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Walkability for utilitarian and leisure purposes: a comparative study on an avenue located in the city of Araçatuba, São Paulo

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ABSTRACT

More walkable cities contribute to building a sustainable city. In the last decades, the increase in the number of urban displacements carried out by foot highlights the importance of developing methods that seek to analyze the quality of this infrastructure to propose improvements for these users. In this context, this paper aims to present the result of the evaluation of the urban mobility infrastructure destined for walkability for practical and leisure purposes in two areas of an important road axis located in the city of Araçatuba, São Paulo, using the Walkability Index of the Macro and Microscale (in Portuguese the acronym ICMME), proposed by Pires (2018). The methodology allows the evaluation of sidewalks and road intersections based on indicators associated with Safety, Security, Comfort, and Attractiveness. The results show that the sidewalks and intersections located in area 2, intended for leisure walking, offer greater Safety, Security, Comfort, and Attractiveness to users. On the other hand, the sidewalks and crossings of area 1, which are used by people predominantly for displacements with utilitarian purposes (study, shopping, and work) are of lower spatial quality, especially in relation to elements associated with Safety and Security (of the sidewalks) and Safety and Comfort (of the intersections) of users. The results made it possible to identify positive and negative points of the pedestrian infrastructure and can be used to formulate public policies for urban mobility aimed at walkability.

KEYWORDS: Pedestrian. Walkability. Performance indicators.

1 INTRODUCTION

More walkable cities have been defended by planners worldwide, as it is the support for building a sustainable city (FORSYTH; SOUTHWORTH, 2008). Walking is a socially equitable means of transport, as all age groups and social classes can use it, to any destination, whether for utilitarian or leisure activities (LITMAN, 2003; FORSYTH; SOUTHWORTH, 2008; ITDP, 2019).

The benefits of walking are widely recognized (SOUTHWORTH, 2005). According to the author, walking can improve individuals' physical and mental health. For health, the benefits are related to improved cardiovascular fitness, reduced stress, stronger bones, weight control, mental agility, and creativity (SOUTHWORTH, 2005).

Spaces that offer good infrastructure for walking contribute to the individual´s health. Recent studies report some evidence related to the influence of the built environment on the practice of walking as physical activity (SOUTHWORTH, 2005; LO, 2009; REISI; NADOUSHAN; AYE, 2019).

Alfonzo (2005) mentions that some studies have identified that certain variables can affect walking and that other studies have shown how these variables can interact and affect a person's decision to walk. The author adds that environmental aspects related to the individual and physical elements (of the space itself) can affect the walk.

Elements associated with the presence and continuity of walks (LO, 2009), the accessibility of space (LITMAN, 2003; ALFONZO, 2005; FORSYTH; SOUTHWORTH, 2008; LO, 2009; LITMAN, 2021), ensuring comfort (ALFONZO, 2005), offering security concerning the crossings and local traffic (LITMAN, 2003; ALFONZO, 2005; SOUTHWORTH, 2005; FORSYTH; SOUTHWORTH, 2008; LO, 2009), security in relation to perceived crime (LITMAN, 2003; FORSYTH; SOUTHWORTH, 2008), providing spatial attractiveness or pleasure while walking (LITMAN, 2003; ALFONZO, 2005; FORSYTH; SOUTHWORTH, 2008; LO, 2009), presence of street network connectivity (SOUTHWORTH, 2005; LO, 2009), among other aspects, can interfere or affect walkability (PIRES; GEBARA; MAGAGNIN, 2016).

Factors associated with urban design (density and mix of land use, street connectivity, sidewalk width, street width, block lengths, among other aspects) can also positively or negatively affect the quality of pedestrian space or local walkability (LITMAN, 2003; LO, 2009; PIRES, 2018).

These elements can be measured using different methodologies to assess walkability from the perspective of analyzing the quality of the infrastructure intended for pedestrians (LITMAN, 2003). These analyzes may include a qualitative and/or quantitative approach to some space for public use.

Researchers from Brazil and abroad have evaluated the space for pedestrian movements based on performance indicators. The indices and performance indicators make it possible to evaluate the physical characteristics of the walking environment and its spatial quality based on some parameters such as sidewalk width, type of floor, floor maintenance condition, shading, and lighting of the streets, presence of urban furniture, presence of obstacles on the street, accessibility, among other aspects (ALFONZO, 2005; PIRES, 2018; REZENDE; SCHMITZ; SILVA, 2018; ITDP, 2019).

In this context, this presents the application of a methodology that allows the comparative evaluation of two walking spaces, with utilitarian and leisure purposes, based on performance indicators associated with Safety, Security, Comfort, and Attractiveness. The instrument entitled Macro and Micro Scale Walkability Index (in Portuguese the acronym ICMME), proposed by Pires (2018), allows the assessment of walkability in the surroundings of travel-generating poles based on an index and macro and micro scale indicators. The case study was carried out on a stretch of an important avenue in the city of Araçatuba (SP) that underwent spatial requalification.

2. OBJECTIVE

This paper aims to evaluate the urban mobility infrastructure destined to walkability for utility and leisure purposes in two areas of an important road axis located in the city of Araçatuba, São Paulo, using the Macro and Micro Scale Walkability Index (ICMME) proposed by Pires (2018).

