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General Geometrical Features of the New Airport Terminal Building and a Brief Review on Its Fire Safety Provisions

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Abstract: The general geometrical features of the new airport terminal building in Hong Kong were described. Fire safety provisions were surveyed by means of a site visit without disturbing the normal operation of the airport. Retailing shops were inspected with their minimum heat release rate for flashover estimated.

Key words: Geometrical feature; airport; fire safety

1 Introduction

The new airport terminal in Hong Kong (now the Hong Kong Special Administrative Region, HKSAR), opened on 6 July 1998[1], was built to stimulate economic growth by encouraging tourism, and to meet the annual capacity of 35 million passengers and 1.4×10^6 tons of air cargoes[2]. This airport passenger terminal is one of the biggest in the world. It is obvious that fire safety provisions[3] should be provided properly, bearing in mind that an accidental fire[4] had occurred before the terminal building was in actual operation.

Because of security reasons, not much information was released by the Provisional Airport Authority[5] (now the Airport Authority) before 1997. In fact, very little information on fire safety of the airport was released, apart from several conference papers[6~9] that give a preliminary introduction on the fire safety provisions. Earlier studies[10~12] were therefore based on limited information released to the public.

Upon smooth reunification of Hong Kong to China, the airport terminal was opened and now in good use, though something unpleasant happened in the first few days after opening the airport[13]. The new SAR government is now open, as reflected by distributing consultation papers before setting up or modifying regulations. A good example is on implementing licensing control on karaoke establishments[14~15]. With such policy changes, comments and criticisms from academics are most welcome by the new Airport Authority[1].

Conducting site survey on the safety aspects from the perspective of a passenger on the concourse and the retailing areas at the terminal building is a good starting point for making recommendations to the new authority on how the fire safety provisions can be improved. Such a study will not affect the normal operation of the terminal nor impose any security problems.

2 Geometry

The new airport terminal building is divided into restricted areas and non-restricted areas[16~17] with dimensions estimated in Table 1. Only the non-restricted areas, such as the arrival hall concourse area, the departure concourse area, and the retailing shops area are reported.

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Tab. 1 Dimensions of different zones in the airport terminal building

Level	Name of Level	Zones	Zones (Restricted Area *)	Width / m	Length / m	Height / m
Roof	Roof	—	—	—	—	—
8	Non— Restricted Mezzanine	Restaurant Area		80	28	10
7	Check—In Level	Entrance Hall		330	40	12. 3
		Departure Hall	330	95	12. 3	
		Retailing Area	120	28	2. 3	
			East Hall	—	—	—
6	Boarding Level		North Concourse	—	—	—
			South Concourse	—	—	—
			East Hall	—	—	—
			Central Concourse	—	—	—
			West Hall	—	—	—
			Northwest Concourse	—	—	—
			Southwest Concourse	—	—	—
5	Arrivals	Arrival Hall		330	53	8
		Retailing Area		48	10	2. 3
			Pre— Immigration Hall	—	—	—
			North Concourse	—	—	—
			South Concourse	—	—	—
			Central Concourse	—	—	—
			West Hall	—	—	—
			Northwest Concourse	—	—	—
			Southwest Concourse	—	—	—
4	Apron	Apron / Plant Platform		—	—	—
3	Not Applicable	Stores		—	—	—
2	Not Applicable	Baggage Hall/ Plantrooms		330	120	10
1	Station Platform / Tunnel	Station Platform / Tunnel		—	—	—

* The dimensions of restricted areas cannot be observed

The geometrical shapes of levels 5, 6 and 7 of the terminal building are shown in Figures 1 to 3. The dimensions shown were estimated by walking through the part of the terminal accessible to public. Basically, each level of the terminal building is divided into the east hall, the north concourse and the south concourse. Special features of interest are:

◦ The passenger terminal is 1.2 km long;

◦ The terminal complex has a total area of 550, 000 m^2.

A spacious, bright, airy and comfortable environment is provided. Facilities and services provided are:

◦ 48 airbridge—served gates for wide—bodied aircraft and 27 remote stands.

◦ 2. 5 km of moving walkways, a driverless train system operating along the 750 m long central concourse.

◦ A baggage handling system with 12 reclaim carousels to handle 19, 200 pieces of luggage per hour.

◦ Ramps, travelators, lifts and escalators give better horizontal transportation of passengers moving from one level to another.

