A PRELIMINARY REVIEW ON BUILDING FIRE CODES AND APPLICATION PROCEDURE FOR NEW PROJECTS IN CHINA

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ABSTRACT

Consequent to having so many big fires in the Far East, building fire safety provisions are now very important. As there are more overseas involvements in larger-scale construction projects in China, it is interesting to report on the assessment and approval procedures of fire safety designs. In this paper, the building fire codes in China will be briefly reviewed. The application procedure is outlined by taking a big stadium in Beijing as an example. Finally, the possibility of integrating with the insurance system is discussed.

1. INTRODUCTION

After joining the World Trade Organization, more overseas construction organizations are involved in large-scale projects in China. It is interesting to report on the assessment and approval procedures of providing fire safety in those projects. The development of fire safety science and technology in China was reviewed recently in an international symposium [1]. Consequent to so many big fires happened in the Far East, fire safety provisions are very important and will be assessed vigorously [2]. Departments responsible for fire safety are the Commission of Construction (建设行政主管部门), Municipal Commission of Urban Planning (规划行政主管部门) and the Fire Brigade (消防机构) under the Ministry of Public Security (MPS) in China. In assessing buildings for industrial purposes, the Administration of Work Safety (安全生产监督管理局) would also be involved.

The Municipal Commission of Urban Planning is responsible for the approval of land use, assessment of construction plans, issuing permit for construction, taking care of the separation distance and rescue passages (known as evacuation access EVA in Hong Kong) in case of fire.

The Commission of Construction is responsible for the examination of the design, construction, monitoring and services on technology transfer when necessary, assessment of construction plans, preliminary design, detailed works drawings, occupational safety and health, construction management and quality inspection. Some approval responsibility of the Commission of Construction is dedicated to licensed technical service agents or intermediary organizations[1] (中介技术服务) (those are acting as 'middle-person' organizations). Examination of work drawings, quality control, testing and inspection upon completion of the projects are carried out by such 'middle-person' organizations. Records after completing the works are kept by the Commission of Construction.

The Administration of Work Safety is mainly responsible for auditing, design assessment, testing and inspection of the occupational safety aspects upon completion of construction. Licensed technical services agents (again, acting as 'middle-person' organizations) are also appointed in the safety activities. Such 'middle-person' organizations will be responsible for any mistakes made in the process.

A summary on the building characteristics in China was reported recently [3]. Assessment on fire

[1] Intermediary organization 中介机构
This is a business term from HKSAR Civil Services Bureau. Organizations that play a fundamental role in encouraging, promoting, and facilitating business-to-business linkages and mentor-protégé partnerships. These can include both nonprofit and for-profit organizations: chambers of commerce; trade associations; local, civic, and community groups; state and local governments; academic institutions; and private corporations.
http://www.csb.gov.hk/hkgcsb/o1/netglos/porder/v10_i.htm

safety of buildings is basically controlled by the Fire Brigade under the MPS with the following procedure. The construction projects will be applied by the unit command to the local government at levels of regions (地), states (州), cities (市), or flag counties (旗). Fire safety will then be transferred to the Fire Brigade at different levels for examination. The levels are classified as provinces (省级), Municipalities directly under the Central Government[2] (直辖市), and Autonomous Regions (自治区).

A two-level approval system is designated by the Fire Protection Bureau of the MPS. Both passive building construction and active fire protection system (or fire services installations in Hong Kong) will be examined. Technological aspects will be inspected before issuing signed approval documents. This is an important stage in the whole system. After that, construction process will be inspected randomly. All fire aspects after the completion of construction will be inspected. However, inspecting and testing are carried out by a technical agent. Such practices might be different in different parts of the country depending on the local characteristics. Legal documents will be issued three days after checking. Those documents are on building assessment, testing and inspection and graded as "agreed (同意)" or "to be revised (修改)"; and "passed (合格)" or "failed (不合格)". Monitoring and assessment procedures by the Fire Brigade are very vigorous at very high standards. The architectural firms, building design professionals, construction units, building users and facilities management will be responsible when there is a fire. A pictorial view is shown in Fig. 1.

2. FIRE CODES IN CHINA

Establishments of all fire codes are held responsible by the Government of China, not professional bodies nor privately owned organizations. Most of the codes are mandatory and worked out by the Fire Brigade of the MPS. However, experts are invited to participate in establishing or revising the codes when necessary.

