

# PARKING FOR LOADING AND UNLOADING VEHICLES IN URBAN AREA

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*Abstract - The operations of loading and unloading in business center generate negative impacts, especially traffic restrictions; increased risk over other vehicles and pedestrians; conflicts between passenger and cargo; and obstructions to traffic. Thus, the load distribution process must be planned so as not to generate urban chaos. The lack of planning of freight transport in business center slows traffic in general and generates jams; increasing travel time and the cost of freight transport itself, with the consequent increase in the final cost of the product. Therefore, it is of great importance a joint action between urban planning and the operation of vehicles for loading and unloading. The objective of this paper is to determine a lot for vehicles loading and unloading, and demonstrate the benefits of a parking for this.*

*Keywords – Loading, unloading, parking*

## I. INTRODUCTION

The increase in the volume of goods produced and consumed, as well as the need for services in a region promotes its economic expansion, generating a significant increase in the demand for transport, but, on the other hand, generates negative impacts on traffic. (Carvalho 2008).

So it is necessary a joint action in the planning of cargo vehicles movement that includes operators, retailers and local authorities, in order to avoid the undesirable consequences of urban growth process.

The conflict between the passenger and freight transport in urban area causes problems in three segments, highlighting: Urban area Traffic restrictions; traffic obstructions; jams; accidents; soil and building vibrations; noise, visual and atmospheric pollution. Passenger transportation Conflict between vehicles and pedestrians; speed reduction; longer travel time and increased fuel consumption. Carriage of load Increased cost of load transportation service and increased final cost of products.

Once the lack of planning in loading and unloading operations in an urban area also causes deterioration in life quality, the process of load distribution must be planned so it does not cause chaos in commercial centers.

According to Allen et al, (2000), the amount of time spent in cargo vehicle's is divided as follows: 10% on the route, 1% with customer interaction, 2% in several traffic jams and 87% looking for parking sites, parking the vehicle and providing the levy and delivery of the load. Therefore, during 87% of its time the cargo vehicles circulate in commercial centers, generating conflicts.

However, loading and unloading operations are essential to the functioning of the urban system and cities economic growth. But these operations must be carried out in specific areas to maintain the traffic harmony and local development.

## II. LOADING AND UNLOADING OPERATIONS IN URBAN AREA

According to Sinay et al. (2010), the participant agents of the loading and unloading process are: the community, that demand goods and services; the retailers, which enable the communication between the firms responsible for transportation and logistics operators; the transportation companies that connect manufacturers and retailers; and the local authorities.

Local authorities should regulate the cargo vehicles movement, to protect and meet the community expectations without damaging the local economy, which depends on distribution logistics to grow and compete. The incorporation of cargo transportation in the planning of urban transport can result in significant improvement of urban transport system as a whole, and generate corresponding benefits for the community.

The urban circulation of people and products, together, constitute the main subject of urban transportation. But, according to Carvalho (2008), the loading and unloading of the urban area are rarely considered when planning urban transport.

The flow of freight vehicles in urban area comes from two types of transport: Internal transport The one in which the goods come from the city itself and the freight vehicles are already part of urban fleet. External transport The one in which the goods come from another city and freight vehicles are not part of urban fleet. This type of transport generates additional problems to traffic and the demand is difficult to be quantified because of its random behave.

The efficient transport of loads has significant role in the competitiveness of a given urban area; interfering in the economy of the region and serving the industry and the activities of trade, which are essential to the generation of wealth (Dutra, 2004).

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According to Vilela et al. (2013), the process of urban logistics (city logistics) considers the costs and benefits of public and private sectors; therefore, the freight carriers (private sector) aims at reducing its costs, and the public sector tries to ease the traffic congestion and environmental problems.

According to Dablanc (2007), the flow of cargo crossing a city represents 25% of urban traffic and between 16% to 50% of the pollutant emissions from the city. The lack of specific sites for loading and unloading goods is the reason these operations are performed in the bands of traffic, causing jams. In addition, the cargo vehicles are difficult to drive in urban centers, once they are larger and heavier. According to Oliveira (2014), these difficulties are exacerbated by the lack of an adequate infrastructure for the loading and unloading operations.