◦ Simple and clear signposting throughout. Sensible provision has been made for the aged and those with disabilities.

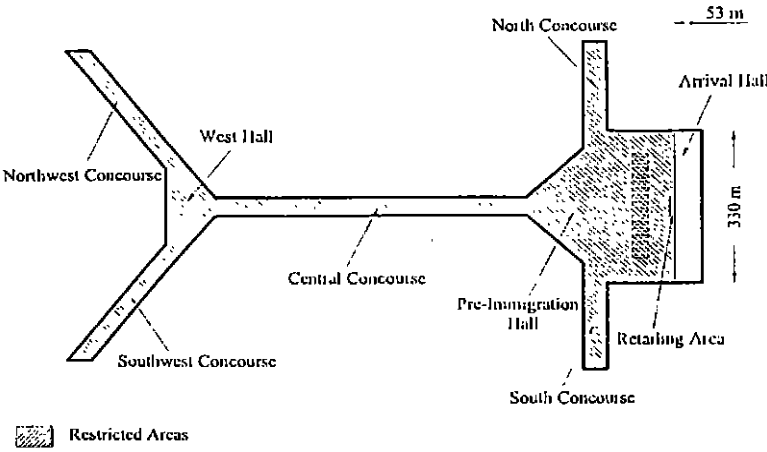

Fig. 1 The layout of level 5 of the airport terminal building

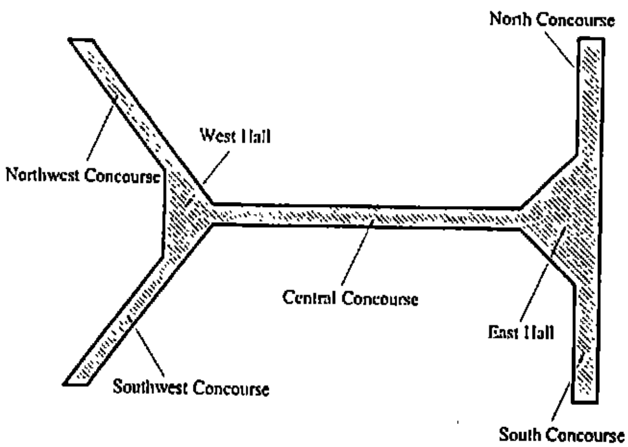

Fig. 2 The layout of level 6 of the airport terminal building

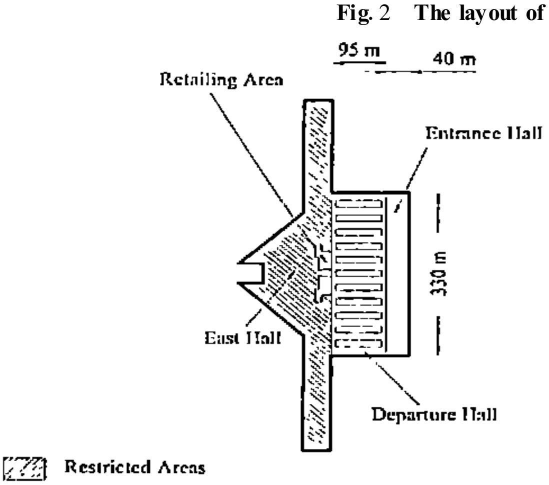

Fig. 3 The layout of level 7 of the airport terminal building

There are eight levels in the terminal building with their functions listed in Table 1. Shopping malls are located in the non—restricted areas (Landside) at both the arrival and the departure halls on levels 5 and 7. The height of the level at the retailing area is estimated to be 2.3 m. The other retail zones are in the restricted areas (Airside) of the east hall of level 7 and the whole level 6. Level 8 is a non—restricted mezzanine floor where the whole zone is used for restaurants.

3 Fire Safety Provisions

Passive building design for fire safety follows those required by the government Buildings Department (BD), i.e. the codes on Means of Access (MoA)[18], Means of Escape (MoE)[19] and Fire Resisting Construction (FRC)[20]. Active fire protection systems should be provided according to the local codes on fire services installation (FSI)[21] issued by the government Fire Services Department (FSD).

Concerning passive building design, the airport terminal building is subdivided into several evacuation zones with similar emergency operation modes. Adequate number of exits were observed with provisions complied with the local MoE and MoA codes. During the site visit, it is observed that the building facade and the restaurant areas are constructed with curtain wall to give an aesthetic effect. Glass with special treatment is installed to avoid breaking into small pieces in case of fire. No combustible materials were observed. Though it cannot be judged from such a survey whether the constructions are of adequate fire resistance period, it is believed that local FRC code was complied.

