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TIME OVERRUN IN TRANSPORTATION PROJECT - A CASE STUDY OF MUMBAI MONORAIL

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Abstract - *In recent year Government of India's Ministry of Urban planning and development had declared 100 smart cities all over the India. This dream can't be completed without development of Maas Rapid Transit System (MRTS) in the city. For development of MRTS in the city, the viability of various MRTS must have to check economically, financially, and environmentally.*

The case study of Mumbai Monorail check the viability of system in above mentioned ways and it gives satisfactory results. The study shows benefits of monorail in comparison of other MRTS. The study elaborate various planning stages such as alignment planning, station planning, land management, environmental impact analysis. It also includes the various challenges the team Monorail faced during execution. It also elaborate the cause and remedies for time delay in projects

In Mumbai Monorail study, it is observed that some activities like utility diversion, rehabilitation and resettlement will finish before actual execution of work will help in minimizing time delay. This will be further useful in construction of MRTS in various cities in scheduled time

The Study ends with the conclusion that, the activities like proper alignment planning , rehabilitation of project affected people , utility diversion should be executed first. The study also suggest about 'Cushion Time' during execution of work, empowerment of organization and addition of 'Heavy Penalty Clauses' while preparation of tender in future MRTS project.

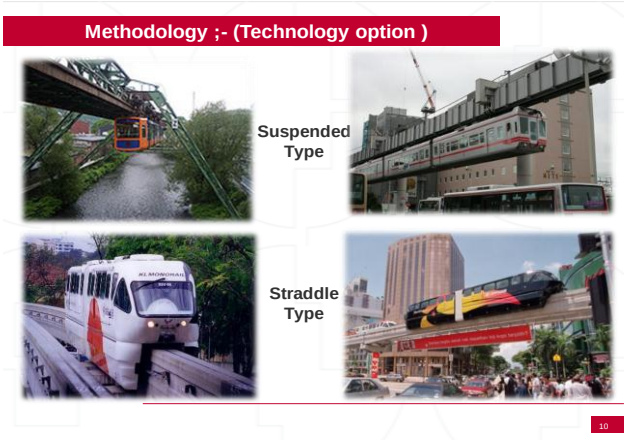
Keywords *– Smart city, MRTS, Mumbai monorail, construction challenges, time delay*

1.0 INTRODUCTION

Mass Rapid transit is a high capacity public transport system fond in urban area .Mass Rapid transit system (MRTS) play a crucial role in promoting urban development. Throughout India a number of mass rapid transit systems have been implemented into the various metro cities that includes suburban railway, Metro rail, Light rail transit (LRT) in number of type, Monorail & BRTS. The Comparison of various MRTS according to their various defining features is as given below:

Serial .No.	**Features**	**Suburban Rail and Metro Rail**	**Mono Rail**	**LRT**	**BRT**
1.	Line capacity (pphpd)	11,000 to 81,000	1,780 to 32,000	5832 to 20,000	11,000 to 81,000
2.	Maximum Gradient	3 to 4 %	6 %	6 to 09 %	-
3.	Row requiems	underground or elevated support	elevated support	elevated	minimum two lane of road
4.	Coaches/ Train	4 to 10	2 to 06	2 to 4	-
Serial .No.	**Features**	**Suburban Rail and Metro Rail**	**Mono Rail**	**LRT**	**BRT**
5.	Operating Speed (Km/h)	25 to 60	25 to 40	18 to 040	15 to 25
6.	Frequency	20 to 40	15 to 020	10 to 090	120 to 300
7.	Environment impact	high noise pollution	low noise pollution	low noise pollution	medium noise pollution

2. Comfortable Ride- due to rubber tyres and pre-cast beam track
3. Passenger Safety- grade separated exclusive guide way
4. Ease of Maintenance - simplified structure
5. Ensuring Reliability – on board puncture detector
6. Periodicity of Scheduled Maintenance – life of consumables
7. Environment Friendly – low noise.
8. Enhanced Mobility – full flat floors
9. Safety and Rescue - emergency passenger evacuation



4.3 Suitability of monorail system for the proposed corridor

Still the Monorail system has not been used in India but it is extensively used in Japan since 1964. There are several countries where Monorail is under construction like Dubai and Malashiya. A number of cities in India have also evinced interest in monorail e.g. Chandigarh, Bangalore, Kolkata, Mumbai and Goa.