In Brazil, one of the main problems faced by transport operators is the difficulty of finding an authorized place in central areas to park and load/unload their goods (Oliveira et al. , 2011).

The growth of urban population generates a greater movement of freight in urban area. These two growth factors potentiate the problems of traffic, especially in commercial centers.

Therefore, a specific parking area for loading and unloading operations in commercial centers should be included in the system of urban transport. Thus, the movement of urban goods will be the solution and not a problem for the population.

### **III.PUBLIC PARKING**

Parking site is the set of designated bays for stationary vehicles, for a certain period of time, at location within the urban area. The parking lots are built for temporary, and not permanent, use of bay.

There are two types of parking lots: private and public. Private parking can be classified as individual or collective. The public parking can be used by any car.

In economic theory, the public parking can be treated as a modified form of a public good or a common good, as it demonstrates a number of different dimensions (Kerley, 2007)

Parking lots can also be classified as open or closed. The closed ones control the entry and exit of vehicles. The open parking do not have this control.

Parkings are a key component to any urban mobility policy, due to its direct relationship with accessibility, with management and operation of movement, and with use and quality of public space.

The parking sites on public streets are the most common in Brazil. This type of parking may be allowed along the curb or in wide areas located along the avenues. The parking in the curb can be parallel to the it or at an angle of, generally, 45 degrees.

By offering access more easily and having, most of the times, lower costs, parks on public roads are the most sought by users. The free parking lots are those who provide

greater attractiveness to drivers because they do not impose restrictions on users.

Although, according to Antonio (2009), the free parking is very convenient to the user, the absence of controlling mechanisms to on-street parking can cause a number of negative impacts on business and residential areas; abuses can cause, among others, parking at unfit areas with prejudice to the traffic flow and safety.

Antonio (2009) pointed out that the parking on public streets, although it is convenient for the user, presents various conflicts, with losses to the society, ranging from jams to environmental pollution, as well as road safety and economic losses caused by delays in travel.

However, in many cases, the parking sites on public roads are essential to the functioning of the activities in urban areas, especially for those already occupied and with a large number of private transport users.

The lack of transport planning and the failure of public transport in Brazil causes a shortage of parking lots that meet the demand in certain urban areas.

When there are not enough places to park, unpleasant consequences are created on traffic, making drivers keep driving in circles, spending time and fuel, polluting the air and interfering with the traffic flow.

The lack of space for parking in an urban area reduces the accessibility, causes impairment to the commercial activities and leads to irregular parking (Antonio 2009). To correct this problem, a new sizing must be done to adequate the park to its current demand.

The plan of urban transport should contemplate a specific area for parking, loading and unloading in shopping centers. The choice of the area should be a function of the following factors:

- Type of load
- Land use and its occupation
- Geometric designs of roads
- Flow of freight vehicles

The planning of urban transport should consider the basic principles of sizing the area for loading and unloading operations in shopping centers, which are the following:

-Recognize the complexity of loading and unloading operations

-Characterize the problems arising from the operations of loading and unloading

-Characterize and quantify the demand of vehicles loading and unloading

### **IV.METHOD**

One of the techniques for sizing parking lots is the simulation. The simulation is a planning tool, available for Operational Research (OP), that allows the creation of scenarios which can be used to guide the decision-making process, allow analysis and assessments of performance and propose solutions for improvement of systems.

The simulation process consists in replicating a system, which allows you to analyze a sequence of hypothetical

events over time, treating the entities that traverses the model in an aggregate or individualized form (Antonio, 2009).

Simulation models, due to its characteristics of randomness, incorporate the variability of demand over time, which gives them a great power of representativeness in public parking on urban streets. The technique of Operational Research (PO) used in this study is the Theory of Queues.

