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EVALUATION OF IMPROVEMENTS IN ROAD INFRASTRUCTURE, TRAFFIC OPERATION AND ACCESSIBILITY FOR PEDESTRIANS TO THE FORTALEZA CITY STADIUM, DURING THE FIFA WORLD CUP 2014, USING MICROSIMULATION.

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ABSTRACT

In sporting events in Brazil such as soccer games, often planning and attention to the impact of these events is facing the vehicle; is taken to ensure minimum flow of cars and set the parking places, and are rarely carried out studies aimed at people, even if they come in cars or transit, they always walk to the stadium sections. Given this gap, we intend to evaluate three scenarios consist of improvements that can be deployed around the Castelão stadium in Fortaleza city, in relation to road infrastructure for pedestrians, the traffic operation, and accessibility of people, in order to ensure fluidity, comfort, and consequently greater road safety the spectators while walking between the parking or transit stations and access to the stadium, and vice versa.

Evaluation of improvements in road infrastructure, traffic operation and accessibility for pedestrians to the Fortaleza city stadium, during the FIFA World Cup 2014, using microsimulation.

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1. INTRODUTION

It presents the memorial modeling the flow of people moving between the parking lots and the stadium governor Plácido Castelo, in Fortaleza, through the operation of traffic as planned for the games of the World Cup 2014.

2. OBJECTIVE

The objective of this project is the analysis of the draft plan of operational mobility program for urban mobility FIFA world cup 2014, by developing an evaluation model of pedestrian flow in parts of the stadium from the parking lots designated for the general public and the authorities, which permits the evaluation of operating strategies of traffic surrounding the Arena Castelão, to ensure good flow and road safety.

3. DESCRIPTION OF THE COMPUTER MODEL USED

The micro-simulation is a tool that provides the study of complex systems, where analytical models become inaccurate. The use of the term micro refers to the ability to assess the behavior of the simulation elements individually, in this case vehicles and pedestrians, differing models of macro-or macro-simulation analysis, which assess the behavior of the elements of the simulation in aggregate, for example, flows in vehicles per link in a given time interval.

A major advantage of micro-simulation modeling features are dynamic and stochastic (probabilistic) built into the system. The behavior of each of the elements can vary during the simulation, producing more accurate results, and incorporate the randomness observed in the real world through probability distributions that govern the behavior of various elements of the model.

The behavior of drivers and pedestrians as well as vehicle characteristics, geometry and details of the operation, including the interaction between pedestrians, cars, buses and all other types of vehicles are considered with a level of detail that enriches the technical results and also facilitates the understanding of complex situations of current transport system.

All geometric characteristics of the tracks and pedestrian areas, such as number of tracks, each track width, speed in each range, points of speed reduction, retention bands among others are considered by the model.

The model presented here is developed in VISSIM software, using the simulation module pedestrian VISWALK. The VISSIM is a micro-simulation of traffic and pedestrians based on the model of car Following Wiedemann for vehicle traffic and the social forces model of Helbing for pedestrians.

The VISWALK is the solution for the computational simulation of pedestrians that realistically simulates the behavior of people walk and allows the analysis of their results in a professional manner. Individually, VISWALK allows the simulation of pedestrians outdoors or inside buildings with multiple floors. As a software module VISSIM, the VISWALK permits analysis of the flow of pedestrians in conjunction with the operation of vehicles, making it possible for pedestrians interact with individual transportation vehicles and public transportation. The VISWALK allows pedestrians literally hop on and off buses, trains, subways and other vehicles (Figure 1). Thus, the formation of groups of pedestrians, due to the arrival of vehicles at stations, can be studied in detail.

The VISWALK is recommended for the following applications:

- space optimization and capacity planning for pedestrians;
- Analysis evacuation stations, buildings, stadiums, etc;
- Planning and optimization of the flow of people at big events;
- Analysis routing and queuing;
- Assessment of waiting time at terminals, stations, etc..

Figure 1: Detail of the boarding platform.

The VISWALK is ideal for studies of public transport terminals such as bus stations, trains, subways, trams and others. The operation of the public transport system can be simulated by VISSIM, including details such as type, size, number of cars of each composition, number and dimensions of doors, while opening doors and more. The location of the blockages (turnstiles), stairs, escalators (see Figure 2) and lifts is defined in detail, allowing the study of the impact of queues and flows of people moving within the study area.

