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Critical Analysis of Parking Situation of GEC Circle of Chittagong City, Bangladesh

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***Abstract*—**Chittagong is the Commercial Capital of Bangladesh. The study area at GEC in Chittagong is one of the most commercial activity centers of Chittagong. This paper first analyzes the parking demand of the commercial centers, based on the parking survey. Further, it analyzes the relationship between the parking demand of the commercial buildings and the public transport accessibility. The conclusion is that the parking demand rate of the shopping centre and supermarkets decreases with the increasing of the public transport accessibility. This paper also provides the parking demand rate under the different levels of the public transport accessibility and the parking demand model with the accessibility. The conclusions are valuable for the researches on the parking demand and the making of the parking index for the commercial buildings.

***Keywords*—**Parking, accumulation, inventory, demand, supply, occupancy.

I. Introduction

PARKING is an essential part of the overall transportation system. It is very important for the sustainable development of urban transport [9]. Inadequate parking could lead to unnecessary circulation as motorists search for parking spaces, or to illegal and double parking, thus reducing roadway capacity [11].

Chittagong is an old and commercial city in Bangladesh. Overall parking facility is not sufficient. Parking on the road has been creating congestion every day from Tigerpass to Barik Building Moor, a distance of around two kilometers. On-road parking of vehicles is one of the main reasons behind serious traffic congestion on different parts of the port city including GEC, Muradpur, CDA Avenue, Nizam Road, Zakir Hossain Road, Station Road, Dhaka Trunk Road, Madarbari, Shuvapur Bus Stand, EPZ intersection and Olankar [1]. The purpose of this analysis is to determine the study area's parking demand and supply, to identify areas where parking deficiencies exist, and to generate recommendations to address the area's short and long-term parking needs. Both on-street and off-street parking facilities exist in the study area. On-street parking is generally permitted on all streets in the study area except where parking regulation prohibits. The on-street parking survey focused on the major corridors in the study area where commercial activities and high density residential uses are concentrated. Off-street parking facilities are associated with large multi-unit dwellings as well as with some commercial, entertainment, and recreational establishments in the study area [2]. The scope of this study may improve planning standards, optimizing the use of existing facilities, managing parking demand, providing additional parking facilities.

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II. Study Method

The study method is mixed method. The research is conducted both patrol & questionnaires and modify the patrol survey. According to patrol survey counted various vehicles which were park both off street and on street parking lots at a regular interval [3], [5], [8]. We collected primary data by conducting survey in study area. We conducted survey in one week day and one weekend day from 10:00 AM to 07:00 PM. And we consider 10.00am to 1.00pm and 5.00pm to 7.00pm peak hour and 2.00 pm to 4.00 pm off peak hour. Then prepared a questionnaire and based on it we interviewed some drivers and owners of motor cars about level of service in parking lots and their expectations and demands on this subject. We input the collected data in various spatial formats like SPSS and Excel in order to prepare them for data analysis & analyzed the data in spatial formats and derived parking occupancy and demand in various on-street and off-street parking provisions as well as overall parking scenario in study area. We get parking demand by parking accumulation curve.

III. Study Area

GEC Intersection area is under the administrative jurisdiction of Chittagong City Corporation. It is located in latitude & longitude; 22°21'N 91°50'E. Altitude: 29 m (95 ft). It is an important commercial area in Chittagong city. There are many shopping centers, a number of Bank, Office, a Hospital and many other restaurants in the study area. The major land use of this study area is for commercial purpose, and has also some residential building. Most of the structure of this area is 2-8 storied building. The shopping centers are 4-8 storied building, & most of the shopping center has lift system.

IV. Conceptual Framework

A. Parking Concept

Parking facilities and programs are of considerable importance in traffic engineering. Most persons to Urban and regional commercial centers are accessed primarily by cars. The viability of these areas depends on the availability of convenient parking facilities adjacent to or easily accessible to desired destinations, especially off-street parking facilities [12].