The following FSI were observed:

° Smoke detectors are not observed in the main concourse area but are found at the ceiling of the retailing area of the departure level and the main entrance of the arrival level. Fire detectors are found at the check—in counters.

° Sprinkler heads are observed in the retailing area of the departure level, waiting areas, and the retailing shops.

° Fire hydrants, hose reels, break—glass alarms are found near the access with ‘EXIT’ signs, and at the two ends of each group of check—in counters.

° Public announce systems are installed to assist in controlling the flow of people.

4 Retailing Shops

There are two retailing zones in the non—restricted areas at the arrival level and the departure level. Restaurants are found at level 8 and at the dining area of the departure level. In addition, fast food services are provided at the arrival level.

The dimensions of the retailing shops are listed in Table 2. Besides, the opening areas of the shops were recorded for assessing the fire hazard scenarios. The minimum heat release rate Q_{fm} (in kW) for flashover of a shop of length L (in m), width W (in m), height H (in m) and with an opening of area A_v (in m^2) and height H_v (in m) can be calculated by using the following equation proposed by Thomas[22]:

$$Q_{fm} = 7.8A_t + 378A_v\sqrt{H_v} \quad (1)$$

where

$$A_t = 2[LW + (L + W)H] - A_v \quad (2)$$

Equation (1) was also incorporated in the fire engineering tool FIREWIND[23]. Two ventilation conditions with width Wv estimated as shown in Table 1 were assessed for calculating Q_{fm}:

° V1: A door of height 2.3 m was opened.

° V2: The door was closed, leaving a gap of only 0.01 m, but taking the width as in V1.

It is observed that flashover can occur in a retailing shop if the heat release rate is higher than the values of Q_{fm} as shown in Table 2. Bigger shops such as Shop 24 would require a 9 MW fire for flashover under ventilation condition V1 where all the doors are opened. However, if the doors are closed leaving with a small gap of height 1 cm, flashover can occur easily. For example, only a 0.2 MW fire in Shop 36 selling wines and cigarettes would give flashover. Care must be taken so that a fire will not be allowed to grow unattendedly.

5 Conclusion

The general features of the terminal building in the new airport are reported by touring on the site. The fire safety provisions, both passive building design and active fire protection system, are observed from the view of a passenger. Preliminary observations indicated that sufficient fire safety is provided.

The retailing areas should be of greater concern. The minimum heat for flashover in each retailing shop was estimated. Care should be taken not to keep excessive amount of combustibles. The retailing area is protected by the cabin concept[24~25]. This is a good design in utilizing more hall space without installing an excessively large smoke extraction system. As reported in the literature[10~12], the following points should be considered:

° Likelihood of flashover in the cabin and its consequences of occurrence. The fire load density and nature of the shop are key factors[10~11, 26~27].

° Will the ’cabin’ become a big heat source to give large production rate of smoke[10~12]?

° Effectiveness of operating the cabin sprinkler system in controlling a fire[26].

° To answer the question ”How big is the cabin fire?” by understanding the heat release rate in a cabin. Full—scale burning tests have to be carried out if necessary[28].

° Possibility of using a water mist system[29].

