

APPLICATION OF PERFORMANCE BASED FIRE ENGINEERING IN HONG KONG

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ABSTRACT

Unlike other well-developed countries such as New Zealand, Australia, and the USA, there is still no local performance based fire engineering codes in Hong Kong. Yet, the local government recognizes the importance of the fire engineering codes by issuing guidelines seven years ago to set out a framework on fire safety design by accepting both prescriptive and performance based fire engineering approach on design submission. Meanwhile, a Fire Safety Committee has been set up and a consultancy firm has been commissioned to draft the local fire engineering safety codes. On the other hand, lack of proper training for building professionals and the limitation of space in Hong Kong make the application of Performance Based Fire Engineering unpopular.

1. INTRODUCTION

After about half a century, Hong Kong is still using fire codes in prescriptive based forms. The codes themselves, which consist of four documents [1-4], are actually simple tools and are written in layman terms. The codes have been widely used and are familiar by local building professionals. With the change of our living environment and the invention of new building materials, not only new architectural designs such as huge unobstructed space and unusual layout often challenge the existing prescriptive fire codes, but the existing buildings especially those with composite uses and those with historical merits also confront the existing codes most of the time. In recent years, even though Hong Kong does not have any local performance based fire codes, performance based fire engineering (PBF) have been frequently used in a number of cases in order to justify the proposed or existing designs maintained a suitable level of fire safety. In this regard, a Fire Safety Committee has been set up in Buildings Department to response and to securitize those performance based fire safety proposals. Meanwhile, the government has commissioned a consultancy firm to draft a local performance based fire code.

This paper aims at illustrating how PBF is used in Hong Kong. Moreover, difficulties in using PBF in Hong Kong are going to be discussed.

2. DESIGN SUBMISSION

In accordance with section 4 of Buildings Ordinance [5], Chapter 123 of the Laws of Hong Kong, only Authorized Person (AP) shall be eligible to submit building plans to the government for approval. As stipulated in section 3 of the same ordinance, the qualification of being an AP can be obtained by an

interview in order to test the candidate's knowledge in local buildings codes and development procedures whereas the candidate shall be either a

- registered professional architect;
- registered professional engineer in civil or structural discipline; or
- registered profession surveyor.

It is the Buildings Department who acts as a centralized processing unit in Hong Kong. Copies of plans that have been prepared and signed by an AP shall submit to Buildings Department for approval. It is the duty of the Buildings Department to transmit copies of plans to other relevant government departments for commenting other important issues. For instance, it is the Fire Services Department to comment on the adequacy and layout of the proposed fire services installations and equipment in accordance with the "Red Book" - Code of Practice for Minimum Fire Service Installation and Equipment [4] while it is the Lands Department to comment whether the proposed work conflicting the terms and conditions of the relevant land lease. After receiving all the comments from government departments in concern, the Buildings Department shall consolidate all the comments with theirs and shall reply the AP in writing.

There are only four fundamental issues [6] which Buildings Department will then check the general building plans, namely,

- density;
- major issues under allied legislations;
- health and environment; and
- safety.

"Density" refers to site parameters such as site area and site classification, and it also covers site coverage together with plot ratio. The term - "major

issues under allied legislations” refers to the provisions of disable facilities, airport height restriction, zoning plan and so on. As far as “health and environment” is concerned, it refers to the issues regarding lighting and ventilation. For “safety”, it refers to fire safety design according to the three codes of practice, namely,

- Code of Practice for Fire Resisting Construction (FRC) [1];
- Code of Practice for Provisions of Means of Access for Firefighting and Rescue Purposes (MoA) [2]; and
- Code of Practice for Provisions of Means of Escape in case of Fire and Allied Requirements (MoE) [3].

The FRC describes the minimum fire resistant period required for walls, ceiling, and doors of a compartment of a specific use. It also sets out the type and thickness of material to be used in order to achieve that requirement. Moreover, this document sets out technical details such as the maximum size of a compartment and minimum size of a structural member for all parties concerned in the design and construction of building.

The MoA sets out the basic requirements for the locations and number of staircases for fire fighting, the size of protected lobby, the size of lift car, and the size of vent in common area.

The MoE gives the framework of the minimum requirements of the width and number of exit doors and exit routes, the maximum direct distance and travel distance from a dead end to the protected exit, and the minimum number of staircase. For instance, every building exceeding four storeys in height shall have staircase continue to the roof of the building unless a secondary staircase of fire escape of fire escape is provided. Moreover, building which exceed six storeys in height or more than 17 m above the ground level shall be provided with a second staircase as means of escape in case of emergency. Besides, the code also specifies the requirements for basements, garage, carparks, refuge floors and so on. On the other hand, the MoE also establishes some pre-determined numerical figures to estimate the maximum number of occupants in a particular room or storey for a particular use.

