Study On Parking System And Its Analysis

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Abstract—The increasing rate of private car usage in the urban areas as a result of the fast-growing economy, derelict policies and subsidies are the main causes making car parking one of the main concerns for transport and traffic management all over the world. The coordination between parking policies and traffic management revealed how parking is becoming a barrier to the through-traffic operation. Also, it is responsible for the inefficient use of available resources, even the decisions are made on an ad-hoc basis while making policy. Hence, it is necessary to understand the parking choice behavior and actual demand of parking space.

Keywords—Transportation Engineering; Parking Demand And Capacity; Parking Characteristics; Parking Choice Behaviour; Policy Guideline; Planning And Management

I. INTRODUCTION (*Heading 1*)

In developing countries around the world, the population of vehicles is increasing day by day. This is especially true for urban areas in those countries, where there is steep rise in human population. Cities usually provide a wide array of travel and transportation facilities including public transportation. But, the proportion of private modes among various travel options is increasing in urban areas which is leading to various problems like increased congestion and accidents. Increased income and improved socio-economic parameters contributes to the explosion in vehicle population in cities. In Ettumanoor city, the human population increased from 45000 to 1 lakh 2022. Subsequently, the vehicle growth in the city is from 2 lakh to over 5 lakh in the last 26 years. Parking could be considered as one of the inevitable aftereffects of traveling using private modes.

Parking is one of the least studied aspects of urban transportation. Parking is considered as the act of stopping and disengaging a vehicle and leaving it unoccupied. The provision of vehicle parking plays an important role in demand for traveling as well as basic functioning
of the transport system. Increase in travel using private modes and reduction in public transport usage adds to parking demand. Addition of new parking supply facilities could
attract more private vehicles. Thus, the most effective method to reduce the parking woes is to reduce the parking demand. In small cities like Ettumanoor, short distance trips account for about 60 % of total trips. changed to public transportation instead of traveling using private modes like personal cars and two-wheelers.
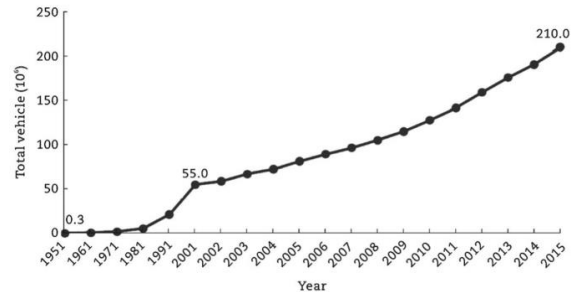

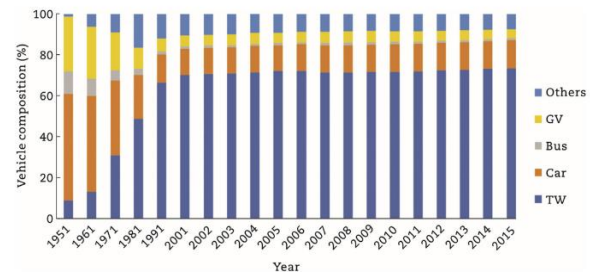Fig. 1 – Vehicle growth in India (MoRT&H, India, 2018).

Fig. 2 – Composition of vehicle population (MoRT&H, India, 2018).

1.2 NEED OF THE STUDY

Parking is an inevitable part of personal transportation. The demand for parking in urban areas is increasing day by day. This is because of increase in vehicle numbers, especially cars, which consume more space in comparison two-wheelers. In cities like Ettumanoori, two-wheelers accounts for about 60 % of t otal traffic, while cars are about 15-20 %. The decadal rise in the number of two-wheelers is 3-9%, but the rise in number of cars is 10-12% . This adds to the parking woes. As the number of cars increases, parking demand also increases. But, the on-street supply will remain more or less the same. This increases the gap between parking demand and parking supply. Study of this gap is important to evaluate the extent of parking problem prevailing in the area.This study could be used as an indicator of parking condition in urban regions in developing economies. Urban areas are in dire need of parking spaces. The most logical method to avoid parking problems is to reduce the parking demand. But this could be implemented only as a part of a long term plan. Short term plans are also needed, which includes addition of supply facilities.

