Ekoloji 28(108): 1023-1028 (2019)

LETTER TO THE EDITOR

Architectural Design Method in Rainfall Area Based on Environmental Adaptability

Jun Tu*, Jian Shen
Department of Art and Design, Zhejiang Agricultural Business College, Shaoxing 312088, China
*Email: xds5842132@163.com

In rainy areas, especially in tropical storm and typhoon-prone areas, the environmental adaptability design of civil buildings is particularly important. This paper mainly discusses the design of windows in civil buildings in rainy areas. Because of the common hidden dangers of rainwater leakage, improper sealing, glass bursting and fan falling, the exterior windows of civil buildings have aroused widespread concern of the society, and even caused serious consequences that endanger people's lives and safety. Based on the analysis of the problems existing in the application of the external windows in civil buildings, this paper puts forward the control measures of the key points of the design, selection, processing, fabrication, installation, construction, supervision and management of the external windows in order to improve the application level of the external windows in civil buildings.
Environmental Adaptability; Rainfall Area; Architectural Design

1 INTRODUCTION

Outer windows are the eyes of architecture and the irreplaceable carrier of communication between man and nature in architecture. At the same time, the outer window is also a movable and vulnerable component of light and thin-walled structure, and it is the weakest link in the building envelope structure. Outer windows have the main functions of wind and rain shielding, lighting, ventilation, sound insulation, thermal insulation, mosquito prevention, and play an important role in adjusting indoor comfortable environment. In tropical storms and typhoons-prone areas, there are many hidden dangers in building windows, such as rainwater leakage, improper sealing, glass bursting and fan falling, which have aroused widespread concern in society and even caused serious consequences that endanger people's lives and safety. In rainy areas, typhoons are often accompanied by typhoons. In 2015, strong typhoon "Sudiluo" had a maximum wind pressure of 13 levels, and in 2016, super typhoon "Moranti" landed in Fuqing and Xiamen, respectively. The maximum wind pressure of typhoon reached 15 levels, which caused great damage to the building windows in Fujian coastal areas. The wind pressure levels of these two strong typhoons have exceeded the basic wind-proof pressure of the design of the outer windows and so on. A large area of water seepage appeared in many building windows, especially the "Moranti" super typhoon, which caused the overall damage of arc-shaped windows in a high-end residential quarter in Xiamen, but also exposed many problems in the application of civil building windows. For this reason, relevant scholars have done a lot of research.

Yang Zhang, Shuo-Fang Liupublished apaper in Ekoloji (Issue 64) entitled “Research on the Landscape Image of Urban Architecture Environment -A Case Study on Shenzhen” (Zhang and Liu 2019). This document

takes Shenzhen as an example to study the landscape image of urban architectural environment. Due to the negligence of architectural landscape culture, the lack of such cultural characteristics, which are usually presented from the inside to the outside of the city. This study will start with culture, combine the emotional values of the public, and explore the sensory intentions of some landmark elements in emerging cities. SPSS (statistical software) was used to analyze the results of the questionnaire by factor analysis. Six groups of visual intention factors were obtained. Then they reintegrate into society and rename. After descriptive analysis of the six groups of factors after renaming, the radar maps of the corresponding landmark elements are produced, showing the public's perception images.

How to improve the application level of civil building windows in typhoon rainstorm climate is an urgent problem to be solved in the building window industry. Based on the analysis of the problems existing in the application of the external windows in civil buildings, this paper puts forward the control measures of the key points of the design, selection, processing, manufacture, installation, construction, supervision and management of the external windows in order to improve the application level of the external windows in civil buildings.

2 IDEA DESCRIPTION

2.1 Analysis of Problems Existing in the Application of Outer Window in Civil Buildings

Generally speaking, there are the following problems in the application of building windows:

2.1.1 Existing Problems in Design and Selection of Outer Window Engineering

(1) No further design has been carried out for the exterior window project (Fu et al. 2017, Yuan et al. 2017; Saieg et al. 2018). Many external window projects, construction units did not entrust professional companies to deepen the design, production units of external windows based on experience, according to the external performance indicators and elevation requirements of the main design of the building, apply the relevant atlas, processing and production. The performances of the external window project can not meet the actual requirements of the project, especially the wind pressure resistance and water tightness (Yakubu and Yusop 2017).

(2) The performance indicators of the external windows proposed by the main building design do not meet the requirements of the code (Radicetti et al. 2018). Wind pressure performance and water tightness performance indicators are not calculated, or directly apply other project window performance indicators, performance indicators are generally low (Wang et al. 2018). Water tightness performance indicators of different projects should be calculated according to the actual project, and can not be directly applied.

(3) In some cases, the level of window deepening design units is not high, there are design checking errors, or fail to deepen the design according to the main body design requirements, arbitrarily reduce the performance indicators of the window (Yao et al. 2018). For example, in a high-rise residential district, the design requirement of water-tightness index is 940 Pa, the design value is 700 Pa, the air-tightness index is 6 grade, and the air-tightness index is 3 grade.

