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ADVANCES IN FACILITIES PREVAIL IN MASS TRANSIT RAILWAY STATION IN ASIAN CITIES INCLUDING DHAKA: A REVIEW

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ABSTRACT

The fast growth of population in the urban areas of Asia mostly South Asian and East Asian countries has necessitated the modern and speedy mode of transport. Mass rapid transit (MRT) or metro rail and light rail transit (LTR) is a common approach to facilitate mass transportation thereby reducing traffic congestion in the cities. Usually MRT service are applied for a better, faster, safer, more comfortable and accessible transportation system to answer the mobility problems of citizens. Rapid transit systems are electric railroads that run on an exclusive right-of-way. That is constructed as grade-separated pattern either in tunnels or on elevated railways. This way is not accessible by pedestrians or other vehicles of any kind. Tokyo being one of the most developed Asian cities has a total 304 km of rapid transit line with 286 stations serving 6.84 million daily rides. The another image can be seen in Hong Kong with 230.9 km long mass transit railway with 165 stations and serving 4.96 million rides daily. The situation of Kula Lumpur MRT is also considered in this review. In comparison with these cities Dhaka the ninth largest and sixth most densely populated city in the world with approximately 8.9 million people is lagging far behind in case of a smooth and suitable urban mass rapid transportation system. The government of Bangladesh has taken a scheduled plan of building a railroad network consisting of 6 modernized metro rail under Dhaka Mass Transit Company Limited (DMTCL) with objectives of reducing traffic congestion and improving air quality of Dhaka City by constructing mass rapid transit system. Being a part of the Dhaka Transport Coordination Authority (DTCA) this whole system will cover a total of 128.74 km of railway with a total of 104 stations. The stations in MTR system are very modern in both of its construction and post-construction operation phase Therefore, this paper primarily reviews the facilities provided by mass transit railway stations including structural provisions, ticketing systems, basic equipment used and management system in different Asian cities. Finally, the outcome of the paper will be used by the students and graduates in engineering and management background.

Keywords: *Mass transit; Rapid transit; Grade separation; Traffic congestion; Station facilities.*

1. INTRODUCTION

The rapid growth of population worldwide has led to the construction and expansion of faster ways of communication. Usually mass railway transit (MRT) or light rail metro transit (LRMT) service are applied for a better, faster, safer, more comfortable and accessible transportation system to answer the mobility problems of citizens (Cledan 2010, MRT Jakarta 2013), consequently reduce the huge traffic congestion (Masirin et al. 2017). Rail way system depends on convenient transfers to attract users compared to any other modes of transportation. In an integrated transport system, railways are assigned the role of line haul service, with buses and other public vehicle performing the 2nd and 3rd tier of complementary services, according to their capacities and inherent advantages. The station plazas of major stations play a basic role in MRT system. They should be constructed to achieve smooth interchange between modes of transport. Metro Rail System is one of the most significant fields for further research and development. The system has many major components like, Rail tract, Rail coach, Stations, Signal system etc. The station of MRT is itself has importance as it has many different components in engineering and modern management point of view. The comparison among MRT stations are needed to be known for gaining knowledge by the undergraduate engineering and management students for their future involvement in design and operation of MRT stations to provide users satisfaction also. Brons (2009) state that, satisfaction with the level and quality of the access to the station is an important dimension of the rail journey which influences the overall satisfaction from that journey and that the quality and level of accessibility is an important element in explaining rail use.

