Optimization of Pune Metro Rail

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I. Abstract
The objective of this paper is to present a pre-feasibility study conducted by carrying out household surveys and focusing on the short-comings of the Pune metro (India) to be faced in near future based on the available data and providing suggestions for the afore-mentioned problems. Construction, geological and the cost factors have also been considered in the paper. The proposals given can serve as a reference to avoid the future infrastructure conflicts and planned development for the Pune metro department.

Keywords: Technical Surveys, Infrastructure, Metro, Indian Transportation

II. Introduction
With the increasing population and the development being carried out in cities of India, congestion is a new problem arising in front of the transportation department. Keeping in mind the congestion and the environmental problems and a need for integrated network, rail based transit system is gaining world-wide popularity among the people. Delhi metro rail corporation i.e. DMRC has already successfully implemented the Delhi metro with the 2 phases covering the capital from periphery to core. After its successful construction and implementation, the need for rail based transit system in other cities was realized. The latest city to get under the radar is “Pune”. Pune is a fast growing city and with the increasing population and development, a plan for “Pune metro” was proposed. This has been a topic of controversy ever since. Land acquisition, traffic and construction problems, geological conditions, proposed alignment, everything has been met with a controversy and a delay. The cost problems just add to the story. Various committees like Pune Metro Jagruti Abhiyaan(PMJA) have come into existence which is against the development of Pune metro keeping into mind the traffic and route efficacy, environmental impact and other afore-mentioned problems. In this paper, the various problems of Pune metro have been discussed in detail and also, solutions have been given to the related problems. In addition, the solutions given by PMC for the proposed problems have been discussed and new proposals have been given to implement.

III. Literature Survey
Initially, to understand the problems being faced by the city, visits were made to the assigned offices and a better outlook towards the Pune Metro was achieved. Development plans of DMRC and BMRC were studied in detail along with the proposed development plan of the Pune Metro. Various persons associated with the Delhi or the Bangalore metro were approached and the problems faced during the construction were discussed. The problems being faced for Pune metro were also discussed. Various maps have also been used for reference and the geological problems concerning the strata were found out. Based on the study, the construction problems were sought after and the proposed solutions were given. For the traffic problems, traffic department of Pune was visited and the details regarding the Pune metro and the problems it will pose on the traffic were discussed. PCMC department was also visited regarding the surveys conducted for the metro and the approach to this methodology was discussed with the executive engineer. The proposed phases of the Pune metro also pose a problem for land acquisition and the existing structures will be hampered with at certain places which are valuable from the historic viewpoint. The cost proposed for the Pune Metro is close to 10,000 crores and for this amount, central government, state government and the municipal corporation along with the World Bank are expected to contribute. This burden on the government and public due to the civic taxes has been discussed too. The Vanaz- Ramwadi corridor has various construction problems and this point had been discussed with the officials and solutions for this problem were found out. Along with this, a pre feasibility survey was conducted on households near the PCMC region where the need for the metro was found out and the public view point was presented in the form of graphs and pie charts and solutions were found out.

IV. Methodology
While accumulating the information concerned with the Pune metro, various problems were studied in detail and were categorized into five main categories:

A. Traffic Congestion
Construction of metro rail is being troublesome due to Elevated metro and insufficient road width for today’s 6,190 phpd (person per hour per direction) Daily Ridership (2013). In phase I (i.e. Pimpri - Swargate) the sufficient road width is available from Shivajinagar for Elevated metro & from Shivajinagar to Swargate being traffic prone -Underground route is proposed. In Phase II, insufficient road width is a problem for construction of metro rail Pillars. Continuous traffic flow cannot be achieved in Pune due to the jam packed roads. Focusing on Vanaz to Nal stop area, it suffers from traffic problems as it connects Warje, Malwadi, Swargate, FC road, MG road, Law college road, especially NH 4 highway, Yerawada, Ramwadi, etc.
Heavily congested roads with mixed type of traffic leaves little possibility of widening of roads and restriction of laying new roads due to heavy built up areas. Problems concerning the traffic are—

- Frequent traffic jam at intersections.
- 75% of traffic consisting of low occupancy vehicles;
- Vehicles causing heavy noise pollution.
- High parking demand due to proliferation of personalized vehicles.
- Over-crowded buses with long routes.
- Modal split in favour of public transport is about 46%, which was supposed to be 70 to 80%. Trends show a decline in this share over the last two decades.
- Inadequate and unsatisfactory public transport system.