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Fig. 3 Illegal on-parking at ettumanoor temple road

GENERAL BACKGROUND
PARKING

Parking is the act of stopping and disengaging a vehicle and leaving it unoccupied. Parking is inevitable but is creating problems also, especially in urban areas. Parking is usually made along the sides of the street or road itself near to residence, shopping malls, markets or other busy areas. This might reduce the capacity of the roadway, if not properly managed. Proper parking management strategies and proper enforcement is necessary for urban areas. If properly managed, parking facilities can generate revenue also. It could also help in reducing the demand for parking.

TYPES OF PARKING

Parking is usually done along the sides of the street. It could be shifted to some other places as a part of parking management. Based on this, parking could be categorized into on-street parking and off-street parking

On-street Parking along the sides of the road itself is known as on-street parking. This is the most common type of parking. In some roads, there could be restrictions which might be intended to avoid obstructions to nearby facilities. Restrictions are imposed commonly using sign boards. Parking could be done on only one or both sides of the roadway. On-street parking could be divided into following types based on the parking angle:

Parallel parking

The vehicles are parked along the length of the road. In this type, there is no backward movement involved while parking or unparking the vehicle. Thus, it is the safest type of parking. But, it requires more kerb length and thus reduces the parking capacity. It causes least obstruction to through traffic.

Perpendicular parking

In this type, vehicles are parked perpendicular to the road. It consumes more road width compared to other types, thus reducing through traffic capacity. It needs less kerb space. So, more number of vehicles could be parked. The complex maneuvering in this type of parking could cause accidents.

Angular parking

Angular parking is similar to perpendicular parking, except that the parking angle is inclined. As parking angle increases, more number of vehicles could be parked. Thus angular parking could help in occupying more vehicles compared to parallel parking. Also, it consumes less road width than perpendicular parking. The parking angle could be 30°, 45° or 60°.

Off-street Parking

These are parking areas in some urban centers, which are exclusively allotted for parking which will be at some distance away from the main stream of traffic. Such a parking is referred to as off-street parking. They could be managed by either private or public agencies. Access for these facilities could be for public or private use. Construction of such facilities might require large amount of funding. This cash could be returned by collecting parking fees. Also, it should not be too high, which might encourage on-street parking. The types of off-street parking facilities include:

Surface car parking

These are parking facilities provided at the surface and at some distance from the area of activity. Arrangements are made for systematic entry and exit of the vehicles. Proper the circulation area should be there for the vehicles to move around. Stalls should be there with suitable dimensions as per the need. The main advantage for this type of parking is that it requires minimum investment. Also, this could be facilitated only if there is availability for proper land area. Land cost in urban areas could come out as an issue during investment.

Underground parking

This is usually built if there is not much space available for surface parking. It is usually located near urban centers or shopping malls where space is less. The construction of this facility could be costlier due to the fact that it requires extensive excavation, construction of retaining walls, ventilation and lighting. Also, it could be single level or multi-level and it depends on the type of soil available at the site and also the level of water table there.Underground parking facility requires illumination during all hours.

Multi-level Car Parking

These are parking facilities which have more than two-levels above the surface. They are usually provided in apartments & commercial establishments including malls, multiplex for parking of cars. This requires large amount of investment as well as large extent of parking space. The major problem faced by this facility is that it is difficult to get returns because vehicle owner's reluctance to park in a multi-level car parking facility. In urban areas, most of the vehicle park for short durations. Drivers of such vehicles would not like park in a multi-level facility because of the chance of time loss and maneuvering difficulty. Thus multi-level parking systems are not always a feasible solution for parking woes.

Roof parking

Roof top parking is one of the creative ways to solve parking problems in urban areas. This kind of parking does not require extra land space as it utilizes the area above roofs. Also, investment will be much lesser. Access ramps or mechanical lifts should be provided for vehicles to access roof.

Automated parking systems

In this type of parking, after the vehicle is parked on the platform, the system will move the vehicle to available parking spaces somewhere in the structure. The vehicles can be moved horizontally as well as vertically within the system. The major advantage is that the parking space could be smaller because no one need to get in and out of the vehicle and it parks by itself. Since it is automatic, it does not require any staff.

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PARKING PARAMETERS

The extent of improvement required for a parking facility could be identified only after analyzing the existing parking conditions prevailing in the region. This study could be done by finding out certain parking parameters. These parking parameters include:

Parking Accumulation

It is the total number of vehicles which was parked in a given interval of time. It can be depicted by using an accumulation curve with number of vehicles on ordinate and the time interval on abscissa. Accumulation curve for each type of vehicle at a particular parking spot could be drawn. The maximum value of accumulation at a given time interval will give the peak parking demand for that parking area.

