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Research Status on Bonding Behavior of Prefabricated Concrete Shear Wall

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Abstract. Prefabricated shear wall structure adapts to the development and requirements of China's residential industrialization. The key to the prefabricated concrete shear wall structure is the connection between the prefabricated members, where the reliability of the connection of the concrete joint is related to the overall performance and seismic effect of the structure. In this paper, the microstructures of the joint surface and shear properties are analysed, and the formula for calculating the shear strength of the joint is obtained.

1. Introduction

The key technology of precast concrete shear wall is the connection of prefabricated components, in which the reliability of the joint surface generated from the joint connection is directly related to the overall performance and seismic effect of the structure, and the assembly shear wall joint surface as the bonding part of a shear wall connection, the bonding performance of the overall performance of the assembly wall have a great impact. With a good connection ability of the combination, not only can guarantee the overall performance of the assembly wall, but also can increase the ductility of the wall and improve the seismic capacity.

In this paper, the microstructures of the joint surface, the shear performance and the shear strength calculation theory of the joint surface are studied and analysed.

2. Bonding surface micro-model

2.1. Adhesive model of concrete bonded surface bonding

Due to the different scholars' research methods or different experiments, different concrete adhesive surface models are proposed. As early as 1994, Emmons, P.H. et al. [1] proposed a three-zone bond model, which is the new mixing zone, the interface area and the old concrete area, respectively.

Shantou University Xiong Guangjing et al. [2-5] through a large number of experiments on the concrete interface area for a detailed study and analysis, proposed a concrete interface area of the three-tier model, that is, the permeability layer, the reaction layer and gradient layer.

3. Bonding surface micro-model Joint surface shear performance

3.1. Joint surface shear failure mechanism

The experimental [6] results show that the shear strength of the joint at the initial stage of the load is mainly borne by the van der Waals force, the mechanical bite force and the chemical force between the new and old concrete joints. Since this stage of the interface displacement is very small, so the impact of this stage of steel less is. With the increase of interfacial shear force, the interfacial shear capacity reaches the limit by the cohesive force. The interface is relatively sliding, and the displacement parallel to the interface and the displacement perpendicular to the interface, of the displacement of the interface tension, and the pull of steel so that the interface of extrusion force is increasing. Because the interface has a certain degree of roughness, which makes the joint surface friction to resist parallel to the interface of the sliding. In this process, due to steel shear deformation, resulting in pin bolt force, and friction with the common shear. Figure 3.1 shows the shear-displacement curve model of the joint surface.

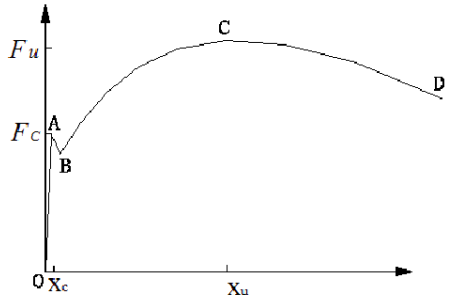

Figure 3.1. Joint surface shear load - displacement curve model.

3.2. Influencing factors of shear bearing capacity

There are many factors that affect the shear performance of the joint surface. According to the domestic and international experimental study, the influence factors of the joint bearing capacity include interface strength, new and old concrete strength, interface agent, interface roughness, keyway size and quantity, the role of shear steel, the role of positive pressure [7-8] and so on. Among them, the effect of shear reinforcement on the interface ultimate shear strength plays a decisive role.

4. Joint surface shear strength

4.1. Joint surface shear cracking strength

From the shear stress-shear displacement model of the joint surface, it can be seen that the interfacial sheer force of the joint surface is mainly affected by the interfacial concrete, and the effect of the reinforcement at this stage is small. So, the shear strength of the joint surface before cracking is the interface concrete shear strength.

At present, the theory of shear strength calculation is mainly based on the roughness and the concrete strength. According to the different types of boundary, the correction coefficient is given by the test result.

In the literature [9] for the roughness of 5.5 ~ 6.15mm, concrete strength grade C20 ~ C55 range of test results fitted to the interface cracking shear stress and concrete measured strength relationship formula:

$$\tau_c = 1.2661 e^{0.0164 f_{cu}} \quad (1)$$

In the literature [9] through a batch of roughness between 0.85-4.21mm test specimen between the study, the interface crack shear stress calculation formula is as follows:

$$\tau_c/f_{cu}=0.0113048h+0.0267976 \qquad (h=0.85\sim4.21mm) \tag{2}$$

In [10], the comprehensive analysis of each influencing factor yields the formula:

$$\tau_c=(0.3h+0.94)(0.23S+0.8) \tag{3}$$

Where S is the interface dose, S = 1, 2, 3, 4. Ordinary Portland cement paste = 1; fast hard chloroaluminate cement mortar = 2; butyl emulsion modified hard chloroaluminate cement paste = 3; fast hard chloroaluminate ate cement paste = 4.

4.2. Joint surface ultimate shear strength

From the shear stress - shear displacement model of the joint surface, we can see that the joint shear strength is mainly provided with the interface friction force and the steel pin force.

The interface friction is:

$$\tau_c=\mu\rho f_y \tag{4}$$

The effect of the bolts on the shear strength of the anchorage bars after the interfacial cracking is complex. The interfacial shear resistance of the interface bolts can be calculated according to the formula proposed by Dulacska [11]:

$$\tau_d=1.617\rho(f_{cu}f_y)^{1/2} \tag{5}$$

In summary, the bound surface interface ultimate shear strength formula is:

$$\tau_c=\tau_m+\tau_d=\mu\rho fy+1.617\rho(f_{cu}f_y)^{1/2} \tag{6}$$

4.3. Shear wall joint surface shear strength

The domestic scholar Yang Yong [12] and others on the concrete joint surface of the shear performance of the experimental study, through the joint surface at home and abroad shear strength calculation formula and test data were compared to obtain the shear and pin bolt together, more suitable for use as a prefabricated concrete shear wall joint surface design formula, and has a reliable security. According to the experimental data, the following shear capacity formula is advised for the design of this joint surface strength under the repeated load:

$$Vu=0.8[\delta n_k A_k f_{jv}+0.7a\sum Asfy+k_s\sum A_S[f_y f_c(1-a^2)]^{1/2}+\mu N \tag{7}$$

5. Conclusion

In this paper, a bond strength in the bonding face with the old and the new concrete is analyzed theoretically. Based on the analysis of the microstructure of the bonding surface, the influence factors of the bearing capacity of the joint surface are summarized. According to the different factors, calculation formula of shear strength.

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