Figure 2: Detail of escalators.

There are no limitations on the number of levels and pedestrian routes can be defined including stops at service counters and queuing. Distributions of time to assess the impact of the number of points of service in the performance of lounges and check-in areas, for example.

The behavior of the pedestrian is parameterized so as to allow various aspects are subject to calibration. This allows the models are constructed to represent complex situations of operation and generate results that effectively responds technical questions about time travel, evacuation time and service level of pedestrian areas. Different methods for assessing service level are included in the standard software license (see Figure 3). Having been originated in VISSIM as an additional module functions generate results usually utilized in VISSIM also part of VISWALK.

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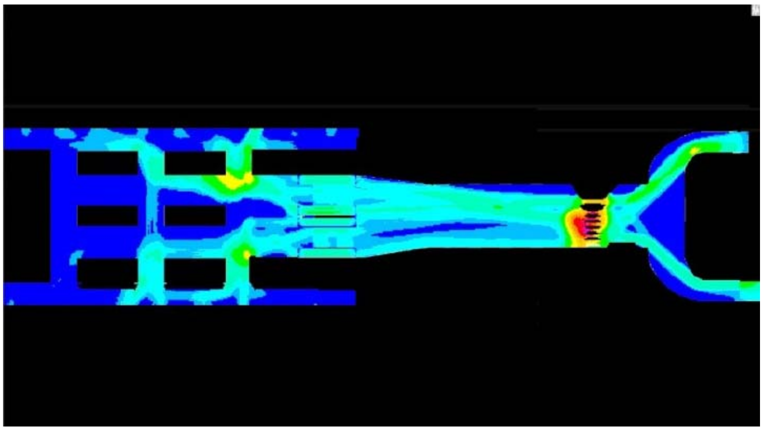

Figure 3: Example of viewing aggregated results.

4. DESCRIPTION OF SIMULATED SCENARIO (OUT OF STADIUM)

The microssimulação developed in this study represents the model of the road around the stadium Castelão and access roads for vehicles to parking lots planned for the days of games in the 2014 World Cup, according to Figure 4. The routes used are Av. Alberto Craveiro and Av. Dede Brasil. The parking lots will be accessed by any of the routes previously named. The project stipulates the use of three parking lots, two of them located on roads: São Sebastião Street and Paula Frassinetti Street and the other, located in the parking lot of the stadium itself.

The pedestrian access is made from the roads: First April Street, Ademar Paula Street, São Sebastião Street and Paula Frassinetti Street. In microssimulação model used four types of modes of transport, namely: cars, buses, bicycles and pedestrians. Points of origin and destination traffic were selected considering blockades of roads that will take place on match days. At the points of conflict between pedestrians and vehicles used a form of control in stages, where the vehicles have right of way, so pedestrians do not start crossing the street if there are buses or cars approaching the crosswalk.

However, if the pedestrian has already started crossing, cars and buses wait until the pedestrian reaches the opposite side of the road. In this scenario were predicted points boarding public transport with bus routes pedestrians taking the places of embarkation to the point of landing at the time of the parking CEUs and continuing through the central region and airport, which the model was discontinued at the northern limit of the area simulation.

Figure 4: Location of Study

5. TIME SIMULATION AND DEMAND

The simulated period was 2 hours, considering the period immediately following the event, divided into intervals 0s-1800s, 1800s-3600s and 3600s-7200s. In this scenario, the generation points are the four ramps of the stage, and an output side intended to VIP as shown in Figure 5, below. The volumes hours pedestrian generated at each point of generation are shown in Table 1.

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Table 1: Demand for Pedestrians

Ponto de geração	Período de Simulação		
	0-1800	1800-3600	3600-7200
1	316	528	1588
2	316	528	1588
3	78	132	396
4	78	132	396
5	500	0	0

From the exit ramps of the stadium, pedestrians follow to the parking lots and CEUs for bus boarding points located on the streets Iraci de Souza and Mto. Neomiranda, both lanes of Boundary Street.