(4)There are some errors in the design and selection of windows. Some low-performance windows are applied to some high-rise buildings. Ordinary 868 push-pull window, water tightness performance is generally around 200 Pa, air tightness performance is about 4 levels. However, in practical application, many high-rise buildings still use a large number of ordinary push-pull windows, water and air tightness performance can not meet the actual requirements of the project. For example, in the coastal area of Xiamen, a building with a height of 50 meters, according to the calculation formula of water-tightness performance and the requirements of relevant standards and codes, the water-tightness performance index should be more than 600 Pa and the air-tightness performance should not be less than 7 grades, and the selection of ordinary push-pull windows can not meet the actual requirements of the project at all. When typhoon rainstorm comes, the seepage of the outer windows will be

inevitable.

2.1.2 Outer window manufacturers generally have poor equipment, poor quality control in the processing process, and many of them are even manufactured on site with poor conditions and poor product quality.

(1) Some production enterprises of windows are small in scale and non-standard in management. There are some on-site processing phenomena in some projects, such as on-site processing in projects.

(2) Processing quality control is generally not strict, and the overall quality is not high. In particular, there are prominent problems such as improper configuration of profiles, hardware and sealing materials, discontinuous sealant strips and non-bonding of corner sealant strips; excessive deviation of blanking size of outer window components, resulting in excessive assembly clearance and direct assembly without coating of corner sealant on corner parts; insufficient overlap between window fans and window frames, and non-conformity of assembly dimensions between glass and groove.

2.1.3 The construction and installation of outer windows mostly adopt wet method. The installation quality of outer windows is poor, and serious water leakage often occurs.

(1) When installing by wet method, the dimension opening of the outer window is not in place, and the gap size deviation between the opening and the outer frame is large. It is easy to cause quality and safety hidden dangers such as water seepage in the connecting part between the window frame and the wall of the opening.

(2) Installation and connection of outer window frame and main structure are not firm, such as fixing connectors on mortar surface of filling wall, fixing spacing greater than 600 mm stipulated in specifications, etc.。

2.1.4 Insufficient supervision and inspection can not reflect the actual level of the windows used in the project

(1) Supervisors are generally not familiar with the technical requirements of external windows, and the process supervision is lax. Sampling inspection is not carried out according to the specifications. Samples sent for inspection are inconsistent with actual engineering windows, or only small windows are selected for inspection. Some large windows and the most out-of-position windows are not sent for inspection, which is not representative.

(2) Supervisors have not checked and confirmed whether the test results meet the design requirements, resulting in the application of the outer window products whose watertight and wind pressure performance is lower than the design value.

(3) Most testing institutions lack integrity and testing ability, and there are many problems in the market of building window testing, such as inconsistency between inspection samples and engineering practice, untruthful data of inspection reports or direct false reports of non-inspection reports.

3 RESULTS

Therefore, the measures to improve the application level of external windows in civil buildings are as follows:

3.1 Improving the key performance design indicators of building window products, the design of window engineering should be considered as an important content of the examination by the drawing and auditing organ.

(1) The experience and lessons of strong typhoons Sudilo in 2015 and Moranti in 2016 should be learned. Some key performance indicators, such as water tightness and wind pressure resistance, should be properly improved in the design of outer windows. In the design and selection of outer windows, high-performance standardized outer windows products suitable for the climatic characteristics of multiple storms and rainstorms should be selected.

(2) By incorporating the design of outer windows into the examination of construction drawings and strictly controlling them from the source of design, some outer windows which do not meet the standards and

specifications and actual engineering requirements due to design errors are avoided.

3.2 Forbid to manufacture windows on site, promoting standardized windows, realize factory production of window

The manufacturing quality of the window needs good processing equipment and production site to achieve. If the simple processing equipment is used in the site to complete, the production quality of the product can not be guaranteed. Standardized outer window is to optimize and shape the profiles, glass, hardware, seals and accessories of the outer window, and to standardize the size of the outer window.There are too many non-standard designs, too many special-shaped windows, the quality of windows is difficult to control, and the production efficiency is also difficult to improve. Through the implementation of standardized windows, building windows products are processed into finished products in the factory, and are inspected according to product standards.The production conditions and inspection conditions of the factory can effectively guarantee the quality of window products, and the defects can be better solved in the factory.

3.3 Dry installation with standardized enclosures, standardizing the installation and construction of building outer window

At present, the construction and installation method commonly used for building windows is wet installation. The installation method has the following shortcomings:

(1) During the construction of civil engineering, the hole size error is often very large, which easily results in poor filling of window frame and hole, and rainwater leakage.

(2) The cross-construction between civil construction and window installation results in the contamination of window frames and the quality of window installation.

