

# A Case Study of Atomised Multi Level Parking

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**Abstract**— Transportation is regarded as the lifeline of a country through which a country or specific region would communicate with rest of the world. A major proportion of development of a region is owed to the transportation system of that region. Our city is in the stage of development. Many fields of infrastructure, technology and applied sciences have developed to a notable extent which some of them are in the developing stage. Proper nurturing and planning of these processes will lead to development while an unplanned progress may yield benefits but these may be short term. One such concern in our city is the increasing pace of private transport. It is no doubt a progress but needs properly planned resources to go well. With the increase in the volume of private transport, the city has entered into developmental phase but to accommodate the progress proper planning is to be done. At present, city is facing acute problems of traffic congestion due to insufficient road area, especially in the Central Business Development Areas (CBD) such as Lal Chowk. A major factor in this regard is the shortage of sufficient parking in these areas. The local businessmen thus reside to street parking which renders roads inappropriate for efficient drive. The motive of this project is to initiate a series of developments by introducing first of its kind in the city, Multi-Level Atomized Parking Concept. As a result of this more cars would be accommodated in less space. This will relieve the CBD roads from street parking besides generating revenue.

**Key words:** Multi Level Parking, Central Business Development (CBD), Automated Parking

## I. INTRODUCTION

Transportation is essential for any nation's development and growth by facilitating trade, commerce, and social interaction, while consuming a considerable portion of time and resources. Traffic congestion is becoming a serious problem. Therefore, there is a pressing and growing need to measure congestion levels in a consistent manner. Many organizations and agencies exist to plan, design, build, operate, and maintain transportation systems. The movements of people and goods, which is the basis of transportation, has always been undertaken to accomplish those basic objectives or tasks that require transfer from one location to another. The main purpose of Multi Level Parking is to maximize car parking capacity by utilizing vertical space, rather than expand horizontal.

The present transportation system is inadequate with only 3% of the area under transportation as against 10 - 14% in metro cities. The major problem associated with transportation is traffic congestion in the main market area. Due to this, on street parking has been found on major roads. Approximately half of the road space is being used for parking.

Srinagar like any other historical city has a very complex road network. The present urban transportation

situation in the city is unorganized. Usage of private transportation is predominantly observed in Srinagar like other major cities in India. Registration of vehicles in Srinagar District shows a significant growth in private transport.

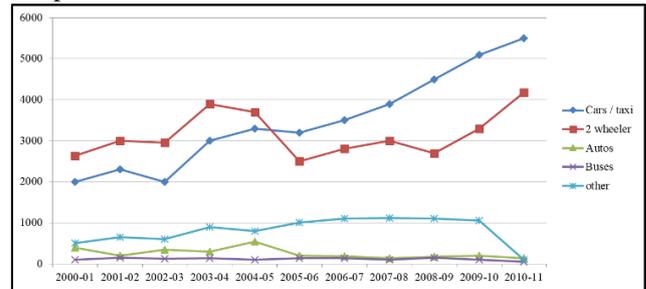


Fig. 1: Number of vehicles registered in Srinagar (Source RTO) 2016

## Types of Parking Systems.

The various Parking System Types:

### 1) Conventional Surface Parking.

- a) On Street.
- b) Off Street.

### 2) Multi-level Parking.

- a) Multi Floor Conventional.
  - 1) Ramp Based.
  - 2) Lift based
- b) Mechanised.
  - 1) Automated Multi Level.
  - 2) Puzzle.
  - 3) Tower.
  - 4) Mechanised Multi Level.
  - 5) Rotary.

### B. Conventional Multi-Level

Conventional multi-level parking system can be underground, above ground or both under and above ground structure. The above ground structures are usually Open Deck parking structures. The open parking structure is preferable as it does not require mechanical ventilation and specialised fire protection systems. The design for conventional multi-level parking includes entry and exit ramps or car lifts. The conventional system also require circulation space between vehicles and car park area.



Fig. 2: Conventional Multi Level Parking System. Source (Internet)

In the case of manual MLCP's the car is to be driven in and parked in available slots. Conventional MLCP's generally consumes greater area because of circulation space of the vehicles.

### C. Automated Multi Level Parking

Automatic multi storey car parks provide lower building cost per parking slot, as they typically requires less building volume and less ground area. However, the cost of the mechanical equipment within the building that is needed to transport cars internally needs to be added to the lower building cost to determine the total cost. Other costs are usually lower too, for example there is no need for an energy intensive ventilating system, since cars are not driven inside and human cashiers may not be needed.