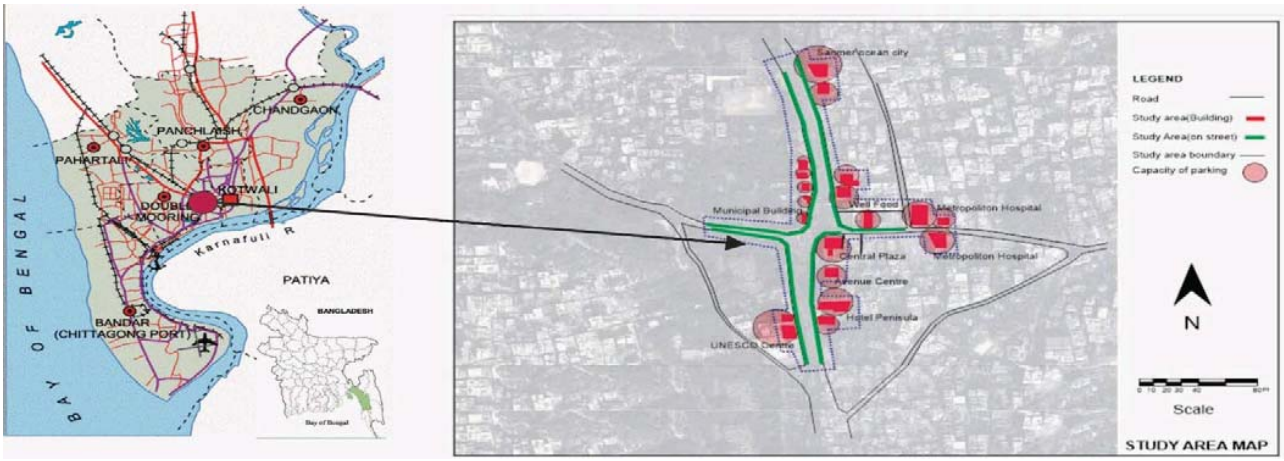

Fig. 1 Study area map

B. Parking Capacity

The number of parking behavior a given area can accommodate. Parking capacity Includes planning capacity and actual capacity. Planning capacity is the total parking spaces in the study Area and the actual capacity is the number of park space which can be accommodated in the actual parking Management and operation [13].

C. Average Duration

Average parking time of a vehicle in a given time interval (D). Parking duration is the length of time that individual car taken parking space. This characteristic is a distribution of individual Values, and both the distribution and the average value are of great interest.

D. Average Parking Duration (D)

$$D = \frac{\sum_x (N_x) XI}{N_T} \quad (1)$$

Where D = average parking duration (hr. /veh); N_x = no. of vehicles parked for x intervals; X = number of intervals parked; I = length of observation interval (hr.); NT = total no. of vehicles observed.

E. Parking Turnover (Veh/Stall/hr.) (Tr)

$$TR=N_T/(S\times T_S) \quad (2)$$

Where TR = parking turnover rate (veh/stall/hr.); S = total number of legal parking stalls; T_s = duration of the study period (hr.).

F. Parking Supply (P)

$$P= [(\sum (N\times T))/D] \times F \quad (3)$$

where P = parking supply (veh.); N = no. of spaces of a given type and time restriction; T = time that N spaces of a given type and time restriction are available during the study period (hr.); D = average parking duration during the study period (hr. /veh); F = insufficiency factor to account for turnover--values range from 0.85 to 0.95 and increase as Average duration increases.

Many parking studies stress on the establishing, the distribution of accumulation with time and to determine the peak accumulation and time at which it occurs. Of course, observed accumulation is limited by parking supply and constrained demand cannot be directly observed [4].

G. Parking Demand Approach

Parking demand problems have been studied for many years and got much progress on approach. The analysis can be divided into two types, the economic analysis models and parking behavior statistics models [14].

The second one, parking behavior statistics analysis, some major parking demand analysis formula are like parking choice model, parking generation rate, the relation of parking demand with building size etc.