(3) Not conducive to the replacement of windows. According to GB/T31433-2015, the service life of window design is not less than 25 years, while that of main building design is not less than 50 years. Therefore, when installed by wet method, some of the window frames are covered by cement and so on. When replaced, the window openings will be damaged and not easily replaced.

Dry construction can completely avoid the above problems, realize the convenient replacement of window products, and will not damage the window opening.

3.4 Strengthening Supervision and Management of Building Outer Window Project

(1) Strengthen supervision of external window project. The project supervision unit should supervise the external window project, strictly control the product entry, sampling inspection, project acceptance and other links, increase the frequency of parallel inspection and inspection on important parts, and do not sign up for non-conforming requirements.

(2) Improve the current way of testing and witnessing for windows. At present, the inspection of outer window samples is generally witnessed by the supervision unit. After all, the supervisors are not the professionals of outer window. They are not familiar with the technical requirements of outer window projects. They can not accurately grasp the types and performance indicators of the inspection of outer window samples, which often results in the non-representative of the inspection samples or the wrong requirements of performance indicators.The deepening design unit of the external window project has clear technical requirements for the performance of the external window project, and knows that the most disadvantageous windows in the project should be tested and verified.Therefore, it is suggested that the window type for sampling and inspection should be clearly defined in the general description of the design of the outer window project, and the technical indicators of various performances should be clarified. Then, the supervising unit should witness the sampling according to the requirements of the deepening design unit. At the same time, the personnel of the testing unit should also come to

the scene to witness the sampling, so as to avoid the problem that the inspection sample is not representative and the testing can not reflect the actual level of the engineering window.

(3) Add on-site air and water tightness performance witness sampling inspection after the completion of the installation of the outer window. At present, the quality inspection of the external window project is only sent to the laboratory by sampling before the entry of the external window products. There is no inspection of the quality of the external window construction and installation, and the quality of the external window installation and construction has a great relationship with the quality of the external window project. The connection between door and window frame and wall of tunnel is the most frequent point of water seepage. Therefore, the sampling inspection of air and water tightness performance in the field after the installation of the external window system is added to ensure the final pass for the quality of the external window project. Three diaphragm windows should be randomly sampled for on-site testing of air and water tightness. At the same time, supervision units and installation units must witness together on the spot to ensure that the test results are true and reliable.

(4) Strengthen the management of acceptance and filing of external window projects. Management organizations at all levels, such as quality supervision of construction projects and building energy conservation, should conscientiously implement the special acceptance system for external window projects, strengthen daily management and special supervision, and take the acceptance records, witness inspection reports and spot inspection reports of hidden external window projects as necessary information for project acceptance.

3.5 Establish building window marking institution

At present, there is no product logo for all building window projects, and the quality problems can not be traced back. Therefore, product identification should be set in the eye-catching parts of window products, indicating brand, specifications, main performance indicators, production dates and other information, so that consumers can transparently consume, source traceability, flow direction can be queried, accountability can be pursued.

4 Conclusion

For rainy areas, the water tightness and wind pressure resistance of building windows are required to be higher. In order to solve the problem of application of external windows in civil buildings, we should first improve some key performance design indicators of building external windows products. When selecting the type of external windows, we should give priority to the selection of high-performance standardized external windows suitable for climatic characteristics. At the same time, we should strengthen the effective control of the design, selection, manufacture, installation, construction, supervision and management of building external windows, enhance the overall quality of building windows and ensure the safe application of building windows.

References

Fu H, Shi Z, Zeng L. (2017) Formation mechanism and distribution of transient saturated areas of residual slope under rainfall conditions. Journal of Civil Architectural & Environmental Engineering 39(2):1-10.

Radicetti E, Baresel J P, El-Haddoury E J, et al. (2018) Wheat performance with subclover living mulch in different agro-environmental conditions depends on crop management. European Journal of Agronomy 94:36-45.

Saieg P, Sotelino ED, Nascimento D et al (2018) Interactions of Building Information Modeling, Lean and Sustainability on the Architectural, Engineering and Construction industry: A systematic review. Journal of Cleaner Production 174: 788-806

Wang Q, Gao B, Li T, et al. (2018) A triangular mesh generator over free-form surfaces for architectural design. Automation in Construction 93:280-292.

Yakubu M L, Yusop Z. (2017) Adaptability of rainfall simulators as a research tool on urban sealed surfaces â

a review. International Association of Scientific Hydrology Bulletin 62(6):996-1012.

Yao Z, Zheng W, Jing L, et al. (2018) Screen for sustainable cropping systems in the rain-fed area on the Loess Plateau of China. Soil & Tillage Research 176:26-35.

Yuan Z, Wang Y, Sun C (2017) Construction schedule early warning from the perspective of probability and visualization. Journal of Intelligent and Fuzzy Systems 32(1): 877-888.

Zhang Y, Liu S (2019) Research on the Landscape Image of Urban Architecture Environment - a Case Study on Shenzhen. Ekoloji 28(UNSP e107095107): 805-811.