The Monorail system serves ideally as a feeder for a Mass Rapid Transit System. Moreover the attractiveness of the system is in handling pphpd of 5,000 – 20,000 keeping stations light and train compositions smaller.

In view of the analysis/ details presented above, the choice for the proposed corridors in Mumbai is Straddle Type Mono Rail. The exact system to be chosen can be decided by MMRDA through open competitive bidding process.

4.4 Salient Features

The salient features of Mumbai Monorail are tabulated below:

Serial No	Features	Description
1	Road Length	20 km.
2	Alignment	Elevated
3	Max. Gradient	5%
4	Min. Clearance above ground	5.5 M
5	No. of Station	17
6	Platform Length	65 M
7	Journey Time	37 Minutes
8	No. of Cars	4
9	Passenger Capacity	568/train
10	Average Speed	31 km./hr.
11	Maximum Speed	80 km./hr.
12	Frequency	Jacob Grcle to Wadala – $4^1/_2$ Minutes.
13	Frequency	Wadala to Chembur – 9 Minutes
14	Operation Hours	5 am to 11pm.

4.5 Corridor planning

Corridors start from Keshavrao Khadye Marg about 300 m West of Sant Gadge Maharaj Chowk. Start point of corridor has been decided keeping in view future extension of monorail system along this road. It runs in Northeast direction along Sane Guruji Marg –NM Joshi Marg – Mahadev Pallav Marg (Curry Road) – Sai Baba Mart – GD Ambedkar Marg – Katrak Road – DS Baretto Road – Rafi Ahmad Kidwai Marg – Sheikh Misari Road – Wadala Depot Area – Bhakti Park – APLR – R C Marg – N G Acharya Marg and terminates in front of Chembur Railway Station. Entire Route is through densely populated area which is also full of commercial activities. Most of the Roads have sufficient ROW to accommodate monorail corridor except at certain stretches where available ROW of road is too narrow. Perhaps these stretches are occupied by unauthorized construction on both sides of road. These narrow stretches are identified in subsequent paras. Major localities along the corridor are Maha Laxmi, Parel, Naigaon, Dadar East, Acharya Atre Nagar, Antop Hill, Guru Teg Bahadur Nagar, Bhakti Park, Mysore Colony and Chembur.

Over all length of corridor from Start Point to Dead End is 19.543 Km. Total 18 Nos. of stations have been planned along the corridor between these two station, Sant Gadge Maharaj Chowk and Chembur

8. Departure and arrival track
9. Departure inspection track
10. Drill track
11. Maintenance vehicle stabling track
12. Workshop
13. Operation control Center
14. Water supply/ Sewer line

4.8 Automatic Fare Collection

Rail transit system handles large number of passengers. Ticket issue and fare collection play a vital role in the efficient and proper operation of the system. To achieve this objective, ticketing system shall be simple, easy to use/ operate and maintain, easy on accounting facilities, capable of issuing single/ multiple journey tickets, amenable for quick fare changes and require overall lesser manpower. In view of above, computer based automatic fare collection system is proposed. This helps in keeping the station area litter free

Automatic fare collection systems have the following advantages**:**

1. Less number of staff required.
2. Less possibility of leakage of revenue due to 100% ticket check by control gates.
3. Recycling of ticket fraudulently by staff avoided.
4. Efficient and easy to operate, faster evacuation both in normal and emergency.
5. System is amenable for quick fare changes.
6. Management information reports generation easy.
7. System has multi-operator capabilities. Same Smart Card can be used for other applications also

4.0 MUMBAI MONORAL PLANNING AND MANEGMENT

5.1 Alignment Planning

For the Mono Rail system with a maximum speed of 80 kmph, a minimum Horizontal curve radius of 300 m is considered desirable with allowable Cant (%) = $V^2/1.27$ R ≦12 and cant deficiency (Cd) = 5%. However, such radius is not achievable on the proposed corridor. At certain locations, radius of 50 m is also provided, which would necessitate reduction in permissible speed,

a) Horizontal Curves

- Desirable Minimum curve radius in mid section :100 m
- Absolute Minimum curve radius in mid section :50 m
- Minimum curve radius at stations :300 m
- Permissible cant (Ca) %:12
- Cant deficiency (Cd) : 5%

b) Transition Curves

-Generally a Clothoid curve is adopted for transition curves.