Fig. 3: Automated Multi Level Parking System. Source (Internet)

Cars parked in steel pallets and a target pallet comes up or down to the driveway level at the press of a button, for parking or retrieval. This system is very expensive. The driver leaves the car in an entrance module. It is then transported to a parking spot by a robot trolley. For the driver, the process of parking is reduced to leaving the car inside an entrance module.

With mechanical parking system the cars are moved by machines. No one is opening doors into the parking cars. This reduces the nicks and scratches normally received from the parking. The engines do not run after they enter the parking facility, which significantly reduces pollution.

There is also increased safety as there is no need for anyone to go into a dark garage. The modern computer operated parking lots of today are extremely reliable, cost effective, safe and environmentally friendly. Proper system selection is the most important phase of design.

#### 1) Advantages

- Fast retrieval time, generally within two minutes.
- Very much safe and reliable with safety sensors and optional automatic gate.

The maintenance cost for an automated system is high as it will require power backup as well as fire extinguishing systems in place in case of power cuts or ignition due to the electrical systems which are constantly running. Further although wait time for an automated system may be zero, during loading and unloading waiting for those in line as compared to a manual parking facility where the loading and unloading can take place at the bay.

## II. TYPES OF AUTOMATED PARKING SYSTEMS

Automated system may be of different types as discussed below:

### A. Puzzle Type

The latest in automated parking system is the puzzle car parking style. A simple steel palette is responsible for its movements and it can easily be moved from right to left and vice versa. They are easy to operate. The biggest advantage of this car parking application is that it is tailored to suit most parking spaces underground or above ground. Car parking lifts are new but are proving to be very practical especially for congested places that do not have enough parking spaces.

#### 1) Advantages

- Operation is simple.
- Fast retrieval time, generally within 2 to 5 minutes depending upon the no of floors and cars in a row.
- Extremely safe and reliable with safety sensors.

### B. Elevator Type

The elevator type often called the Parking Tower is designed to automatically move the vehicles on a pallet vertically on the elevator; it then transfers it horizontally left or right for storage. Very fast retrieval time is accomplished in less than two minutes. This system is suitable for medium or large scale buildings. It can also be used as standalone tower for a parking garage business. Its operation is very user friendly.

#### 1) Advantages

- Minimal land use. An area of 25 mtr x 22 mtr can park up to 72 vehicles.
- Low noise and vibration.
- Entry and exit is very quick and convenient.
- Incorporate a built in turntable on the elevator.
- Retrieval time is less than two minutes.
- Completely equipped with multiple sensors and safety devices.

### C. Multi Floor Parking Type Circulation

After entering the vehicle in the parking garage, the parking system is designed to move the vehicles vertically with elevators on each end. The garage consists of several levels where the vehicles are moved horizontally which rotate the pallets in conjunction with the elevators. The multi floor circulation type is suitable for small and mid-sized buildings because of its high space efficiency.

#### 1) Advantages

- With eight times the space efficiency of a ramped garage, this system can use the narrow basement spaces to its maximum capacity.
- Up to six levels can be equipped with this new technology.
- With the upper entrance design, it is convenient because the built in turntable allows for easy entry and exit.

### D. Rotary Type

The perfect solution to park the maximum number of cars in the least amount of space. There is no need for a parking attendant, just insert the key and press your parking space number and the pallet will rotate either clockwise or counter

clockwise. It will automatically sense which way to rotate by space number.

1) Advantages

- Up to 12 vehicles can be accommodated within the space normally taken up by two vehicles.
- It is not applicable by the regulations of building coverage.
- There is no need for an attendant because of its simple one touch operation method.
- Senses where vehicle is closer and rotates bi-directionally for fast retrieval time.
- Extremely safe and reliable.

III. OBJECTIVE

- Decongestion of traffic in Lal Chowk Area.
- Reduction of on street parking.
- Providing safe, secure and efficient vehicular circulation inside as well as outside.
- To offer greatest possible flexibility for the realization of optimum parking solution.
- Time-saving vertical and horizontal movements take place simultaneously ensuring fast parking and retrieval times.
- To provide lower building cost per parking slot, as they typically require less building volume and less ground area than a conventional facility with the same capacity.

IV. STUDY AREA & METHODOLOGY

KMDA ADDA is located at Lal Chowk to the north of MA Road. Approximate area currently available 3471.75 sq. mt. This is an appropriate place for parking facility for Lal Chowk market area. In preliminary design, multi-level semi-automatic parking is proposed at this site to accommodate 288 vehicles.



Fig. 4: Satellite View of KMDA ADDA (Source: Internet)

A. Studies & Analysis – Vehicular Traffic & Parking

Parking and traffic surveys are essential for the estimation of parking demand hampering traffic movement in the CBD.