There are numerous MRT stations which provide almost all kind of passenger facilities such as Shinjuku station in Japan, the busiest MRT station in the world serves almost 3.59 million people daily during 2018 with multiple facilities since 1885 (Web-1, 2021). The Central station in Hong-Kong is one of the longest stations in the world serving approximately 200,000 people on a daily basis (Web-2, 2021). These MRT stations have been providing different sort of passenger facilities. Among the stations 180 of Tokyo, 165 of Hong-Kong, 116 of Kula Lumpur and 104 (on going) of Dhaka are modern and well facilitated.
Dhaka is the capital and the largest city in Bangladesh. It is the ninth largest in area and the sixth most densely populated city in the world. The estimated population is 8.9 million (BBS, 2015) within the metropolis having an area of 302.92 square km (BBS, 2013), as of 2011. The city is surrounded by four rivers namely: Buriganga, Turag, Dhaleshwari and Shitalakshya with many canals mostly polluted and low flows. The past statistics has shown rapid population growth and it is expected to increase gradually in upcoming days. The annual population growth rate of Bangladesh is 1.003% (World Bank, 2020), whereas it is 4.2% specifically in Dhaka city estimated as of 2021 (Web-3, 2021). Population of other big cities of Bangladesh is also growing fast. The impact of such population growth has significant implications for the transportation sector's ability to provide mobility for all people. Again this proves the necessity of MRT in Dhaka and other cities of Bangladesh. An important part of MRT system is its station as it has specific design, construction, post-construction management method. Their service management with all IT facilities are also important to know. Sometimes the services are different for different stations. An analysis of the status of the facilities at railway stations can be established through the safety of passengers and observations in the field. The facilities available at the urban service station are more complete than in rural service station (Masirin et al. 2016).

Therefore, a critical comparison for the facilities provided in these modern stations are not available in literature. However, which is necessary to acquire knowledge by the undergraduate engineering and management students who will work for railway station project design and management in future. Achieving design quality with systematic design management is essential for any construction project (Chin et al. 2011). To know all the facilities adopted in the Asian cities and Dhaka is important for the future undergraduate students.

2. METHODOLOGY

This review paper is written mainly on the basis of thorough reading of different published literature in print and electronic form. Point to be noted that Bangladesh has lack of experts in transportation design and operation field. Information on design, construction, post-construction phase management and operation in service phase of MRT stations are rare in literature so far specifically for target groups of under graduate readers in the engineering and management fields. As the literature on MRT stations are very rare and not easily accessible by the readers, different data related on MRT station are collected form their specific website and also generated to written form from their videos. Information on MRT stations for Dhaka are also collected from accessible websites and personal communication.

With the purpose of reviewing, data on MRT stations of four cities namely are Hong Kong, Tokyo, Kuala Lumpur and Dhaka are collected and analyzed in this research based on the available data on internet website. General description on stations of cities are done first. After that specific description on different parts of stations of MRT of Hong Kong will be done on details as most of their information are available in English together with its local language. Final steps will be taken to form two comparison tables. One will be on comparison of overall MRT facilities among the cities and the other will be the comparison of elements of the stations.

3. OBSERVATION AND DISCUSSIONS

3.1 Facilities provided by different MRT stations

3.1.1 Shinjuku Station, Tokyo

Shinjuku Station (Shinjuku-eki) is a significant railway station in Tokyo, Japan, located in the Shinjuku and Shibuya wards. Which is in the Nishi-Shinjuku and Shinjuku districts of Shinjuku. Operator East Japan Railway Company (known as JR East) runs the main station at Shinjuku (Wikipedia, Shinjuku Station, 2021). The station serves as the main connecting center for train traffic between Tokyo's special wards and Western Tokyo on intercity rail, commuter rail, and subway lines. It serves an average of 3.59 million peoples/day in 2018, making it the world's busiest station and registered as such with Guinness World Records. Shinjuku Station boasts about 200 exits and a 53 number of platforms, as well as department stores on practically every side. There are four major access points for Shinjuku Station: the West Gate, East Gate, South Gate and New South Gate, with many smaller ones in between. (Web-1, 2021).