The three aforementioned fire codes allow alternative approach other than what has been prescriptively stipulated and have the same objectives that are listed below [1-3].

- Preventing the outbreak of fire;
- Inhibiting the spread of fire;
- Providing adequate means of escape in case of

fire;

- Fire suppression;
- Prevention loss of property and
- Providing means of access and assisting in fire fighting and rescue.

Generally, an AP will try to adjust the design of a proposed development in order to fulfill the requirements of the four fire codes. Only in the cases which involving special design or converting an existing building to a different use, an AP will think of using PBF to justify the proposed fire safety standard is equivalent to the four prescriptive fire codes.

Although currently there is no written local fire codes regarding PBF, Buildings Department provides guidelines [7] in March 1998 on how fire engineering approach for the design of new buildings or alteration and addition works in existing buildings can meet the fire safety objectives as mentioned above and the performance requirements of the legislation [5] and can act as an alternatives to the prescriptive requirements set out in the FRC, MoA, and MoE. It is only in this document which the performance requirements of the legislation are firstly spelled out and they are listed in the following.

- Given the function and purpose of the building or installation, the design should not present an unacceptable risk of a fire developing and spreading.
- Occupants should have time to reach a place of (temporary and/or permanent) safety without being dangerously affected by heat or smoke from a fire.
- A fire should not spread to adjacent property.
- A fire (and smoke) should not spread beyond the compartment from which the fire originates.
- Firefighting personnel should be able to gain access and mount firefighting and rescue operations without undue risk to their health and safety.
- The stability, insulation and structural integrity of the building should be ensured in a fire of specified intensity and duration.

A flow chart [7] shown in Fig. 1 is also attached with the March 1998 document and outlines the major steps to be followed in the fire engineering design of a building.

For example, if a proposed design has a travel distance (from a room to the protected staircase) longer than what is stipulated in the MoE, the AP shall demonstrate the evacuate time of the occupants is sufficient to enable all occupants to reach a place of safety.

