POLITECNICO DI TORINO

Corso di Laurea Magistrale

in Ingegneria Automobile

Fire protection system between Chinese and UK standard in Automotive engineering

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INTRODUCTION

Accompanied by the economic and technological development rapidly, more and more big buildings appeared in any where. They response different functions, in the city center as large number of people poured in, the residential building with higher layers (36-40 recently), the shopping center with capacitance of 50 thousand people are needed; In city side the factory is growing bigger and bigger, to satisfy the need of high quality and high quantity.

At the same time, because those large building with big volume, and response of many functions, the division of fire zone and design of fire protection system is quite important, this paper is to discuss the fire prevention of the automotive production in different countries.

As we see that China is a country with very fast improve in development, as the fast of its developed, there are lots of problems following with it, not only in the educational level, but also in building design, safety care and so on. From 2008 to 2018, a total of 1757099 fire accident occurred. The annual direct economic loss of fires reached 1.208 billion RMB (0.15billion Euro), and in average 2,088 people lost their lives in the fire every year. According to statistics, the main cause of fires is electrical fires and burning of thermal material let fire can't be stopped easier. The fire caused by this cause accounts for almost half of the total number of fires. As an example in 2016 the dead peole in fire accident, the fincial cost in it and fire reason are writed below, as shown in the picture we can find that:

1 in the fire accident the most dead are appear in the residential building.

2 with the fincial loose part, the residential building is the top one, but the plant loose is also quiet special, with less number of fire accidents but high fincial cost, and high death percentage.

3 the reason for causing the accident is meaningful, most reason is from electronic, the over used of electronic products, old wires, old mechine is becoming the murder facility in killing lives. In plant design it has big connection with alarm system which can warn of the accident, and stop it in time. Then the plant production fire cause is the second of total accidents, which means there needed more fundamental operation with machine, welled design in facility set,

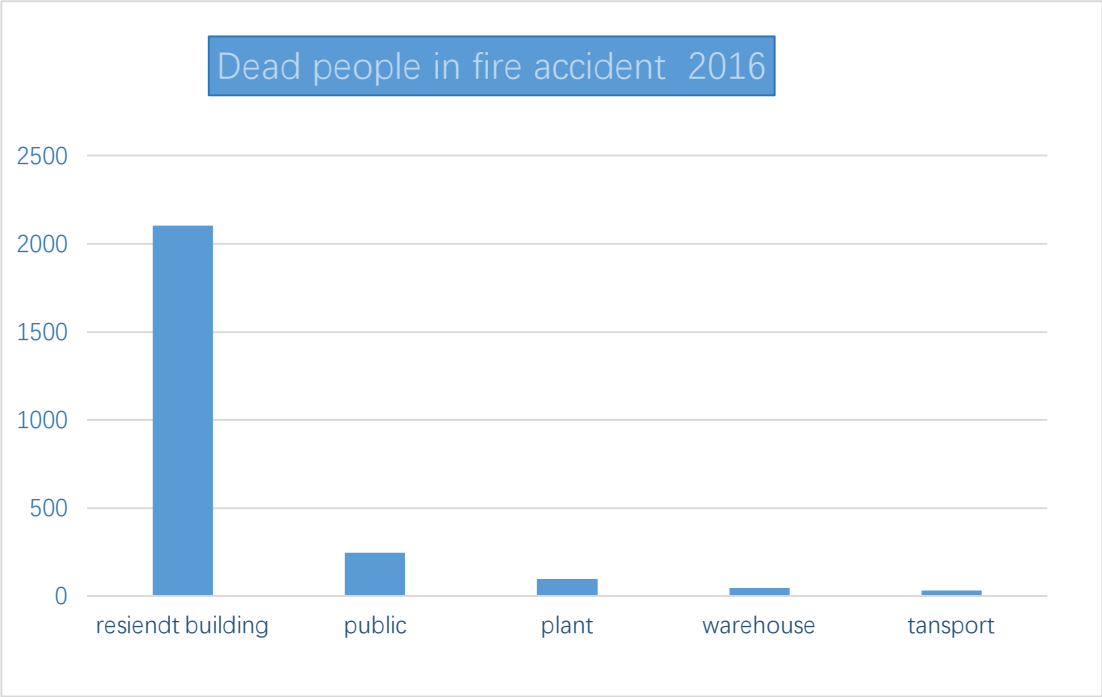


TABLE 1

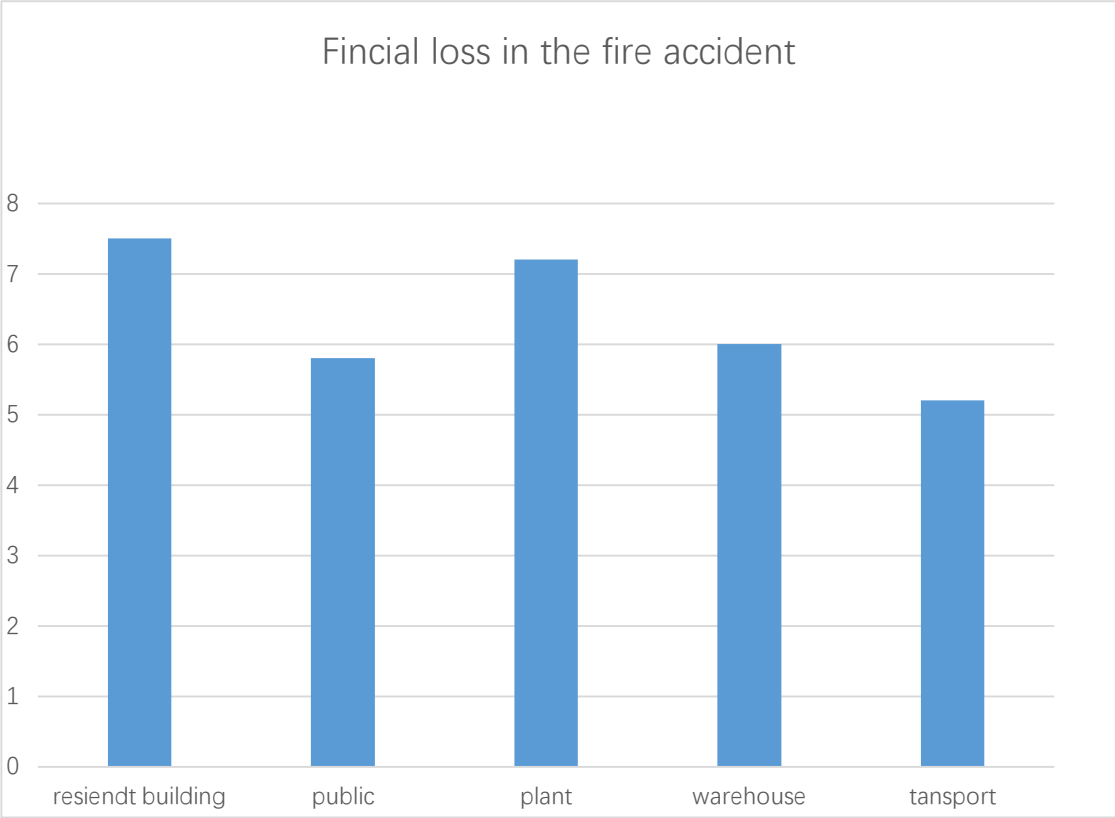


TABLE 2

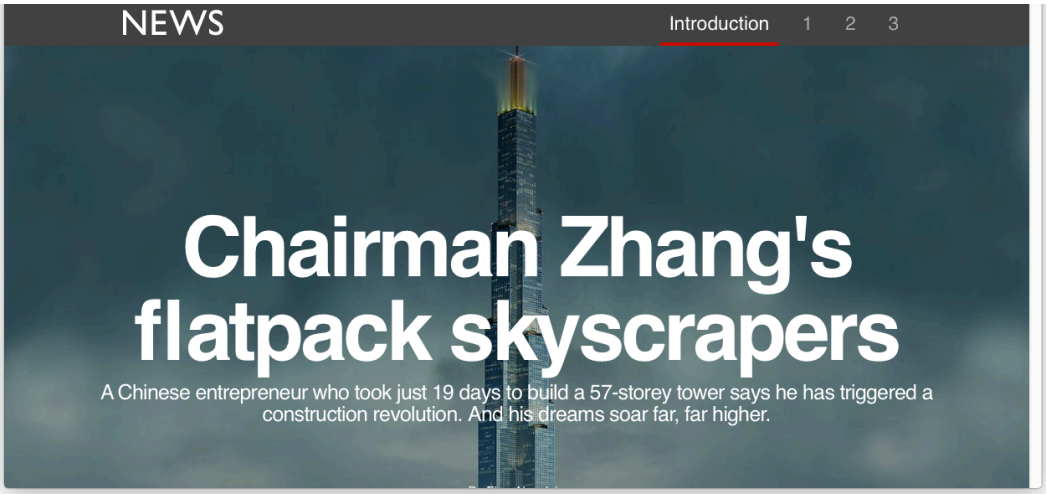


FIGURE 1

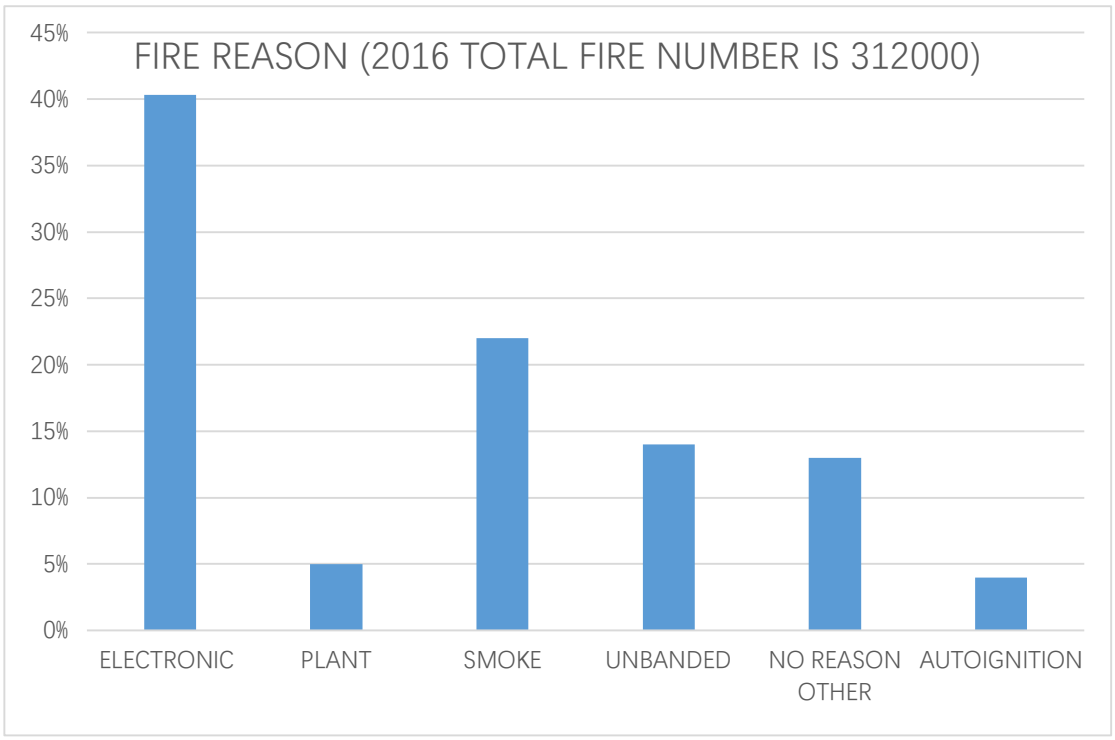


TABLE 3

In the other side the Chinese structure is famous of its impossible build speed, creative building technology, and relatively high percentage of good quality like buildings bridges, high rail trains... So dose there is a balance with high quality building and high quality inner design, to react the accident.

Recently the Chinese government has paid lots of attention to the environment care, so most of the fire resistance material used in the production, the architecture, and other places are forbidden. Which cause lots of fire accident in this two years. Then because of the fire resistance standard we use is just copy the America, Europe, and British one with thirty to fifty years ago, as time passed, every codes changed except the Chinese one, also as the growth of the plant, the asked functionality of the structure, those standard just with data in not really suitable with the inner design needs in huge plant area.

But the simple standard is also helped people to finish the Architecture drawing in a short, the easy picture also helped to build up the structure in a quiet short time, then in plant construction the higher the speed is the much money it saved, that also helpful for a marketing sizing and the other following profiles.

Finally, as the globalization developing process, more and more super factory are needed, the obviously the Automotive Engineering. So that dose there is also a balance with Chinese speed and British design? What dose Chinese and British can learn from each other, its quiet interesting that through the analyzation and comparison in the standards, it may find some useful advice with the plant fire safety design, also it may find some way to simplified the British standards, and some significant design point for building up the huge plant in an effective, and low cost way.

Therefore, in this paper the aim is to define a well detailed learning with the standards between the to example countries, try to find a better fire safety system in Automotive engineering plant construction. Considered with high effective utilization, simple built, low cost, and the most considered is better fire safety.

In a word, as summarized of lots of structure design standard with the two countries, and learning some code book of architecture materials I find there are lots of interesting difference needs to be talking about, such as the alarm joining with air condition system; the internal/ external thermal material used; the fire resistance time with in China is most twice of the British one, why dose they have this huge difference; there still many details to be shown then, so that depending on analyze some of the impressive fire accidents more and more potential safety hazard will appear below. Through those kinds of information collection and summarizing of the data, the tragedy, it would find some tips to improve the fire safety system in Automotive Engineering.

CHAPTER1 FIRST OF ALL IS TO DEFINE THE "FIRE RESISTANCE RATE" in china

There are 4 levels of the building

Fire resistance

Fire endurance of Building					
Fire endurance of level / Fire property and fire endurance (h)		level 1	level2	level3	level4
wall	firewall	noncombustibles 4.0	noncombustibles 4.0	noncombustibles 4.0	noncombustibles 4.0
	main wall, staircase, elevator shaft	noncombustibles 3.0	noncombustibles 2.5	noncombustibles 4.1	hard combustibles 0.5
	no bearing wall, escape route wall	noncombustibles 1.0	noncombustibles 1.0	noncombustibles 4.2	hard combustibles 0.25
	room wall	noncombustibles 0.75	noncombustibles 0.5	noncombustibles 4.3	hard combustibles 0.25
pillar	pillar with multi layer	noncombustibles 3.0	noncombustibles 2.5	noncombustibles 4.4	hard combustibles 0.5
	pillar with single layer	noncombustibles 2.5	noncombustibles 2.0	noncombustibles 4.5	combustibles
	girder	noncombustibles 2.0	noncombustibles 1.5	noncombustibles 4.6	hard combustibles 0.5
	floorslab	noncombustibles 1.5	noncombustibles 1.0	noncombustibles 4.7	hard combustibles 0.25
	roof bearing	noncombustibles 1.5	noncombustibles 0.5	combustibles	combustibles
	escape stair	noncombustibles 1.5	noncombustibles 1.0	noncombustibles 4.0	combustibles
	suspended celling	noncombustibles 0.25	hard combustibles 0.25	hard combustibles 0.25	combustibles

FIGURE 2

1.1 THE MULTI STORIED AND HIGH RISE INDUSTRY BUILDING with fire resistance level 2 which with the stock average weight over 200 kg/m^2, it`s room pillar and floor slab should accord to the fire resistance level 1 but if they have automatic fire extinguishing equipment, the level could still be level 2 [1].

1.2 WHEN SUSPENDED CELLING IS NONCOMBUSTIBLE INDUSTRY building and so that with it`s no bearing wall, the fire resistance time could be 2.5hour, when it is limited combustible the time could be 0.5 hour

1.3 The floor slab with fire resistance level 2, if the resistance time is hard to achieve 1 hour, then it could flop to 0.5h. The roof with fire resistance level2, which allow people to stand, the resistance time should higher then 1h.

1.4 If the roof with fire resistance level 2 have difficult to achieve the 0.5h of the resistance time, it also can be solved by build up it with the uncoated metal materials.

1.5 The room inside the building should build with noncombustible materials, but if the building with fire resistance level 1 or level2, it could use something combustible in their surface.

1.6 The indoor trim of those building below, should use noncombustible or limited combustible materials. 1 high quality hotels 2computer rooms 3 play, video room.