3 METHODOLOGY

To evaluate the factors that can contribute positively or negatively to walkability on a street section in the city of Araçatuba (SP), the Macro and Micro Scale Walkability Index (ICMME), developed by Pires (2018), was used.

This index makes it possible to “identify and rank problems that can contribute positively or negatively to walkability” in the surroundings of any travel-generating hub (PIRES; MAGAGNIN, 2021, p. 1).

The ICMME consists of 5 steps: (1) identification of the unit of analysis in the object of study; (2) definition of the hierarchical structure of the index components and the respective evaluation method; (3) definition of the weights that compose the evaluation of the different parameters of the index; (4) data collection through technical audit and (5) index calculation

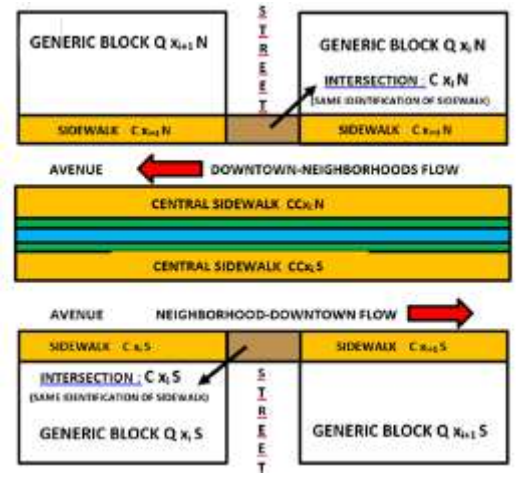
(PIRES, 2018; PIRES; MAGAGNIN, 2021).

In this paper, some adaptations were made in relation to the original proposal of the method developed by Pires (2018), namely: i) identification of the unit of analysis in the object of study - change in the nomenclature of the units of analysis due to the spatial cut being a comparative analysis between two areas belonging to a stretch of Joaquim Pompeu de Toledo Avenue, located in the city of Araçatuba – SP; ii) definition of the hierarchical structure of the components of the index and the respective form of evaluation – depending on the spatial scope, some indicators were suppressed; those associated with the Sidewalk and Intersection domains, belonging to the Micro Scale of analysis were used; iii) definition of the weights that make up the evaluation of the different parameters of the index – in this paper, different weights will not be used for the indicators; and iv) the steps of data collection through technical audit and index calculation; the same procedures proposed by the ICMME were adopted.

Identification of the unit of analysis in the object of study - The process of application of the ICMME in the spatial cut begins with the definition of the segments to be evaluated. According to Pires and Magagnin (2021, p. 4), "each analysis segment is composed of a face and the consecutive intersection".

In this paper, the numbering of the faces of the block follows a different criterion from that proposed by Pires (2018). On the block faces bordering the avenue, an increasing numbering is adopted, following the direction of the flow of local traffic in both directions. The letters N (North) or S (South) are added to the numbers (Figure 1). The longitudinal axis of the avenue (córrego do Machadinho) was adopted to divide the area into the North side (above the stream) and the South (below the stream). The sidewalks belonging to the central median of the avenue follow the same criteria presented above; the only change occurs concerning the nomenclature of the sidewalks of these square faces, which identified by the letters "CC" - central sidewalk (example: CCxiN and CCxiS). Moreover, the numbering of the street intersections follow the same identification (Figure 1). The intersections beyond the study area's boundaries are not included in this assessment.

Figure 1: Example of identification of the analysis unit of sidewalks and intersections (square faces).



Source: Authors (2022).

Definition of the hierarchical structure of the index components and the respective form

Revista Nacional de
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of evaluation - The index proposed by Pires (2018) is composed of 42 indicators grouped into 7 themes (T1 - Urban Design, T2 - Density, T3 - Diversity, T4 - Security, T5 - Attractiveness, T6 - Safety, T7 - Comfort), 04 domains (Urban Structure, Sidewalk, Intersection and Bus Stop) and 02 scales (Macro Scale and Micro Scale).

In this paper, due to its objective of it, the evaluation is based only on indicators belonging to the Sidewalk and Intersection domains, which allow evaluation from the Micro Scale, the infrastructure aimed at walkability. The assessed themes refer to the Safety, Security, Comfort and Attractiveness of the respective domains (Table 1).

Table 1: Presentation of the hierarchical structure of the indicators used to assess the spatial profile.