H. Parking Generation Rate

It is formed under the local soil using character, and gets different parking demand. The parking volume is

$$P_i=\sum [(j=1) (\partial_{ij}) (L_{ij})] \quad (4)$$

Where P_i- the peak hour number of parking demand in i area; ∂_{ij} -the rate of the land use or the No. of stuff at the i area; L_{ij}- the forecast area of the land use in the i district; n-the number of land use type.

I. Peak Hour Parking Generation

$$Q \text{ (peak-hour)} = Q\times r=r\times R\times N=KN \quad (5)$$

where q (peak-hour) -vehicle volume in peak hour; Q-the number of daily parking; r -the proportion of flow/peak hr. in the daily parking volume; R -turnover of parking space; N -the number of parking supply; K -constant, K=r×R, coefficient traffic flow in peak hour.

J. Europe City Model

$$P = 2CK /100 \quad (6)$$

where P-the parking demand; C-the capacity of road; K-the rate of non- pass through capacity.

V. Parking Demand & Supply Analysis

A. Existing On Street Supply

The number of on-street parking spaces within the study area was determined by counting the number of vehicles on several full blocks and dividing the length of each by the number of vehicles parked [3], [7]. Based on this method, a vehicle parked in the study area needs approximately 20 to 25 feet for park on the street, which represents a fairly typical parallel parking space length. All space is count as the car measurement scale.

B. Existing Off Street Parking Supply

It is the specify parking lot. There are many of street parking lots in the study area. Most of them are ground floor. The capacities of each parking space are averagely. The sannmer ocean city, the UNESCO Centre, hotel peninsula, meridian, the avenue Centre has a parking space on their ground floor under the building.

C. Occupancy Analysis

Since the overall aggregate parking supply for the study area adequately meets the total parking demand created by the current land uses, there does not appear to be a need to provide additional parking in the form of a dedicated public parking lot or structure [4], [6], [10]. The primary challenge in both areas is to encourage turnover of the on-street spaces so they can accommodate more of the evening restaurant demand, which is best accomplished by adding time restrictions and extending them beyond 7 PM so they are effective during the demand period in question. Furthermore, there are two segments near the most congested area that currently do not allow parking, but appear to have sufficient width to allow for additional on-street spaces and thus might be able to increase the on-street supply.

D.Parking Demand & Supply

In the study are the parking capacity or supply are around 200 for on street and around 400 for off street parking. Fig. 2 represent the Parking Demand & supply of weekend day in GEC intersection. Weekend day demand is 822.2 car per hour.

TABLE I
Parking Rate of Three Kinds of Buildings

Symbol	The Rate of visiting car	The Rate of M. Bike
Office building	55% - 65%	35% - 40%
Shopping	75% - 80%	20% - 35%
Shopping+ building	65% - 80%	20% - 25%

A. Parking Duration &Turnover

Table I represent the three kinds of building parking rate such as Office building, Shopping, Shopping & building for such types of vehicles as car and motor bike. The shopping center has high rate of parking.

Table II represents the turnover and duration of vehicles parking as shopping, shopping & building. The overall shopping and office building turnover rate & average duration of parking are moderately high.

