VIEWS OF BUILDING PROFESSIONALS ON THE IMPLEMENTATION ASPECTS OF FIRE SAFETY ENGINEERING APPROACH IN BUILDING DESIGN – A PRELIMINARY STUDY

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ABSTRACT

In theory, the Hong Kong practice permits alternative approaches to the building codes so long as equivalent safety standard can be demonstrated. If a designer has not followed the guidance, such as the fire safety standard prescribed in the fire codes, it will be evidenced that the design has not complied with the regulations. It will then be for the designer to demonstrate by other means that the design has satisfied the requirements. Traditionally, a building designer will provide qualitative argument to justifying that equivalent standard has been provided. As buildings become complex and demonstration of equivalency by qualitative judgement becomes difficult. The recently published fire codes in Hong Kong recognize the use of quantitative evaluation in the form of fire engineering approach to justify the alternative design. The codes provide preliminary framework of what should be considered in the fire safety engineering study. However, the Government has yet neither published guidance to explain the rationale behind each prescriptive requirement nor engineering guide to illustrate the acceptable evaluation methods. The Building Authority has also pointed out that there is no accreditation of fire safety consultants to carry out fire engineering studies. Authorized Persons who are considered as the building projects managers under the Hong Kong Buildings Ordinance should assume the pivotal role in the consultative procedures when the fire strategy and fire engineering design is developed. However, the Authorized Persons, who may usually be architects, structural engineers, or building surveyors, are normally not trained in fire engineering. Apart from technical issues, problems in the implementation stage may be the practicability of carrying out fire safety engineering studies, the liability of the building professionals and etc. Surveys are carried out to analyze the views of Authorized Persons who is considered as the representative group of building professionals. This paper presents the initial findings of the survey. The objectives of this paper are to examine the problems in implementing the fire safety engineering study.

1. INTRODUCTION

Of all the fire codes[1] issued by the Hong Kong Government, the Code of Practice on Means of Escape was the first published and came into operation on 1st January 1960. It provided guidance for the design of the sizes and capacities of various building elements in respect of evacuation purpose. Although some minor amendments were added to the code over the intervening years, the majority of the requirements had not been updated since its first publication. In the circumstances, the Hong Kong Government in 1990 decided to update the requirements in the code and a working party on the review of the Code of Practice was established. Subsequent to the extensive consultation, the new edition of the codes of practices on Means of Escape and Fire Resisting Construction were published in 1996. In response of construction professional bodies (Hong Kong Institute of Architects, Hong Kong Institute of Engineers, Hong Kong Institute of Surveyors, etc.) in Hong Kong, the new codes explicitly allow the use of fire engineering approach for the design of new buildings or alteration and addition works in existing buildings to meet the fire safety objectives and performance requirements set out in the Building Regulations and the corresponding fire codes [1-4].

The fire codes [1-3] and the practice note (PNAP:204) [5] provide preliminary framework of what should be considered in the fire safety engineering study. However, the Government has yet neither published guidance to explain the rationale behind each prescriptive requirement nor engineering guide to illustrate the acceptable evaluation methods. No doubt the building designers will find difficulties in satisfying the Government's requirements. In addition, the Building Authority has pointed out [5] that there is no accreditation of fire safety consultants of fire

1 a) Means of Escape Code [1]
b) Fire Resisting Construction Code [2]
c) Means of Access For Fire Fighting and Rescue Code [3]
d) Fire Service Installations Code [4]

safety engineering approach. Problems arising from ambiguous standards and undefined specialists may cause implementation difficulties.

Apart from technical issues, problems in the implementation stage may be: the attitude of the building professionals as well as the control officers in various Government departments on the use of fire safety engineering approach, the management problems arising from the use of alternative design, the liability of the building professionals and etc. The objectives of this paper are an initial discussion on the problems in implementing the fire engineering approach.

2. BUILDING CONTROL IN HONG KONG

All building works in Hong Kong should have prior approval given by the Buildings Authority[2]. Under the Buildings Ordinance, every person (e.g. a developer) for whom building works are to be carried out should appoint an Authorized Person (AP)[3] as the project coordinator, who will be entirely responsible for submission of building plans, supervision of the building works and to ensure that the works are in compliance with the Buildings Ordinance [6]. It implies that an AP is normally considered as the building project managers under the Hong Kong Buildings Ordinance. Fire safety design in building is one of the major aspects that should be scrutinized by the Authority. Accordingly, an AP should assume the pivotal role in the consultative procedures when the fire strategy and fire engineering design is developed in the design as well as in the implementation stage of a building project. The attitude of the AP on the use of fire safety engineering approach will no doubt affect the successfulness of using such a design in buildings. In view of the fact that an AP is statutory responsible for endorsing the design of a building, he/ she should therefore be liable for the fire safety design. As the central figure of building projects, their attitude towards the use of fire engineering is important. However, the AP, who may usually be architects, structural engineers, or building surveyors are normally not trained in fire engineering. Will their limited knowledge in fire engineering affect the use of such approach in building design? A research is thus initiated to collect views of practicing AP on the use of fire engineering design.