E	D	T	C	INDICATOR
MICRO SCALE	SIDEWALK	T 1	C 1	Exposure to traffic (speed and flow of vehicles on the street).
			C 2	Lateral separation between traffic and pedestrians.
			C 3	Unevenness (height difference between the pavement floors).
			C 4	Height clear of obstacles (tree branches, signs, etc.).
			C 5	Conflict with vehicles on the sidewalk.
		T 2	C 6	Street lighting.
		T 3	C 7	Sidewalk width.
			C 8	Surface conditions (floor maintenance, defects, holes).
			C 9	Type of floor.
			C 10	Longitudinal slope.
			C 11	Cross slope (between min. 1% and max. 3%).
			C 12	PERMANENT obstacles in the sidewalk traffic lane.
			C 13	TEMPORARY obstacles in the sidewalk traffic lane.
			C 14	Grid.
		T 4	C 15	Physically permeable facades.
			C 16	Visually permeable facades.
			C 17	Attractiveness of the environment.
			C 18	Urban afforestation.
	INTERSECTION	T 1	I 1	Crosswalk.
			I 2	Curb ramp.
			I 3	Tactile warning floor in pavement recesses.
			I 4	Traffic lights on arterial or collector roads.
			I 5	Time for crossing.
			I 6	View of approaching vehicles.
			I 7	Possibility of conflict between pedestrians and vehicles.
			I 8	Pedestrian waiting space at the corner.
		T 3	I 9	Width of the crosswalk.
			I 10	State of maintenance of crosswalks.
			I 11	State of maintenance of the pavement recess.
			I 12	Width of the free lane in front of the curb ramp.
			I 13	Width of the cross street to the pedestrian crossing.

Legend: E – Scale D – Domain T – Theme C – Indicator code
T 1 - Safety T 2 – Security T 3 - Comfort and T 4 - Attractiveness

Source: authors (2022), adapted from Pires (2018).

The Macro Scale domain, for example, is not used due to the spatial cut defined for analysis. The coverage area, being reduced, does not involve the area of adjacent

neighborhoods; the parameters of this scale do not contribute to this investigation. And the Bus Stops domain was also deleted because there is no public transport network in the study stretch, nor bus stops.

To define how the indicators were evaluated, the same scoring criteria defined by Pires (2018) were used. The author used numerical values in the range from 0 to 1, avoiding the need to normalize the grades. The following values were adopted for the scoring of the indicators' scores: a) 0.0 and 1.0; b) 0.0, 0.5 and 1.0; c) 0.0, 0.33, 0.66 and 1.0; and d) 0.0, 0.25, 0.50, 0.75 and 1.0, (PIRES, 2018; PIRES, MAGAGNIN, 2021), see Table 02.

Table 2: Example of the evaluation criteria and respective scores for the Intersection theme.

Code	Indicator	Evaluation Criteria	Point
I 1	Crosswalk	Presence of crosswalk	1.00
		Absence of crosswalk	0.00
I 2	Curb ramps	Presence of curb ramps aligned with each other and located next to the crosswalk	1.00
		Curb ramps not aligned with each other and/or next to the crosswalk	0.66
		Absence of one of the curb ramps	0.33
		Absence of the two curb ramps	0.00
I 3	Warning tactile floor in the curb ramp	Presence of a warning tactile floor in the two curb ramps	1.00
		Absence of a tactile warning floor in one of the curb ramps	0.50
		Absence of a tactile warning floor in the two curb ramps	0.00
...	...	...	...
I 13	Width of the cross street to the pedestrian crossing	Width of the cross street is less than 8.00 m	1.00
		Width of the cross street is less than 10.00 m	0.75
		Width of the cross street equal to 10.00 m	0.50
		Width of the cross street width greater than 10.00 m	0.25
		Width of the cross street width greater than 12.00 m	0.00

Source: Pires; Magagnin (2021, p. 06).

Definition of weights for index components- In this paper, weights will not be used to ponder the evaluations of indicators and themes. The methodology proposed by PIRES (2018) provides for the application of questionnaires to the population and experts to identify the weights of the index. However, due to the fact that the research was carried out at a time of the COVID-19 Pandemic, it was chosen, for the safety of the researchers, not to carry out the application of the questionnaires. Thus, all indicators are calculated only with the values obtained in the field survey.

Data collection through a technical audit - The indicators are evaluated through field data collection, carried out by researchers or technicians/specialists previously trained.

Pires (2018) suggests that the collection be carried out using a form containing all the indicators, but a map of the study area must also be used, which must contain the implementation of all urban equipment that will be evaluated (curb ramps, traffic lights, crosswalks, trees, benches, among others). This map record, according to the author, must be carried out from a preliminary field visit to the area.

Calculation of the Macro and Micro Scale Walkability Index (ICMME) - The same procedures were adopted for the calculation of the walkability index defined by Pires (2018),

