

PROVISION OF NATURAL VENTILATION IN HONG KONG RESIDENTIAL PREMISES AND THEIR ASSOCIATED FIRE SAFETY PROBLEMS

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ABSTRACT

Building green is a universal highlighted topic among the building construction industry. Our advanced society in the twentieth century is enormously contributed by the natural fuel, which provides us a comfortable internal living space and all kinds of essential technologies. However, the abuse of the use of unrenewable resources or development of extreme pace have put our world into harmful situation that the global ecology system has been damaged and also the usable energy is about to be used up. Global warming due to greenhouse effect has accelerated the effort paid on energy conservation. Inadequacy of energy resources will definitely suspend all kinds of technology development in the future. Therefore, it is urged to use all means to save our natural resources.

Buildings are responsible for about half of the consumption of fossil fuels. It was reported that thermal comfort accounts for about 80 % of that in domestic buildings [1]. Passive means to provide thermal comfort inside dwelling spaces are therefore encouraged.

Hong Kong Government has paid lots of effort to promote the concept of environmental-friendly building as emphasized in the Policy Address by the Chief Executive in October 2001. Government departments, including Buildings Department, Lands Department and Planning Department have collaborated to advocate the green and innovative buildings as spelled out in their joint practice notes [2]. Introduction of some building features, for instance, balconies, acoustic fins and wind catches, are encouraged. Building regulations are also under review to enhance the development of green buildings. Revising codes on ventilation provisions is known to be one of the actions taken.

Natural ventilation is not a latest excogitation, but has been abandoned since the successful adoption of mechanical means which provide more concise control to the internal thermal environment. Also, the neighboring properties' blocking each other in the congested urban area hinders the use of natural ventilation, it was uncommon to introduce natural air flow into the buildings years ago. Nevertheless, some of the latest residential developments in the new urban areas of lower density, for instance in Tung Chung and Tseung Kwan O, have made use of this as a design theme. It is believed that more developments are trying to apply this environmental-friendly feature instead of the energy-consuming mechanical counterpart.

How the existing residential building designs achieve the goal of integrating natural ventilation into the built environment will be briefly described. Their primary differences from the ordinary design will also be discussed. However, behind the success in terms of energy conservation, there are potential fire hazards which may be ignored; in particular, the prescriptive codes are already satisfied. Human life is of ultimate importance; therefore, the possible fire risks are also to be disclosed in the following sections.

The prescriptive codes governing building fire safety, not as up-to-date as the building design, are used to check the compliance of the latest buildings with the prescriptive requirements. It seems not difficult to get approval by satisfying every single figure in the codes; however, the same fire safety level is not necessarily maintained since the existing codes are only specified for several types of building uses. The developing engineering performance-based fire codes (EPBFC) are envisaged to be more appropriate to the ever-changing innovative building designs.

1. INTRODUCTION

Humid and hot are the characteristics of the local weather. Natural ventilation is a means to maintain thermal comfort in the living spaces other than the mechanically-driven one, which is considered as the major energy killer in domestic

buildings. Wind action can promote the air flow rate and remove internal accumulated heat effectively. In addition to thermal comfort, providing natural ventilation can also improve the indoor air quality (IAQ) by venting in fresh outdoor air.

One of the large private developments in Tung Chung has been awarded the highest honor by Architectural Services Department (ASD) for its accomplishment in providing natural ventilation to the built environment. However, it is obvious that relying wholly on the passive means is not realistic because overheating takes place easily in hot climate. Manual adjustment to the combination of both active and passive means is therefore necessary.

2. DIFFERENCE FROM OLD-DEVELOPED PREMISES

There should be windows in every room for habitation in traditional domestic buildings as required in the local Building (Planning) Regulations Cap. 123F Part IV [3]. Concrete is the inexpensive building material commonly used in general developments; glazed areas on wall are primarily built for satisfying existing regulation. Therefore, the size of the openings in old buildings is generally smaller than that possessing natural ventilation function. Furthermore, in order to increase the capability of wind-catching of the natural-ventilated building, windows are extended from one elevation to the corner, and even to the adjacent perpendicular face of the building.

Master layout plan is in totally different format. A semicircular master layout plan, at which all building blocks are adjoining next to each others, of a well-known private development in Tung Chung has come into sight. Breezes are invited to every block more directly without being diverted by the neighboring towers. Building orientation also plays a role in wind-catching. Premises in old districts or even the newly erected public housing are usually closely spaced so as to increase the number of accommodations. For the estates of public housing and Housing Ownership Scheme, four wings are extended from the central lift core. It is believed that passive cooling is ineffective in most of the units in such layout and active means solely relies on preventing overheating in summer time. Moreover, the provision of natural ventilation can be shown up only in the new urban area since the polluted, older area may probably create adverse effect in this aspect.

3. POTENTIAL FIRE HAZARDS

If a fire breaks out, openings in the fire compartment can help remove the toxic gases and smoke so that occupants inside are able to evacuate from the room under the clear path. Bigger-sized windows obviously help to vent the hot gases more efficiently when compared to the small counterparts.

However, when the fire reaches the development stage, it becomes a 'ventilation controlled' fire. At the time being, the severity of fire would be dependent on the available air supply. Large window openings allow further fresh air supply to accelerate the burning process which may endanger adjacent structure and occupants.

Smoke flowing out through the openings would probably move upwards due to its buoyancy, but what would happen when the windows upstairs are also open at the same time? The undesirable situation is that prevailing wind may assist in moving it into the upper floor provided that it is at the windward side. The jeopardized area would be expanded to an irrepressible level in this respect. Instead, in this case, larger openings invite more smoke, hot gases and even flame.

If, however, the openings are closed at either the fire origin or the adjacent levels, the fire resistance performance of the glass window and the external wall would play a key role in confining the spread of fire. Large area of external wall in conventional buildings is constructed by concrete which is of higher fire resistance period (FRP) when compared to glazed element. The heat performance of glass is therefore very significant. Breaking glass can be considered as an opening, resulting in smoke flowing up to the other levels, but simultaneously the shattered pieces of glass falling out from the frame will put the pedestrians downstairs in danger.

4. CONCLUSION

It is revealed that many building types or features are not covered in the existing legislation in Hong Kong since the requirements were mostly developed decades ago. New building designs are able to comply with the numeric requirements in the prescriptive legislation but extra fire risks are believed hidden and received inadequate attention. More thorough studies should be carried out for this kind of green building design and EPBFC should be used to replace the lag-behind prescriptive-based fire codes since the requisite fire safety measures are required based on the fire safety engineering analysis to the particular premises, but not on the building uses which is in a more general manner.

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REFERENCES

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Q & A

Q1: As we all know, the weather in Hong Kong is always warm and humid. Is it suitable to make use of natural ventilation in modern buildings? Have you done any survey?

Hung: I have not yet carried out such survey, but I think the effectiveness of this design feature is not within the scope of my study. My main concern in this study is the fire safety problems induced by the design feature.