CHAPTER 2 THE PLANT

2.1 FIRE RISK CLASSIFICATION DURING MANUFACTURE.

2.1.1 the form of fire risk classification

Type	Fire risk classfication	
		limitation
A	1	liquid which Flashpoint lower than 28 C°
	2	the gas with lower explosive limit less than 10%
	3	Substances that spontaneously decompose or oxidize in the air at room temperature which can cause rapid spontaneous combustion or explosion
	4	The substance that can generate flammable gas and cause combustion or explosion under the effect of water vapor in the air or room temperature air
	5	the strong oxidants which easy to burn or explode under acid, heat, impact, friction, and catalysis such as organic matter or sulfur,
	6	Substances that can cause combustion or explosion when they are struck, rubbed, or contacted with oxidants or organic matter.
	7	The operating temperature in a closed device is not less than the spontaneous ignition point of the substance itself
B	1	liquid with flashpoint from 28C° to 60C°
	2	the gas with lower explosive limit not less than 10%
	3	the oxidants but not from type A
	4	the inflammable solid but not form type A
	5	floating dust, fibers, and (flash point of not less than 60°C) liquid droplets able to form an explosive mixture with air,
	6	the gas easy to burn and react
C	1	liquid with flashpoint no less than 60C°
	2	inflammable solid
D	1	Processes incombustibles and aways produces intense radiant heat, sparks, or flames at high temperatures or in molten states
	2	use gas, liquid and solid as fuel,or producing other production with the gas, liquid combustion
	3	use or producing the limited combustible substance under room temperature
E	1	use or producing the noncombustible substance under room temperature

TABLE 4

Ps: In the production process, if the amount of flammable and flammable substances used or generated is not enough to pose an explosion or fire risk,

The actual fire hazard category can be determined

2.1.1 In the case of fire hazard production in any of the fire prevention zones within the same plant or plant, the production fire hazard category within the plant or fire zone shall be determined in accordance with the greater risk of fire; use or flammability may occur during production. When the amount of combustibles is small enough to constitute an explosion or fire hazard, it can be determined according to the actual situation; when one of the following conditions is met, it can be determined according to the part where the risk of fire is small.

2.1.2 The fire risk of stocks should be based on factors such as the properties of the stocks and the quantity of combustibles in the stocks, it also can separate to 5 (A B C D E) levels with the form below [3].

Fire risk level of the strocks	Fire risk properties of the stock	
A	1	liquid which Flashpoint lower than 28 C°
	2	the gas with lower explosive limit less than 10%
	3	Substances that spontaneously decompose or oxidize in the air at room temperature which can cause rapid spontaneous combustion or explosion
	4	The substance that can generate flammable gas and cause combustion or explosion under the effect of water vapor in the air or room temperature air
	5	the strong oxidants which easy to burn or explode under acid, heat, impact, friction, and catalysis such as organic matter or sulfur,
	6	Substances that can cause combustion or explosion when they are struck, rubbed, or contacted with oxidants or organic matter.
B	1	liquid with flashpoint from 28C° to 60C°
	2	the gas with lower explosive limit not less than 10%
	3	the oxidants but not from type A
	4	the inflammable solid but not form type A
	5	floating dust, fibers, and (flash point of not less than 60°C) liquid droplets able to form an explosive mixture with air,
	6	Contact with air at room temperature can be slowly oxidized, and the product will burn spontaneously due to accumulated heat
C	1	liquid with flashpoint no less than 60C°
	2	inflammable solid
D	1	hard combustibles
E	1	non combustibles

TABLE 5

2.1.3 When storing fire hazards in any of the fire compartments of the same warehouse or warehouse, the fire hazard of the warehouse or fire compartment shall be determined according to the item with the highest fire risk.

2.1.4 The fire risk of storing warehouse which belongs to level 4 and 5 When the weight of the flammable package is greater than 1/4 of the weight of the article itself or the flammable package volume is greater than 1/2 of the volume of the article itself, it shall be determined in accordance with level C.

2.1.5 The maximum allowable building area and layers of the plant and warehouse should be limited by the fire risk levels. As the form showing below.

The number of layers of the plant and the maximum allowable area for each fire zone

fire risk type	fire resistance level	maximum allowable layers	muximum allowable building area of each fire zone (m^2)			
			single layer plant	muliti layer plant	high rise layer plant	Underground or semi-underground building
A	1 2	single	4000 3000	3000 2000	— —	— —
B	1 2	no limit 6	5000 4000	4000 3000	2000 1500	— —
C	1 2 3	no limit no limit 2	no limit 8000 3000	6000 4000 2000	3000 2000 —	500 500 —
D	1,2 3 4	no limit 3 1	no limit 4000 1000	no limit 2000 —	4000 — —	1000 — —
F	1,2 3 4	no limit 3 1	no limit 5000 1500	no limit 3000 —	6000 — —	1000 — —

TABLE 6

2.1.6 ps: a, Fire partitions should be separated by a firewall. In addition to the Class A and Class II fire-resistant factory buildings outside the Class A building, when the building area of the fire compartment is larger than that specified in this table and the firewall is difficult to install, it may be separated by a fire shutter or a fire screen.

b In addition to the Mafang factory, the maximum allowable floor area of each fireproof zone can be increased by 0.5 times in accordance with the provisions of this table, but in the multi-story fire-fighting multi-storey textile workshop and the secondary fire-resistant single and multi-layer textile workshops, The fireproof partition wall of the raw cotton opening, the flower cleaning workshop and other parts of the factory shall be separated by a fireproof partition wall with a fire endurance of not less than 2.50h. When doors, windows, and openings are to be opened, Class A fire doors and windows shall be installed.

c For a single and multi-layer papermaking production joint factory of Class I or Class II fire-resistance, the maximum allowable floor area of each fire prevention zone may be increased by 1.5 times according to the provisions of this table. In the first and second class fire-resistant wet papermaking joint

workshops, when an automatic fire extinguishing system is installed in the dryer hood of a paper machine and the effective fire extinguishing facilities are protected during construction, the maximum allowable floor area of each fire zone can be determined according to the process requirements.

d The operating platform and maintenance platform in the factory shall not be included in the construction area of the fire prevention zone when the number of users is less than 10 persons.

layers and area of the warehouse										
Fire risk type of the stocks		Fire resistance of the warehouse class	the muximum number of layers allowed	the upper limited area of the warehouse m^2						
				single stage warehouse		multi stage warehouse		high rise stage warehouse		underground or semiundergroun d
				each warehouse	fire zone	each warehouse	fire zone	each warehouse	fire zone	fire zone
A	3、4	1	1	180	60	—	—	—	—	—
	1、2、5	1,2	1	750	250	—	—	—	—	—
B	1、3、4	1,2	3	2000	500	900	300	—	—	—
		3	1	500	250	—	—	—	—	—
	2、5、	1,2	5	2800	700	1500	500	—	—	—
		3	1	900	300	—	—	—	—	—
C	1	1,2	5	4000	1000	2800	700	—	—	150
		3	1	1200	400	—	—	—	—	—
	2	1,2	unlimit	6000	1500	4800	1200	4000	1000	300
		3	3	2100	700	1200	400	—	—	—
D		1,2	unlimit	不限	3000	不限	1500	4800	1200	500
		3	3	3000	1000	1500	500	—	—	—
		4	1	2100	700	—	—	—	—	—
E		1,2	unlimit	不限	不限	不限	2000	6000	1500	1000
		3	3	3000	1000	2100	700	—	—	—
		4	1	2100	700	—	—	—	—	—

TABLE 7

2.1.7 Except as the form upside, the number of layers and area of warehouses shall comply with the table below [2].

ps: a, The fire zone in the warehouse must be separated by fire walls. The fire zone between the fire partitions in the warehouses of categories A and B should not have doors, windows, or openings; and the maximum allowable space for

underground or semi-underground warehouses (including underground or semi-basement). The area should not exceed the maximum allowable floor space of the corresponding category of above-ground warehouses.

b, The coal ranks of the first and second class refractory grades shall have a maximum allowable floor area of 12,000m^2 for each fire zone.

C, Independently constructed ammonium nitrate warehouses, calcium carbide warehouses, polyethylene and other polymer product warehouses, urea warehouses, coal distribution warehouses, and paper mills' independent product warehouses. When the fire resistance rating of a building is not less than two, the maximum allowable per warehouse is The floor space and the maximum allowable floor area for each fire zone can be increased by 1.0 times as specified in this table

2.1.8 When an automatic fire extinguishing system is installed in a plant, the maximum allowable floor area of each fire prevention zone may be increased by 1.0 times according to the provisions. When the automatic fire extinguishing system is installed in the ground floor of the D and E class buildings, the maximum allowable floor area of each fire zone is not limited. When an automatic fire extinguishing system is partially installed in a plant, the increase in the area of the fire prevention zone is calculated based on 1.0 times the local area.

2.1.9 When an automatic fire extinguishing system is installed in a warehouse, the maximum allowable area of each warehouse and the maximum allowable floor area of each fire prevention zone may be increased by 1.0 times according to the provisions expect the fire zone of the cold storage.

2.1.10 Class A and B production sites (warehouses) should not be located at underground or semi-underground.

2.1.11 Staff quarters are strictly prohibited within the factory building. Offices, restrooms, etc. shall not be installed in Class A or Class B plants. When it is necessary to affix adjacent to this plant, the fire resistance rating shall not be lower than Class 2 and the explosion-proof wall with a fire endurance of not less than 3.00h shall be used to separate the building from the plant. , And set up an independent safety exit. When offices and restrooms are installed in a Class C building, fireproof partition walls with a fire-resistance limit of 2.50 hours and floors not less than 1.00 hours shall be separated from other parts, and at least one independent safety exit shall be provided. If a partitioned wall needs to open interconnected doors, Class B fire doors shall be used.

2.1.12 When the intermediate warehouse is build up in the plant building, the following regulations shall be achieved: 1) Class A and B intermediate

warehouses should be arranged by external walls, and their reserves should not exceed the requirement of 1 day and night. 2) Class A, B, and C intermediate warehouses shall be separated from other parts by firewalls and with a fire resistance no less than 1.50h. 3) The D and E intermediate warehouses shall be separated by firewalls with a fire resistance no less than 2.00h and 1.00h floors which separated from other parts.

2.1.13 The Class C liquid intermediate storage tank in the plant should be set up in a separate room, and its capacity should not exceed 5m3. In the room where the intermediate storage tank is installed, use the firewall with a fire-resisting limit of no less than 3.00h and the 1.50-h floor to separated from other parts, and the room shall use a Class A fire door.

2.1.14 Transformer and distribution electronic stations should not be installed in A or B plants or adjacent to them, and should not be installed in hazardous areas of explosive gas and dust environment. For transformers and substations dedicated to Class A and Class B buildings of 10 kV and below, when using firewalls without doors, windows, and openings, they can be attached side by side and should comply with current national standards. When Class B power plants need to open windows on the firewall, Class A fire windows should be used.

2.1.15 Staff quarters are strictly prohibited in warehouses. Offices, lounges, etc. are strictly prohibited within the class A and B warehouses and also should not be attached. When offices and restrooms are set up in the C and D warehouses, firewall with a fire-resistance limit of 2.50h and 1.00h floors shall be used to separate them from other parts, and an independent safety exit shall be provided. When a partitioned door needs to have interconnected doors, Class B fire doors shall be used.

2.1.16 Fire protection design of logistics buildings: 1) When the construction function is mainly based on sorting, processing, etc., it shall be determined in accordance with the provisions relevant, and the storage part shall be determined according to the intermediate warehouse. 2) When the main function is warehousing or the building is difficult to distinguish the function, it should be determined according to the provisions of the relevant, but when the operating area such as sorting is completely separated from the storage area by a firewall, the fire protection requirements of the operating area and storage area can be Respectively according to the provisions. Among them, when the sorting and other operating areas are completely separated from the storage area and meet the following conditions, except for the automated controlled C warehouse, the maximum allowable building area of the fire zone and the storage zone can be increased by a factor of 3.0 as specified one.

2.1.17 Class A and B plants (warehouses) should not set up railway lines.

2.1.18 the form shown the relationship of spacing and other reference.

Fire prevention racing between plant and between B, C, D and E warehouses (m)										
name			A plant single,multi	B plant (warehouse) single ,multi		high rise	C,D,E plant (warehouse) single,multi			high rise
plamt	layer	class	1,2	1,2	3	1,2	1,2	3	4	1,2
A CLASS	single,multi	1,2	12	12	14	13	12	14	16	13
B CLASS	single,multi	1,2	12	10	12	13	10	12	14	13
		3	14	12	14	15	12	14	16	15
	high rise	1,2	13	13	15	13	13	15	17	13
C CLASS		1,2	12	10	12	13	10	12	14	13
	single,multi	3	14	12	14	15	12	14	16	15
		4	16	14	16	17	14	16	18	17
	high rise	1,2	13	13	15	13	13	15	17	13
D,E CLASS		1,2	12	10	12	13	10	12	14	13
	single,multi	3	14	12	14	15	12	14	16	15
		4	16	14	16	17	14	16	18	17
	high rise	1,2	13	13	15	13	13	15	17	13
Outdoor charge and distribution station	total amount of oil in transformer (t)	≥5, ≤10	25	25	25	25	12	15	20	12
		>10, ≤50					15	20	25	15
		>50					20	25	30	20

TABLE 8

2.1.19 ps: a) The fire separation distance of Class B plant and main public buildings should not be less than 50m; it should not be less than 30m with fire or spark. The fire separation distances between single and multi layer class-E plant and class E warehouses can be reduced by 2m in accordance with the provisions of this table. The living quarters separately provided for the services of the C, D, and E plants shall be determined according to the civil buildings, and the fire separate distance between the plant and its own factory shall not be less than 6m. When they must be arranged adjacent to each other, they shall comply with the requirements of the table. b) The higher wall adjacent to the two buildings is a firewall, or the firewalls with external one to any two neighboring with the same height, and when the fire resistance limit of the roof is not less than 1.00h, The distance of fires separation is not limited, but the distance between Class A plants should not be less than 4m. Two adjacent plants of C, D and E class, its should use non-combustible walls. When there are no exposed flammable eaves, the sum of the area of the doors, windows and openings on each external wall is not greater than the area of 5% ofthe external walls, and when doors, windows, and openings are not symmetrically set, the fire separation can be reduced by 25% according to the provisions of this table.

Class A and B plants (warehouses) should not be adjacent to other buildings outside the provisions of Article of this form. C) Two first- and second-class fire-resistant buildings, when the adjacent lower wall is a firewall and the roof of the lower factory is without sunroof, the fire-resistance limit of the roof is not less than 1.00h, or the adjacent high-side external wall When a door, window or other opening is provided with Class A fire doors, windows or fire separation screens or fire screens are installed in accordance with the provisions of the table the fire separation distance between Class A and Class B workshops shall not be less than 6m; The fire separation between C, D, and E buildings should not be less than 4m.
d) The main transformer in the power plant, its amount of oil can be determined by a single station. e) The plant with fire-resistant grade is lower than the fourth-class, its fire-resistant rating can be determined in four levels. F) when adjacent two C,D,E plant together, it should follow the table 1,2 limitations.

2.1.20 The fire separation distance between Class A workshops and important public buildings shall not be less than 50m, and the fire separation distance from open flames or places emitting sparks shall not be less than 30m.

2.1.21 The fire separation distance between Class A factory buildings emitting flammable gas and flammable vapor and railways, roads, etc. shall not be less than that specified in Table 3 but the fire separation distance may not be affected by Table 3 when there are safety measures in the railway loading and unloading lines belonging to the factory buildings. 3 Fire resistance distance between Class A buildings which emitting flammable gas and flammable vapors, and railways, roads, etc. (m)

name	Outside rail way	Inside rail way	Outside road	Inside road	
				main	secon dary
A class	30	20	15	10	5

2.1.22 The fire separate distance between high-rise plant buildings and Class A, B, and C liquid storage tanks, combustible and combustion-supporting gas storage tanks, LPG storage tanks, and combustible material yards (except coal and coke off site) shall comply with Chapter 4 of this specification. Provisions, and should not be less than 13m.

2.1.23 When the fire-resistant grades of C, D and E buildings and civil buildings are both Class I and Class II, the fire separate spacing between C, D and E buildings and civil buildings may be appropriately reduced, but the following regulations should met: a) When the higher external wall is a firewall with no doors, windows, or openings, or a wall with a height of 15m or less below the adjacent lower building roof is a firewall without doors, windows, or openings, the fire spacing can be not limited. b) The adjacent lower wall is a firewall, and there is no skylight on the roof, the fire-resistance limit of the roof is not less than 1.00h, or the wall on the adjacent high side is a firewall, and fire prevention measures are taken at the opening of the wall. The fire-proof distance can be appropriate. Reduce but not less than 4m.

2.1.24 The fire-resistance distance between the outer wall of the equipment attached to the outside of the plant and the external wall of the adjacent factory outdoor equipment or the external wall of the adjacent plant shall not be less than the provisions of Article 2.2.1 of this code. Outdoor equipment made of non-combustible materials can be determined according to Class I or Class II fire rated buildings.

2.1.25 The fire-proof distance between adjacent wings in the same U-shaped or Yamagata workshop should not be less than the provisions of Article 2.2.1 of this Code, but when the floor space of the plant is smaller than each fireproof partition specified in Article 2.1.1 of this Code. The maximum allowable building area, the fire spacing can be 6m.

2.1.26 exception of high-rise buildings and Class A plants, all other plants which the sum of the area is less than the maximum allowable floor area of fire prevention partitions specified in Article 2.1.1 of this Code, but the maximum allowable for the fire partitions If the construction area is not limited, it shall be arranged in groups when it should not exceed 10000 m2. When the plant building height is not more than 7m, the fire-resist distance between the workshops in the group shall not be less than 4m; when the building construction height is greater than 7m, the fire-breaking distance between the workshops in the group shall not be less than 6m.

2.1.27 First-grade autobus stations, first-grade auto liquefied petroleum gas refueling stations, and first-grade auto gas refueling and gas stations should not be located in urban built-up areas.