Parking Volume

It is defined as the total volume of vehicles parked at a given duration of time. Repeating vehicles are not considered for finding this parameter. It depicts the actual volume of vehicles entered into the area.

Parking load

The area under accumulation curve gives the parking load. It could be obtained by multiplying the number of vehicles occupying a parking area at each time interval with the time interval. Its unit is vehicle hours.

Average parking duration

It could be defined as the time duration for which the vehicles each type is parked in a given area. It could also be defined as the ratio of total vehicle hours to the total number of vehicles parked.

Parking supply

Parking supply could be defined as the total number of available space required for the vehicles to park. It is usually expressed as per the space requirement for cars.

2.4 PARKING SURVEYS

Parking surveys are commonly done to find out the parking parameters. The most commonly employed parking survey methods include in-out survey, fixed period sampling and license plate method of survey.

In-out survey

In this survey, the occupancy count in the selected parking lot is taken at the beginning.Then the number of vehicles that enter the parking lot for a particular time interval is counted. The number of vehicles that leave the parking lot is also taken. The final occupancy in the parking lot is also taken. Here the labor required is very less. Only one a person may be enough. But from this survey, one cannot get any data regarding the time duration for which a particular vehicle used that parking lot. Thus, we cannot estimate the parking fare from this survey.

Fixed period sampling

For quick survey purposes, a fixed period sampling can be done. This is almost similar to in-out survey. All vehicles are counted at the beginning of the survey. Then after a fixed time interval that may vary between 15 minutes to 1 hour, the count is again taken. Here there are chances of missing the number of vehicles that were parked for a very short duration. License plate method of survey Using License plate method of survey, the most accurate and realistic data could be obtained. In this type of survey, every parking on the road is monitored at a continuous interval of 15-30 minutes or so and the license plate number is noted down. This will give the data regarding the duration for which a particular vehicle was using the road way as parking. This will help in calculating various parking statistics and the fare because fare is estimated based on the duration for which the vehicle was parked. If the time interval is shorter, then there are less chances of missing short-term parkers. But this method is very labor intensive.

STUDY AREA

Ettumanoor is a City in Kottayam District of Kerala State, India. It belongs to South Kerala Division Kottayam City , Palai City , Vaikom City , Changanassery City are the nearby Cities to Ettumanoor.It is in the 28 m elevation(altitude) .Kottayam (Akshara Nagari) , Kumarakom , Mararikulam , Alleppey (Alappuzha) , Kuttanad are the near by Important tourist destinations to see.

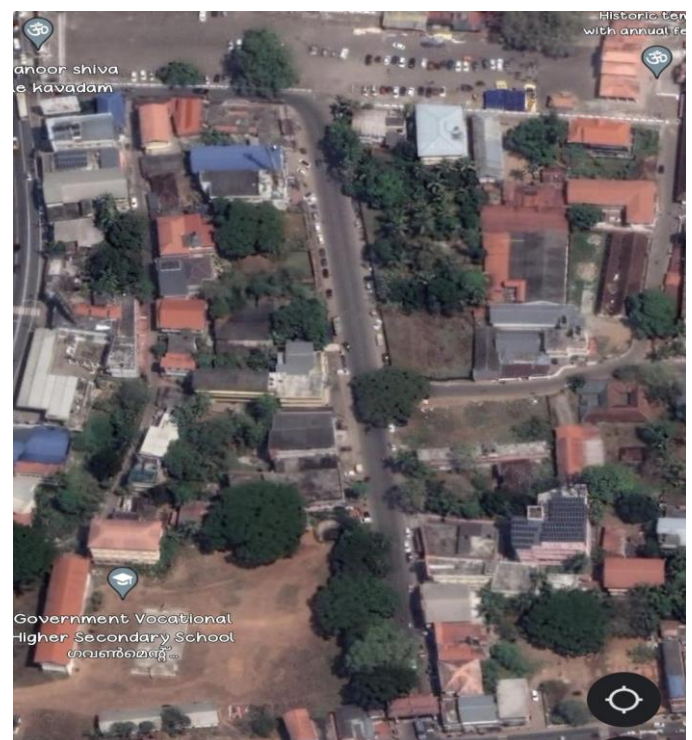Major spots are:

