

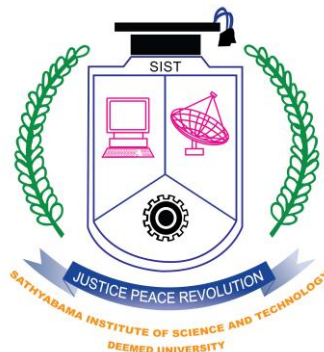
VALIDATING THE EFFICIENCY OF BUILDING AUTOMATION SYSTEM OF SAFETY & SECURITY SYSTEM INCORPORATED IN UNDERGROUND METRO STATION

A Thesis

Submitted in partial fulfillment of the requirements for the award
of Master of Architecture degree in Building Management

by

DIVYAA.Y.B(39840007)



**DEPARTMENT OF ARCHITECTURE
SCHOOL OF BUILDING AND ENVIRONMENT**

SATHYABAMA

**INSTITUTE OF SCIENCE AND
TECHNOLOGY (DEEMED TO BE
UNIVERSITY)**

**Accredited with Grade "A" by NAAC
JEPPIAAR NAGAR, RAJIV GANDHI SALAI, CHENNAI - 600
119**

MAY 2021



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BONAFIDE CERTIFICATE

This is to certify that this Report is the bonafide work of **DIVYAA.Y.B (39840007)** who carried out the Thesis entitled "**VALIDATING THE EFFICIENCY OF BUILDING AUTOMATION SYSTEM OF SAFETY & SECURITY SYSTEM INCORPORATED IN UNDERGROUND METRO STATION**" under our supervision from January 2021 to May 2021.

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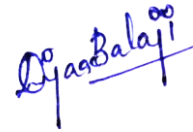
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DECLARATION

I **DIVYAA.Y.B** hereby declare that the Thesis Report entitled “**VALIDATING THE EFFICIENCY OF BUILDING AUTOMATION SYSTEM OF SAFETY & SECURITY SYSTEM INCORPORATED IN UNDERGROUND METRO STATION**” done by me under the guidance of **Ar. SHANKAR** (Internal) and **Ar SARATH C. KANTH**, Principal Architect, Designtech (External) at Sathyabama Institute of Science and Technology is submitted in partial fulfillment of the requirements for the award of Master of Architecture degree in Building Management.



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ABSTRACT

India is a developing country, new infrastructure is been developing in the major cities of India such as Delhi, Bangalore, Chennai, Hyderabad, Kolkata, Mumbai etc. The new rapid transit system called metro is been introduced in this major city which include both overhead metros and underground metros

Covering metro projects proposed and undertaken across the major Indian cities of Delhi, Bangalore, Kolkata, Chennai, and Mumbai, among others, the analysis focuses on the complexities of project planning. In addition, it also looks at how large cities across the globe effectively addressed their urban transport problems to provide a comparative view. The study also helps to distil important lessons for other infrastructure projects undertaken in developing countries.

The study has covered the compare the fire evacuation plan,, automation system in fire safety and security check implemented . Now a days safety is important in the underground subways , So taking into the consideration the study reveals the solution and standards for the following elements and also gives the comparison of the following stations – banglore majestic station and Chennai metro phase 2 underground metro station

KEY WORDS – SAFETY AND SECURITY, AUTOMATION IN FIRE SAFETY IN UNDERGROUND METRO STATION

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CHAPTER 1

INTRODUCTION

1.1 AIM:

To Achieve the efficiency of automation in fire safety and security check &, EVACUATION process to be implemented, in underground metro station and to make stations safe ,secured and user friendly in majestic,banglore ,&Puratchi Thalaivar Dr. M.G. Ramachandran Central

1.2 OBJECTIVE:

To check and increase the efficiency of automation system of fire safety and security check implemented in underground metro station and to suggest the better option that can be practiced or to be implemented in future to be free from any accidents or threat in the stations

1.3 SCOPE AND LIMITATIONS :

To understand the functions of metro station and state some automation system for security such as

- Fire Alarm and Protection Systems,
- Lighting, PHE,
- UPS,
- Lifts and Escalators,
- Automatic Fare Collection System (AFC)
- CCTV and various other electrical and mechanical systems.
- Security check in pedestrians involved in it

And to ensure fire safety standards to be incorporated as per the guidelines and material used comparative analysis of stations in banglore , and Chennai.



Fig 1.1 LIFTS AND ESCALATORS



Fig 1.2 AUTOMATIC FARE COLLECTION SYSTEM - AFC

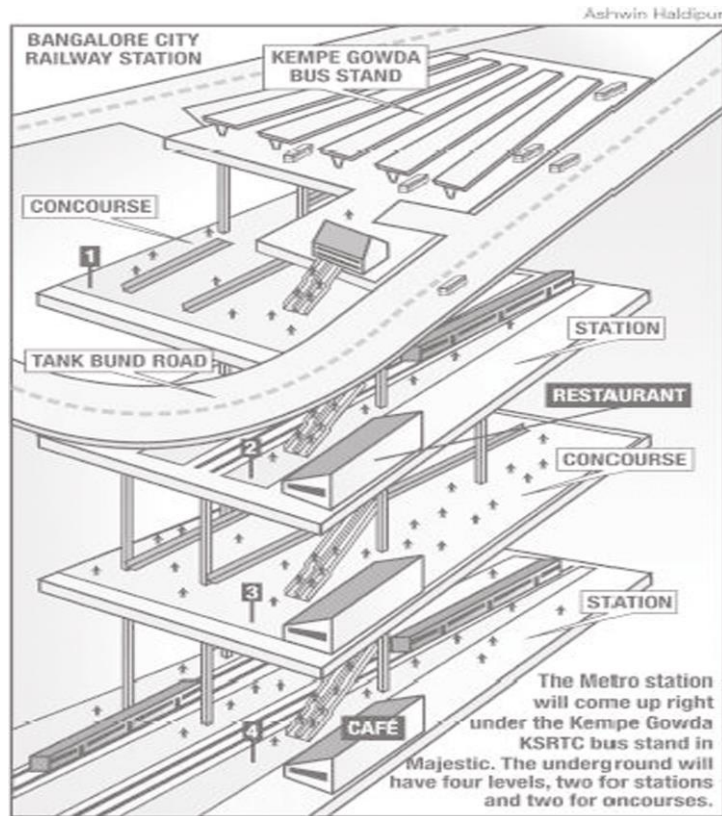


Fig.1.3 The station layout of underground metro station

1.4 INTRODUCTION:

The characteristics of the fire accidents are indicated in the preceding section. According to the type of tunnels, the standard/design guideline for fire accident management is regulated by some countries taking these characteristics into consideration. On the other hand, the countries which do not have tunnels and underground stations blindly use or apply other country's standard/design guideline. As a result, the scale of the tunnel and station becomes more excessive than its requirement in some cases. In order to apply appropriate measure and method, the present conditions of standards/guidelines for metro construction/operation in the world are explained in this section and some points of these standards are studied in the following section.

The design, engineering, supply, installation, testing, commissioning & life cycle support of the Integrated Building Management System (IBMS) at 66 ultra-modern stations and 3 depots, including the setting up of an OCC and Back up Control Centre (BCC).

For the convenience, comfort and better security of travellers, each station/depot of HMRL has various systems such as HVAC, Power Distribution System, Fire Alarm and Protection

Systems, Lighting, PHE, UPS, Lifts and Escalators, Automatic Fare Collection System (AFC), CCTV and various other electrical and mechanical systems.

1.5 METHODOLOGY:

STAGE - 1

- Understand the guidelines for fire safety in underground metro station
- NBC , NFPA , IFC
- Detailed study about the security check implemented in other developed countries through journals'

STAGE - 2

- Detailed study of automation system
- Incorporated in underground metro-station
- Analyse the fire safety system and automation system in Bangalore majestic metro station
 1. Automation
- **Fire safety**
 - a. Passive
 - b. Active
- **security check**

- Detailed study in Puratchi Thalaivar Dr.M.G. Ramachandran Central metro station
- the proposal and design consideration in fire and its automation
- The security check to be inspected in every critical areas



STAGE - 4

- Safe and security analysis for users
 - Inference and conclusion
Proposal
 1. Automation system that should be implemented in the station for fire safety and security check
- Comparison of stations
- Fire inspection check list
 - Managerial services
 - DISASTER
MANAGEMENT &
SECURITY MEASURES

CHAPTER -2

RESEARCH PAPER

- Research Needs on the Fire Safety of Subway Stations-Fire disasters, regulations, research efforts and recent smoke movement tests in subway stations in Japan
- Use of Fire Suppression Systems in Underground Stations and Metro Tunnels
Steven K.H. LAI^a , Tim K.W. CHO^a , William Y.M. XIE^b, Hadi WIJAYA^c , K.W. ANG^c
^a WSP (Asia) Limited, Hong Kong, ^b WSP Consultant Pte Limited, Singapore, ^c Land Transport Authority, Singapore
- Understanding Impacts of Security Check on Passenger Flow in a Metro Station and Improving Measures: A Case Study in Guangzhou, China

RESEARCH PAPERS

PAPER -1

Smoke analysis and evacuation process in platforms

PAPER -2

Fire suppression systems in metro stations

PAPER -3

Security check involved in the metro stations and case study

2.1 Research Needs on the Fire Safety of Subway Stations-Fire disasters, regulations, research efforts and recent smoke movement tests in subway stations in Japan

ABSTRACT :

Since then, there have been few significant subway fires that have killed passengers, but the general similarity of the Japanese and Korean subway systems suggests a significant risk and potential hazard of subway fires. Experiments with subway stations that were actually in use in Tokyo in 2003 revealed significant difficulties in the conventional operation strategy of smoke control and firefighting in subway stations. Importance of limiting heat release rate through either lining material combustibility control or automatic fire extinguishments, as well as the establishment of alternative evacuation routes on either end of a platform, and appropriate operation of shutters on the on the stairs between the platform and the concourse is pointed out.

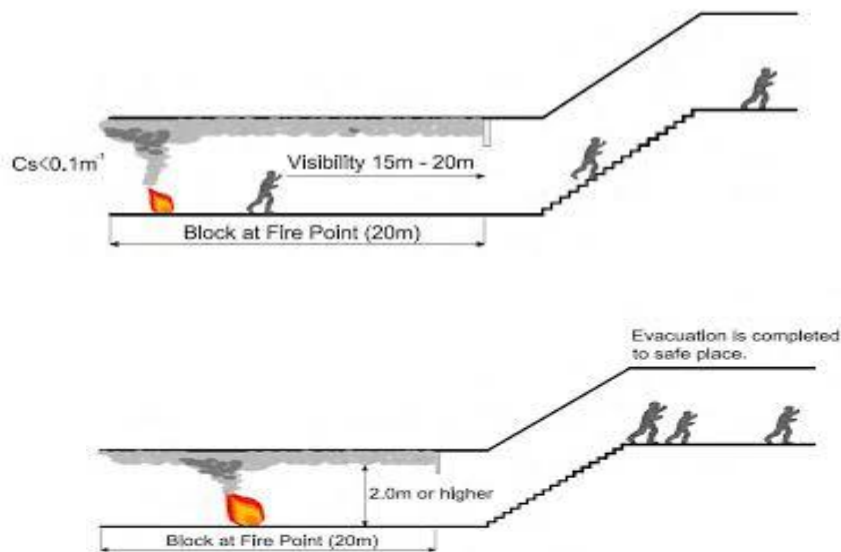


Fig 2.1 showing the smoke in underground tunnel

INTRODUCTION:

On 18 February 2003, a subway train and station fire in Daegu, Korea, revealed a significant risk of fire in underground railway systems. While underground railway systems are common in every major city around the world and employ some fire safety measures in general, it is believed that the effectiveness of these fire safety measures is based on a weak technical foundation. Few experiments or modelling works on smoke movement, fire growth, and human behaviour in underground railway trains or stations have been conducted, despite the fact that the relatively low ceiling and high fire load in trains, as well

as the connection of a station to tunnels, are thought to be detrimental to fire suppression or the effectiveness of mechanical smoke control.

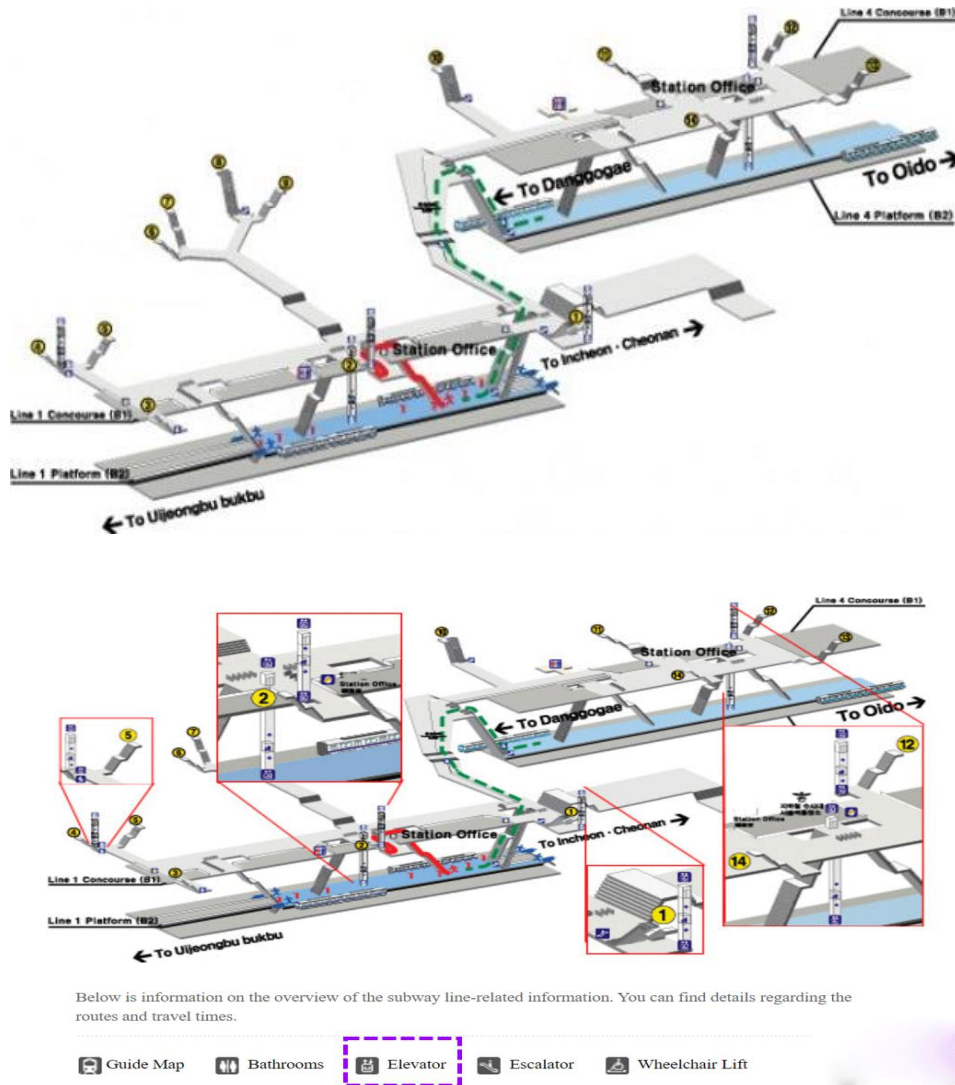


Fig 2,2 ESCAPE PLANS IN CONCOURSE

This should draw the attention of international transportation authorities and fire experts to the need to reevaluate the effectiveness of current fire regulations on subway systems and implement functional fire safety measures. It is also critical to promote international cooperation in research and development on the fire safety of underground systems because the features of the related facilities are quite similar. This paper examines fire disasters in underground railway systems, regulations, and research efforts on subway fires in Japan, as well as recent on-site experiments on the control mechanism of smoke movement in actual subway stations, which were conducted jointly by authors and Tokyo Fire Department(TFD).

Fire experiences in underground railway systems in Japan

While the first subway in Japan opened in 1928 in downtown Tokyo, the subway network did not become operational until the 1960s, when Japanese economic growth had reached a peak and inner-city traffic in major cities was experiencing significant difficulties. Until the 1960s, the only fire-related regulation applied to underground railway facilities was the Fire Service Law, which specifies the requirements for fire extinguishers and other appliances to aid in firefighting..

Fire safety regulations for subways in Japan

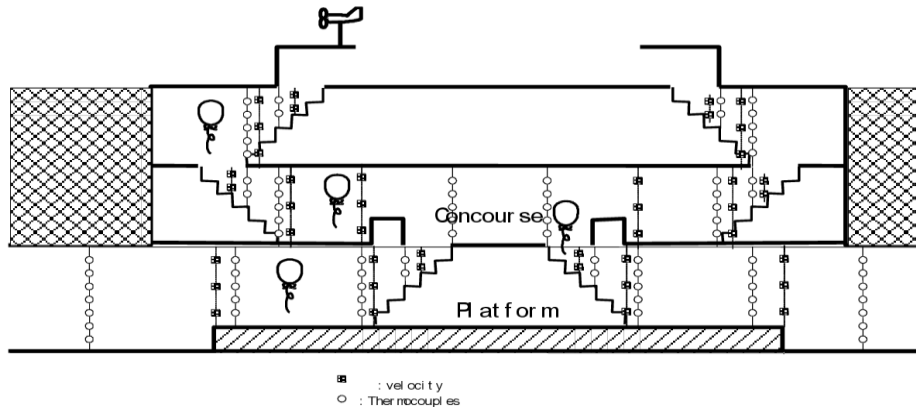
The 1968 Subway Hibiya Line fire and 1972 JR Hokuriku tunnel fire brought great public attention to railway systems' fire protection. It is also worth noting that these fires were contemporary with major buildings and industrial fires, including an Osaka Tenroku Subway gas explosion (1970), Osaka Sen-nichi fire department (118 victims, 1972). (103 victims, 1973). There were already significant building fires involving several deaths in the late 1960s, which led to revisions to the Building Standard Act to establish a smoke control requirement in newly planned public buildings and high-rise facilities.

Smoke movement in subway stations

Smoke movement testing took place in three subway stops currently in operation in Tokyo in October 2003 using simulated fire sources on the platform. Two most typical metro stations layouts were selected, the single track platform ("island" type) and two track slides ("bank type"), both island and bank type stations were chosen from an Eidan metro line, and the Toei Subway was chosen as an island type station.

Table 2 Smoke Movement Test Conditions

Series	Fire Source	Smoke Extraction	Shutters on the Stairway between Platform and Concourse
1	off	off	open
2	methanol pans on platform	off	closed, half open, open
3		on, platform level	closed, half open, open
4*		on, both platform and concourse	closed, half open, open

**Fig 2.3 smoke extract from the metro station****DISCUSSIONS :**

1. The use of shutters on the stairs primarily affects the movement of smoke due to a platform level fire. Shutters are usually advantageous not only to save smoke from the competition but also to keep the smoke layer stable on a platform level.
- (2) The smoke distribution on the platform may be restricted within certain area where the fire source intensity is controlled and the shutter is close to the fire source. This indicates that alternative evacuation routes at both ends of a platform are generally important.
- (3) It is primarily important to limit the fire intensity. Increasing the heat release rate should result in the increased temperature of the smoke layer, even if the shutters and so forth operate properly and could prevent evacuees from getting into smoke, which should further cause difficulties with the evacuees' exposure to strong radiation.

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1. Tokyo Fire Department, Report on Full scale experiments and study on railway trains, 1994(in Japanese).
2. Moriyama,S.,Tanaka,S., Yonezawa,M., Hasemi,Y., Nam,D., Ding,W.,Okazawa,N., Smoke Movement Behavior in Subway Station Fires, Part 1-3, Kanto Branch Meeting, Fire Safety Section, Architectural Institute of Japan, March 2004(in Japanese).

2.2 Use of Fire Suppression Systems in Underground Stations and Metro Tunnels

Steven K.H. LALa , Tim K.W. CHOa , William Y.M. XIEb, Hadi WIJAYAc , K.W. ANGc a WSP (Asia) Limited, Hong Kong, b WSP Consultant Pte Limited, Singapore, c Land Transport Authority, Singapore

ABSTRACT:

Fire control systems such as a fire hydrant, pads, sprinklers, water mist, etc. are usually used in buildings to control or eliminate a fire. Fire and paddle are commonly used to serve the public areas at a subway station (e.g. platform, concourse, adits or long subways, etc.). For subway tunnels, fire hydrants are also common in the tunnels. To enhance the safety of fire and life, certain countries have reviewed their standards and considered providing additional fire removal systems for underground metro installations (e.g. sprinkler, water mist system, drencher system). However, in a busy subway station, In the case of a fire it will be a challenge for the operator to monitor the secure evacuation and to arrange a path for the emergency departments to get onto the scene if there are many people in the station during the morning or evening peaking periods. Some towns have therefore revised their regulations to include the use in their underground metro system of the sprinklers for the public area. Shanghai has also considered using the water mist system instead of a sprinkler system at its metro stations in order to reduce the tubing size and the spatial supply for the sprinkler system. This paper discusses the use of water neuter systems and sprinkler systems for public areas of stations.

