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Evaluation of Fire Risk in Commercial Complexes of District 12 of Tehran and its Relationship with their Structural and Usage Characteristics

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ABSTRACT

Introduction: Commercial complexes are one of the most prestigious public and city-centered areas in terms of urban safety and passive defense. The purpose of this study was to determine the fire safety risk score of commercial complexes and its related factors.

Material and method: The commercial complexes of area 1 of District 12 of Tehran were studied. The characteristics of the complexes, including construction, height, activity, Occupancy Coefficient and etc in each complex were collected. Fire risk assessment was performed using NFPA101 standard and CFSES software in three areas of control, Egress and general safety. In SPSS software version 21, linear regression and ANOVA tests were used to determine the relationship between variables.

Results: Of the 79 commercial complexes studied, only 8 in control area and 4 in general area achieved acceptable risk level. None of them achieved an acceptable score in the Egress .According to the results, there was no significant relationship between risk levels and height, type and activity Coefficient of them ($p>0.05$). However, between Occupancy Coefficient of complexes with fire safety risk levels of control ($p<0.001$) and genera l($p= 0.013$) and between construction with all risk levels (($p_{Egress}= 0.004$), ($p_{Control}$ & $p_{General}<0.001$)) There was a significant relationship.

Conclusion: The results showed the current situation of the studied commercial complexes is prone to cause a disaster in the 12th district of Tehran; Using the results of this study in urban planning and cross-sectoral communication to improve the safety of commercial complexes in the region is suggested.

Keywords:

Risk Assessment, Commercial Complex, NFPA101, CFSES

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1. Introduction

Today, commercial complexes are considered to be one of the busiest and most public places, which with two economic and social functions are important places in the urban structure [1]. Large wildfires have been reported in commercial complexes around the world, causing extensive casualties or loss of life, property and even irreparable cultural damage to buildings and objects. Given the recent fire incidents in these complexes, especially the Plasco disaster, the importance of assessing fire safety risk and the resulting human, cultural and financial risks is of particular importance. The purpose of this study was to determine the fire safety risk score of commercial complexes and its related factors in district 12 of Tehran.

2. Material and Methods

In this study, all known commercial complexes with the nature of workshop in area 1 of the 12th District of Tehran (79 complexes) with a census method were studied. Fire risk assessment was carried out in accordance with the NFPA101 standard using the Computerized Firearms Assessment System software (CFSES). Compatibility of CFSES software with Iranian national regulations for fire safety have confirmed in a previous Study[1]. Quantitative and qualitative information including type of building's construction, hazard separation, vertical openings, fire alarm systems, internal surface coatings, smoke control, access to outlet, outlet and room separation/corridor and emergency response program as software input variables. The collection and fire safety risk level were evaluated in three areas of control, egress and general evaluation. Other variables including Occupancy Coefficient, type and activity Coefficient of complexes were obtained. The relationship between variables and the levels of fire safety risk was determined using linear regression and ANOVA.

3. Results and Discussion

Of the 79 commercial complexes studied, the level of acceptable fire control in only 8 and in the general in only 4 complexes was obtained. None of them received an acceptable level of fire safety risk in the egress. All commercial complexes are in the priority of follow-up and the need for renovation or improvement to reduce the risk of fire safety (Table 1).

In a study by Jahangiri et al., In examining the fire safety risk of hospitals, most of them had an acceptable fire safety status [2]. In fact, the findings of that study show that hospitals are safer in terms of fire risk than commercial complexes. The reason for this difference in the results of the two studies seems to be the existence of a more coherent monitoring mechanism for hospital safety compared to commercial complexes.

The following is a brief discussion of the variables of type of structure, height, occupancy coefficient, and type and activity coefficient (Table 2).

3.1. Structure

According to the results, there was a significant relationship between the type of structure and all three levels of fire safety III -۲۱۱ of the complexes studied had ٪٦٠,٧٦ .risk in buildings In general, fire-resistant structures prevent .(۱ structures (Fig the spread of fire and prevent rapid collapse of the building and provide more time to evacuate the building. Naturally, these structures increase the level of fire safety. In Jahangiri's .[۲] study, all the studied buildings were non-flammable type In Mohammad Fam's study, the roof material of most of the market units was iron structures, which is consistent with the .[۳] present study

3.2. Height (number of floors)

The results of the variance test in this study showed that there was no significant relationship between the levels of fire safety risks with the height of buildings. It seems that the risk of collapsing high-rise complexes after a fire is greater In this study, due to the .[٤] than buildings with lower heights lack of significant difference between the number of floors ۲ of complexes between ٪٩٣,٧٣ of buildings (which were floors), there was no significant relationship between ٥ and fire safety risk levels with their height. However, the results of studied showed that the thermal behavior of high-rise buildings and the movement of smoke was strongly influenced .[٥] by the ambient wind

