

SUMMER TRAINING...2005

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Mathura Road
New Delhi - 110020



SWENA GULATI

BP/351

crri



CRRI AT A GLANCE....



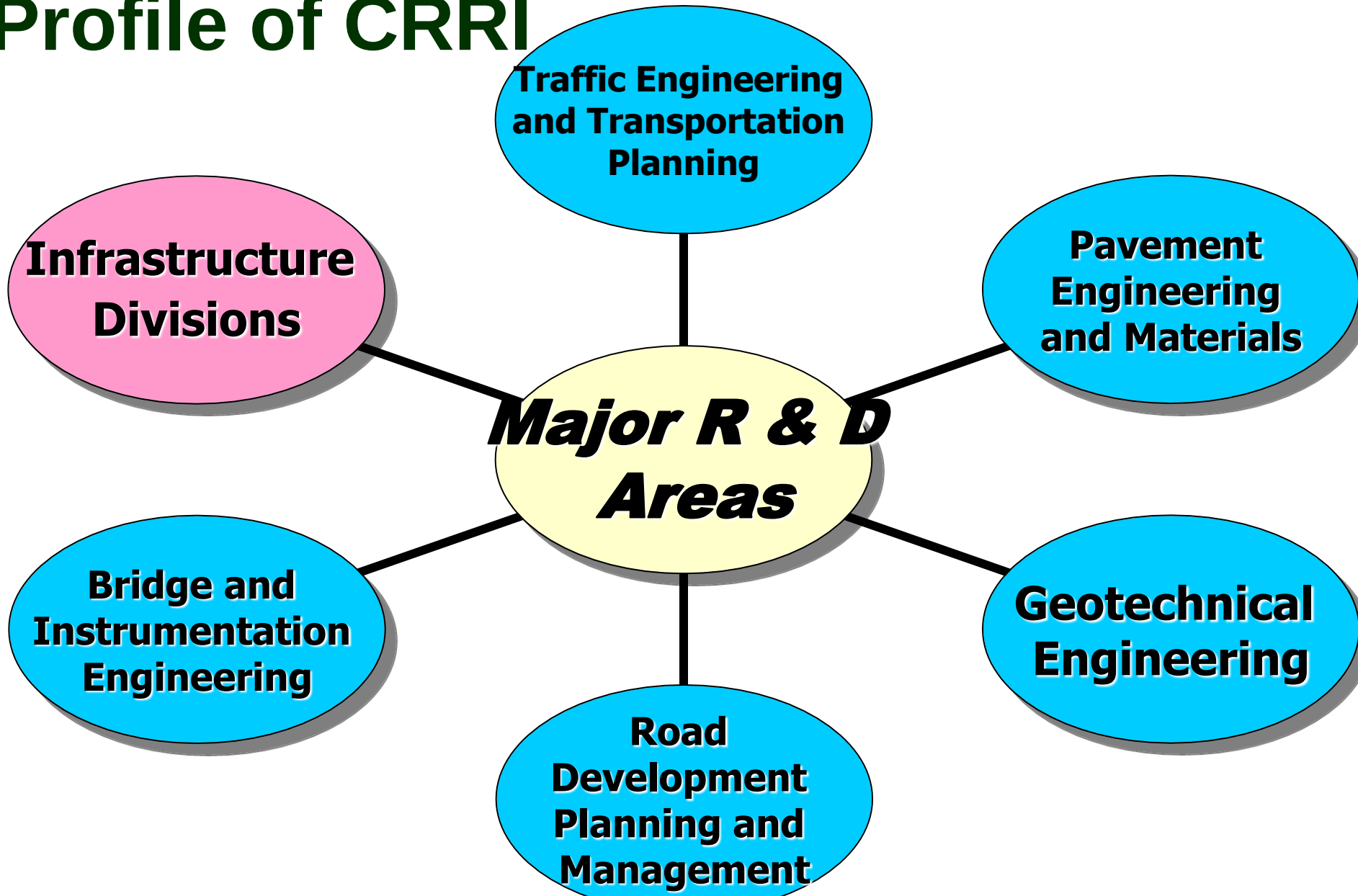


CRRI status in Road Transport sector

- **Crri established in 1852 as a constituent Laboratory of the CSIR**
- **Advanced R&D Based Knowledge Bank**
- **Close Links with User Agencies**
 - Ministries of Central & State Govt.
 - State PWD's
 - Public and Private Sector Agencies
- **International Collaboration & Linkages**
- **Major Contributor to**
 - BIS Standards and Specifications
 - IRC Standards and Specifications