KEYWORDS Sprinkler System, Water Mist System, Drencher System, Fire Heat Release Rate



2.4 water mist system used in tunnels



Fig 2.5 fire suppression system

INTRODUCTION:

When a fire happens to suppress or control the fire in the building, a fire suppression system installed in the building is activated. It aims to improve life security and reduce possible fire damage. Normally the fire hydrant, shovel and other water-based firefighting system (FFFS, for instance), such as sprinkler, water mist system, etc., are included.

There are different types of water-based FFFS, although they share a similar principle of operation. It consists essentially of an exhaust nozzle, water distribution pipes, pumps, control valve and water tank. When a fire exists, the fire heat activates the system through the fire sensitive element in the pin or the heat detector should be triggered and water pumped to the nozzle, from which the water droplets are distributed to the fire. These drinking water droplets suppress or control the fire

- (I the lowered fire temperature by evaporation of the water,
- (ii) by isolating the fire from oxygen by means of evaporated and expanded water vapour and
- (iii) by wetting the fuel and fuel surface of the fire

Since the fire-risk is expected to be lower than commercial facilities for the public areas of a station in the underground station (see Table 1) FFFS on water is not commonly required. Some towns have supplied the FFFS (e.g. sprinkler) for public stations

. The concern on installation of water based FFFS is mostly from its possible adverse impact on the evacuation path.

Table 1: Commercial Building vs Station Concourse/Platform

	Commercial Building (e.g. shopping mall)	Station Public Area (e.g. Concourse/Platform)
People Density & Characteristic	Can be high during holiday or special events (e.g. Chinese New Year)	- Can be high during morning / evening peak hours or special events (e.g. Chinese New Year) - High passenger density
Likely Cause of Fire	- Shop fire - Rubbish bin fire	- Baggage fire - Rubbish bin fire ⁽¹⁾
Fire Heat Release Rate	- Shopping mall (5MW) - Atrium (7MW) [15]	Baggage (not more than 2MW)
Overall Fire Risk	Higher, no control for goods in the building	Lower, as stricter requirement on building material and goods in the area
Impact to general public	Minor, building closed	Huge, interruption or suspension of metro services

Table 2.1 commercial building vs station concourse

Table 3: FFFS for Different Underground Metro Projects

	Hong Kong [6]	Singapore [13]	Mainland China [16][17]			UAE [5]	NFPA 130 [9]
			Shanghai	Hangzhou	Beijing	Dubai	
System	PSD	PSD	PSD (new station)	PSD (new station)	PSD (new station)	PSD	Not applicable
Station Concourse	- HR - FH - SP (New station)	- HR - FH (Dry Type)	- HR - FH - SP / Water Mist System⁽¹⁾	- HR - FH - SP	- HR - FH - SP ⁽²⁾	- HR - FH - SP	- HR - FH - SP ⁽³⁾
Station Platform	- HR - FH - SP (New station)	- HR - FH (Dry Type)	- HR - FH - SP / Water Mist System⁽¹⁾	- HR - FH - SP	- HR - FH - SP ⁽²⁾	- HR - FH - SP	- HR - FH - SP ⁽³⁾
Tunnel	FH	FH (Dry Type)	FH	FH	FH	FH	FH

Table 2.2 FFs for different underground metro stations

Abbreviations:

FH – Fire Hydrant

HR – Hose Reel

PSD – Platform Screen Door

SP – Sprinkler Notes:

(1) A water mist system has been installed in the station platform and trackway of the Shanghai metro line 11 phase 1 station.

(2) Commercial sprinkler system

(3) Sprinkler system for combustible loadings in the area as well as The major concerns of using water based FFFS in underground metro station are discussed below:

Concern 1: Visibility along Evacuation path

When water-based FFFS is activated, visibility in the environment is reduced due to the cooling of hot smoke and steam near the fire site. Passengers may take longer to evacuate from the station if visibility is poor. When water-based FFFS is activated, visibility at the fire site is reduced, according to commercial building experience. However, the reduction in visibility is only noticeable in the immediate vicinity of the fire. The water-based FFFS in most cases enables people to move from the fireplace and to the exit. The visibility in the area is reduced by the cooling of heat and steam near the fireplace when water-based FFFS is activated. If the visibility is poor, passengers can need more time to evacuate the station. When FFFS is activated, the visibility on the fireplace is reduced according to the business experience of building. But only in the immediate vicinity of the fire can visibility be reduced. In most cases the water-based FFFS allows people to move from and out of the fireplace

Concern 2 : Steam

The evaporation of water released to the fire by the water-based FFFS also raises a concern. The warm steam would make the passengers scald. Some research has shown that FFFS activation could cool the temperature around the fire and block the transmission of radiant heat from the fire. Therefore, passengers may also suffer a scald injury from radiant fire heating by steam from the water-based FFFS, if no water-based FFFS is available. The argument is also made to extract smoke and steam from the smoke extraction system, making high-temperature steam a lower probability of spreading away. The concern of steam scald can therefore have to be examined and evaluated further.

Concern 3: Slippery Evacuation Path

Another concern is that the floor is moistened by slippery water when water-based FFFS is activated. This increases the risk of injury to the slippery floor or slippery handrail during evacuation. Sprinkling water can also make the passengers feel uncomfortable particularly if the air temperature in the station is low. The activation of FFFS based on water normally only affects the area around the fire and does not involve most of the evacuation path. It could be more important for passengers who are close to the fire to protect them from radiant fire heat and to stop the expansion of fire than to keep the evacuation track dry. Moreover, the appropriate selection of floor finishes and handrails can minimise slippery floor or slippery handrail impact. This concern can therefore be reduced.

Concern 4 : Cost effectiveness

Since the operators control the public area of the station and numerous mitigation measures have been put in place (such as use of low-fire materials, only low-fire activity is permitted at the station) so as to reduce fire hazard in the station. Installing and maintaining the water-based FFFS at a station may not be cost-effective

Comparison of Sprinkler System and Water Mist System

	Sprinkler System	Water Mist System
Major Fire Fighting Mechanism	• Wetting the fuel surface	• Heat Absorption • Blocking fuel from oxygen
Water Flow Rate	• Higher (3-5 times of Water Mist System) [7]	• Lower
Installation Cost	• Lower	• Higher
Operation and Maintenance Cost	• Lower	• Higher
Impact to operation when falsely activated	• Only area near faulty head affected	• Only area near faulty head affected
Tank Size	• Larger	• Smaller

Table 2.3 Comparison of Sprinkler System and Water Mist System

Fire Services Provision in Train and Metro Tunnel

	Train	Tunnel
Fire Detection	• Smoke detector • CCTV	• Aspirating type smoke detector ⁽¹⁾ • Linear heat detector ⁽²⁾
Warning	• Train communication systems such as break glass, intercom phone, and public address system	• Intercom phone
Manual Fire Suppression	• Potable fire extinguishers	• Fire hydrant
Smoke Control	• Close the intake of the train air-conditioning unit	• Tunnel ventilation system
Egress Path	• Side door • Detrainment device at first / rear car (optional)	• Cross passage between tunnels • Escape staircases
Fireman access		• Fireman staircases • Special vehicle (long tunnel)

Table 2.4 Fire Services Provision in Train and Metro Tunnel

CONCLUSION :

FFFS has been installed in some municipalities for the underground public area to enhance fire safety in metro systems. Efficacy and risks of water-based FFFS are concerned and consequently, in some cities water-based FFFS has not been installed in the public subway station areas. In metro tunnels the FFFS experience based on water can be described in the highway tunnel, but more research and experimentation is necessary because of special features in metro tunnels.

(I) the water based FFFS impact on large-scale fires at the subway tunnel,

(ii) how the water based FFFS can be activated with the associated overall response time and

(iii) the water-based FFFS efficiency of the subway tunnel.

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2.3 Understanding Impacts of Security Check on Passenger Flow in a Metro Station and Improving Measures: A Case Study in Guangzhou, China

ABSTRACT :

Some towns choose to establish security controls at the entrances of metro stations to ensure the safety of passengers using metro stations and staff working at them. The security check can certainly help keep dangerous objects away from a metro station. The safety check can however also slow the entry speed of the passenger flow and lead to congestions which could affect travel plans for passengers. It is a matter of concern how the safety check will affect the flow of passengers and how to decrease impact. In this study, metro station modelling was built using a realistic Guangzhou metro station's building structure and passenger flow data.. The traffic conditions of passenger flow in the scenarios were compared and discussed using the Any Logic Simulation Software with and without a safety check. Congested areas and potential causes were analysed in the station hall. In order to test their efficiency in station reductions, possible improving measures such as adding safety control machinery and ticket vending machinery were also modelled. Results show that the flow rate of passengers into the gate machine may decrease by 49.4 percent, or 83.3 percent, at each entrance to the station being studied, which can cause severe congestion in rushing time at the entrance. The congestion near those entrances could be reduced substantially by adding safety control machines and ticket sellers at entries that have high demands for passenger transport.

1.INTRODUCTION

In this paper, it was chosen to analyse and study a metro station with large passenger flows in Guangzhou, China. First, passenger flow data from different dates in this station were analysed and the number of passengers entering the station was determined in the peak hours. Then, using Any Logic simulation software, simulation models of passengers entering a station were developed based on its actual construction structure and passenger flow data during peak hours. The simulation results show that the passenger density charts were analysed at the station and congestion areas were determined in the station hall. Security control models and safety control models were also calculated as well as improvement measures. There has been a discussion of the impact of safety controls on the flow of passengers and the efficiency of improvements.

Introduction of AnyLogic

AnyLogic is a software for the simulation of complex environment models, like production & logistics, health care, mining, stations and traffic. AnyLogic is an interactive software. AnyLogic can also provide an environment where users can model such systems without experimenting on the ground. In addition, the AnyLogic Pedestrian Library package

implements pedestrian movement to enable pedestrian operators to move around in continuous space and to react on various kinds of obstacles (walls, various types of areas) and pedestrians.

Blocks from the AnyLogic Pedestrian Library may be used to build flowcharts that simulate pedestrian movement. These blocks can be used to build footpaths, control the flow of the pedestrian pathways, and to manufacture footpaths. AnyLogic was chosen in this paper to define the models and the design was based on the true dimension and layout of T Station

No.	Symbol	Name	Introduction
1		PedSource	Generates pedestrians. It is usually used as a starting point of the pedestrian flow.
2		PedSink	Disposes pedestrians. It is usually used as an end point of the pedestrian flow.
3		PedGoTo	Causes pedestrians to go to the specified target.
4		PedService	Simulates how pedestrians are serviced in services.
5		PedWait	Causes pedestrians to wait for a specified time in a specified location.
6		PedSelectOutput	Routes the incoming pedestrians to one of the five output ports depending on specified ratios or conditions.

Fig 2.6 any logic software commands and results

ped pedding Football flow services define a number of similar physical objects (ticket vending machines, security checkpoints, check-in counters, etc.). It is possible to simulate physical services of pedestrian flow using two types of service. (a)Area service: used for the definition of electronic queue service(s) (like in bank office, information office on the railway station, etc.). Walkers aren't in line, but wait in the vicinity for their turn. (b)Lines service: used to define queue services, where pedestrians have to wait until the service is available in a queue line. There are two different types of queues: normal queue lines and "serpentine" queues typically used in airport check-in areas

In this paper's model, the function of PedServices simulates the safety control of passengers, the purchase of tickets and the crossing of door engines. For passengers, the service with the routes is usually waiting in line for these steps to simulate the progress of passengers who are waiting to be examined, to buy a ticket and to pass the gate.

Route Design in the Station Model

Before entering T Station, passengers must be checked. Some of them will then purchase tickets and go to the gate machines. Some passengers with the metro cards are going

straight to the gate machines. They then go down to the platform by escalators and board the subway trains.

The number of passengers in the extreme rush hour is estimated in Section 3.2 to be around 18,000, meaning that approximately three hundred passengers enter the station each minute. All the entrance tunnels within the model, which are divided into 2 parts, are also used as exits at the same time. Only half of the entrance tunnels are used by the passengers. The passengers' diameters must be uniformly distributed (0.4, 0.5) m, the passenger original speeds are uniformly distributed (0.5 m, 1.8 m/s), and passengers' convenient speeds must be evenly distributed (0.8, 1.3 m/s). By taking the security check time, T1 in model is set to comply with the same distribution for each passenger, meaning $T1 \sim \text{uniform}(3.0, 5.0)\text{second}$. According to Guangzhou Metro statistics, about 65% of passengers have underground cards. Only 35% of passengers are allowed to buy a ticket before entering the gateway. Therefore, the model buys a ticket after security checks, 35% of passengers entering each entry.

T2 is set to comply with the normal distribution, which is $T2 \sim \text{normal}(12.36, 42)\text{seconds}$, for a passenger to buy the ticket from a ticket machine. The time T3 is also set to comply with the exponential distribution for each passenger, which is $T3 \sim (3.63)\text{seconds exponentially}$.

Normally passengers from different entrances, after security controls, are attempting to use the TVM and gate machine closer to them, so that passengers from different entrances design the TVM and gate machine utilities. There are many choices for passengers from some entrances to use TVM, gate machines and escalators; the proportion of passengers using each machine is presumed. In extreme rush hours and the contribution ratios from each access point of entry, the entry speed is also calculated by the total entry number.

Entrance	Entering speed (p/min)	TVM used	Gate machine used	Escalator used
A	42	TVM2 (35%)	GATE2 (100%)	ESC2 (30%), ESC4 (35%) ESC5 (35%)
B	21	TVM6 (12.25%) TVM7 (22.75%)	GATE5 (100%)	ESC3 (40%), ESC4 (60%)
C	30	TVM6 (12.25%) TVM7 (22.75%)	GATE5 (100%)	ESC3 (40%), ESC4 (30%) ESC5 (30%)
D	30	TVM4 (17.5%) TVM5 (17.5%)	GATE4 (100%)	ESC2 (40%), ESC4 (30%) ESC5 (30%)
E	75	TVM1 (35%)	GATE1 (100%)	ESC1 (70%), E2 (30%)
G	48	TVM3 (35%)	GATE2 (60%) GATE3 (40%)	ESC2 (60%), ESC4 (16%) ESC5 (16%), ESC6 (8%)

Fig 2.7 keys and abbreviations in any logic software

Because the effect of security checks on the flow of passengers entering this document is a key concern, the Pedesink blocks are positioned at downstream escalators. This means that here in the model passengers will disappear and passenger movement will be excluded once it is taken into account. The routes of passengers coming from each entry are built on the basis of information. Entry route E for entry passengers The same route will be used for passengers entering from other entrances as entrance E.

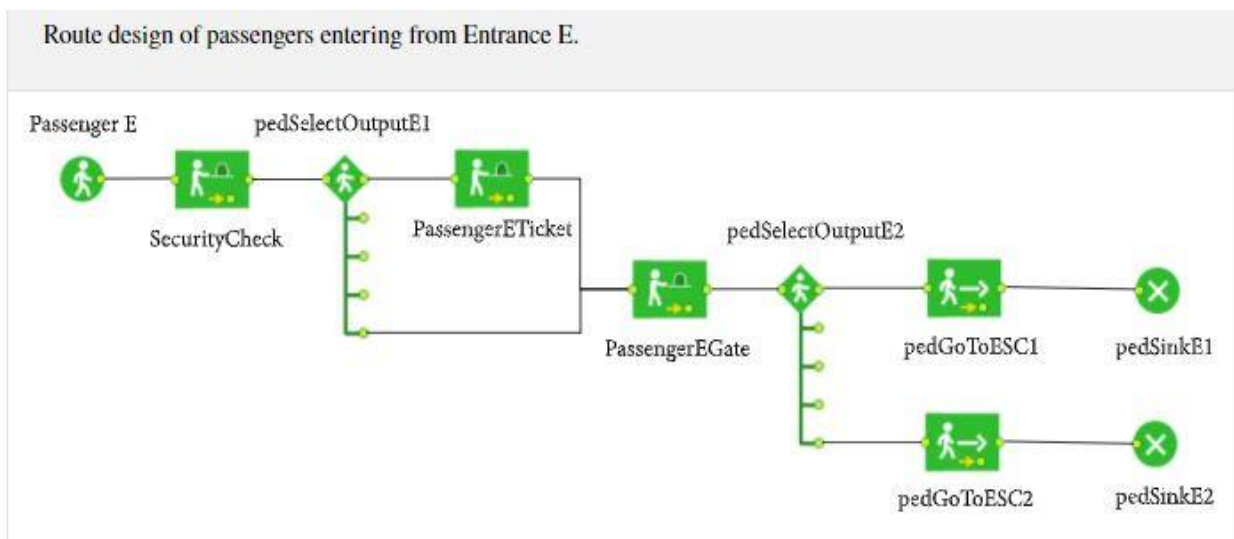


Fig 2.8 any logic results flow chart of usres

Result Analysis

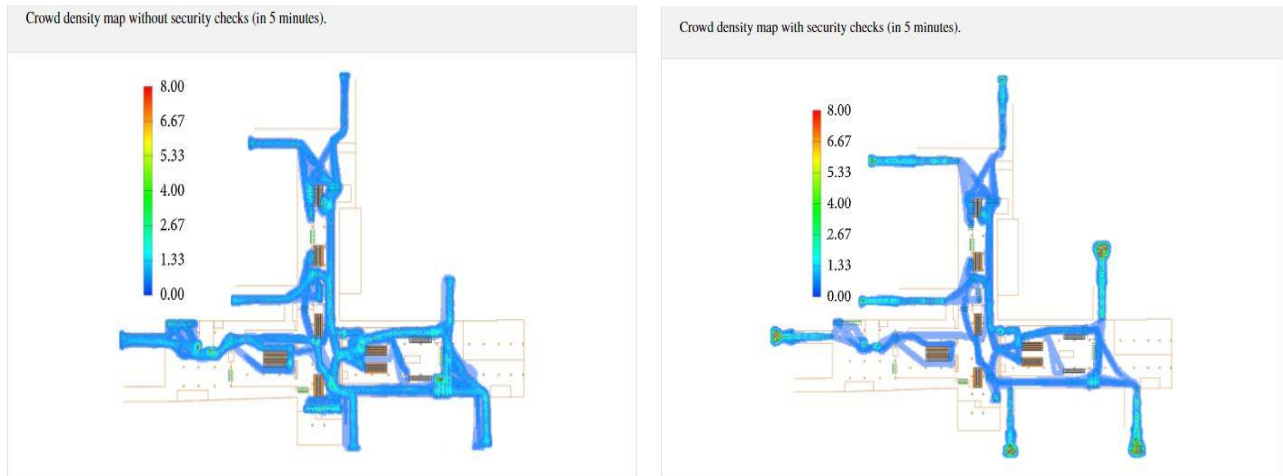


Fig 2.9 Crowd density map without security checks (in 5 minutes). **fig 2.10 Crowd density map with security checks (in 5 minutes).**

CONCLUSION :

A method was introduced to assess the impact of safety controls on the incoming passenger flow by setting up metro station models based on the structure of building and passenger flow data of a real station. Model simulation also studied the efficiency of improved measures to relieve congestions. We draw the following conclusions from the analysis above.

- (i) Set-up of simulation software models of metro stations AnyLogic is an effective way to assess the impact of the safety inspection. It can be used to evaluate the security checks at a metro station before making any decision and to find better measures to enter passengers. management.
- ii) The number of passengers entering gate machines may decrease by 49.4 percent ~83.3 percent according to the simulation results, once security checks are added. The safety check can therefore be said to sharply lower the speed at which people enter.
- (iii) The congestions caused by security tests can be greatly eased by adding a safety check machine and ticket sellers at the entrance with a large number of passengers. If the improved actions above are taken in the area, the amounts of passengers entering the gate machines can be increased by 60% ~240%.

There have been some simplifications when the model was developed. The first thing to do is to select passengers from each entrance, according to the routes designed by the

models, is to select television and gate machines. Secondly, this paper does not consider possible conflicts between passenger flows. In further research, these two factors can be changed.

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INFERENCE – SUMMARY OF RESEARCH PAPER

1. PAPER -1

- This paper reveals the smoke analysis , and what to be followed when the presence of smoke in the tunnels and how the people would evacuate safely without any accidents. So they have used the smoke extracts and block the zone by small slit so that it cannot spread all over the area
- They have also explained about the designing parameters by experimenting in two different platforms

2. PAPER – 2

- This paper talks about the fire suppression system involved in metro station and they have said about the FFFS system used in it and also the have defined some concerns to proceed with the FFFs and they were aware of the cost effectiveness

3. PAPER – 3

- This paper talks about the security check and also the pedestrian movements analyzed by the any logic software . The movement and a process involved in the pedestrians is maintained periodically by the software and the maintained the security in the stations

CHAPTER -3 LITERATURE REVIEW

3.1 FIRE SAFETY STANDARDS

Group D Assembly – UNDERGROUND METRO STATION

3.1.1 PASSIVE FIRE PROTECTION SYSTEM (PFP)

3.1.1 a) Escape Lighting and Exit Signage

The entrance, exit and exit discharge are identified properly and sufficient lighting shall be maintained in the egress system elements in such a way that all occupants can safely leave the facility.