Building fire codes in China are classified based on the functions of the provisions. There are two main areas on 'building fire protection' (might be prevention) and 'fire services'. It is similar to "active" and "passive" fire protection systems in elsewhere [4,5].
Codes for 'building fire protection' include those for integrated buildings design and those for special buildings. Codes and mandatory national standards for buildings fire protection are summarized [6-48] in Table 1.

For integrated buildings, "Code for fire protection design of buildings (建筑设计防火规范)", "Code for fire protection design of tall buildings (高层民用建筑设计防火规范)" and "Code for fire protection design of civil air defence works (人民防空工程设计防火规范)" are the main items. For special buildings, "Code for fire protection design of power plants and substations (火力发电厂与变电所设计防火规范)", "Code for fire protection design of garages, motor-repair-shops and parking-areas (汽车库、修车库、停车场设计防火规范)", "Code for fire protection design of aircraft hangars (飞机库设计规范)" and "Fire prevention code for crude oil and natural gas engineering design (原油和天然气工程设计防火规范)" are referred to.

Further, a set of technical codes for fixed fire protection systems were set up to give more coherent building fire codes. Basically, these codes are divided into two types on 'design' and 'construction and inspection'. There are design codes for the sprinkler systems; water mist suppression systems; carbon dioxide gas extinguishing systems; halon systems; high, medium and low expansion foam systems; dry powder systems; fixed water guns; and automatic fire alarm systems. There are four codes on the construction and checking of automatic water suppression systems, gas protection extinguishing systems, foam systems and automatic fire alarm systems. Hosereel and fire hydrant systems, smoke exhaust systems, and passive fire protection systems are specified in the codes for fire protection (here, might be referred to prevention) design of buildings. Key codes for the design and testing of fire protection systems are listed in Table 2.

Special application areas might have different standards for their own characteristics. Most of them were developed based on the principle behind the national standards. Some examples of the fire prevention and control standards are listed in Table 3.

[2] Municipalities directly under the Central Government 直辖市: This is a term used in Government (People's Republic of China) homepage http://english.gov.cn/index.htm.

