PERFORMANCE ANALYSIS OF OFF-STREET PARKING AND ON-STREET PARKING AROUND THE KHULNA CITY CORPORATION (KCC) KHULNA, BANGLADESH

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ABSTRACT

Khulna City Corporation (KCC) has a dense traffic which results in parking problems that are causing accidents and other uneven occurrences. 16 points were selected for detailed study in Khulna City Corporation (KCC), Khulna Bangladesh. Parking surveys were conducted to evaluate their parking index (efficiency) using both close and open-ended questionnaires. Parking index (efficiency) for ONP1, ONP2, ONP3, ONP4, ONP5, ONP6, ONP7, ONP8, ONP9, ONP10, ONP11, ONP12, were obtained as 95.42%, 68.61%, 65.28%, 73.615, 66.67%, 23.46%, 7.04%, 24.67%, 45.83%, 64.33%, 27.67%, 35.50%, OFP1, OFP2, OFP3 and OFP4 were obtained as 3.10%, 70.67%, 17.08% and 42.50%, respectively. Here ONP and OFP refer to On-Street Parking and Off-Street Parking respectively. The study shows that ONP6, ONP7, ONP8, ONP9, ONP11, ONP12, OFP1, OFP3 and OFP4 operated below the maximum capacity at parking index lower than 50%, while ONP1, ONP2, ONP3, ONP4, ONP5, ONP10 and OFP2 operated above the maximum capacity when compared with Policy 7 of the Parking Space Requirements in Parking Code Guidance 2012 of San Francisco Department of Transportation. Furthermore, 50%, 36% and 14% of the respondents affirmed that the existing facilities are not adequate, adequate and very adequate respectively. Inadequacy in parking signage and deficiency in enforcement by Management was observed. However, effective communication, parking enforcement, operational efficiency and provision of parking signage should be adopted in the study area.

Keywords: Traffic, Parking index, Enforcement, Operational efficiency.

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1. INTRODUCTION

Parking, a fundamental component of the transport system, is a serious problem that antagonizes the urban planner and traffic engineer, as it plays a decisive role in the management of traffic and congestion extenuation (Joseph, 2016). The growing use of the automobile as a personal feeder service to transit systems "park-and-ride" has also increased the demand for parking spaces at transit stations. In areas of high density, where space is very expensive, the space provided for automobiles usually has to be divided between that allocated for their movement and that allocated for parking them. Providing adequate parking space to meet the demand for parking in the KCC may necessitate the provision of parking bays along curbs which reduces the capacity of the streets and may affect the level of service (LOS). Before any measure for the betterment of the conditions can be formulated, basic data pertaining to the availability of parking space, extent of its usage and parking demand are essential. It is the responsibility of the planner to provide proper parking space in the KCC area within possible shortest distance from the individual business or commercial shops. Because flexibility of parking space is desirable in any city center or central business district as because this place is the mostly traffic gathered area. Parking of vehicles is an integral part of the KCC area. Parking demand is particularly high in KCC area because of intense commercial activities. On-street parking and illegal occupants are mainly responsible for traffic congestion in Khulna city (Ahmed, 2012). Improper parking facilities decrease the effective width of roads or reduce the traffic flow capacity of roads and cause congestion. In the KCC area of Khulna city, it is a common feature that many motorized and non-motorized vehicles are parked in the main point or intersection of Dakbanglow that creates heavy traffic congestion. It also creates delay of the passengers and the pedestrian and causes a great loss in the economy and hampers the normal life cycle. So management of parking is an important issue for the urban area, especially, in KCC.

2. OBJECTIVES

The Specific objectives of the study are given below:

- a. To find out the places around KCC, Khulna area with their capacity, location and cross sectional area.
- b. To categorize the selected places in two parts commercial & Residential.
- c. To recommend initiative to make those Commercial & Residential places to a suitable and working parking Space.

3. STUDY AREA

Khulna the south-western divisional city in Bangladesh is situated between 21.38' and 23.1' north latitude and 88.58 east longitude and is 12 ft above mean sea level. According to the census of 2011, Khulna city area of 4394.45 sq km, and 24,07,678 respectively. List of the parking location are given below:

1	Save & Safe New Market, Khulna (Commercial).
2	New Market, Gate #1, Khulna (Commercial).
3	New Market, Gate #2, Khulna (Commercial).
4	New Market, Gate #3, Khulna (Commercial).
5	Gollamari Bus Stand Out Side of (Auto Stand), Khulna (Commercial).
6	Save and Safe Daulatpur (East), Khulna (Commercial).
7	Save and Safe Daulatpur (West), Khulna (Commercial).
8	Hotel Castle Salam, Khulna (Commercial).
9	City Medical Collage Hospital, Moylaputa, Khulna (Commercial).
10	Hadis Park Khulna Lake (South Gate), Khulna (Commercial).