Profile of CRRRI





Broad Areas of R&D related to Traffic and Transport Division

Traffic Engineering and Transportation Planning

Transportation Planning and Policies

- Demand Modelling
- Mode Choice Analysis
- Route Choice Modelling
- Planning & Evaluation of Transport Systems

Transportation Economics

- Road User Costs
- Cost-Benefit Analysis
- Risk and Uncertainty Analysis

Transport Environment

- Noise and Air Pollution
- Air Pollution Monitoring and Modelling
- Environmental Impact Assessment



Broad Areas of R&D related to Traffic and Transport (*Contd..*)

Traffic Engineering and Transportation Planning

Transportation Infrastructure Design

- Geometric Design of Highways and Streets
- Planning and Design of Intersections
- Planning and Design of Interchanges
- Design of Passenger Terminals and Interfaces
- Design of Freight Terminals and Allied Facilities

Transportation Systems Management

- Traffic Regulations and Controls
- Traffic Circulation Planning
- Transport Systems Priority Measures
- Parking Policies and Designs
- Area Traffic Control Systems

LITERATURE SEARCH ...

...ON VEHICLE PARKING





CONTRIBUTIONS TO THE PROJECT

- Detailed literature search on parking
- Data collection & surveys for 4 locations
- Preliminary data analysis & O–D mapping
- Preparation of report of the work which was carried on the project during summer training



NEED FOR PARKING

- Each mode of transportation involves three general elements for efficient operation : “ **Vehicle, Right-of-way, and Terminal** “ .
Terminals in terms of parking space demand their share of attention.
- Parking problems originate due to rapid population growth , with an increase in the number of motor vehicles
- Car is parked for 8360 hrs out of 8760 hrs in a year.
- Car requires about 30 sq m of space at the residence alone
- Usefulness or utility of a vehicle is greatly diminished if the accessibility to the vehicle is not very high.
- Increasing concentration of human activity on the limited land both in terms of residential activity and commercial activity causes the parking problem.



URBAN PARKING SYSTEM

TYPES OF PARKING SUPPLY FACILITY

ON-STREET

Curbside, Parallel to the road way
High turnover, Rapid access
Free parking , Fee paying
Reserve parking

SPECIAL PARKING

On street or Off street
Park and Ride
Shared Surface
Multi-storied Parking Structure