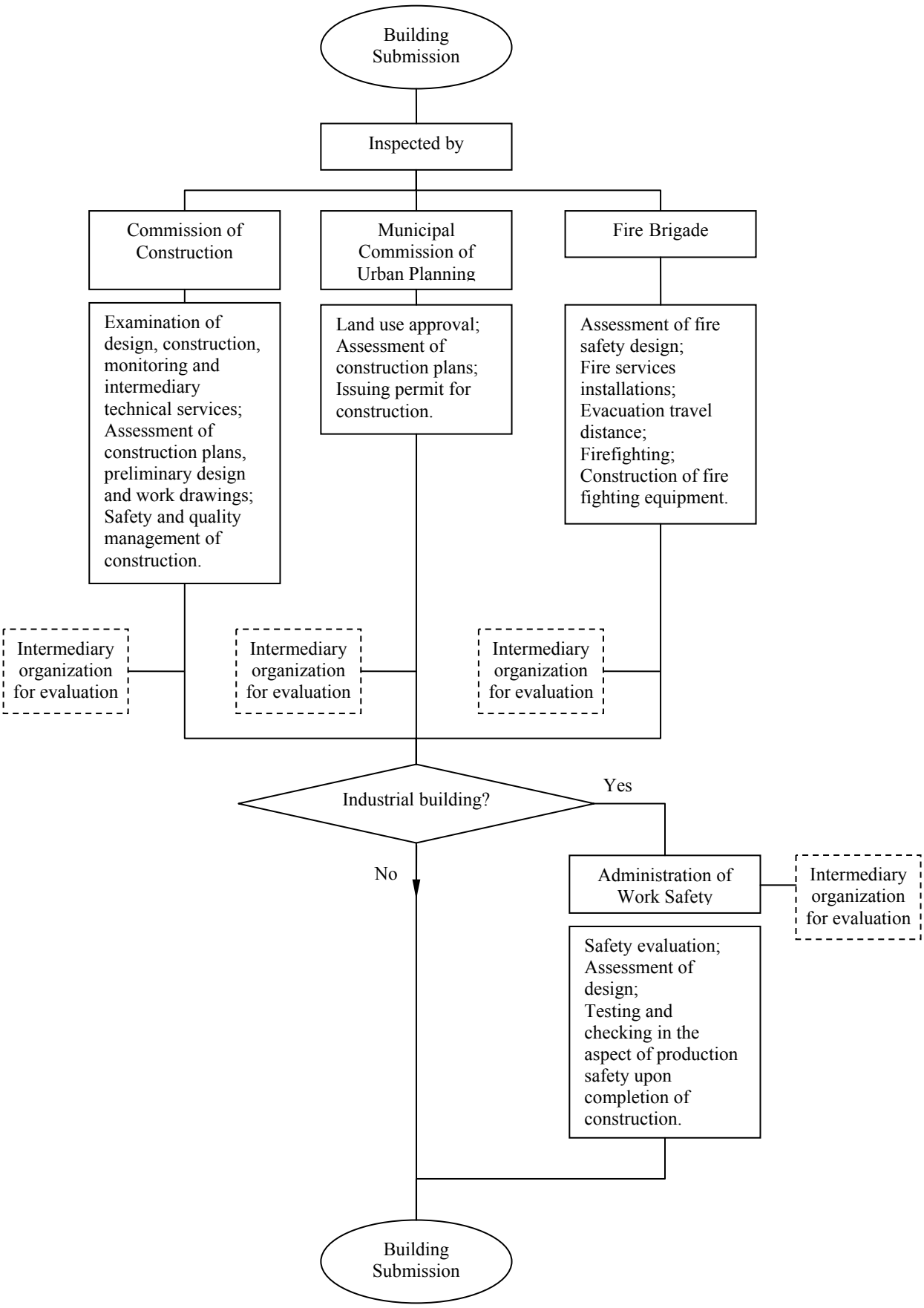

Fig. 1: Assessment and approval of building constructions

Table 1: Building fire design codes in China

Name	Code	Year
Code for fire protection design of buildings 建筑设计防火规范	GBJ 16-87	2001
Code for fire protection design of tall buildings 高层民用建筑设计防火规范	GB 50045-95	**2005**
Code for design of oil depots 石油库设计规范	GB 50074-2002	2002
Code for fire protection design of civil air defence works 人民防空工程设计防火规范	GB 50098-98	2001
Fire prevention code of petro chemical enterprise design 石油化工企业设计防火规范	GB 50160-92	1999
Code for fire protection design of rural buildings 村镇建筑设计防火规范	GBJ 39-90	1990
Fire prevention code for crude oil and natural gas engineering design 原油和天然气工程设计防火规范	GB 50183-2004	2004
Code for fire protection design of power plants and substations 火力发电厂与变电所设计防火规范	GB 50229-96	1996
Code for fire protection design of garages, motor-repair-shops and parking-areas 汽车库、修车库、停车场设计防火规范	GB 50067-97	1997
Code for fire protection design of hydraulic and electrical engineering 水利水电工程设计防火规范	SDJ 278-90	1990
Code for fire prevention in design of interior decoration of buildings 建筑内部装修设计防火规范	GB 50222-95	2001
Safety code for design of industrial explosive materials manufacturing plants 民用爆破器材工厂设计安全规范	GB 50089-98	1998
Code for design of oxygen stations 氧气站设计规范	GB 50030-91	1991
Code for design of acetylene stations 乙炔站设计规范	GB 50031-91	1991
Code for design of gas transmission pipeline engineering 输气管道工程设计规范	GB 50251-2003	2003
Code for design of oil transportation pipeline engineering 输油管道工程设计规范	GB 50253-2003	2003
Design code for producer gas stations 发生炉煤气站设计规范	GB 50195-94	1994
Code for design and construction of automobile gasoline and gas filling stations 小型石油库及汽车加油站设计规范	GB 50156-92	1992
Code for design of metro 地铁设计规范	GB 50157-2003	2003
Code for safety design of fireworks and firecrackers plants 烟花爆竹工厂设计安全规范	GB 50156-2002	2002
Safety code for design of underground and earth cover store of powders and explosives 地下及覆土火药炸药仓库设计安全规范	GB 50154-92	1992
Electrical installations design code for explosive atmospheres and fire hazard 爆炸和火灾危险环境电力装置设计规范	GB 50058-92	1992
Code for design of small-size power plants 小型火力发电厂设计规范	GB 50049-94	1994
Code for design of secondary and primary school buildings 中小学校建筑设计规范	GBJ 99-86	1986
Code for fire protection design of aircraft hangars 飞机库设计规范	GB 50284-98	1998

