

INLET CROSSING INSPECTION IN URBAN WAY BASED ON ROAD SAFETY FACTORS.

Irauna Maiconá Rodrigues de Carvalho

Civil Engineer, Federal Institute of Amazonas (IFAM)
Única University
iraunaaa@gmail.com

Luiz Mauro Brandolt

Civil Engineer, Federal Institute of Amazonas (IFAM)
maurobrandolt1995@hotmail.com

Átila Sielskis Vieira Ermes

Civil Engineer, Federal Institute of Amazonas (IFAM)
atilasielskis13@gmail.com

Juliana Christine da Silva Granja

Unyleya University
Juliana.chirstyne2@gmail.com

Abstract

The reference object is located on two arterial avenues making the bridge for pedestrians to use bus lines from different urban areas. Bus terminals offer the option for passengers to use lines to different areas of their origin, in the city of Manaus there are some bus stops that perform this function, and the crossing under review is the tool that makes this connection between the places. Through Geographic Information System (GIS) tools and Traffic Agency data, the goal is to show that such a crossing does not serve the entire population.

Key-Words: Securite Traffic. Walkability, Manaus City.

1. Introduction

The city of Manaus has a little more than 2 million inhabitants, and not so far from the great metropolises of Brazil, it faces major problems in urban mobility. Traffic in the capital city is growing exorbitantly, the ease of buying and selling motor vehicles has gradually added to traffic in the city. The lack of efficiency in the inspection of Organs competent bodies regarding the traffic of vehicles is also one of the factors that associate difficulties in traffic, but the biggest problem that generates a restriction in the improvement of

traffic is the scarcity of the applicability of research projects in the main urban roads. regarding the fluidity of motor vehicles.

Being run over, in addition to harming the health of those involved, this when they are not fatal, generates disorders in the roads and expenses to the public power. It is noteworthy that, they happen mainly during the attempt of crossing the pedestrian, but they can happen while walking, or even are stopped, by the track or sidewalk. According to GOLD (1998), crossing conditions, which are a function of traffic engineering and the behavior of drivers, must be analyzed through the ease with which pedestrians cross the street without coming into conflict with vehicles.

The objective of the Urban Bus Terminal is to be a place of choice for the user of public transport of bus routes to different areas from their origin to another. In Manaus, not all bus lines follow a route to the passenger's final destination, right in the capital of Amazonas there are 5 terminals that perform this function for the user, terminal 1 is located in the central region, terminal 2 in the south of the city in neighborhood of Cachoeirinha, terminal 3 in the North zone in the neighborhood of Cidade Nova, terminal 4 on the border between the north (Bairro Cidade Nova) and east (Bairro Jorge Teixeira) and terminal 5 on the east side in the Zumbi dos Palmares neighborhood. However, for some pedestrians, there is the advantage and agility of making the alternative from the route of origin to the final destination, alternating at stops, for users who use electronic ticketing is a great advantage, since the use of the card gives the user the advantage of have a period of 30 minutes to change from one bus to another without a new payment. In the analysis of the object of study, we selected the uneven crossing of Carrefour das Flores as the interconnection of this type of alternative to the user, however it is not a crossing with accessibility for all users.

According to the DNIT's Special Works Project Manual, the walkways are special works of art intended essentially for pedestrian traffic and, eventually, for cyclists; whenever the importance of separating vehicle traffic from pedestrian crossing grows, increasing pedestrian safety and facilitating traffic flow, it is necessary to build a walkway.

Also according to the DNIT Manual, the catwalks in the project design must be considered in the requirements of ABNT NBR 9050 - Accessibility for People with Disabilities to Buildings, Furniture Space and Urban Equipment. The walkway in question belongs to the requirements of the standard, of the type above the superstructure of the permanent road defined by overlying walkways, since they can be designed in the open or covered, by reinforced concrete slab, or other material, for protection against weather.

Extensive networks of circulation structures internally connect urban agglomerations interconnecting the landscape and forming the systems that represent an important part of the built environment. Accessibility to this system is an essential condition for all individuals to enjoy urban spaces with adequate mobility. And, this being the result of the interaction between the displacement of people and goods with the city, observing and favoring these displacements becomes an important object of investigation (BRASIL, 2004). Accessibility can be understood as the possibility and condition of reach, perception and understanding for the use, with security and autonomy, of spaces, furniture, urban equipment, buildings, transport, information, communication, including its systems and technologies, as well as other services and facilities open to the public, for public or private use for collective use, both in urban and rural areas, by people with disabilities or reduced mobility (ABNT, 2015).