3.1.1 b) Lighting

The output, exit and exit systems shall be continuously illuminated. The floors of the exit media will be lit at every point and in corridors and crossroads, staircases, stairways and exit landings

Escape lighting shall be capable of

- 1) providing clear and unambiguous indications of escape routes;
- 2) ensuring adequate lighting along those routes to enable people to move safely to and through the exits; and
- 3) ensure that there are ready locations of fire alarm points and firefighting equipment along escape routes.



Fig 3.1 signage and location of fire corridors and exits

Passive fire protection is an integral part of structural fire protection and building fire safety. PFP tries to contain fires or slow the spread, such as walls, floors and doors with fire resistance.

- .(i) Fire Evacuation Route – Circulation - Exit Path
- (ii) Fire Staircase – Numbers, Dimensions - Distance & Access
- (iii) Fire Rated Door – Numbers, Dimensions – Access & maintenance
- (iv) Fire Risen Access – Refuge Area – Capacity
- (v) Fire Walls
- (vi) Signage
- (vii) Fire Lifts: - Numbers & Access
- (viii) Emergency Lighting
- (ix) Command &Control Center

3.1.2 Fire or fire/smoke dampers

The following points are assessed for the location of these dampers in air ducts, cool air and air-return ducts/passages:

- a) At the fire separation wall,
- b) Where ducts/passages go into the vertical shaft at the fire separation wall,
- c) the passage in the floors of the canal and
- d) The air duct inlet and air duct of each room on each floor at the supply inlet..

3.1.3 Air handling unit

Separate air handling units (AHUs) shall be provided for each floor in order to avoid risks from fire and smoke dissemination via air conditioning pipelines from a fire security perspective. The air ducts shall be separate from each AHU to the ground and shall not interconnect with any other ground ducts in any way. Within a floor, each compartment

should be supplied with a separate air handling unit. The event of an air filter fire or from other sources draughted into the system, the Air Handling Unit shall be provided with effective means to prevent the circulation of smoke through the system and must have smoke sensitive actuation instruments in accordance with the accepted standard and controls

3.1.4 ACTIVE FIRE PROTECTION SYSTEM (AFP)

Active fire safety is an integral part of the protection against fire. AFP is characterised by items and/or systems that, contrary to passive fire protection, require a certain amount of motion and response for operation.

(i) Fire Alarm System: -

- (a) Smoke Detector
- (b) Heat & Gas Detector
- (c) Alarm bell & Break Glass
- (d) Fire Control Room
- (e) Voice Communication
- (f) Fire Switch and Manual call Points
- (g) System Operation

(ii) Fire Sprinkler System: -

- (a) Types; - - Upright Sprinkler – Recessed Pendant Sprinkler
- (b) Valve Types
- (c) Pumps; - - Jockey Pump - Stand by Pump
- (d) Water tank
- (e) System Operation

(iii) Hose Reel System:-

- (a) Components
- (b) Hose Drum

(c) Hose Reel Drum Pumps

(d) System Operations

(iv) Wet Riser System:-

(a) Components

(b) Wet Riser Pump sets

(c) Operation System

(d) Maintenance

(v) CO2 Fire Suppression System: -

(a) Operation & Maintenance

(vi) Fire Extinguisher:-

(a) Types & Numbers

(b) Access Location & Operation

(vii) Fire Hydrant:-

(a) Types & Numbers

(b) Distance and Water Consumption

(viii) Fire Pump Room

(ix) Fire Tanks:-

(a) Capacity and Maintenance

(b) Public Address System

3.2 STAIRCASES (as per NBC norms)

All buildings must have at least two steps

I All buildings with a high elevation; the floor area on any level exceeding 500m².

- ii. Two cellars or more, and more than 500 m² of buildings with one cellar.
- iii. For staircase, a minimum width of 250 mm is required for the tread without nosing.
- iv. A height of maximum 150 mm is required for the riser.
- V. The number of risers per flight shall be restricted to 12.

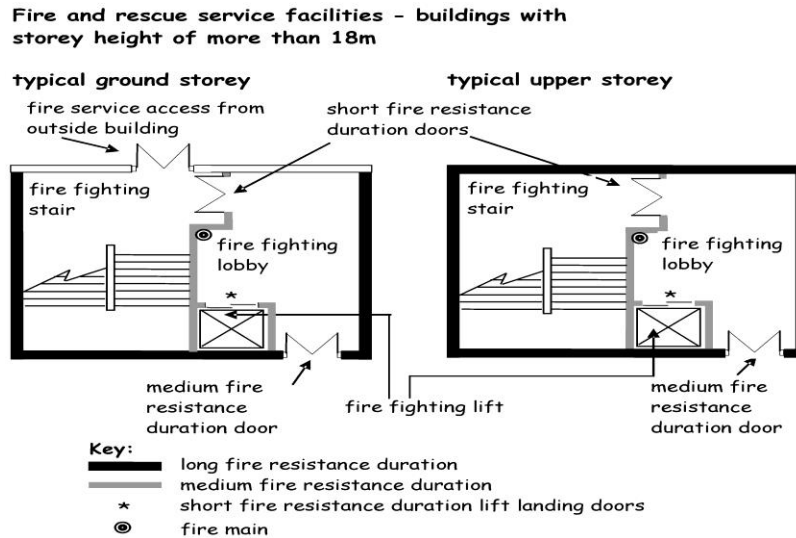


Fig 3.2 location of fire fighting lobby

3.3 FIRE LIFTS (as per NBC norms)

In order to facilitate fire services, one fire lift per 1200 m² of floor space should be provided and exclusively accessible in an emergency to firefighters. The floor area shall be no less than 1.4 m² in the elevator. It shall be able to load not less than 545 kg with automatic closing doors with a minimum width of 0.8m (8 persons elevator). The lights and supply lights shall be operated on 24 V in elevators with wooden panels or steel sheets construction.

In case of an emergency, a firefighting elevator should be equipped with a ceiling hatch so that it can be easily opened when the car is stuck. The elevator is so wired that it descends on the ground floor and stops with the door open in the event of an energy failure. The fire lift speed - from ground level within 1 min. The top floor is reachable.

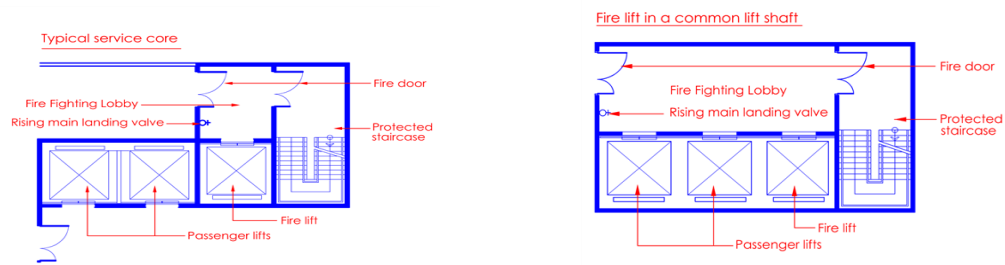


Fig 3.3 comparison of staircases planning

DATA COMPARISON OF NBC, IFC AND NFPA (UK)

Passive fire protection

S.No	Specify Area	NBC	IFC	NFPA
1.	Site Entrance	Two way	20ft	Direct access to main road
2.	Road Width	If single way – 50ft Two way – 100ft	25ft	All around 25ft Single way
3.	Door	Min of 7ft width with 2hr FR	2-4 hr FR	2-4 hr FR
4.	Corridor Width	10Ft min Handrail	10Ft	15Ft with Handrail
5.	Staircase	2 stairways more than 500m2 Min thread- 250mm Min riser – 300mm	Staircase with stairway exit	Staircase min of 10ft exit
6.	Lift	Min – 2nos Fire rated material with 2hr FR	Had separate backup	Near critical area
7.	Signage	Clear and visible	Illumination board	Illumination with lighting
8.	Refuge area	Above 1200m2 to be provided	If height of the building is more than 50ft	Near critical area
9.	Emergency lighting	24Hrs Backup	Min Backup	N/A
10.	Assembly area	Emer exit and open ground	Emer exit and open ground – min 10m2	Open ground to be provided

**Table 3.1 DATA COMPARISON OF NBC, IFC AND NFPA (UK) -
Passive fire protection**

DATA COMPARISON OF NBC, IFC AND NFPA (UK)

Active fire protection

S.No	Specify Area	NBC	IFC	NFPA
1.	Extinguisher	Required above 1000m2 or g+1	Provide 25ft once with a minimum 3-A:40-B:C rating.	Provide in each floor with accessible
2.	Hose Reel	Required above g+1	75ft once Provide next to hydrant	50ft once
3.	Wet Riser	Required above g+2	10ft Once with down face.	Provide on emergency way
4.	Yard hydrant	Required plot area exited 1000m2	Site plot extended 1500m2	25ft once in all around the site
5.	Manually operated fire Alarm	Required in all area	Required in all area and critical zone	Provide in all floor
6.	Automatic Fire detection	Required above g+2	Provide in all fire prediction zone Eg:- Kitchen, Scan etc...	Install with latest technology
7.	Water supply storage	OHT is need G+1 and need both OHT and UWT above G+1 or 2500m2	Required with minimum 100k capacity	N/A
8.	Pump	Required above g+1 and Diesel pump need G+2	Needed	Pump with 3Kg/m2 Capacity

Table 3.2 DATA COMPARISON OF NBC, IFC AND NFPA (UK) – Active protection

3.4 Evacuation Time for Passengers in Case of Station Fire

It is important to consider and study passengers' evacuation time in order to ensure the safety of passengers when there is a fire accident at the station. If it takes too much time to evacuate from the dangerous point to the safe point, the fire will expand and passengers suffer fire or smoke. One of the main factors in evacuating passengers from a dangerous spot is the width and number of stairs. If the larger stairs are provided at the station, the safety of passengers is strengthened. However, if there is no consideration or study for the width of the stairs in the station, the station size is very big and the station will cost more. In addition, passenger safety is not increased proportionately according to stair width. Building is inefficient if it is too widespread blindly. The relationship between passenger safety and building costs does not always exist. The regulation of evacuation time therefore has great influence and influence on the station's design and scale.

In the case of the NFPA 130 the regulation of the evacuation time is very strict and the NFPA 130 station is susceptible to being big and exceedingly applicable. In addition, the problem with the time of evacuation in NFPA 130 is the failure to identify the reason for and basis for the stringent regulation. Therefore it is hard to apply the NFPA 130 Regulation in some cases for the deep station. Consequently, the cost reduction is studied and compared to the Japanese standard..

3.5 Evacuation Time of NFPA 130

Passenger safety at the station is checked and evaluated during evacuation. In NFPA 130 the permitted evacuation time is as follows:

- Platform evacuation time • Sufficient exit lanes should be available to evacuate the station occupant (passenger), within 4 minutes or less, from station platforms.

EXCEPTION: Changing evacuation time by evaluating heat release material rates, the geometry of the station and the ventilation emergency systems based on an engineering analysis

Removal time from the platform to a security point The station should also be designed to allow evacuation to a point of safety in six minutes or less from the most remote point on the platform.

EXCEPTION: Changing evacuation time by evaluating heat release material rates, the geometry of the station and the ventilation emergency systems based on an engineering analysis.

In NFPA 130, there is an undefined and unclear description in the regulation for the evacuation time. The following points caused by the indefinite description in NFPA 130 must therefore be taken into account:

- The permissible platform evacuation time is set to 4 minutes and 6 minutes, respectively, at a point of safety. However, it is not clear why the acceptable evacuation time is allowed and not described for the passengers.

CHAPTER - 4

LITERATURE CASE STUDY

4.1 BEIJING STATION CHINA

A comparative analysis on the evacuation time of atrium-style metro station
STUDY ON THE GENERAL SIGN SYSTEM FOR THE DAILY SERVICE AND
DISASTER-PREVENTION

4.1.1A comparative analysis on the evacuation time of atrium-style metro station

Atrium-style metro station

This station (station A) is a two-layer island-platform station with a cubic shape 158m×14m×5.2m (L×W×H), as shown

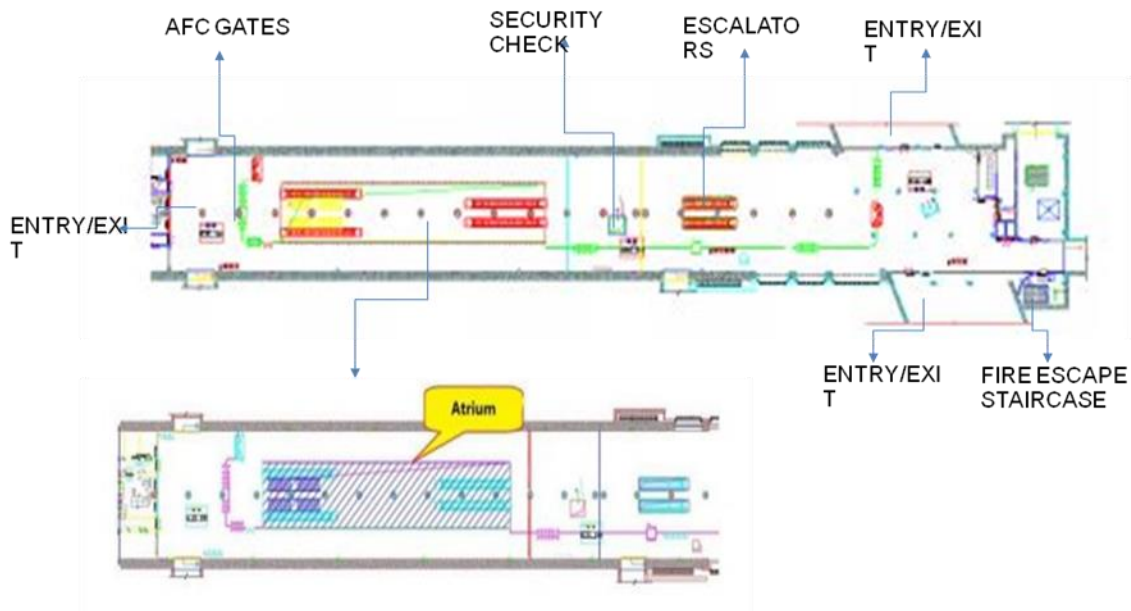


Fig 4.1 atrium style metro station plan

Station A's platform was designed in the style of an atrium. The atrium is 45 metres long and 10 metres wide, combining the platform and the concourse into a multi-story communal space for ventilation. However, because there is no space for ventilation ducts or fans, conventional mechanical ventilation cannot be arranged at the atrium ceiling or anywhere else.

4.1.2 Calculation of the evacuation time using The United States “NPFA130” (2014)

According to the NPFA130 (2014), data of Station A is analyzed,

Egress Element	Width (mm)	Capacity per mm (p/mm-min)	Capacity $\Delta p/\min^v$
Staircase(2)	3400	0.0555	189
Escalators (6*)	5500	0.0555	305
Fare gates (22)	Capacity=50 person/minute		1100
Emergency exit door	16500	0.0819	1351

Table 4.1 Calculation of the evacuation time using The United States “NPFA130” (2014)

F_p (time to clear platform) = Platform occupant load $\div$ Platform egress capacity = 5.43 minutes.

W_p (waiting time at platform exits) = $F_p - T_1 = 4.30$ minutes.

F_{fb} (fare barrier flow time) = Evacuation occupant load $\div$ Fare barrier exit capacity = 3.28 minutes.

W_{fb} (waiting time at fare barriers) = $F_{fb} - F_p = 3.28 - 5.43 = 0.00$ minutes.

F_c (concourse exit flow time) = Evacuation occupant load $\div$ Concourse exit capacity = 2.67 minutes.

W_c (waiting time at concourse exits) = $F_c - \max(F_{fb} \text{ or } F_p) = 2.67 - 5.43 = 0.00$ minutes.

Total exit time = $T + W_p + W_{fb} + W_c = 6.46$ minutes.

Calculation of the evacuation time using Japanese “JIS Railway Standards”



4.1.3 Calculation of the evacuation time using Japanese “JIS Railway Standards”

The evacuation route must be established prior to calculating the evacuation time, according to JIS Railway Standards. Station A's concourse has three evacuation exits and four fare entrances, and the evacuation route is designed accordingly. Route A/B: Train entrance Escalator/Staircase Entrance A/B Exit A/B Ground Route C/D: Escalator to the train door Entrance C/D Exit C Ground Fare The evacuation time is determined by the walking time and the dwell time, and the walking time (t_1 - t_5) and dwell time (T_1 - T_5) are divided into five parts.

Differences in evacuation features

Specified in “Code for Design of Metro” (GB50157-2013), the methodology of calculating the evacuation time considers primarily the capacity of staircases and escalators, while no clear regulation about the structural layout or evacuation routes have been prescribed. The NFPA130 defines the concept of total evacuation time, together with the computational methodology of the walking time, the flow time of evacuation corridor, and the dwell time during evacuation. This methodology includes not only the capacity of staircases and escalators, but also takes capacity of evacuation corridors and fare barriers into account. The JIS Railway Standards prescribe the evacuation time to be determined by the walking time and the dwell time. The latter is relevant to the flow coefficient, the usage of each exit. The amount of people is distributed based on the exit width

Conclusion

It can be concluded that the Chinese code tends to produce errors in evacuation time, whereas the American and Japanese standards demonstrate certain superiorities in that they correctly reflect the effect of the station's structural layout and represent predictive bottlenecks. As a result, for the sake of the most precise evacuation time, a synthetic methodology that takes into account multinational codes is highly recommended in practise.

4.2 STUDY ON THE GENERAL SIGN SYSTEM FOR THE DAILY SERVICE AND DISASTER-PREVENTION

The subway's safety and disaster-prevention general sign system is an important component of the subway structure that ensures the subway's operation is safe and convenient, and it also plays an important role in evacuation. The concept of a subway safe and disaster-prevention general sign system is defined in this paper. The similarities and differences between domestic and foreign signs are studied through an investigation of the subway sign systems of Tokyo, Seoul, Busan, Beijing, and Nanjing. By comparing the main design factors of subway signs, the subway becomes systematic, concise, geographical, functional, and international.

4.3 INVESTIGATION ON SIGN SYSTEM IN DOMESTIC CITY AND ABROAD

Subway Station Identification Sign

According to the survey, Seoul, Korea's outside distinct of the station identification sign is the form of a rectangular, and four sides sign is the same, the passengers can receive

information in all directions of station, additionally, all of those are provided with Seoul subway standard sign, Chinese and English explain, and the bottom figures also indicate that the stations lines,

Subway station identification signs are analogous to station identity cards; each station identification sign should be unified in form, but the content should be distinguishable. Station identification signs can be found throughout the subway station, with the most important area being the outside distinction of stations and station platforms. The crowd of 750 metres around the station is served by outside distinct station identification signs. As a result, the outside distinct of stations identification sign should be in large size, and care should be taken to care for the crowd in all directions. The platform function's station identification sign helps passengers identify stations more accurately, preventing them from entering the wrong station and exiting at the wrong time.



Fig 4.2 subway placement and signages



Outside distinct station identification signs in domestic subway station use in the form, the sign towards only one side, the visual range is from -90° to 90° , it is not serviced in all directions around the area, additional stations Identification sign should be set in the opposite direction. Some signs only inform about subway stations; station names and operating lines are not provided.

