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Constructability & Cost Feasibility Analysis of Pune Metro Rail Project Including Planning & Design Specifications

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ABSTRACT: India a country with 1.3 billion people (2017) needs better transport system throughout the country. But the major problem arises due to unequal population of cities that is some cities like Pune, Mumbai and Delhi are densely populated on the other cities in India are not such, these leads to many problems like utilization of resources is unbalanced, traffic problems, water shortage in populated areas, land related problems etc. But the major problem among them is traffic problems which leads further to resources depletion and pollution related problems. To overcome this sort of problems government has released several metro projects throughout the country depending upon the city's population. Thus this paper deals with the detail observational study of pune metro project depending upon factors like Station Locations & Station Construction, Planning and Design Criteria for Station, Train Operational Plan Cost Estimation.

KEYWORDS: Pune metro, Station Locations & Station Construction, Planning and Design Criteria for Station, Train Operational Plan, Cost Estimation.

I. INTRODUCTION

Pune is the 'Queen of Deccan' because of its picturesque, excellence and rich common assets. Plus, it is well known for its religious and recorded spots. Pune city is known for its educational, research and development institutions. The area likewise has significance as a vital army installation. Pune is the most industrialized area in western Maharashtra and well known IT center point in the nation. Pune embodies an indigenous Marathi culture and ethos, in which training, expressions and artworks and theaters are given due conspicuousness. Pune is social capital of Maharashtra. Pune area is situated between 17° 0' North Latitude and 75° 0' East longitude. The locale is limited by Ahmednagar region on the North-East, Solapur area on the South-East, Satara region on South, Raigad region on West and Thane district on North-West. Pune locale shapes a piece of the tropical storm arrive and in this way demonstrate a huge regular variety in temperature just as rain fall conditions. Atmosphere of Western district of Pune is cool while the Eastern part is hot and dry.

Pune is biggest city of Maharashtra state. Pune has developed complex throughout the most recent two decades in term of zone, populace and home. As far as possible have expanded part and regions like Aundh, Kothrud remain as one of quickest developing rural areas. In pune region there are two metropolitan organization viz., Pune Municipal Corporation (PMC) and Pimpri Chinchwad Municipal Corporation (PCMC) and region is spread over the territory of 15642 km². In the last evaluation (2001), the number of inhabitants in area was 80.22 lakhs out of which the urban populace of pune city was assessed as 60.08%. Populace projections recommend that in 2021, there may be 70.10 lakhs individuals in pune and the populace size of city may cross 80 lakhs by 2031. With growing population, modern and

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business advancement designs coming up to the city, the movement request is relied upon to develop steeply. With the developing economy and insufficient open transport benefits, the travelers will move to private modes, which is as of now clear from the high vehicle possession drifts in the locale. This would irritate the blockage on avenues as well as increment the contamination. Thus, it is basic to design and accommodate a Metro System in pune Metropolitan region.

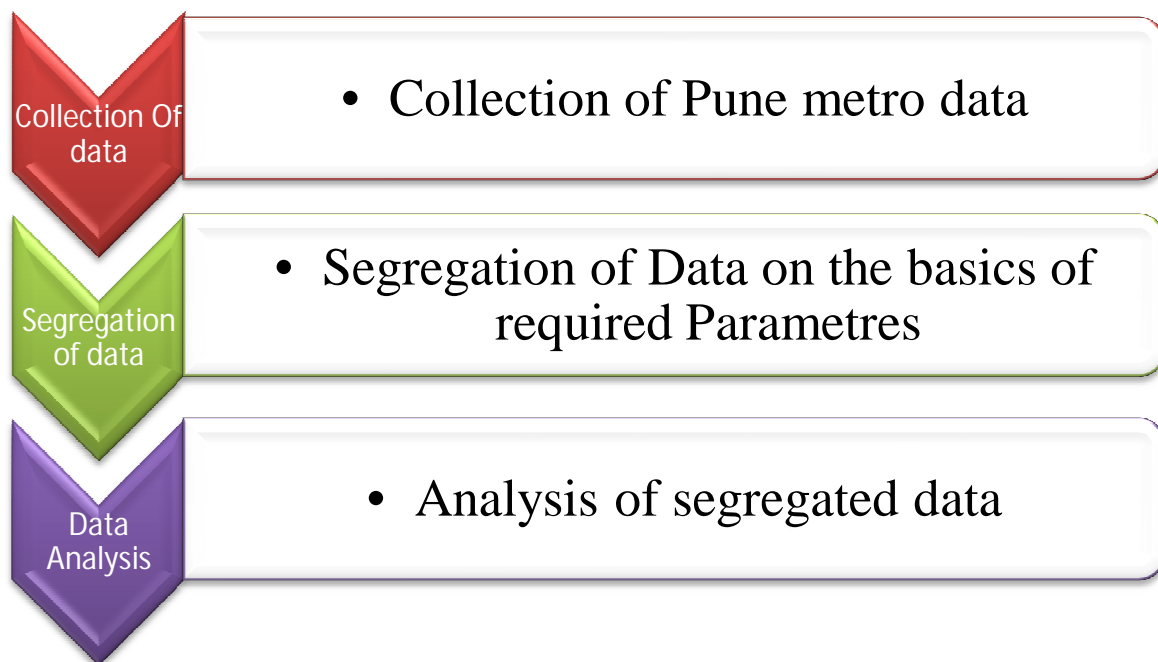
An investigation did by Mumbai metro rail organization has demonstrated that earn back the original investment point between transport and rail based metro framework is 8,000 phpdt considering just Operation and Maintenance (O&M) cost and deterioration. Assuming, be that as it may, alongside O&M cost and deterioration the expense of capital at 10% loan cost is additionally consider, the make back the initial investment point is around 15,000 phpdt. Be that as it may, it may not be actually plausible to work transport past 10,000 phpdt in the blended transport situation acquiring on pune city roads. The in all likelihood crest traffic request on Katraj-Swargate hall has been evaluated as 18,110 phpdt for 2011 and this like prone to increment to 20,035 phpdt continuously 2031. Populace in the city has effectively crossed as far as possible. In this way, pole based open transport won't serve the propose and there is a dire need to present a Metro framework in the city to give quick, protected, conservative and condition well-disposed mode for mass development of travelers.

