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Regulatory median parking: a case study on Recanto das Emas Avenue, Brasília, DF, Brazil

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Abstract

This paper addresses the impact of median parking areas, implemented in 2007 along Recanto das Emas Avenue in Brazil's Federal District, on road safety. The analysis is grounded on Brazilian legislation, technical manuals, and data from the Statistics Division of the Federal District's Traffic Department (Gerest-Detran/DF) regarding types of accidents and traffic volume both before and after median parking in the area was regulated. The lack of a compulsory physical barrier and pedestrian traffic along the avenue are among the factors which have helped increase the number of accidents. Interference with the city's cycling network as well as parking policies also affect the application of sustainable mobility.

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1. Introduction

1.1. Research justification and aim

Research on Recanto das Emas Avenue was initially designed to provide supporting evidence for the revitalization assessment of Paranoá Avenue, which showed similar functional, geometrical, and hierarchical characteristics. The proposal in the revitalization project which most appealed to local shop owners foresaw a high number of parking vacancies along the road median.

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However, electing Recanto das Emas Avenue as object of study was based not only on the above-mentioned similarities to Paranoá Avenue, but also on the fact that median parking areas were put into effect there in 2007. It should also be pointed out that median bike lanes on both avenues have been in place since 2011. Therefore, this research aims to analyze the impact of regulated median parking on road safety in the region.

1.2. Recanto das Emas Avenue

Recanto das Emas Avenue, an 8km-long arterial road, is the main avenue within the administrative region of Recanto das Emas, whose population in 2015 was estimated to be 145,304 people (CODEPLAN, 2015). One end of the avenue connects to federal highway BR-251, an exit for those traveling to Brasília and other regions.

The road profile changes considerably along its length and sidewalks often exhibit damaged pavement, lack of accessibility, surface discontinuities, detours, and width variations caused by moving or fixed obstacles, all of which pose hazards for pedestrian flows. The avenue has four 3.5km-wide lanes, two in each direction, as well as boarding and alighting areas for bus passengers. Regulatory speed limit is 60 km/h, except in places with speed monitoring displays which indicate speed reduction to 50 km/h.

In addition to the median parking areas put into effect in 2007, another significant change to the avenue landscape was the construction of a two-way, 2.2m-wide median bike lane in 2011. The median is approximately 12 m wide, the sidewalk is 2 m wide, and the bike lane is 2,2 m wide, with the remaining area covered by vegetation (grass). Median parking areas offer drivers, in addition to the actual parking place, a 5 m area for maneuver with no physical barrier, an infringement of Brazilian traffic legislation. The bike lane is interrupted in the maneuvering area, leaving bikers of all ages traveling in both directions to face motorized vehicles in the left lane (to be used by high-speed vehicles) or vehicles entering the parking areas. Figures 1a and 1b show, respectively, the initial section of one of the median parking areas (with a vehicle blocking the bike line) and its end section (with a biker traveling against traffic).



Fig. 1. (a) Initial section of a median parking area; (b) End section of a median parking area.

2. Literature review

2.1. Legislation

The Brazilian Traffic Code (CTB), established by federal law number 9,503/1997 (Brasil, 1997), defines median as a “physical obstacle devised to separate two lanes, to be eventually replaced by road markings” (our translation). In accordance with CTB’s section 181, subsection VIII, parking vehicles “on sidewalks or pedestrian lanes, on bike lanes or bike paths, as well as on refuge islands next to or on central medians, lane dividers, channelling markings, grassy lawns or public gardens” constitutes a traffic violation. For parking to be permitted in these locations, markings under specific conditions are required.

Brazil’s Manual de sinalização vertical de regulamentação (CONTRAN, 2007), or Manual for Vertical Traffic Signs, states that the regulatory parking sign (R-6b) is used to allow parking in places where parking and/or stopping are normally prohibited. Medians are included in the application scope of this regulatory sign.

Recanto das Emas Avenue is an arterial road, a type defined by the CTB as “being characterized by at-grade intersections normally controlled by traffic lights, offering accessibility to bordering plots and to secondary and local roads, thus enabling traffic throughout the urban area” (our translation). Arterial roads are firmly grounded on mobility, despite also involving accessibility.