Revista Nacional de
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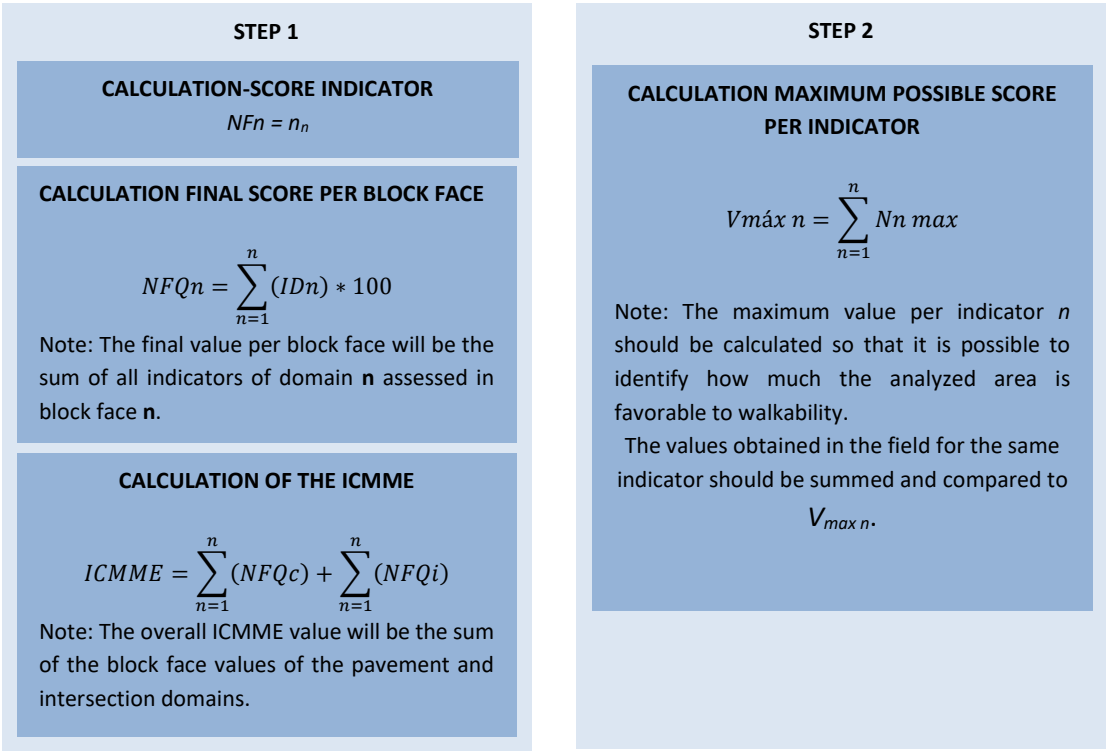
which includes two steps: i) calculation of the ICMME with scores obtained in the field and ii) calculation of the ICMME with the maximum score for the indicators (Figure 2).

Figure 2: Calculation of ICMME components.



Source: Pires (2018); Pires; Magagnin (2021), adapted by the authors (2022).

Initially, each indicator is calculated based on the score obtained in the field for the sidewalks and intersections domains. Next, the calculations for the block faces are performed. The final index, in this paper, will be given by the sum of the scores of all the scores of the block faces. To calculate the maximum score for each indicator, it is necessary to assign the maximum value to the indicators, that is, 1.0 point. This same procedure is performed to calculate the block faces.

The comparison of these two scores (value in the field with the maximum value) allows for identifying how much the analyzed area is favorable to walkability. Pires (2018) defined five levels of classification of the spatial quality of the environment intended for walkability, as shown in Table 3.

Table 3: Classification of the results of the indicators and the index.

Classification of the walkability index		
0% a 20%	VERY BAD	Walkability Very Unfavorable for pedestrians
21% a 40%	BAD	Walkability Unfavorable to pedestrians
41% a 60%	REGULAR	Walkability Partially pedestrian-friendly
61% a 80%	GOOD	Walkability pedestrian-friendly
81% a 100%	EXCELLENT	Walkability Very pedestrian-friendly

Source: Pires; Magagnin (2021).

In this paper, the walkability indexes are calculated individually for Area 1 – Sidewalks

Revista Nacional de
Gerenciamento de Cidades
ISSN eletrônico 2318-8472, volume 10, número 78, 2022

on the neighborhood's block faces, and Area 2 – Sidewalks on the central median of the avenue. The values obtained in each area must be analyzed individually and, later, be compared with the maximum values obtained in each area.

4 CASE STUDY

The area defined as the object of investigation is located in the southeastern region of the city of Araçatuba, São Paulo. A medium-sized city, with an estimated population of 199,210 inhabitants (IBGE, 2021) and located in the western region of the state of São Paulo (Figures 03-**a**, **b**).

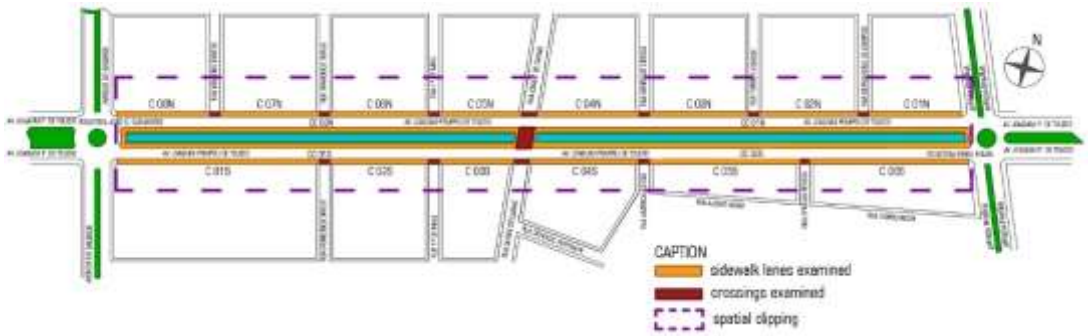
Figure 03: Location of the municipality on the map of São Paulo State (a) identification of the section chosen for analysis – section of Joaquim Pompeu de Toledo Avenue (b).

(a) **(b)**

Source: Wikipedia and Aerial photo of the Municipal Government of Araçatuba (2021), adapted by the authors (2022).