- Desirable length of Transitions of Horizontal Curves (rate of change of angular acc^n 0.3 m/s^2/s) :$V^3/14$ R m
- Minimum length of transition curves:15 m
- Minimum straight length between two Transition curves: 15 m or NIL
- Minimum curve length between two Transition curves: 15 m or Nil
- Curves overlap between transition curves and vertical curves are permitted but will require casting/ fabrication of beam to required profile.

However, it may not be possible to provide transition curves of desirable length due to constraints of circular curve length or otherwise. At such locations the permissible speed may be restricted due to comfort parameter.

5.2 Station Planning

Stations are planned as minimal structures required to facilitate the passengers board and alight from the monorail coach and negotiate the street to platform height with the maximum ease and within minimum time. Hence it is proposed that the monorail station will be more like a 'big bus stand' as opposed to being a 'small metro station'.

Salient features of a typical station are as follows:

1. No passenger's concourse has been proposed. Passengers will directly reach the platforms from street.
2. Two foot over bridges under the track beams will connect the two sidewalks as pedestrian links.
3. Ticket vending is expected to be by Passenger Operated Machines (POMs) at the foot over bridges. AFC and manual ticketing proposed at each station. No separate ticket vending rooms are proposed at the stations.
4. Platforms are 95 m long adequate to receive a 6 coach monorail train. Due to road width constraints, platform supporting columns have to be placed at least 19 m apart, which makes the platforms about 8.5 m wide. The additional space on the platforms thus available is proposed to accommodate all the S & T and Electrical equipment that may be required at the station at the four corners since no mezzanine similar to a metro station is provided.
5. The platform level has adequate assembly space for passengers for both normal operation conditions and a recognized abnormal scenario.

6. Automatic Fare Collection (AFC) gates, if required can be located at the starting point of stairs at platform level.
7. Station entrances are located with particular reference to passenger catchment points and physical site constraints within the right-of-way allocated to the MRTS.
8. Office accommodation, operational areas and plant room space is required at each station. The functions of such areas are given below

5.3 Land Management

Land will be Required for the following main Components
1.Monorail Structure (including Route Alignment), Station Building, Platforms, Entry/ Exist Structure, Traffic Integration Facilities, Depots etc.
2.ASS/Traction Sub-Station
3.Radio Towers
4.Temporary Construction Depots and work sites

5.4 Environmental Impact Assessment

A) Positive Environmental Impact

Based on project particulars and existing environmental conditions, potential impacts have been identified that are likely to result from the proposed project and where possible these have been quantified. The positive environmental impacts are described below :
1.Traffic congestion reduction .
2.Quick service and safety
3.Less fuel consumption
4.Reduction in Air Pollution
5.Carbon Dioxide Reduction
6.Savings In Road Infrastructure
7.Employment opportunities

B) Negative Environmental Impacts

Based on project particulars and existing environmental conditions. Potential negative impacts likely to result from the proposed development have been quantified. Negative impacts have been listed under the following headings ;

a)Impacts due to project location

1.Change of Land Use
2.Loss of Trees
3.Loss of Historical and Cultural Monuments
4.Loss of community property resources

b)Impacts due to construction works,

1 Soil Erosion and Health Risk at Construction Site
2Traffic Diversion and Risk to Existing Buildings
3 Impact on Water Quality
4 Increased Water Demand
5Disposal of soil during construction

6.0 CONSTRUCTION CHALLENGES

During Monorail construction challenges faced at every level, start from beginning at boring of pile up to successful running of the trains.

