

Traffic Management of Pedestrian at Railway Stations using Vissim

Parthiban P

Department of Civil Engineering
Jyothi Engineering College
Thrissur, India

Anju M J

Department of Civil Engineering
Jyothi Engineering College
Thrissur, India

Geethu Asok

Building Structural Engineer
Thrissur, India

Neeraja P G

Department of Civil Engineering
Jyothi Engineering College
Thrissur, India

Abstract— An enormous growth has been observed in the recent years that number of passengers travelling by Indian railway has been increased significantly in the pilgrim season due to rapid urbanization. The passengers are in high density inside the station premises course the operation time particularly in ingress, egress and transfer of trains at sub-urban transit stations. This thesis is a try and check the levels of services and satisfaction perceived by passengers with recognize to amenities on platforms within the State of Kerala, India. The present study is carried out in the pilgrim area of railway stations in Kerala state namely, Palakkad Junction, Thrissur, Kottayam, Chengannur and Trivandrum Central which has the highest annual passenger of boarding and alighting. Concentrate on pedestrian attributes on the basis of age, gender, luggage carrying & parameters of flow, density and speed. With that simulation model of the pedestrian network at the railway station was developed with the help of PTV Vissim / Viswalk and analysis was carried out stairways and entrance passageways respectively. The findings of this study comparing the results with field and simulation studies and pedestrian level of services. The discoveries of this study are expected to be useful for policymakers working on the idea of world-magnificence stations.

Keywords— *Levels of Services; Pedestrian; Railway Station; Simulation;*

I. INTRODUCTION

In contemporary years, the use of rail transit systems as a reliable and handy manner of travel has gained growing recognition in city towns around the world. Services provided by railway get hold of fine aid due to its excessive capacity, comfort, protection, and reliability. Tour by way of train transportation has ended up more favorable and has extended in reputation and recognition. The growth of rail transit is one of the known considerations in terms of excellent mass transportation attributes and attracting as many passengers as possible. In India, the railway stations are classified on the basis of annual passenger flow in the past 10 years with that the Indian railway stations located with the highest passenger earnings which are greater than Rs. 50 crores are considered as A1 categories, railway stations, and based on maintaining complete hygiene in the railway station premises as denoted as non-suburban 1 (NSG1 to NSG4). For this study, A1 and A class railway stations in Kerala are selected and via considering

the nearby famous pilgrim centers, considering they have excessive passenger flow as compared to different railway stations located in Kerala similarly to that which boom pedestrian moment capacity and risk of congestion, even if the arrival of 2 or more trains in the railway station eventually leads to discomfort and delay. While studying the passenger flow parameters for A1 category railway stations, it will be easy for modeling the pedestrian facilities in the other category railway stations with lesser passenger flow.

A. PTV Vissim

PTV VISSIM evolved by using PTV (Planung Transport Verkehr AG) in Karlsruhe, Germany. It's far that one of the maximums used simulation software programs to simulate, compare, and validate new transport guidelines and management structures. It allows for a seamless road network coding, not like other simulation software programs are ARCHISIM, AIMSUN and SUMO necessitates complex or time-consuming coding. It's a maximum commercial simulator for assist all sort of the automobile, in addition to the pedestrians, public transit vehicles and emergency vehicles in a student's version. It supports GIS. Finally, by considering the infrastructure of software for user flexibility and easy accessing and also in the future development, PTV Vissim is a user-friendly simulation software.

B. Objectives and Scope of the study

- To analyses, the level of service of pedestrians
- Predict the passenger flow capacity at stairways and entry/exit of passage
- To provide valuable perception to enhance the rail transit facilities for the individual's humans.

II. LITERATURE REVIEW

A pedestrian behavioural exploration of an intermodal terminal transition within the district of metropolitan of Calcutta. Speed, density, flow, and area relations have evolved. The theory of speed-density was discovered along with sequence to be linear, while others followed quadrate courting. This is the jam density range-me-down to be discovered 4.17

ped / m². They include walking speeds ranging from 50.55 meter/minutes to 87.51 meter / minutes, most of them glide load being about 92 ped / m - min [9].