FIRE SIGN

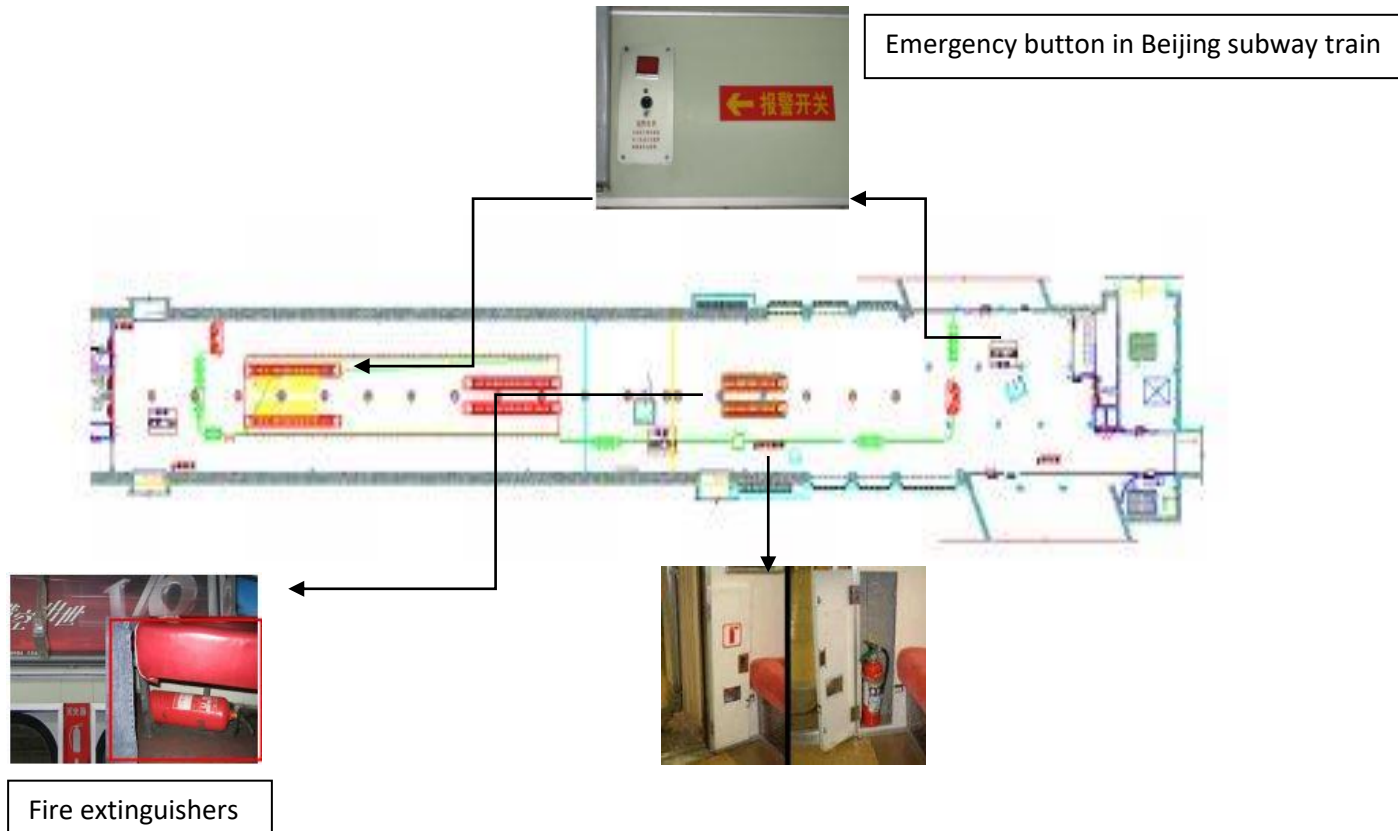


Fig 4.3 fire suppression system in metro station

Firefighting equipment should be placed near the location, as well as a sign in the appropriate location. Furthermore, the relative subway department in Seoul had increased inputs in the area of emergency rescue equipment, such as emergency masks, emergency stretchers, and reserved power flashlights. Use method and attention issues should be marked on the equipment repository in order to make passengers in disaster use relative equipment by themselves during disaster time..

Furthermore, the fire sign in the Beijing subway varies by region, which affects passengers' understanding of the sign to some extent. As a result, the unity of the fire sign must be improved. To prevent similar incidents from occurring again, the Seoul Subway sign has been replaced with burn-resistant, low-smoke, and halogen-free materials. Additionally, sign design and planning have been improved.

Subway disaster prevention should not only invest fully in equipment and signage, but also place the signage and related equipment in the proper location and coordinate with one another.

There are currently two sets of automatic fire safety facilities in Beijing subway station: one set of two automatic monitoring systems, one in the station and one in a central control room, to monitor the subway station's situation; and another set is an automatic fire sprinkler system. It is equipped with a water jet and a gas spray, making it suitable for various types of fire control..

. Emergency Exit Sign



Fig4.4 identification of emergency exit

When the large-scale emergency incident happens, exit is the destination of passengers evacuated to escape. Because the number of passengers has suddenly increased, and the standard exits are unable to meet the evacuation requirement. As a result, the emergency exits should be prepared. Meanwhile, because passengers are unfamiliar with emergency exits, emergency exit signs should be installed to direct them. There is no relative sign system for the refuge exit and space. Furthermore, due to unfavourable factors such as unreasonable signs, unobvious inducing lights, and so on, emergency evacuation and refuge of a large number of passengers is impossible. Some foreign city subways use relative system configuration.

Evacuation Sign

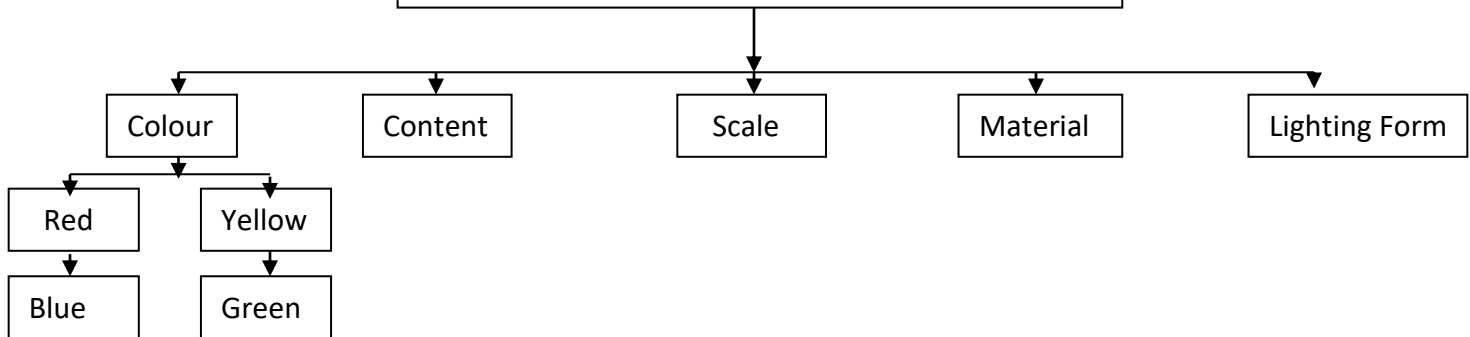


Fig 4.5 evacuation signages

The evacuation sign is very important in the subway. The subway emergency rescue work can proceed smoothly, passengers will be safe, the scheduling command system and the emergency rescue system will be confirmed if the emergency evacuation time is reduced

and the most scientific emergency evacuation line is provided by a reasonable effective sign. The subway space is cramped, directional, and mundane; it is difficult to find one's way around a subway station. Using an evacuation sign, passengers will not only be able to retrieve the current location of the subway space and comprehensive information on the ground, but they will also have a relatively accurate and stable psychological safe space. It is useful for escaping on time and for the smooth progression of emergency evacuation work. Furthermore, given the complexity of the subway space's structure, in order to assist passengers unfamiliar with subway space travel in getting off and transferring trains, the same style in subway stations should be unified to avoid mutual confusion. There are currently some issues with exit signs, not only in terms of form but also of position. Figure 9 depicts the exit signs at the Nanjing and Beijing subway stations..

FACTORS AFFECT OF SUBWAY SIGN SYSTEM



COLOUR



Black and white are the two background colours. In the meantime, aside from safe signs, there are some no-function signs in subway stations, such as line signs and so on. As a result, the colours used in the subway sign system exceed the safe colour standard.

CONTENT

Most countries have adopted bold Chinese characters in the current subway sign system because they are similar to the Latin alphabet of a decorative line. Text can be designed as a separate entity in subway sign design, or it can be integrated with graphic design. Create a design based on the design concept and the morphological characteristics of the environment, including the font, word meaning, and other factors.

SCALE

The design of a Subway sign must adhere to ergonomic standards. Using statistical data, obtain a scale for various activities, then apply the scale in the sign design to ensure that activities are designed to meet demand. To create a good and comfortable scale, the whole conformation, micro material, and texture must be combined. Subway sign design should also take into account the environment scale in order to scale in an orderly manner.



MATERIAL



Sign materials should be chosen in subway sign design based on the sign's objective and structure. Some materials have visual effects, but they do not correspond with the design philosophy or the structure, which is difficult to achieve. The subway sign's material should be fire resistant. Subway space is complicated and limited. In the event of a fire, the presence of a good fire-resistant material can effectively delay the spread of fire, as well as provide time for evacuation and rescue. Furthermore, the subway sign requires smoke-free or non-toxic smoke distribution at high temperatures.

Lighting Form



Artificial lighting is the most common type of lighting. Color, light, and form are typically more creative. Natural lighting is pleasant and natural, but it has more limitations. The subway sign's primary lighting source is artificial lighting. Natural lighting can be used in some outdoor situations, such as guide signs near entrances and exits.

4.4 INCIDENTS ON FIRE AND VENTILATION PROVISION IN SUBWAY SYSTEMS IN HONG KONG

In urban cities, life safety is always a priority in underground metro systems. Among life-threatening emergencies, heat and smoke emitted by fires in stations or tunnels would be the most serious concern. In comparison to other Chinese cities, Beijing's subway system has relatively reliable prescriptive codes for the stations.

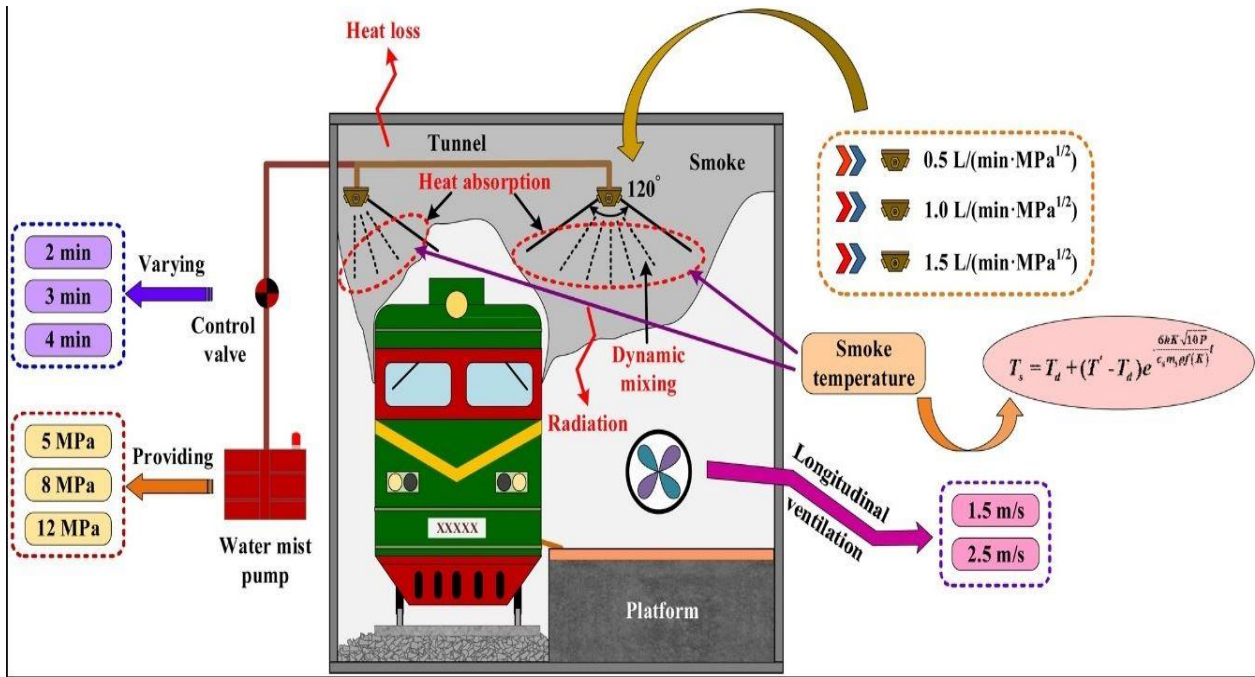


Fig 4.6 Drench system in the metro station

Drenchers are a system of water heads that are used for the fire protection. In contrast to sprinklers which are found internally, drenchers are normally found on the exterior of a building to protect against a fire from a neighbouring building. They tend to be positioned on roofs and over windows and external openings.

Another difference between sprinklers and drenchers is that all nozzles in the drencher system are activated simultaneously, whereas individual nozzles in a sprinkler system open when activated.

CHAPTER – 5

LIVE CASE STUDY

5.1 INTRODUCTION

LIVE CASE STUDY - MAGESTIC METRO STATION

LOCATION - KEMPEGOWDA , BENGALURU

BUIDING TYPOLOGY - METRO STATION

STRUCTURE - At Grade and Underground

5.1.1 SITE ACCESSIBILITY

The station has
entry -2
exist -2 .

The one entrance is on the southern side
And the other Entrance is on the Western Side



Fig 5.1 station entrance signage

5.1.2 THE STATION

THE Station is an At Grade and Underground

Station's Platform are designed to handle
20,000 commuters at any given time .

This is the largest metro station in Asia

Currently

The Station Platform is 365 metres Long for
Purple line and 300metres long for the Green line

Platform 1 – Baiyappanahalli

Platform 2 - Mysore Road

Platform 3 - Nagasandra

Platform 4 - Yelachenahalli



SITE PLAN

- 1 - SOUTHERN ENTRANCE
- 2 - WESTERN ENTRANCE
- 3 - TWO WHEELER PARKING
- 4 - BUS TERMINAL 2
- 5 - BUS TERMINAL 1
- 6 - PRIVATE BUS STSTION
- 7 - PRIVATE BUS PARKING
- 8 - BUS TERMINAL 3



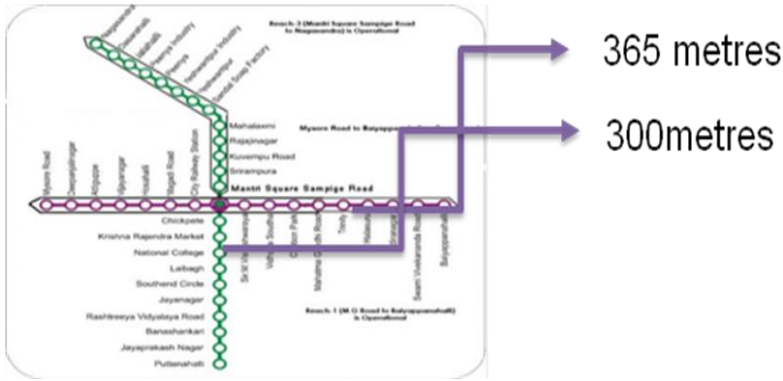


Fig 5.2 indication of purple and green line platforms

Preceding station	Namma Metro	Following station
Sir M. Visveswaraya <i>toward Baiyappanahalli</i>	Purple Line	City Railway Station <i>toward Mysore Road</i>
Sampige Road <i>toward Nagasandra</i>	Green Line	Chickpete <i>toward Yelachenahalli</i>



Fig 5.3 SOUTHERN ENTRANCE

5.1.3 Station layout

GROUND LEVEL

STREET LEVEL

Entrances and Exits and parking

UG Level-1

Mezzanine

Fare control, station agent, Metro Card, vending machines, crossover



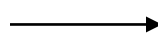
Fig 5.4 STREET LEVEL



fig 5.5 concourse floor

UG Level-2

Eastbound



platform 1 - Baiyappanalli

West bound ← platform 2 – Mysore road

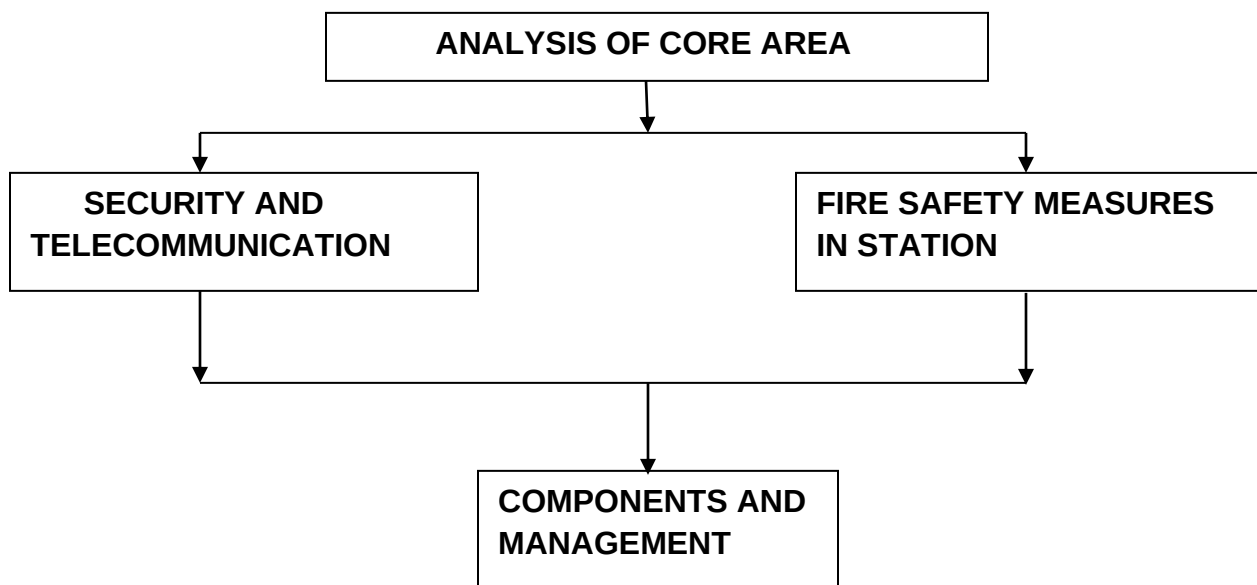
UG Level-3

Southbound → platform 4 - yelachenahalli

North bound ← platform 5 - Nagasandra



Fig 5.6 platform levels



5.1.4 FORM ANALYSIS - BUILDING STUDY

This is an At Grade & Underground station. It has three levels with total surface area of 25,000 sqm.

STOREY & HEIGHT

This is a 3-storey building. The total depth of the basement structure is 24m.

STRUCTURAL SYSTEM

The structure is RCC.

The front facade is clad with ACP panels. And partially glazed.

5.1.5 MATERIAL ANALYSIS

FLOOR FINISHES	WALL FINISHES
Kotah Stone	Clear toughened Glass
Granite stone	Glass Facade
Ceramic Stone	Polished Granite
Concrete paver block	Counter Top Granite
Yellow Warning strip	Vitrifies wall tile

5.2 AUTOMATIC FARE COLLECTION

Manual fare collection systems disadvantages	Automatic fare collection systems advantages
For the issue and check of tickets, many employees are necessary.	Fewer employees needed.
Changes in fare structure take time, just as each station requires.	Less opportunity for income leakage due to a 100% control gates ticket check.
Manipulation of mechanical parts possible by jamming.	The fraudulently avoided recycling of tickets by employees.
The interaction between personnel and passengers leads to increased confrontation.	Fast evacuation both in normal and in urgency is efficient and easy to operate
You cannot check 100% ticket at your entry/departure..	The system is easy to change quickly.

5.2.1Choice of Control Gates

The Control Patterns offer high performance, require less maintenance and the latest are available internationally in modern metros. Retractable flap or paddle swing. The gates of the tripod type turnstiles offer less and more maintenance is necessary and are therefore not proposed. In the early morning and in the late evening hours the traffic on this traffic will peak. As far as possible to better manage traffic, there is therefore a series of entry, exit and bidirectional gates between them.

5.2.3Add Value Machines:

The Credit/Debit Card and/or Bank Note module will serve to charge your card. These machines are also used as a value-added device if payment is made by Internet-based channels like Net Banking, CRD (Payment Gateway), etc.