II. OBJECTIVES

To study the Pune Metro Project on following parameters

- I. Station Locations& Station Construction.
- II. Planning and Design Criteria for Station.
- III. Train Operational Plan and Cost Estimation

III. METHODOLOGY



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IV. OBSERVATIONAL & EXPERIMENTAL STUDY

Station locations

The sequence of stations along with their respective chain ages, site & platform characteristics are presented in the Table below:-.

Table 1: Station Locations

Sr.No	Name of Station	Distance from previous station	Platform Type	Alignment
1	Katraj	-	side	Elevated
2	Bharti Vidyapith	1.05	side	Elevated
3	KK Market	1.22	side	Elevated
4	Natu Bag	1.47	side	Elevated
5	City Pride	1.12	side	Elevated
6	Swargate	1.28	side	Elevated

Station Construction

It is proposed to develop the raised concourse over the street at a large portion of the areas to limit arrive obtaining. To keep the rail level low, it is proposed not to take viaduct through the stations. Consequently a different basic design is required (in spite of the fact that this may require the break in the starting operational at each station areas. Sub-structure for the station bit will likewise be like that of viaduct and will be completed a similar way. In any case, there will be single viaduct section in the station territory, which will be situated on the middle and supporting the concourse braces by a cantilever arm in order to dispose of the segment on option to proceed.

Superstructure will comprise of 3 precast U Girder for supporting the track structure and I brace/Double T Girder for supporting the stage and concourse zones. A pre-cast or cast in situ pre-stressed traverse the center wharfs for supporting stage structure. Box molded in situ pre-stressed cantilever cross brace are made arrangements for supporting the concourse support and elevators at mezzanine level. Every one of the individuals will be pre-thrown in a development terminal and propelled at site through cranes. However the grade of concrete used (Approx) for several components is been shown in tabular format

Table 2: Station Construction

Sr No.	Components	Grade of Concrete
1	Piles	M-35
2	Pile cap & open foundation	M-35
3	Piers	M-40
4	All precast element for viaduct & station	M-45
5	Cantilever piers & portals	M-45 to M-60
6	Other miscellaneous structure	M-30

Planning & Design Criteria for Station

1. The station can be isolated into open and non-open regions (those zones where get to is confined). The general population region can be additionally subdivided into paid and unpaid zones.
2. The stage has satisfactory get together space for travelers for both typical working conditions and a perceived unusual situation.