Ettumanoor Manargad Road

Ettumanoor Kuravilangad Road

Ettumanoor Temple Road

Ettumanoor Kidangoor Road

Ettumanoor Kottayam Road

Ettumanoor Peroor Road

DATA COLLECTION

Time of the day	Cars & Vans	2Ws	Autos & Goods	Vikram & Tempos	Others
10:30 am to 11:30 am	220	206	45	0	0
11:30 am to 12:30 pm	267	283	26	12	2
2:30 pm to 3:30 pm	197	273	13	10	4
3:30 pm to 4:30 pm	320	376	19	10	5
4:30 pm to 5:30 pm	371	329	16	23	5
5:30 pm to 6:30 pm	301	295	10	19	5

Table 1 Accumulation result for ettumanoor manargad road

Time of the day	Cars & Vans	2Ws	Autos & Goods	Vikram & Tempos	Others
9:30 am to 10:30 am	89	94	18	2	0
10:30 am to 11:30 am	133	145	22	1	0
11:30 am to 12:30 pm	210	216	35	2	1
2:30 pm to 3:30 pm	102	220	19	0	0
3:30 pm to 4:30 pm	155	323	17	0	0
4:30 pm to 5:30 pm	164	313	21	0	0
5:30 pm to 6:30 pm	108	139	8	5	0

Table 2 Accumulation result for Ettumanoor Kuravilangad road

Time of the day	Cars & Vans	2Ws	Autos & Goods	Vikram & Tempos	Others
10 am to 11:00 am	136	95	10	10	5
11:00 am to 12 noon	176	114	15	14	5
12 noon to 1:00 pm	172	113	13	9	7
2:30 pm to 3:30 pm	146	61	13	4	4
3:30 pm to 4:30 pm	147	98	21	18	4
4:30 pm to 5:30 pm	104	61	16	9	3
5:30 pm to 6:30 pm	135	70	7	5	0

Table 3 Accumulation result for ettumanoor temple road

Time of the day	Cars & Vans	2Ws	Autos & Goods	Vikram & Tempos	Others
10:00 am to 11:00 am	76	48	9	11	5
11:00 am to 12:00 pm	48	58	7	0	3
12 noon to 1:00 pm	63	83	11	1	3
2:30 pm to 3:30 pm	55	70	0	6	1
3:30 pm to 4:30 pm	74	58	1	8	3
4:30 pm to 5:30 pm	80	56	0	8	4
5:30 pm to 6:30 pm	92	43	5	10	3

Table 4 Accumulation result for Ettumanoor Kidangoor Road

Time of the day	Cars & Vans	2Ws	Autos & Goods	Vikram & Tempos	Others
9:30 am to 10:00 am	9	24	11	0	1
10:00 am to 10:30 am	18	33	7	0	0
10:30 am to 11:00 am	25	41	13	0	0
11:00 am to 11:30 am	20	71	20	0	0
11:30 am to 12 noon	24	67	19	0	0
12 noon to 12:30 pm	37	70	31	0	0
12:30 pm to 1:00 pm	50	83	21	0	0
3:00 pm to 3:30 pm	56	84	22	0	0
3:30 pm to 4:00 pm	57	86	20	0	0
4:00 pm to 4:30 pm	55	82	26	0	0
4:30 pm to 5:00 pm	54	84	24	0	0
5:00 pm to 5:30 pm	56	93	23	0	0
5:30 pm to 6:00 pm	49	92	24	0	0
6:00 pm to 6:30 pm	42	91	22	0	0

Table 5 Accumulation result for Ettumanoor Kottayam Road

NDA

Time of the day	Cars & Vans	2Ws	Autos & Goods	Vikram & Tempos	Others
10 am to 10:30 am	67	38	8	1	0
10:30 am to 11 am	67	43	7	2	0
11 am to 11:30 am	69	49	2	2	0
11:30 am to 12 noon	77	57	4	2	0
12 noon to 12:30 pm	82	64	7	0	0
2:30 pm to 3:00 pm	72	73	3	1	0
3:00 pm to 3:30 pm	74	55	4	1	0
3:30 pm to 4:00 pm	78	74	3	1	0
4:00 pm to 4:30 pm	81	74	4	1	0
4:30 pm to 5:00 pm	79	80	4	1	0
5:00 pm to 5:30 pm	83	67	8	1	0
5:30 pm to 6:00 pm	81	70	8	1	0
6:00 pm to 6:30 pm	85	59	3	1	0