2.1.28 Classification of auto refueling stations, refueling stations and refueling and refueling stations, vehicle refueling stations, refueling stations and refueling and refueling stations, and refueling (gas) machines, storage tanks, etc. The fire separation distance between buildings, railways, and roads, and the fire

separation distance between buildings or facilities within a station shall comply with the provisions of the current national standard, "Design and Construction of Auto refueling Stations" GB 50156.

2.1.29 For outdoor buck substations with a power system voltage of 35kV-500kV and an outdoor transformer station with a transformer capacity of not less than 10MV·A and an industrial plant with a total transformer oil capacity of more than 5t, the fireproof distance from other buildings shall not be less than this The provisions of Articles 2.2.1 and 2.3.1 are regulated.

2.1.30 The spacing between the fences in the plant area and the buildings in the plant area should not be less than 5m. The spacing between the buildings on both sides of the fence shall meet the fireproof spacing requirements of the corresponding buildings.

FIRE SEPARATION DISTANCE OF WAREHOUSE

2.1.31 The fire separation distances between Class A warehouses and other buildings, open flames or sparking sites, railways, roads, etc. shall not be less than the requirements of Table below.

Fire separation distance of the warehouse (m)

name		A class warehouse (storage, t)			
		A class storage 3、4 level		A class storsge 1、2、5、6level	
		≤5	>5	≤10	>10
the place with fire and spark		30	40	25	30
A class warehouse		20	20	20	20
plant and B,C,D,E warehouse	1,2 level	15	20	12	15
	3 level	20	25	15	20
	4 level	25	30	20	25
Transformer and power substation		30	40	25	30
outside rail way		40			
inside rail way		30			
outside road		20			
inside road	main	10			
	secondary	5			

2.1.32 Except as otherwise provided in this Code, the fireproof distances between Class B, C, D and E warehouses and civil buildings shall not be less than the

requirements of Table below.

Class B,C,D,E warehouse's fire separate distance (m)													
name			B class warehouse			C class warehouse				D,E class warehouse			
			single multi layer		high rise	single,multi layer			high rise	single, multi layer			high rise
			class 1,2	class 3	class 1,2	class 1,2	class 3	class 4	class 1,2	class 1,2	class 3	class 4	class 1,2
warehouse B,C,D,E	single,multi layer	class 1,2	10	12	13	10	12	14	13	10	12	14	13
		class3	12	14	15	12	14	16	15	12	14	16	15
		class4	14	16	17	14	16	18	17	14	16	18	17
	high rise	class 1,2	13	15	13	13	15	17	13	13	15	17	13

TABLE 9

2.1.33 ps: a) The fireproof spacing between single and multi-storey class E warehouses can be reduced by 2m according to this table. B) When the adjacent exterior walls of the two warehouses are all firewalls, the fire separation distance can be reduced, but Class C should not be less than 6m; D and E should not be less than 4m. When the exterior walls of two warehouses adjacent to each other are firewalls, and the total floor space is not greater than the maximum allowable floor area of a warehouse in Article 3.3.2 of this code, the fire separation distance is not limited. C) The fire prevention distance between Class B warehouses with Class B items other than Class B and the civil buildings shall not be less than 25m, and the fire separation distance with important public buildings shall not be less than 50m. The fireproof distance with railways, roads, etc. shall not be less than that in Table. Fireproof distances between Class A warehouses and railways, roads, etc.

2.1.34 When the fire resistance ratings of D and E warehouses and civil buildings are both Grade 1 and Grade 2, the fire separation distance between warehouses and civil buildings may be appropriately reduced, but the following regulations shall be met: a) When the higher external wall is a firewall with no doors, windows, or openings, or a wall with a height of 15m or less below the adjacent lower building roof is a firewall without doors, windows, or openings, the fire spacing can be not limited ; b) The adjacent lower wall is a firewall, and there is no sunroof or hole on the roof, the fire-resistance limit of the roof is not less than 1.00h, or the adjacent high wall is the firewall, and fire prevention measures are taken at the opening of the wall. Can be reduced appropriately, but it should not be less than 4m.

2.1.35 The space between the wall in the reservoir area and the building in the reservoir area should not be less than 5m. The spacing between the buildings on both

sides of the wall should meet the fireproof spacing requirements of the corresponding buildings.

2.2 ANTI-EXPLOSION OF PLANT AND WAREHOUSE

2.2.1 Class A and B plants with explosion hazards should be set up independently and should be open or semi-open. The load-bearing structure should adopt reinforced concrete or steel frame and truss structure.

2.2.2 The pressure relief facilities shall be installed in the explosion-hazardous areas where there is a danger of explosion.

2.2.3 Pressure relief facilities should use lightweight roofing panels, lightweight walls, and doors and windows that are susceptible to pressure relief. Materials such as safety glass that do not produce sharp debris during explosion should be used. Pressure relief facilities should be set up to avoid people-intensive places and major traffic routes, and should be located close to the risk of explosion. The weight roof panels and walls as pressure relief facilities should not exceed 60 kg/m2.

2.2.4 The pressure relief area of the plant should be calculated according to the following formula, but when the aspect ratio of the plant is greater than 3, the building should be divided into multiple calculation sections with an aspect ratio of not more than 3, and the public section in each calculation section must not be used as pressure relief area A − pressure relief area（m^2）；

$$A = 10CV^{\frac{2}{3}}$$

V − plant volume（m^3）；

C − pressure relief ratio，（m^2/m^3）

2.2.5 For a Class A factory that emits combustible gas and combustible vapor that is lighter than air, lightweight roofing panels should be used as the pressure relief area. The ceiling should be as flat and free of dead ends, and the space above the plant should be well ventilated.

2.2.6 Group A plants that emit combustible gases and combustible vapors that are heavier than air and Class B plants that have dust and fiber explosion hazards should meet the following requirements: a) Grounds that do not spark should be used. When using insulating material as a whole

surface layer, anti-static measures should be taken. B) Plants that emit combustible dust and fiber should have a smooth, smooth surface and be easily cleaned. C) It is not advisable to install trenches in the workshop. When it is necessary to set the trenches, the cover plates shall be tight. The trench shall take effective measures to prevent the accumulation of flammable gas, flammable vapor and dust, and fibers in the trench, and shall be sealed with the fireproof material at the connection with the adjacent factory building.

2.2.7 Parts of Classes A and B that are at risk of explosion should be placed near the pressure relief facility at the outer wall of a single-layer factory building or the pressure relief facility at the top floor of a multi-layer factory building.

2.2.8 The total control room of Class A and Class B plants with explosion hazards should be set independently

2.2.9 The sub-control rooms of Class A and Class B factories with explosion hazards should be set up independently. When adjacent to exterior wall installations, fire-resisting partition walls with a fire-resistance limit of 3.00h or more should be separated from other parts.

2.2.10 explosion-hazard areas with stairwells, outdoor stairs or places of communication protective measures such as douche doors shall be provided. The partition wall of the door hopper shall be a fireproof partition wall with a fire-resistance limit of not less than 2.00h. The door shall be Class A fire doors and shall be set in a staggered position with the stairway.

2.2.11 The use and production of Class A, B, and C liquid plants, the pipe, ditch should not be connected with the adjacent plant's pipe, ditch, grease trap facilities should be set up.

2.2.12 Class A, B, and C liquid warehouses should be provided with facilities to prevent the liquid from flowing. Storehouses that will burn and explode in case of wetness shall take measures to prevent water from impregnating

2.2.13 For silos with dust explosion hazard, the top cover plate should be equipped with necessary pressure relief facilities.

2.2.14 The pressure relief area of the food silo working tower and the upper corridor shall be determined according to the provisions of Article 2.4.4 of this Code. Other food storage facilities that are at risk of dust explosions should take anti-explosion measure.

2.2.15 In areas where there is a risk of explosion within a warehouse or warehouse where there is a risk of explosion, explosion-proof measures and pressure relief facilities should be provided in accordance with the provisions of this section.

2.3 SAFE EVACUATION OF THE PLANT

2.3.1 The safety exits of the factory buildings should be distributed. The horizontal distance between the nearest edges of two adjacent safety exits shall not be less than 5m for each floor of each fire partition or one fire partition.

2.3.2 The number of safety exits shall be determined and not less than 2 per fire floor of a plant or every floor in a fire partition; one safety exit may be set when the following conditions are met: a) Class A workshops, each floor area not exceeding 100m^2, and no more than 5 workers at the same time.

TABLE 10

class	LEVEL	single plant	multi layer plant	high rise plant	semi underground or underground	
A	1, 2	30	25	—	—	
B	1, 2	75	50	30	—	
C	1, 2	80	60	40	30	
	3	60	40	—	—	
D	1, 2	no limit	no limit	50	45	
	3	60	50	—	—	
	4	50	—	—	—	
E	1, 2	no limit	no limit	75	60	
	3	100	75	—	—	
	4	60	—	—	—	

B) Class B workshops, with a floor area of no more than 150m^2 per floor, and no more than 10 people at the same time. C) Category C buildings, floor space per floor not more than 250m^2, and no more than 20 people at the same time. D) D, E class factory buildings, each floor area is not more than 400m^2, and the number of workers at the same time does not exceed 30 people. E) Underground or semi-underground buildings (including underground or semi-basement) shall have a floor area of no more than 50m2 per floor and shall have no more than 15 people at the same time.

2.3.3 In underground or semi-underground buildings (including underground or semi-basement), when there are multiple fire prevention partitions adjacent to each other and separated by a fire wall, each fire prevention partition may use Class A fire doors on the firewall leading to adjacent fire partitions as the first Second, safety exits, but each fire prevention zone must have at least one independent safety exit through the outside.

2.3.4 The total net width of the evacuation stairs, walkways, and doors in the plant shall be determined according to the number of evacuees based on the minimum evacuation width per 100 persons not less than the requirements in Table 3.7.5.

However, the minimum net width of evacuation stairs should not be less than 1.10m, the minimum net width of evacuation walkways should not be less than 1.40m, and the minimum net width of doors should not be less than 0.90m. When the number of evacuations on each floor is not equal, the total net width of the evacuation stairs shall be calculated in layers, and the total net width of the lower stairs shall be calculated based on the number of evacuees with at most one evacuation at or above this level.

Number of layers	1~2	3	≥4
Minimum width of net evacuate (m/person)	60	80	100

2.3.5 The stairs for evacuation of high-rise factory buildings and Class A, B, and C multi-layer factory buildings shall be closed stairwells or outdoor stairs; smoke-resistant stairwells or outdoor stairs shall be used for buildings with a building height of more than 32m and a population of more than 10 persons on any floor.

2.4 SAFE EVACUATION OF THE WAREHOUSE

2.4.1 Warehouse safety exits should be distributed. The horizontal distance between the nearest edges of two adjacent safety exits shall not be less than 5m for each floor of each fireproof partition or one fireproof partition.

2.4.2 The safety exit of each warehouse shall not be less than 2, and when the area of a warehouse is not more than 300m^2, a safety exit may be set. There should be no less than two exits from each fire partition in the warehouse leading to evacuation walkways, stairs, or outdoors. When the building area of the fire partition is not more than 100 m2, one exit may be set. Doors leading to evacuation walkways or stairs shall be class B fire doors.

2.4.3 The safety exits of underground or semi-underground warehouses (including underground or semi-basement) should not be less than 2; when the construction area is not more than 100m2, 1 safety exit can be set.

2.4.4 Underground or semi-underground warehouses (including underground or semi-basement) When there are multiple fire prevention partitions adjacent to each other and separated by a fire wall, each fire partition can use the Class A fire door to the adjacent fire partition as the second Safety exits, but each fire zone must have at least one safe exit that leads directly to the outside.

2.4.5 When the outdoor metal ladders of warehouses and silos meet the requirements of Article 2.2.5 of this Code, they can be used as evacuation stairs, but the fire-resistance limit of the outdoor stairways of the silo shall not be less than 0.25h.

2.4.6 Evacuation stairs in high-rise warehouses should use closed stairwells

2.4.7 In addition to the Class I and Class II fire-resistant multi-layer class E warehouses, the lifting facilities for vertical transport items in other warehouses should be installed outside the warehouse. When it is required to be installed in the warehouse, the fire-resistance limit on the borehole wall should not be lower than 2.00h inside the wellbore. Doors on the entrance to the warehouse of indoor and outdoor lifting facilities shall use Class B fire doors or fire shutters in accordance with the provisions of the table.

2.5 CHINESE STANDARD FOR EXTERNAL THERMAL LAYERS

In china it has three ways for thermal layers its internal, external, and sandwich thermal layer, the external thermal layer is well used because it well thermal resistance, thermal keep ability, structure keep, and well work condition.

Problems: because of the air protection problem, most of the polymers are not allowed to use, right in the market, the most used thermal material is XPS, EPS and PU. But those is combustible material, it means they have very dangerous in the fire protection, also as the special component in side the material, when it get burned, the smoke is a poison. After china begin with the environment friendly materials the fire accident is linearly rise up.

Thermal Properties of different material

	Thermal properties	Maxium temperature (C°)	Chemistry properties	Environment standard	Thermal conductivity λ(w/(m•k))	Fire prevension level	Endurance(YEAR)
STP (polyurethane)	Best	800	Inoganic	Friendly	0.008	A1	60
PU POLYURETHANE	Better	120	organic	Pollutant	0.022-0.036	B1	⩾ 15
Phenolic aldehyde	Good	180	organic	pollutant	0.016-0.036	B1	
XPS polystrene	Better than normal	60	organic	pollutant	0.033-0.045	B2	⩾5
EPS extruded	Normal	60-80	organic	pollutant	⩽0.03	B2	⩾5
Cortton-glass	Worse than normal	500	inoganic	pollutant	0.039-0.042	A	
Rock wool	Bad	600	inoganic	pollutant	0.04	A	
Inoganic insulation mortar	Bad	35	organic	pollutant	0.08	B1	
Glass bead	Bad	800	inoganic	pollutant	0.036-0.054	A	

TABLE 11

there are the thermal properties of different materials, STP sheet is well generalized by the Chinese government since 2016, as they begin to concern the

environment influence of the industry and architecture. Controlling the pollution from abused material. But because STP in China is a new material, it can't be fully used, also as the forbidden of the other material, it caused lots of fire accidents. Also because in Chinese as the form shown before, it just limit the distance between and fire resistance of the different as the detailed design part it's a empty area, so for further learning the external cladding material, its necessary to concern more of the British standards and the Europe one, all in all, this technology is used in those countries over fifty years.

AIMS OF THE STANDRAD	
Requirement B1	When there is a fire, ensure satisfactory means of: a. sounding an alarm b. escape for people.
Requirement B2	Inhibit the spread of fire over internal linings of buildings.
Requirement B3	The building must be built such that in the event of a fire: a. the premature collapse of the building is avoided b. sufficient fire separation is provided within buildings and between adjoining buildings c. automatic fire suppression is provided where necessary d. the restriction of unseen spread of fire and smoke in concealed spaces.
Requirement B4	a. the potential for fire to spread over external walls and roofs b. the spread of fire from one building to another.
Requirement B5	a. satisfactory access for the fire service and its appliances b. facilities in buildings to help firefighters save the lives of people in and around buildings.

TABLE 12

The building regulations about those fire safety requirements should be followed when design the plant, and those arranged standards will be described below, this chapter is just a conclusion of the ADB handbook, which provide a guidance of the British fire

protection code.

Classification of Buildings		
Title	Purpose for which the building or compartment of a building is intended to be used	Group
Residential (dwellings)	Flat.	1(a)*
	Dwellinghouse that contains a habitable storey with a floor level a minimum of 4.5m(or not) above ground level	1(b)/(or1(c)+)
	Hospital, home, school or other similar establishment, where people sleep on the premises. The building may be either of the following. • Living accommodation for, oraccommodation for thet reatment, care or maintenance of, either: – people suffering from disabilities due to illness or old age or other physical or mental incapacity -people lower age 5 a place lawful detenson	2(a)
Residential (other)	Hotel, boarding house, residential college, hall of residence, hostel or any other residential purpose not described above.	2(b)
Office	Offices or premises used for any of the following and their control: • administration •clericalwork(includingwriting,bookkeeping,sortingpapers,filing, typing, duplicating, machine calculating, drawing and the editorial preparation of matter for publication, police and fire and rescue service work) •handlingmoney(includingbankingandbuildingsocietywork) • communications(includingpostal,telegraphandradio communications) • radio,television,film,audioorvideorecording • performance(premisesnotopentothepublic).	3

TABLE 13

Shop and commercial	Shops or premises used for either of the following. •Aretailtradeorbusiness(includingsellingfoodordrinktothe public for immediate consumption, retail by auction, self-selection and over-the-counter wholesale trading, the business of lending books or periodicals for gain, the business of a barber or hairdresser, and the rental of storage space to the public). • Premisestowhichthepublicareinvitedeither: – to deliver or collect goods in connection with their hire, repair or other treatment – (except in the case of repair of motor vehicles) where the public themselves may carry out such repairs or other treatments.	4
Assembly and recreation	Place of assembly, entertainment or recreation, including any of the following: •bingohalls,broadcasting,recordingandfilmstudiosopentothe public, casinos, dance halls •entertainment,conference,exhibitionandleisurecentres • funfairsandamusementarcades • museumsandartgalleries,non-residentialclubs,theatres,cinemas, concert halls	5
Industrial	Factories and other premises used for any of the following: •manufacturing,altering,repairing,cleaning,washing,breakingup, adapting or processing any article • generatingpower • slaughteringlivestock.	6
Storage and other non-residential	Either of the following: •place(otherthandescribedunder7(b))forthestorageordepositof goods or materials • anybuildingnotwithinpurposegroups1to6.	7(a)
	Car parks designed to admit and accommodate only cars, motorcycles and passenger or light goods vehicles that weigh a maximum of 2500kg gross	7(b)

TABLE 14

3.1 ALARM SYSTEM AND FIRE DETECTION SYSTEMS

All buildings should have arrangements for detecting fire and raising the alarm. In most buildings, fires are detected by people, either by sight or smell, and therefore often nothing more is needed. In this document, the term 'fire detection system' describes any type of automatic sensor network and associated control and indicating equipment. Sensors may be sensitive to smoke, heat, gaseous combustion products or radiation. Normally the control and indicating equipment operates a fire alarm system, and it may perform other signaling or control functions as well. Automatic sprinkler systems can also be used to operate a fire alarm system

A large house of no more than 3 stores (including basement stores) may be fitted with an automatic fire detection and alarm system of Grade B type LD3 as described in BS 5839-6 instead of an L2 system. (L2 – systems installed only in defined parts of the protected building)

3.2 DESIGN HORIZONTAL AND VERTICAL ESCAPE ROUTE

When the fire accident happened, the first thing is finding the correct escape route, in the building point the escape position should be considered in all where of the whole building. So that the escape route design include route numbers and exit position are quiet important.