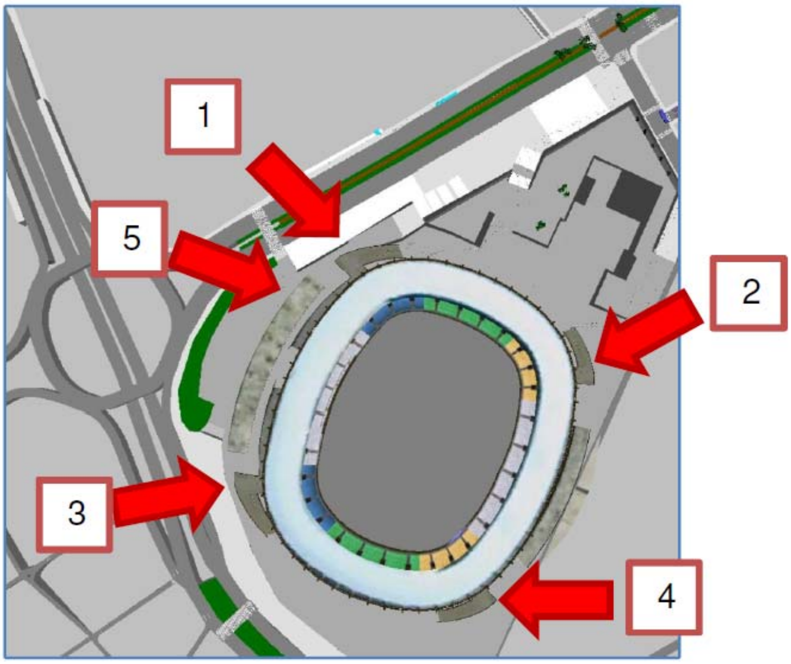

Figure 5: Access to the stadium.

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6. ROUTES OF PEDESTRIANS

The routes used by pedestrians between the outputs of the stage and the parking or points of loading are shown in Figures x, y, z, t, below.

Figure 6: Destinations with origin at Exit 1.

Figure 7: Locations originating in output 2.

Figure 8: Destinations originating at exit 3.

Figure 9: Destinations with origin at Exit 4.

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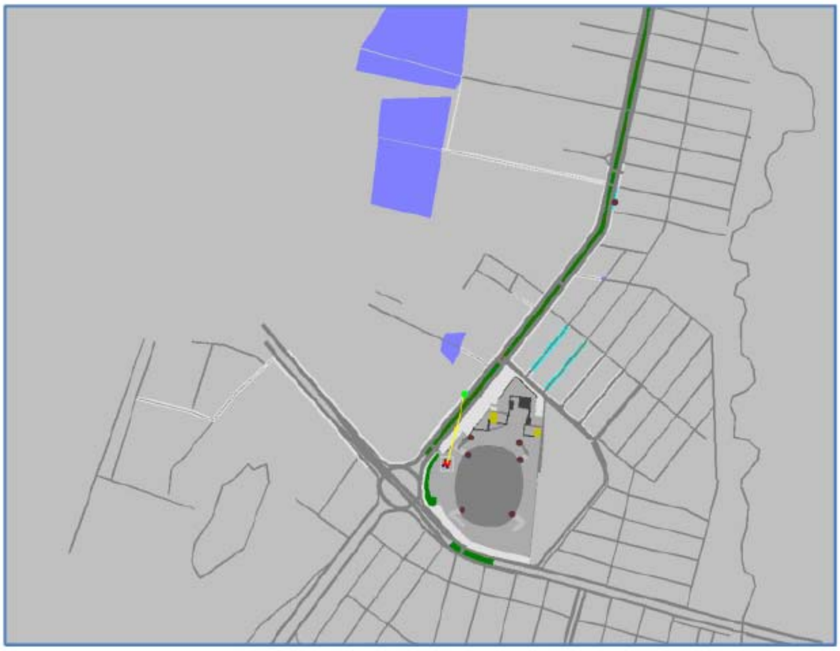

Figure 10: Destinations with origin at exit 5.

Figure 11: Routes for pedestrians.

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The simulated volumes of cars leaving the parking lots are shown in Table 2 below. The generation points 1 and 2 refer to parking CEUs. The generation point 3 refers to the stadium parking procedure. The routes taken by the vehicles are shown in Figure 12.