The technique of Queuing Theory allows you to find, through mathematical analysis detailed, a point of balance that satisfies the customer and be economically viable for the service provider. In most cases, the three basic processes of the Queuing Theory's method (arrival process, care process and sizing) provide the steps that are appropriate for studying a park system.

**Arrival procedure**

The procedure of costumers arrival in a system is represented by Equation 1:

$$\lambda = \frac{N}{T} \quad (1)$$

Where:

- $\lambda$ : arrival rate (veh/min);
- N: Numbers of arrivals (veh);
- T: Observation time (min)

In public car parking in urban road, the vehicle arrival process is stochastic, i.e., the drivers park their vehicles randomly over time. Thus, it is necessary to determine the probability distribution of vehicle arrivals over the time period analyzed using the arrival estimates.

**Treatment Process**

The treatment process of a service is represented by Equation 2:

$$\mu = \frac{1}{T} \quad (2)$$

Where:

- $\mu$ : rate of attendance (min/veh)
- T: Average length of parking of vehicles (min/veic).

In a public car park in urban road, the treatment process of the vehicles is also stochastic, i.e. vehicles present parking times different from each other. Thus, it is necessary to determine the probability distribution of the vehicles times parking over the period analyzed, using the calculated park times.

**Dimensioning**

The sizing of a service is determined by Equation 3, which represents the system jams rate.

$$\rho = \frac{\lambda}{\mu C} \quad (3)$$

Where:

- $\rho$ : jam rate of the system
- $\lambda$ : rate of arrivals (veh/min)
- $\mu$ : rate of attendance (min/veh)
- C: number of service channels

The rate of system jams represents the average of service application. If the value of the jam rate is less than 1, it means that there is no formation of queues. If it is greater than 1, it means that there is a formation of queues. If it is equal to 1, it means that there is no formation of queues, but the system is operating at maximum capacity, i.e., all customer service channels are always occupied.

**V. CASE STUDY**

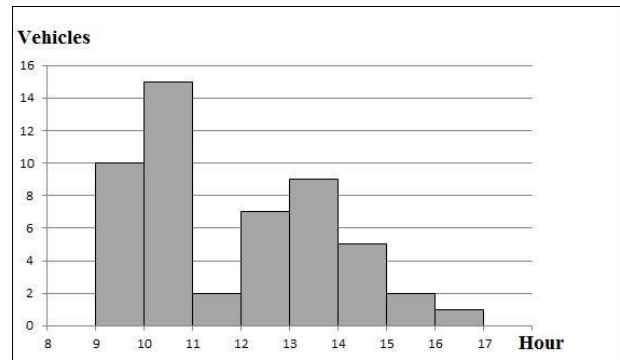
This paper presents an analysis of existing parking sites on the main line of retail trade of Ilha Solteira city; an inland city of São Paulo, close to the Tietê and Paraná Rivers and located on the border between the States os São Paulo and Mato Grosso do Sul.

The study area consists of Avenida Brasil, which crosses the city from North to South, as the main route of retail trade and, for this reason, it has the most requested parking lots of the city. The Avenida Brasil is divided into two major segments: Brazil avenue North and Brazil Avenue South.

The data collection was performed using a standardized form. The data collection process consisted of identifying the cargo vehicles by its license plate and register the times of arrival and departure.

The process of tabulating the data consisted in calculating the time of inter-arrival, which is the time difference between the arrival of two consecutive vehicles, and the permanence time at the parking spot in spreadsheets with the use of Microsoft Office Software Excel.

The data of inter-arrival and the times of parking were used to scale the parking lot within the studied area. Figure 1 shows the fluctuation of demand for cargo vehicles during the period of data collection.



**Figure 1:** Demand fluctuation of cargo vehicles

Figure 2 shows the parking times of trucks. The analyzed commercial center does not have an particular area for loading and unloading activities. Therefore, the vehicles that perform these types of operation park in car bays or occupy the traffic lane parallel to the parking spots, forming a double row of parking and decreasing the capacity of the road.

The presented data refer only to the shopping center which is located in the segment of Brazil Avenue North, in district-to-center direction. It can be observed that the peak hour of cargo vehicles arrivals is from 10 to 11 hours.