1) Survey Methodology

Parking survey was under taken by ERA at 10 identified locations in Srinagar CBD. Speed and delay survey was also conducted for the assessment of parking impact on travel characteristics. The survey results were analysed to arrive at parking demand in the CBD.

2) Speed and Delay Survey

This study evaluates the quality the of traffic movement along a route and identifies the location, cause and extent of the delays. This allows the planners to develop improvements. It

can also be used as a tool to compare the pre and post effects of any improvement.

Speed & Delay Survey was conducted on Residency Road and M A Road for the assessment of impact of parking on traffic movement. The survey was conducted during peak hours of parking as well as during time when there was no parking.

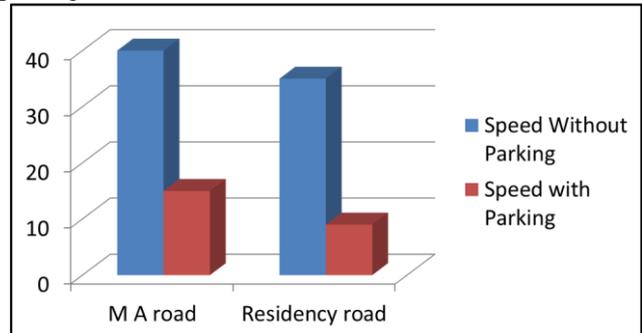


Fig. 5: Speeds on Main Roads of CBD (Source RTO) 2016

B. Parking Survey

Both on street and off street parking was conducted in the influence area to know the total parking on the project area. Parking was conducted for 16 hours on a typical working day. Both on and off street survey was conducted on 10 locations:

Location No.	Name of Road
1.	Opposite Biscoe School
2.	Opposite Biscoe School Parking (SUMO)
3.	Polo Ground Parking
4.	Sheikh Bagh Parking
5.	Old State Motor Garage Parking
6.	KMDA Parking
7.	SBI Bank to Lal Chowk
8.	Taj Hotel to Central Telegraph Office
9.	Lal Chowk to Zero Bridge
10.	SBI Bank to Zero Taxi Stand

Table 1: Parking Accumulation at Various Locations.

Parking Accumulation for an on street parking area for a time period is taken as the number of vehicles present at the parking place in that period. For an off street parking site, parking accumulation is the no. of vehicles present in a parking area at any time. Peak parking accumulation at various locations has been presented

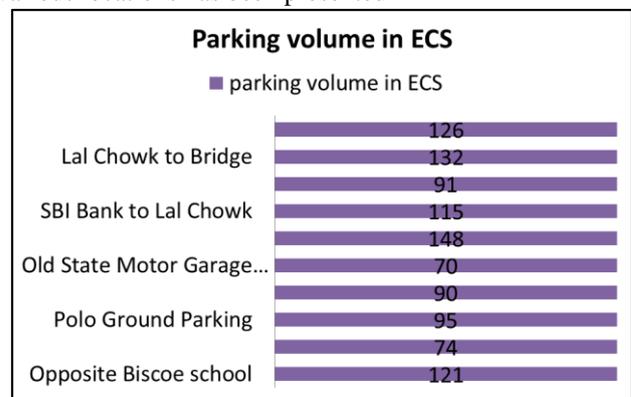


Fig. 6: Parking Accumulation at Various Survey Locations of CBD (Source RTO) 2016

Location No.	Name of Road	Side	Time	Peak Parking			Peak Parking Accumulation Equivalent Car Spaces	Parking Type
				Car	Two Wheeler	Cycle		
1	Opposite Biscoe School	-	1130-1200	97	24	0	121	Off
2	Opposite Biscoe School (Sumo)	-	1200-1230	74	0	0	74	Off
3	Polo Ground	-	1130-1200	78	17	0	95	Off
4	Sheikh Bagh	-	1100-1130	65	25	0	90	Off
5	Old State motor Garage	-	1200-1230	70	0	0	70	Off
6	KMD parking	-	1400-1430	140	8	0	148	Off
7	SBI bank to Lal Chowk	Left	1000-1030	99	16	0	115	On
8	Taj Hotel to CTO	Left	1300-1330	64	21	6	91	On
9	Lal Chowk to Zero Bridge	Both	1230-1300	113	19	0	132	On
10	SBI bank to Zero taxi stand	Left	1600-1630	101	23	2	126	On
Grand Total				901	153	8	1062	