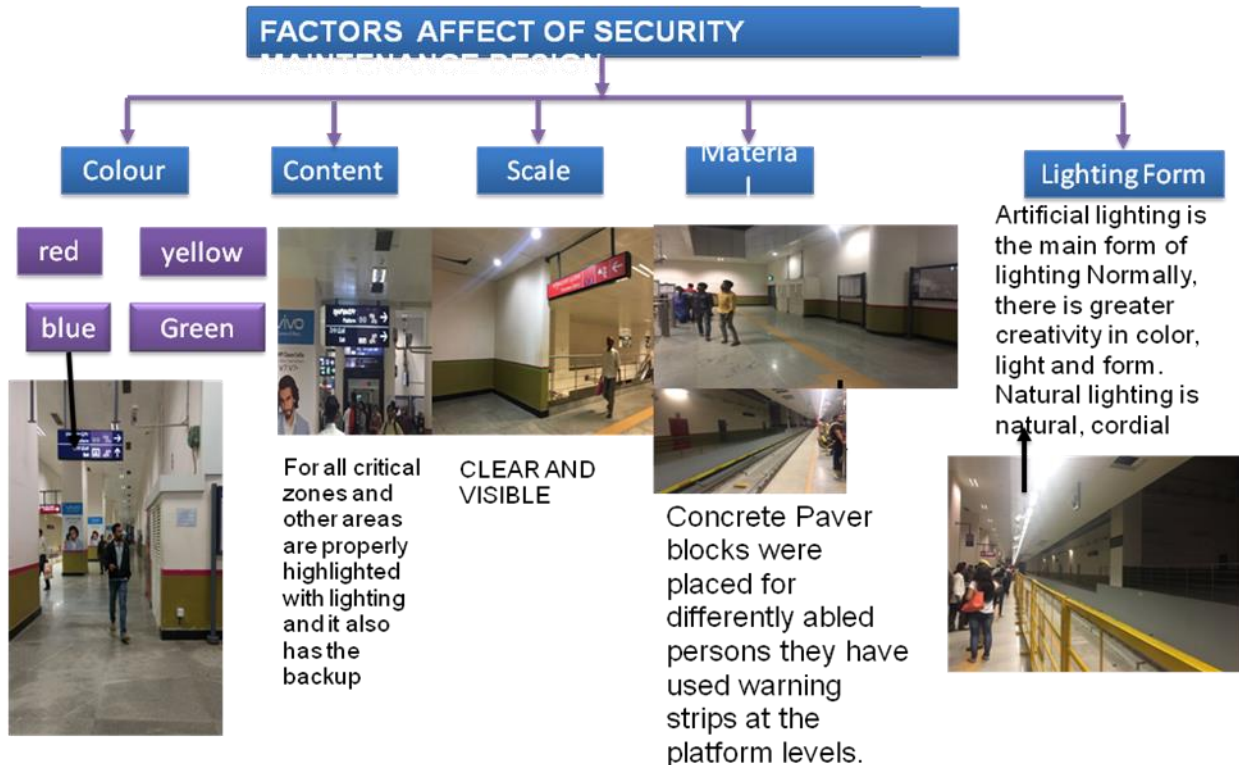
Standards	Description
Fare Media	a) a) Less intelligent contact token – Single trip. For a particular journey they have saved value. At the exit port, Tokens are captured b) The first of these is the first one. (b) Smart Card Contact – Multiple travel
Gates	Automatic gates input and output computer controlled retractable flap or paddle type. The following kinds of gates are available: Bidirectional input/output – can be set to input or output. Wide bidirectional door for people with disabilities.
Station computer, Central computer and AFC Net work	In the local area network all fare collection equipment is connected with a station server that controls all machines' activity. Those station servers are connected via the optical fibre communication channels to the central computer located in the operational control centre. The system's centralised control shall provide real-time revenue data, passenger flow analysis, blacklisted data, etc.
Ticket office machine (TOM/Customer Care)	Manned ticket office equipment for the sale of cards/token to passengers shall be installed at the stations.
Ticket Reader and Portable Ticket Decoder.	In the vicinity of Customer Care, ticket reading devices shall be installed to verify information stored in tokens
UPS (uninterrupted power at stations as	The S&T system Common UPS is to be used.

Add Value Machines

These machines are used for analysis of credit/debit cards and/or bank note module fare media and re-charge of smart cards.

Table 5.1 The standard proposed for AFC systems

5.3 SIGNAGE AND INDICATION



5.4 Signaling, Telecommunication & Train Control and PSG

CBTC Integrated fibre optic system, SCADA system, radio train system, PA system...
Communication-based train control system... Train information system, telephones control and centralised platform clock system screen doors

5.4.1 SIGNALLING SYSTEM AND TELECOMMUNICATION

Metro Railway's Signalling & Train Control system plays an important role in providing frequent, quick and safe travel in city areas. The telecommunications system acts as the backbone of communication for the signalling system and provides telecommunication services to comply with rail / metro network operating and administrative requirements.

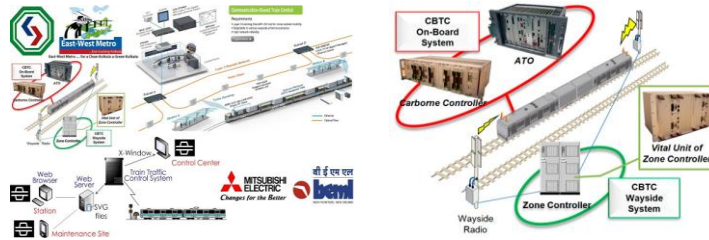


Fig 5.7 signalling system – cbtc

5.4.2 The CBTC system offers following advantages:

- a) High confidence, improved availability and less susceptible to failures.
- b) Easier maintenance.
- c) Provides greater capacity for traffic.
- d) More energy-efficient systems are reported to be DTG signalling in comparison.
- e) Adaptable and scalable to any level of automation.

The DTG system is also obsolete and the newest signaling/train control technology available is the Train Control Communication (CBTC). Most providers switch their design and production expertise from the DTG to the CBTC system, because global CBTC signalling is the only way for new metros. In India too, it has been a trend, as Delhi Metro lines have just been introduced, and Hyderabad Metro and Kochi Metro are equipped with this technology only.

5.4.3 ADOPTION OF CBTC BASED SIGNALLING SYSTEM:

Metro Train Control Requirements are scheduled to be met using the Continuous Automated Train Control System (CATC) based on the CBTC System. Continuous communication with Central control determine the position of the train. As a fall-back option, the circuits/axle counters are installed and un-equipped movement is controlled. This system includes Automatic Train Protection (A Train Protection) and Sub-Systems Automatic Train Operation (ATO) with continuous bi-directional radio communication of track and train and ATS.



Fig 5.8 showing the announcement system

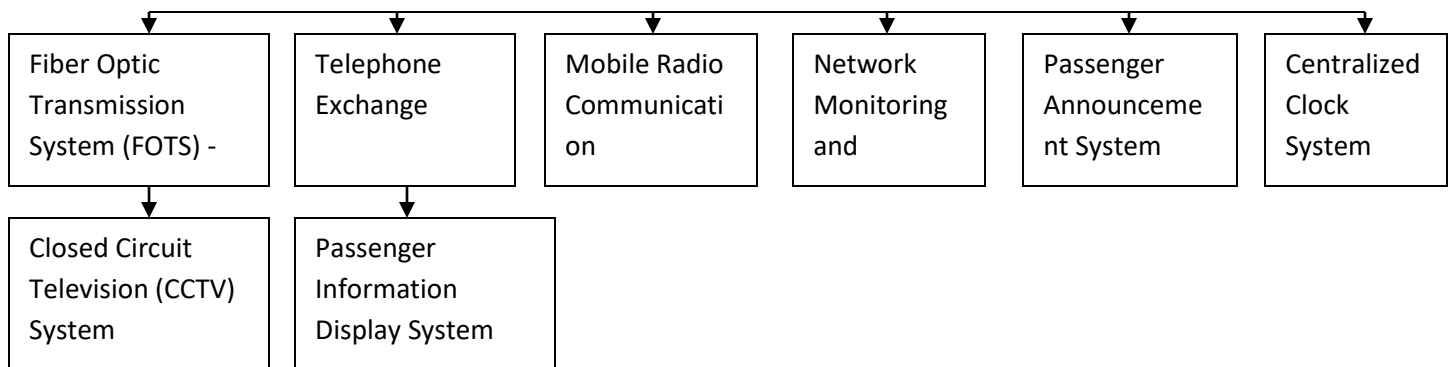
5.4.4 Standards Adopted With Regards To Signalling System

Description	Standards
Interlocking	Computer-based interlocking, used for switches and crossing of a station. All the equipment involved will be centralised as far as possible in the station equipment room. All Depot lines shall be interlocked subject to track layout constraints.
Block working	Principle of move block
Track Vacancy Detection systems	Primary mode for the mainline, stabilisation lines and test track in the track vacancy detection system can be through radio, and can be done via track/axle track counters for the depot/secondary detection.
Signals at Stations with points and crossings	Line Side signals for point protection (switches). Maintenance LED type signals
UPS (uninterrupted power at stations as well as for OCC)	For signals in the station control room, for telecommunications, for AFC and PSG and at stations cover all equipment.
Train protection systems	The system for the protection of trains shall be based on CBTC system. Redundancy must be provided by the system architecture.
Train Descriptor System	System for automatic train monitoring. All trains are moved to a central computer and shown in the OCC/BCC and SCR workstations. OCC/BCC Remote Station Control. Redundancy must be provided by the system architecture.
Cables	Outdoor cables are, as far as possible, reinforced in steel.
Fail Safe Principle	SIL-4 safety standards as per the CENELEC Signals and Train Management System standard.
Immunity to External Interface.	All cable/OFC/Radio data transmission. The signal cables and telecommunications cables are separated according to standards from power cables.
Environmental Conditions	All air-conditioning equipment rooms

Maintenance Philosophy	The philosophy of continuous system status monitoring and preventive and corrective maintenance of signalling devices must be respected. In the field and repairs undertaken in the Central Laboratory/premises, manufacturer's card/module/subsystem level replacement shall be performed. Annual Obsolescence and evolution management contract for relevant vendor/OEM hardware and software.
Train Working Under Emergency	On-site running with an automatic speed limit of 25Kmph on line side signals

Table 5.2 Standards Adopted To Signaling System

5.5 TELECOMMUNICATION SYSTEM



System	Standards
Transmission System	MAN/LAN based on SDH or Ethernet
Transmission Media	Fiber optics system as the main carrier for the Telecom Network Main.
Telephone Exchange	An Exchange 60 Ports to be provided in Terminal Stations and the Depot shall be provided with IP EPABX of a minimum of 30 ports at all stations.
Train Radio System	Digital Train Radio (TETRA) Train Operator of moving cars, stations, maintenance staff, depots and central control communication.
Train Destination Indicator System	LED/LCD boards with a sufficient visibility at every station to be provided for a bilingual visual indication of the running train status and special messages in emergencies in a convenient location.

Centralized clock system	Precise time-display through a slave clock sync system driven by a master clock on the OCC and a station/depost sub-master clock.. This is also used for other systems synchronisation..
Passenger Announcement System	Passenger advertising system covering all local platform and competition areas
Video Surveillance	Network video recorders on stations, central management, video analytical features, and video wall display.
Redundancy (Major System)	Radio base station equipment redundancy. Path Redundancy in ring configuration for Optical Fiber Cable
Maintenance Philosophy	Automatic switching system to alternative routes/circuits in case of failure to the maximum possible extent. Preventive maintenance control philosophy to be followed. System for error diagnosis and coordination networked with NMS. Replacement of card/modul levels in the field and repairs carried out in the central laboratory/manufacturing premises shall be carried out. Hardware / software maintenance contract as needed to manage the advancement of technology.

Table 5.3 standards for telecommunication system

SN	Description	Minimum requirement
1	Type of Signalling	CATC Cab Signals (ATP, ATO, ATS). ATP and ATS are necessary, optional ATO
2	Back up Signalling	Line side (CLS) in all interlocked stations at entry and exit..
3	Train control system	CATC(ATP, ATS, ATO optional)
	For Main Line	High tensile, high-performance machine point non-trailable
	For Depot	High-performance trailable machine with high thrust
4	Redundancy in cab equipment for ATP (Cab Sig.)	1+1(hot standby)

Table 5.4 inspection checklist for signalling system

SN	Description	Minimum requirement
1.	Tele communication	The system is integrated with OFC, train radio and CCTV, clocks, PA system and should also include train display boards on stations. As far as the radio system is concerned, the standards should be fully digital and duplex based on technological and economical factors..
2.	Positive Train Identification	The ATS and Train Radio interface is provided with

Table 5.4 Inspection checklist for telecommunication

5.5 FIRE SAFETY AND SERVICES –

- 12 Staircases
- 2 common lifts
- 2 main entry and exit
- 24 Escalators
- 18 Emergency Exits
- 8 Toilets



Fig.5.9 common lifts

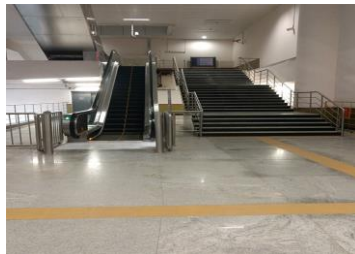


fig 5.10 staircases

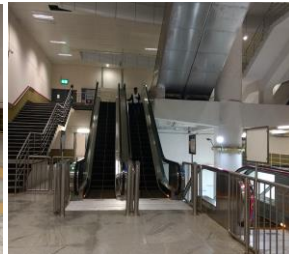


fig 5.11 Escalators



fig 5.12 An entry for fire entry man



Fig 5.13 Fire Extinguishers



fig 5.14 Fire exit Corridor

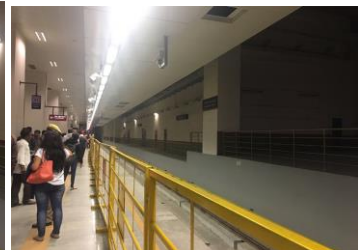
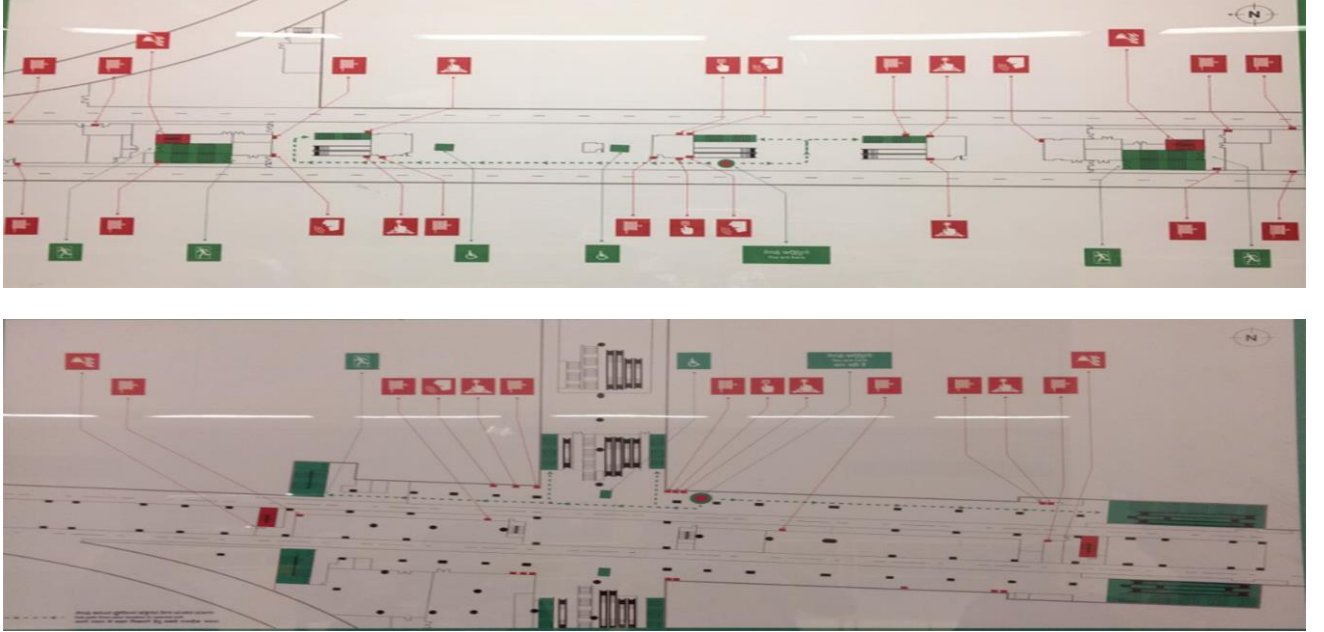


fig 5.15 Warning strip

The safety of passengers is primarily ensured through access control and CvCTV installation in stations, sensors and alarm systems for the monitoring, check and check of passengers in unmanned

areas. Concourses gates, intrusion detection system baggage scanning.(IDS), video on-board monitoring Train recording, sabotage control, etc.

EMERGENCY EXIT PLAN



LEGENDS



Fig5.16 EMERGENCY EXIT PLAN

S. No	SPECIFY AREA	NBC	IFC	NFPA	BANGLORE METRO STATION	
1.	Site entrance	Two way	20ft	Direct access to main road	2 Entrances West and south	

2	Road width	If single way – 50ft Two way - 100ft	25ft	All around 25 ft single way	100ft Provided	
3.	Door	Min of 7ft width with 2hr FR	2-4 hr FR	2-4 hr FR	provided	
4.	Corridor Width	10Ft min handrail	10 ft	15ft with handrail	Provided with handrails each and every coridor	
5.	Staircase	2 stairways more than 500m2 Min thread- 250mm Min riser – 300mm	Staircase with stairway exit	Staircase min of 10ft	12 staircases 5 fire staircases	
6.	Lift	Min – 2nos Fire rated material with 2hr FR	Had separate backup	Near critical area	2 common lifts provided	
7.	Signage	Clear and Visible	Illumination board	Illumination with lighting	Provided with back up	
8.	Refuge area	Above 1200m2 to be provided	If height of the building is more than 50ft	Near critical area	Na	Na

9.	Emergency lighting	24Hrs Backup	Min backup	N/A	Provides in every	Critical zone
10.	Assembly Area	Emer exit and open ground	Emer exit and open ground – min 10m2	Open ground to be provided	Provided both side of entrances	

Table 5.5 comparison of standards with station provisions

FLAMMABLE AND COMBUSTIBLE MATERIALS			
Are combustible scrap, debris and waste materials (oily rags, etc.) stored in covered noncombustible containers and promptly removed from the worksite?	☐	☐	☐
Is proper storage practiced to minimize the risk of fire, including spontaneous combustion?	☐	☐	☐
Are approved containers and tanks used for the storage and handling of flammable and combustible liquids?	☐	☐	☐
Are all flammable liquids kept in closed containers when not in use (e.g., parts cleaning tanks, pans, etc.)?	☐	☐	☐
Are bulk drums of flammable liquids grounded and bonded to containers during dispensing?	☐	☐	☐
Do storage rooms for flammable and combustible liquids have explosion proof lights and mechanical or gravity ventilation?	☐	☐	☐
Are firm separators placed between containers of combustibles or flammables, when stacked one upon another, to insure support and stability?	☐	☐	☐
Are fuel gas cylinders and oxygen cylinders separated by 20 feet or fire resistant barriers 5 feet in height during storage?	☐	☐	☐
Is liquefied petroleum gas stored, handled and used in accordance with safe practices and standards?	☐	☐	☐
Are liquefied petroleum gas storage tanks guard to prevent damage from vehicles?	☐	☐	☐
Are "NO SMOKING" signs posted on liquefied petroleum gas storage tanks?	☐	☐	☐
Are "NO SMOKING" signs posted in areas where flammable or combustible materials are used or stored?	☐	☐	☐
Are "NO SMOKING" rules enforced in areas where flammable or combustible materials are used or stored?	☐	☐	☐
Are all solvents and flammable wastes kept in fire resistant, covered containers and promptly removed from the worksite?	☐	☐	☐
Are approved containers used for storage and dispensing flammable or combustible liquids?	☐	☐	☐

Table 5.6 checklist for fire suppression system

CHAPTER -6 STUDY AND ANALYSIS

6.1 INTRODUCTION

UNDERGROUND METRO STATION – CHENNAI

Chennai Metro Phase-II

6.1.1 STATION PLANNING

We have 2 types of underground station implemented in Chennai

Type -1 190M X 21.80M X 2 LEVELS

150M X 21.80M X 2 LEVELS

Type -2 -150m x 21.40 m x 3 levels

- stations are generally scheduled around island platforms, while higher platforms are proposed. Subway stations with side platforms can also be planned in special circumstances.
- Boarding/enlightenment station and the resulting input/output requirement.
- Railway level ground constraints due to existing/planned structures such as flyovers, ramps etc.
- Providers such as fires, ventilation and water needs
- Structural needs
- Design flexibility to allow stations to meet specific site requirementFuture expansion if required
- If necessary, further expansion