The review on Pedestrian environments is turning out to be more significant in an urbanizing world where strolling is progressively being energized. Designers and organizers decide a connection's presentation utilizing measures arranged as the level of- service, which gives direction on satisfactory or attractive norms. A scope of methods is utilized in figuring out a pedestrian level of service, consolidating a huge collection of components and with plenty of discussion regarding what should or ought now not to be utilized. There has been no orderly endeavour to blend this examination and give an overall viewpoint. Our audit studied PLOS models from the companion evaluated writing utilizing a precise quantitative writing audit strategy dependent on the convention created by the Preferred Announcing Items for Systematic Review Recommendations (PRISMA). On the whole, these components can be assembled in topics of solace, wellbeing, and versatility. The most utilized components were, all together: trail width; checks to the person on foot stream; engine vehicle paces and volumes; shoulder widths; and supports, for example, on-road stopping. Notwithstanding, a significant number of the components being incorporated have not been experimentally considered and practically nothing there of them was apparatuses being used have been tried for such issues as between ratter dependability [6].

To evaluate, the pedestrian speed is completed at four places within the north part of India. For the upstream free-flow ranges from 82.21 meter / minutes to 88.93 meter / minutes and for the downstream ranges from 80.80 meter / minutes to 86.38 meter / minutes. It got closed from the consequences that with the boom in frictions confronted with the aid of a pedestrian, inverse to the regular notion [12].

The analyst on the assessment of a walker stream with picked boundaries. Consider the zone is picked at Dakor, arranged in dist. Kheda, Gujarat. For this concentrate right off the bat recognizing the top hour for pedestrian flow at that point, furthermore breaking down the pedestrian space, speed, low density in pinnacle period after in conclusion, they checked an advantage level for the individual by pedestrian gathering as heading by street limit manual 2000. For the data gathering period, fundamental data is taken from the video recording position from 8.10 am to 12.16 pm after optional information gathered as broad subtleties AutoCAD drawing a guide of Dakor town from Dakor Nagarpalika. The outcome was contrasted, and both public global principles of level of administration found that degree of administration is "E" [16].

It has been seen in various travellers utilizing railroad transportation because of everyday urbanization. It brings about an expansion in the quantity of travellers utilizing the railroad station platform; as a rule, this client is characterized as a common stream at the platform. During appearances and take off of trains at metropolitan travel stations, there is exceptionally high blockage because of pedestrian flow. The pedestrian stream goes to top level with snappy variety also, achieves development of person on foot streams and may incite to the hazardous pedestrian facility. The investigation of this pedestrian flow in certain conditions in purpose of the gravity of circumstance turning ominous, thusly for the capability design, and furthermore convincing tasks, displaying of

pedestrian flow for such condition is imperative to expand the person on a foot level of administration. A recreation model of the pedestrian network at Nagpur railroad station was created with the assistance of PTV Vissim 9 and examination was done. The outcomes show that the contrast on the way and incline independently, the difference between field research and replication study is 15% and 10% Patange and Bhakhtyapuri [17].

A. Summary

To summarize, many of the research had been centered on pedestrian glide characteristics, setting up members of the family between pedestrian motion characteristics. A need emerges for defined knowledge an effect on of special attributes on pedestrian motion in degree trade facilities. The entirety of the research is focused on straightforward towns within dedicated pedestrian facilities. In train stations, where walking is harder compared to plain locations, there hasn't been any work done undertaken and the lack of dedicated services makes it harder. Therefore, further study is needed to clarify the different facets of pedestrian activity at the entry or exit of railway stations.

III. METHODOLOGY

After the successful understanding of the study of literature. The methodology for the pedestrian flow of capacity analysis at the railway stations are listed below.

A. Study Location

The study focuses on A1 and A category railway stations in Kerala state, namely Palakkad Junction, Thrissur, Kottayam, Chengannur and Trivandrum Central are nearby to a famous pilgrim center Sabarimala temple.