District decree number 33,741/2012 regulates section 20 of complementary law number 803, drafted on April 25, 2009, regarding traffic flow norms, general concepts, and parameters for urban road systems in terms of planning, formulating, and altering urban projects (Distrito Federal, 2012). In section 36, subsection III, paragraph 1, the decree states that creating public parking areas is permitted after meeting the following requirement: “For parking along fast lanes and arterials, a physical flow divider of at least one meter wide must be in place” (our translation).

Based on such legislation, medians come through as an unusual but feasible solution for designated parking spaces, even though the legal text fails to associate it with road types. An important observation at this point is that Recanto das Emas Avenue does not have a physical flow divider.

As far as traffic flow norms are concerned, CTB's section 29, subsection IV states that “when a given roadway comprises several lanes in the same direction, those on the right are intended for slower and heavier vehicles, in case a special lane has not been designated for them, and those on the left are intended for overtaking and vehicles at higher speeds” (our translation) (Brasil, 1997).

2.2. *Technical manuals*

According to volume 4 of *Manual de planejamento das acessibilidades e da gestão viária* (CCDR-N, 2008), or *Manual of Accessibility and Road Management Planning*, arterial roads (known as *distribuidoras principais* or main distributors in Portugal) must be designed and planned to ensure a high level of safety and reasonable levels of traffic fluidity and speed, by adopting solutions to prevent traffic congestion and promote circulation at suitable speeds. As far as parking is concerned, the manual states that it is normally permitted and in virtually all situations must take place along roadways and away from intersections, but does not specifically refer to medians for this purpose.

According to Belo Horizonte's transport and traffic department (BHTRANS, 2010), parking regulations must consider, in addition to roadways' formal classification and operational characteristics, land use, traffic, topographic features, visibility, etc. As for vehicle flow, parking areas located along medians imply an acceleration/deceleration conflict of vehicles on the left lane, designed for overtaking and vehicles at higher speeds.

The use of medians as parking areas also affects pedestrian movements. Drivers who park along roadways often attempt to cross outside a pedestrian crossing, and errors in pedestrian channeling on arterial roads increase the risk of accidents.

Specifically in regard to Recanto das Emas Avenue, the bike lane implemented in 2011, four years after the parking areas were put in place, exhibits serious pavement discontinuities which force bikers traveling in both directions to share road space with motorized vehicles in the opposite flow. Given the fact that the bike lane ends in front of a parking space, bikers have to get off their bikes in order to continue their route, therefore hindering mobility. Resolution number 514/2014 of the National Traffic Council (CONTRAN, 2014), which establishes the National Traffic Policy, includes among its guidelines the development of public transport and non-motorized systems (section 5, subsection III, clause “c”).

Parking policies which strive for urban sustainability are worth mentioning at this point; they adopt the notion of preferred user to better select the demand in view of a limited availability of parking spaces.

3. **Case study**

Data on road accidents from 2000 to 2014 was collected from the Statistics Division of the Federal District's Traffic Department (Gerest-Detran/DF) and then divided into two periods: prior to (Table 1) and following (Table 2) implementation of the median parking areas. Data includes accidents' location, nature (collision between vehicles, run-over, collision with fixed object, fall from vehicle, etc.), severity (injured or fatal victims), date, time, day of the week, and types of vehicles involved.

Table 1. Number of accidents by severity and nature following median parking implementation on Recanto das Emas Avenue (per year).

Severity	Nature	2000	2001	2002	2003	2004	2005	2006	Total
	Animal run-over	0	1	1	0	0	1	1	4
	Pedestrian run-over	26	18	16	14	18	14	11	117
	Rollover	0	1	1	0	2	0	2	6
	Collision with fixed object	6	4	7	4	5	4	2	32
Injury	Collision between vehicles	37	30	24	21	34	29	26	201
	Fall involving persons	1	1	2	3	2	2	0	11
	Fall from vehicle	3	1	0	2	0	1	2	9
	Tip-over	0	0	0	0	0	0	1	1
	Others	0	0	0	1	1	1	2	5
	Pedestrian run-over	3	1	2	1	0	0	0	7
Fatality	Collision between vehicles	2	0	1	0	0	0	1	4
	Fall involving persons	0	0	1	0	0	0	0	1
Total		78	57	55	46	62	52	48	398

Table 2. Number of accidents by severity and nature following median parking implementation on Recanto das Emas Avenue (per year).