The discussion about the conflict between accessibility versus urban infrastructure has intensified in the era of social media. In 2012, Law No. 12,587 was enacted, which institutes the guidelines of the National Urban Mobility Policy, bringing conceptually in its Article 4 urban mobility as the condition in which the displacement of people and cargo in the urban space takes place. Accessibility as the facility made available to people with autonomy in the desired trips, respecting the legislation in force. The law adopts universal accessibility as one of its principles (Art. 5 of section II) and aims (Art 7 of section II) to reduce inequalities and promote social inclusion and provide improvement in the urban conditions of the population with regard to accessibility and mobility (BRASIL, 2012).

Based on bibliographic references in the definitions of unevenness and accessibility crossings, on-site analyzes of the object of study were made and transformed into a tool in the referred research.

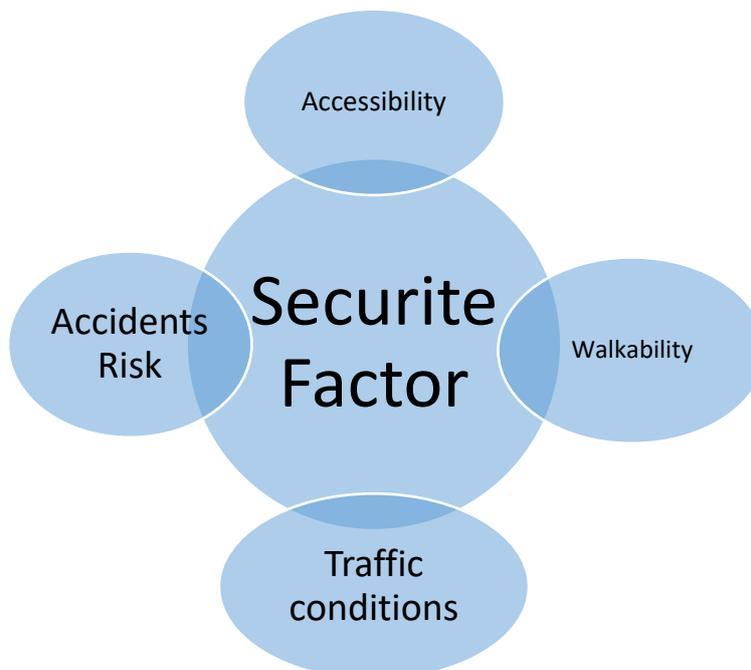
2. Metodology

The walkway is located between the end and the beginning of two main high-flow avenues in the city, Avenida Djalma Batista and Avenida Torquato Tapajós. Three PGV's are located in its vicinity: the Tropeiro grill, the Carrefour supermarket and the Ciesa University, which possibly leverages the flow of users of the walkway.

The analysis will be made with assessments of the conditioning factors of safety factors in the current offer of the walkway with on-site visit and with pertinent information on the routes in the Urban Mobility plan of the City.

The conditions that make up the safety factor are expressed according to flowchart 1.

Flowchart 1. Securite Factor.



The conditions that make up the safety factor have been inspected according to the principles of the user's needs.

As for the defined conditions, Table 1 defines the conditions according to the degree of offer favorable to users, following the methodology adopted by Prof. Dr. Hugo Pietrantonio.

Table 1- Safety factors in a current and future offer. Source: Own.

Degree of offer to the user	Safety factor in the current catwalk scenario	Degree of offer to the user	Safety factor in a future scenario with the renovation of the catwalk
3	Comfort	4	Comfort
2	Accessibility	5	Accessibility
3	Walkability	4	Walkability
4	Traffic Conditions	4	Traffic Conditions
2	Accidents Risk	1	Accidents Risk

For the understanding to be made, the degree of supply will take place in 5 levels, with 0 to 2 being an unfavorable safety factor, 3 an intermediate environment and 4 to 5 being an environment-friendly safety factor

The assertion of the degree of security of these factors will occur with the analysis of the data of the current scenario and the prognosis of the future scenario with the necessary adjustments.

Current Scenario

• **Comfort:**

The user needs to have good physical conditions to climb the inclined stairs, and the city's climate is not conducive to aerobic exercise. The walkway coverings and painting recently have a tone of good energy for the pedestrian.

• **Accessibility:**

The individual who has physical and visual disabilities is unable to enjoy the walkway, the infrastructure completely excludes this population.

• **Walkability:**

The width of the walkway is narrow, users who travel in opposite directions are obliged to have preference for one of both directions. At night, the lighting it has has no efficacy to illuminate the entire path.

• **Traffic Control:**

Users who transit at peak times are obliged to reduce their steps due to the catwalk not being able to accommodate everyone due to its narrowing.

• **Accidents Risk:**

Users who are excluded from using the walkway need to cross the avenue, putting their physical integrity at risk.

Boulevard

According to the data in volume 1 of the Urban Mobility Plan of the city of Manaus 2015 developed by the company Oficina Consultorias, we have the data treated in the simulation of the transport network for the

individual motorized mode in the current offer scenario at the peak hour of the morning of the flow of vehicles in both directions of the avenues that house the crossings according to Table 2.