B. Data Collection

Information is obtained using the visual graphic images captured method in the railway station premises in mid-December to January end (2019 - 2020). Based on the criteria the distribution of pedestrian from the study area is graphed in Fig. 1.

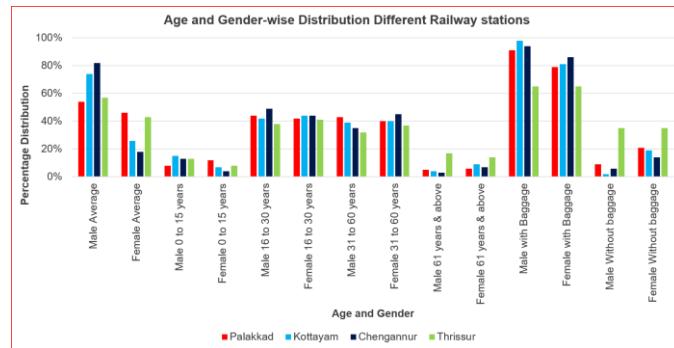


Fig. 1. Pedestrian attribute classification

C. Data Analysis

Preparation of excel data sheet to note down the findings of passenger flow parameters such as speed, density and flow are retrieved from the video graphic footage on train arrival at the railway station premises in the halt duration of ten-minute

which are displayed in TABLE I. Space availability of individual pedestrians is also found out.

TABLE I. PEDESTRIANS FLOW PARAMETERS

Railway Station	Palakkad / Thrissur / Kottayam / Chengannur		
	Maximum flow (ped/min/m)	Mean Speed (m/min)	Maximum Density (ped/m ²)
Stairways	51 / 79 / 70 / 63	34.27 / 25.97 / 32.34 / 24.7	5.59 / 4.01 / 2.42 / 6.53
Entry/exit	68 / 101 / 92 / 69	34.86 / 25.9 / 30.07 / 22.9	8.35 / 3.96 / 4.6 / 7.81

Passenger data collected from the study area is tabulated in TABLE I. From the data analysis in stairways when flow rate is higher corresponding speed and density of the pedestrian is low.

IV. PEDESTRIAN MICRO-SIMULATION SOFTWARE

The microscopic software program considers all characteristics as we depend and affords appropriate results in designing / planning of the recent facility. Wide open transit structure, typically passengers / pedestrian ambulates in on one plane, vertically or amenable route on prominent infrastructure such as a platform, ramps, escalators, elevators, stairs and passage benefit for to attain a pedestrian on departure factor. As a result, adequate infrastructure was needed, such as a new opportunity orientation, appropriate configurations or designs for the planning or modeling stages.

A. Comparison of an field with simulation study

Micro-simulation offers facts approximately pedestrian interactions with conflicting pedestrian flows and the difference between field and simulation examine. The stairway, a passageway and entrance region is in relation to five separate simulation runs on the same input in PTV Vissim with random seed 42,43,44,45 and 46 and an average value of density and speed respectively, and this is used in the Fig. 2 and Fig. 3.

