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Research on the Fire Protection Design of Commercial Building Evacuation Analysis of the Factors Affecting Safety

Zhang Lei
College of Architecture, Chang'an University, Shaanxi, Xi'an710064, China

Abstract: In view of shortcomings about fires showing an upward trend existing in China's urban construction commercial construction with developed rapidly. Building fire protection and safety evacuation is designed and studied. The large-scale and big space commercial building fire protection and safety evacuation design in advance system is established and factors affecting of fire protection and safety evacuation is discussed. The analysis of system based on the functional requirements of commercial building internal contradictions and fire protection design is verified. Results show that, fire in the flue gas evacuation response and fire damage Are important Factors Affecting fire protection design in commercial buildings, adjust rotational speed and load and shutdown. Provide the basis for commercial building fire protection and the design of safe evacuation.

Key words: Commercial buildings, fire damage, safe evacuation, fire protection design

INTRODUCTION

As China's economic development and the improvement of building technology, architectural form has undergone tremendous changes. In recent years, the China's major cities have built many large-scale, full-featured commercial buildings. Commercial building has developed into a sophisticated organization, complex structure, form a rich architectural complex. Therefore, building fire protection design has also become the most important commercial building development of safety precautions. Commercial building fire safety evacuation difficulties and factors affecting a building fire protection design.

COMMERCIAL BUILDING FIRE PROTECTION DESIGN CHALLENGE

Commercial building space can be divided into confined spaces easily and non-confined space. Commercial building space is different from the non-restricted open space in the forest and offshore drilling platforms, nor as a building space of about 100m^3 approximate cubes in a restricted space. (Yang, 2007) In the confined space and fire burning test statistics based on the experience of established design requirements and fire compartment fire protection measures will be produced with the use of the building features prominent contradiction. In the confined space of the building space, especially in large, complex space of the indoor environment is generally difficult to have a clear identification, had to rely on a variety of signs to boot, that large, complex spatial orientation of recognizability not high. When operating in the commercial businesses of different formats require different scale commercial area and trade show interface specification is often associated with the level of fire protection district area do not match. Separated by fire code requirements often affect large space stores the layout of commercial activities, which restricts commercial operations. Currently the main way to solve this problem is based on "Building fire safety design specifications" with automatic fire protection systems for fire district can reach the maximum area of 5000 m^3 for the tens of thousands and even hundreds of thousands of large commercial buildings cannot meet the needs of space usage time is used to divide the fire shutter fire district. "Building fire safety design specifications" and shopping malls is the most prominent contradiction fire district with commercial space requirements conflict.

BUILDING FIRE IN MOBILITY CLUSTER IMPACT FACTORS ON THE SAFE EVACUATION

In the design of building fire evacuation are assumed by a certain direction and orderly conduct of the actual evacuation is not the case, especially when the evacuees density is greater than a critical value, the performance of the cluster evacuation flow characteristics with cluster dynamics.

Fire personnel density: According to various rooms in buildings of different functions of its occupant density is not the same, so the room occupant density directly

Table 1: effective width to the actual width minus the distance near the wall

Type	Staircase wall	Handrail	Theater seats	Corridor walls	Other obstructions	Wall of wide channel	Door
Reduce the width of the index (cm)	15	9	0	20	10	4 6	15

affects the size of the room into a safe room safe evacuation of personnel evacuation routes in the length of time that the safe evacuation of the length of time.

Various houses occupant density is not only required to decide on each floor into evacuation channel number, as well as evacuation routes based primarily on size, but also decided to indoor personnel evacuation channel cluster migration time, flow rate and evacuation exits width and an important basis for the flow of people. Under normal circumstances, when the evacuation channel space per capita area of S = 0.28 m^2 $person^{-1}$, then the channel space may be the danger of traffic accidents migration flows. When the per capita area S = 0.25 m^2 $person^{-1}$, the body appears to push each other before and after the close, when it will occur in the evacuation channel blocking another person in the room, trampling, stacking casualties. Thus, in the safe evacuation routes, in order to ensure the flow of migration flows evacuation of security, you must control its per capita minimum size should be S = 0.28 m^2 $person^{-1}$, that the corresponding maximum flow density compared to P = 3.57 people m^{-2}. The design of the channel width is the distance between the walls on both sides. Fire experts Pauts After a lot of fire drills, the conclusion is the channel, stairwells, etc. The flow depends on the effective width and not true widths. Table 1 effective width to the actual width minus. Effective width of the wall near the actual width minus the distance, the distance was not used during the evacuation. The boundary layer near the wall was the result of staff does not want to walk too close to the wall which will hit the wall.

