Retraction

Retraction: Review Analysis on Factors Influencing the Design of Bus Station (IOP Conf. Ser.: Mater. Sci. Eng. 1145 012078)

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This article (and all articles in the proceedings volume relating to the same conference) has been retracted by IOP Publishing following an extensive investigation in line with the COPE guidelines. This investigation has uncovered evidence of systematic manipulation of the publication process and considerable citation manipulation.

IOP Publishing respectfully requests that readers consider all work within this volume potentially unreliable, as the volume has not been through a credible peer review process.

IOP Publishing regrets that our usual quality checks did not identify these issues before publication, and have since put additional measures in place to try to prevent these issues from reoccurring. IOP Publishing wishes to credit anonymous whistleblowers and the Problematic Paper Screener [1] for bringing some of the above issues to our attention, prompting us to investigate further.

[1] Cabanac G, Labbé C and Magazinov A 2021 arXiv:2107.06751v1

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Review Analysis on Factors Influencing the Design of Bus Station

S Logeswaran¹, P Indhiradevi¹, A Charumathy¹, A Anitha¹, Muthu Subramaniam¹ and S Karthikeyan²
¹Department of Civil engineering, KPR Institute of Engineering and Technology, Coimbatore.
²Kamalam Constructions, Tirupur.
¹logeswarancivileg@gmail.com

Abstract. In India, rapid increase in urbanization increases the demand of bus transportation usage with growth rate of 3% every year. This results in development of new routes in city and rural areas. The terminal operations in India are centric in nature for both pedestrians and vehicles. In order to design the efficient transportation system in terminal area the traffic operation should be centralized by implementing the correction factors. The previous research works were reviewed and the solution for developing the model was suggested in this study. The study of previous researches suggested various factors which influences the terminal design. All those factors were considered and the performance of each factor was studied and reframed with corrected values. This study integrated the terminal factors (Element factors + Operational factors + Structural factors + Dwell time factors (both vehicles and pedestrians) for efficient terminal design and operations. In associated with the above-mentioned factors bus scheduling was included as a factor in this study and suggestion were made for improvements.

Keywords: Bus terminus, Terminal design, Bus bays, Dwell time.

1. Introduction

A bus terminus is a public area from where the bus services start its journey or ends its scheduled route. In other words, it is represented as the place where passengers boarding and alighting from buses occurs. It is usually larger than the bus stop. For handling a smaller number of buses, a road side bus stop is sufficient but for handling a greater number of buses in doing boarding and alighting, it is better to built a structure for bus station to avoid traffic congestion and noise [1].

The point from where bus route starts or ends with basic operations like turning or reverse movements and wait before departing on their return journeys.

Bus transport is the main mode of public transportation in the country among various other modes. More than 1.6 million buses are in service as on 2016. Out of that 1.7 buses running under public sector which carries around 70 million people every day. The federal government planned to introduce Electric vehicle in contribution with existing bus transport system for reducing the pollution level. Thus, it further increases the traffic congestion rate. The existing infrastructure of the terminals in Indian cities lost its full capacity due to improper land use activities [2]. For better understanding
about the evaluation of terminal capacity, the starting point is taken as the capacity of the loading area. The loading area capacity is the basis for calculating the bus stop capacity in bus terminals. The bus departure procedure must be taking into account at maximum count for estimating the travel demand. The safety operations of buses such as reverse movements and turning movements should be well designed.

1.1 Functions of Bus terminus

➢ Bus terminus acts as a serving point for processing of buses, pedestrians and other vehicles. In order to achieve the smooth flow of traffic the necessary provisions should be given.
➢ For creating a multimodal connectivity, the bus terminus is integrated with other modes of transport.
➢ It also works as a function of neighbourhood with high-density mixed-use activities in its vicinity.

1.2 Requirements of bus terminus

➢ It should protect the passengers from passing traffic inside the terminal area
➢ It should give easy access for the people with disabilities
➢ Pavement of the terminus should be weathered surface to step from/to the bus
➢ Proximity to pedestrian crossings and trip generators
➢ Ventilation and lighting system should be clear [5]
➢ The bus terminus should ensure the safety, security and general welfare of the people those who are using the terminal area
➢ It should ensure compatibility with surrounding uses and properties and also to avoid impact associates with such uses. [Riverside Municipal code]

1.3 Elements of bus operations

➢ Adequate curb space to stop high number of buses at a same time.
➢ Pattern of bus routes and arrangements
➢ Direction/width of intersection streets
➢ Volume and turning movements to the other traffic
➢ Width of the pedestrian pavements
➢ Roads adjacent to the terminal area
➢ Pedestrian activity through intersections [3]

1.4 Objectives of the study

➢ To collect the traffic data from various bus terminus
➢ To collect the performance review of each bus terminus [7]
➢ To list the factors affecting bus terminal operations and new terminal design
➢ To develop a model with correction values for each factor observed

2. Literature review

“Architectural and Urban design for developing Interstate Bus transport” Bhubaneswar Detailed project report Vol – 1 suggests that the elements design must satisfy the following minimum requirements.