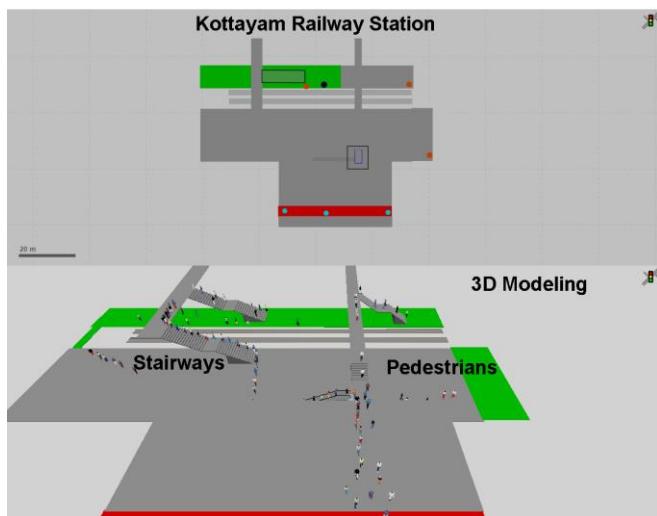


Fig. 2. Pedestrian simulation analysis on the Kottayam railway station

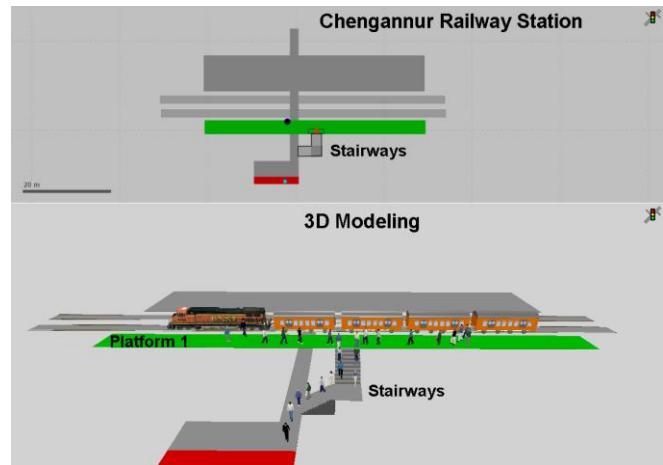


Fig. 3. Pedestrian simulation study on Chengannur railway station.

The micro-simulation gives information approximately pedestrian interactions with conflicting pedestrian flows and the distinction between the existing station and an simulation railway station are 14% and 12% on stairways and entrance passageways respectively.

V. LEVEL OF SERVICE FOR THE PEDESTRIAN (PLOS) BY GUIDELINES

The pedestrian level of service appears to be a comprehensive measure, including its operational state for the centres. It refers to the comfort level offered by the pedestrian facilities.

A. PLOS Ranges for stairways - Indo HCM

The pedestrian Level of Service (PLOS) is defined based on essential pedestrian flow parameters for 3 specific parameters are flow, speed, area or space uses only in the case of stairways as test sections taken into consideration in encompassed stairways makes use of it. Eventually, 6 LOS are defined starting from LOS A to LOS F for stairways land use in Indian context. Based on the guidelines laid down by Indo-HCM 2017. The range of flow values derived for a stairway is PLOS for stairways are presented in TABLE II.

TABLE II. PLOS FOR STAIRWAYS

Railway Station	Flow (ped/min/m)	Speed (m/min)	Space (m ² /ped)	PLOS
Kottayam	70	32.34	1.49	C / C / C
Chengannur	92	30.07	0.51	C / C / D

From TABLE II, the pedestrian LOS for the locations Kottayam railway station is observed as C, due to flow rate is high in the mixed proportions of both regular and pilgrim devotees.

In the Chengannur railway station is observed as C for flow and speed, but for the space will ranges in down D, this is due to the width of the stairways is less to accommodate the flow of pedestrians in the structure.

B. PLOS Ranges for stairways - Indian Railway manual

The Indian railways was used by a vast number of people from all walks of life. Massive cities such as Mumbai, Kolkata, and Chennai have been a lifetime of managing large commuter site visitors. The one that stands all of them is out commuting traffic and broadways to the travellers. The commuter travellers unnumbered the broad way to the tourists with the aid of a big margin in those urban cities.

It is indeed a view of the station platforms of incoming trains must be isolated from long altitude systems as they plague travellers who need an extraordinary LoS. The overall performance criteria of LoS provide a technique of counting passengers by circulating factors that respond to the wishes of the pedestrians totally decided by J. J. Fruin's pedestrian planning and layout (1987). This is the ability to shift the elements of the passenger would enable the normal, free-speed movement of the passenger, along with the body spaciousness of the human body and the human locomotive.