Table 2: Demand for cars and bikes.

Ponto de geração	Veículo	**Período de Simulação**		
		0 - 1800	**1800 - 3600**	**3600 - 7200**
1	Carro	1000	1000	1000
2	Carro	1000	1000	1000
3	Carro	150	0	0
4	Bicicletas	200	100	100

The flow of cyclists happens for a route through the central reservation of Avenida Alberto Craveiro bound at the stadium or Dede Brazil Av. The cars have their origin by Alberto Av Craveiro and destination in the parking lot of the CEU.

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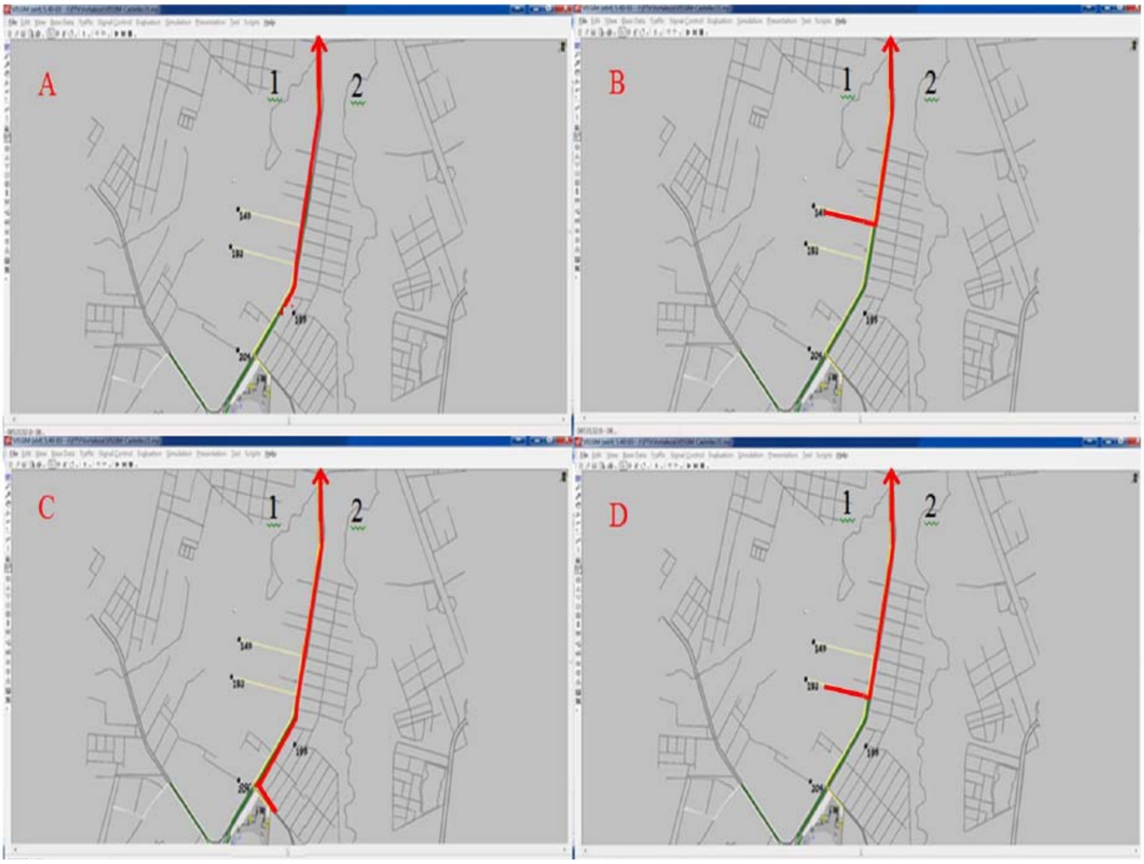

Figure 12: Routes of vehicles.

The bus carrying VIPs run throughout the stadium Av Alberto Craveiro, from the point of shipment in their own way in the area of the stadium. The route of this bus line is shown in Figure 13. The frequency used in the simulation was 120s. It was considered an occupancy of 50 people per bus.