Table 2: Some codes on the design and testing of fire protection systems

Name	Code	Year
Code for design of automatic fire alarm systems 火灾自动报警系统设计规范	GB 50116-98	1998
Code of design for sprinkler systems 自动喷水灭火系统设计规范	GB 50084-2001	2001
Code of design for water spray extinguishing systems 水喷雾灭火系统设计规范	GB 50219-95	1995
Code of design for low expansion foam extinguishing systems 低倍数泡沫灭火系统设计规范	GB 50151-92	2001
Code for design of high & medium expansion foam systems 高倍数、中倍数泡沫灭火系统设计规范	GB 50196-93	1993
Code for design of halon 1211 fire extinguishing systems 卤代烷 1211 灭火系统设计规范	GBJ 110-87	1987
Code of design on halon 1301 fire extinguishing systems 卤代烷 1301 灭火系统设计规范	GB 50163-92	1992
Code of design for carbon dioxide fire extinguishing systems 二氧化碳灭火系统设计规范	GB 50193-93	1999
Code for design of fire communication and command systems 消防通信指挥系统设计规范	GB 50313-2000	2000
Code for design of extinguisher disposition in buildings 建筑灭火器配置设计规范	GB 50140-2005	2005
Code for installation and commissioning of automatic fire alarm systems 火灾自动报警系统施工及验收规范	GB 50166-92	1992
Code for installation and acceptance of gas fire-extinguishing systems 气体灭火系统施工及验收规范	GB 50263-97	1997
Code for installation and commissioning of automatic fire-extinguishing sprinkler systems 自动喷水灭火系统施工及验收规范	GB 50261-2005	2005
Code for installation and acceptance of foam extinguishing systems 泡沫灭火系统施工及验收规范	GB 50281-98	1998

Table 3: Codes and standards in some special areas

Name	Code
Code for design of archives buildings 档案馆建筑设计规范	JGJ25-2000
Code for design of library buildings 图书馆建筑设计规范	JGJ38-99
Design code for theaters 剧场建筑设计规范	JGJ57-2000
Code for design of cinema buildings 电影院建筑设计规范	JGJ58-88

3. CODES ESTABLISHMENT

Basically, there are four stages in establishing fire codes in China on preparation, consultation, assessment and approval.

At the preparation stage, key procedures are:

- The key editing unit of codes (or management unit of that code) would submit application to the Committee of Code Design (规范行政主管部门) to work out a new code or to revise existing codes.
- Experts in the relevant fields would be invited for assessing the codes to be set up or revised.
- According to the plans of the Ministry of Construction, the Committee of Code Design would instruct the editing unit to work out the codes, inform the units involved and appoint officers involved.
- The key editing unit of codes would carry out the preparation work for the setting up or revision of the codes;
- Upon completing the preparation work, the key editing unit would call for the first meeting of the work group;
- Regular meetings of the work group would be held with representatives appointed by the Committee of Code Design.

At the consultation stage, the work group would investigate the following in setting up national standards:

- Testing and verification work.
- Holding extra-ordinary meetings when necessary to discuss important issues.
- Proposing a consultation paper after thorough discussion.

The consultation paper and the associated descriptions of articles would be published by the key editing unit for the relevant administration departments of the State Council, all related construction administration departments and units in all provinces, autonomous regions, and municipalities directly under the Central Government for soliciting opinions.

At the assessment stage, the work group would revise the consultation paper based on different views solicited. Responses to the committee will be made. Meetings for assessing the drafts for approval would be hosted by the Committee of Code Design. Circulars and minutes of the meeting are published by the Committee of Code Design with record kept by the Ministry of Construction.

At the approval stage, the work group would revise the drafts and finalize all associated articles, reports and related documents for inspection by the Committee of Code Design based on the minutes of the assessment meeting.

If agreed by the Committee of Code Design after the examination by a more senior committee, the drafts would be submitted to the Ministry of Construction for approval.

4. A CASE STUDY ON A STADIUM

A large sports stadium in Beijing is taken as an example for demonstrating the submission procedure to different government departments. Since large sports stadia are not covered in the existing codes, the Beijing Fire Protection Bureau (北京市消防局) would decide the criteria. The parts on architectural design which should follow the codes strictly would be identified. The parts requiring "alternative" approach, in fact performance-based design (PBD), would be highlighted [5].