A LoS up to C or more will be used as opposed to all passenger circulating variables presumed to be totally at, they blew up passenger / ridership load goal target stated herein for a concession evaluate whether as, whether as, or as long as alluded to in section 2. There are 4 bases up to the layout. Even so, the station architecture shall remember the use of seasonal height and ensure that each station part complies with LOS D in this timeframe. The following two are the maps detail the criteria of the Level of services LoS up to a variety of station components. This applies to the construction of such buildings, of which J. J. Fruin's criteria rarely extend to international aviation membership requirements.

TABLE III. PLOS FOR STAIRWAYS - J.J FRUIN'S

Railway Station	Flow (ped/min/m)	Space (m ² /ped)	PLOS
Kottayam	70	1.49	D
Chengannur	92	0.51	D

From the TABLE III the pedestrian LOS for the locations Kottayam and Chengannur railway station is observed as D is standing barring touching is not possible circulation is severely confined inside the queue and ahead movement is solely feasible, long-term readiness at this density is unsettling as a group.

C. PLOS Ranges for entry or exit - Indian Railway manual

So, one can switch passengers correctly from the road stage to educate and conversely, station planning got to be primarily based on hooked up ideas up to pedestrian waft along with arranged to minimize useless taking walks distance along with pass flows among arrival along with departure of passengers. The range of flow values derived for entry or exit is PLOS for entry or exit are presented in TABLE VI

TABLE IV. PLOS for entry / exit - Indian Work Manual

Railway Station	Flow (ped/min/m)	Space (m ² /ped)	PLOS
Kottayam	70	1.49	E
Chengannur	92	0.51	D

From the TABLE VI. The pedestrian LoS for the locations Kottayam Railway Station is PLOS E stands for physical interaction with others is inevitable; travel inside the queue is not possible; the queuing at this density can be managed for a limited period of time without critical discomfort. And even for Chengannur is PLOS D it is difficult to stand without sense of touch; mobility is impossible highly limited Only as a community is feasible in the queue and forward movement; lengthy awaiting for such a density is frustration.

VI. CONCLUSIONS AND FUTURE SCOPE

Present study finds out concludes the points are,

- Walking speed of pedestrians for A1 and A class railway stations is determined and compared with field and simulation study by using Vissim software
- However, a distinction relies upon the age, gender and carrying luggage with stipulations of pedestrians will vary
- By analyzing the space with respect to the passenger flow, space is insufficient in Kottayam and Chengannur railway stations since the values are below 0.75m² and it depicts the widening of the entrance/ exit location for having a smooth flow of passengers, especially in peak hours

A. Future Scope

- The findings grant higher perception and into characteristics of the pedestrian flow via conceiving less duration masking period of arrival of the train
- The learn about are being found in addition accelerated via protecting a higher a broad range of stations, including variance in the stairways of design and pedestrian holding baggage

ACKNOWLEDGMENT

I am thankful to my guide Ms. Archana S and teaching staffs in Department of Civil Engineering, Jyothi Engineering College, for great support throughout this project. My sincere thanks to Ms. Vincy Verghese, our beloved Head of the Department, for providing all the facilities. I am deeply indebted to the Divisional Managers of Palakkad Railway Division, Trivandrum Railway Division of Kottayam and Chengannur railway stations for granting me permission and also assisting me during the entire data collection process.

REFERENCES

- [1] L. D. Vanumu, K. R. Rao, and G. Tiwari, Fundamental diagrams of pedestrian flow characteristics: A review. European transport research review, 4th ed., vol. 9, 2017, pp.49.
- [2] G. R. Bivina, P. Parida, M. Advani and M. Parida, Pedestrian level of service model for evaluating and improving sidewalks from various land uses. European Transport-Trasporti Europei 2018.

[3] N. H. Kasehyani, Evaluation of pedestrian walking speed in rail transit terminal. International Journal of Integrated Engineering, 9th ed., vol. 11, 2019, pp.026-036.

[4] C. Gruden, I. I. Otković and M. Šraml, Neural Networks Applied to Microsimulation: A Prediction Model for Pedestrian Crossing Time. Sustainability, 13th ed., vol. 12, 2020, pp.5355.