Table 2. Flow of vehicles in both directions. Source: PlanMob 2015, Volume 1.

Boulevard	Direction	2015	2020	2025	2030	2035
Djalma Batista	Downtown - Neighborhood	1.828	1.528	1.612	1.572	1.595
Torquato Tapajós	Neighborhood - Downtown	2.353	2.629	2.816	2.885	3.023

It is noticeable the large flow of vehicles in this region, the forecasts of the following years tend to gradually increase in the neighborhood-center direction while the other way undergoes an oscillation. The demand for the number of passengers at the Avenida Torquato Tapajós bus stop may be higher than that of the other route.

According to the Mobility Plan report, Avenida Torquato Tapajós is used as part of the route of an expressive number of damaged typology lines that serve the North, West and Northeast regions, resulting in a frequency of 146 Buses / hour in the section greater vehicular flow. On Avenida Djalma, there is a strong presence of commercial activities, and therefore constitutes a pole of attraction for specific trips, which leads to the existence of numerous bus lines.

Accidents

The main function of uneven crossings is to make the crossing safe for the user, in this aspect according to table 1, it is possible to visualize the high accident rate that both avenues that house the walkway present.

Table 3. Road accidents.

Boulevard	2011	2012	2013	2014	2015	2016	Total
Torquato Tapajos	21	31	32	26	24	43	177
Djalma Batista	15	16	16	26	17	19	109

The information contained in table 3 was taken from data provided by ManausTrans, it is the 10 avenues with the highest number of accidents in Manaus, however for research analysis only those that segregate the walkway were emphasized, it was possible to evaluate that Avenida Torquato Tapajos presents an unpleasant number of accidents per year, where its highest rate was in 2016 and Avenida Djalma Batista in 2014.

Localization

Pictures 1,2 and 3 show the condition of the current catwalk scenario, it is notable that the catwalk undergoes some renovations in part of its infrastructure.



Figure 1. Location of the crossing. Source: Google Earth Pro.

As shown in figure 1, the walkway is approximately 102 meters long, with two accesses on both avenues. In image 2 it is possible to analyze the walkway in another perspective of access, made the analysis through another angle it is possible to make the necessary necessary recommendations later.

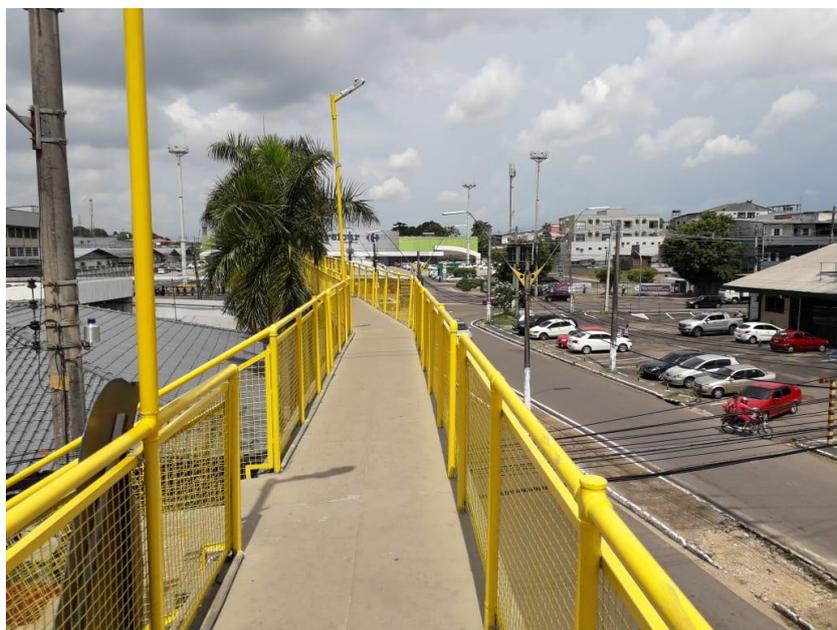


Figure 2. Footbridge. Source: Own.

Recently, some repairs were made to the painting and lighting of the walkway, the visual generated a positive visual impact because with the painting it was possible to give the user a safe form of handholds on the handrail, which was previously unusual due to the irons being, in their greatest long, rusty.



Figure 3. Footbridge. Source: Own.

According to image 3, traffic between users is restricted along their path, as its width is very narrow (less than one meter wide) and users who cannot have the privilege of using the walkway must cross with motorized vehicles, in this case the visually impaired mostly, await other users to assist them in maneuvering up and down stairs.

In Manaus, some walkways are distinguished by good accessibility, a few kilometers from the object of study, the walkway that connects a bus stop to a shopping center, accessibility was valued differently, elevators were not installed, but wide corridors were made, as shown in image 4.