On the fire safety provisions designed by "alternative" approach, consultants from a recognized list of professional fire engineering organizations will be appointed. Peer review on the design would be carried out by another group of consultants in the list. The final design would be submitted to an 'Expert Committee' for examination. Members of this committee are experts in relevant fields appointed by the Beijing Fire Protection Bureau. If the design is accepted, the Committee would recommend to the Beijing Fire Protection Bureau for final approval. Otherwise, the design has to be revised, and resubmitted for consideration.

A pictorial presentation of the application procedure is shown in Fig. 2.

5. NECESSITY OF PERFORMANCE-BASED DESIGN

With the rapid development of the economics and construction industry, more and more buildings with new design have difficulties in complying with the existing prescriptive fire codes. These types of buildings are currently assessed by experts through the performance-based design (PBD), with engineering performance-based fire code (EPBFC) developed [5,49-53]. However, there are no EPBFC in China yet [2].

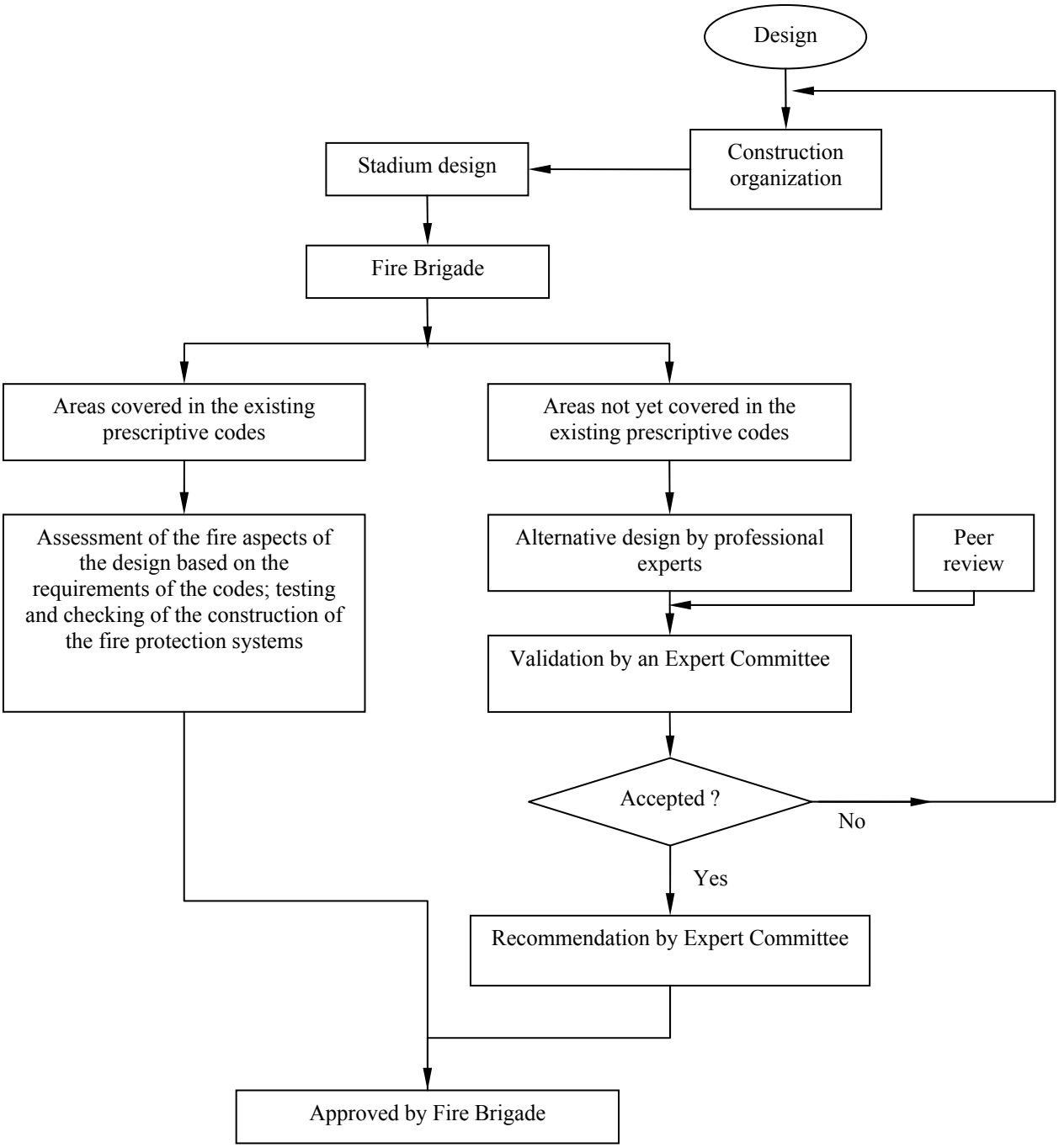

Fig. 2: Assessment procedure for a stadium

The Fire Brigade of the MPS would invite experts in the relevant fields to form an Expert Committee to discuss, verify or make recommendations on the parts not covered in the existing codes. An intermediary organization is appointed to carry out a 'peer review'. Fire safety of the original and the revised (if requested) architectural design will be evaluated. This approval procedure is currently adopted in China during the transition period from implementing prescriptive fire codes to performance-based fire codes.

As there are more new architectural features failed to comply with the existing prescriptive fire codes, there is a need to establish EPBFC in China. Research is necessary to support the implementation of EPBFC. Most of the research laboratories [1] dealing with fire science and technology in China are listed in Fig. 3.

