Study on Durability of High-Rise Buildings under the Effection of Load and Environment

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Abstract: At Present, the Problem of the Phenomenon of the Outer Insulation Layer Falling Off of High-Rise Buildings Frequently Occurs, Causing Widespread Concern of Relevant Departments. among Them, the Safety of the Outer Insulation System of the High-Rise Building, as Well as the Impact of the Wind Load and the External Environment on the Insulation Board, is the Main Reason for the Current Insulation Board Falling Off. Based on This, This Paper First Analyzes the Safety of High-Rise Buildings, as Well as the Damage of External Thermal Insulation Layer by Wind Load, and Introduces the Bonding Mode of Concentrated Insulation Layer, in Order to Provide Theoretical Basis for Related Research.

1. Introduction

1.1 Literature Review

High-rise buildings can be seen everywhere in cities. Therefore, it is of great practical significance to study the durability of high-rise buildings under the combined action of wind loads and external environment. Wang Suyan et al. studied the durability of the bonding interface of high-strength concrete in freeze-thaw cycles and dry-wet cycles. It was found that high-strength concrete has strong frost resistance, so it can be used in the insulation of high-rise buildings (Wang et al., 2017). Luo Daming discovered through research that the load effect may cause the physical properties of concrete to change and affect the durability of concrete. Therefore, Luo et al. focused on the anti-seepage energy, neutralization and anti-chestnut erosion of concrete (Luo, 2019). Zhu Hongtao pointed out that China's coastal areas have long been affected by factors such as seawater and salt spray, and axial compression loads have a strong effect on the durability of concrete structures. A study of this phenomenon has found that axial compression loads have a significant impact on concrete durability in the long and short term (Zhu, 2017). Therefore, when applying concrete to the bonding layer of high-rise building insulation, it is necessary to consider the influence of axial pressure. Yao Guowen and others studied the durability of RC strengthened by bonded steel. It was found that the reinforcement anchors in the load and hot and humid environment, as well as the hot and humid environment, will destroy the concrete properties, causing cracks, cracks, etc., and further increase the damage evolution phenomenon (Yao et al., 2019).

1.2 Research Purposes

At present, the external thermal insulation of high-rise buildings is one of the important ways to achieve energy conservation and environmental protection of high-rise buildings. However, with the wide application of thermal insulation equipment, due to the imperfection of external wall protection technology, there are often hollowing, falling off and other phenomena, increasing the difficulty and cost of later maintenance. Among them, under the joint action of high wind load and external environment, the phenomenon of high-rise building insulation layer falling off frequently affects the service life of high-rise building insulation layer to a certain extent, and increases the loss of materials. At the same time, due to the influence of wind loads and the complexity of the external environment on the outer building, there is less research on this aspect. Therefore, based on the above literature, this paper further studies the durability of high-rise buildings under the

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combined action of wind loads and the environment.

2. Safety Analysis of High-Rise Buildings

2.1 High-Rise Building Stress Situation

At present, there are more and more high-rise buildings in urban life, and in order to keep warm, many high-rise buildings have outer thermal insulation walls. Therefore, in the actual situation, it will be affected by the external force, mainly including the adhesion force in each layer of the outer insulation wall, the positive and negative wind pressure loads, and the gravity of the decoration in the system and outside. Normally, the system can last for more than 20 years at a certain wind level (Wang at al., 2017). Based on this, the stress of the external thermal insulation system in the above systems is further analyzed. The first is the analysis of the stress of the external wall insulation system. The important bearing capacity of the outer insulation system of high-rise buildings is the self-weight of resources and the impact of external loads (Xu et al., 2017). In response to these forces, the high-rise building anchor reinforcement layer and the mortar bonding layer are mainly required. In order to bear these forces, it is also necessary to have good adhesion between the link layers of the high-rise building. The horizontal wind force that the high-rise building is subjected to is mainly undertaken by the mortar bonding layer. The gravity of the upper outer protective layer and the outer decorative layer is mainly shared by the bonding layer and the anchoring layer. The remaining external forces are protected by anchor reinforcement.

At the same time, various forces inside the high-rise building are transmitted through the layers, and eventually all the forces are transmitted to the outer insulation board. In order to prevent the insulation wall from falling off, it mainly relies on the oblique support of the anchor and the friction to increase the reinforcement. Among them, the frictional force and the bonding surface are mainly transmitted to the wall structural layer through the form of oblique pressure to maintain structural stability. High-rise buildings in the specific life, will be subject to the entire system self-gravity, as well as negative wind pressure load and external environment pressure, so the internal atmospheric pressure strong stripping is a great test for the durability of high-rise buildings. Therefore, it is necessary to cooperate between the anchor and the mortar to ensure the safety of the outer wall of the high-rise building.

2.2 Wind Pressure on High-Rise Buildings

The height of a building is limited by the size of the wind, so the height of a building will be affected by the wind pressure. Among them, the higher the high-rise buildings, the greater the wind pressure. It can be seen that high-rise buildings are greatly affected by wind pressure, and the higher the height, the greater the damage caused by wind pressure. In order to reduce the impact of wind pressure on buildings, buildings need to consider the effects of self-vibration characteristics, height, shape, and surrounding environment. Based on this, the above factors need to be considered at the beginning of the construction of high-rise buildings. Through research, it is found that the building has the same height and the pulling force in the windward direction is positive. Under the influence of this force, the insulation performance of the high-rise building insulation board and the base wall is better. Moreover, under the influence of this pulling force, the middle of the thermal insulation board is subjected to the greatest pressure. When the wind direction is negative, the high-rise building layer is affected by the wind speed suction, and the two sides interact with the windward and leeward sides, and the wind is more destructive. In addition, as the height of the building continues to increase, the pressure on different levels gradually increases. The middle area on the upper side of the wind is the positive pressure area. Four-fifths of this area will generate a lot of pressure, which in turn will form a safe zone for the outer insulation of high-rise buildings. In the windward bottom of the high-rise building and the positive and negative pressure of the leeward, the influence of the external thermal insulation board is relatively small. In addition, the high-rise buildings are subjected to wind pressure and are affected by the shape of the gas and the surrounding environment, resulting in uneven pressure on the exterior of the high-rise building. The

distribution of wind pressure at the same height of the building is shown in Figure 1.