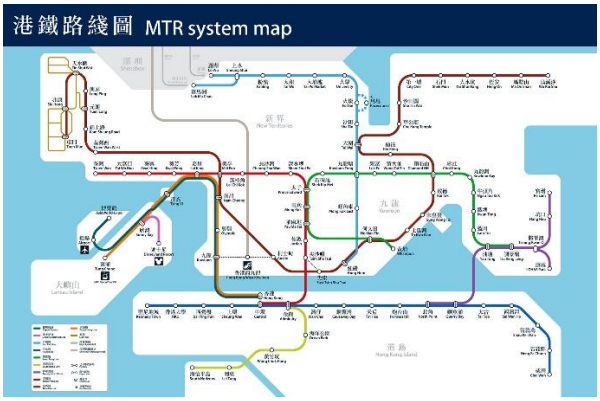
It is feasible to walk from one part to another around the outside of the station, but this is time-consuming. Walking from the New South Gate to the West Gate is also doable, but it takes time and requires passing through train stations. Passengers may find themselves below or above the railway platforms depending on the entry used. The signs directing to the platform must be followed. The station building also provides information desk, Tokyo tourist information center JR East Travel Service Center, Odakyu Sightseeing Service Center, currency exchange and ATM booths, police box, lockers for keeping luggage etc (Web-4, 2021) as shown in Figure 1a and 1b.

(a) Information center (b) currency exchange machine

Figure 1: Different facilities at Shinjuku Station. (a) Information center (b) currency exchange machine (Web-4, 2021)

3.1.2 Central MTR Station, Hong-Kong

The Central station in Hong-Kong is one of the longest stations in the world serving approximately 200,000 people on a daily basis (Web-2, 2021) as shown in Figure 3a. It was inaugurated on 12 February, 1980. The station has 4 tracks and 4 platforms.



MTR System map

3d view of station

Entrance/Exit

Platform and Train

Figure 2: Station facilities and structure. Which are MTR System map, 3d view of station, Entrance/Exit and Platform and Train. Source: (web-1, 2021)

The platforms are situated in 3 levels. The top level, which runs from World-Wide House to Alexandra House on the northern side of the road, is erected beneath Des Voeux Road Central at the intersection of Pedder Street. The platform serves the Island line's Chai Wan-bound trains, and this level also houses the connecting walkway to Hong Kong station. Platforms 1 and 2 have a shared island on the intermediate level. They were built right beneath Chater Road, stretching from Des Voeux Road Central to Club Street, and service the Tsuen Wan line. Platform 4 is on the bottom level, two floors below the top level, and serves Island line trains heading to Kennedy Town station as shown in Figure 3b. Kennedy Town station is at one end having one level and can accommodate two train (start and end) in two lines as shown in figure. The station have all the facilities including ticketing machine, escalator, telephone, toilet etc. Typical example of exit/entrance and a platform with train is shown in Figure 2c and 2d, respectively.

3.2 Scenario of Dhaka

Present major mass transportation modes of Dhaka metropolitan city are roadway, railway and waterway, which serves for both internal and intercity communication. Short description on each modes are presented in the following section.

3.2.1 Roadway

Roadway is the leading transportation mode for mobility within the Dhaka city area. The transportation network of Dhaka city consists of some 1868 km of roads and 163 km of sidewalks called footpaths (Sultana, 2013). Both motorized and non-motorized vehicles use the same road. Non- motorized rickshaws, bicycles, motor cycles, two-stroke engine auto rickshaws (CNG), private cars are used as par transit modes and buses are the most common form of public transport service. The use such heterogeneous type of vehicles made it one of the worst traffic congested city. There is moderate developed mass transportation system in the city. Buses being the main form of mass transportation system. There are 9311 numbers of registered buses and 8459 numbers of registered mini buses in Dhaka city (BRTA, Annual Report, 2018) run through 170 different routes (BRTA, 2014). Which are becoming insufficient for day to day movement of large number of people. Bangladesh Road Transport Corporation (BRTC) operates comparatively good quality buses on a few selected routes that serve a small portion of the city. Bus firms that are privately owned and are run according to their experience and are partly disorganized and dispersed. Lack of proper bus stops and bus bays and implementation of rules cause traffic jams.