3.3. Occupancy Coefficient

there was a significant relationship According to the results

between the occupancy coefficient of complexes and the risk levels of control and general areas, but not significant relationship between the occupancy Coefficient and the risk levels of egress. Because the effect of manpower and its errors on the software's working method has not been seen independently. individuals in complexes have an unbalanced distribution or the number calculated in this study as an occupancy factor may not well greater .represent the distribution of individuals at the complex occupancy Coefficient were expected to pose a greater risk to the fire safety level of complexes due to greater activity and According to the results of this study, in other. performance articles, the effect of occupancy coefficient on the parameters of has been access and emergency response system in fire safety .[٧ ,٦] confirmed

3.4. Activity Coefficient

The results of the linear regression test showed that there was no significant relationship between the activity coefficient of the complexes and the levels of fire safety risk. Although complexes with higher activity coefficients were expected to impose more risk on the fire safety level of complexes due to more activity and performance, followed by the use of more materials and tools to produce or provide more service, the results of this study suggest a link between levels. The fire risk of the studied buildings with the coefficient of activity of the .studied complexes was not confirmed

3.5. Type of Activity

According to the results, there was no significant relationship between the type of workshop activity and the levels of fire safety risk in the studied buildings. Changing the use of commercial units without considering the appropriateness of the existing and required infrastructure is one of the most important factors threatening the building's fire safety. the result of the Behnam's study testify to this claim that is the change in the type of use of the Plasco building over time has .[٨] been effective in the occurrence and spread of the fire

4. Conclusions

According to the results of this study, the current status of commercial complexes is prone to catastrophic disasters in District 12 of Tehran. These complexes will allow the fire to spread after the initial fire. It is essential to use a comprehensive fire safety program to protect against fire in commercial complexes.

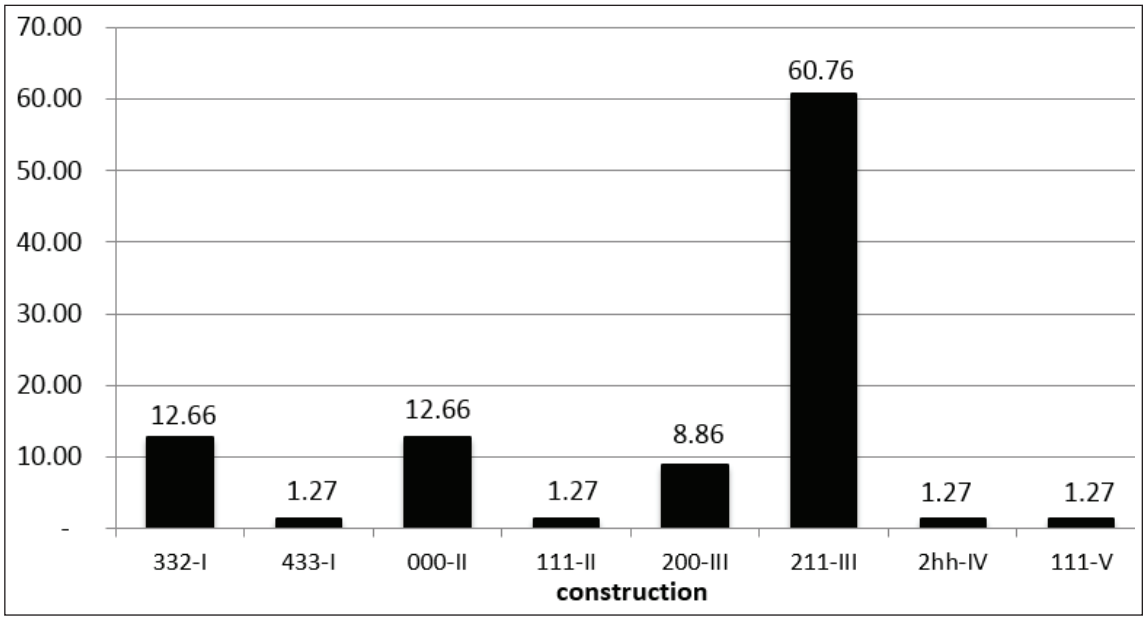

Fig. 1. Frequency percentage of Buildings of commercial complexes by type of construction

Table 1. Triple fire safety risk scores of the studied complexes

Risk Level	Unacceptable percentage	Average (Standard deviation)	Minimum score	Maximum score
control	%89.87 (71)	-7.36 (5.89)	-22.5	3.5
egress	%100 (79)	-14.26 (5.36)	-26	1
general	%94.93 (75)	-15.68 (7.68)	-35	4

Table 2. Determining the relationship between risk levels and study variables

Variables	statistical test	general	egress	control
Activity Factor	Regression Linear	P>0.05	P>0.05	P>0.05
Occupancy Coefficient		P<0.05	P>0.05	P<0.001
height	ANOVA	P>0.05	P<0.05	P>0.05
Type of Activity		P>0.05	P>0.05	P>0.05
construction		P<0.001	P<0.05	P<0.001

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