Guidance on health and safety at work. Design safety and fire-fighting systems in urban rail transport networks

Orientación sobre salud y seguridad en el trabajo. Diseño de sistemas de seguridad y extinción de incendios en redes de transporte ferroviario urbano

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ABSTRACT

In this paper, considering the importance and safety status of urban train systems, we study and assess the urban management requirements and requirements for equipping the inner city network using the results of "cost-benefit" techniques in order to analyze the methods Fire control and fire, as well as the use of fire safety systems in the urban train network. On the other hand, the development of tools for measuring and comparing the effectiveness of fire prevention and fire prevention measures in various rail transportation systems, which are very useful in various safety engineering methods in the design of mass transportation systems such as LRT or tram. And can be effective in analyzing the fire safety of its systems.

Keywords: Safety, Fire, Inland Rail Transport Network, Train, Station, Tunnel

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Recibido: 05/01/2019 Aceptado: 16/04/2019

RESUMEN

En este documento, considerando la importancia y el estado de seguridad de los sistemas de trenes urbanos, estudiamos y evaluamos los requisitos de gestión urbana y los requisitos para equipar la red de la ciudad utilizando los resultados de las técnicas de "costo-beneficio" para analizar los métodos de control de incendios y de incendios, así como el uso de sistemas de seguridad contra incendios en la red de trenes urbanos. Por otro lado, el desarrollo de herramientas para medir y comparar la efectividad de las medidas de prevención y prevención de incendios en varios sistemas de transporte ferroviario, que son muy útiles en diversos métodos de ingeniería de seguridad en el diseño de sistemas de transporte masivo como LRT o tranvía. Y puede ser eficaz en el análisis de la seguridad contra incendios de sus sistemas.

Palabras clave: seguridad, incendio, red de transporte ferroviario interior, tren, estación, túnel

Introduction

Generally, the goal of designing, constructing, and operating fast transportation systems in the world's cities as well as modernizing them is to create an efficient and efficient transportation network at the city level, so that in an integrated and efficient way Satisfies the needs of citizens in the field of inland transport (Archives of Technical Documents of the Tehran Metro Operations Company, 2017) and (Archives of Technical Documents of the Rail Transportation Engineering Society, 2018). On the other hand, achieving this goal requires that suppliers, builders, shareholders and users of fast-moving transport systems ensure the safety of passengers on the rail network. The important thing is that through the design and deployment of an intelligent and precise fire alarm system with the respect of international and international standards. On the other hand, one of the most important and safe strategies to prevent fire occurrence is to minimize the losses and financial losses of passengers and to make arrangements for their rapid evacuation and their transfer to safe stations of the station, and also facilitating and accelerating the relief operations of firefighters and relief teams in the event of fire and fire accidents (NFPA, 2013). It is important to note that in the early stages of the construction and commissioning of the urban train system, due to the lack or lack of available resources in the design of fire safety systems and the gradual completion of the experiences, the conceptual design of the stations and the system Confronting the safety challenges of the stations are completed and the fire-related instructions are set up and developed.

In the mode of the rail, the rail network within the city has a station including a passenger lounge and platform. The main hall is divided into two parts: a sales hall and a saloon, in the sales hall, in addition to automatic ticket sales (TVM), gate collection and station control rooms. On the other hand, there is a technical room and equipment room in the space of the station (Archives of Technical Documents of the Tehran Metro Operations Company, 2017). Of course, on both sides of the sales hall, it is generally possible to provide some public services through the deployment of ATMs, public telephones, small stores, etc. In the design of the safety system, it is necessary to consider the arrangement of the corridors leading to the sales hall and the platform, while the trains have the same length as the length of the passenger platform in the city's train stations. Is. Of course, in some of the inline urban lines and networks, PSDs are used to separate the rail and platform privacy of the station.

Typically, the surface of the platform is less than the lounge space, and passengers are waiting there until the train arrives. Majority of technical rooms and equipment are also located on either side of the area or along the rails. The main hall of the station and other platforms of the platform are connected to the metro rail network through communication corridors. The corridors and stairs in the station are the tools that connect these two parts. Emergency walkways and corridors, usually installed at the bottom of the platform, can provide passengers with emergency access in an emergency.