Purpose group	Use of the premises or part of the premises		Maximum travel distance [1] where travel is possible in: One direction only (m)	More than one direction (m)
2(a)	Institutional		9	18
2(b)	Other residential:			
	a. in bedrooms [2]		9	18
	b. in bedroom corridors		9	35
	c. elsewhere		18	35
3	Office		18	45
4	Shop and commercial [3]		18 [4]	45
5	Assembly and recreation:			
	a. buildings primarily for disabled people		9	18
	b. areas with seating in rows		15	32
	c. elsewhere		18	45
6	Industrial [5]	Normal hazard	25	45
		Higher hazard	12	25
7	Storage and other non-residential [5]	Normal hazard	25	45
		Higher hazard	12	25
2–7	Place of special fire hazard [6]		9 [7]	18 [7]
2–7	Plant room or rooftop plant:			
	a. distance within the room		9	35
	b. escape route not in open air (overall travel distance)		18	45

TABLE 15

3.2.1 Number of occupants and exits

The building design should be based on a number of occupants. If the number is not known, use the appropriate floor space factors (Appendix D).

Table gives the minimum number of escape routes and exits from a room or story for different numbers of occupants. This number is likely to be increased by the need to observe travel distances and other practical considerations.

Minimum number of escape routes and exits from a room, tier or storey	
Maximum number of people	Minimum number of escape routes/exits
60	1
600	2
over 600	3

TABLE 16

3.2.2 the minimum with to escape

Widths of escape routes and exits	
Maximum number of people	Minimum width (mm) [1][2][3]
60	750[4]
110	850
220	1050
More than 220	5 per person [5]

TABLE 17

A when talk about vertical escape route, first is stair, the width, position and high of the stair define the escape time for saving life. As the difference of amount of people in the plant the design of stair is quiet different.

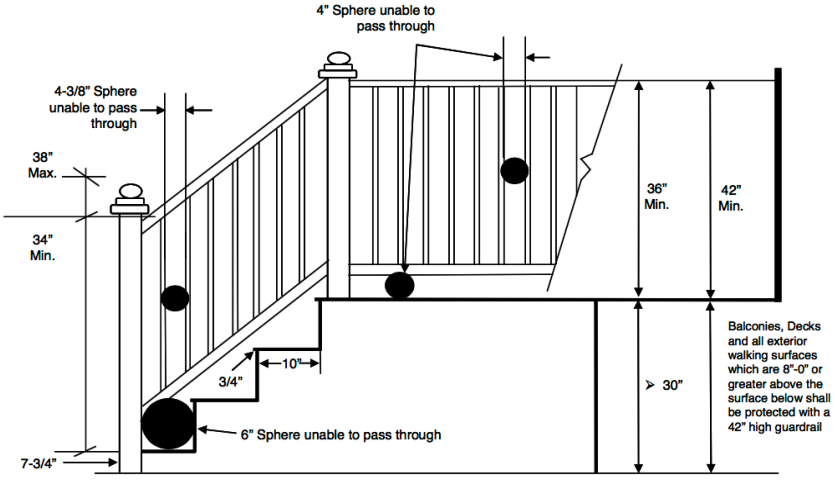


FIGURE 3

/ we can see the

r is needed in the

structure.

Minimum widths of escape stairs		
Situation of stair	Max people	Minimum stair width (mm)
1a. In an institutional building (unless the stair will only be used by staff)	150	1000
1b. In an assembly building and serving an area used for assembly purposes	220	1100
1c. In any other building and serving an area with an occupancy of more than50	over 220	over 1100
2. Any stair not described above	50	800

TABLE 19

served	1000mm	1100mm	1200mm	1300mm	400mm	1500mm	1600mm	1700mm	1800mm
1	150	220	240	260	280	300	320	340	360

TABLE 18

3.3 FIRE RESISTANCE FOR LOADBEARING

3.3.1 As a minimum, elements of structure should have the fire resistance given in the following.

a. Provisions to ensure that where one element of structure supports or stable another element of structure, the supporting element has no less fire resistance than the other element.

b. Measures so that elements common to more than one building or compartment are constructed to the standard of the greater of the relevant provisions.

c. Special provisions about fire resistance of elements of structure in single storey buildings.

d. Concessions in respect of fire resistance of elements of structure in basements where one or more sides of the basement are open at ground level.

Exclusions from the provisions for elements of structure

3.3.2 The following are excluded from the definition of ‘element of structure’.

a. A structure that supports only a roof, unless either of the following applies.

i. The roof performs the function of a floor, such as for parking vehicles, or as a means of escape.

ii. The structure is essential for the stability of an external wall that needs to be fire resisting.

b. The lowest floor of the building.

c. A platform floor.

d. A loading gallery, fly gallery, stage grid, lighting bridge or any gallery provided for similar purposes or for maintenance and repair.

3.4 PROVISION OF COMPARTMENT BETWEEN STRUCTURE

3.4.1compartment wall: the wall between two structures. Buildings are separated by the compartment wall and compartment parts. Which can achieve the purpose of rise fire resistance, protect the loaded shaft, and cut off fire expansion.

3.4.2 to start up effective compartment it is considered in two ways

a. Fire resistance should be continuous at the join between elements forming a compartment.

b. Any openings between two compartments should not reduce the fire resistance.

Purpose group of building or part	Height of floor of top storey above ground level (m)	Floor area of any one storey in the building or any one storey in a compartment (m^2)		
		In multi-storey buildings		In single storey buildings
Industrial[2]				
Without sprinkler system	Not more than 18	7000		No limit
	More than 18	2000[3]		N/A
With sprinkler system[1]	Not more than 18	14,000		No limit
	More than 18	4000[3]		N/A
	Height of floor of top storey above ground level (m)	Maximum compartment volume (m^3)	Maximum floor area (m^2)	Maximum height (m)[4]
		Multi-storey buildings	Single-storey buildings	
Storage[2] and other non-residential:				
a. Car park for light vehicles	No limit	No limit	No limit	No limit
b. Any other building or part:				
Without sprinkler system	Not more than 18	20,000	20,000	18
	More than 18	4000[3]	N/A	N/A
With sprinkler system[1]	Not more than 18	40,000	No limit	No limit
	More than 18	8000[3]		

TABLE 20

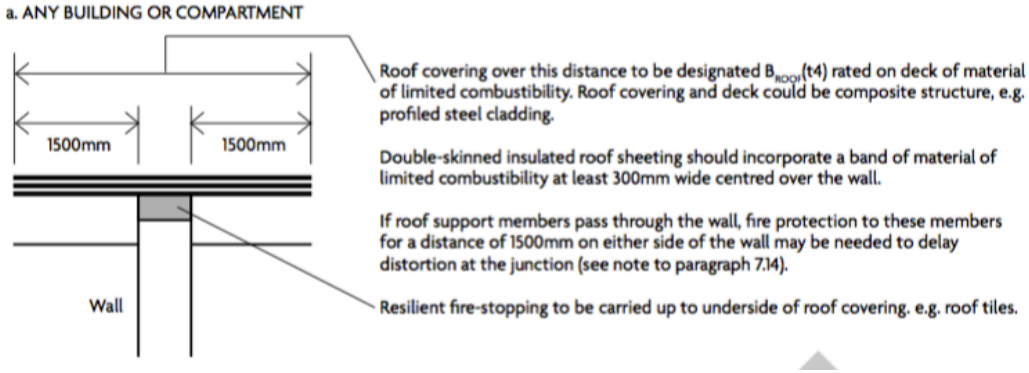


FIGURE 4

3.5 PROTECTION OF OPENINGS AND FIRE-STOPPING

the fire separate elements are well needed in fire propagation defense, every joint imperfect opening should be sealed, and the fire stopping also can help to reduce the smoke separate.

3.5.1 opening pipes and the air condition system

a Where a proprietary sealing system is not used, fire-stop around the pipe, keeping the opening as small as possible. The nominal internal diameter of the pipe should not exceed the relevant dimension (Lead, Aluminums alloy, Fiber-cement, Upvc is 110mm, other material are 40mm).

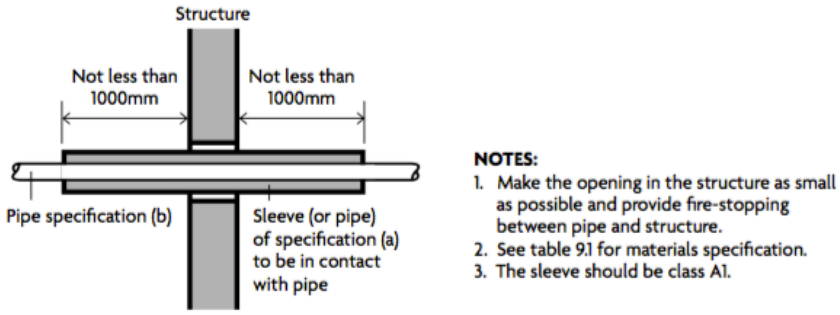


FIGURE 5

b The air condition system, when the fire happened, we need a workable smoke detector system, then it should be clear that where the smoke appearing, and the air condition system can generate the smoke, stop it splits every where, then it can stop the

fire, recycle the air, save the life.

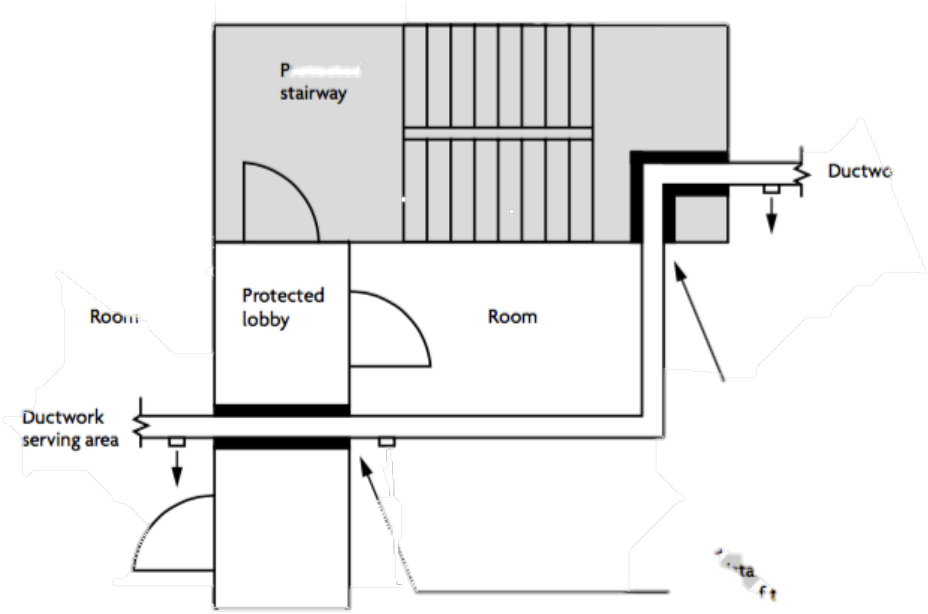


FIGURE 6

3.6 SPRINKLER SYSTEMS AND FIRE SUPPRESSION

A Where required, sprinkler systems should be provided throughout the building or separated part, unless acting as a compensatory feature to address a specific risk. They should be designed and installed in accordance with either of the following.

For non-residential buildings, or residential buildings outside the scope of BS 9251, either of the following.

i. The requirements of BS 5306-2, including the relevant hazard classification together with the additional requirements for life safety.

ii. The requirements of BS EN 12845, including the relevant hazard classification together with the special requirements for life safety systems.

Any sprinkler system installed to satisfy the requirements of Part B of the Building Regulations should be regarded as a life safety system. However, there may be some circumstances in which a life safety requirement specified in BS 5306-2 or BS EN 12845 is inappropriate or unnecessary.

Further guidance can also be found in the BAFSA's Sprinklers for Safety: Use and Benefits of Incorporating Sprinklers in Buildings and Structures.

For non-residential sprinkler systems designed and installed to BS EN 12845, water supplies should consist with Two single water supplies complying with clause 9.6.1, independent of each other.

• The capacity of each tank should be at least half the specified minimum water volume of a single full capacity tank, appropriate to the hazard.

• One tank should be at least equivalent to half the specified water volume of a single full capacity tank, and the other shall not be less than the minimum volume of a reduced capacity tank appropriate to the hazard.

The total capacity of the water supply in iii, including any inflow for a reduced capacity tank, should be at least that of a single full holding capacity tank that complies with table 9, as appropriate to the hazard and pipework design.

3.7 EXTERNAL FIRE SPREAD

3.7.1 requirement:

(1) The external walls of the building shall adequately resist the spread of fire over the walls and from one building to another, having regard to the height, use and position of the building.

(2) The roof of the building shall adequately resist the spread of fire over the roof and from one building to another, having regard to the use and position of the building.

3.7.2 intension:

- Resisting fire spread over external walls

The external envelope of a building should not contribute to undue fire spread from one part of a building to another part. This intention can be met by constructing external walls so that both of the following are satisfied.

a. The risk of ignition by an external source to the outside surface of the building and spread of fire over the outside surface is restricted.

b. The materials used to construct external walls and how they are assembled do not contribute to the rate of fire spread up the outside of the building.

The extent to which this is necessary depends on the height of the building.

- Resist fire over building to building:

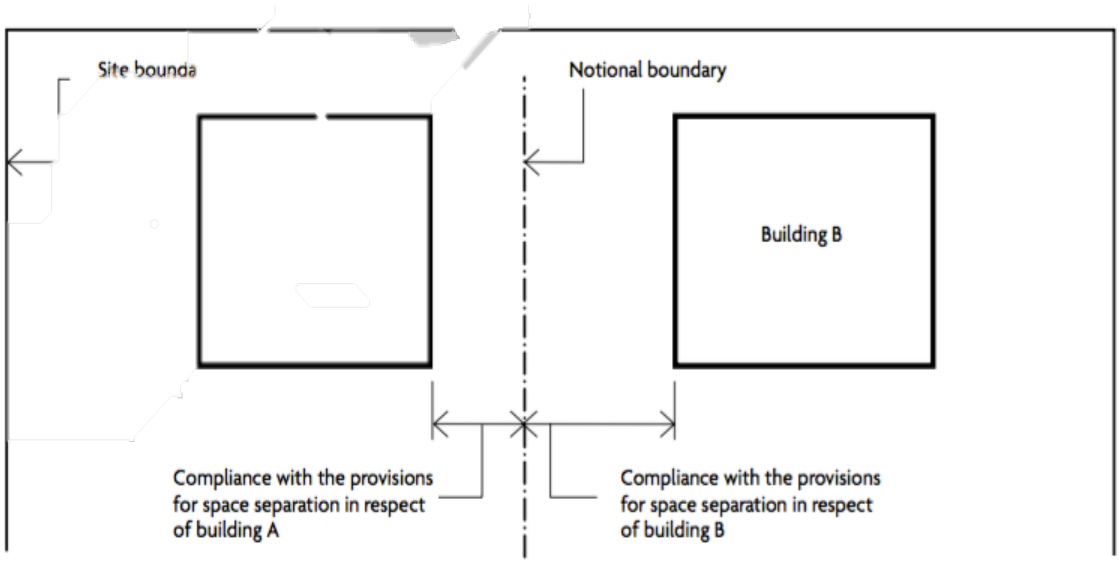
The external envelope of a building should not provide a medium for undue fire spread to adjacent buildings or be readily ignited by fires in adjacent buildings. This intention can be met by constructing external walls so that all of the following are satisfied.

a. The risk of ignition by an external source of the outside surface of the building is restricted.

b. The amount of thermal radiation that falls on a neighboring building from window openings and other unprotected areas in the building on fire is not enough to start a fire in the other building.

c. Flame spread over the roof and/or fire penetration from external sources through the roof is restricted.