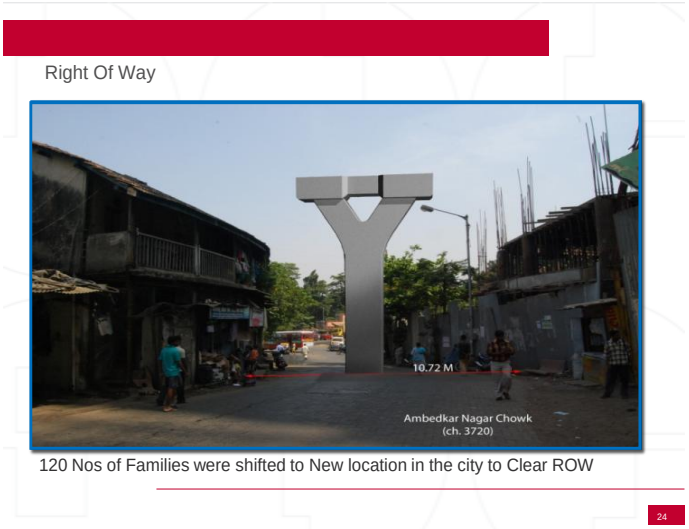
The major construction challenges faced and their successful solutions are listed here to get on overall idea.

6.1 Right of way:

To clear the right of way 120 Nos. of families were shifted to new location. This shifting activity consumer lot of valuable time of the project period. Which causes the delay in the completion of the period.

During this shifting activity the officers have to faces falls criminal cases, court cases, which demoralize the officers at certain extent, but continuous motivation & support from superior staff leading to completion of the project.

The second major hurdle to clear the right of way is the infringement of temple at Curry Road (ch. 1760). The pier location which come exactly center of the temple and there was strong opposition for shifting of temple location the pier location have to shifter as shown in figure.



6.2 Trees Cutting:

This is the major challenges to cool down the oppose of tree cutting raised by NGO/ People/ Local residents. This challenge is overcome by planting the town time no of tree cut.

5	Delay due to land acquistation from Mumbai Port Trust and Indian Railway crossing pier 1H4A-1H12	36	1.Poor Coordination and planning 2.Delay due to land handover to MMRDA by MBPT 3.Rehabilaion of existing tenant at old building very near to alignment.	1.Proper alignment designing 2.Prior planning of rehabilitation plan
6.	Delay in Manufacturing of rolling stock	60	1.Design issues as per Indian Safety norms and IRC loading Condition 2.Remodeling and Redesign takes multiple years	Heavy Penalty Condition in tender should be implemented.
7	Delay in permission for Tree Cutting	18	Delay occurred by Tree Authority	Single Window Clearance as implemented in DMRC Delhi
8	Delay due to taxation Complexity	24	1.Delay in decision making process for tax exemption for particular activity 2.Mltiple taxation system .	Single taxation system like GST

8.0 CONCLUSION

The first phase of Mumbai Monorail i.e. from Chembur to Wadala was completed on January 2014. In first phase it is covering the area of industrial establishment like Bharat Petroleum Colony, Fertilizer township etc, so the ridership for this phase is very low and limited up to pick hours only.

In present status all the civil works of alignment and station is 100% completed and the balancing mechanical, electrical, electronic work will be expected to be completed up to Dec 2017 .Once this work will completed in all respect, the monorail will get full ridership & project will be economical and financial feasible. The following point should be consider while developing any other MRTS in city.

1. Alignment for the work should be fix consoling all possible factor like probable utility division, retaliation at project attached people, land acquistation, traffic division etc.
2. After this the proper plan for utility diversion, rehabilitation of project affected people, land acquisition should be prepared before execution of work.
3. 'A cushion time' should be kept to overcome unforeseen activities while planning for execution.
4. Tender document should be prepared which include 'heavy penalty condition' for time delay by contractor and consultant.
5. Most of the MRTS technology are new in India so that a planned documentation for human resource management should be prepared.
6. The permissions / clearance / liasioning activity should be carried out before execution of the work.
7. Empowering of implementing authority (MMRDA) like DMRC, Delhi which help in implementation of single window clearance system for getting various permissions/clearance.
8. The manufacturing of monorail coaches in India under 'Make in India' initiative by Govt. which help in reduction in time delay upto certain extent.
9. The implementation of GST will help in implementation of single taxation system for monorail which helps in reduction time of implementation in future.

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