11	Hadis Park Khulna Lake (North Gate), Khulna (Commercial).
12	Dak Bangla Mor, Khulna (Commercial).
13	Rail Way Station, Khulna (Commercial).
14	Sib-Bari Mor (Toymur Center), Khulna (Commercial).
15	Sonadanga Residential Area, Khulna (Residential).
16	Western Inn International Ltd, Khulna (Commercial).



Figure 1: Khulna City Cooperation Area Map.

4. METHODOLOGY

This part is subdivided into 3 (Three) major parts.

(a) Population and Sample

- (b) Constructs and Measurements
- (c) Analytical Approach.

4.1 Population and Sample

The Study areas are Save & Safe New Market, New Market, Gollamari Bus Stand Out Side of (Auto Stand), Save and Safe Daulatpur, Hotel Castle Salam, Western Inn International Ltd, City Medical Collage Hospital Moylaputa, Hadis Park, Dak Bangla Mor, Rail Way Station, Sib-Bari Mor, Sonadanga Residential Area Khulna. Khulna city area of 45.65 sq km, and 1500000 people respectively. It's situated between 21.38' and 23.1' north latitude and 88.58 east longitude and is 12 ft above mean sea level. The sample size has been determined by using Solven's formula-

Number of sample: $\frac{N}{(1+N.e^2)}$ (Altares, 2003)

Where, e = Accuracy parentage, N= Number of users

4.2 Constructs and Measurements

Following the reconnaissance survey of the study area, four parks around the KCC shown in Figure 1 were selected for detailed study. The parks were as coded and shown while license plates 1 to 16 shows typical scene at the point. The primary data were obtained from well-structured questionnaires and personal interview while the parking surveys were conducted between 8a.m and 5p.m. License plate method of survey was adopted, so in this case of survey, every parking stall was monitored at a continuous interval of 15 minutes or so and the license plate number was noted. This gave the data regarding the duration for which a particular vehicle was using the parking.

4.3 Analytical Approach

To analysis of off-street & on-street parking for residential area, off-street & on-street parking for Commercial area Parking Accumulation, Accumulation, Occupancy, Average Parking Index % to implement this Formula and use Microsoft Office Excel,

a.	Parking Index (Efficiency) = (Accumulation / parking capacity) * 100	(1)
b.	Accumulation=Initial count+ no. of entering vehicles-minus the no. of exit vehicles	(2)
c.	Average Parking Index % = (Total Parking Index/Number of Time Interval	(3)
d.	Average Accumulation = (Total Accumulation / Number of Time Interval)	(4)

5. RESULTS AND DISCUSSION

Different type of data such as Parking Capacity, cross sectional area, use characteristics of place, Number of Vehicles Parked inside the Parking Lot, accumulation, occupancy, etc. was collected from the selected 16 station and then the calculation was done through process which is shown in methodology. Different type of result is given below which is obtained from field survey.

No	Point Name	Capacity	Area	Location	Park Use
			(m^2)		Characteristics
1	Save & Safe New Market, Khulna.	40	18.55	New Market,	Commercial, Truck
				Khulna.	Parks
2	New Market, Gate #1, Khulna.	60	92.76	New Market,	Commercial, Truck
				Khulna.	Parks.
3	New Market, Gate #2, Khulna.	60	92.76	New Market,	Commercial, Truck
				Khulna.	Parks,
4	New Market, Gate #3, Khulna.	60	185.52	New Market,	Commercial, Truck
				Khulna.	Parks,
5	Gollamari Bus Stand Out Side of	20	92.76	Gollamari Bus	Commercial, Truck
	(Auto Stand)			Stand.	Parks,
6	Save and Safe Daulatpur (East),	200	83.48	Save and Safe	Commercial, Truck
	Khulna.			Doulutpur.	Parks,
7	Save and Safe Daulatpur (West)	200	83.48	Save and Safe	Commercial, Truck
				Doulutpur	Parks,
8	Hotel Castle Salam, Khulna.	50	148.42	Royal Mor,	Commercial, Truck
				Khulna	Parks,

Table 1: Table shows the on street and off-street parking place there parking capacity, cross sectional area and location and use characteristics of place.

No	Point Name	Capacity	Area	Location	Park Use
			(m^2)		Characteristics
9	City Medical Collage Hospital,	50	139.14	Moylaputa,	Truck Parks, and
	Moylaputa.			Khulna.	Residential.
10	Hadis Park Khulna Lake (South	50	102.04	Hadis Park	Commercial, Truck
	Gate)			Khulna	Parks,
11	Hadis Park Khulna Lake (North	50	111.31	Hadis Park	Commercial, Truck
	Gate)			Khulna	Parks,
12	Dak Bangla Mor, Khulna.	50	278.29	Dak Bangla Mor	Commercial, Truck
					Parks,
13	Rail Way Station, Khulna.	1000	6261.5	Rail Way	Commercial, Truck
				Station, Khulna	Parks,
14	Sib-Bari Mor (Toymur Center),	50	148.43	Sib-Bari Mor	Commercial, Truck
	Khulna.				Parks,
15	Sonadanga Residential Area,	20	143.78	Sonadanga,	Residential.
	Khulna.			Khulna.	
16	Western Inn International Ltd,	30	27.82	Bangladesh Bank	Commercial, Truck
	Khulna.			Mor,	Parks,

5.1 The graph of Parking Accumulation & Parking Index



Figure 2: The graph of accumulation & parking index.