Table 2: Parking Accumulation at Areas surrounding CBD Area (Source RTO) 2016

C. Overall Parking Accumulation in CBD

Overall Parking Accumulation is taken as the number of vehicles present at the parking place in that period at on street and off street parking sites. The overall accumulation of vehicles in the area has been presented in the table:

Time	Car	Two Wheeler	Cycle	Total
0600:0630	25	07	00	32
0630:0700	45	10	00	55
0700:0730	70	14	00	84
0730:0800	110	22	1	133
0800:0830	162	38	6	206
0830:0900	243	56	4	303
0900:0930	297	76	6	379
0930:1000	382	69	7	458
1000:1030	472	86	5	563
1030:1100	557	95	1	653
1100:1130	617	117	4	738
1130:1200	725	123	5	853
1200:1230	752	107	4	863
1230:1300	732	100	8	840
1300:1330	717	99	6	822
1330:1400	666	83	4	753
1400:1430	634	101	2	737
1430:1500	597	100	1	698
1500:1530	595	106	4	705
1530:1600	492	92	5	589
1600:1630	487	88	6	581
1630:1700	473	95	5	573
1700:1730	453	76	2	531
1730:1800	461	86	4	551
1800:1830	465	72	2	539
1830:1900	431	61	2	494
1900:1930	333	58	2	393

1930:2000	236	40	2	278
2000:2030	181	32	1	214
2030:2100	212	19	0	231
2100:2130	70	15	0	85
2130:2200	32	10	0	42

Table 3: Overall Parking Accumulation in CBD Area (Source RTO) 2016

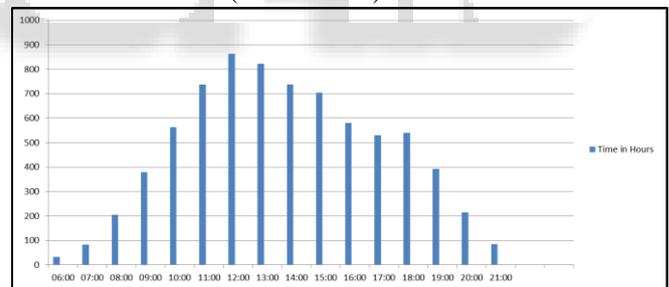


Fig. 7: Overall Parking Accumulation in CBD Area

V. FUTURE PARKING DEMAND

A projection is done for a period of 10 years of operation of parking facility which results as below. Creation of new parking facility in a very congested area will attract induced demand. A normal 10 % growth and 15% induced growth is assumed and estimated demand is presented below.

VI. RESULT

As mentioned earlier, due to scarcity of space in CBD area, Puzzle Parking System is the obvious choice. One such system will be constructed at KMDA ADDA. The proposed facility is designed as Multi Story Electro Mechanical Puzzle Parking with total capacity of 288 car spaces.

The proposed facility will only accommodate on street parking demand of M.A Road, Residency Road and existing parking demand of KMDA Parking. Other major

parking places i.e. Polo Ground, Sheikh Bagh and Old State Motor Garage will meet the additional parking demand.

In preliminary design, multilevel parking is proposed to accommodate a minimum of 288 parking spaces at KMD ADDA.

The multi-level puzzle type parking system will be up to four levels; resulting in multi-layer parking solution with a single drive lane. It is designed to allow multi-level storage spaces above ground with user friendly operation and ease of maintenance. It will be fully covered especially for extreme hot and cold areas and designed according to the user requirements with parking positions for different cars. The storage and retrieval of cars within the system is done on the ground floor with a user friendly control panel to retrieve the stored cars from higher levels.

## VII. CONCLUSION

It is expected that the proposed project will significantly reduce traffic congestion; traffic jams due to unauthorized road side parking by providing adequate parking facilities in core city areas. This will also result in decreased noise levels and vehicular exhaust due to smooth traffic flow leading to better environment quality in the project area. On the basis of the IEE, it is expected that there will be no significant negative environment impacts and hence no additional study is required. To conclude, the project will have overall beneficial impacts, after completion, in terms of parking facility in the project area. Therefore, on the basis of available information, field visits, discussions with the project sponsors, local people and various government officials, it has been concluded that overall all elements of the sub - project will be beneficial. No comprehensive, broad, diverse or irreversible adverse impacts have been identified. All negative impacts, during construction could be properly mitigated.

The benefits from the implementation of the project will be:

- Decongestion of traffic.
- Reduction in delay and time saving.
- Enhancing public safety & security.
- Strengthening attractive and image capacity as an economic location factor.
- Improvement in the road efficiency.
- Visually comforting urban image & identity.
- Improves infrastructure.

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