3.2.2 Railway

Railway is one of the oldest form of public transport in Dhaka city. It started on 1862 when railway tracks were first implemented in this country by the British administration. Due to partition of the country and then independence of Bangladesh made huge impact on the railway system. Though railways are a considerably safer and cheaper mode of transportation, they are unable to play the expected role in public transportation system of Dhaka due to a lack of sufficient efforts and investment in the urban corridor. Furthermore, rail tracks run through only a part of central business area and crowded regions with several level crossings. There are 8 local railway stations in Dhaka metropolitan city (BBS, 2013) and most of the express trains do not stop in every station.

3.2.3 Waterways

Dhaka is surrounded by four rivers: Buriganga, Dhaleshwari, Turag and Shitalakshya. These rivers might have offered a basic facility for the operation of circular waterways but due to cost restrictions and a lack of proper planning for inter-connectivity among other modes, the waterway transportation system of Dhaka is not well developed. The length of waterway (river plus canal) in Dhaka metropolitan area in monsoon season and round the year are 18 km and 12 km, respectively (BBS, 2013). The main terminal for waterway transportation system in Dhaka city is Sadarghat. It mainly offers trips near and far to other southern districts

and towns having water connectivity. Water bus services within the city are available on Buriganga River within a limited range of connectivity. Water buses of the Buriganga River carry passengers on Sadarghat to Gabtali route (BBN, 2010). Water taxis available in Hatirjheel and Gulshan lakes provide trips via two routes, one route between Tejgaon and Gulshan and the other route between the Tejgaon and Rampura areas (Masum, 2016). The waterway transportation system is inadequate with respect to the population and coverage throughout the whole city.

In summary, the together roadway, railway and waterway transportation system are now became insufficient for easy passing of the passengers of the city. Therefore, Metrorail is become essential for Dhaka metropolitan area.

3.2.4 Metrorail of Dhaka

Bangladesh's government has set a schedule for constructing a railroad network that includes six updated metro rail lines under the Dhaka Mass Transit Company Limited (DMTCL). Dhaka MRT is targeted for controlling environmental pollution and boosting up economic growth (Saniul 2010). The project's goals are to reduce traffic congestion and improve air quality in Dhaka City by building a mass rapid transit system, thereby contributing to the Greater Dhaka Region's economic and social development and improving the urban environment. (Web-5, 2019).

This whole MRT network will cover a total of 128.741 km of railroad between which 67.569 km will be elevated railway and 61.172 km will be underground railway. This project will include a total of 104 stations having elevated stations 51 and underground stations 53 numbers (Web-6, 2020). The construction plan is shown in Table 1. Total lines are divided into six and each will be constructed in different three phases.

Table 1: Scheduled Work-plan 2030

Serial No	MRT Line Name	Phase	Length (Km)			Number of Stations		Probable Time of Completion
			Elevated	Underground	Total	Elevated	Underground	
1.	MRT LINE-6	1st	20.10	-	20.10	16	-	2024
2.	MRT LINE-1	2nd	11.369	19.872	31.241	7	14	2026
3.	MRT LINE-5 Northern R	2nd	20.00	6.50	13.50	5	9	2028
4.	MRT LINE-5 Southern R	2nd	4.60	12.80	17.40	4	12	2030
5.	MRT LINE-2	3rd	9.00	15.00	24.00	4	18	2030
6.	MRT LINE-4	3rd	16.00	-	16.00	15	-	2030

(Source: DMTCL, 2021)

3.2.5 MRT LINE-6 or the first ever elevated metro rail in Dhaka city

The construction of MRT LINE-6 was prioritized and decided to be completed in first phase. The deal for construction of the line-6, costing $2.8 billion, was signed by the Government of Bangladesh with the Japan International Cooperation Agency on 20 February 2013 (France-presse, 2013). The route alignment for MRT LINE-6 starts from Uttara 3rd Phase through Pallabi, Rokeya Sarani, Khamar Bari, Farm Gate, Hotel

Sonargaon, Shahbag, TSC, Doyel Chattar, Topkhana Road and to Bangladesh Bank. MRT LINE-6 will be further extended to Komolapur in future (DMTCL, Progress Report, 2021). It will have 16 stations throughout its course of 20.10 km in major points of the metropolis.