The study area is located on a stretch of Joaquim Pompeu de Toledo Avenue. It consists of 18 block faces and 14 intersections (Figure 4). This avenue is located in a valley bottom area, on the banks of the Machadinho stream. It consists of two bearing lanes, which border the aforementioned stream. This entire area has infrastructure for the movement of pedestrians.

Figure 4: Map of the study area with the identification of blocks and intersections (no scale).



Source: Authors (2022).

The area is an integral part of a process of spatial requalification that the avenue went through between 2009 and 2016, carried out in several stages, aiming to serve users who used this space for the practice of walking and/or other leisure activities. Among the elements

ISSN eletrônico 2318-8472, volume 10, número 78, 2022

implemented are landscaping changes, replacement of the floor, the inclusion of tactile flooring along the entire length of the sidewalks, implementation of crosswalks, accessible ramps, benches and gym equipment, and the stream bed was protected by mesh closure.

It is observed that the sidewalks of the central median avenueare used, preferably, for leisure and sports activities, walking or running. Different age groups use this area for leisure, such as parents with strollers, dogs, young people, teenagers, adults and the elderly. It is observed that the place is used by people with some type of disability, whether physical or visual. Some people with visual impairments do motor sensitization exercises; work practice is linked to the Institute for the Blind located near this area.

While the sidewalks on the opposite side of the avenue are, in turn, more used for commuting for everyday activities (or utilitarian commuting), for example, for work, shopping, etc, the buildings in this area are predominantly for commercial or service uses.

The technical audit was carried out in November 2021. Based on an updated aerophotogrammetric survey (Figure 03b), provided by the Municipality of Araçatuba, a base map was produced that enabled the implementation of all urban equipment (Figure 04).

From the information provided by Google Street View (GOOGLE, 2019) the existing physical elements were identified, such as signaling elements, afforestation, road status, etc. Subsequently, through an “in loco” visit, the technical audit was carried out. In this step, the data obtained in the digital survey were updated. And, to obtain the lighting indexes on the sidewalks, the cell phone application “Lux Meter” was used.

5 RESULTS AND DISCUSSIONS

The application of the ICMME in the two analyzed sections of the area shows that the qualification process that this area went through was not the same on the block faces that border the stream (area 2) compared to the opposite block faces (area 1). The micro-scale walkability index of area 1 is regular (56.66%) that is, the area is “partially favorable to pedestrian walkability”; while in area 2 there is an index of 84.33%, which represents an evaluation of “excellent or very favorable to pedestrian walkability” (Table 4).

Table 4: Comparative results of ICMME global and by domains

DOMAIN	Area 1			Area 2		
	Actual Value	Result (%)	Ideal Value	Actual Value	Result (%)	Ideal Value
SIDEWALKS	166.12	65.92%	252.00	62.00	86.11%	72.00
INTERSECTIONS	65.05	41.70%	156.00	20.64	79.38%	26.00
ICMME	**231.17**	**56.66%**	**408.00**	**82.64**	**84.33%**	**98.00**

Legend:				
Very Bad	Bad	Regular	Good	Excellent
0% a 20%	21% a 40%	41% a 60%	61% a 80%	81% a 100%

Source: Authors (2022).

Table 4 shows that the result obtained for the *Sidewalk domain* is different for the two areas, however, both areas have infrastructure that favors walkability in the analyzed stretch, as the results ranged from "good" (area 1 - ICMME of 65.92%) and “Excellent” (area 2 – ICMME of 86.11%).

Revista Nacional de
Gerenciamento de Cidades
ISSN eletrônico 2318-8472, volume 10, número 78, 2022

The analysis of data from area 1 (Side Sidewalks) reveals that of the 18 indicators, 12 indicators (67%) have a score considered "Good" (72.70% for the Comfort theme and 68.39% for the Attractiveness theme) due to specific physical conditions, such as floor with adequate slope, absence of surface gratings, adequate width, unobstructed lanes, among others.

Regarding the analysis of area 2 (central median street) of the 18 indicators analyzed, 5 indicators associated with the Safety theme obtained a result considered "Regular" (60.0%), while 13 indicators belonging to the themes Safety, Comfort, and Attractiveness, obtained the “Excellent” score (100.00%; 93.65% and 100.00%, respectively).

The characteristics of the sidewalks located in the central median of the avenue satisfactorily meet the objectives for the practices developed on it for the following reasons: condition of the floor, cleanliness, unobstructed surfaces, adequate slope, presence of benches, the inexistence of grilles, night lighting, adequate and present afforestation, that is, justifying the preference of the population in the daily practice of walking in the place (Figure 5).

Figure 5: Map with the ICMME evaluation by block face for the sidewalkdomain referring to areas 1 and 2, without scale.

Source: Authors (2022).

The evaluation of the *Intersection domain*, Table 4, shows a difference in the quality of space between the two areas. The global index varies from “regular” (area 1 – ICMME of 41.70%) to “good” (area 2 – ICMME of 79.38%), which means that the crossings on the opposite side of the stream need improvements so that the pedestrians can move around these blocks safely and comfortably.