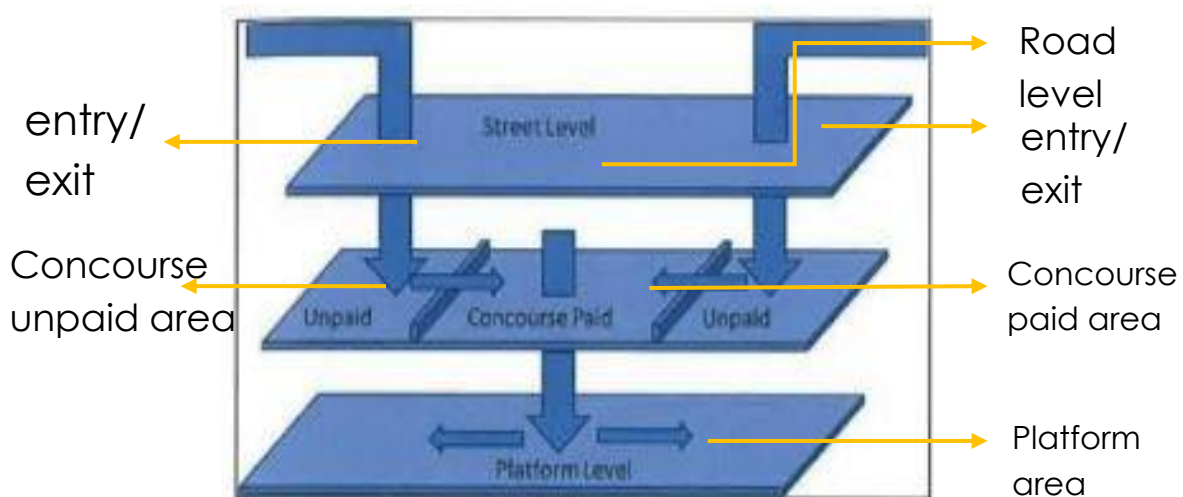


FIG – 6.1 Arrangement of underground station chennai

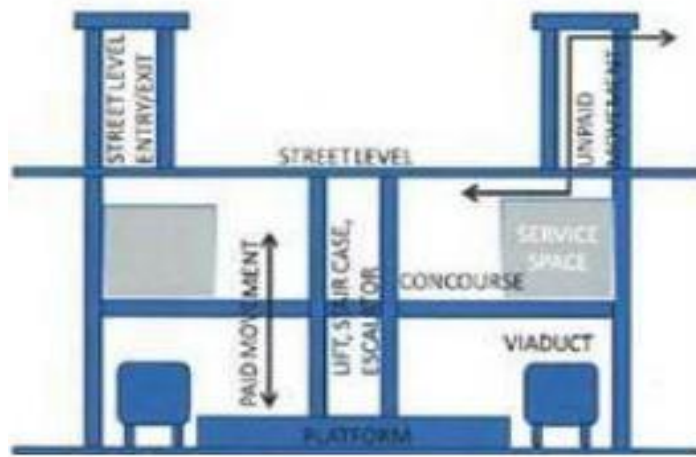


Fig 6.2 CROSS-SECTION OF A TYPICAL UNDERGROUND STATION

Type -1 150m x 21.40 m X 2 LEVELS

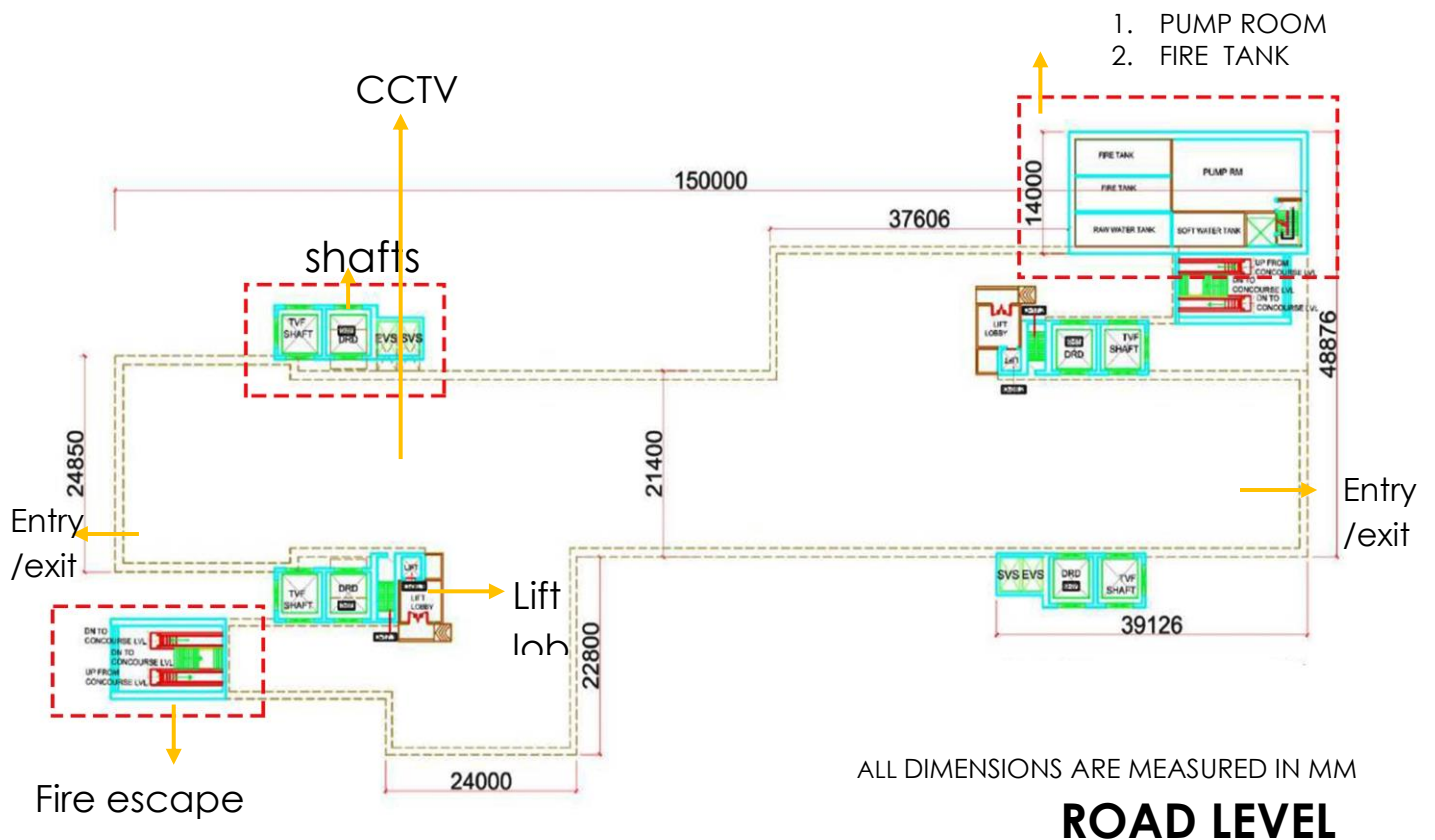
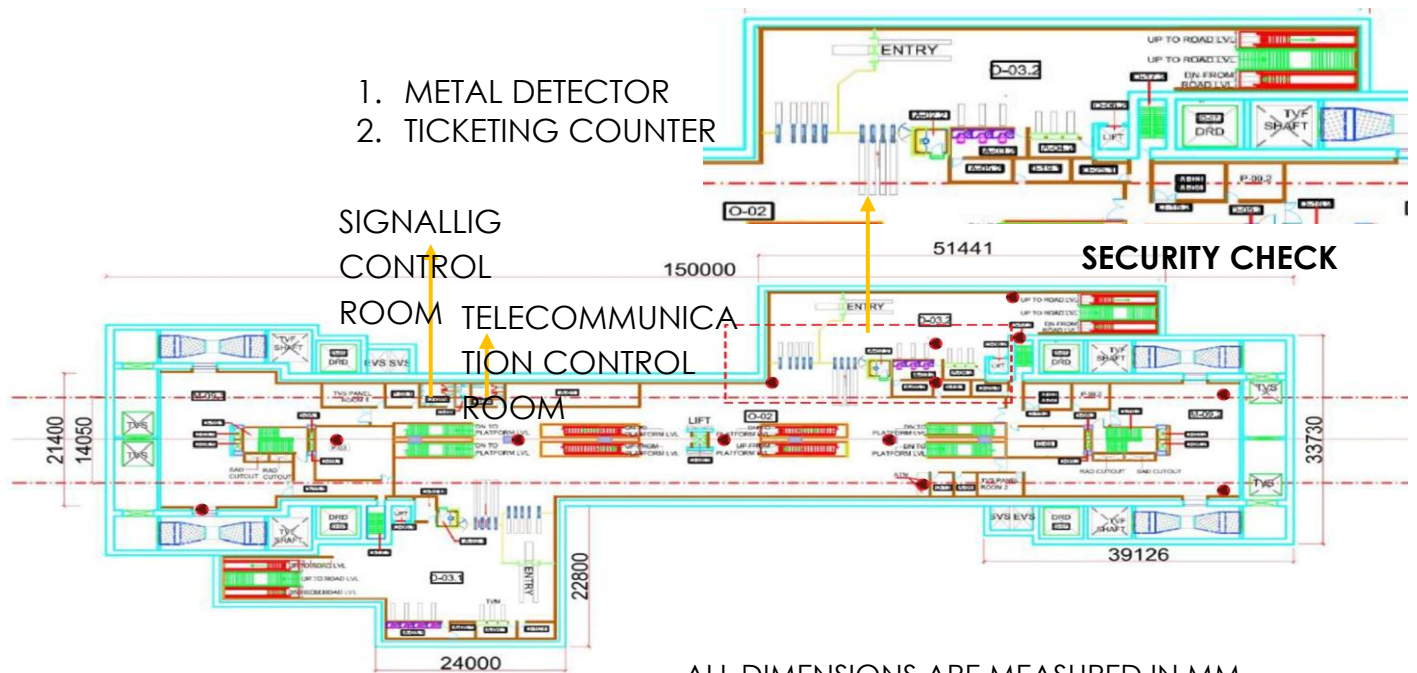


Fig 6.3 plan showing the road level in Chennai underground stations type -1



CONCOURSE LEVEL PLAN

Fig 6.4 plan showing the concourse level in Chennai underground stations type -1

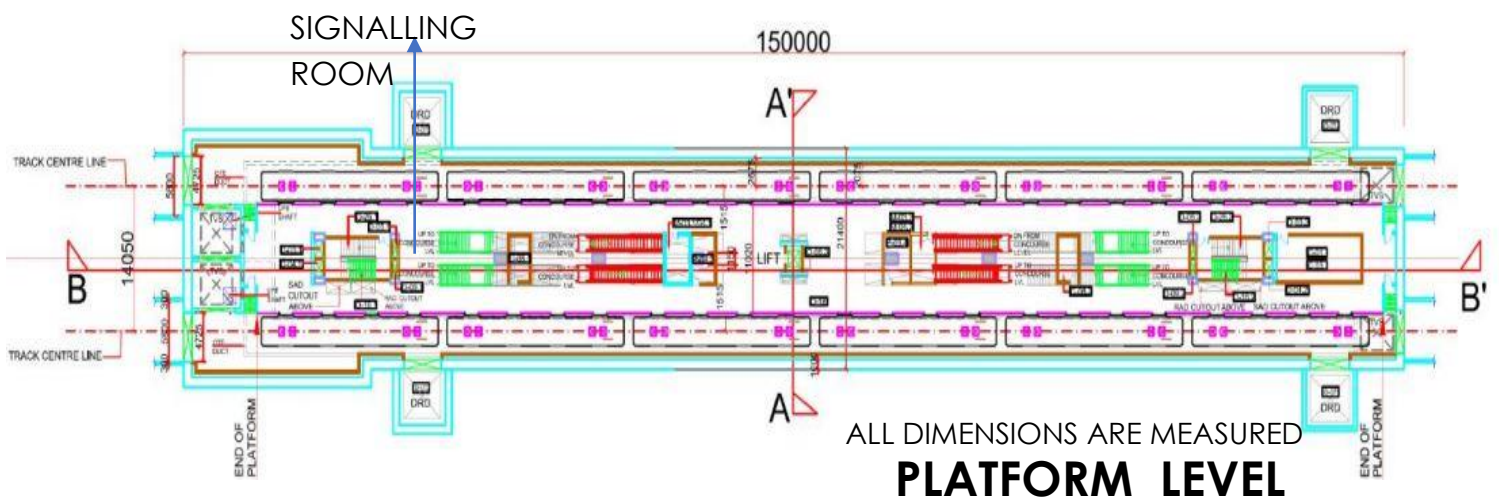


Fig 6.5 plan showing the platform level in Chennai underground stations type -1

6.2 The concourse level comprises of

1. unpaid concourse,
2. TOMs, AFC In and out Gates,
3. public toilets (located in paid area) and
4. EFO and few retail spaces.
5. All the passenger amenities,
6. mechanical equipment rooms,
7. TVS panel rooms,
8. UPS rooms, station operation areas such as
 - station control room,
 - communication room,
 - UPS & battery room,
 - janitors & refuge rooms etc are also providedin the concourse and the extended area

Platform level has platforms,

1. tracks,
2. Signaling Room,
3. Telecommunication Closet,
4. seepage room, sewage & drainage rooms,
5. Tunnel ventilation room and
6. similar ancillary spaces beyond the platforms on either side.

Two banks of 2m of staircases on each side, 4 escalators and 2 fire escape staircases have been designed from concourse to platform to meet the traffic demands. In addition, provision of lift has been done to bring passengers from concourse to platform level and vice versa

CROSS SECTION OF TYPE 1- UNDERGROUND STATION

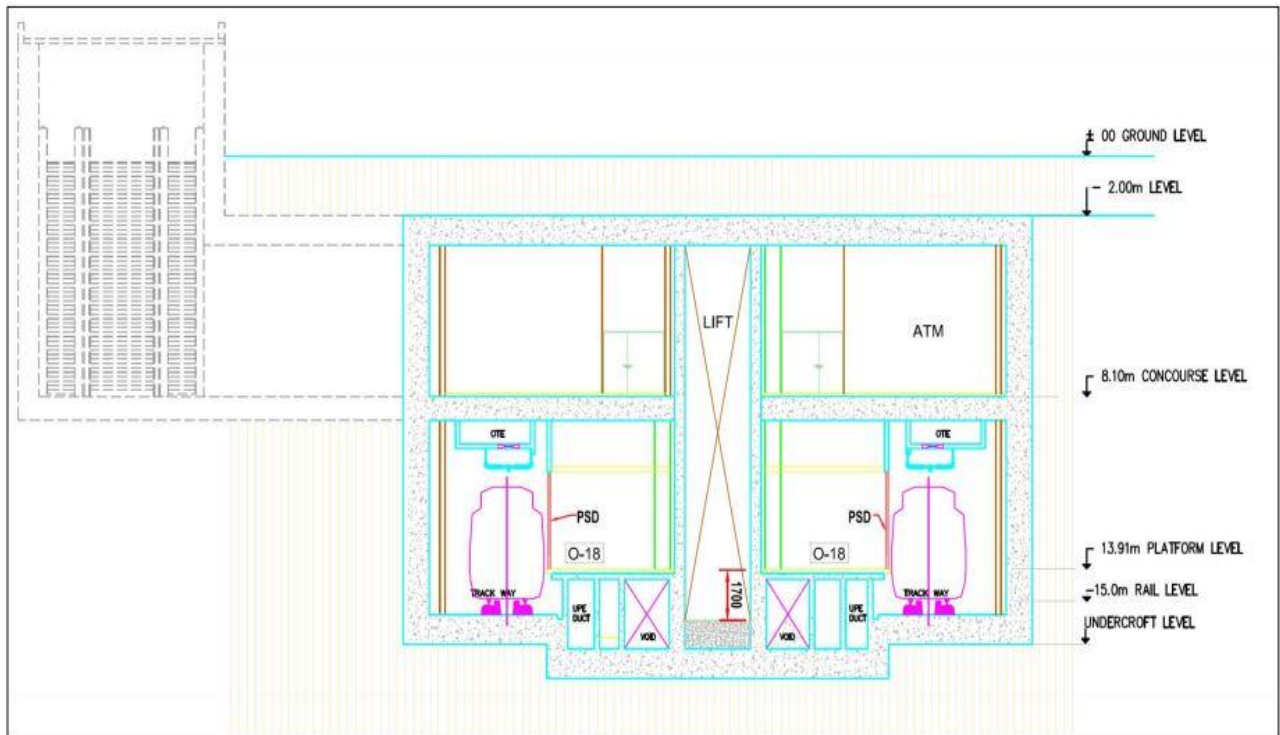


Fig 6.6 plan showing the cross section of Chennai underground stations type -1

Type -2 - 150m x 21.40 m x 3 levels

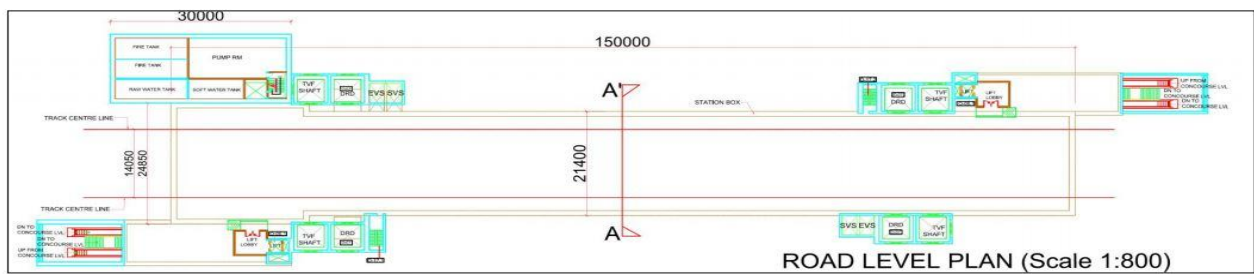


Fig 6.7 plan showing the Road level in Chennai underground stations type -1

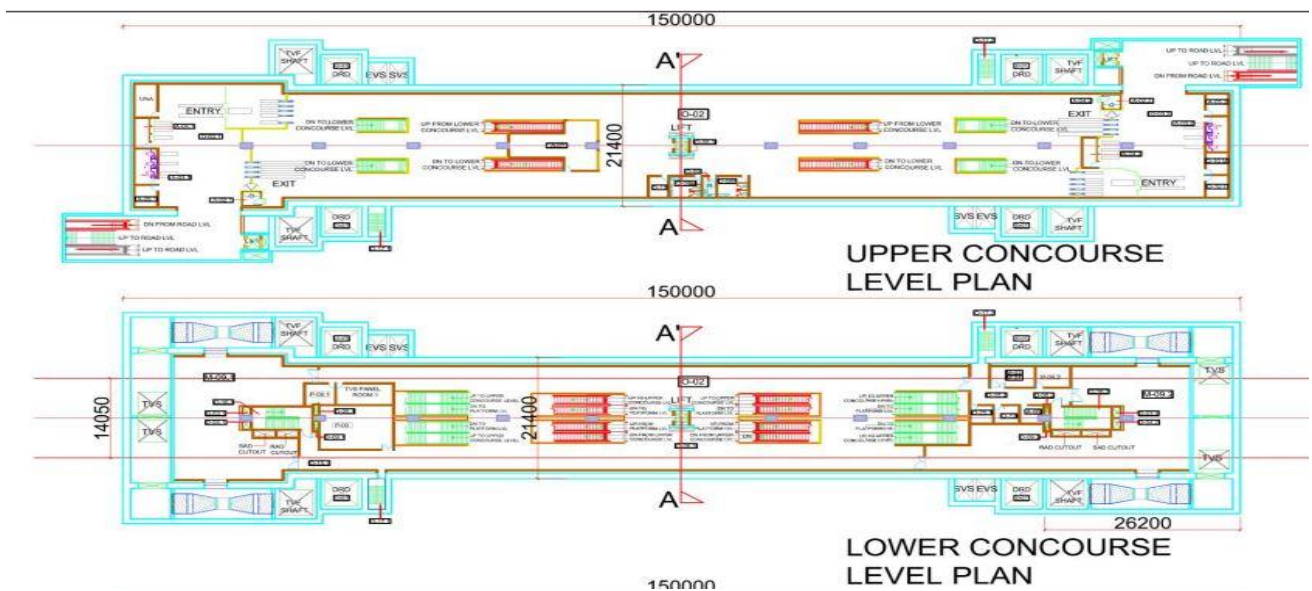


Fig 6.8 plan showing the upper and lower level in Chennai underground stations type -2

6.3 Emergency Evacuation Standards

The principles to be followed are: -

- i. The NFPA 130 states that the station is also designed to allow the evacuation in 6 minutes or less from the most remote point on the platform. The maximum travelling distance at the platform is not exceeding 100 m by a means of an exit route (300 ft).
- ii. The competition may be defined as a security point for enclosed stations equipped with an emergency ventilation system
- iii. According to NFPA, a platform should not exceed 4 minutes by maximum evacuation time. In view of the fact that the last person takes 4 minutes for the maximum occupant load to reach the nearest escalator staircase, the evacuation time for the underground station is calculated as
- iv. 3 levels. The layout of the station has been kept within 50 metres from the farthest point on the exit road. The control will be undertaken to ensure that the passengers are removed as a safe place at a level sufficient to allow people to move freely as they arrive from the staircases and escalators
- v. The emergency is only supposed to take place in one direction at any time

Standards	Time taken
The last person takes the time to evacuate the site	4min
Time for the escalator climb up to 6m vertical height competition (considered to be 14.63 m/min in accordance with the requirements of the NFPA 130)	0.41min
The time to walk is 20m (with a speed of 37.8m/min according to the NFPA 130) steps toward the upper race at the lower concourse level.	0.53 min
Time for escalation/escalator climbing up to the upper vertical height contour 5,25m (taking into account the 14,63m/min travel speed as per NFPA 130)	0.36min
Walking time of max. 20m at the upper level (61.0m / min in accordance with NFPA 130)	0.33min
Total Time	5.63min

Table 6.1 showing the standards of time taken for evacuation

6.4 Stairs Requirements

- There is a central handrail with a stair width of 4.5m or higher.
- Risers by air: at least 3, at least 12.
- Every step of a stair flight has the same size
- The width of the steps is 300mm / 150mm Riser
- Intermediate landing length: less than 2m or stair width
- Handrail: 50 mm (0.9m) high, 45 mm wall clearance.
- Step noses are rounded and coloured
- Public use: 2400mm minimum stair width;
- Evacuation Minimum Stair Width: 1100mm

6.5 Elevator Requirements

Public-service lifts will be classified with a minimum of 180 starting times per hour.