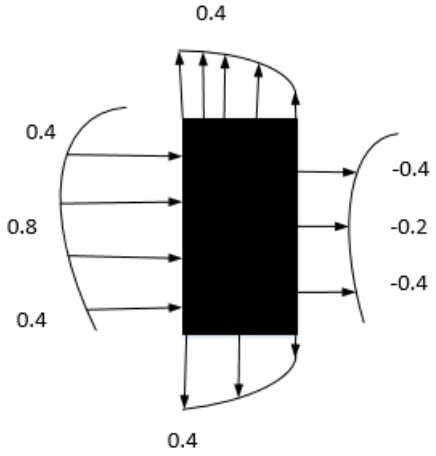

Fig.1 High-Rise Buildings Are Subject to Wind Pressure At the Same Height

3. Analysis of Damage Caused by Wind Pressure on High-Rise Buildings

3.1 Disaster-Prone Area

Because high-rise buildings are unbalanced by wind, they are affected by wind damage. Among them, the two-story wind surface of the building and the leeward side will generate a large suction force. Therefore, the area where the suction is generated is referred to as a suction area. The wind pressure generates thrust on the building and is called the positive wind pressure zone. For the outer insulation wall of most high-rise buildings, the air pressure in the negative wind pressure zone will be higher than the outside air pressure, which in turn will generate negative wind pressure. This phenomenon is expressed as tension in the positive wind pressure zone. For insulation systems without cavities, the effect of positive and negative wind pressure on high-rise buildings generally only affects the base layer, which will reduce the insulation performance of the insulation board, but has less impact on safety. High-rise buildings are very prone to parallel with the wind direction. The stressed area is mainly concentrated on both sides of the building and the leeward side. Among them, the sides of the building are under the most pressure, which is very easy to damage the insulation board. Therefore, the relevant departments of high-rise building construction should attach great importance to this phenomenon.

3.2 Connected Cavity Area

The negative wind pressure of high-rise buildings often occurs in the area. The insulation layer connected to the cavity can concentrate the force generated by the negative wind pressure on the maximum position, and the uneven use of the bonding paint can cause high-rise buildings. A certain area of the object is too strong, destroying the insulation board and affecting the heat preservation effect. Due to the existence of the connected cavity area, the stress of each bonding point of the high-rise thermal insulation board is weakened and gradually disappears, and finally the thermal insulation board is subjected to large-area falling under the action of large wind force, which poses a safety hazard.

3.3 Thermal Insulation Board Destructive

Under the combined action of wind load and external environment, the thermal insulation board will produce long-term fatigue load phenomenon, accelerate the aging damage of the thermal insulation board, and serious conditions will lead to large-area falling off. When the insulation layer of the high-rise building has been gradually increased by the wind, the pressure difference between the internal and external parts of the high-rise building using the cavity as the insulation system shows an upward trend, which in turn causes a large external thrust inside the system, which increases The suction of the load on the insulation board finally causes the insulation board to fall off from the area where the bonding area is small. When the area of the connected cavity is

encountered, the phenomenon of the external insulation board falling off will be aggravated.

4. High-Rise Building Insulation Structure Against Wind Loads and External Environment

A large number of experiments have shown that the use of full adhesion and point frame bonding between the insulation board and the high-rise building can improve the safety and durability of the insulation system and is more resistant to wind loads. Under normal circumstances, high-rise buildings using the above three bonding methods, as well as standard external thermal insulation work, can be used for more than 25 years under normal conditions. Therefore, the above three bonding methods are analyzed.

4.1 Fully Sticky

Fully viscous mainly means that the bonding layer is filled with mortar, and no cavity phenomenon occurs, so that no negative wind pressure phenomenon occurs. In this case, the insulation layer caused by the external environment such as the cavity and the negative wind pressure can be prevented from falling off. Currently, this bonding method is widely used in high-rise buildings. Full adhesion This bonding method requires that the bonding height of the bonding layer is as high as 6mn, and the bonding area needs to be more than 70%. Compared with other bonding methods, this method requires higher cost, but has better prevention effect on wind load and external environment, and can reduce the maintenance cost of the later insulation board. In addition, this bonding method has high requirements for high-rise building walls. If you want to use this method to bond the insulation board, you need to properly plaster the wall to improve the flatness of the wall.

4.2 Point Frame Stick

The surrounding area of the high-rise building is greatly affected by the wind load and the external environment. Therefore, the vertical and horizontal bonding of the surrounding buildings also has an important protective effect. In order to better use the point-and-frame bonding method to transform, a composite thermal insulation board with an L shape is produced. The dimensions of the two sides of the insulation board are 600mm*600mm*1200mm. Since the dimensions of the two sides of the insulation board are the same, more strict supervision work is required during construction. In addition, due to the special nature of the insulation board, it is necessary to pay attention to the destruction of the insulation board during construction. Specifically, when the insulation board is implemented, the mortar should be limited for bonding and then fixed by anchor bolts. This design can ensure the insulation corner structure, which can prevent negative wind pressure damage and improve system safety.

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