The majority of vehicles (68%) remain 20 minutes parked for loading and unloading operations. This small parking duration is consisted with characteristics of the commercial center in study that receives vehicles of internal transport of goods, i.e., goods that are coming from the city itself.

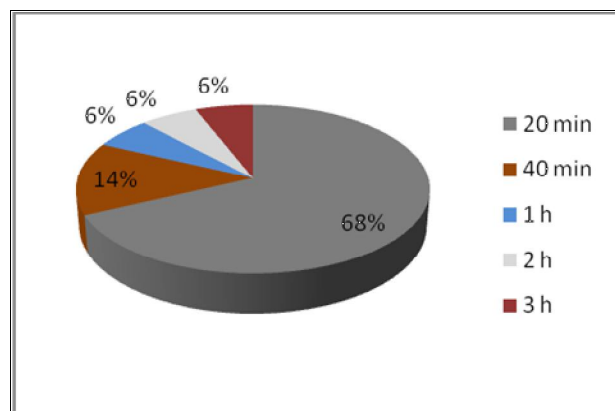


Figure 2: Times the parking of cargo vehicles

## VI. SIZING THE PARKING

The rate of incoming loading and unloading vehicles for parking is calculated by equation 1, using the number of vehicles arriving in peak hour (15 vehicles). Thus, the rate of arrival ( $\lambda$ ) is equal to 0.25 vehicles per hour.

The average time of parking is equal to 27 minutes per load truck. Thus, the rate of attendance ( $\mu$ ) of parking for load vehicles, which is calculated by the following equation 2, results in 0.04 minutes per vehicle.

The number of customer service channels (C) calculated by equation 3 for the load vehicles are equal to 7 bays, whereas the Index of Congestion (r) is equal to 0.9.

After calculating the number of vacancies in the parking lot, a simulation was held with the actual data of the commercial center in question to check if the amount of vacancies calculated is satisfactory to the demand of loading and unloading trucks.

The simulation indicated that there would be queue formation for vehicles that would arrive to perform the operations of loading and unloading. In this case, the specific area for parking, loading and unloading would not be enough for the demand.

Therefore, a smaller value of the Index of Congestion ( $\rho$ ) was used, the value of 0.8. The number of customer service channels (C) was calculated the by equation 3 for the parking of trucks, which resulted in 8 bays.

A second simulation was held to check if the current number of vacancies calculated is satisfactory to the demand of vehicles. The simulation showed that a parking area with 8 vacancies would be sufficient to meet demand.

## VII. CONCLUSIONS

The development of this work showed that the commercial center in study needs a specific area for parking, loading and unloading of vehicles with 8 vacancies. This

shopping center is small, but the shops are arranged along a segment of the road, and there is no vacancy signaled for loading/unloading.

The goods vehicles arriving to park are small, medium and large. The small truck occupies the equivalent of 1.5 car parking space along the track.

The midsize truck occupies an area of to 2 parking spaces for cars. The large truck occupies the equivalent of 5 cars in the parking lot.

A specific area for parking loading and unloading vehicles is very important to ensure the safety of the population and allow the free flow of traffic. At the commercial center in study, it was observed several problems that would be solved with the particular parking for loading and unloading.

The main problems found in commercial center in study are caused by the action of parking in the prohibited following locations:

- Pharmacy specific parking areas
- Garage
- Crosswalk
- Yellow band
- Roundabout
- Disabled Parking areas
- Motorcycle parkink areas
- Dual queue
- Curb cuts (ramps from sidewalk to street)

The benefits of specify parking are a consequence of overcoming the problems detected, with the application of resources in the load transport from the perspective of the several factors involved.

The compatibility of the agents involved in urban transport of load must be added to the system of urban transport as a whole, which is characterized by the integration between the parts and not by the performance of its components separately.

The purpose is to find the balance in meeting the expectations of all urban transport system users, because a certain set of measures may favor a specific segment over others of the urban population.

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