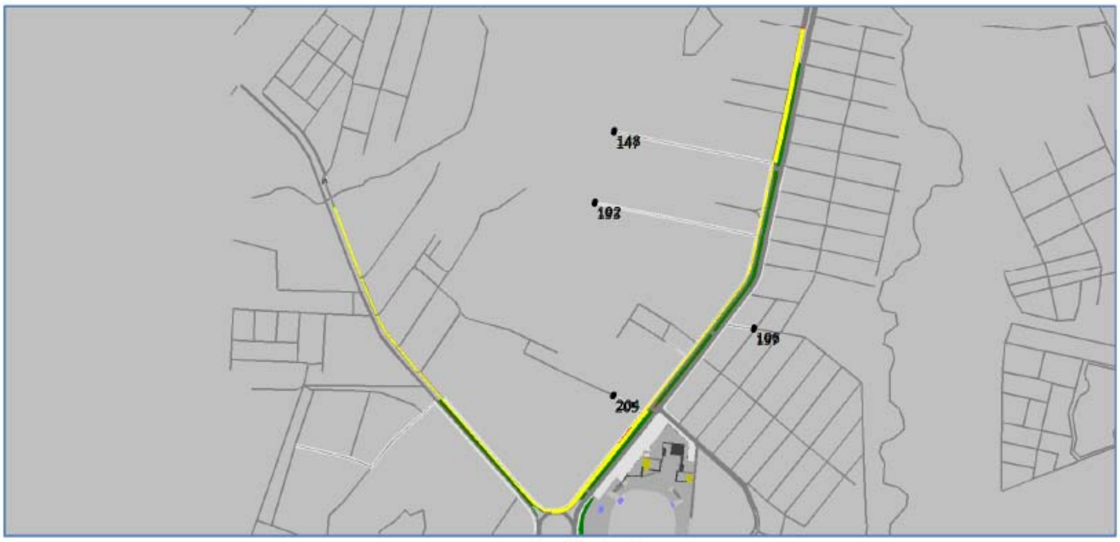

Figure 13: Bus routes for VIPs.

7. ANALYSIS OF LEVEL OF SERVICE

The analysis of the service level was made in time greater flow of persons using the evaluation aggregate space utilization by pedestrians. For classification of the results was used to scale level of service Highway Capacity Manual (HCM), as shown in Figure 14.

The volume of pedestrian per square meter was added at intervals of 120 s, obtaining the results shown in Figures 15, 16 and 17.

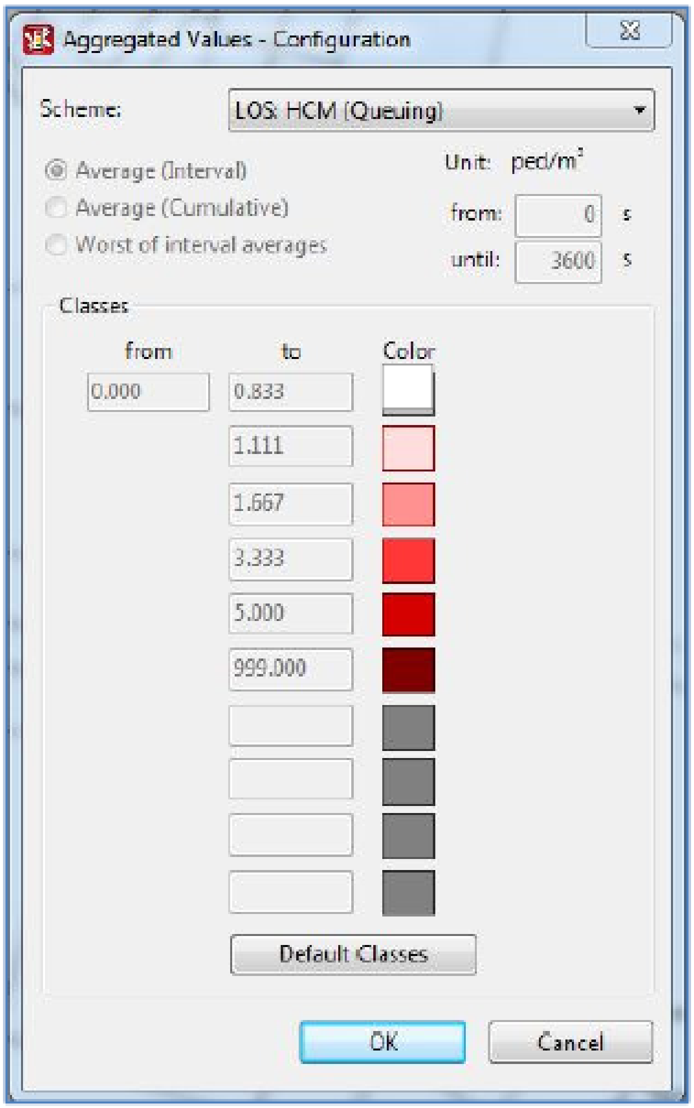

Figure 14: Scale Service Level.