Methodology

Safety requirements for station design to deal with fire

In the urban rail network, due to passenger traffic congestion, stations should be built in such a way that they are resistant to fire. Therefore, the components and elements of the structure of the station are chosen and used in conjunction with In terms of the architecture of the station, in the event of a fire, resist fire for at least 4 hours. On the other hand, materials used in station equipment should also be selected in order to meet the safety standards of fireproof and fire-resistant materials. Electric cables in subway stations should be selected from low-harmless and non-halogenated materials that increase fire resistance. In order to ensure safety in the inter-city rail transport network, the architecture of the station is to comply with the NFPA-130 standard principles, regarding the determination of the station's classification requirements in terms of resistance to fire and fire, public places (technical) On the other hand, according to the standard principles, all commercial spaces in the rail network should be able to withstand fire for at least 2 hours. On the other hand, the specific places of the station where the passenger traffic is low Such as technical spaces such as equipment rooms, generator and station power generation, electronic rooms One in stores, stairways, etc., places should also be able to withstand fire spreading for at least 2 hours, although in stairwells, elevators, and stairs of station power stations, passengers can be moved to a passenger platform or elsewhere Providing normal and non-emergency conditions for passengers to navigate through the passageway. On the other hand, the design requirements of the station, according to the NFPA130 standard, should be in the emergency condition of the stairs, stairs and other outlets, in such a way It is possible to provide easy and fast departure of passengers from the station. On the other hand, given the necessity of emplacing emergency staircases at the ends of the platform as a secondary means of removing passengers from the station, it is necessary, in general, to bring the passengers directly to the safe areas of the station and main hall, and to enable the station and (NFPA, 2010), (NFPA, 2013). At the main hall level of the station, there are also gate and ticket collecting gates, which are fully opened at the time of the incident of the gates. By issuing a command from the control room of the station, it is possible to speed up the evacuation of the station from the passengers, in which case the output capacity in the form of an eye The increment is increased, so these gates, which are normally closed in order to control the flow of traffic and prevent fleeting escape, is completely opened by pressing the emergency button when an emergency occurs. In the control room of the station, it is possible to control the station through the station building automation software (BAS), escalators and other local equipment in the remote control and through the system. Therefore, in emergency situations, stairs the electric motors that operate in the direction of the exit are stopped and, as a result, passenger capacity increases to the outlet.

The maximum distance of the garage from the platform to the station outlets according to the NFPA130 standards should not exceed 4,114 meters. In the case of commercial spaces such as shops, there is no need to exceed the total room space of 111 square meters from the total room space. These spaces should be designed to withstand fire for at least 3 hours (Siwyeecheon, 2010).

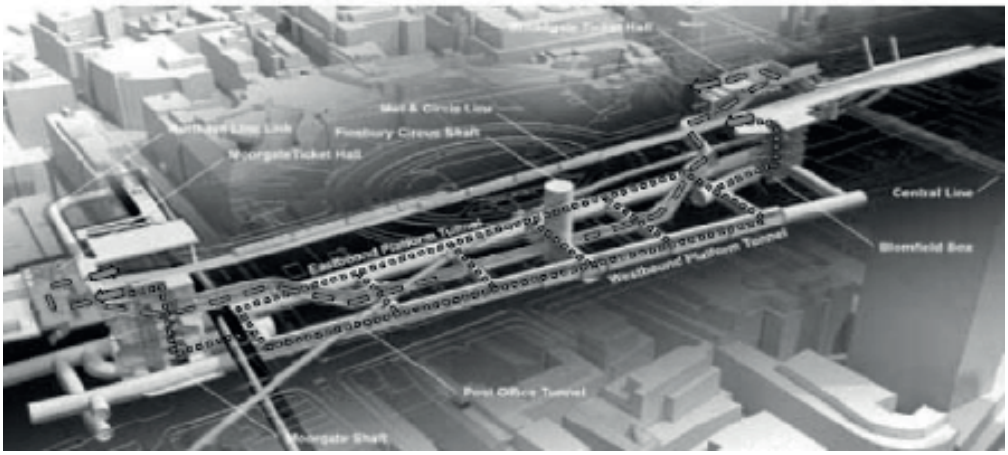

Figure 1. An example of emergency evacuation routes in the urban rail network

One of the most important criteria for determining the output capacity in rail network stations is the determination of the capacity of output stations such as stairs, escalators, elevators, passenger gate stations and other time-passes (Siwyeecheon, 2010). In the design and architecture of metro stations, the passageways are not intended to be used by passengers for normal and busy hours, but the time frame defined by the NFPA130 to evacuate a passenger from a station on a time scale. The best method is to determine the station's capacity and discharge the station from the platform level is at the outputs of a total of 4 minutes, and for the other points far away from the platform outlets to the safe storage location of the station are considered to be 6 minutes (NFPA, 2010) and (NFPA, 2013).