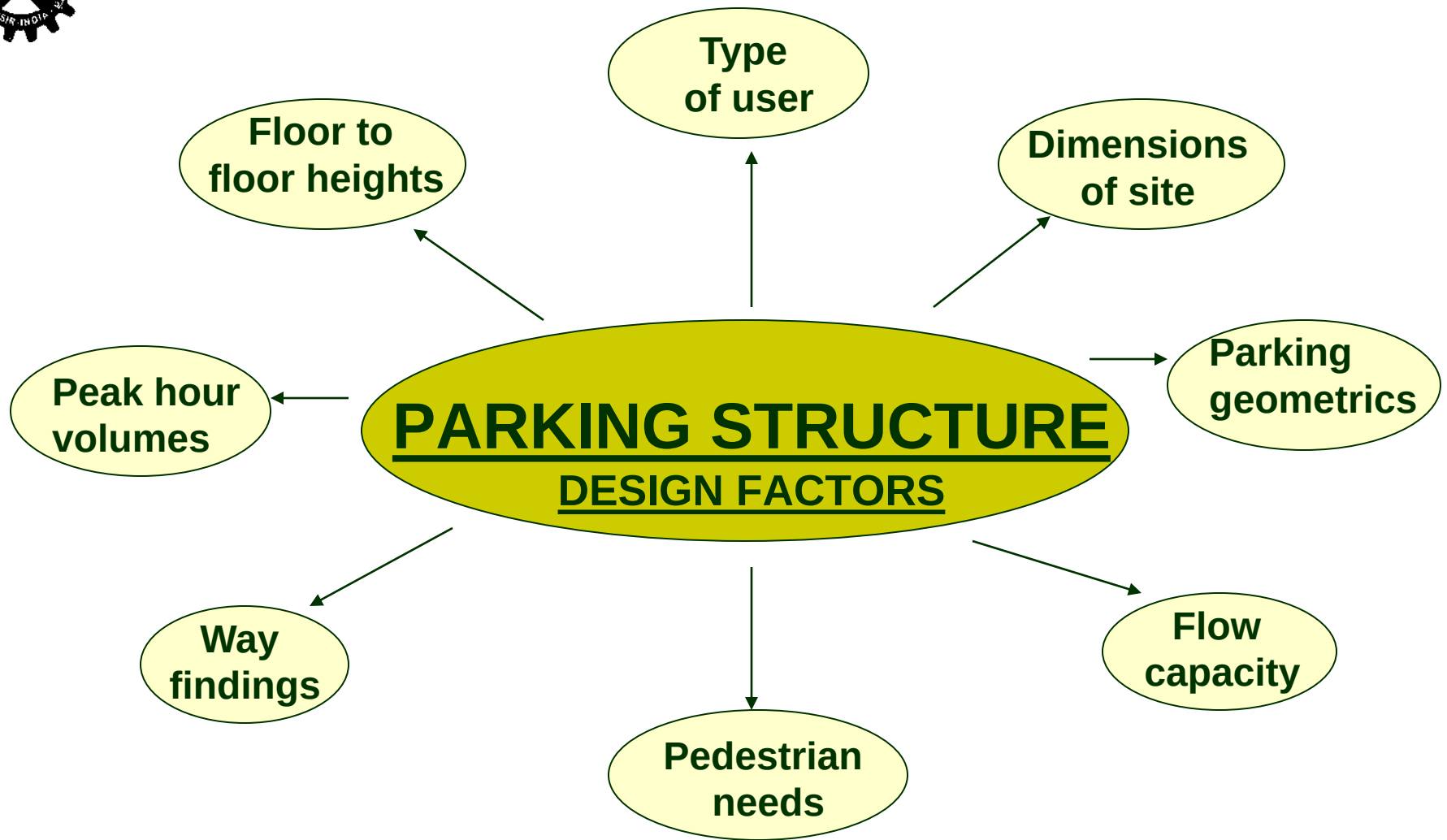
OFF-STREET

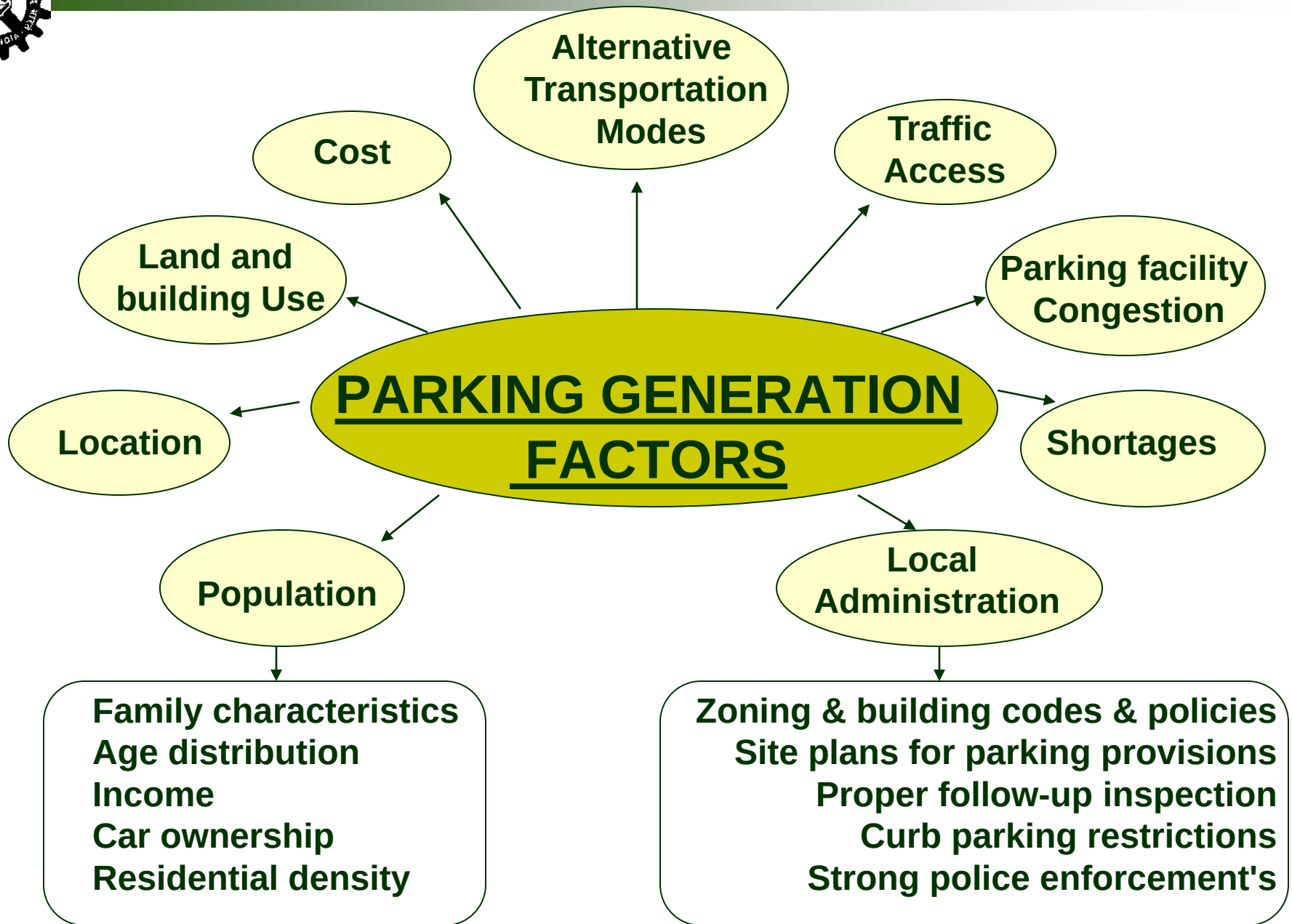
Surface parking lot,
Underground or elevated.
Free or fee paying