Tab. 2 Retailing shops at the arrival concourse

Level	Shop number	Business	Width W / m	Length L / m	Height H / m	W_v / m	Ventilation conditions V1 (H_v= 2.3 m) A_v / m^2	V1 (H_v= 2.3 m) Q_{fm} / MW	V2 (H_v= 0.01 m) A_v / m^2	V2 (H_v= 0.01 m) Q_{fm} / kW
5	1	Food services	2	4	2.3	1.3	3	2	0.013	0.3
	2	Food services	2	6	2.3	2	4.6	3.1	0.020	0.5
	3	Magazines, food, medicine and toiletries	3	6.5	2.3	3	6.9	4.5	0.030	0.6
	4	Magazines, food and drinks	2	6	2.3	2	4.6	3.1	0.020	0.5
	5	Food services	6	5	2.3	6	13.8	8.7	0.060	0.9
	6	Food services	2	3	2.3	2	4.6	2.9	0.020	0.3
	7	Storing service	3	6	2.3	3	6.9	4.5	0.030	0.6
	8	Food services	4	10	2.3	3.5	8.1	5.7	0.035	1.1
	9	Flowers	2	4	2.3	1	2.3	1.6	0.010	0.3
	10	Press conference room	4	4	2.3	1	2.3	1.8	0.010	0.5
	11	Money exchange	6	6	2.3	4	9.2	6.2	0.040	1
7	12	Police	1.5	7	2.3	1.5	3.5	2.4	0.015	0.5
	13	Money exchange	3.5	2.5	2.3	2.5	5.8	3.6	0.025	0.4
	14	Wines and cigarettes	2.5	2	2.3	2	4.6	2.8	0.020	0.2
	15	Watches, clothes, bags and foods	7	7	2.3	8.5	19.6	12.3	0.085	1.3
	16	Magazines, food, medicine and toiletries	7	8	2.3	10	23	14.4	0.100	1.4
	17	Food	3	3	2.3	2	4.6	3	0.020	0.4
	18	Books, magazines and stationery	6	3	2.3	5.5	12.7	7.8	0.055	0.6
	19	Money exchange	3.5	2.5	2.3	2.5	5.8	3.6	0.025	0.4
	20	Clothes	4	6	2.3	9	20.7	12.4	0.090	0.7
	21	Souvenirs	5	3	2.3	4.5	10.4	6.4	0.045	0.5
	22	Food services	3	3	2.3	2	4.6	3	0.020	0.4
	23	Food services	2	3	2.3	2	4.6	3	0.020	0.4
	24	Food services	28	6	2.3	4	9.2	9	0.040	3.8
	25	Food services	4	4	2.3	3.5	8.1	5.1	0.035	0.5
	26	Souvenirs	2.5	7	2.3	9.5	21.9	13	0.095	0.6
	27	Money exchange	3.5	2.5	2.3	2.5	5.8	3.6	0.025	0.3
	28	Books	6	3	2.3	8	18.4	5.1	0.080	0.5
	29	Post service	3	6	2.3	1.5	3.5	2.6	0.015	0.6
	30	Telephone services	4	9	2.3	2	4.6	3.6	0.020	1
	31	Snacks	4	4	2.3	6	13.8	8.3	0.060	0.5
	32	Toys	4	6	2.3	5	11.5	7.2	0.050	0.7
	33	Food services	10	6	2.3	1.5	3.5	3.5	0.015	1.5
	34	Saving service	6	10	2.3	6	13.8	9.3	0.060	1.5
	35	Audio and video products	6	3	2.3	7.5	17.3	10.4	0.075	0.6
	36	Wines and cigarettes	2.5	2	2.3	2	4.6	2.8	0.020	0.2
	37	Money exchange	3.5	2.5	2.3	2.5	5.8	3.6	0.025	0.4
8	38	Food services	10	28	10.3	76	614			
	39	Food services	10	20	10.3	60	569	No walls on four sides		
	40	Food services	20	11	10.3	62	598.3			
	41	Food services	40	18	10.3	116	1078			

° Fire safety management programs including training of the store-keepers and the building management staff.

Preliminary experimental works on fires of sufficiently high heat release rate in a' bare cabin'[28] were carried out by the Hong Kong Polytechnic University (PolyU) and University of Science and Technology of China (USTC) in their joint PolyU/USTC Atrium. Experimental data for understanding cabin fires in an atrium were obtained through the full-scale burning tests. Answers to some of the questions can be obtained from the studies.

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三个机场候机厅的火灾安全分区评述

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摘要:通过参观机场对公众开放的区域,对三个机场候机厅的火灾安全分区进行了评述。这三个机场是:香港的旧启德机场、澳大利亚的悉尼机场和墨尔本机场。指出了一般的被动建筑设计和积极的火灾防护系统。按照估计的火灾载荷密度对零售区域商店的形状和商品进行了记录。利用消防工程计算程序FIRECALC对三种水喷头的启动时间进行了预测。

关键词:火灾安全;机场;FIRECALC

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香港新机场侯机厅的基本几何结构特点及其火灾安全分区的简短回顾

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摘要:描述了香港新机场侯机厅的基本几何结构特点。在没有扰乱机场的正常运作的情况下,对侯机厅的火灾安全分区进行了实地考查。对候机厅内的零售店发生轰燃所需的最小热释放速率进行了调查。

关键词:几何特点;机场;火灾安全

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