[5] N. S. A. Sukor, N. A. Rahman, M. Md, K. A. Rohani and S. A. Hassan, Pedestrian Movement at the Unpaid Concourse Area in KLCC Train Station, International journal of integrated engineering, 8th ed., vol. 11, 2019, pp.279-291.

[6] Z. Asadi-Shekari, M. Moeinaddini and M. Zaly Shah, Disabled pedestrian level of service method for evaluating and promoting inclusive walking facilities on urban streets, Journal of Transportation Engineering, 2nd ed., vol. 139, 2013, pp.181-192.

[7] T. Chen, W. Wang, Y. Tu and X. Hua, Modelling Unidirectional Crowd Motion in a Corridor with Statistical Characteristics of Pedestrian Movements, Mathematical Problems in Engineering, 2020.

[8] W. H. Lam and C. Y. Cheung, Pedestrian speed/flow relationships for walking facilities in Hong Kong. Journal of transportation engineering, 4th ed., vol. 126, 2000, pp.343-349.

[9] A. K. Sarkar and K. S. V. S. Janardhan, Pedestrian flow characteristics at an intermodal transfer terminal in Calcutta, World transport policy and practice, 1st ed., vol. 7, 2001, pp.32-38.

[10] K. Kang, Application of NFPA 130 for Emergency Evacuation in a Mass Transit Station, ASHRAE transactions, 2nd ed., vol. 112, 2006.

[11] U. Chattaraj, A. Seyfried and P. Chakroborty, Comparison of pedestrian fundamental diagram across cultures, Advances in complex systems, 3rd ed., vol. 12, 2009, pp.393-405.

[12] K. L. Kotkar, R. Rastogi and S. Chandra, Pedestrian flow characteristics in mixed flow conditions, Journal of Urban Planning and Development, ASCE, 3rd ed., vol. 136, 2010, pp.23-33.

[13] L. F. L. Hermant, Human movement behaviour in South African railway stations: Implications for design, SATC 2011.

[14] M. I. Nazir, S. K. Adhikary, Q. S. Hossain and S. A. Ali, Pedestrian flow characteristics in Khulna metropolitan city, Bangladesh, Journal of Engineering Science, 1st ed., vol. 3, 2011, pp.25-31.

[15] S. H. K. Soltani, M. Sham, M. Awang and R. Yaman, Accessibility for disabled in public transportation terminal, Procedia-Social and Behavioral Sciences, vol. 35, 2012, pp.89-96.

[16] C. Brahmbhatt, L. Zala and M. Advani, Measurement of pedestrian flow parameters—case study of Dakor, Gujarat. International Research Journal of Engineering and Technology (IRJET), 3rd ed., vol. 2, 2015.

[17] P. Patange and V. Bhaktyapuri, Micro-simulation study on pedestrian flow at railway station, International Journal of Science Technology and Engineering, 9th ed., vol. 3, 2017, pp.594-599.

[18] P. Parthiban and S. Archana, Pedestrian facilities and safety analysis at railway station in the pilgrim season, In New and effective Innovations, Technologies and Key Challenges, 2020, pp.28.

[19] P. Parthiban and S. Archana, Pedestrian Flow and Capacity Analysis at Railway Station,” In Proceeding of National Conference on Emerging Trends in Civil Engineering, pp. 316–325.

[20] Ministry of Railways, Rail Bhawan, New Delhi 110001, Manual for standards and specifications for railway stations, Land and Amenities Directorate, Railway Board (Ministry of Railways), 1st ed., vol. 1, 2020.

[21] National Fire Protection Association, Standard for Fixed Guideway Transit and Passenger Rail Systems NFPA 130, [E-book], National Fire Protection Association 1st ed., vol. 1,2020. [https://www.nfpa.org/codes-and-standards/list-of-codes-and-standards/detail?code=130](https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=130).

[22] I. R. Congress, Guidelines for Pedestrian Facilities, IRC: 103-2012, first revision