Table 6 Accumulation result for Ettumanoor Peroor Road

RECOMMENDATIONS

The guidelines as per IRC SP: 12-2015 for implementing an off-street parking facility
include:
 A 1000 m (10minute walking) radius around the multilevel facility shall be
designated a strict "NO PARKING" Zone for all streets. Road space within this zone may be reclaimed for Intermediate public Transport (IPT) Vehicles or Non-motorized Transport (NMT) parking and pedestrians.
 In case it is essential to provide on-street parking within the 1000 m zone, it should be priced exponentially so that the multi-level facility has more demand, thus making it viable for the parking provider to cross-subsidies the facility.
 On-street parking is the premium, most convenient parking space having maximum demand. Low pricing of on-street parking will lead to the failure of off-street multi-level parking facilities.
 Public multi-level parking facilities cost can never be recovered through simple pricing. It should be recovered through cross subsidy from on-street pricing within the Parking Business District (PBD).
 It would be very difficult to recover the cost of construction of the off-street parking facility only through the fees collected from users. This is because only those vehicles which park for a medium stay or longer stay will most probably use the off-street parking facility. Short duration parkers may not be willing to use the off-street facility. In Indirapuram, about 70 % - 80 % of vehicles park for very short duration (less than 1 hour). Thus, cost recovery from off-street facility will be very less.
 To manage the reduced cost recovery from the off-street facility, pricing for on-street parking for a radius of 1000 m around the facility could be implemented. The cost could be recovered only by combining the amounts collected from both on-street and off-street parking facilities.
 Since, short term parkers are more and they park only along the sides of the street, the cost for short duration on-street parking could be made higher. This adds to the generated revenue.

SPACE REQUIREMENT

The gap between demand and supply in on-street parking in Ettumanoor in 2030 will be 2048 ECS. The area required to accommodate this have to be found out. Cars and two-wheelers mostly use the off-street facility. Of these, considering the scenario that 60 % of total vehicles will be cars and 40 % will be two-wheelers. Approximately 123 car spaces and 82 two-wheeler spaces are necessary. Area of cars is taken as 8 square meters and that of two-wheelers is taken as 2 square meters. Thus, total area required = 123*Area of one car + 82*Area of one two-wheeler
= 123* (8) + 82* (2)
= 984+ 164
= 1148 square meters.
Thus approximately 1148 square meters of area is required to satisfy the future parking demand.

Location Selection
In this study, mainly 6 roads in Ettumanoor locality are considered. As per IRC SP: 12- 2015 guidelines, the off-street parking facility must be at a maximum of 1000 meters or 10 minutes walking distance from the roads where on-street parking is prevailing. Based on this condition, using Google Earth application, we find a common area for the selected roads. It represents the suitable space for building an off-street parking facility.
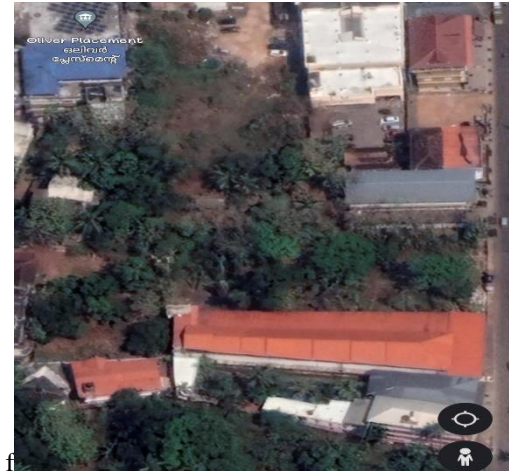

Figure 3

CONCLUSION

Traffic congestions are mainly created by traffic users by misbehaving in road and violating the rules. Congestion on Ettumanoor Kottayam route can be solved by providing proper width for road, avoid congested road side shops, provide parking area for vehicles, separate lane for heavy vehicles, proper signals, bypass roads etc. Parking should be restricted on the roads as it decreases the width of carriageway. By factor analysis we found that each factors contribute how much amount of congestion on road. Public transport should be increased to reduce gridlocks and accidents. The selected area for providing parking system is more efficient to reduce the traffic block and accidents

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