1. Pavement of the terminus should be designed to withstand the heavy loads.
2. Adequate drainage and pavement slope in order to avoid the stagnation of water.
3. The design of lighting system in bus terminus should have high intensity [8].
4. Proper signage and information boards must be installed at the necessary places both inside and outside the terminus.
5. Design of proper set back distance and architectural appearance.
6. Zoning of bus station platforms.
In addition to the above-mentioned concepts the traffic operational behaviour must be taken into account. Planning of transport utilities is compared with real world situation by comparing the values between the existing and the newly developed questionnaires. This helps the traffic Engineers to predict the correct solution for empirical solutions [9]. On the contrary, the travel demand modelling should be considered for research domain. The pedestrian movement also takes the part of design consideration in bus terminals with carrying capacity of more than 100 buses per hour. The following principles in the proposal of new master plan of Kochi Mobility Hub were considered,

- Conflict free movement for pedestrians
- Conflict free movement of vehicles and pedestrians
- Specified pedestrian link between the bus and ferry terminal.

[3] explained the concept for evaluating the capacity of the bus terminus by considering starting point is the capacity of the loading area. In this study HCM 2000 which described capacity based on dwell time was considered. Bus arrival distribution is not taken into account instead of that a correction factor was used to obtain better results in large sized cities. Since there is no Swedish model to calculate the bus stop capacity instead of that they used American based HCM 2000 model. As per the study the factors which affects the capacity of the terminal are,

1. Planning of traffic operations such as bus route cycle, location and frequency of buses and driver exchange.
2. Time scheduling
3. Terminal type
4. Terminal design
5. The purpose and function of the bus stop
6. Type of bus line
7. Reduced bus terminal capacity due to interference of buses and other vehicles traffic inside the terminal area

There are two methods suggested for calculating the bus terminus capacity. They are,
Method - 1: Empirical analysis (Independent bus movements and Dependent bus movements)
Method – 2: Simulation of bus terminal operations to calculate the terminal capacity and delay time.

Recommendations given in the study are,
- Safety margin between reverse and passing area of angle terminals.
- Dedicated alighting area on terminal capacity
- The ratio of bus parking spaces to the number of loading areas.
- Long term investigation and analysis of congestion.

[10] explained the concept of performance of the terminals based on the following three factors namely,
- Location of the terminus:
  1. Based on population density
  2. Business activities
  3. Planning of new transport terminals outside the city area to reduce congestion and avoiding high land costs.
- Accessibility of the terminus from all the parts of a city of easy local and regional connectivity for the people
- Infrastructural requirements such as Parking, Information services and food & security.
[4] described that the terminal orientation in India is not easily understandable to reach the desired point when one enters the terminal area. So, for evaluating the terminal design quantitative method was applied for two rail terminals in Mumbai. The study suggested the criteria for calculating the Level of service and direction design. As per this study, orientation is based on facility location and identification not by the representation of numbers or operational efficiency. The criteria which give significance in determining LOS in terminal was explained. The entire transport terminal is considered as Nodes (facilities) and Links (Path for passenger flow). The recommendations suggested in this study are determining the values of compactness index, De-centralization method, walking disability index and degree of utilization index.

[6] Zoning - Riverside Municipal code, California chapter 19.275 Bus terminals explained the concept of designing the bus terminus with respect to location, applicability & permit requirements, operational standards, security regulations and additional findings to approve a discretionary permit. The modifications in these standards are applicable up to certain conditions.

[7] explained the advantages of Taipei Bus station. The bus station plays major role in reduction of traffic congestion, energy conservation and pollution. The study used an adaptive signal control model combined with Artificial Neural Network demand forecasting model to manage the bus traffic in Taipei bus station.

Transit capacity and Quality service manual explained the concept of station elements and their capacities

3. Design principles of terminal elements

The general principles to be considered for the design of bus station are:
1. Design for the people
2. Design for the public
3. Design for the standardization and scalability.

4. Conclusions

In Indian cities, the terminal parameter considers the traffic flow in a heterogeneous path (i.e.) by including the design of traffic operations for both buses and other vehicles inside the terminal area. The factor of optimal route timings in most case of terminals is not satisfied due to either terminal elements alignment missing or terminal operation conflicts. In both the cases the responsibility of attaining the maximum utility is suffered by vehicle operations and passenger flow. The model developed above helps the traffic assigners to enable the calculation for bay loading rate and dwell time comparisons in bus terminals.

References

[1] Architectural and Urban design for developing Interstate Bus transport, Bhubaneswar Detailed project report, 1
[2] Azhar Al-Mudhaffar, Albania Nissan, Karl-Lennart Bang, Bus stop and bus terminal capacity, Transportation Research Procedia 14 (2016), pp 1762 – 1771.
[3] Interstate bus terminal – Literature study.
[4] Part 7 Stop, Station, And Terminal Capacity Chapter -4 Station elements and their capacities, Transit capacity and Quality service manual, 2nd edition.
[5] Balasaraswathi, M., Srinivasan, K., Udayakumar, L., Sivasakthiselvan, S. and Sumithra, M.G., 2020. Big data analytic of contexts and cascading tourism for smart city. Materials Today: Proceedings.
[6] Sivakumar, P., Boopathi, C.S., Sumithra, M.G., Singh, M., Malhotra, J. and Grover, A., 2020. Ultra-high capacity long-haul PDM-16-QAM-based WDM-FSO transmission system using coherent detection and digital signal processing. Optical and Quantum Electronics, 52(11), pp.1-18.

[7] IRC 3:1983, Dimensions and Weights of road design vehicles

[8] S.K.Khanna, C.E.G.Justo, Highway Engineering, Nem Chand & Bros, Roorkee, India, 2011.

[9] Bus terminus design guidelines, SG Architects, Delhi.

[10] Chetan C Patil and Shilpa, Traffic impact study of k alasipalayam journal from IJET.