Lifts must be cord traction for a period of up to 20 hours a day (except special vacations which may be operated 24 hours a day) to operate safely and smoothly without jerking under any loading condition. Seven days a week shall be operating in the context of environmental conditions within the lift route and where elevators are installed.

The lift will be able to carry a minimum load of 750 kg, and can be measured so that the injured can be conveniently placed on a stretch with room for the lift bearer.

The lifting is at least 1.400 mm x 2.300 mm wide, and the door width is at least 1.100 mm clear and 2.200 mm high.

The lift speed will not exceed one minute at the upper discharge point.

The time to open at the top discharge point is calculated from the time when the doors are closed fully at the lowest discharge point. Regardless of the travel distance, the minimum speed shall not be less than 1.0 m/s. In accordance with the relevant standards, elevators will be fitted with facilities for the physically challenged

Minimum Corridor width

Standard	Minimum Corridor width
Movement of one direction	1.8 m
Movement in both directions	2.0 m
Where length of the corridor is more than 30m	3.0 m
For staff	1.2 m

Table 6.2 showing the minimum corridor width

Ramps

Preferred gradient	1:20
Maximum gradient	1:12
Minimum width: -	1.2m
• Unidirectional movement: • Bi-directional movement	1.5m
For ramp exceeding 10m,rest platform	1.8m

Table 6.3 showing the minimum ramp ratio

6.6 Installing Warning Paver Sites

There is traffic in front of an area.Before an entrance/exit to and from a crossing or staircase.. Metro stations and boarding areas are entering/exiting.Guidance & Alert Metro system tactile paving

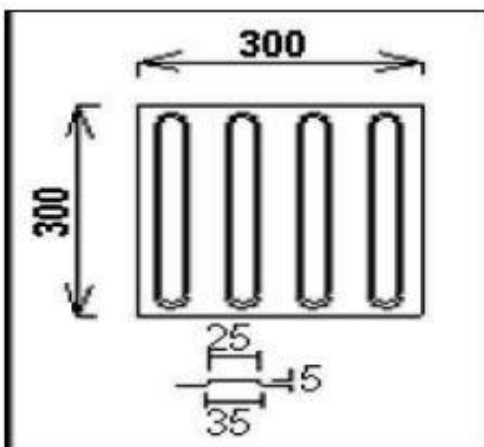


Fig 6.8 GUIDING PAVER

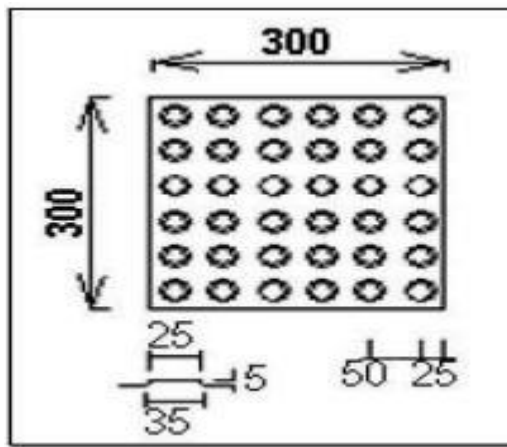


fig 6.9 WARNING PAVER

6.7 CONSIDERED MEASURES SECURITY for the disagreement of CHENNAI

6.7.1 Layout of the site and construction –

The main entrances/exits are on the front and street views of the site.

Controlled space is defined by a clear boundary (public to private)

6.7.2 Parking area and car parking facilities

Avoid a hidden recess.

6.7.3 Interior building

Natural monitoring shall be provided for common/open areas. Waiting areas and external entrances are situated in the vicinity of active areas to make them visible from the entrance to the building.

6.7.4 Entrances (To avoid confusion in locating building entrances)

Even design features and directional signage are easily recognisable.

There is limited access to the facilities.

There are minimised entry points.

6.7.5 Materials: materials (Usage of materials that reduce the opportunity for vandalism)

Vegetative screens are used where large walls are unavoidable

6.7.6 Terminals and Stations

The station design shall not contain storage lockers and baggage lockers.

Centres, ticket sales machines and concessions are placed in order to prevent sights from being obstructed.

In the nearby travelling part, the bathrooms are located, not a far away area.

Stations/terminals have open shafts or skyscrapers for natural light, where possible.

Stairways to increase visibility are left open.

6.7.7 Layout inside

a. For maximum presence and visibility in stations the operator booth is placed

6.8 Platform Planning Standards

The platform length is 140 metres. The length of the 6 auto train and the tolerance to stop for the railways is thus permitted.

The nominal platform wide measured between the edge of the platform and any continuous fixed structure (less than 2000mm) shall be at least 3000 mm. The minimum distance from the edge of the platform to isolated blockage, for example columns, is 2500 mm (an isolated obstruction shall not be longer than 2000 mm). This clearance is maintained, regardless of passenger flow, for safety reasons. In stations with large passenger flows, the platform width greater than the minimum is necessary.

With a non-rutting surface and a yellow warning band 100 mm width, the platform edge must have a safety margin of 600 mm. A 1200 mm wide safety entrance and a press mat alarm system shall be installed at the platform ends

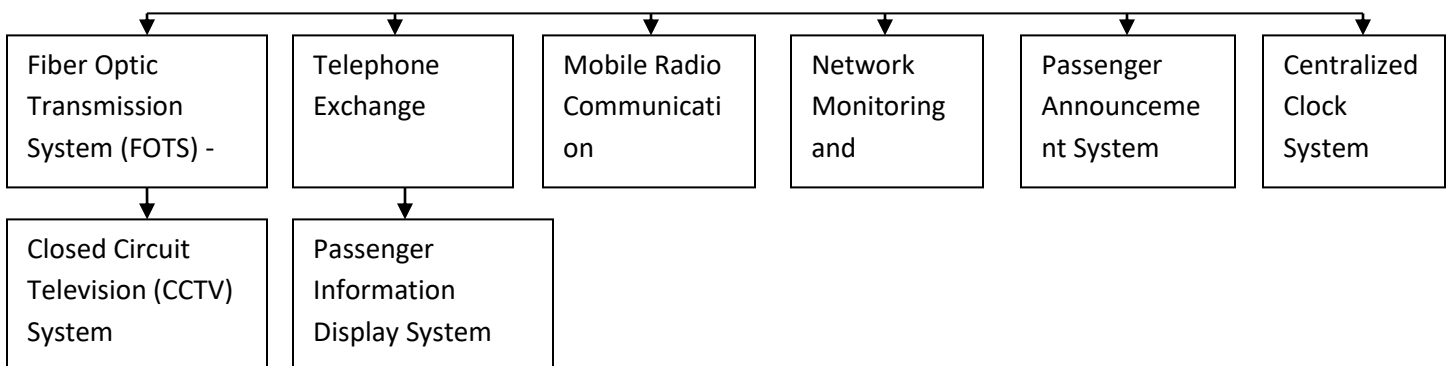
he platform and ramps must be marked with a view to assisting and checking passenger flows for boarding and alighting with step-free access from/to trains. Tactile trailers and warning strips shall also be provided for visually impaired persons to make it easier for disabled people to travel.

Built platforms also ensure bright colour contrast to people of low vision; large displays of signs and information and digital signage; elevators with lowered braille control panels and elevated control buttons and auditory signals, large doors and gripping rails at the lift's side walls; resting places for senior citizens and persons with reduced visibility; well lit platform corridors along the lift car. The room for wheelchair users, audio announcement and sensory door closing mechanisms will be available inside the cars.

The platforms shall have a clear headroom with structural and platform signs at least 3000 mm width across the entire length of the platform edge. The minimum clearance of 2100mm above the finished floor shall be suspended signs, fittings and fittings

Automatic screen walls / platform screen doors shall be provided for the platforms in order to ensure passenger safety. When the train comes in sync with the train doors, the platform screen doors would open. The screen doors on the platform would be high in the subway stations (to ceiling level).

6.9 TELECOMMUNICATION SYSTEM



6.9.1 Passenger Announcement System

The public address system is capable of digitising voice messages and long-range PA functionality for emergency evacuation. The public address will usually be for stations, providing automated information for the time and destination of the next schedule train, the special upcoming event, pre-determined safety and security announcements, and general information for all users but in particular the visually impaired.

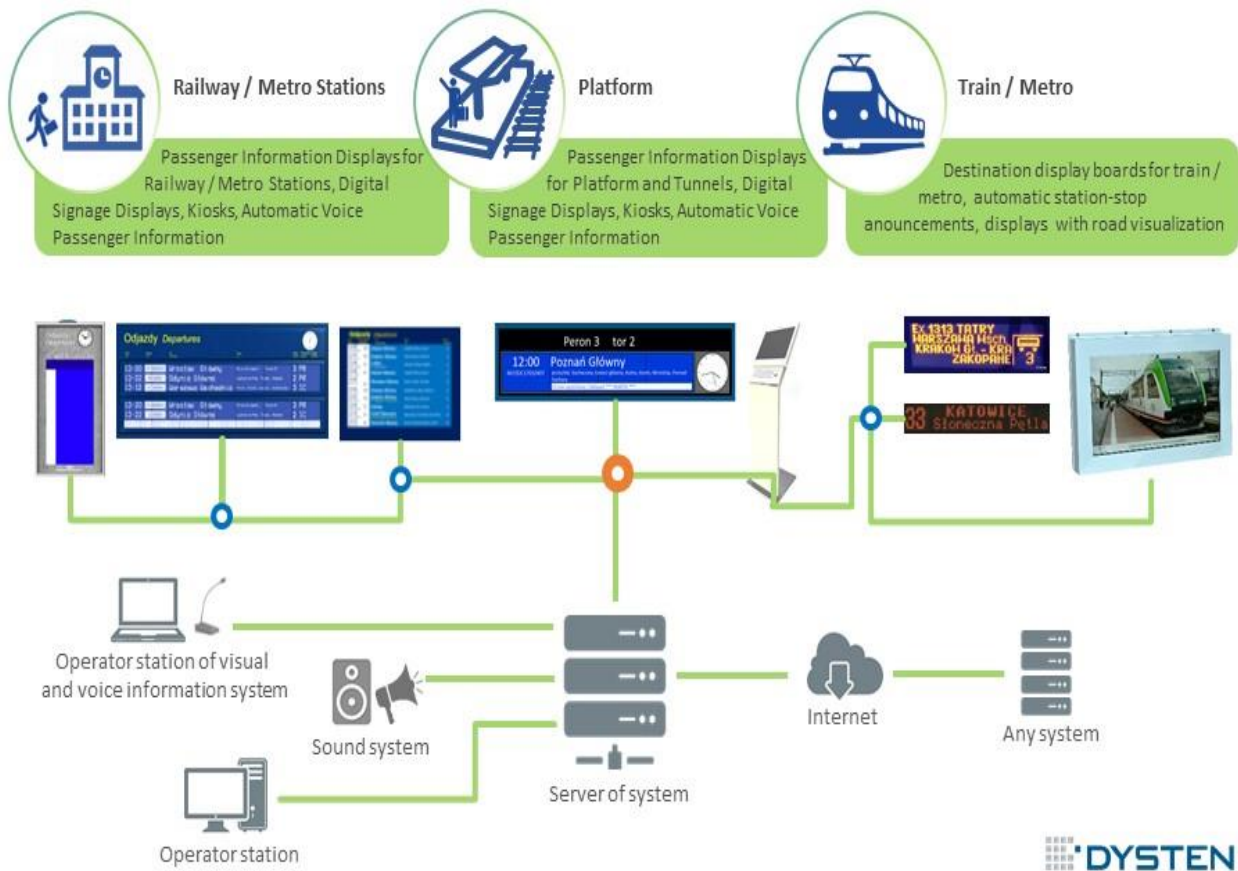


Fig 6.10 Passenger Announcement System

6.9.2 Closed Circuit Television (CCTV) System

CCTV system should ensure that all public and selected areas such as cross-passes, auxiliary buildings, secure passenger management, crowd control and other emergencies are monitored in real time and fully covered. For post-video analysis, event reloading is possible. Operational rooms such as OCC, SCR etc. must also provide CCTV cameras. A

proper IP-based capture and storage facility is guaranteed for recording and storing events for at least one month.

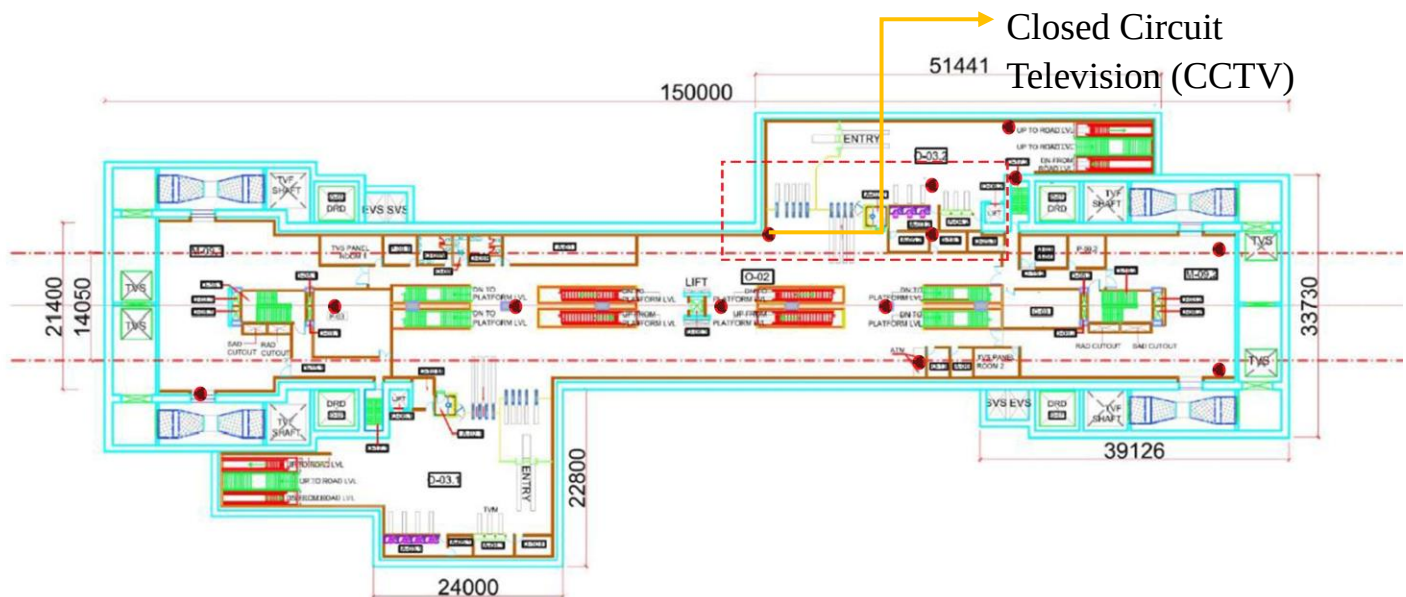


Fig 6.11 plan showing the cctv placements in the platform

6.9.3 Passenger Information Display System

Available LCD/LED (Flat Panel) display boards will preferably be available at all stations. The PIDS is train-operated (signalled) with manual input facilities at the local station as well as the central location (OCC) In order to provide a trilingual indication on the status of running trains (Tamil, English & Hindi), the Passenger Information display boards will be presented at convenient locations at all stations and typically provide information such as destination, platform numbers, arrival and departure times, as well the special emergency messages. Boards are available at all terminal and junction station platforms and competitions

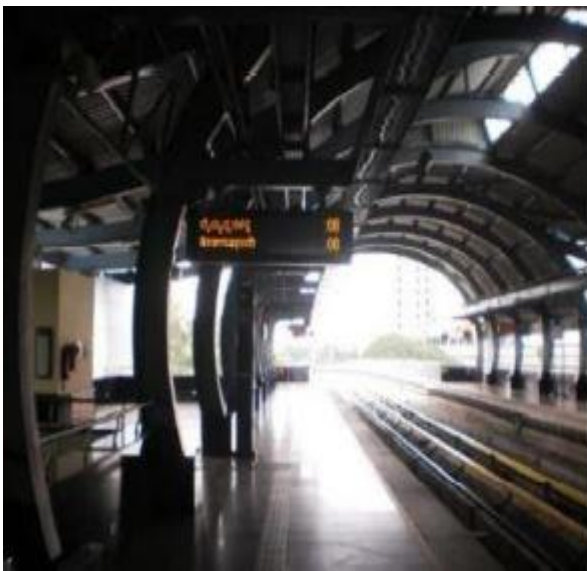


Fig 6.12 Passenger Information Display System

6.10 SERVICES

An efficient system must be established, including
Fire detection and removal system,
Management of smoke,

System for Environmental Control (ECS),

Ventilation system for tunnels,

Exhaust System Track-way (TES),

System of illumination,

Power supply system of the station,

Seepage system, DG Sets & UPS,

The system of water supplies and drainage,

The system of wastewater treatment,

Area Lights Station

6.11 MEASURES IN CASE OF FIRE

Because of the large concentration of passengers in stations and in trains, fire is recognised as one of the most feared accidents on metro. Therefore the most significant component in Metro's disaster management is fire prevention and rapid response to any incident of fire or smoke emissions. Fire prevention measures universally accepted include:

- i. Strict compliance with non-smoking regulations
- ii. Total prohibition of the transport of flammable/explosive substances to metro facilities and trains
- iii. Non-missile accumulation in and within the metro station
- iv. The directions must be rigidly implemented through regular inspections by all staff posting in stations.

CHAPTER 7

RECOMMENDATIONS AND CONCLUSIONS

7.1 NEED FOR DISASTER MANAGEMENT MEASURES

- Save life and ease the pain.
- Provide assistance and arrange rapid evacuation for stranded passengers.
- Providing accurate information gives everyone a sense of security.
- Protect the property of Metro Rail.
- Relaunching trains as early as possible quickly.
- Draw up actions necessary to ensure that personnel take prompt and coordinated crisis management in the event of a disaster at Chennai Metro Rail Corporation
- Ensure that all officials responsible for handling the situation know their duties and responsibilities thoroughly. In order to prevent confusion and chaos in the present situation, and to allow them to discharge their responsibilities with vigilance and rapidity, it is important that these officials & workers are adequately trained beforehand

7.2 MEASURES IN CASE OF FIRE

Fire and Smoke

Fire in a Train

Station Platform Fire in the Train

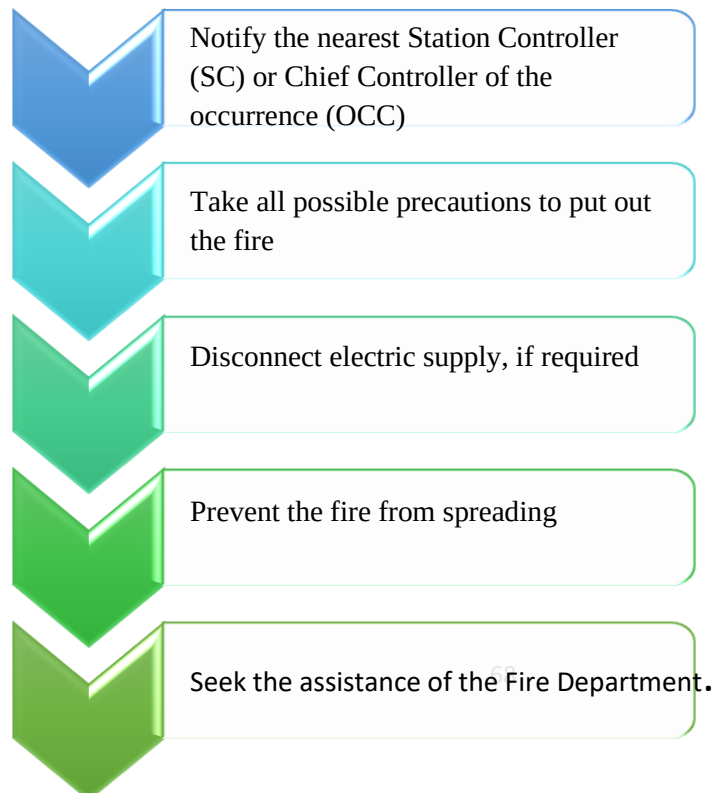
Underground Special Instructions

Fire Suppression System

Fire in the premises of Metro Station

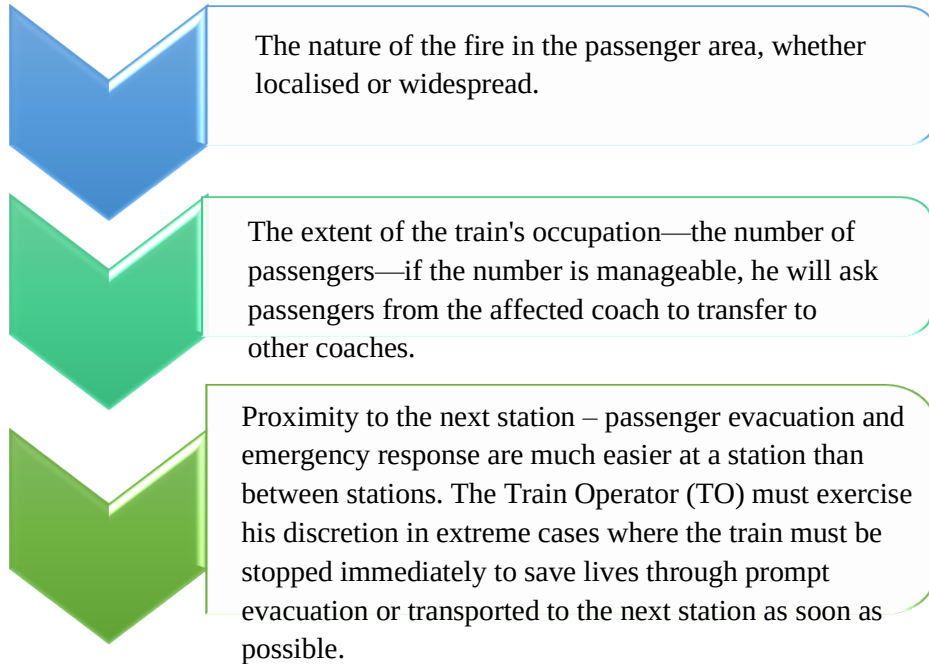
7.2.1 Fire and Smoke

Every Metro Rail Official, whether duty or not, in the event of a fire and/or smoke in the train, station premises, right of way, including the tunnel or other subway facilities