Figure 4. Footbridge Amazonas Shopping. Source: Acritica.com

In the capital of Amazonas, there are few walkways that serve the entire community, on Avenida Torquato Tapajós recently installed one near a club, excluding the physically and visually impaired. The authorities do not realize the need to serve the entire community. The number of walkways with nearby

PGV's that serve all communities are few, from an analysis carried out on the spot it is estimated that only that of Amazonas shopping, shopping manauara and shopping ponta negra (Main) are the ones that serve everyone.

3. Results

As a result, some notes were cataloged, with an opinion poll (16 people were consulted on the spot), with scores from 5 to 10 to assess the crossing studied.

Table 04. Conclusion Opinions.

Indicator	Note	Observation
Comfort	6,5	It has no cover, and the crossing is narrow. The painting presents a tone of good energy to the pedestrian.
Acessibility	6,0	It does not present instruments for people with physical and visual disabilities (such as podotactil or directional floors) to use the walkway more safely.
Walkability	6,0	Walkway is narrow. Lighting that it has, has no efficacy to illuminate the entire path.
Traffic Control	6,0	At peak times, users are forced to reduce their steps due to the walkway being unable to accommodate several people due to its narrowing.
Accidents	6,0	There is no elevator for PCD, users who are excluded from using the footbridge need to cross the avenue.

The walkway was considered average by users. A study can be redone by the IMMU by repairing the main problems faced by users.

4. Conclusion

Urban mobility must not, by law, restrict pedestrian traffic of any race, ethnicity, culture, origin, handicap and community. The metropolis of the state of Amazonas, erroneously, is excluding people with visual and physical disabilities in not adapting such needs in the infrastructure of walkways close to PGV's.

It is noticeable that this North-South Axis - formed by the avenues Djalma Batista and Mário Ypiranga - divides the city into two little integrated portions as described in the Manaus Mobility Plan. This is usually occurring because there are very few points of transposition of these routes. There are not enough pedestrian crossings and pedestrian crossings and even from the point of view of motor vehicle traffic, there are few options of roads that cross it.

Recently, the city government announced a package of works with revitalization of more than 20 walkways, however these reforms do not provide for adjustments in the constructions regarding the width, ramps or facilities for PCD elevators.

The safety factors of the current scenario reveal in another form of perception that the user with special needs is unable to use a public urban heritage due to the lack of adequate infrastructure. In order to improve infrastructure in the future scenario, there must first be awareness of the government towards the PCD community. Elevator installations are the best way of renting the walkway, as the space is not conducive to making ramps, improvements in lighting, it will also be necessary to increase the length and width, make installations in strategic places of devices that emit sounds indicating the direction that the visually impaired must follow to make the crossing safely.

With the analysis of on-site visits, reading of construction codes, interviews with local users of the walkway, analysis of road data, analysis of accidents and road flows, it is possible to mention that the main problems presented by the walkway are:

- Exclusion of physically disabled people, in particular to PCD's.
- Partial exclusion of visually impaired people.
- Poor traffic by users due to its narrow width.
- In a future scenario, there will be conflict in the trafficability of PCD's that are in opposite directions.
- Low light illumination.
- Very steep stair slope, making users physically fit.

With the reported difficulties, it is advantageous for the population that the competent bodies do not just make basic reforms, and redo a drastic assessment of the walkway analyzing all its infrastructure and accessibility to everyone in the place.

5. Acknowledgement

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6. References

ASSOCIAÇÃO BRASILEIRA DE NORMAS TÉCNICAS. NBR 9050: Acessibilidade a edificações, mobiliário, espaços e equipamentos urbanos. Rio de Janeiro: ABNT, 2015. Disponível em: http://www.pessoacomdeficiencia.gov.br/app/sites/default/files/arquivos/%5Bfield_generico_i_magens-filefield-description%5D_164.pdf

BRASIL. Política Nacional de Mobilidade Urbana Sustentável: Princípios e Diretrizes Aprovadas no conselho das cidades em setembro de 2004. Secretaria Nacional de Transporte e Mobilidade Urbana. Ministério das Cidades, Brasil: 2004

Brasil Acessível: Programa Brasileiro de Acessibilidade Urbana - Caderno 2: Construindo a cidade acessível. Secretaria Nacional de Transporte e da Mobilidade Urbana, Ministério das Cidades, Brasil: 2006. Disponível em <<http://www.cidades.gov.br>>. Acesso em: 05 de Outubro de 2019.

GOLD, Philip Antony. Segurança de trânsito – Aplicações de Engenharia para reduzir acidentes. Estados Unidos da América, 1998;

Manual de projeto de obras-de-arte especiais - Rio de Janeiro, 1996. 225p. (IPR. Publ., 698).

Plano de Mobilidade Urbana de Manaus – Manaus, 2015, vol I.

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