Moving speed of clusters evacuation: In the case of horizontal travel, when the evacuation channel occupies an area of 2.3 m^2 per capita, this value is the cluster migration evacuation routes free-flowing state for the minimum limit. At this time, the average travel speed of clusters migration of 1.27 m s^{-1}. In the case of horizontal travel, when the average area of 0.5 m^2 occupied channel, then the corresponding flow rate of migration of people traveling 0.73 m s^{-1}. At this time, the cluster appears stranded migration flows. In the case of horizontal travel, when the per capita area of ??0.18 m^2 occupied channel, then the crowd moving speed of migration flows will be reduced to zero. At this time, the crowd appeared stalled. In many fires have occurred in the outlet channel or stairwell while blocking phenomenon, prone to falls, collisions, causing heavy casualties squeeze. Therefore, the person entering the evacuation channel density determines the channel clusters evacuation status and movement speed size. So, when the flow of free movement in the evacuation channel, the channel density was 0.5 people in person m^{-2}, the free flow speed of 1.27 m s^{-1}. When passenger stranded in the evacuation channel flow channel occupant density is for 2 people m^{-2}. Data indicate that flow in a dangerous evacuation channel density limit of 3.57 people m^{-2} (Zhang and Chen, 2001) Occupant density than this value, it will cause the evacuation of the danger. (Li, 1989)

Human behavioral responses of fire: For people in the shortest possible time to leave the fire scene to achieve safe evacuation points depends on two factors: First, the person making the psychological behavior of fire, including reaction, decision making and evacuation route selection; Second evacuation design is reasonable. (Zhang, 2004).

These two factors, the former the latter is both the basis and premise, but the latter is to determine whether a reasonable basis. Therefore, the study of fire behavior in personnel psychology is to reduce fire casualty's important basis.

Fire in the building of human behavior in fire safety evacuation time greatly affect the impact fire personnel can be safely evacuated. In the commercial building fire, due to large numbers of people in the fire by investigating behavioral responses to design particularly necessary for the safe evacuation. Human behavior in the fire reaction to a certain extent, determine safe evacuation time, determines whether human fire safety evacuation. Customers and staff of different shopping malls, without specialized training in fire situations fire often make irrational behavior. Generally mall fire occurs, the customers easily choose their own familiar way back along the original import evacuated to escape. Some customers are not familiar with the safety outlet mall location, when the time comes in the usual familiar route or the road is blocked Panic. Some customers think there will be a bright place safe direction towards a bright and open space instinct. Some customers have to follow the normal behavior of group behavior lead to gaffes or do not have time to form their own judgments. These reactions are essential personnel to evacuate an impact on the important factors. The designer should recognize that these cases may arise, during the design of fire protection and create more favorable conditions for evacuation. Such as: to ensure that commercial buildings

Table 2: O_2 content affects the human body

Impact on the human body	Decreased muscle activity	Weakness, mental confusion, confusion direction	Suffocation fainted	Died of suffocation
O_2 content in the air(%)	15	10-14	6-10	6?