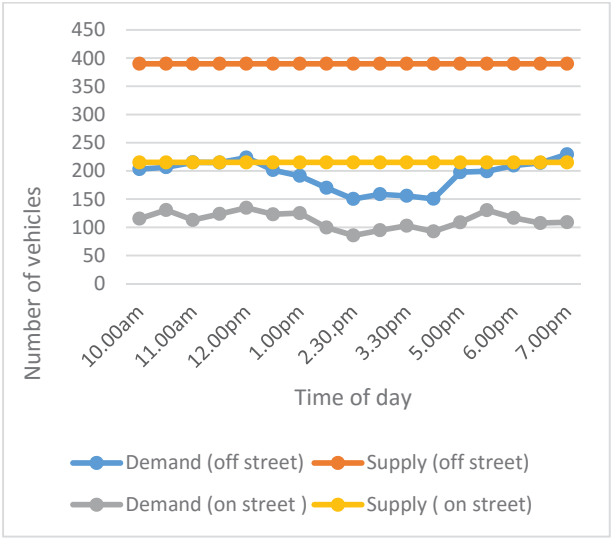

Fig. 2 Parking demand & supply in Weekend day

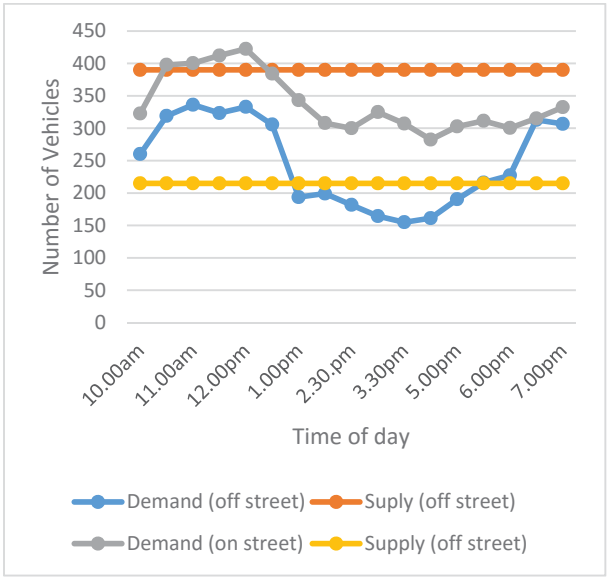

Fig. 3 Parking demand & supply in Week day

TABLE II
Duration and Turnover of Parking

Symbol	Duration(hr.)	Turnover (space/hr.)
Office building	2.52	3.7
Shopping	1.02	4.38
Shopping+ building	1.58	4.27

B. Trip Purpose

The study area is a high class commercial area. So, the maximum trip purpose is office and shopping. A number of shopping center are situated here named Central plaza, Sanmer Ocean City shopping Complex, The Hotel Peninsula, UNESCO City Centre, Avenue Centre, WELL food etc.

VI. Findings & Recommendation

The following represents a summary of the key findings:

- On-street accumulation levels were found to peak at 10:00 to 12:00 am, and of street.
- Overall on-street occupancy rates approximately 70% around mid-morning.
- Off-street parking was occupied at approximately 55% of total capacity in weekend day and about 75% in the weekday.
- Turnover rates indicated that on average, approximately 1 to 2 motorists would park in each off-street stall while 3 to 4 would park in each on-street stall during the daytime.
- Reduced efficiency of the existing parking capacity is experienced due to seasonal conditions and the physical context of certain areas of the commercial area.
- A significant number of clients of businesses complain about the lack of parking in that area.
- Some businesses indicated that it may be beneficial to separate business from retail shopping parking.

Overall, the current aggregate parking supply for the study area adequately meets the total parking demand created by the current land uses; on-street occupancy ranged from 50 to 60 percent while off-street ranged from 20 to 30 percent.

The following options should be considered to address the parking issues in the study area:

- Increase the on-street parking supply. Near Hotel peninsula & Meridian, it is very essential for avoiding traffic congestion.
- Maximize the efficiency of existing on-street parking areas in marked areas and delineating spaces in unmarked areas.
- Encourage shared parking for off-street lots. Since many of the restaurants in the area have little to no off-street parking, they should be encouraged to enter into shared parking agreements with nearby offices and other daytime commercial establishments that do have private lots to more fully utilize their available off-street parking supply.
- Replace existing parallel parking spaces on the north side of Central Plaza with angle parking spaces. This would increase the on-street parking supply from 22 to 35 spaces. In order to minimize vehicle conflicts as a result of the change to angle parking it is also recommended that these were be changed to Sharing parking.

VII. Conclusion

Parking behavior is an important part of the transportation system. The fact has indicated that cruising is the main reason of the inefficiency of the parking and the congestion on streets. These analyses give a way to solve the parking problem from three aspects, namely, parking demand, parking supply and the parking time.

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