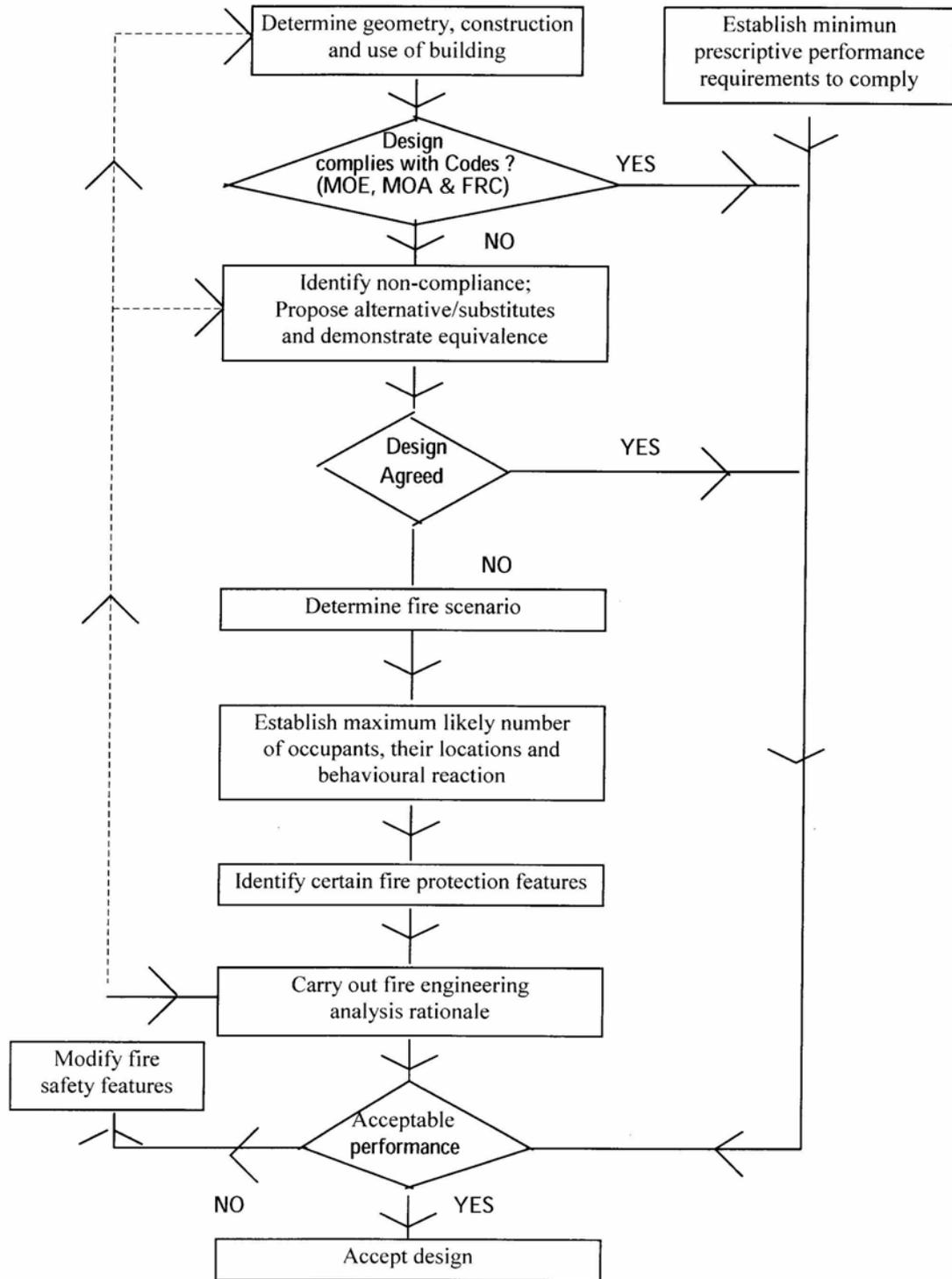


Fig. 1: Overview of fire engineering design

3. DIFFICULTIES IN APPLYING PBFE IN HONG KONG

It is undeniable that up to now PBFE approach is still unpopular in Hong Kong. When we revisit the profession qualifications of an AP, it is not difficult to know that there is lack of both academic

professional trainings in PBFE for an AP generally. Only when there is no way to comply with the prescriptive fire codes, a fire engineering consultants will be engaged to assist the AP to submit a fire engineering safety design by using PBFE approach. Indeed, there are only a few fire engineering consultants in Hong Kong and the fees

of them are therefore not competitive enough to encourage property client to use or at least to try the PBFE approach in fire safety design.

Furthermore, there is no local PBFE code in Hong Kong. Although the government recognizes the importance of the PBFE approach by setting up a Fire Safety Committee and commissioning a consultancy firm to draft the local PBFE code, it is expected the first round public consultation of the draft will not commence before the end of year 2003. In this connection, a local PBFE code should only arrive after year 2004. In the meantime, overseas PBFE codes such as Life Safety Code of NFPA [8] are often referred in local submission to Buildings Department.

Besides, it is virtually impossible to establish a full scale model in Hong Kong to conduct burning and smoke test in order to demonstrate the proposed design using PBFE approach achieving the minimum requirements as stipulated in the prescriptive fire codes.

4. RECOMMENDATIONS AND CONCLUSIONS

The local government is advancing the existing fire codes by adapting alternative fire engineering approach. Since both the prescriptive fire codes and the PBFE codes have their advantages and limitations, the prescriptive shall not be shelved even the up coming local PBFE codes are in force. The PBFE approach should be useful especially when innovative and special building designs are involved. Moreover, the PBFE can also be used to assess the fire safety level of existing composite buildings and buildings with historical merits that alterations works shall be kept to minimal. In view of the continuous fast development in Hong Kong, there are reasons to expect the application of PBFE approach will be more frequent. One of the key elements for making PBFE more popular is continued professional development on this advanced topic. It is foreseeable that either an AP is going to acquire the knowledge and techniques in using PBFE approach in fire safety design or the role of an AP in fire safety design is going to be substituted by a professional fire engineer. It should be noticed that it is currently only The Hong Kong Polytechnic University, with the objective to provide 'Quality Teaching', providing 3 levels of education on fire engineering adequate education in this field:

- BEng (Hons) in Building Services Engineering with specialism in Fire Engineering.

- MSc in Fire and Safety Engineering.
- MPhil/PhD research project on fire engineering.

On the other hand, research cooperation with other universities in mainland China and in other overseas countries in order to compensate the space limitation for full scale experiments in Hong Kong can certainly fine tune the local fire codes and fire safety standards.

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