The results obtained point to a sub-bands using the pedestrian streets blocked, probably due to lack of crossing points (Figure 14). There is also a high agglomeration of pedestrians in crossing points due to the conflict with the bus lines under this scenario.

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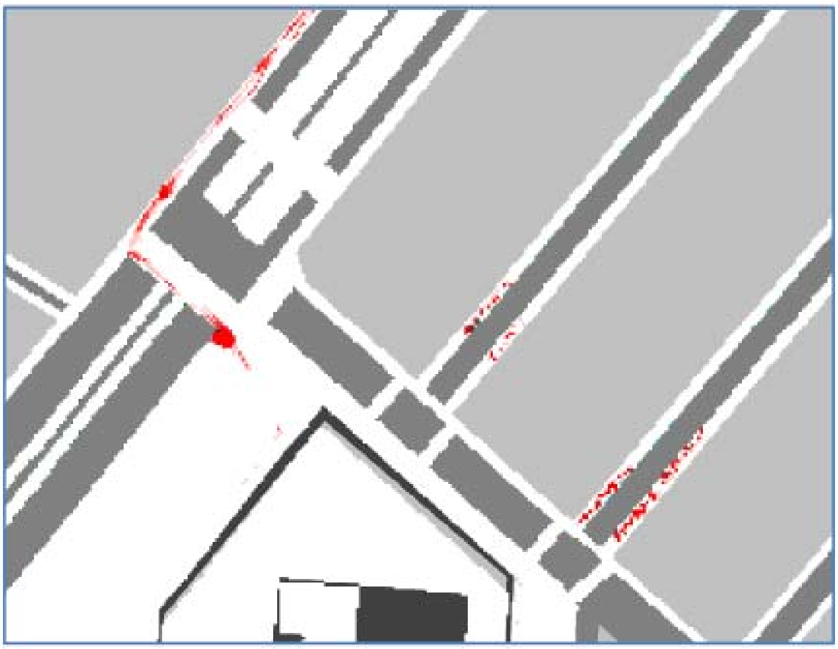

Figure 15: Level of service on pedestrian crossings.

The results also show an increase in density of surrounding pedestrians stadium. The high density is caused by the concentration of pedestrians who use Exits 3 and 4 and head for the parking CEUs or embarkation points (Figure 16).

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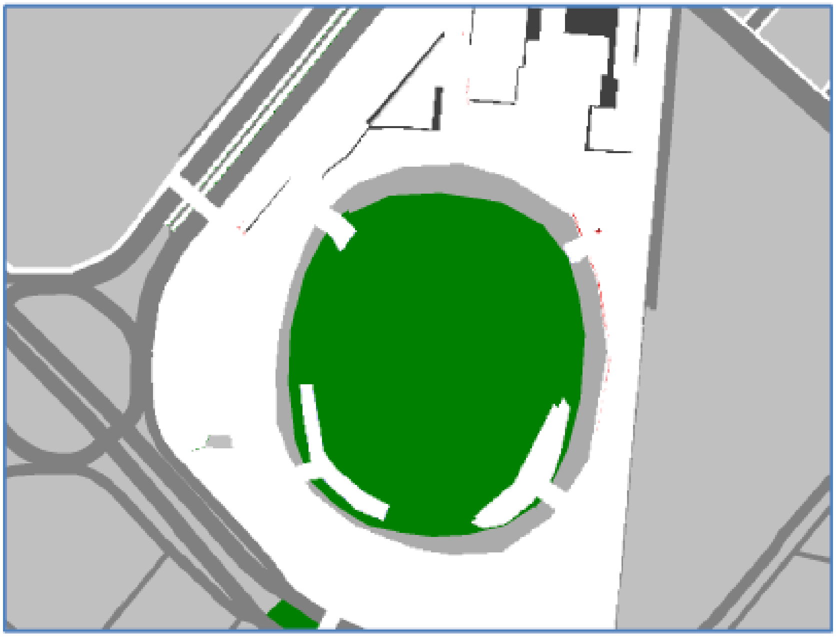

Figure 16: Level of service on pedestrian crossings.