At the intersections of area 1, all 13 indicators evaluated had low scores. The themes: Safety with 6 indicators (I1 - I6) and Comfort with 7 indicators (I7 - I13) obtained “Regular” and “Bad” assessments (55.28% and 30.06%, respectively). The main problems are related to the lack of painting of the pedestrian lanes and the absence of accessibility ramps, the presence of types of floors that do not favor accessibility and differences in levels on the sidewalks favoring the entry of vehicles into the properties, lack of adequate space in the front of the ramps, mainly for wheelchair users, presence of fixed obstacles (dumpsters and protective grids of urban trees royed), trees implanted in an irregular location and tree height that can compromise pedestrian safety.

Only the crossings located in areas 1 and 2, located in the center of these areas, obtained the evaluation considered "Good", because they have adequate and correctly positioned crosswalks, accessible ramps located next to the crosswalks, signposted with tactile

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flooring, pedestrian waiting space for crossing before accessible ramps, adequate crossing times and visibility, among others (Figure 6).

Figure 6: Map with the ICMME evaluation by block face, for the intersection domain referring to areas 1 and 2, without scale.

Source: Authors (2022).

The evaluation of the two areas by theme reveals that in the *Sidewalk domain*, among the four themes (Security, Attractiveness, Safety, Comfort) evaluated, the one that obtained the highest index in area 1 was the Comfort theme (72.70%), followed by best results were the themes Attractiveness (68.39%), Security (59.00%) and Safety (38.04%). In area 2, it is observed that the highest rate of walkability is related to the theme Security and Attractiveness (both with 100%) and in the sequence where the theme's Comfort (93.65%) and Safety (60.00%) (Table 5).

The evaluation of the *Intersection domain* shows that among the Safety and Comfort themes, the one with the highest evaluation in the field in area 1 refers to the Safety theme (55.28%), followed by the Comfort theme (30.06%), but both with a very low score; these results show that the themes Safety and Comfort contribute negatively to the walkability in this area.

And, the results of the analysis of area 2, show that although the ordering of the themes was the same as that obtained in area 1, the general index of each theme was different. The Safety theme has a score that reaches 80.33% in area 2 and the Comfort theme score is 78.57%, which means that both are considered good and contribute positively to the walkability in area 2; while in area 1, the values obtained for the same themes emphasize that the walkability was, respectively, regular (55.28%) and bad (30.06%), Table 5.

Revista Nacional de
Gerenciamento de Cidades
ISSN eletrônico 2318-8472, volume 10, número 78, 2022

Table 5: Results of the Indicators by domains and themes for areas 1 and 2.

D	T	C	INDICATOR	AREA 1		AREA 2	
				Actual Value	%	Actual Value	%
SIDEWALK	T1	C 1	Exposure to traffic (vehicle speed and flow on the street).	0.00		0.00	
		C 2	Lateral separation between traffic and pedestrians.	0.00		0.00	
		C 3	Unevenness (height difference between the pavement floors).	10.00	---	4.00	---
		C 4	Clearance height of obstacles (tree branches, signs, etc.).	8.00		4.00	
		C 5	Conflict with vehicles on the sidewalk	8.63		4.00	
			ICMME Theme 1 (Safety)	**26.63**	**38.04%**	**12.00**	**60.00%**
			ICMME Max.	**70.00**	**100%**	**20.00**	**100%**
	T2	C 6	Street lighting	8.26	---	4.00	---
			ICMME Theme 2 (Security)	**8.26**	**59.00%**	**4.00**	**100%**
			ICMME Max.	**14.00**	**100%**	**4.00**	**100%**
	T3	C 7	Sidewalk width.	14.00		4.00	
		C 8	Surface conditions (maintenance, defects, floor holes).	9.54		3.00	
		C 9	Type of floor.	9.76		4.00	
		C 10	Longitudinal slope.	13.25	---	4.00	---
		C 11	Cross slope (between min. 1% and max. 3%).	9.75		4.00	
		C 12	PERMANENT obstacles in the circ. from the sidewalk.	11.13		3.00	
		C 13	TEMPORARY obstacles in the sidewalk traffic lane	11.50		4.00	
		C 14	Grid.	14.00		4.00	
			ICMME Theme 3 (Comfort)	**81.43**	**72.70%**	**30.00**	**93.65%**
			ICMME Max.	**112.00**	**100%**	**32.00**	**100%**
	T4	C 15	Physically permeable facades.	9.16		4.00	
		C 16	Visually permeable facades.	9.49	---	4.00	---
		C 17	Attractiveness of the environment.	10.14		4.00	
		C 18	Urban afforestation.	9.51		4.00	
			ICMME Theme 4 (Attractiveness)	**38.30**	**68.39%**	**16.00**	**100%**
			ICMME Max.	**56.00**	**100%**	**16.00**	**100%**
INTERSECTION	T1	I 1	Crosswalk.	4.00		2.00	
		I 2	Curb ramp.	7.98		1.32	
		I 3	Tactile warning floor in pavement recesses.	3.50	---	2.00	---
		I 4	Traffic lights on arterial or collector streets.	1.32		1.32	
		I 5	Time for crossing.	11.00		1.00	
		I 6	View of approaching vehicles.	12.00		2.00	
			ICMME Theme1 (Safety)	**39.80**	**55.28%**	**9.64**	**80.33%**
			ICMME Max.	**72.00**	**100%**	**12.00**	**100%**
	T3	I 7	Possibility of conflict between pedestrians and vehicles.	0.50		0.00	
		I 8	Pedestrian waiting space at the corner.	4.00		2.00	
		I 9	Width of the crosswalk.	4.00		2.00	
		I 10	State of maintenance of crosswalks.	1.00	---	1.00	---
		I 11	State of maintenance of the curb ramp.	5.00		2.00	
		I 12	Width of the free range of circulation in front of the curb ramp.	3.00		2.00	
		I 13	Width of the cross street to the pedestrian crossing.	7.75		2.00	
			ICMME Theme 3 (Comfort)	**25.25**	**30.06%**	**11.00**	**78.57%**
			ICMME Max.	**84.00**	**100%**	**14.00**	**100%**