The extent to which this is necessary depends on the use of the building and its position in relation to adjacent buildings and therefore the site boundary.



The notional boundary should be set in the area between the two buildings using the following rules.

1. The notional boundary is assumed to exist in the space between the buildings and is positioned so that one of the buildings would comply with the provisions for space separation having regard to the amount of its unprotected area. In practice, if one of the buildings is existing, the position of the boundary will be set by the space separation factors for that building.
2. The siting of the new building, or the second building if both are new, can then be checked to see that it also complies, using the notional boundary as the relevant boundary for the second building.

FIGURE 7

as the area is over 1000m^2 the combustible area is then shown below:

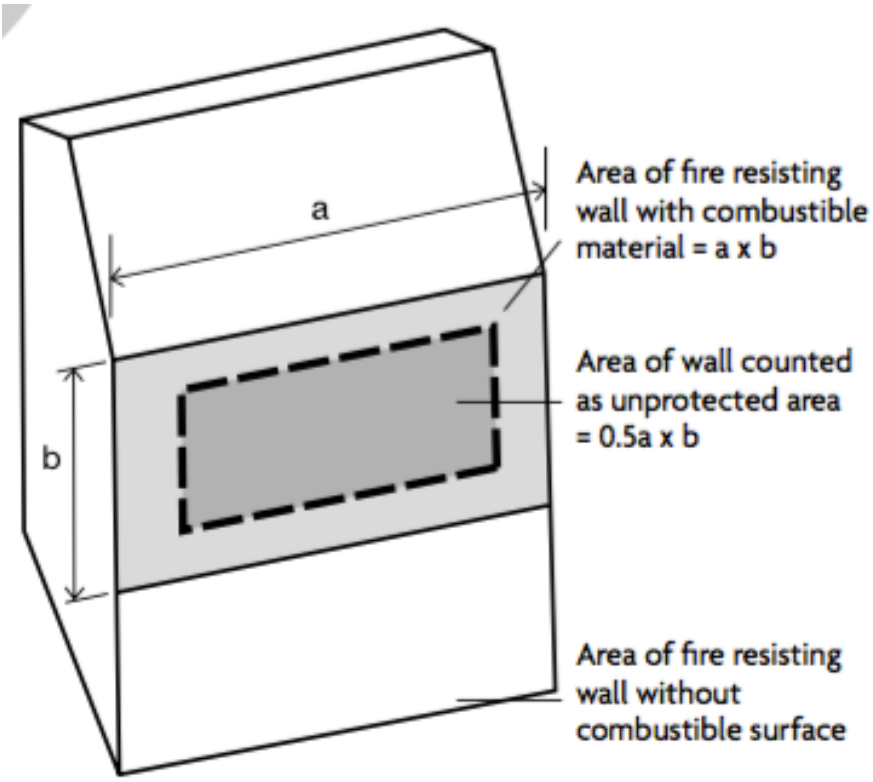


FIGURE 8

3.8 INTERNAL FIRE SPREAD (STRUCTURE)

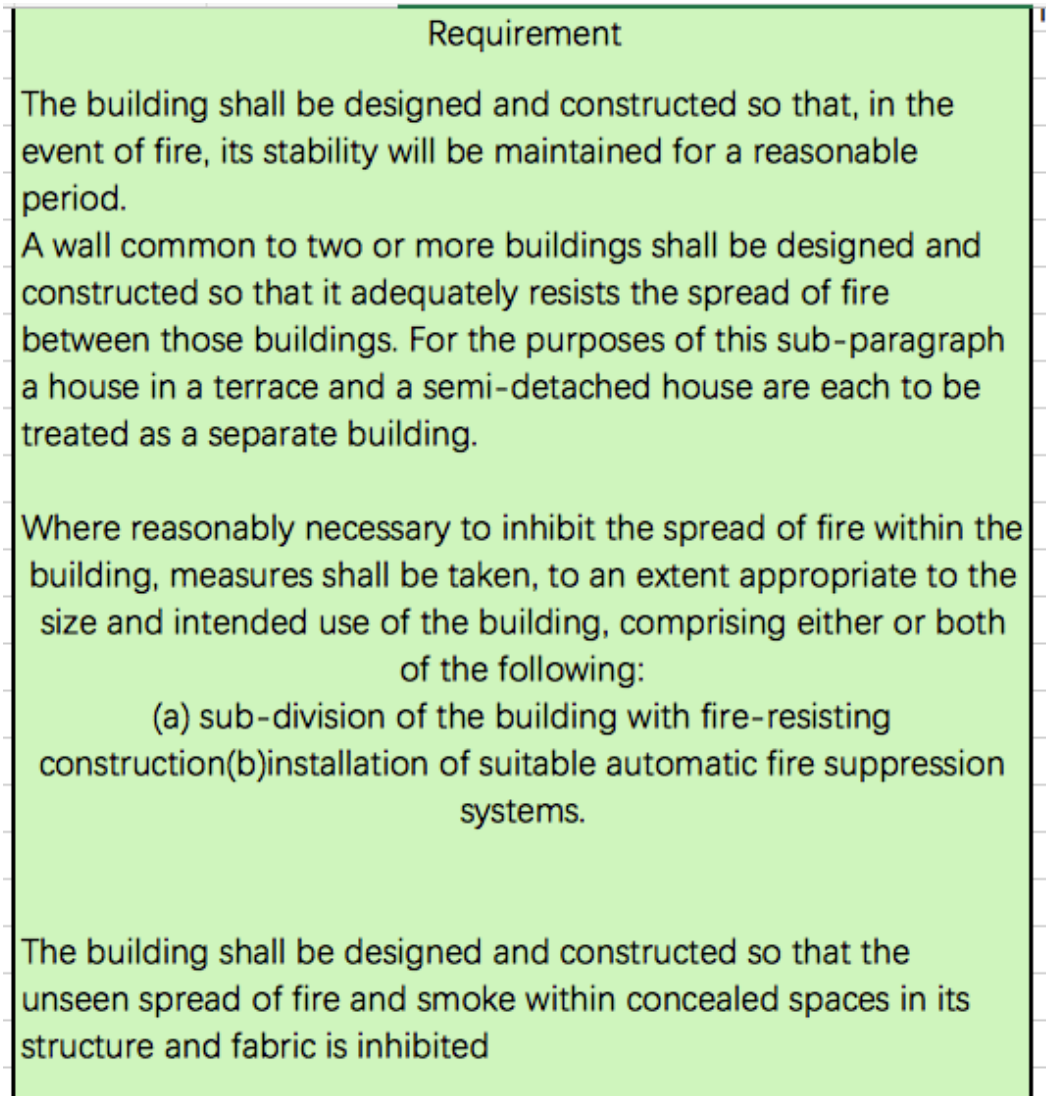


FIGURE 9

INTENSION

In the Secretary of State's view, requirement B3 is met by achieving all of the following.

a. For defined periods, loadbearing elements of structure withstand the effects of fire without loss of stability.

b. Compart mentation of buildings by fire resisting construction elements.

c. Protection of openings in fire-separating elements to maintain continuity of the fire separation.

3.9 Celling:

For the purposes of this requirement, a ceiling includes all of the following.

Glazed surfaces.

Any part of a wall at 70 degrees or less to the horizontal.

The underside of a mezzanine or gallery

The underside of a roof exposed to the room below.

For the purposes of this requirement, a ceiling does not include any of the following.

Trap doors and their frames.

The frames of windows or roof lights and frames in which glazing is fitted.

Architraves, cover molds, picture rails, exposed beams and similar narrow members.

Fire resisting ceilings

The need for cavity barriers in concealed floor or roof spaces can be reduced by installing a fire resisting ceiling below the cavity.

Roof lights should meet the following classifications, according to material. No guidance for European fire test performance is currently available, because there is no generally accepted test and classification procedure.

Non-plastic roof lights should meet the relevant classification.

3.10 Resisting fire spread over roof coverings

a. Separation distance is the minimum distance from the roof, or part of the roof, to the relevant boundary. In addition, roof covering products (and/or materials) defined in Commission Decision 2000/553/ EC of 6 September 2000, implementing Council Directive 89/106/EEC, can be considered to fulfil all of the requirements for the performance characteristic ‘external fire performance’ without the need for testing, provided that any national provisions on the design and execution of works are fulfilled, and can be used without restriction.

b. The performance of roof lights is specified in a similar way to the performance of roof coverings. Plastic roof lights may also be used.

c. Plastic rooflights , The method of classifying thermoplastic materials is given in Appendix B. Other than for the purposes of diagram, polycarbonate or uPVC rooflights achieving a minimum of class C-s3, d2 rating can be regarded as having an $B_{ROOF}(t4)$ classification.

d. Unwired glass in rooflights: When used in roof lights, unwired glass a minimum of 4mm thick can be regarded as having a $B_{ROOF}(t4)$ classification.

e. Thatch and wood shingles :If the performance of thatch or wood shingles cannot be established, they should be regarded as having an $E_{ROOF}(t4)$ classification in table

3.11

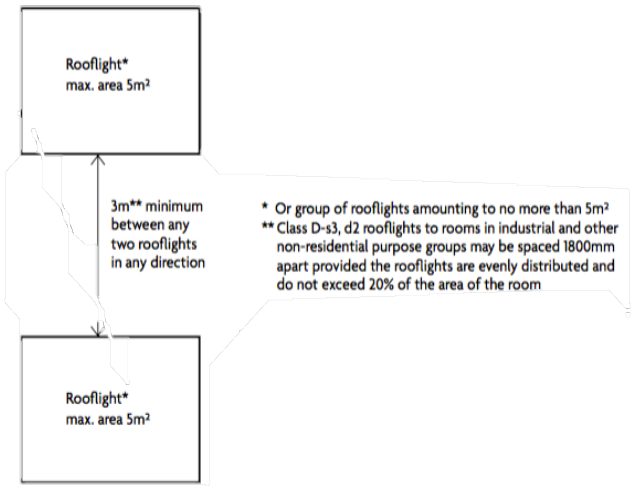


FIGURE 10

EXTERNAL LAYERS

Recently, many fire accidents in city bring the thermal material in internal and external layers to the public sight. As the tragedy in Grenfell Tower, the Beijing Television Cultural Center fire, the winter cherry shopping mall fire in Kemerovo…

The cause of those accidents are quiet different, but the reason which let the accident out of control, is the thermal material in wall. Although there are lots of strict limitation in the amount, type, properties of those material, however it still had the response of those people passed away in the accidents.

When we talk about external layer, we consider the external wall insulation system, the EWIS, which is mean property of the thermal keeping, also for instance the more information are in the table.

cladding material	expanded polystyrene, mineral wool, polyurethane foam or phenolic foam, topped off with a reinforced cement based, mineral or synthetic finish and plaster
thermal insulation	dependent on whatever type is required in order to create a partition with a heat transmission factor of U=0.25-0.3 W/m2K but it still depended, on the stanard. Besides the loadbeam, liner should be considered for them no changeable thermal resistance
Carbon Emissions	As the signed paper of environment friendly keeping, External wall insulation is a great and confirmed way to reduce energy usage needed to heat up the building. Installing it is a part of and eco home or carbon neutral home idea.
Product Require	need to be met such as the external wall insulation product reaching a particular u-value in order to make the building sufficiently thermally insulated and therefore be used for a environment care
Dampness	The application of External Wall Insulation can help to deal with rain penetration problems through solid walls by blocking wind-driven rain. However, it can also make the problem worse if poor detailing (e.g. around eaves) allows water to pass behind the external wall insulation where it can become trapped. A high standard of design and installation should therefore be insisted upon. The dangers of not adequately designing and specifying these systems is dealt with in a research paper written by Joe Malone and published in the CIOB's Construction, Research and Innovation Journal

TABLE 21

CHAPTER 4 MEAN DIFFERENCE BETWEEN THE CHINESE AND UK STANDARD

There are several difference in china and UK, generously because of the different logic in plant protection design, Chinese people more focus on the exactly data, the amount of people, the precise size of each single area, but the English one they care more about functioning of the plant and put more space to the plant designer.

4.1 THE BASE OF THE TWO SYSTEM, THE FIRE RESISTANCE IS QUIET DIFFERENT.

Purpose group of building	Minimum periods of fire resistance (minutes)					
	Depth (m) of the lowest basement		Height (m) of top floor above ground, in a building or separated part of a building			
	more than 10	up to 10	up to 5	up to 18	up to 30	more than 30
Industrial:						
– without sprinkler system	120	90	60	90	120	no
– with sprinkler system	90	60	30	60	90	120
Storage and other non-residential:						
a. any building or part not described elsewhere:						
– without sprinkler system	120	90	60	90	120	no
– with sprinkler system	90	60	0	60	90	120

It can be clearly find that the component fire resistance of UK standard is commonly half lower to the Chinese one. Even as the lowest fire level 1, the Chinese codes with the resistance in WALL, FLOOR, ROOF, STAIR are 1.5 hour, but UK are 30 to 60 mints, further in the highest resistance always used for plants which have multi layers, crowded people and with dangerous products, like cotton, fire work, paper, etc.… that's the level 3 in China limitation, and its 4 to 4.7 hours 8 times of the British one. With this huge difference the problem appeared, its quiet confused that why the fire resistance in UK are so low, dose they have enough function to protect the fire accident?

As after some generating of the code book, design book, it shown that, there are many reason cause the lost in fire, but less of them is connected with the lower thermal resistance. As the British one they have many advices on the logical design side instead of just adding fire resistance numbers, separate levels, they put more attention to the

people safety. How can let people escape easier, how to reduce the escape rote, how to let the water system cover every where. Then we can saw that in table.

Specific provisions of the test for fire resistance of elements of structure				
Part of building	Loadbearing capacity(min)	Integrity	Insulation	Minimum provisions when tested to the relevant European Standard
Floor	60	60	60	REI 30
Roof	30	30	30	RE 30
External wall 1 over 1000 mm 2 lower 1000mm 3 decided by escape route	with external wall over than 1000, its with no limition, then the other two is 30	30	-	RE 30
compartment wall	60	60	60	REI 60
Protected shaft 1 any glazing 2 any no mentioned parts	30	30	30	REI 30
Enclosure 1 protected stairway 2 lift shaft.	30	30	30	REI 30
Firefighting shafts 1 construction that separates firefighting shaft from rest of building	120 60	120 60	120 60	REI120 REI 60
Fire resisting construction	30	30	30	REI 30
Cavity barrier	-	30	15	REI 15
Ceiling	-	30	30	EI 30
Duct	-	30	No provision	EI 30
Casing	-	30	No provision	EI 30
Flue walls	-	30	15	EI 15

TABLE 22

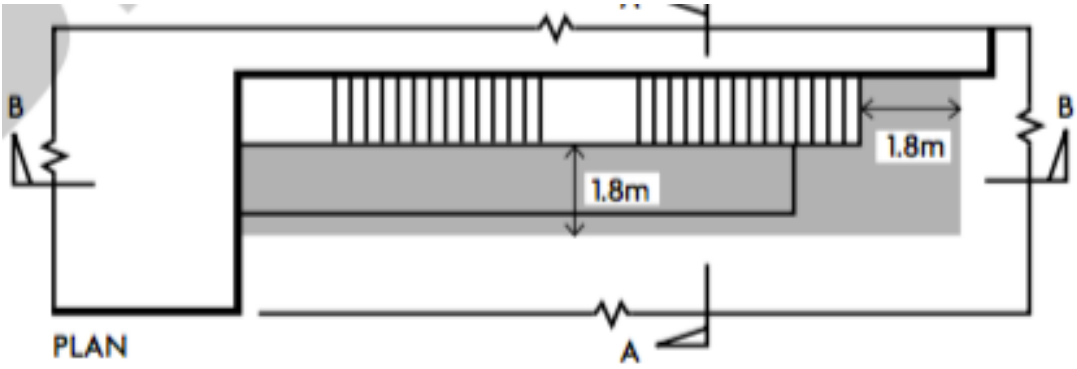


FIGURE 11

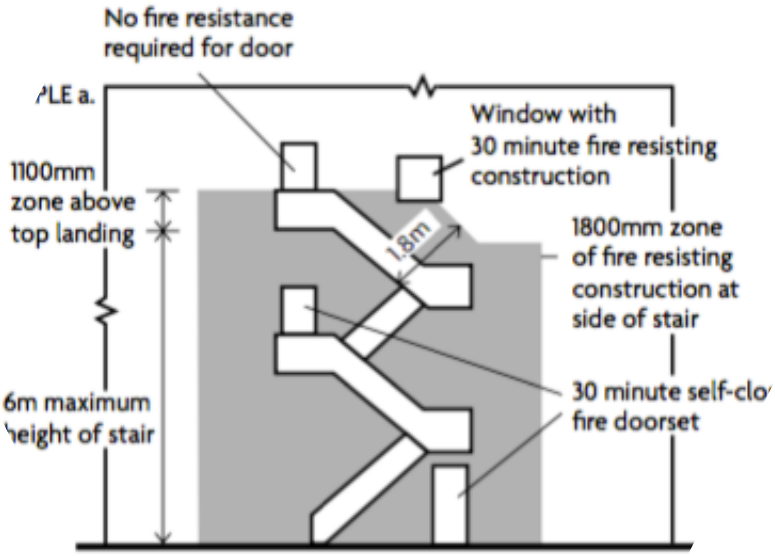


FIGURE 12

In UK if its first layer retail steel frame plant, then there no need to design the fire prevention system. But in China as the previous every warehouse need to be designed well. So that if processing Chinese standard needs to do the fire retardant coating in every single frame, it means it will cost more budget and more time finishing the coating also there has more following treatment of the coating is still considerable.