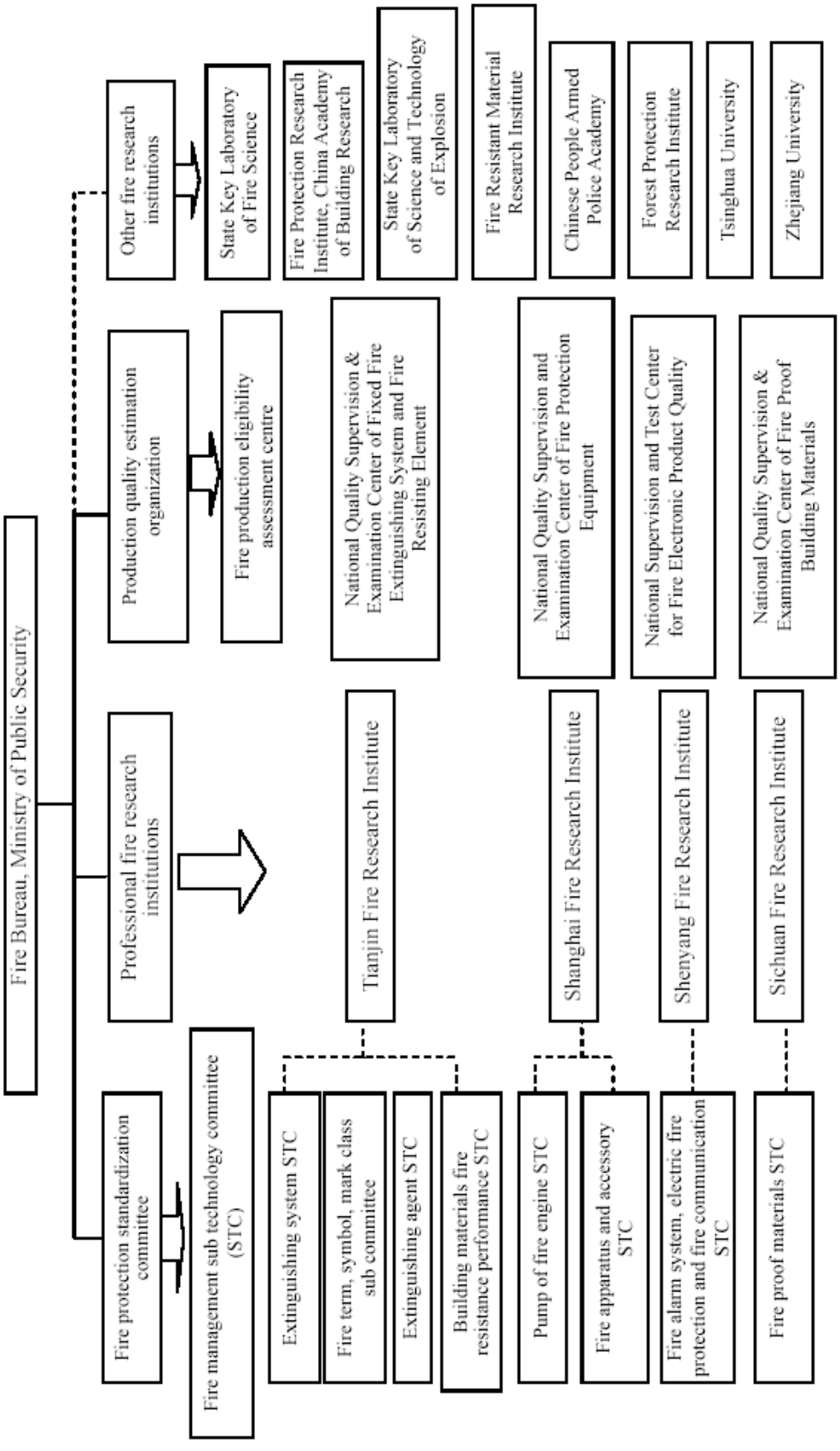

Fig. 3: Key fire research laboratories in China (Talk by General Guo TieNan at the 8th IAFSS in Beijing)

Fire dynamics was supported by a National project [54]. A research project on performance-based fire codes led by the Tianjin Fire Research Institute of the MPS was funded by the National Key Technologies Research and Development Program (NKTRDP) in the "Tenth Five-Year Plan" in China. Other fire research institutes under the MPS; the State Key Laboratory of Fire Science, University of Science and Technology of China; and the Fire Protection Research Institute of the China Academy of Building Research are also involved in such preparation work for setting up the performance-based fire codes. That research project has just been completed with a draft performance-based design guide for buildings just worked out for consideration.

Education and training of adequate number of professionals is another key working area. Degree programmes at the higher education institutions (HEI) and continuing professional development (CPD) for the practitioners should be worked out. HEIs are still the training base for fire safety professionals. The Chinese People Armed Police Force Academy in Hebei; University of Science and Technology of China in Anhui; and College of Chinese People Armed Police Force in Kunming are offering such degree programmes. To promote continuing professional development for practitioners, the Ministry of Education has implemented the plan of offering Master of Engineering degree programmes. As most of the practicing fire personnel are familiar with the prescriptive fire codes, more CPD training on performance-based design are required. Over 100 students were recruited from the Fire Brigade in the new Master of Engineering degree programme on safety engineering established at the State Key Laboratory of Fire Science, University of Science and Technology of China from 2001. 58 students have already passed the oral defense of their dissertations in 2004 and 2005. They are expected to give good contributions on performance-based design of fire safety in the future.

6. INSURANCE