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D	T	C	INDICATOR	AREA 1		AREA 2	
				Actual Value	%	Actual Value	%
Legend: E – Scale D – Domain T – Theme C – Indicator code. T 1 – Safety T 2 – Security T 3 – Comfort and T 4 – Attractiveness.							

Source: Authors (2022).

The data presented in Table 5 reveal that the index obtained for the theme Safety (T1) - Sidewalk domain, in area 1 is considered "Bad or Unfavorable to pedestrians (38.04%) and in area 2 the classification is considered "Regular or Partially favorable to pedestrians (60.00%). Their respective indexes demonstrate the existence of weaknesses related to pedestrian comfort in both areas. The indicators with the worst score (zero) refer to Traffic Exposure and Lateral Separation between Traffic and Pedestrians. The other indicators also have low scores, which reflects a low final index for both areas. Area 1, for example, has problems related to low maintenance of the local afforestation, very low branches that make it difficult for pedestrians to pass, of many public garages in commercial establishments, which compromises the circulation of pedestrians in this area.

As for the theme of Security (T2), Table 5 shows that indicator C6 - Public Lighting interferes differently in the evaluation of the two areas. Area 1 is heavily wooded and the public lighting poles have the same height to facilitate the lighting of the vehicle's lane; however, it generates very shaded or dark areas at night. In area 2, despite the intense afforestation, there is postage with lower lighting, aimed at pedestrians, which makes the place brighter, contributing positively to walkability.

The evaluation of the Comfort theme (T3), in the Sidewalk domain, shows that areas 1 and 2 have similar results, "Good" and "Excellent" (72.70% and 93.65%), respectively, contributing positively to walkability (Table 5). The absence of obstacles on the sidewalks, grids on the floors, adequate widths, little inclination and type of floor, punctuate the indicators favorably.

The Attractiveness theme (T4), belonging to the Sidewalk domain, presents indexes that favor walkability due to the attractiveness of the surrounding landscape, which is why they received a rating of "Good" for area 1 and "Excellent" for area 2. Area 2, as it is inserted in the bottom of a valley located on the banks of the Machadinho stream, including having been recently requalified, its score is a little higher. Another differentiating factor is associated with the visibility of the landscape, which, as there are no buildings on the site, does not have any visual impediment. The screen protection fence, located on the inner bank of the stream, only prevents access to the stream channel, maintaining the visual integrity of the place. The landscape, although modified by the rectification of the banks of the stream, remains resilient and present both by the flora and the wild fauna, attracting the attention of the users of the place. The afforestation creates a pleasant microclimate through the partial shading of the sidewalk, equipped with urban equipment for passive and active contemplation of the landscape.

Regarding the Safety theme (T1) of the Intersections domain, the data in Table 5 shows that area 2 reaches a score considered "Excellent" (80.33%) for walkability, while area 1 reaches a score considered "Regular" (55.28%). The main problems identified at crossings in Area 1 refer

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to the lack of properly implemented crosswalks, the absence of timed traffic lights, and where they exist, there is not enough time for pedestrians to cross.

The evaluation of the Comfort theme in the Intersection domain reveals that areas 1 and 2 continue with different evaluations, being classified as “Bad” (30.06%) and “Excellent” (78.57%), respectively. In this theme, the main problems are associated with the presence of accessibility ramps installed outside the alignment of the crosswalks; these are in a poor state of conservation, with width in disagreement with NBR 9050 (ABNT, 2021), as there is no space for waiting for wheelchair users or pedestrians on corners; also, the circulation lane in front of the curb ramps (ramps) are insufficient.

The problems identified in this case study show that the population generally seeks areas in the city, usually in stretches of avenues and wider areas of free and public access to meet the need for sports, health, or leisure. However, many of these areas may not have infrastructure that offers spatial quality and compromise the comfort, safety, and security of these users.

6 CONCLUSION

With the intention of evaluating and comparing the walkability in two urban spaces for recreational and/or leisure and utilitarian purposes, in the city of Araçatuba, São Paulo, this study applies the Macro and Micro Scale Walkability Index (ICMME) proposed by Pires (2018).

The results show that the sidewalks and crossings (intersections) located in the central median avenue, intended for leisure walking, have higher quality and offer Safety, Security, Comfort, and Attractiveness to users.

However, the sidewalks and crossings of area 1, which are used by people predominantly for displacements for practical purposes (study, shopping, and work), are of lower spatial quality, especially in relation to elements associated with Safety and Security (regarding the sidewalks) and Safety and Comfort (crossings) of users.