3. APPROACH OF THE STUDY

In order to review the attitude of AP on the use of fire engineering design, it is prepared to carry out a two-stage survey. At the first stage, 26 AP were interviewed. They are requested to answer structured questions and their views are analyzed. To minimize the influence of interviewer, the questionnaires were set at a multiple-choice basis. The experience and preliminary results will form the basis of the second stage survey in which finalized questionnaires will be sent to the AP currently registered under Section 3 of the Buildings Ordinance upon the availability of funding. This article is going to present the findings obtained in the first stage survey.

4. KNOWLEDGE OF FIRE ENGINEERING

Watt has quoted [7] from a report, America Burning, that:

"Fire safety is lagging behind other safety areas because of considerations such as aesthetics and economy in building design. Reasons given for the gap between building and fire safety design included the observation that fire safety analysis was not keeping up with innovations in building design, and architects and engineers were unenthusiastic about fire safety. Our knowledge of fire was sufficient to permit reliable application of a sophisticated approach to fire safe design, but that much of the information was being ignored, in part because of the scarcity of formal fire safety education programs for architects and engineers."

This is true in Hong Kong situation. In the architectural or building courses, there are no particular subjects in studying fire safety design. The students acquire the fire safety information from building technology subjects in which building or fire codes have been taught. Indeed, the building regulations and fire codes do not elaborate the rationale behind the requirements. In the circumstance, if an AP wants to provide an alternative design, he/ she should first "guess" the implied requirements for a particular clause in the code. Justifying the alternative design will then be a time consuming task. It is not unlikely that an AP will merely consider the prescriptive requirement(s) for designing fire protection in buildings.

2 The Director of Buildings Department is nominated as the Building Authority under the Hong Kong's Buildings Ordinance.

3 Building professionals such as architects, structural engineers and surveyors have to be enrolled in the Government's Authorized Persons Register before they can practice as AP.

All the AP participated in the interview indicated that they had heard the term "fire engineering approach". 77% of them indicated that they noted the term through codes of practices and none of them indicated that they acquired the knowledge from their undergraduate/ post-graduate study. This implies that the statement in the *America Burning Report* is also applicable in Hong Kong.

Another question concerned the knowledge level of fire engineering design (FED) in respect of the background of the AP. The interviewees were requested to rate their level of knowledge on FED. The question is not to "measure" the actual level of knowledge of the APs. It is used to determine the "feeling" of the APs and to see whether such feeling has been derived from the interviewees' background and has any influence on the promotion of FED. The results (see Table 1) revealed that there has fairly low association between the background of the AP and their self-evaluated knowledge on FED. From this it could be inferred that in this sample the self-evaluated knowledge level does not have significant relationship with the APs basic training.

Table 1: Knowledge of fire engineering design (FED) and background of AP

Background	Knowledge level of FED					Total
	1	2	3	4	5	
Architect	7	4	4	0	0	15
Structural Engineer	0	2	1	0	0	3
Surveyor	1	6	1	0	0	8
Total	8	12	6	0	0	26

Cramer's Coeff. = 0.356 (fairly low degree of association). The Cramer's Coeff. is computed because it is a measure of the degree of association or relation between two sets of attributes or variables. It is useful when we have only categorical information about one or both sets of attributes or variables.

*Remarks:

a) The interviewees were asked to rate their own knowledge level, 1 – very little and 5 very familiar;
b) Their knowledge level was further checked by asking whether they know the term "design fire".

We further assessed whether the AP's self-evaluated knowledge level on FED had any association with their attitude on using FED in building design. Table 2 shows the survey results.

Whether the building designer has positive attitude on the use of FED may not associate ($C < 0.5$) with the believe on the level of FED knowledge. Will the building designer have positive idea on the usefulness of FED while they acquire more FED knowledge? No conclusion can be derived from this study.

Table 2: Knowledge level of FED and attitude on using FED

Attitude on Using FED	Knowledge level of FED					Total
	1	2	3	4	5	
1	5	3	1	0	0	9
2	1	6	2	0	0	9
3	0	1	3	0	0	4
4	2	2	0	0	0	4
5	0	0	0	0	0	0
Total	8	12	6	0	0	26

Cramer's Coeff. = 0.487 (slightly lower than moderate degree of association)

*Remarks: The interviewees were asked to rate their attitude on the usefulness of FED, 1 – very negative and 5 very positive.