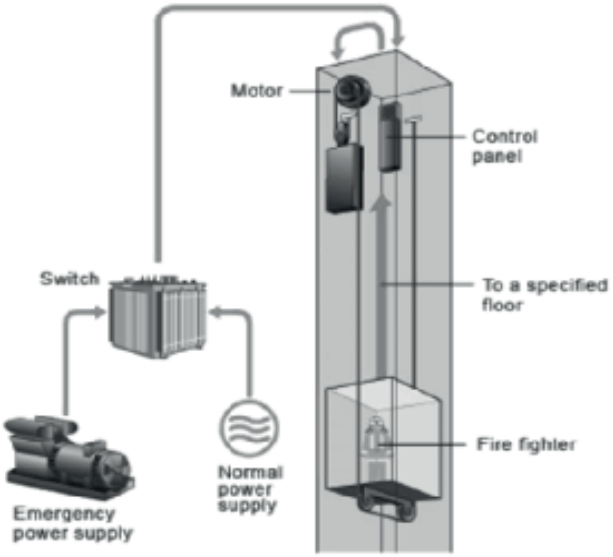

Figure 2. An example of an emergency lift system with components

It is necessary to determine the total station time the space occupied by the station by passengers, plus the parameters of passenger congestion in different parts of the platform. On the other hand, other parameters such as the directions of arrival and departure of passengers to the train from the platform in each station should be considered. In peak traffic times, due to the delay and time missed, and also the increase in hail, it is usually considered, in terms of traffic volume of passengers, as well as a safety item of up to 11 minutes for complete discharging of the time station, that all passengers from the danger zone The station is far off and transferred to the safe area. To calculate the time of evacuation of passengers from the platform, the total space available for the passengers at the station is divided into the capacity of the station's output from the platform to the hall; they are taken as a fraction and extracted. Of course, it should be noted that in some stations not designed as an island, the station has two platforms, which should transfer passengers from the outputs of both platforms to the safe place or from the hall to the outputs finally, all the time should be considered in the calculations. On the other hand, in order to calculate the total time of output at a station, the travel time of passengers and their speed of movement in the station corridors, considering the longest exit path in the calculation, is considered to be maximum compliance with the standards of NFPA130.

Result and discussion

In the inter-city rail network stations, in addition to the opening of the corridor paths and the setting of the route and direction of the stairs, the emergency exit paths at one or both ends of the platform station to evacuate passengers in case of emergencies to safe areas the station or outputs are designed. These routes, on the other hand, can provide firefighting operations for firefighters. On the other hand, during an emergency evacuation of passengers at incidents such as fires, passengers may be heading towards the first outlets, while if other exit routes, such as emergency stairs, stairways, corridors towards The outputs are opened and conducting operations are well done, and passengers can use it and there is less congestion in one or more points. Some features of these outputs that violate the safety of an incident are the locking of these outputs normally, which, if activated,

should be automatically released, which is important due to the power outage of the command or The issuance of a command from the control room adjoining the pick-up gates is possible, and the gates open the door, thus increasing the passenger capacity. On the other hand, the activation of the stairs in the direction of the output path can be a great help in removing congestion in the output.

The need for the safety of the station is required; signs and indications of output are sufficiently installed at appropriate stations where there is a potential danger to passengers. These signs can be used to show passengers the way to the station. On the other hand, emergency lights in the station's outlet path are fed through the secondary power source, which will also turn on during power outages.

In urban train systems, such as Tehran metro, to meet the requirements of safety standards and to increase the fire safety factor, fire protection systems to meet the NFPA130 standard requirements, fire detection and fire detection equipment and systems in the station and in the railroad space On the other hand, in the rail network, fire extinguishing systems are required in its various faces, such as the automatic water system on the fire at the station. The fire alarm system and intelligent fire extinguishing systems are in place. The station, through the use of a system and various methods such as East location of fire in the gas CO2, systems, hose reel, portable devices, extinguishing system spraying water on the fire, Fire Suppression System by pouring sand) quench dry (Operation extinguishing fire station permits.

Automatic watering (sprinkling) (water on the fire at the rail stations, which is provided in accordance with the standard requirements of the NFPA130 in some parts or spaces of the network station, such as commercial spaces, stores, technical equipment rooms, and other available technical facilities In the station, although it may sometimes have no effective effect on firefighting, it is necessary to consider the architecture and construction of the stations. On the other hand, the steps of the electric step to the split halls and the surface of the platform are supported by fire nozzles. On the other hand, all rooms related to electrical or electronic equipment should be designed and engineered. The entire station is separated and finally these spaces can withstand fire for at least 2 hours (NFPA, 2010).

It is necessary that all spaces and public and technical places in the inner rail network are in some way supported by the automatic fire detection system, while some firefighting equipment, such as water flooding on fire, may not be used in all spaces. . Tools such as alarms that are commonly installed at sensitive stations can be warned not only by automatic but manually (non-automatic) (in public areas of the station, through warning alerts) to alert publicly about the occurrence of hazardous conditions. It also prevents the occurrence of accidents. Another advantage of such tools is the prevention of anxiety in the event of fire in the station for passengers, resulting in maximum disarmament and order during evacuation of the station for passengers. The rooms are equipped with technical equipment and tools that produce head and neck In order to inform the crew, in addition to warning alerts, warning lights must be installed, in which case the effectiveness of the immune system will be improved. Here, detectors and diagnostic systems are needed to identify the accident situation. Hazardous situations, floating and mobile switches, and other technical subsystems installed in the main alarm panel installed in the operator's exposed locations; have a proper connection (Kazemi, 2010).