In summary, the data make it possible to conclude that areas whose displacements are predominantly for utilitarian purposes (study, shopping and work) have poorer quality infrastructure. This difference often occurs because, in Brazil, the implementation and maintenance of this type of infrastructure is the responsibility of the landowners. While in requalified areas whose displacements are associated with the practice of leisure and/or sports, the maintenance of this infrastructure is the responsibility of the government.

Based on the results, it is possible to identify the positive and negative points of the infrastructure aimed at pedestrians that can be used to formulate public policies for urban mobility aimed at walkability.

Regarding the use of the ICMME, although the index was not originally proposed to be applied specifically to a street section, as applied in this paper, it effectively meets the proposed initial objective; that is, to comparatively analyze two distinct areas to identify which parameters can contribute positively or negatively to walkability in the same urban area.

For future works, the idea of studying a specific walkability index for areas for leisure and/or sports activities, present in most urban public areas, is strengthened.

BIBLIOGRAPHIC REFERENCES

ABNT. ASSOCIAÇÃO BRASILEIRA DE NORMAS TÉCNICAS. **NBR 9050**: acessibilidade à edificações, mobiliário, espaços e equipamentos urbanos. Rio de Janeiro, 2021.

ADAMOLI, Angélica N.; SILVA, Marcelo C. da; AZEVEDO, Mario R. Prática da caminhada no lazer da população adulta de Pelotas, RS. **Revista Brasileira de Atividade Física & Saúde**, Pelotas, v. 16, n. 2, p. 113 - 119, out. 2011.

ALFONZO, Mariela A. To Walk or Not to Walk? The Hierarchy of Walking Needs. **Environment and Behavior**, [S.L.], v. 37, n. 6, p. 808-836, nov. 2005. SAGE Publications.

ARAÇATUBA. Prefeitura Municipal de Araçatuba. **Plano Diretor Participativo Lei Nº168**. Secretaria de Planejamento, 2006.

FORSYTH, Ann; SOUTHWORTH, Michael. Cities Afoot - Pedestrians, Walkability and Urban Design. **Journal of Urban Design**, [S.L.], v. 13, n. 1, p. 1-3, fev. 2008. Informa UK Limited.

ITDP, Instituto de Políticas de Transportes e Desenvolvimento**. Índice de Caminhabilidade** – Ferramenta. Versão 2.0. 66 p. Brasil, 2019.

LITMAN, Todd Alexander. Economic Value of Walkability. Transportation Research Record. 1828. 3-11. Published in **Transportation Research Record 1828, Transportation Research Board** (www.trb.org), 2003, pp. 3-11 and in Volume 10, Number 1, 2004, of World Transport Policy & Practice. Available in: <www.eco-logica.co.uk/WTPPhome.html>.

LITMAN, Todd Alexander. Evaluating accessibility for transport planning. Victoria, BC, Canada: **Victoria Transport Policy Institute.** 2017. Available in: <https://www.vtpi.org/access.pdf>

LO, Ria Hutabarat. Walkability: what is it? **Journal of Urbanism**: International Research on Placemaking and Urban Sustainability, [S.L.], v. 2, n. 2, p. 145-166, jul. 2009. Informa UK Limited.

PIRES, Isabela Batista; GEBARA, Tatiana Rayra Jacon; MAGAGNIN, Renata Cardoso. Métodos para avaliação da Caminhabilidade. In: FONTES, Maria Solange Gurgel de Castro; FARIA, João Roberto Gomes (Org.). **Ambiente construído e sustentabilidade**. Tupã: ANAP, 2016. p. 110-135.

PIRES, Isabela Batista. **Índice para avaliação da caminhabilidade no entorno de estações de transporte público**. 2018. 153 p. Dissertação (Mestrado em Arquitetura e Urbanismo) - Universidade Estadual Paulista. Faculdade de Arquitetura, Artes e Comunicação, [*S. l.*], 2018.

PIRES, Isabela Batista; MAGAGNIN, Renata Cardoso. Índice de caminhabilidade de macro e micro escala (ICMME) para avaliação de entorno de terminal urbano de transporte público. PLURIS 9° Congresso Luso-Brasileiro para o Planejamento Urbano, Regional, Integrado e Sustentável (DIGITAL) **Anais** [...], p.935-948, abril 2021.

REISI, Marzieh; NADOUSHAN, Mozhgan Ahmadi; AYE, Lu. Local walkability index: assessing built environment influence on walking. **Bulletin of Geography. Socio-Economic Series**, [S.L.], v. 46, n. 46, p. 7-21, 1 dez. 2019.

REZENDE, Caroline Castilhos; SCHMITZ, Anelise; SILVA, Rafael do Nascimento e. Análise do índice de caminhabilidade no centro da cidade de Cachoeira do Sul, RS. Simpósio de Transportes do Paraná (STPR); Seminários em Aeroportos e Transporte Aéreo (Sata) e Urbanidade. **Anais** [...]. Curitiba, v. 3, n. 3, p. 161-172, 24 mar. 2018.

SOUTHWORTH, Michael. Designing the Walkable City. **Journal of Urban Planning and Development**. 131. 246-257. 2005.