Table 3: Various combustible toxic gases when burned to generate

Substance	Wood, paper	Cotton, rayon	Wool	(C2F4)n	Polystyrene	PVC	Nylon	Phenol resin	Epoxy
Principal toxic combustion gases produced	CO2, CO	CO_2,CO, H_2S, NH_3HCN	CO_2, CO,H_2S, NH_3,HCN	CO_2,CO	CO_2,CO,C_2H_4O, C_6H_6,C_7H_8	CO_2, CO, Hcl, $COCl_2$, Cl_2	CO_2,CO, NH_3, C_2H_4O, cyanide	CO, NH_3, cyanide	CO_2, CO, C_2H_4O

Table 4: CO_2 concentration affects the human body

Impact on the human body	Hours have little effect on the human body	50% faster breathing	Difficulty breathing, could not stand being in contact with dangerous 0.5-1 h	Minutes will die unconsciousness puerperal
CO_2 content in the air (%)	2	2	5-6	10

Table 5: CO concentration affects the human body

Impact on the human body	Hours have little effect on the human body	One hour had little effect on the human body	After one hour headache, vomiting	Cause severe headaches, there is the risk of death by 20-30 min	Breathing difficulties, possibly death after 1-2 min
CO content in the air (%)	0.01	0.05	0.1	0.5	1.0

emergency lighting brightness, setting appropriate, clear safety signs, to striking staircases set in place easily identifiable.

SMOKE AFFECT SAFE EVACUATION OF BUILDING FIRE PROTECTION DESIGN

Commercial building fire occurred; a wide range of flue gas will spread. As the new air continuously into the flue gas up to the height will decrease the temperature and concentration, but if there is a large space under the roof will prevent hot gas layer of floating spread out in the horizontal direction. Commercial building height of 6 meters below the room normally used point type smoke or heat detectors, fire occurs in the large space flue gas temperature or concentration to reach the startup parameters required fire detection, fire has spread into quite reach a large scale and the purpose of warming. Therefore, commercial buildings must be controlled parts of the flue gas into the fire a large space, strengthening large space building fire alarm.

Toxic gases produced by fire smoke: People in the fire suffered life-threatening hypoxia caused major smoke, toxic fumes and soot particles caused by suffocation. (Liu, 2002)

Fire people are often lower than in the oxygen content of the desired physiological value, usually the amount of air containing 21% O^2 when the physiological need for people to content. The fire of oxygen content decreases rapidly, while the CO^2 content has risen rapidly. Table 2 lists the fire O^2 content affects the human body. Fire smoke on a variety of combustible toxic gases generated by the combustion of people with toxic, oxygen content in the flue gas is often lower than the one required for normal physiological values. When oxygen in the air lower than 15%, the human muscle activity will fall significantly, reduced to 6-10% of the people will faint short even death. Mall decoration materials and sell goods in the event of a fire burning will emit many harmful substances; Table 3 lists the various sources of ignition substances toxic gases produced by combustion. Some of flue gas to the human eye there is a strong stimulus, such as HC1, NH3, SO2, C12, etc., people blink so that people in the evacuation process of the traveling speed is greatly reduced. As can be seen from the table, almost all the carbon-containing compounds are released in the combustion CO2 and CO. Although hypoxia pose a great danger to the human body, but only by the oxygen content in the fire hazard is unlikely to reduce its harm is often accompanied by CO2, CO and other toxic gases generated. Table 4 and Table 5 can be clearly seen CO2, CO threat to human life.

Fire will produce suspended solids or adsorbed on the substance smoke. These particles floating in the atmosphere through human respiration adhered to the body with the blood of human lungs, causing respiratory diseases and other systems make people sick or died as disaster risks (Du, 2005).

Fire smoke produced by high-temperature heat: Fire will produce higher temperatures. When the temperature rises to above 400°C fire space will be changed in an instant by the partial combustion of full combustion chamber temperature from 400 ? jumped to 800-900 ?, accompanied by a comprehensive indoor instantaneous combustion huge energy release temperature rose rapidly with time. People on the high temperature fire smoke patience are limited. This is because the human body burn in the flame grilled under accelerated heart beat and increased

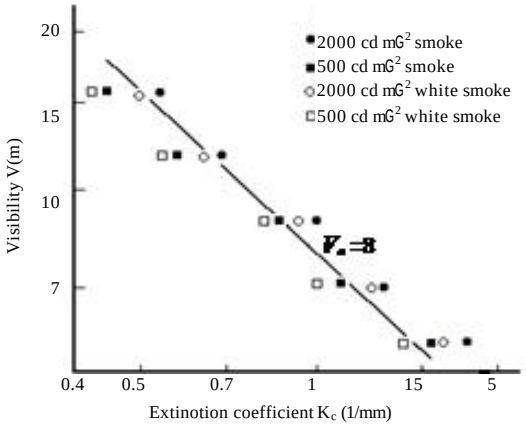

Fig. 1: Luminous signs of reduced visibility and extinction coefficient of relationship