Severity	Nature	2007	2008	2009	2010	2011	2012	2013	2014	Total
	Animal run-over	0	0	0	0	0	0	1	0	1
	Pedestrian run-over	27	33	18	33	24	19	25	22	201
	Rollover	0	1	1	2	1	0	1	0	6
	Collision with fixed object	5	8	4	5	5	3	3	4	37
Injury	Collision between vehicles	50	54	60	60	62	43	52	53	434
	Fall involving persons	1	1	2	4	8	3	4	6	29
	Fall from vehicle	3	0	6	5	7	2	5	2	30
	Tip-over	0	0	1	0	0	0	0	0	1
	Others	1	0	1	1	1	0	0	0	4
	Pedestrian run-over	2	3	1	2	3	0	0	1	12
Fatality	Collision with fixed object	1	0	0	0	0	0	0	1	2
	Collision between vehicles	2	3	1	0	0	1	3	0	10
	Fall from vehicle	0	0	1	1	1	0	0	0	3
Total		92	103	96	113	112	71	94	89	770

Table 3 shows the annual average of aggregate data per group before and after parking implementation.

Table 3. Annual of accidents by period and variation.

Nature	Injury			Fatality		
	2000-2006	2007-2014	Variation (%)	2000-2006	2007-2010	Variation (%)
Animal run-over	0,6	0,1	-78	-	-	-
Pedestrian run-over	16,7	25,1	+50	1,0	1,5	+50
Rollover	0,9	0,8	-13	-	-	-
Collision with fixed object	4,6	4,6	+1	-	0,3	

Collision between vehicles	28,7	54,3	+89	0,6	1,3	+119
Fall involving persons	1,6	3,6	+131	0,1	-	
Fall from vehicle	1,3	3,8	+192	-	0,4	
Tip-over	0,1	0,1	-13	-	-	
Others	0,7	0,5	-30	-	-	
Average	55,1	92,9	+68	1,7	3,4	+97

Table 3 shows that the number of people injured increased by 68%, mainly due to a rise in pedestrian run-overs and collisions between vehicles. The number of falls involving people and falls from vehicles also increased. Fatal accidents increased by 97%, mainly due to pedestrian run-overs and collision between vehicles. Virtually all falls involving people had buses involved (of the 41 occurrences, 40 involved a bus and 1, a lorry). As for falls from vehicles, of the 42 occurrences, 4 involved bikes, 1, a station wagon, and 37, motorbikes.

As previously mentioned, dispersed pedestrian crossing along roadways and vehicles' acceleration/deceleration in faster lanes with access to median parking may be related to the rise in the number of fatal and non-fatal (injury) accidents.

The Geo-referenced Information System of the Federal District's Department of Traffic (Sig-Detran/DF) provided data on six electronic enforcement devices (three in each direction), two of them being speed enforcement devices (speed cameras) and four being speed reducers (speed monitoring displays). Data refers to the 2010-2014 period and includes annual average daily traffic (AADT), annual average daily violations for excess speed and, consequently, traffic violation index (number of violations by vehicle volume).

In sections with the highest vehicle flow (block 101/201), near the exit to the highway, AADT totaled 19,162 vehicles, with an average rate of eight daily violations for every 10,000 vehicles from 2010 to 2014. The equipment located in block 104 registered an AADT of 9,811 vehicles and an average rate of six daily violations for every 10,000 vehicles from 2010 to 2014. There were no significant changes in any of the enforcement devices from 2010 to 2014 with regard to number of vehicles or of violations.

As for accidents involving bikes, average annual rates before (from 2000 to 2010) and after (from 2011 to 2014) the bike lane was implemented totaled 13,9 and 9 accidents, respectively. Therefore, we may conclude that the bike lane is not responsible for the high number of accidents registered since 2007.

4. Final considerations

This study examined the impact of median parking areas along Recanto das Emas Avenue on road safety. From a regulatory standpoint, we verified the absence of a physical flow divider measuring at least one meter in width (law infringement) as well as the conflict with the bike lane at the initial and end sections of the parking areas (implemented before the bike lane). The increase in the number of fatal and non-fatal (injuries) accidents (97% and 68%, respectively) was mostly caused by pedestrian run-overs and collisions between vehicles, and we believe that the nature of these accidents suffered a direct influence from the way median parking was implemented in the region. The lack of a local parking policy must be stressed, in addition to the need for a more effective assessment of the functional and hierarchical features of Recanto das Emas Avenue in view of the implementation of parking spaces. In summary, findings extracted from these analyses have assisted other traffic projects in the Federal District, mainly the one concerning median parking on Paranoá Avenue.

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