7.2.2 Fire in a Train

The guidelines outlined below are best practises based on content analysis of previous accidents on other Metros. Because each fire incident is unique, the train operator must make quick decisions based on



7.2.3 Fire in Train at the Station Platform

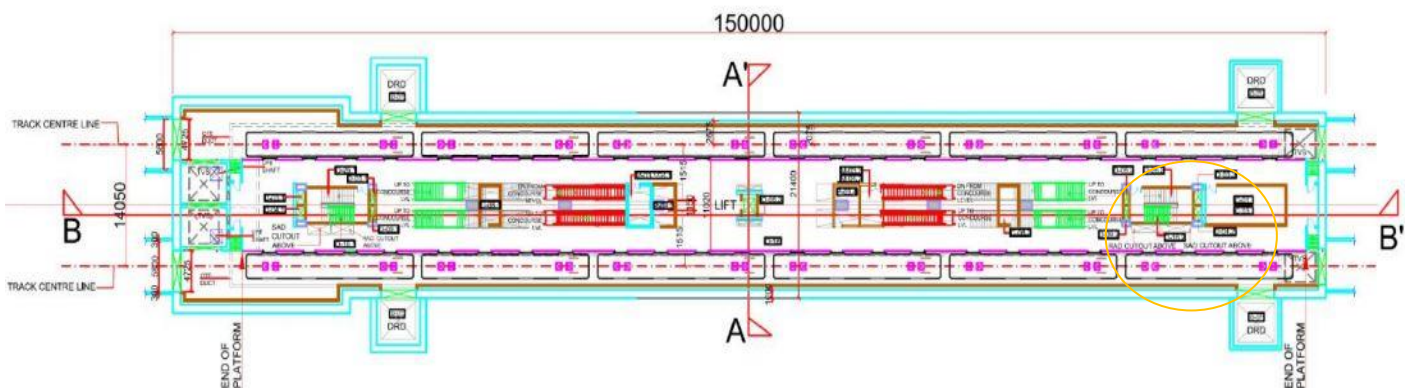
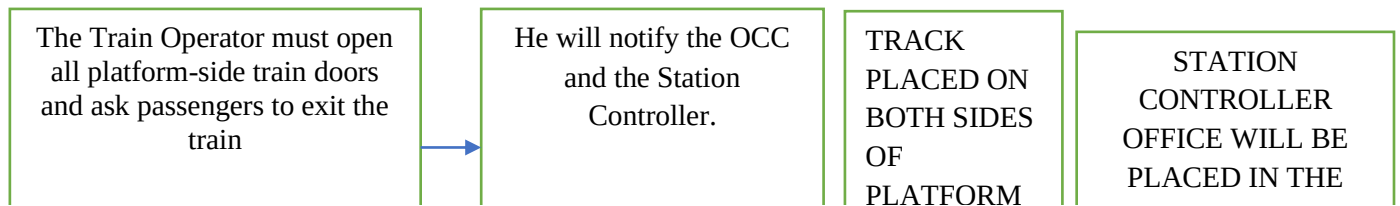
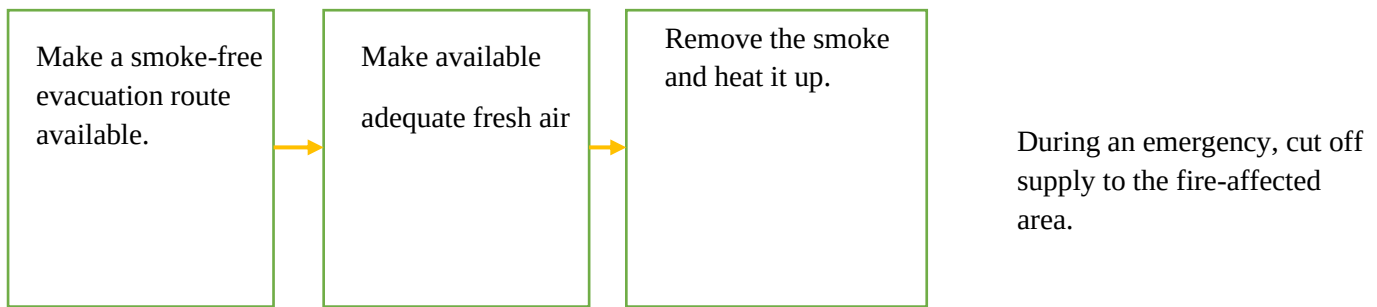


FIG 7.1 PLACEMENT OF TRACKS AND OCC ROOM

7.2.4 Underground Special Instructions

The entire underground Metro network is outfitted with a Tunnel Ventilation system that can be controlled centrally from the OCC as well as locally from Station Control Rooms.



A water pipeline should run the entire length of the underground Metro corridor. Hydrants are installed every 15 metres along these pipelines, where hose pipes can be connected. The pipes are extremely useful in quickly extinguishing any fire outbreak. Each underground section should have one to three cross passages connecting the up and down tunnels. In the event of an emergency, these passages can be used to quickly evacuate commuters. A Fire Detection and Suppression system is installed to automatically activate alarms for Vents, Fans, and Dampers, as well as Suppression equipment. The system is controlled by a panel in the Station Control Room.

7.3 Fire Suppression System

A wet Fire Main System runs the length of the tunnels as well as the station area. There are also automatic sprinklers, inert gas-based suppression systems, and portable fire extinguishers located throughout the facility. Upon receiving information about a train being held up between stations due to a fire, the Auxiliary System Controller (ASC) will act immediately.

Determine the location of the fire (front/back of the train)

Determine the affected ventilation zone

Other trains were held up due to a lack of ventilation.

Assist OCC in determining the best route for passenger evacuation.

Determine the proper TVS Master mode and operate the TVS system.

Inform TO of the evacuation route via TC

7.4 MEASURES IN CASE OF NATURAL CALAMITIES

7.4.1 IN CASE OF EARTHQUAKE

When informed of or experiencing an earthquake in Chennai, the OCC Traction Power Controller (TPC) will switch off Traction Power Supply in a way that does not shut down station supplies, informing the Traffic Controller, who will instruct the TOs to stop their trains and report their position.

- If he arrives at the station, he will not move the train, will notify OCC, and will advise passengers to remain inside the train.
- Trains waiting at stations will detrain passengers once the OCC has confirmed that the earthquake has subsided.
- TOs to visually check the track for trains held up between stations. After informing the OCC/TC, if the track is unaffected and there are no visible obstructions, the train can be moved at walking speed up to the next station where passengers will be detrained.
- The train operator (TO) will keep passengers updated on the situation and ask them to remain calm.

7.5 SECURITY MEASURES – BACKGROUND

THREE PILLARS OF SECURITY

7.5.1 The Human factor

Staff interaction with passengers creates a sense of security that technology cannot fully replicate. Staff must be qualified, trained, well-equipped, and motivated in order for the human factor to be more effective. Staff members should be knowledgeable, well-trained, well-drilled, and well-experienced.

7.5.2 Procedures

The security risk assessment is the first step in determining the needs and allocating resources. Security should be organised in a clear and consistent manner. Security incidents, particularly major ones, frequently occur without warning. In advance, emergency and contingency plans must be developed, communicated, and tested.

7.5.3 Technology

Surveillance systems are one example of a technology that can be used to improve security. Security systems have different goals, such as detecting a plan before an attack, denying access to carry out an attack, and implementing mitigation measures after an attack.

DIFFERENT PHASES OF SECURITY

7.5.4 Prevention

These can be identified through risk assessment and intelligence gathering. Prevention starts with the day-to-day operational security issues. Controlling unused, damaged properties, which could otherwise serve as a breeding ground for more serious crime, must be done with caution.

7.5.5 Preparedness

Plans must be in place to respond to incidents and mitigate their consequences. Staff must be properly trained to carry out the exercises. The results of the risk assessment will serve as the foundation for such plans.

7.5.6 Recovery

After an incident, the urban transportation system should have procedures/instructions in place to quickly restore normal service. Financial health is critical for the recovery operation, but it also sends a clear message to the public, reassuring passengers and instilling confidence in them to continue using the system. Communication is critical to resuming normalcy as soon as possible after such incidents. The restoration process should also include an evaluation of the lessons learned.

7.6 PROPOSED PROVISIONS FOR SECURITY SYSTEM

CCTV coverage of all metro stations, with monitoring in the Station Security Room as well as in a Centralized Security Control Room equipped with a video wall, computer with internet access, TV with data connection, printer, and telephone connection (Land Line and EPBX) for proper operation, and cluster viewing for stations.

Minimum of three multi-zone Door Frame Metal Detectors (DFMD) per entry (2 per AFC array). The number may rise as a result of increased foot traffic at overcrowded stations.



Wireless sets (both static and handheld) as required by the security agency





FIG 7.3 SECURITY EQUIPMENTS IN STATION IN CAUSE OF BOMB THREAT

Dog Squads (Sniffer Dog), with at least one dog assigned to each metro station. The metro train depot administration will also provide dog kennels, as well as provisions for dog handlers and a MI room, as well as land at suitable locations along the lines.

One bulletproof Morcha per security checkpoint (i.e. AFC array) and metro train depot administration entry gate

s.no	specify	kempagowda metro station	Chennai central dr.MGR
1.	location	Bangalore , Karnataka	Chennai, Tamilnadu
2.	Entry/exist	4 no's	6 no's
3.	Platform	4 no's 4 no's Platforms - working	8 no's 4 no's platforms – working 4 no's platforms – not

			working
4.	Levels	G + 3 Levels	G+ 4 levels

5	Station layout	GROUND LEVEL - Street level Entrance	GROUND LEVEL - Street level Entrances&
		Exits	Exits UG
		UG Level-1 - Mezzanine Fare control, station,	UG Level-1 Mezzanine Parking
		Metro Card vending machines, crossover	UG Level-2 concourse Fare control, station,
		UG Level-2 - Platforms	Metro Card vending machines, crossover
		UG Level-3 - Platforms	UG Level-3 - Platforms
			UG Level-4 - Platforms

S . N O	SPECIFY AREA	NBC	IFC	NFPA	kempagowda	Dr.Mgr metro
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1	Site entrance	Two way	20ft	Direct access to main road	West and south	4 ENTRANCES
2	Road width	If single way – 50ft Two way - 100ft	25ft	All around 25 ft single way	100ft Provided	100 FT ROAD
3	Door	Min of 7ft width with 2hr FR	2-4 hr FR	2-4 hr FR	provided	PROVIDED
4	Corridor Width	10Ft min handrail	10 ft	15ft with handrail	Provided with handrails each and every coridor	Provided with handrails each and every coridor
5	Staircase	2 stairways more than 500m2 Min thread- 250mm Min riser – 300mm	Staircase with stairway exit	Staircase min of 10ft	12 staircases 5 fire staircases	16 staircases 8 fire staircases
6	Lift	Min – 2nos Fire rated material with 2hr FR	Had separate back up	Near critical area	2 common lifts provided	4 common lifts provided
7	Signage	Clear and Visible	Illumination	Illumination with lighting	Provided with back up	2 common lifts provided

			n board			
8 .	Refuge area	Above 1200m2 to be provided	If height of the buildi ng is more than 50ft	Near critical area	Na	Na
9 .	Emergency lighting	24Hrs Backup	Min back up	N/A	Provided in the platform level	Critical zone
1 0 .	Assembly Area	Emer exit and open ground	Emer exit and open groun d – min 10m2	Open ground to be provided	NOT Provided both side of entrances	PROVIDED IN 2 ENTRY AND EXISTS

Bulletproof vests and helmets for Quick Response Teams (QRTs) and riot control equipment, as well as space at designated stations According to the current arrangement, one QRT Team is in charge of 5-6 metro stations. One QRT is made up of five people who work in three shifts.

Comparison of banglore kempagowda metro station and Chennai dr.MGR metro station

S,NO	SPECIFY	kempagowda metro station		Dr.MGR Metro station
5.	Material finish	FLOOR FINISHES	WALL FINISHES	
		Kotah Stone	Clear toughened Glass	
		Granite stone	Glass Facade	
		Ceramic Stone	Polished Granite	
		Concrete paver block	Counter Top Granite	
		Yellow Warning strip	Vitrifies wall tile	

6.	services	- 12 Staircases -handrail is provided where stair width is 4.5m - Tread - 300mm - Riser - 150mm - Stair width for emergency evacuation: 1100mm - 2 common lifts - As per the standards - 2 main entry and exit - 24 Escalators - 18 Emergency Exits - 8 Toilets	- 16 Staircases - handrail is provided where stair width is 4.5m - Tread - 300mm - Riser - 150mm - Stair width for emergency evacuation: 1100mm - 4 common lifts - 4 main entry and exit - 32 Escalators - 24 Emergency Exits - 12 Toilets
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s.no	Specify	kempagowda metro station	Dr.MGR Metro station
7.	Fire safety	- Fire suppression method installed in each floor of the metro station - Evacuation plan is placed in the every visible places - The standards for the services such as fire staircase fire lifts are properly maintained and located - The assembly ground as per the norms it is not maintained as the way after evacuation is congested Hose reel fire exit - fire staircase - Fire exit plan	Fire extinguisher Exit hose reel Fire evacuation plan - Fire suppression ,method is placed in the every intervals in the concourse and the platform levels - Evacuation plan is not placed in the platforms only indicated by the signages. Evacuation routes should be placed for every users identification - The standards as per the norms the services is placed and it is more sufficient - The assembly place is kept in 2 entry and exits - The entry and exit of the station is well organized than comparing to the Chennai metro station

S,NO	SPECIFY	kempagowda metro station	Dr.MGR Metro station
8.	SECURITY	- In the entry of the station the security point is kept for checking the passengers - They use metal detectors and screening machines to check any explosives carried out by the passengers - Afc gates are placed for the checking the tickets - CCTV systems are placed in the every intervals which captures 360 degree of high defined focus which is connected and controlled by the communication panel - Warning strips are mentioned in every platforms - Warning strip and fencing	- In the entry of the station the security point is kept for checking the passengers - They use metal detectors and screening machines to check any explosives carried out by the passengers - Afc gates are placed for the checking the tickets - CCTV systems are placed in the every intervals which captures 360 degree of high defined focus which is connected and controlled by the communication panel - Warning strips are mentioned in every platforms

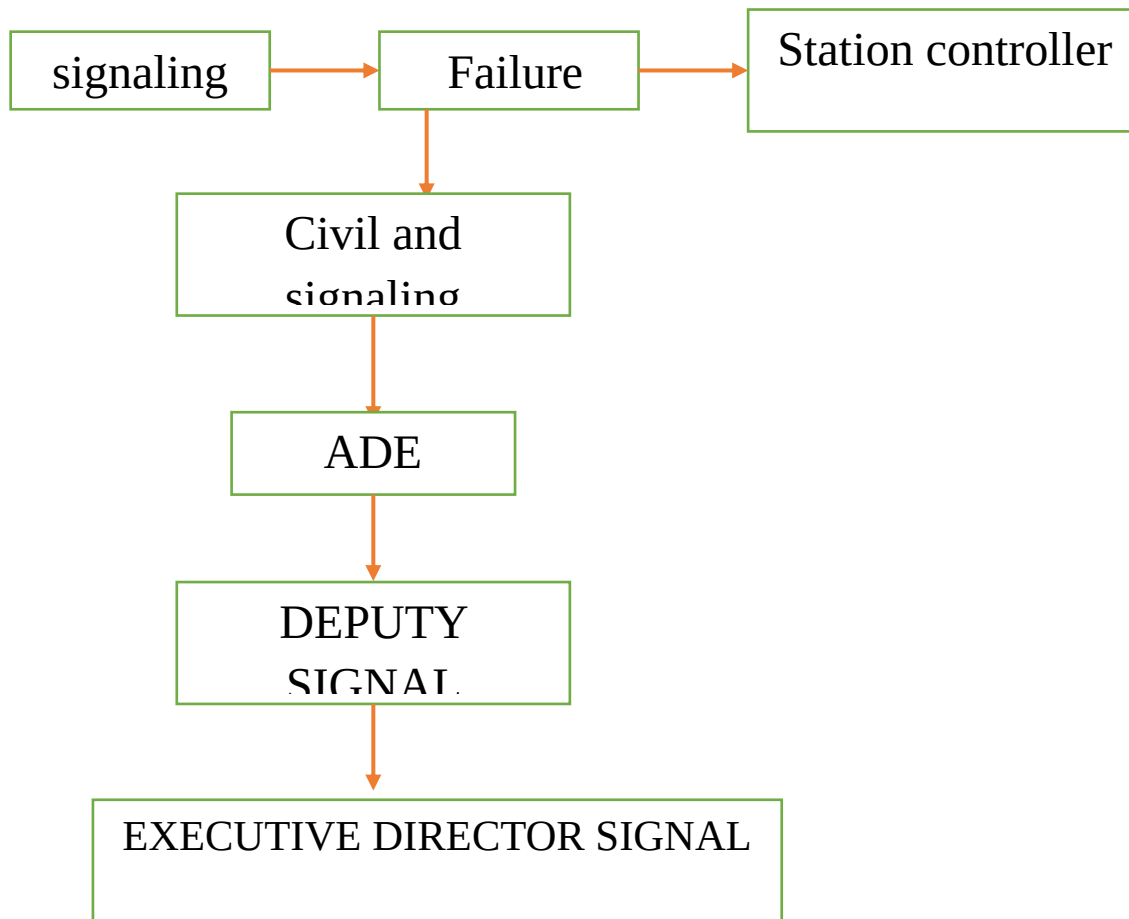
S,NO	SPECIFY	kempagowda metro station	Dr.MGR Metro station
9	Platform doors	- In the vision of safety ,platform doors should be provided but it is not provided in the station	- The platform doors are provided - CCTV FOR SURVELLIANCE AND WARNING THE PEOPLE AND SOME VOLUNTEERS ARE APPOINTED FOR THE GUIDANCE IF ANY ACCIDENTS HAPPEN .AND ALSO TO WARN THE PEOPLE REGARDING THE SAFETY

TABLE 7.1 COMPARISON OF BANGLORE AND CHENNAI METRO STATIONS

S.no	Specification	Yes	No
1	An alarm system, is it tested manually		
2	Fire doors are available and shutter is properly maintained		
3.	Are fire doors operating properly and unobstructed		
4	Are automatic sprinkler system water control valves and water pressure checked periodically		
5.	Is the maintenance of automatic sprinkler system assigned to competent persons or to sprinkler contractor		
6.	Is proper clearance maintained below sprinkler heads		
7	Are fire extinguishers provided in adequate number & type		
8.	Are fire extinguishers serviceable and mounted in readily accessible location		
9.	Are fire extinguishers inspected monthly and noted on the inspection tag		
10.	Are employees instructed in the use of fire extinguishers		
11.	Are required fire extinguishers mounted within 75 feet of any outside areas containing flammable liquids and within 10 feet of any inside storage areas		
12.	Is access to fire extinguishers free of obstruction		
13	Are all fire extinguishers are fully charged and in designed location		

TABLE 7.1 SHOWING THE INSPECTION CHECKLIST

7.7 MANAGEMENT OF SERVICES



- Planning of signaling services are done in the designing stage
- Installation of Mep services are done in the 1st stage of definitive
- The civil contractor and signaling contractor both are responsible in the failure of the work or process

Visibility of Signals

- Any obstruction impairing visibility of signal, permanent or temporary.
- Illumination of signals and focusing