On the other hand, in the main MIMIC panel installed at the control and command center, the LED indicators are installed along with the main equipment and fire alarm panels, and as a result, the control center can monitor continuously over the network through the warning probe There is fire. In summary, it can be said that fire alarms or fault signals are continually updated at stations, and the OCC (1) is informed of it; on the other hand, there are hotline phones in the platform and The station provides a quick and timely connection between the control center and the stations, in which case it should be a 24-hour operator to communicate with the centers and stations and trains at the control center and, if necessary, through Hotline communication with vital centers of the city, such as fire brigade and emergency service, the incident occurs on time and on Expecting, informing them. In the rail network within the city, the Homes Rail system is used throughout the network and lines other than high voltage power lines such as rail or a high-voltage network (750VDC or 25 KV AC). The

hose rail is an average of 31 m long and is installed in the access points and vital points of the station and tunnel, and even in the vicinity of the outlet. Therefore, in order to improve the efficiency of the system in the rail network in the areas that have the highest efficiency and are considered in the architecture of the network according to standards. In this system, some equipment is permanently installed in the respective locations of the station and mobile equipment is also used for transferring and discharging water. This system typically has two electric pumps that pump water (Applied Safety and Performance Indicators in Industry, 2017).

The presence of portable fire extinguishing equipment in different types and sizes and distributed throughout the platform and station is based on NFPA130 standards in the internal rail network. The maximum time interval for reaching the first firefighting equipment by passengers should not be more than 11 meters (Archives of Technical Documents of the Tehran Metro Operations Company, 2017) and (Siwyeecheon, 2010).

Another fire extinguishing tool according to the NFPA130 standard is a fire extinguishing system, which usually does not withstand water systems, but is connected to fire engines or fire extinguishers and is automatically activated in case of fire. This equipment is located at 11 meters in the direction of emergency exits, floors and store room halls, accessible to floodlights and fire engines (Archives of Technical Documents of the Tehran Metro Operations Company, 2017), (Archives of Technical Documents of the Rail Transportation Engineering Society, 2018), and (Siwyeecheon, 2010).

The voice communication system is installed at all points in the station and locally in the form of a voice communication system with passengers, which can be easily manually activated by breaking the glass and pressing the alarm or automatic alarm lever at specific points of the staff as well as In the public areas of the station, it is installed and, as a result, passengers can be trained without stress and anxiety through the sending of appropriate safety and warning messages; on the other hand, the system allows the broadcast of predetermined messages for control room (Labor protection and hygiene regulations, 2007); These messages are communicated via the public announcement system of the station (PA) during an incident or fire for copper Fran is playing. In PA systems, PA systems are connected to the station speakers, which cover all exit paths, escape stairs, alibi, corridors, division halls, and platform levels. On the other hand, emergency phones are connected to the platform or to the SCR, which allows the firewall message to be transmitted. Typically, in the crisis networks within the city's rail networks, the possibility of bilateral radio communication with emergency centers such as fire and emergency services are provided. In addition to these electrical emergency alarms, this system, in addition to control panels, switches, motors and normal power supply, can be activated in an emergency when power outages are triggered through an emergency power supply that is separate from the main power supply and is usually independent of The main lift system of the station provides the possibility of firefighting or removal of passengers. One of the important features of this system is safety and security (Siwyeecheon, 2010).

In this research, the safety, fire prevention and fire protection in the rail network according to the NFPA130 standard were studied and studied. The results of this analysis have examined a variety of public transportation systems in the urban rail network, in which: tunnel and station in the architecture of fire safety systems according to the length of the network, how to arrange the fleet and equipment of Venice The complexity of the operation is considered for the purpose of carrying out the predictions of fire prevention operations. In the urban rail network, fire safety is facing a lot of challenges, however, in order to increase the firewall performance of the network, it is necessary to ensure the safety of the network equipment in case of possible fires. Therefore, in order to prevent the consequences of fire, the responsibility of safety engineers in the rail network is to review and improve the requirements for designing fire safety and continuous control of firefighting systems when dealing with fire hazards in the network. Inside the city, it minimizes the consequences of the fire; on the other hand, it is necessary in other cases such as bombing or terrorist attacks, and so on, to provide passengers with the expectations of the rail system's effectiveness in dealing with the threats.

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