- Overall average traffic speed is about 13.5 kmph. In peak hours it is ideally supposed to be 30-40 kmph.
- Slow average speed from 10 to 12 kmph on road.
- High atmospheric pollution level.
- High rate of road accidents of the order on an average of two persons killed and 18 persons injured every day.
- Narrow roads which constitute more than 40% and cause traffic congestion.
- Road widening is difficult due to dense development. The requirement of right of way for metro is 20 meters (min.).

The following suggestion has been given with diagrams for pictorial representation:

The Right of Way is 25m and total road width is 20m which requires 9m with 3m for pillar diameter. The one way traffic flow is 10m out of which 4.5 m is for construction shown by yellow colour and 4-5m for BRT route shown by orange colour.
Fig. 2 Vanaz- Dashabhuj Ganpati
Fig. 3 Dashabhuja to Nal stop

In the diagrams above, we have showed the diversions. Outflow is represented by green, inflow by yellow.

B. Construction Problems

Land Acquisition is the main problem which is being faced by the officials of the Pune metro. Earlier FSI 1 was selected for Pune but due to insufficient space now FSI 4 has been proposed. The only problem due to this proposal will be environment related as the densification will lead to the hampering of the lush green environment of Pune.

Costing and Funding is next on the list. The overall estimate of the cost is --

Total Length = 31.514 km; Cost Rs Cr/ km= 230 (Jun 2013)  
As on Jul 2009: Rs. 5975 Cr; As on Jun 2013: Rs 7262 Cr.  
Rs. 10183 Cr. incl. interest during construction period – Jun 2013
With the delay in the project, the costing is increasing and hence, is becoming a problem for the Pune metro. Existing structures like Pataleshwar Temple and the Balgandharva Chowk will get affected due to the proposed route of the metro rail and is posing difficulties as the structures have sentimental value attached to it.

The relocation should be done in a systematic manner with proper provisions for reimbursement as the compensation issues will only delay the process and hamper the living of the public as seen in Delhi metro. A suggestion for a private partnership with BOT (build, operate and transfer) technique can be implemented and care should be taken to keep in check the quality of the material being used for the metro rail. The route should be reconsidered as the demolition of the historical monuments will only hamper the sentimental value and the structures to be demolished, the authorities should be reimbursed with the current market rates.

C. Underground vs. Elevated Route

Both the corridors mentioned above were analyzed by experts who have been working on the metro rails and in both the corridors the pros and cons of underground and elevated routes were discussed in detail.

In the first corridor (Swargate- PCMC), the scheduling of underground metro was done under the region of PMC as the congested roads and the heavy traffic makes it impossible to alter the existing roads and any changes in the road alignment will be highly inconvenient to both the Engineers and the public. Various points were laid out to strengthen and reinforce the idea of the underground metro rail which are as follows:

- Less inconvenience to the citizens and speedy construction with less traffic congestion during construction period.
- No land acquisitions and litigations will delay the project which is being experienced in other metros like Hyderabad and Jaipur metros.
- Future expansions of road will not be hampered as the underground metro will not alter the existing road structures.
- Environment will get benefitted as tree cover remains unaffected with minimum noise and air pollution.
- The second corridor (Vanaz- Ramwadi) is proposed to be as fully elevated for the entire 14.925 km but it is raising queries and doubts with suggestions to make the stretch of Vanaz to Yerawada underground. Reasons given for these suggestions are:
  - Inconvenience due to diversions and decreased road width on Karve road and JM Road.
  - Alignment proposed in the vicinity of JM road and Pataleshwar caves will hamper the existing greenery and the old structures of sentimental value.
  - Land acquisition and litigation problems.