4.2 THE DIFFERENCE IN STAIR

As the standard in UK if the width of stair is over 30 inches more or less its 1m, it needed to set two side handrail, but in china only the stair width can allow 3 people in line, the two side handrail is then needed, and the space per people in stair is 0.55m, the total wide need in China to set two side stair then is 0.55*3=1.65m, so in this point the China code has more profile in economy reason. Further more, as both of the standard not mentioned is the connection with height and angle of stair, in general two parts stair with rest layer is easier to climb then one, and lower of each single step is easier to walk. So in the design it can use more narrow connected stairs instead of one wider one.

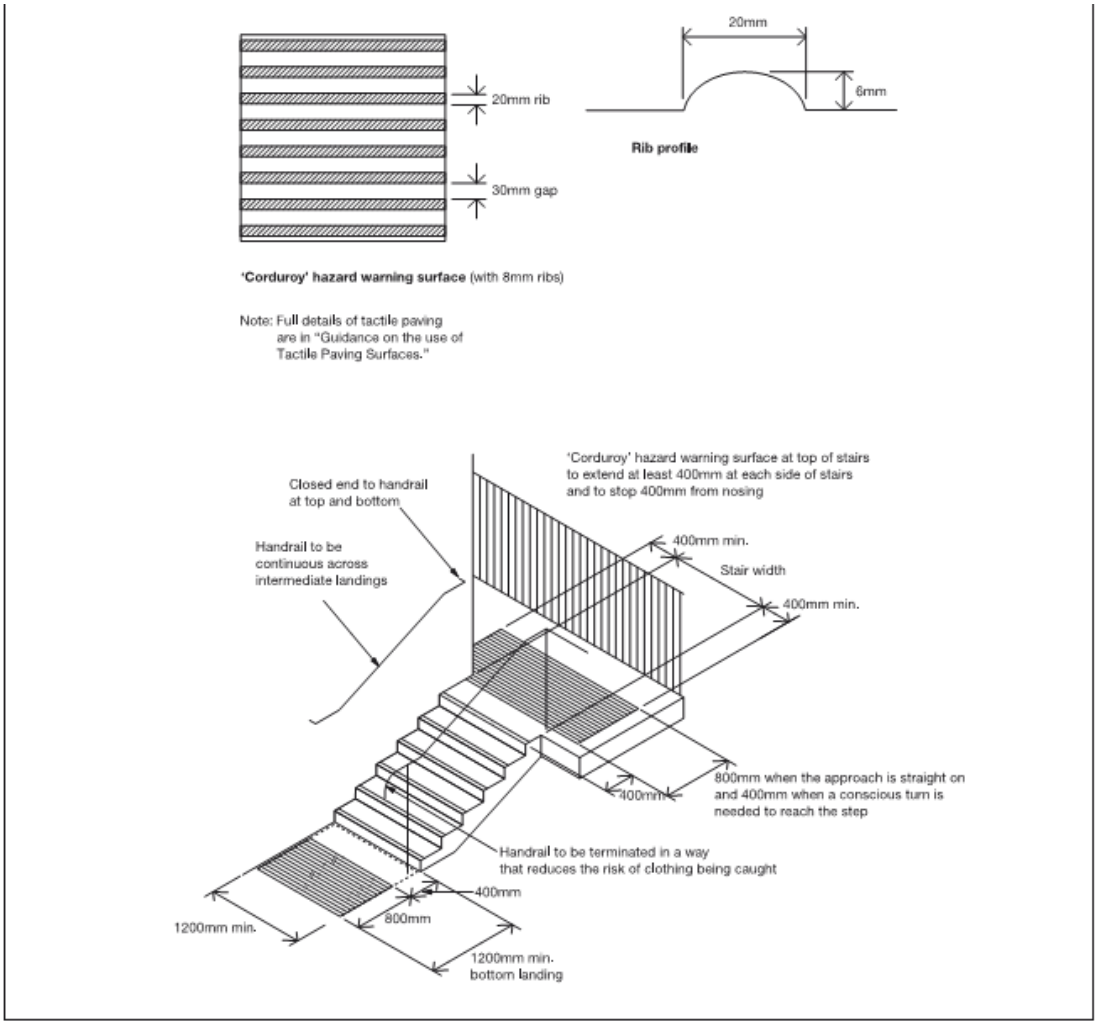


FIGURE 13

And also as the picture shows below in British code books even about the width of stair end connected with the rest layer, same with hand rail, the type and fire resistance of hand rail in no limited but it's height, length beam number should be considered, in

general the higher of the whole stair, the connection higher of it's height, and bigger is the area, wider of is the hand rail. that's kind of design stand more of the people feel and more convenient of the user, so it makes the escape route much easier to use which means it will be easier to save life not only in the fire accident, but also in any other possible conditions, that what this paper's aim, finding secrets inside the fire system, finding better way to define the fire system.

4.3 FIRE ALARM SYSTEM(FAS)

4.3.1 The Fire Alarm System (FAS) has its own network structure and cabling system to enable independent operation, operation and management of the system under all circumstances. With the development of computer technology and network technology, the fire alarm system has the ability to network with the Building Management System (BAS), and provides building automation systems, integrated security management systems, broadcasting systems, and wired/wireless communication systems in the event of a fire. There also have another physical way to (灭火) 灭火器。。。。。

4.3.2 The type of Chinese used alarm system

As Chinese start the fire system is in a quiet late time, the training programs for the related people, the system to use, the sensor choose, also the standard with those systems still have large space to improve. The government is also put much money on it cause it's the key point to protect people and save the money. There are three normal type fire alarm system about smoke detection, temperature detection, light detection.

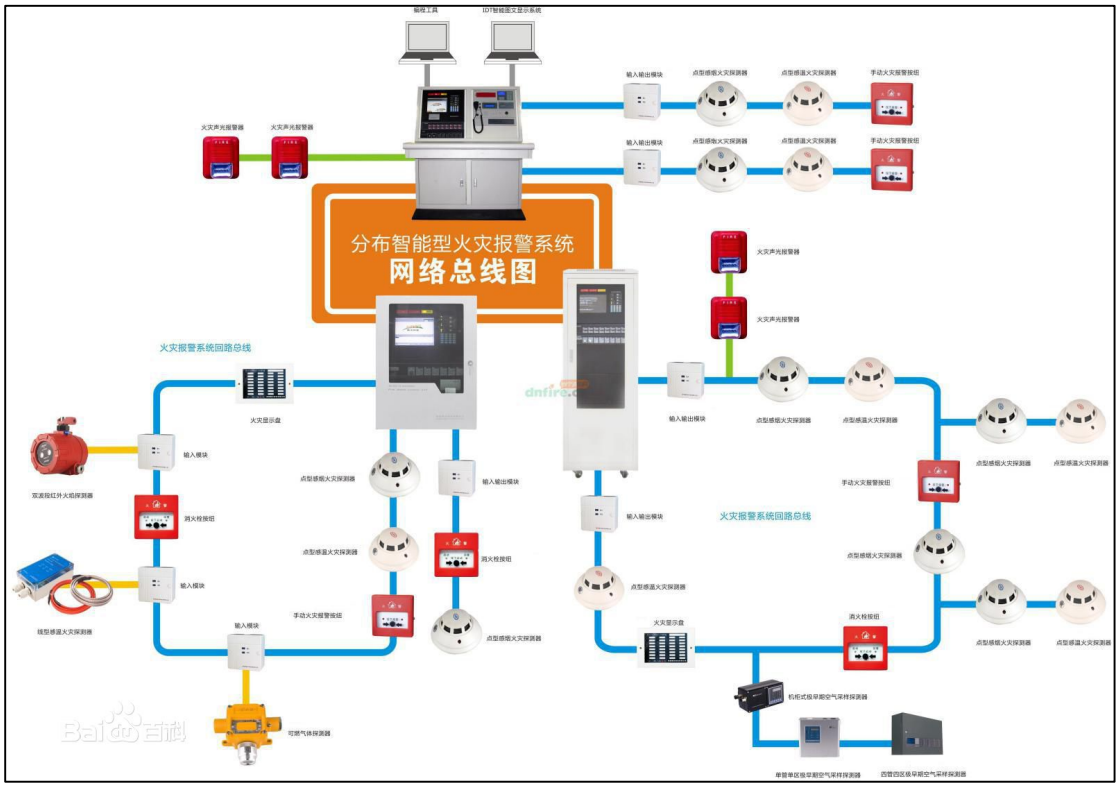


FIGURE 14

a The smoke detection alarm system

When an object burns, a large amount of particles is scattered and suspended in the air. And when the object burns, it will be accompanied by irritating gases. Therefore, there are usually carbon monoxide sensors and dust sensors in the smoke sensor.

A dust sensor is usually a photoelectric sensor that measures the concentration of smoke through a beam of light and a sensor of light. Normally, the beam is off the sensor, and when the smoke enters the sensing chamber, the smoke particles scatter some of the beam light onto the sensor. As the concentration of smoke gradually increases, more lights are scattered onto the sensor. When the beam reaching the sensor reaches a certain level, a current is generated, which can cause the relay to operate and the buzzer to alarm. The carbon monoxide sensor is the principle of potential electrolysis. When carbon monoxide diffuses into the sensor, the output of the sensor idea produces a current output, which is supplied to the sampling circuit in the alarm to convert the chemical energy into electrical energy. When the concentration becomes larger, the current becomes larger, and then the amplifying circuit is driven to drive the buzzer to alarm.

FIGURE 15

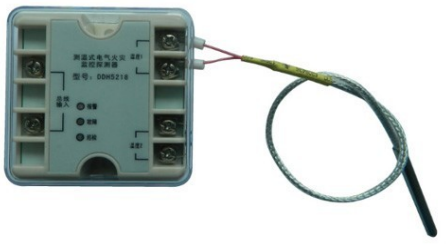


FIGURE 16

This system is most used all over the word, in American and Europe over 90 percent of the factories use the smoke alarm system, but it has some limitation inside the system.

In most accident, the electronic parts cause the mean reason, and also cause lots of cost. And in some time the smoke detector can't react it immediately, then because the security people always ignore the warning mark as they thought it's the wrong warning.

When a factory installs a smoke alarm, over 70% of the warning is not considered, its almost concern with the cigarettes smoke, the electronic problem with the sensor, aging of wire connected to the alarm and so on… in the other side, because in the assembly, or doing some welding jobs plants, there always have small particles mixed with air, cause the alarm ringing, it's same with ware house, when it stored something like flavor, sand or mixed dust, it will cause warning too. Just because the unnecessary warning when the fire real comes, it always be ignored, and thus the plant has relatively high roof the alarm sensor is putted too high to react the dangerous in time, that makes the people dismissed the good timing to protect the facilities even their life. Its quiet common but can't get well improved. Some of the plant even choose the oldest way, they just remove the alarm system, and use the worker to decided if there is a fire dangerous and when some where getting burned, the worker holding fire extinguisher to stop it. It could work, but it makes no sense in the ware house, you can not permit that there is always someone in the warehouse, to see if the auto ignition happens.

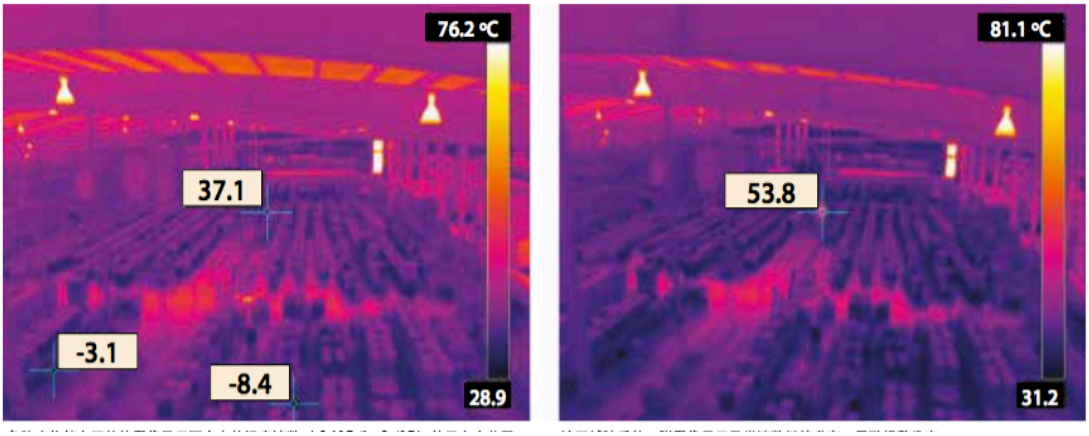


FIGURE 17

Right now there are a way to solve this problem, a HongKong company announce that they increate a new system only for plants and warehouse they throw the smoke sensor, instead they choose temperature sensor, the temperature is small and cheap it can be settled every where, on wall on shaft is both ok, and it connect with an ECU to trans those signal data to a central CCTV, we can set the limited temperature, in each area we want and also it can see the picture inside the warehouse, so when something will getting self ignition, before the flame occurs the temperature around them will raised, then this unusual temperature rise could be known by the sensor, then the ECU turn the

camera automatically to the unsafe area and send warning message to let people find out what's wrong with it, if there really have something burning up, and find some way to solve it but not just inject water in there.

Also the camera is easy to set, for a large plant or ware house over 1000mm^2 just 8 cameras is needed to cover all the area.

1 computer

2 wire

3,7 network exchanger

4 fiber

5 CONNECTION

6 PoE

8 camera

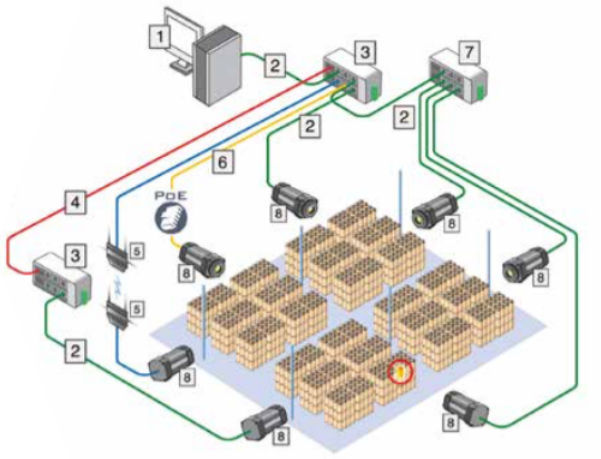


FIGURE 18

It is a really good and safety way because, not any fire condition is suited for water, obviously in plant and ware house, some of the chemical stock can't mixed with water, others as many fire accident is caused by leakage of electronic wires if just put water there, it may cause explosion or electric shock, that not the result we want, it may cause more then just self burning. In other side the reality cheap price is a really competitive part.

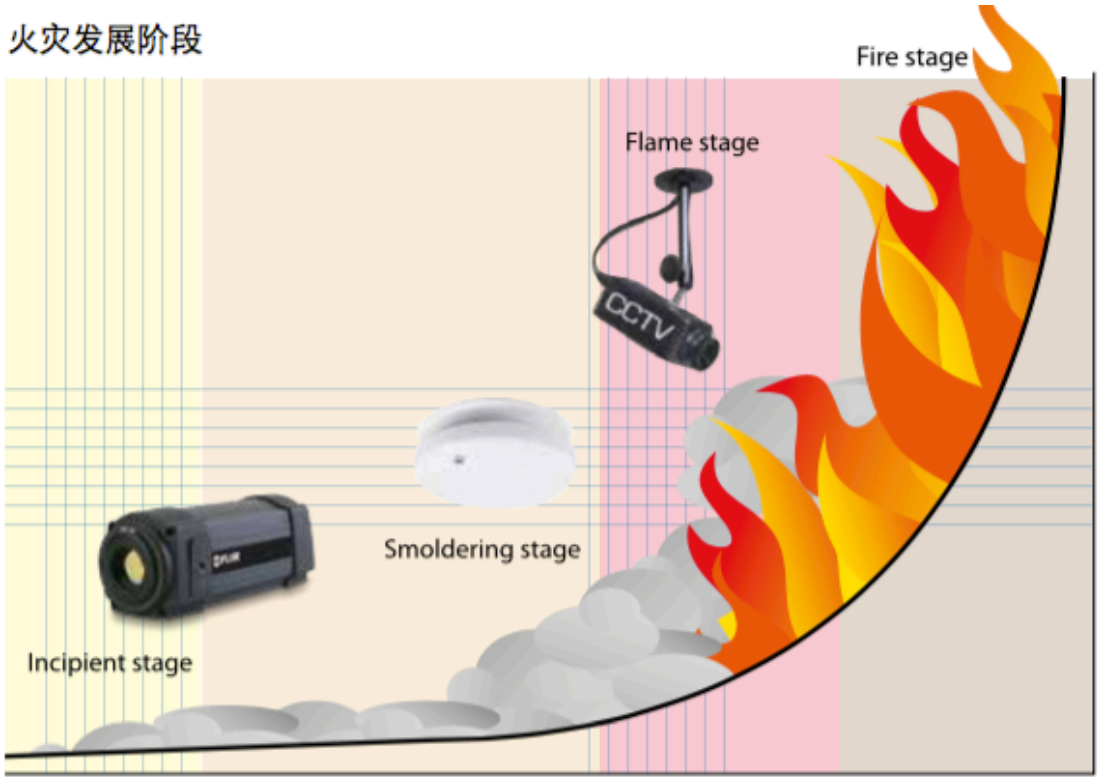


FIGURE 19

b Temperature sensor

The temperature sensor is we usually use to monitor the temperature of a certain area of the room. Once the temperature of the area reaches the set threshold, the circuit of the temperature sensor will drive the buzzer alarm and the corresponding indicator. Shining.

c Flame detector

The flame detector is used to detect the radiant energy of the flame (the illuminance of the flame) and the frequency of the flicker of the flame. And it can identify the radiation beam in the event of fire from the natural light and artificial light existing in the surrounding environment. Currently used to identify infrared flames and ultraviolet flames.

