T-beam bridge was studied. The feasibility of reinforcing concrete T-beam bridges with polyurethane cement wire ropes was verified by combining engineering practice and experiments. Under the same load, polyurethane cement wire rope reinforcement can effectively improve the bending capacity of the beam, and the overall strength of the bridge has been significantly improved. Zhang Shengran [50] Through the polyurethane cement wire rope composite reinforcement bridge experiment, and using the method of finite element numerical analysis, under the action of the test load, the strain and crack width of the reinforced experimental beam were significantly reduced, and the flexural bearing capacity was greatly improved. At the ultimate failure of the experimental beam, the ultimate stress of the steel wire rope reached 90% of the ultimate strength. After reinforced with polyurethane wire ropes, the overall strength and stiffness of the bridge structure are significantly improved. Zhang Kexin [51] Numerical simulations were conducted on beams reinforced with polyurethane cement prestressed steel wire ropes, and the effects of concrete strength and reinforcement ratio on the flexural performance of reinforced beams were analyzed. After reinforcement, the yield load of the component increases slightly due to the increase in concrete strength, and the yield deflection is almost unaffected. When the reinforcement layer of a beam reinforced with polyurethane cement prestressed steel wire ropes breaks, the ultimate load-bearing capacity of the beam increases as the reinforcement ratio increases. Gao Hongshuai [52] Use prestressed wire rope, polyurethane cement and prestressed wire rope-polyurethane cement 3 The reinforced concrete test beam was reinforced with shear in various ways, and the effects of different reinforcement methods and wire rope ratios on the shear performance were studied. The failure process and load of the test beam were analyzed. Displacement curves, characteristic loads and displacements, load-strain curves. The results show that the prestressed steel wire rope-Polyurethane cement composite reinforcement has the best effect and can greatly improve the test results. Check the shear capacity and ductility of beams. Composite reinforcement, steel wire rope Provide pre-pressure to concrete, improve its core strength, limit the development of cracks, play the role of stirrups, and directly participate in shear resistance. Polyurethane The cement reinforcement layer increases the shear area and shear stiffness of the shear span area. Its high strength has a shear-resistant effect similar to that of concrete, and its high toughness has a shear-resistant effect similar to that of steel bars. The combination of steel wire ropes and polyurethane cement significantly improves the shear resistance of reinforced beams. The reinforcement technology of polyurethane cement and other materials composite reinforcement can be used in actual engineering cases, but there is currently little research on this aspect. Finding the optimal reinforcement method by mixing different materials with polyurethane cement can become a future research direction.

### 3. CONCLUSION AND OUTLOOK

Polyurethane cement reinforces and improves concrete. It is of great significance in terms of load-bearing capacity, whether it is a single polyurethane Single reinforcement method or composite reinforcement method of polyurethane material, both represent Ming polyurethane cement has good performance in the field of concrete reinforcement. Application prospects. 2) For the different reinforcement methods of polyurethane cement, there are different There is still insufficient research on the combination of materials, and various reinforcement mechanisms have yet to be studied. 3) As the service life of buildings in our country increases, various concrete Soil destruction and aging occur one after another, and the reinforcement of concrete has Without delay. Polyurethane cement has excellent reinforcing properties. Urethane cement has been used in many ways for concrete reinforcement Extensive attention from domestic and foreign scholars. with polyurethane material The composite reinforcement method that combines other reinforcement methods has better performance in reinforcement The effect is more significant and the research prospects are broader. It can be obtained from compound Reinforcement direction to find new and more superior reinforcement methods.

### COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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