- On the negative side, the financial aspect will have to be dealt with as the underground metro will raise the cost by 2700 crores out of which 1620 crores will have to be managed by PMC alone.
- To reduce the investment cost, the following measures can be taken:
  - Independent excavation to avoid cut and cover.
  - Preferring air cooling over air conditioning to optimize the equipment and O&M costs.
  - Higher use of TBMs for planning of concurrent works.
  - Global tendering of works.
  - The disadvantages of making elevated metro rail are:
    - Insufficient clear space, demolishing of existing structures.
    - Central lane BRT will be impossible with congestion problems for buses.
    - Parking issues with noise and air pollution increase.
    - Environment will get hampered with difficulties for future road expansions and construction.
    - Land acquisition and litigation issues.

D. Pre Feasibility Study

Pre feasibility study in the vicinity of PCMC was conducted and the result for the household survey was presented in the form of graphs and pie charts showing the adaptability and preference of the metro rail, if constructed, by the households who generally prefer the bus as their primary source of commute presently. It was done to check the adequacy of the metro rail and the demand side of dwellers. The methodology which was used is given as follows:

- To evaluate socio economic impact of metro stations of PCMC
- Socio Economic Survey
- Enlisting dwellers aspirations
- Analyzing data
- Main Findings
The first phase PCMC-Swargate was selected and out of that, the stations falling under PCMC i.e. Dapodi, Kasarwadi and Chinchwad were studied in detail.

**Fig.4 Purpose of Using metro**

**Fig.5 Frequency of using metro (X axis: Time, Y axis: Percentage)**

**Fig.6 Means of Communication (X axis: Mode, Y axis: Percentage of dwellers)**

**Fig.7 Dwellers Income (X axis: Income, Y axis: Percentage)**

**Fig.8 Chances of Reduction in Transportation Cost**
The main findings are as follows:

- Dwellers will prefer metro due to economic reasons daily.
- Metro will be popular among the higher middle income group.
- Suggestions for parking and linkages along with proper directions for governance for improving the metro experience.
- Environment related concerns were seen among people.
- Suggestions for efficiency of information desk were given and a need for integrated transportation system was the need of the hour according to dwellers.
- Late night usage of metro along with the frequency of the rails was asked for by the dwellers with a concern for the safety.

V. Future Scope of Work

As it a paper covering the aspects of an intra city development project, the future studies concerning the underground vs. elevated rails, the surveys and the solutions covering the current problems can help with the work which will be undertaken and it can be used as a reference for the development of an integrated transportation system in the city.

VI. Conclusion

Indian cities, with the help of DMRC, are planning to invest about Rs 2 trillion in metro rail systems. But our analysis shows that the DPR prepared by DMRC for Pune has many serious analytical and methodological flaws, making the
proposal highly questionable. Therefore, there is an urgent need to revisit all proposed metro rail projects and critically review them. An independent expert group should conduct the review based on clear, objective criteria and examine all aspects such as their justification, governance, accountability, viability and integration with other modes, and the review findings should be publicly debated. India is urbanising rapidly but its urban governance institutions, systems and capacities have not kept pace. This has given rise to the problems highlighted in this paper, resulting in big, expensive projects that often do not deliver the promised benefits and neglect of cheaper, quicker alternatives that may be more beneficial. The Urban local bodies must be reformed to make them transparent and directly accountable to citizens, and undertake integrated, comprehensive, least-cost planning considering supply and demand side options. Otherwise, it is very likely that there would be large investments in urban transport projects with very little benefits, and our cities will grow increasingly grid-locked and unliveable. In turn, this could well put the brakes on the country’s much-touted economic growth story. So, provisions for other existing transport system like BRTS should be put and improvement for proper transportation should be made instead of merely focusing on metro rail.

The above given solutions which are given, can be put to use to implement and eradicate some of the issues the metro is facing in the market. Care should be taken to develop an integrated transportation system and not favour any one mode of transportation. If the solutions are given and implemented, the problems can be dealt with and the issues which are being faced by other existing metros can be swayed and a faster integrated system can be achieved in a shorter span of time. If possible, underground corridor should be implemented to an extent to achieve an optimal plan with benefits from both the choices. An environmental impact assessment with socio economic surveys for both the corridors in detail can help keep the demands and the supplies under control and these above solutions can be implemented to achieve optimization and efficiency of the Pune metro rail in the following years.

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