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The Blue color in Figure 2 indicates average parking accumulation for on street parking (ONP) & off street parking (OFP). The average parking accumulation of On-Street Parking (ONP) is ONP1, ONP2, ONP3, ONP4, ONP5, ONP6, ONP7, ONP8, ONP9, ONP10, ONP11, ONP12 obtained as 38.17%, 41.17%, 39.17%, 44.17%, 13.33%, 46.92%, 14.08%, 12.33%, 22.92%, 32.17%, 13.83%, 17.75%, & off street parking (OFP) is OFP1, OFP2, OFP3, OFP4 obtained as 31,00%, 35,33%, 3,42%, 12,75%. The color Green in Figure 2 indicates average parking index for on street parking (ONP) & off street parking (OFP). The green color indicates average parking accumulation for on street parking (ONP) & off street parking (OFP). The Average Parking Index of On-Street Parking (ONP) is ONP1, ONP2, ONP3, ONP4, ONP5, ONP6, ONP7, ONP8, ONP9, ONP10, ONP11, ONP12 obtained as 95.42%, 68.61%, 65.28%, 73.615, 66.67%, 23.46%, 7.04%, 24.67%, 45.83%, 64.33%, 27.67%, 35.50%, & off street parking (OFP) is OFP1, OFP2, OFP3, OFP4 obtained as 3.1%, 70.67%, 17.08%, 42.5%.



Figure 3: Parking Accumulation of ONP & OFP

Summary of Parking Accumulation in Figure 3 for ONP1, ONP2 & OFP1, OFP2 time duration before 8a.m to 10.00a.m obtained as 0, 6, 3.5, 0; 10a.m to 12a.m obtained as 15, 40, 3, 80; 12a.m to 1p.m obtained as 25, 50, 4, 90; 1p.m to 3p.m obtained as 10, 34, 1.5, 70; and 3p.m to 5p.m obtained as 20, 80, 4, 50.



5.2 Graph for On Street Parking



Figure 4: Average Parking Index (%) Graph for On Street Parking.

Figure 4 shows On Street Parking Average Parking Index the maximum parking Index is Save & Safe New Market (ONP1) 95.42% and the minimum parking Index Save & Safe Daulatpur (East) (ONP6) 4.04%

5.3 Graph for Off Street Parking



Average Parking Index (%) for Off Street Parking.

Figure 5: Average Parking Index (%) Graph for Off Street Parking.

Figure 5 shows Off Street Parking Average Parking Index the maximum parking Index is Sib-Bari Mor (Toymur Center), Khulna 70.67% and the minimum parking Index Rail Way Station Khulna is 3.1%

5.4 Graph of Parking Capacity in the Study Area



Figure 6: Parking capacity for the study area in KCC.



5.5 Analysis from Users' Perspectives

Figure 7: Adequacy of the Parking Spaces.

Figure 6 shows the parking capacity of various points of study area and Figure 7 is the representation of the user perspective of the parking. Figure 4.6 shows that 44% of the respondents affirmed that the facilities are not adequate, while 19% are of the opinion that it is adequate, and 44% believed it is very adequate.

6. CONCLUSIONS & RECOMMENDATION

6.1 Conclusions

- a. The average parking accumulation of Sonadanga Residential Area, Khulna (Residential) parking accumulation is 3.42; New Market, Gate #2, Khulna (Commercial) parking accumulation 39.17 and City Medical Collage Hospital, Moylaputa, Khulna (Commercial) 22.92.
- b. The average parking index of Sonadanga Residential Area, Khulna (Residential) parking accumulation 17%; Gollamari Bus Stand Out Side of (Auto Stand), Khulna (Commercial) 23.46%; Sib-Bari Mor (Toymur Center), Khulna (Commercial) parking accumulation 70.67%.
- c. The average parking occupancy of Sonadanga Residential Area, Khulna (Residential) parking accumulation 17.3%; Rail Way Station, Khulna (Commercial) 3.1%.

6.2 Recommendation

- a. Residential Parking's have not Sufficient Parking Space & Security. So the owner may take specific measure regarding that.
- b. The Garages are very small for the Residential Parking system that is hampering the regular work. So the space can be enlarged.
- c. Now a day the Residential Area are associated with rent of the school & office that causes huge amount of problem in parking vehicles. So the owner of Building should avoid the rent the school & office.
- d. There is not Sufficient Parking Space to the Commercial Building. So they should increase the more parking spaces. Or they can use the Multiple Vertical Space Parking System. Because this system can park many vehicles.
- e. KCC should take initiative to illegal parking and increase awareness among people in the city.
- f. The illegal parking in many intersection and roundabout in places like Shibabri and Royal mor, Moyla pota mor should be taken under the regulation with the help of law enforcing agencies.

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