FIGURE 20

4.3.3 Gas fire extinguishing system, foam fire extinguishing system should be controlled by special gas fire extinguishing controller and foam fire extinguishing controller

In China only C class plant or the total plan area over 1500m^2 the alarm system is really needed, on the others its not necessary. But in UK no matter what building is, it has to followed with an alarm system. In plant they have a more strict limit, it has to a completely electronic control system which can cover every where, not just manual alarm as seen in some building. This different is quiet important, it can save people in the very useful and timely way. Also I think That's the mean reason the Chinese plant has lower grade in plant safety part compare with the development countries. And may be if we could change this part, it will save a lot of life.

4.4 BUILDING SAFETY TRAINING TO PEOPLE

4.4.1 In the Chinese there no clearly limitation to the employment that how they do their jobs in a safety place, expect some special place such as cotton warehouse, or somewhere placed explosion facilities, the manager send the hand book to the charge worker, the others will without any trained. In UK all people in the plant should attend the fire safety training before they go to work. And the handbook of the fire protection in everywhere is written in details, included the maps, function, escape way of each place. Also about the use of stair, any structure with stair should consider the right way to use the stair. For example, in the design of out side wall, it should be considered the lock of the stair frame. And during the inside stair design it should consider if the change of light on the roof will influence the right use of stair. Which will partially make sure the safety escape during the fire accident. The British standard is not just a standard with numbers its have more advice with design styles.

FIGURE 21

4.4.2 In this picture it shows the awareness of workers and the boss response.

There are lots of things need to care in the fire safety system not just buy a good system and design.

The most valuable thing in the company is the employee's life, the most useful weapon to the fire defense is the people do their jobs in the right way.

FIGURE 22

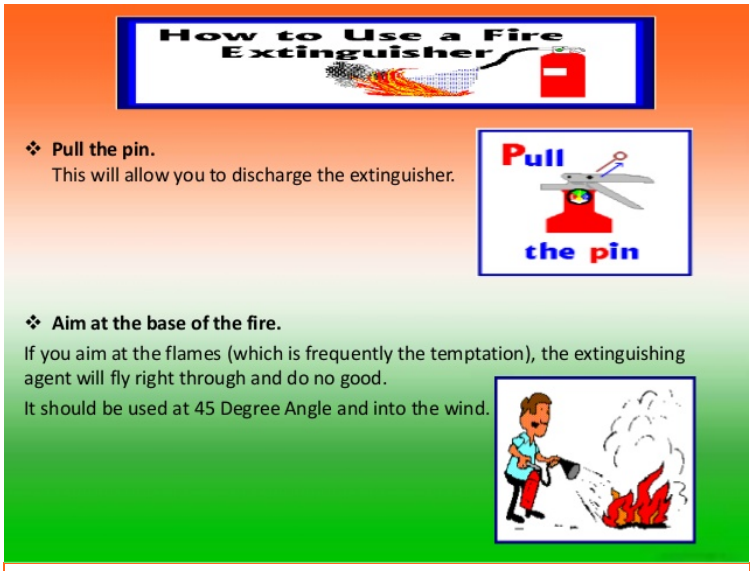


FIGURE 23

FIGURE 24

4.4.3 The trained with Fire Extinguisher

Over 70% of people not know about the fire extinguisher, most wield used is the Dry powder fire extinguisher, but it still has limitations with cooking oil and fats, in temperature lower then -23℃, also as the powder can stop the fire directly it easy to re burn and make the environment get wore clear, then its hard to clean. The carbon dioxide one is well used but it worse to deal with the wood.

Also about how to use the fire extinguisher is really need to care.

4.5 EXTERNAL LAYER

As mentioned in the previous, there are many dangerous project need to be concern in thermal material, type, thickness of the plant. When the big accident happens, the problem can be shown every where, it's about the whole system. The thermal material in external problem is just more obviously between them.

4.5.1 Fundamentals of the thermal layer

As it well known, the wall has different types, mainly there are two kinds the wood one and the steel one. Recently the most popular frame installed for plant is the steel frame.

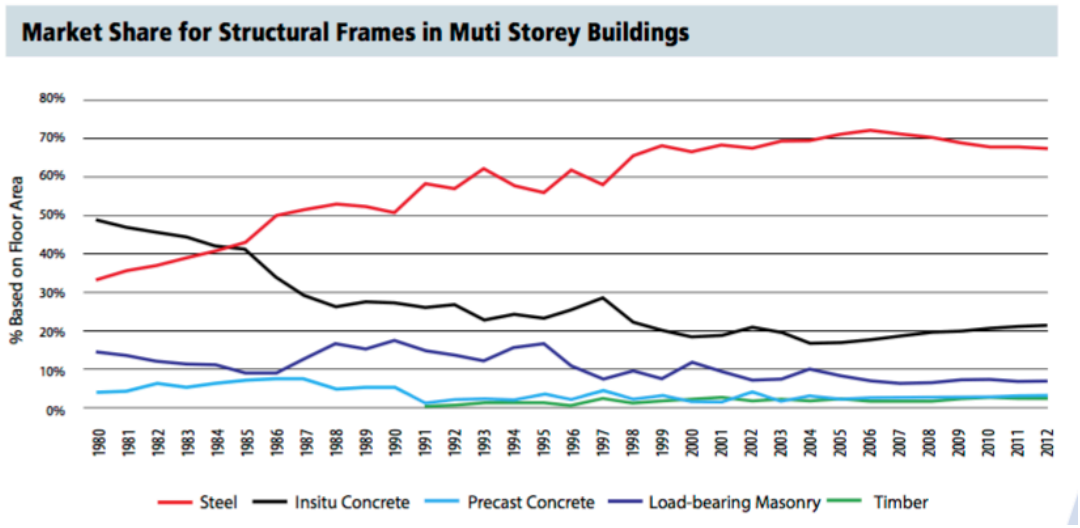


TABLE 23

a. For determine the thermal layer firstly it should be clear the fire resistance of the wall.

Fire resistance of the steel:

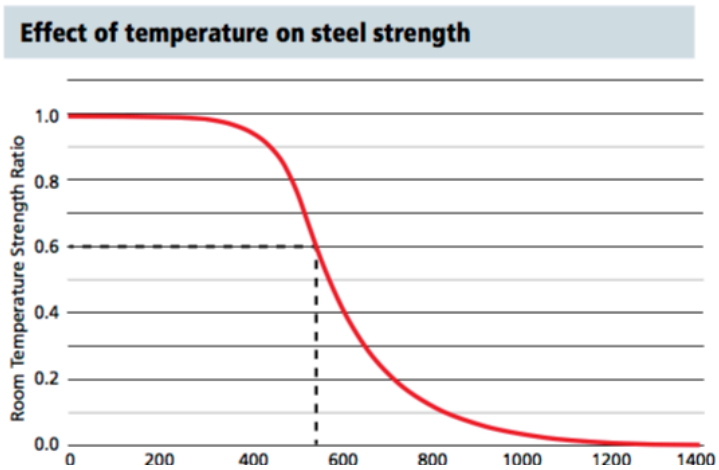


TABLE 24

As the steel is non combustion material, the fire resistance analyze is about its strength. As shown in figure, the higher of temperature, the lower is the loaded is can afford, which means if the temperature of the whole wall is over 600℃, the steel inside the loaded wall

will bended which cause the whole loaded wall loss their functions. In the same time the thermal layer will have a positive approve to that phenomenon, thus the reason why after the big fire, there always with words “it caused by external layer”.

b. Thermal conduction of the wall:

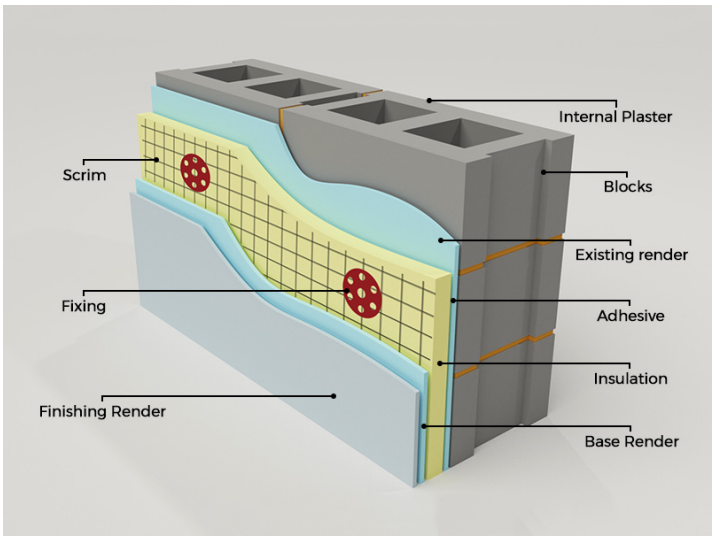


FIGURE 25

As the external installation structure here, as environment care the insulation material is STP. With different thermal resistance in different layers the total energy loose by heat exchange will be reduced a lot. As the equation shown that the higher of the material thermal resistance the more energy it can be saved, it necessary because it can keep the facilities inside the building work in a more normal condition. In the equation, because the wall is made up with multi layer the calculation of thermal conduction and temperature difference has been shown with multi layers.

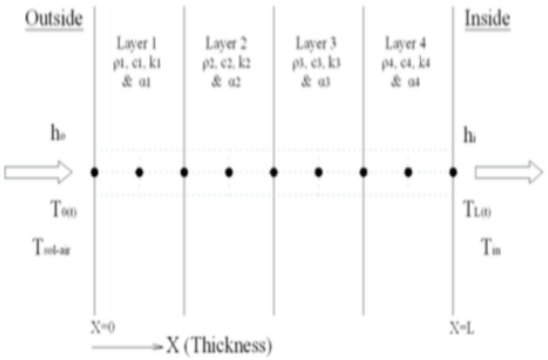
$$Q = v\rho c_p \Delta T$$

where

- Q is heat flux (W/m²),
- ρ is density (kg/m³),
- c_p is heat capacity at constant pressure (J/kg·K),
- ΔT is the change in temperature (K),
- v is velocity (m/s).

$$k\left(\frac{\partial T}{\partial x}\right)_{x=L} = h_o[T_{sa}(t) - T_{x=L}(t)]$$

$$t_{sa}(\tau) = \frac{t_{max} - t_{min}}{2}\sin\left(\frac{2\pi\tau}{P} - \frac{\pi}{2}\right) + \frac{t_{max} - t_{min}}{2} + t_{min}$$



$$q_i = h_i(T_{in}(t) - T_{in})$$

TABLE 25

4.5.2 Main difference in external layer between Chinese and British standards, and the solution of the fire risk.

As known of the two standards in the previous, its easy to find that, in China it do not have the large scale test, which is now popular in Europe and the development countries. After this kind of test, it can be easy to learn how the fire transferred and developed. So that after those test its provide a much more convenient environment to improve the modeling and design tasks. Others, the Chinese government has put more concern of the environment protection, and has not enough experience of using new external insulation material which cause a raised up of fire risks. As the shown of the resistance table, it's clearly to find that the material use in both countries is the same, more over the Chinese one even have higher limitation data of the fire resistance level, but the risk is still high. Some of the expert said it because the lower fire resistance of environment friendly external layer material, the STP, the higher percentage of the material used cause higher risk. But it's not quit correct, because, in British the external insulation material is more than Chinese one, some of the the material is even with well combustion property, such as wood, wool, EPS stc…

So that, what is key point of the use of material? Why the risk is high by using this? The reason is dependence with multi conditions. Mainly is less of experience, this material in China just used about few yeas the construction company isn't familiar with this material, but in others it has been installed over twenty years, so there are lots of design tricks the Chinese haven't found, also the government published the limitation only describe the resistance level, not mention design description and not consider large scale test, for cost reduction it is easier to find there are not so considered design in external wall, that will cause the growth of fire risks.

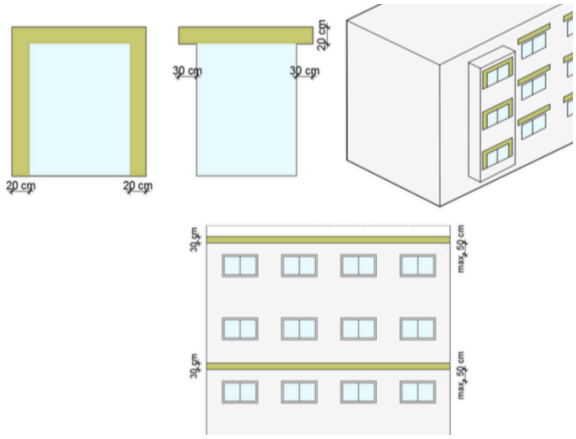


FIGURE 26

A design to improve the external layer installation:

The fire barrier

Normally there are three kinds of fire barrier. Which is the useful fire defense way 1) round corner of the barrier

2) single layer of the window

3) single layer of the multi layer

The figure shows that when the combustion happens, the inter material melting and the fire can be separated into the wall which can stop the fire penetration.

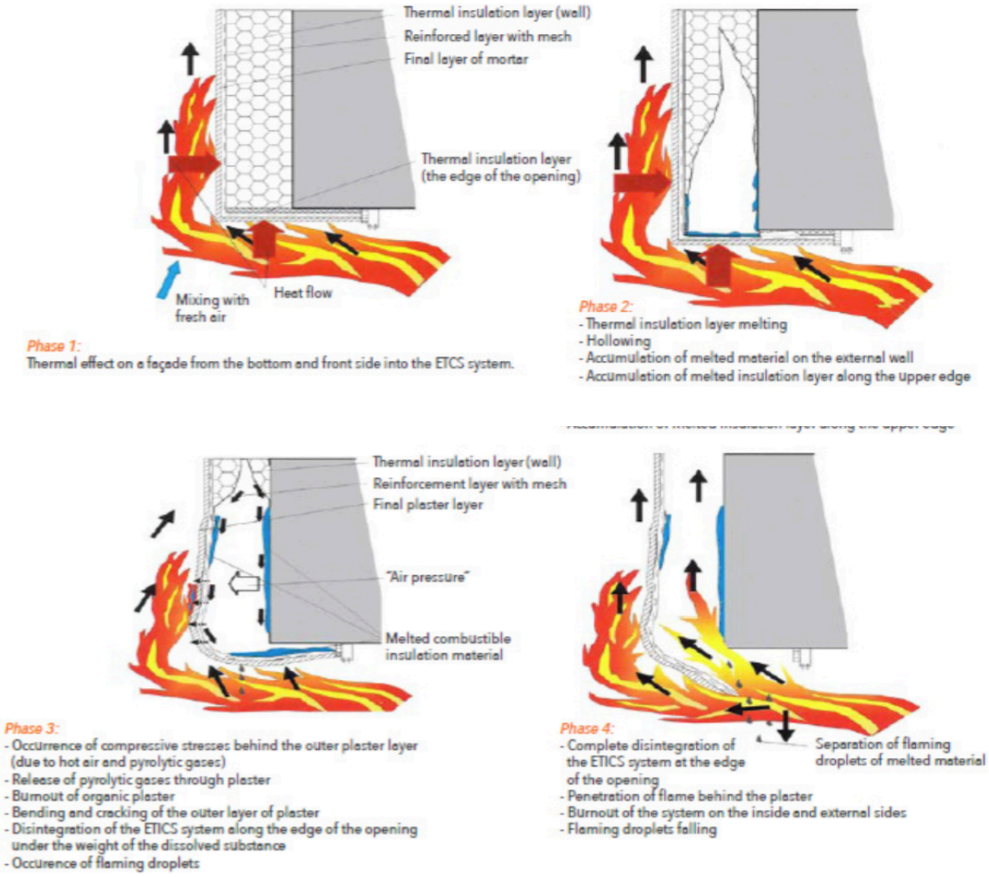
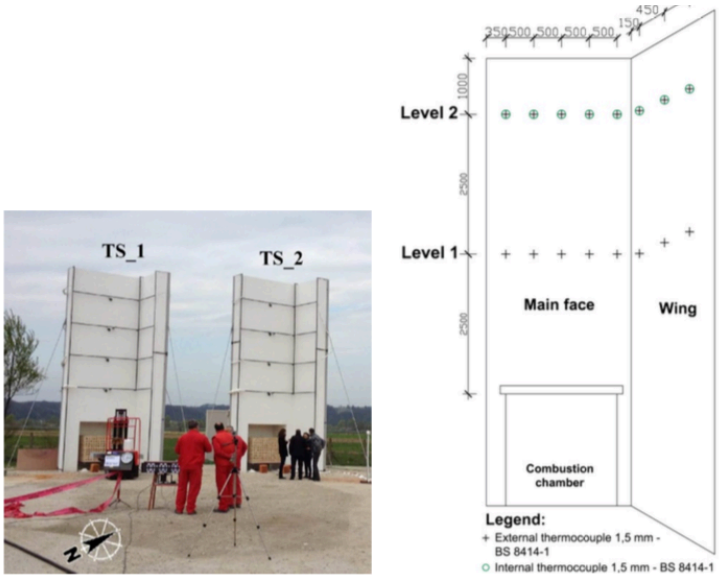


FIGURE 27



The big scale test of the fire barrier

There have two test samples, test 1is normal sample, test 2 is the model with layer barrier.