3.3 Comparison of overall facilities of MRT system

The comparison of overall facilities of MRT system of Hong Kong, Tokyo, Kuala Lumpur and Dhaka city are presented in Table 2. Among these cities Tokyo has its oldest history to start MRT at 1941. After that, Hong Kong in 1979, Kuala Lumpur 1995 and Dhaka (ongoing project) on 2023. The cities have one or more companies of MRT system. Most of the cities have standard track gauge 1435 mm. Hong Kong with 230.9 km long mass transit railway with 165 stations and serving 4.96 million rides daily. Tokyo being one of the most developed Asian cities has a total 304 km of rapid transit line with 286 stations serving 6.84 million daily rides. Kuala Lumpur with 151.1 km long mass transit railway with 116 stations and serving 0.647 million rides daily. Dhaka with 128.74 km long mass transit railway with 104 stations. The average distance between stations ranged from 1.39 km to 1.06 km and the value for Dhaka is 1.23 km, which is seems to be standard.

Table 2: Comparison of overall facilities

	Hong Kong	**Tokyo**	**Kuala Lumpur**	**Dhaka**
Year of start	1979	1941	Dec 16, 1995	Dec,2023
Company name	MTR-CL	Tokyo Metro Co Toei Subway	Prasarana	DMTCL
MTR System map	✓	✓	✓	✓
Location map	✓	✓	✓	✓
Station layout	✓	✓	✓	✓
Service name	MTR	Tokyo subway	Rapid KL MRT LRT	MRT
Service length	230.9 km	195 km 109 km	151.1 km	128.741 km
Stations	165	180 106	116	104
Ave. distance between stations	1.39 km	1.06 km	1.30 km	1.23 km
Service	Heavy rail Light rail Feeder bus	--	Heavy rail Light rail Monorail Feeder bus	--
No. of lines	Heavy rail :10 Light rail :12	13	5	6
Daily ridership	4.962 million	7.58 million 3.21 million	437822 LRT 175213 MRT 34344 Monorail	-

Track gauge	1435 mm 1432 mm	1067 mm 1435 mm 1372 mm	1435 mm standard gauge	1435 mm standard gauge

3.4 Comparison of Station Elements

The comparison of advanced facilities of MRT stations of Hong Kong, Tokyo, Kuala Lumpur and Dhaka city are presented in Table 3. Most of the stations have all the operational items as Platform, Ticket system, Escalators/Elevators, Lighting, Air conditioning, and Announcement system. Their communication system consists of information center and telecommunication. Optional Passenger facilities include Waiting room, Public toilet, Commerce and journal facilities and Prayer room. Most of the MRT stations are multi-leveled either over ground or underground. The different levels are well connected by escalators.

Japan's railway stations are much more than places to jump on a train, shinkansen or subway. Japan's train stations are fully-integrated service and commercial centers offering various options for shopping, dining and entertainment. Most large stations also double as Highway Bus terminals for connections to other cities and the nearest airport (). Some large station complexes are like mini-cities in themselves: Kyoto Station, Nagoya Station (the world's largest station building) and Shinjuku Station in Tokyo have luxury hotels, department stores, cinemas, book shops, underground shopping malls and floors of restaurants, cafes, bars and retail outlets. Hong Kong stations have Babycare Rooms/Breastfeeding Areas, Free Wi-Fi Center, Free Mobile Charging Service, Customer Service Centre, Tourist Services, Lost Property, Toilets, Free Publication, Post Boxes, Three-color Recycle Bin. Similar facilities are provided in some stations in Kula Lumpur. However, the idle railway stations were equipped with lesser facilities as compared to busy railway station (Thanaraju 2019).