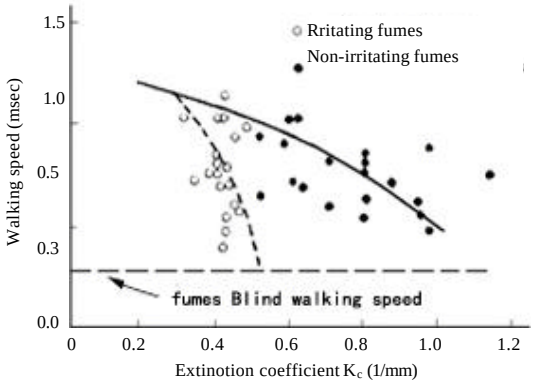

Fig. 2: Irritating and non-irritating smoke gases human walking speed

sweating, fatigue, dehydration were quick to produce the phenomenon, when the heat's intensity exceeds the limits of the human body cannot withstand the people will soon die. In addition, because the blood vessels are damaged resulting in damage to the system who will soon die. Fire risk assessment is currently recommended data: short face exposed safe temperature is 65-100°C.

Reduction light by fire smoke: Fire in smoke reduction light makes indoor reduced visibility. Visibility and smoke colors, the brightness, the brightness of the background and so on. Kim (Jin) exposed to the human visibility and smoke irritation movement speed reduction coefficient relationship with a series of tests, the results were as follows: At a concentration of large and irritating smoke, try to not be affected eyes open long enough to see the target. Figure 1 shows the irritant and non-irritating smoke case, the visibility and less luminous signs luminosity relationship. Figure 2 shows the exposed and non-irritating smoke and fumes irritate the eyes density of impact on human walking speed. The results show that the actual building fires the measured data indicate a fire burning room dimming factor of up to 25-30 m^{-1}, people smoke in the fire of visibility distance of only a few centimeters and often not see evacuation exits, etc. signs. Even for people who are familiar with evacuation routes when smoke obscuration coefficient of 0. 5 m^{-1} evacuation becomes difficult and also hampers fire fighting activities. From the above analysis we can see as soon as possible to find the fire control the spread of smoke is to protect the personal safety of the important measures. While commercial building fire safety design must also strengthen Smoke Design promptly discharged flue gas generated, reducing the concentration of smoke inside the building, slowing their personal injury, for the evacuation to win more time to create greater chance of survival.

CONCLUSION

Commercial building fire protection design needs based on factors affecting the safe evacuation basis for in-depth analysis. Process and resolve clusters and reduce staff turnover and weakening of smoke from fires and hazards to personnel are building fire protection safety evacuation basic elements of design. Commercial building fire protection safety design has comprehensive and complex characteristics. This article does not involve other elements of research and analysis. Commercial building fire protection safety design needs further comprehensive research.

REFERENCES

Du, W.L., 2005. Factors patios safe evacuation of high-rise buildings. Master Thesis, Wuhan University of Technology.

Li, C.N., 1989. Human Behavior in Fire. Shaanxi Science and Technology Press, Beijing, China.

Liu, F., 2002. Atrium fire smoke flow model experiments similar theory. Studies on Smoke Movement and Smoke Management in Atrium Fire, Chongqing University. pp: 75-76.

Yang, Y., 2007. The main factor in commercial building design difficulties and the impact of fire safety evacuation. Research on the Fire Protection and Fire Escape Design of Commercial Buildings, Tianjin University. pp: 11-14.

Zhang, P.H. and B.Z. Chen, 2001. Crowd flow rules of human evacuation in building fire. J. Northeastern Univ. (Nat. Sci.), 22: 564-567.

Zhang, S.P., 2004. Investigation of human behavior in building fire reaction. Study on Human Behavior in Building Fire, Xi'an University of Architecture and Technology, pp: 47-48.