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3. The stage level at raised stations is controlled by a basic freedom of 5.5 m under the concourse over the street convergence, permitting 3.5 m for the concourse tallness, over 1 m for concourse floor and 1.5 m for structure of tracks over the concourse. Further, the stages are 1.09 m over the tracks. This would make the rail level in a lifted circumstance at any rate 12.5 over the ground.
4. In the underground stations, stage level is dictated by a basic freedom of 2.50m over the station box, which would be 13.7 m high. Permitting around 80 cm for the container structure, 70 cm for rails/supporting structure and 1.09m for rail to stage height, would make the stages in an underground circumstance in any event 13.5 m subterranean.
5. The concourse contains programmed admission gathering framework in a way that separates the concourse into unmistakable zones. The 'unpaid region' is the place travelers access the framework, get travel data and buy tickets. Ongoing through the ticket.
6. The game plan of the concourse is surveyed on a station-by-station premise and is dictated by site limitations and traveler gets to necessities. In any case, it is arranged so that most extreme observation can be accomplished at greatest reconnaissance can be accomplished by the ticket lobby chief over ticket machines, programmed passage gathering (AFC) gates, stairs and elevators. Ticket machines and AFC entryways are situated to limit cross streams of travelers and give satisfactory dissemination space.
7. Sufficient space for lining and traveler stream has been permitted at the ticketing doors.
8. Station passages are situated with specific reference to traveler catchment focuses and physical site imperatives inside the option to proceed distributed to the MRTS.
9. Office convenience, operational region plant room space is required in the non-open zones at each station.
10. The DG set, bore well siphon house and ground tank would be found by and large in one zone on ground
11. The system is being designed to maximize its attraction to potential passengers & the following criteria have been observed.
12. Minimum distance of travel to & from the platform & between platforms for transfer between lines. Adequate capacity for passenger movements. Convenience, including good signage relating to circulation & orientation. Safety & security including a high level protection against accidents.
13. Minimum capital cost is incurred consistent with maximizing passenger attraction.
14. The numbers & size of staircase/escalators are determined by checking the capacity against AM & PM peak flow rate for both normal & emergency conditions such as delayed train service, fire etc.
15. Passenger handling facilities comprise of stairs/escalators, lifts & tickets gates required to process the peak traffic from streets to platforms & vice-versa (these facilities must also enable evacuation of the station under emergency conditions, within a set safe time limit).

Train Operation Plan

The basic Operation Philosophy is to make the MRT frameworks increasingly elective and affordable. The principle highlights being, Selecting the most ideal recurrence of train administrations to meet sectional limit prerequisite amid pinnacle hours on the majority of the areas. Economical and ideal train benefit recurrence amid pinnacle period as well as amid off pinnacle period A short train comprises of 4 mentors with high recurrence benefit it tends to be expanded to 6 mentors to meet future necessities.

Salient Features of the proposed train's Operational Plan are:

- Running of administrations for 19 hours of the day (5am to Midnight) with a station stay time of 30 seconds
- Make up time of 5-10% with 8-12% drifting.
- Scheduled Speed for these hallways has been taken as 33kmph for passage.
- A prerequisite of mentors is determined dependent on presumptions that the base unit of 4 Car train involving DTC-MC-MC-DTC setup has been chosen for Pune Metro Corridors for the year 2018.

Capacity Calculations:

- Driving Trailer Car 253 Passengers (Sitting-45, Crush Standing-208)
- Motor Car/ Trailer car : 278 Passengers (Sitting-53, Crush Standing-225)

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- 4 Car Train : 1074Passengers (Sitting-188, Crush Standing-886)
- 6 Car Train : 1594Passengers (Sitting-296, Crush Standing-1298)

Table 3: Cost Estimation Table

Sr.No	Item	Unit	Amount (Cr)
1	Land	Km	158.38
2	Station buildings		130.85
3	Depot		88.25
4	P-way		60.17
5	Alignment & foundation		275.64
6	Power supply		85
7	Signaling& telecom		185.25
8	Capital expenditure on security		12.58
9	Utilities, road works & other civil works	r.km	25.85
10	Rolling stocks	Each	177
11	Total qty (except land)		1040.59
12	General charges incl. design charges		51.72
13	Total of all items (except land)		1092.31
14	Contingencies 4%		43.69
15	Gross Total		1136

IV. CONCLUSIONS & RECOMMENDATIONS

1. Pune has seen colossal modern development amid the most recent 10 years. Quick urbanization in the ongoing past has put the movement framework to push. With countless have come up both in little scale just as in substantial and medium scale industry, and so on traffic in the city is required to shoot up. Being thickly populated zone, Pune traffic needs can't be met by just street based framework.
2. The current urban transport arrangement of Pune City which is street based has just gone under pressure prompting longer travel time, expanded air contamination and ascend in number of street mishaps. With anticipated increment in the number of inhabitants in the city fortifying and enlarging of transport framework has expected criticalness. For this reason arrangement of rail-based Metro framework in the city has been considered.
3. The task has numerous positive ecological effects like decrease in rush hour gridlock blockage, sparing in movement time, decrease in air and commotion contamination, lesser fuel utilization, lesser absolute mishaps and so forth with a couple of negative effect (particularly because of usage period of the undertaking) for which Environment Management Plan has been proposed.
4. • After analyzing the different choices for execution of Pune Metro Project, it has been suggested that the task ought to be got executed through a SPV on DMRC financing design.
5. The passage structure has been evaluated dependent on Delhi Metro tolls chosen by the charge obsession council in 2009 properly heightening the equivalent for year 2018. In this way, to assess comes back from the task, the tolls have been updated each second year with an acceleration of 12 % at regular intervals.

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