Three types of stations based on platform categories are designed for Dhaka MRT namely: Lateral platform which is easy to extend in future, Island platform I and Island platform II. The lateral type platform is proposed for intermediate stations and the Island type platform with less umbers of elevators and stairs is proposed by terminal stations. The station building has two floors, first floor will be the concourse and second floor will be the platform. The number of daily passengers for lateral type stations is 81,000 and for island type (terminal) station is 124,000 (JICA 2011). Ticket System for MRT Line-6 contain many modern equipment to serve the passenger smoothly. The equipment are Ticket Vending Machine (Capacity: about 300 tickets/hr), Contactless IC tickets, Automatic Gate (Capacity: Maximum about 60 p/min), Fare Adjustment Machine (Capacity: about 140 times/hr.), Data collection machine and Ticket checker (Ref).

In summary, The design and planning of the stations has been done according to the most recent advanced technologies and demand which can be expected to serve the desired goal and objectives and thus eliminating the congestion problem of one of the most crowded mega cities in the world. (Ref). The design and planning of the stations for DMTCL has been done according to the most recent advanced technologies and demand as can be seen from online published report of DMTCL. It can also be seen from Table 3 that the MRT stations of Dhaka have all the modern facilities as the other three cities, Hong Kong, Tokyo, Kuala Lumpur. Finally, the MTR Dhaka should applied proper facilities management after completion its construction. The real-time information systems is also a vital point in management of station which could increase the passengers satisfaction (Sweeney, 2012). A better facilities management should take into consideration on the service quality provided in the railway station as it plays a vital role in encouraging citizen towards its services which eventually could overcome traffic congestion and contribute towards sustainable transportation in country (Thanaraju 2019). The highest valued indicator of public transport is cleanliness and comfort. The perceived value of comfort includes customer feelings about brightness of the environment, temperature and cleanliness of the station (Shen et al. 2016). It is hoped that, the final management of Dhaka MRT station will look after about its cleanliness and comfort. Facilities at railway station should be improved to attract people using the facilities (Masirin et al. 2016). Railway station with

better and adequate facilities can generate more revenue as this would increase and encourage people from taking rail transport as their transportation mode (Thanaraju 2019).

Table 3: Comparison of Station elements

Items		**Hong Kong**	**Tokyo**	**Kuala Lumpur**	**Dhaka**
Size of a typical station in meter (m), L, W, H		360, 20.5, 12.3[a]	--	--	--
Operational Item	Platform	✓	✓	✓	✓
	Ticket system	✓	✓	✓	✓
	Escalators	✓	✓	✓	✓
	Elevators	✓	✓	✓	✓
	Lighting	✓	✓	✓	✓
	Air conditioning	✓	✓	✓	✓
	Announcement system	✓	✓	✓	✓
Communication	Information center	✓	✓	✓	✓
	Telecommunication	✓	✓	✓	-
Passenger facilities	Waiting room	✓	✓	✓	-
	Public toilet	✓	✓	✓	✓
	Commerce and journal facilities	-	✓		
	Prayer room	-	-	✓	✓

[a](Chin 2011)

4. CONCLUSION

- It is observed that most of the MRT stations are multi-leveled either over ground or underground. The different levels are well connected by escalators. All of the stations have the modern facilities to buy ticket, check-in and check-out system with well decoration.
- Bangladesh will enter to the history of metro rail system through the operation of MRT Line-6 project in 2022. The amazing effort, investment and planning that Bangladesh Government has provided through DMTCL to ease the daily life of people residing in the capital is praiseworthy.
- A critical comparison for the facilities provided in these modern stations are successfully performed. The knowledge will be helpful for undergraduate engineering and management students who will work for railway station design and management in future. By referring this review study the MRT operators can decide the most vital and critical station facilities that can affect satisfaction of future passenger towards sustainable development.

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