Due to non-use of banned bands, the density of pedestrians on sidewalks is quite high. Due to the lack of opportunities for crossing, the pedestrian flow is concentrated on only one side of Avenida Alberto Craveiro (Figure 17).

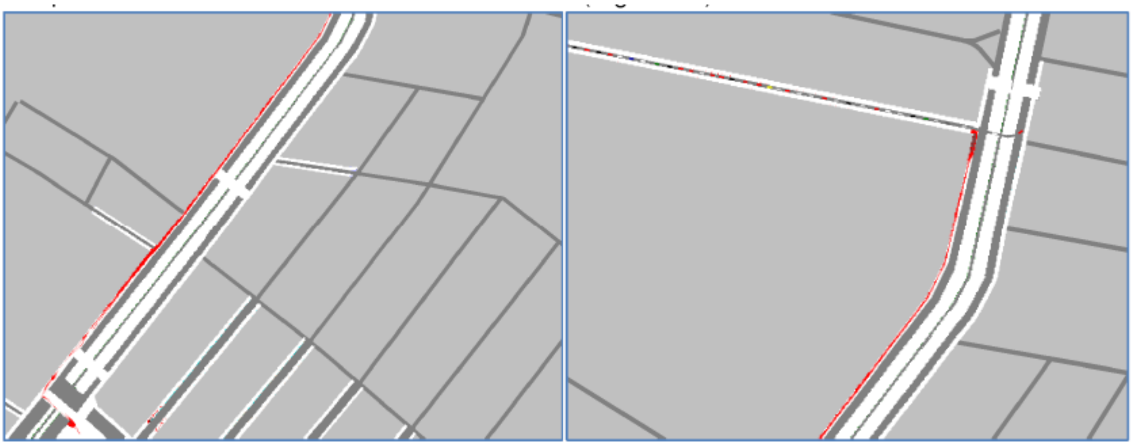

Figure 17: Level of service for pedestrians around the stadium

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8. CONCLUDING ANALYSIS

It was concluded after the simulation scenario input and output scenario the following items:

i. The sidewalks of Avenida Alberto Craveiro, even after enlargement of this pathway, whose width will remain at 3.50 m, on both sides, will not suffice: to safely and comfortably accommodate the high volume of pedestrians that will circulate around the stadium thus, it is recommended that the road operation to be performed is expected to increase the area for the movement of pedestrians in the immediate surroundings of the stadium and the parking lot between the CEU and access ramps to the main Castelão;
ii. It is recommended that the remote service bus CEU and CEU-Stadium-Hotels-Stadium-Hotels, does not have its outlet down the street boundary of the stadium as it will conflict directly with a very dense pedestrian, due to its proximity to the equipment ; an option is that these buses running at least 200m stadium with inputs and outputs so that conflict with the main flow of pedestrians who will disperse after the games-that could be provided through the operation of isolating these major traffic flows;
iii. The crossing of Av. Alberto Craveiro for pedestrians (general public) who are leaving the stadium should not be made right at the intersection of that road with the road boundary of the stadium, since there was a large concentration of people and a considerable delay also because of its proximity to the stadium, it is recommended that this crossing is made at least 200m from the stadium, and with options, aiming disperse the public and improve the safety and comfort of these crossings;

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iv. The crossing of Av. Alberto Craveiro for pedestrians VIP can be performed on this road approximately 150m from the roundabout designed for the local people because this volume is much smaller and can be easily controlled through operation;

v. The simulation showed that the concentration of the bus at the output side of the stadium game may be a critical point of congestion, so it is recommended that they should be positioned in trains should arrive and leave synchronously and are positioned to provide a shorter waiting time user, lower path to be traveled and less conflict with pedestrians that there will be circulating through the region.