5. ATTITUDE ON ACTIVE FIRE PROTECTION SYSTEM

Another question concerned the willingness of using FED and their attitude towards the reliability of active fire protection system. The results (see Table 3) revealed that that the AP who believe the active system is more reliable may not have significant relationship to their attitude on using FED ($C \leq 0.253$).

Table 3: Attitude on using FED and belief on the reliability of active system

Belief on Active system	Knowledge level of FED					Total
	1	2	3	4	5	
1	3	2	1	0	0	6
2	2	5	2	0	0	9
3	2	3	3	0	0	8
4	1	2	0	0	0	3
5	0	0	0	0	0	0
Total	8	12	6	0	0	26

Cramer's Coeff. = 0.253 (fairly low degree of association)

6. THE USE OF FIRE ENGINEERING DESIGN

Designers frequently do not consider fire safety until specifications have been developed and a project is ready to begin [7]. Consideration of fire safety at the inception stage can realize substantial savings in construction costs. Architects and contractors can proceed with construction without interruptions and without the inconvenience or unnecessary expense encountered in adding fire safety at an advanced stage. About 73% of the AP expressed that they would prepare to consider the use of FED at detail design stage. This indicated

that they would not consider using FED at the beginning of the design. It implies that FED may only be considered when prescriptive requirements could not be complied with.

7. LIABILITY OF AP

The AP who is responsible for a project involving fire engineering design will subject to potential liabilities which can be one of the following: statutory liability under the Buildings Ordinance, contractual liability with the client, and liability in tort (negligence).

On the question concerning the need for registered fire engineer, about 73% of the AP thought that fire safety consultants should be registered. This implies that building designers are of the opinion that fire safety specialists should be statutorily liable to their works as similar to that of registered structural engineers.

The liability as well as the registration and also the legal aspects for registered fire engineers will require joint considerations by parties including government departments and professional bodies concerned. This should be done without further delays.

8. TRAINING

Fire safety engineers are inter-discipline professionals. One professional group obviously to be considered as possibly registered fire engineers is those building services engineers involved primarily in fire services systems design and installation. One may say that a building service engineer is suitable for considered as a fire engineer. However, fire safety design is not necessary the design of merely mechanical and electrical services (i.e. active fire protection or prevention) systems in buildings. A total, comprehensive, overall assessment of building safety including compartmentations, lobby protections, design of escape routes, access for fire fighting and etc, are very often required. In traditional building services engineering courses, the fire science and passive fire safety protection are seldom taught. In this respect, a BSE may not fully equipped to act as a fire safety engineer. However, if the BSE are provided with additional training in the areas of fire science and building safety, they may be suitable professionals in fire safety design. This additional training may be introduced in the undergraduate programmes; or alternatively this can be acquired by the practicing professional engineers through courses by local universities (e.g. post-graduate courses) or professional institutions such as HKIE (e.g. in the form of continuous professional development courses or schemes).

On the other hand, some other building professionals, such as architects, building surveyors, and etc. are normally acquired building safety knowledge through their undergraduate studies. They are normally familiar with buildings' spatial design, the use of building materials, structural fire safety, etc. If they can provide additional engineering training in fire science, active and passive fire protection systems, they may also be considered as suitable professionals in fire safety design.

In order to cope with the society's need in fire engineering, universities and other professional institutes may need to consider to provide suitable courses, at various level (undergraduate? Or postgraduate?), so as to improve the basic knowledge of the building professionals as well as to train suitable professionals to be fire safety engineers. Government should provide a mechanism to accredidate the qualification of the professionals who are responsible for carrying out the fire safety engineering design in buildings.

9. CONCLUDING REMARKS

It is no doubt that the project manager/ building designer has significant influence on the use of fire engineering approach in designing fire protection system in a building. The current study gives some indications of the initial reactions, preparedness and knowledge of the APs on the application of the fire engineering design. Further training are needed by the professionals in this aspect. The general recognition of the need for registered professionals in carrying out fire engineering design is worth studying in the very near future by both professional bodies and the Government. As the fire engineering design, in essence, shall be carried out by relevant professional engineers, a similar survey study on the attitudes of building services engineers concerned should also be performed. The authors have started the work and will also expand the sampling population of the current study in the second stage survey. Further reports will be made once these works have been completed.

REFERENCES

1. Code of Practice on Means of Escape, Buildings Department (1996).
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4. Code of Practice on Minimum Fire Service Installations and Equipment, Fire Services Department (1994).

5. Practice Note for Authorized Persons and Registered Engineers No. 204, Buildings Department (1998).

6. Buildings Ordinance, Section 4, Chapter 123, Hong Kong Laws (1974).

7. J. Watts, “Life safety as a design parameter”, Fire Technology, Vol. 34, No. 2, pp. 97-98 (1998).