Another key area is on establishing a proper fire insurance system which is still developing in China. As China has just joined the World Trade Organization (WTO), several overseas fire insurance companies are starting up to search for business opportunities. The government is trying to work with overseas fire insurance corporations in developing appropriate fire insurance system. A Symposium [55] on Fire Insurance System was held in Anhui, China in 2004 to discuss the development of such system in China. The fire insurance system is attempted to be integrated with the development of performance-based fire codes in Yunnan, China. Experts in relevant fields are invited to participate in a forum on "Fire Protection Reform and Development" [56].

The main focus of insurance companies is on risk management related to fire. As a business corporation, the insurance company serves to diverse and transfer risk of the company to be insured in return for regular payment of insurance fees. Under normal situations, before undertaking to provide insurance, the insurance company would consider carefully the fire safety conditions of the enterprise to be insured. The insurance fees for corporations with low fire risk would be lower and those with higher risk would be higher. In order to have a clear understanding of the fire safety conditions and danger level of the building to be insured, the insurance company has to conduct a systematic analysis on the building. The fire services installation in the entire building and all possible factors that would lead to a fire would be considered in determining the insurance fees. In the past, some insurance companies invited the Fire Brigade to carry out the assessment. However, setting up their own professional risk assessment team as in other countries is suggested.

7. CONCLUSION

The building fire codes [6-48] in China were briefly introduced in this paper. The implementation procedure was outlined. Prescriptive codes have to be followed for typical buildings, such as low-rise residential buildings [3]. However, 'alternative' design or PBD would be required in bigger projects such as Olympic halls and stadia. Some ideas useful to those who have interests to work on those larger-scale construction projects in China were reported as in above.

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