FIGURE 28

can be fined below, it's obviously that the second test has much better fire resistance than the previous one.

In a word, for solving the problem of the high fire risk caused by external thermal layer. The design of fire barrier is quiet useful; it can control the fire separation in an effective way. However, it can't be considered as fire as the non combustion insulation materials, the fire barrier only can partially stop the fire, it not only can separate the fire and control the fire growth.

4.6 THE TASK ANALYZES

The following pictures comes from Case and New Holland Industry, which is designed by Italy company, build up in China, it follows the both standards and almost have no change of the previous design. The plant is used for product combine, off road vehicle, it mixed with all functions together, it has two layers first for production the shell, assembly support cover, and assembly the whole combine, also it has stuff rest room, ware house, PV office are also settled there. Second is the office for PS, PD and buyer, also it has three meeting room for people to talk about plan and jobs.

The reason why chooses this plant, is because it both related with Chinese, European, American standards, it quiet international. Then the function of the plant is much enough, it can be large machine assembly plant, the ware house for electronic parts, the sheet metal production company, the office, and because it is build in north of China the low temperature is also quiet suitable for external thermal layer analyze.

4.6.1 As figure water splitter is settled every 5m, smoke detector is settled every 10m, the air system settled every 8m, as talked before, the smoke detector should as close as the air condition system, it can rise the sensitivity of the smoke detection and increase

the safety level. But for saving cost, this setting method is also acceptable. Water splitter has larger distances in the meddle area, it may cause some area between them can’t be covered.

This picture shows that the smoke detector with large distance with air system, which may reduce its sensitivity, rise dangerous

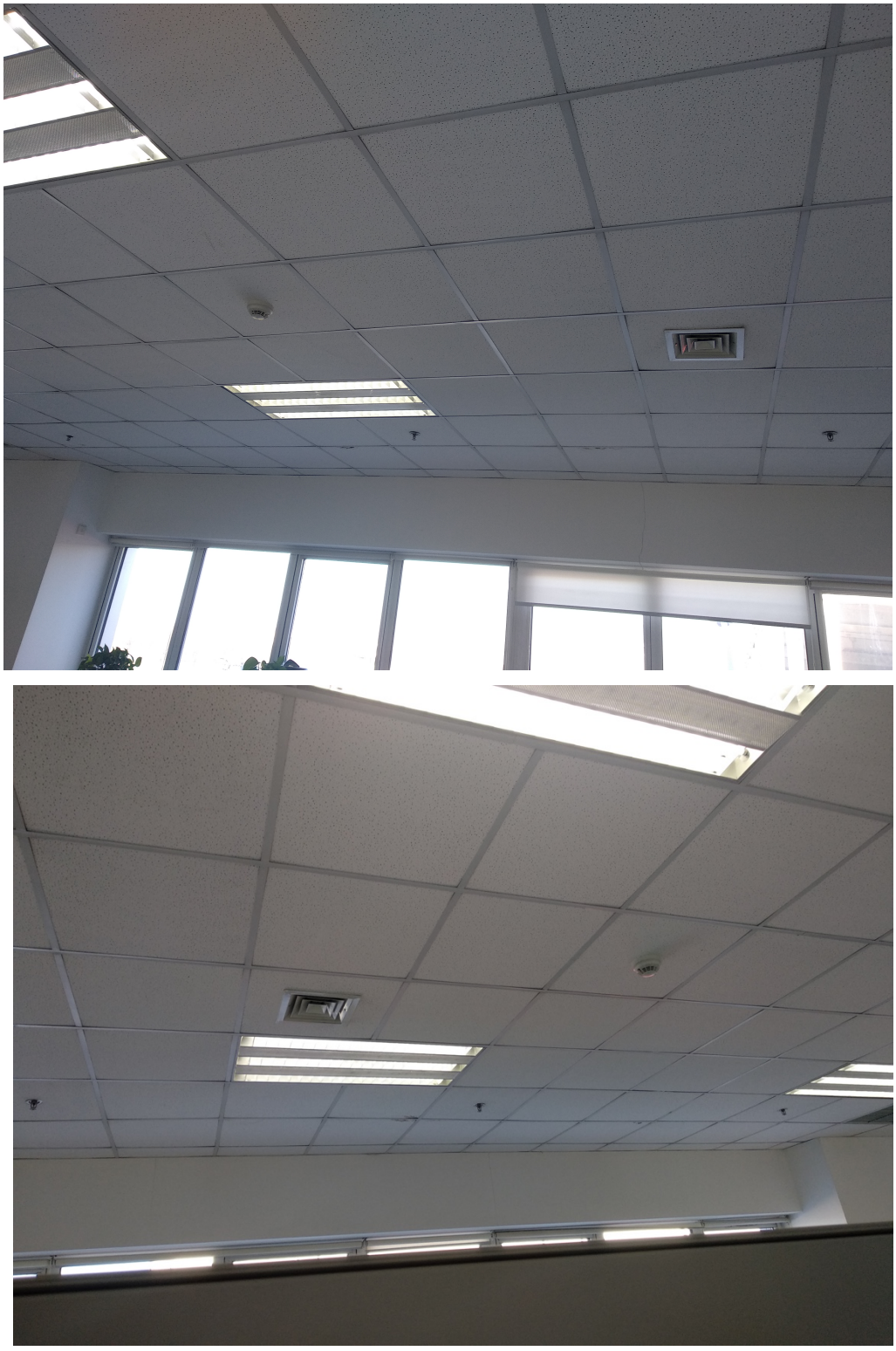


FIGURE 29

4.6.2 Escape route and stairs

The second floor have 27 engineers, there are two stairs in both side of the floor, it can allow two people go through in a time. As the area and number of people, both lower than the limitation, the single side stair, the width with 1.1m and height of each step with 1.3m is acceptable.

FIGURE 30

On the wall of first floor is hanged a picture which clearly sign the escape route with red arrows.

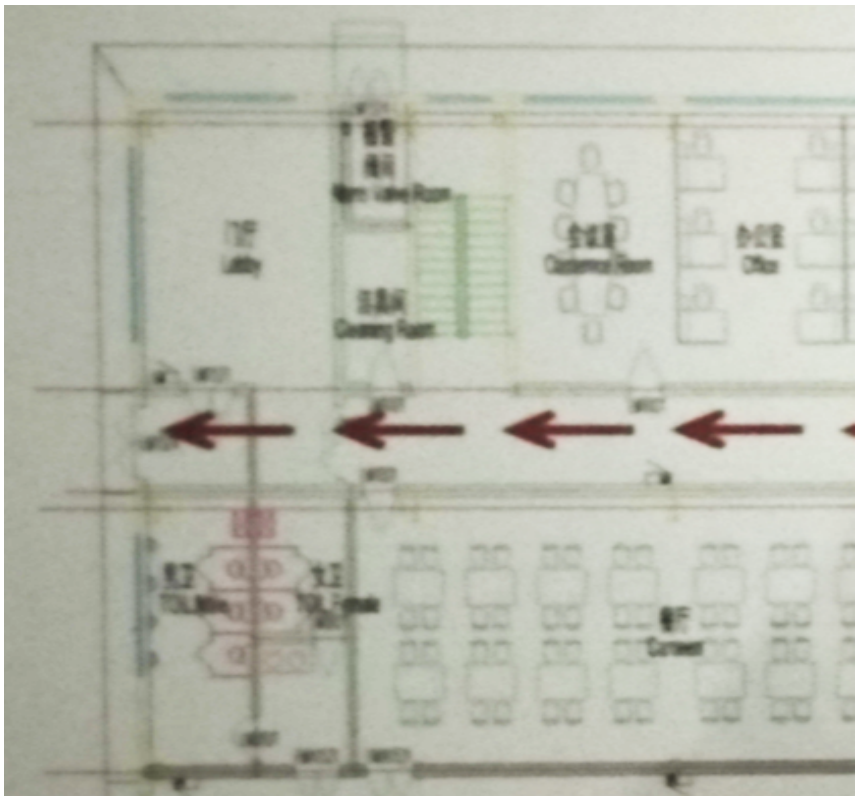


FIGURE 31

as enter to the company because its in winter, 2 of 3 main escape route is locked, there are only two hallway doors opened to connect the inner and outside, which can cause crowded of people during escape, its quiet dangerous to do so, and also the door of hallway should be more wider for escape. Alarm for fire is easy to find, every floor has three physical alarm to help people report the fire accident, in case the detection doesn't work.

FIGURE 32

4.5.3 The plant and fire extinguisher

FIGURE 33

inside the plant it has clear picture to tell worker be aware of the related dangerous, include ware suit, protect ear, ware gloves, use no conduction shoes.

FIGURE 35

FIGURE 34

the fire extinguisher is putted every where, inside the plant there are eight pairs of the fire pipe and fire extinguisher together. Inside the pipe box the facility are clean and new, ready to be used any time.

at the same time, the fire extinguisher box is okay, it shows to people how to use the extinguisher in a correct way, but all the extinguisher is the dry powder one, as I mention before, people has less learn of the type of fire, and type of fire extinguisher, the dry powder extinguisher can't stop the fire, it only can reduce the oxide around fire, an it hard to clean up after the fire finished, and it has no effective work in electronic parts. So the extinguisher here should use Carbon dioxide one. It is no hard to find there in no smoke detector in the plant, it because the height of the plant is around 6m, and there enough wall to install the smoke detector, and of course the plant connects with warehouse, but in side warehouse, there don't have any facility to stop fire, it quiet dangerous if the warehouse have fire risk but without fire extinguisher, may be try to install the temperature camera system is better.

In conclusion, the design of the fire system in the plant is good, it have well defined escape route, enough alarm system, clearly signature of risk area, clearly use of fire extinguisher. But it still has some pros the worker didn't follow the necessary suit, the escape door is lock, the detector has more distance with air system, the plant have lower fire safe level, and the choose of extinguisher is not so correct… it maybe small but during the fire accident, it may cause big loose, so no matter what country it is, it should be aware of fire risks.

SUMMARY

The aim for this paper is try to understand the relationship between fire safety and the other follows limitations, systems, training materials, wall types stand with different countries and different cultures.

From them, it is clear that, no matter what country is, people doesn't pay enough attention on the fire safety and the follows related with it. In China, the government start to care the fire things in recent years, they published lots of limitations, refresh the standards, update the fire level, separate the construction with functionality, but its just work on paper, not quiet useful for real. For example, in external layer, the standard book only tell people to use STP sheet but there no word to describe how to use it, how much is and where is should be putted. So for the architecture worker they have no idea with it, the wrong use of the sheet causes many fire accidents in that reason.

In the other side the leakage of manage the fire prevention system is another unsafety reason. That's a problem even in British also Europe, all the company, public organization have the fire drill but less people will truly learn how to escape in the right way, how to read the escape map on the wall, then recognize which door is fire stop door and where it is. As well in the plant, not enough training to worker cause lots of injury. The training of right way to use fire extinguisher should be added, the classification of fire and the related type of extinguisher should teach to every work member clearly. The work suit, gloves, shoes, welding glass used in the plant should prepared in enough amount and easy to get. Escape map, escape route should be well designed and easy to saw on the wall.

After those small details, the general design, type of frames and their materials can be concerned. Because the big scale test is just start from Germany (modeling the construction and burning it with test fire), it can't find quiet suitable data matching the material of frames and structure design, so the data write on the previous side is just general data, the standard is not so precious, that's why in fire resistance part the Chinese standard are triple higher then the British. It should use all land of China, which it should included the coldest place of China, where the wall is get larger, as that reason with the total standard, there always follow a small description for different places.

In a word the purpose of this research is try to find some improve parts in the fire prevention system we used now, because the higher quality of the whole fire prevention system to use the more safety environment the member can work with and the less loss in the accident. In the end, not only the government, the company but also the employee, the normal people should get more trained with the fire accident, cost reduction can't become a knife for killing.

REFERENCE

1 [book auth.] Minitry of Public Secirty of China. *GB 50736-2012 Design Code for Heating Ventilation and Air Conditioning of Civil Buildings.* GB-50736 2012.

2 Alarm and air condition system. [book auth.] Minstry of Public Society in China. *GB 50736-2012 Design Code for Heating Ventilation and Air Conditioning of Civil Buildings.*

3 General principle in Plant design. [book auth.] Minstry of Public Securty of China. *Code for fire protection design of buildings.* GB 50016-2014.

4 Ministry of Public Society in China . Fire prevension in structure. *GB 50016-2014 Code of Design on Building Fire Protection and Prevention.*

5 Ministry of Public Society in China. fire resistance of the structure. *GB 50016-2014 Code of Design on Building Fire Protection and Prevention.*

6 plant classcification . [book auth.] Minstry of Public in China. *GB 50016-2014 Code of Design on Building Fire Protection and Prevention.*

7 Malone, Joe (1 December 2013). "The risky business of covering up" (PDF). Construction, Research and Innovation Journal. Retrieved 5 December 2015.

8 BS 5306: Part 3: 2009 Fire extinguishing installations and equipment on premises. Commissioning and maintenance of portable fire extinguishers. Code of practice ISBN 978 0 580 57261 6

9 BS 7671: 2008 Requirements for electrical installations. IEE Wiring Regulations (17th edition) ISBN 978 0 86341 844 0

10 BS 5839: 1: 2002 + A2: 2008 *Fire detection and fire alarm systems for buildings. Code of practice for system design, installation, commissioning and maintenance* ISBN 978 0 580 60438 6

11 BS 5306: Part 1: 2006 *Code of practice for fire extinguishing installations and equipment on premises. Hose reels and foam inlets* ISBN 0 580 48282 0

12 BS 9999: 2008 *Code of practice for fire safety in the design, management and use of buildings* ISBN 978 0 580 57920 2

13 BS 5499: Part 1: 2002 *Graphical symbols and signs. Safety signs, including fire safety signs. Specification for geometric shapes, colours and layout* ISBN 0 580 33205 5

14 BS 5440: Part 1: 2008 Flueing and ventilation for gas appliances of rated input not exceeding 70 kW net (1st, 2nd and 3rd family gases). Specification for installation of gas appliances to chimneys and for maintenance of chimneys
15 ISBN 978 0 580 57065 0

16 BS 5440: Part 2: 2009 Flueing and ventilation for gas appliances of rated input not exceeding 70 kW net (1st, 2nd and 3rd family gases). Specification for the installation and maintenance of ventilation provision for gas appliances
ISBN 978 0 580 64793 2

17 BS 5482: Part 1: 2005 Code of practice for domestic butane- and propane-gas-burning installations. Installations at permanent dwellings, residential park homes and commercial premises, with installation pipework sizes not exceeding DN 25 for steel and DN 28 for corrugated stainless steel or copper ISBN 0 580 44747 2

18 Pasker, R., "WDVS in Europa, European Association for External Thermal Insulation Composite Systems EAE", EUMEPS Master Class ETICS, Vienna, Austria, 2013.
19 I. Kotthoff, "Fire performance of external thermal insulation composite systems (ETICS) in buildings", 4th Global insulation conference, 2. – 3. 11.2009. in Prague.
20 http://www.telegram.hr/politika-kriminal/u-studentskom-domu-cvjetno-naselje-doslo-je-do- pozara-vatrogasci- trenutne-gase-vatru/ [web page accessed: 27.3.2017.]. (In student dormitory Cvjetno naselje fire broke out and firemen are extinguishing fire).
21 http://www.sesvete-danas.hr/hrvatska-i-svijet/zagreb/pozar-u-studentskom-domu-cvjetno-naselje- 1196 [web page accessed: 30.3.2017.]. (Fire in student dormitory)
22 Jelcic Rukavina, M., Carevic, M., Banjad Pecur, I., "Fire protection of façades - The Guidelines for Designers, Architects, Engineers and Fire Experts", University of Zagreb, Faculty of Civil Engineers, 2017.
23 Mayr, J., Battran, L., "Handbuch Brandschutzatlas Grundlagen – Planung – Ausführung. FeuerTrutz", 2014.
24 National Fire Protection Association, 2015 NFPA 101: "Life Saftey Code"