PARKING CHARACTERISTICS

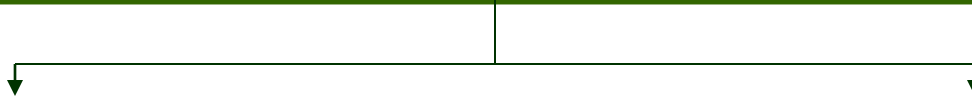
- **PARKING ACCUMULATION** - total number of vehicles parked in a given area at a specified moment of time.
- **PARKING VOLUME** - number of vehicles parked in a particular area over a given period of time.
- **PARKING LOAD** - area under the parking accumulation curve plotted for a given area during a specified time.
- **PARKING DURATION** - time spent by a vehicle in a parking space.
- **PARKING INDEX** - percentage of theoretically available number of parking bays to the total number of bays actually occupied by parked vehicles.
- **PARKING TURNOVER** rate of usage of available parking space.







PARKING MANAGEMENT



ECONOMIC STRATEGY PRICE VARIATION

**Levying Revenue Taxes
Parking Surcharges
Rate Regulations
Parking Licensing Scheme**

PHYSICAL STRATEGY

**Parking Prohibition
Operational Measures
Incentives to Encourage
Car Pools
Incentives to Encourage
Public Transport
Regulatory Measures**



PARKING SPACE STANDARDS

Parking space arrangement	area/space (in sqm)	possible no. of spaces/100sqm	possible no of spaces/100m of road
0-parallel to road. Entry & exit to parking bay difficult Suitable for narrow streets	22.7	4.4	17
30 - Angle to access road. easy entry to parking bay & Exit. Uses large area	26.3	3.8	21
45 - Angle to access road. Good entry to parking bay and exit. Relatively small area/parking Space. Normal type of layout	20.3	4.9	31
60 - angle to access road. Relatively good entry and exit to parking bay: small area/parking Space. Arrangement often used	19.2	5.2	37
Right-angles to road (parking access 2.5m wide) Sharp turn needed for entry & exit.	19.4	5.1	40
Right angles to road (parking Space 2.30m wide.)Small area needed/parking space. Ideal for compact parking layouts. Used frequently	19.2	5.2	37



PARKING POLICY ABROAD

LONDON

- The maintenance and improvement of public transport services.
- The restraint of the road traffic in congested areas.
- The management and improvement of the road system
- The harmonization of the land use and transport development.

VANCOUVER

- To provide metered curb parking on an central streets
- During rush hours curb parking is prohibited
- Off-street parking on the outskirts of the town-center to be provided
- Wherever the on-street parking does not affect the traffic flows, it is encouraged.

LEICESTER

- To remove certain uses from central areas
- Provision of interchange car parks on fringe of town centers
- Public transport in Town Centers to be encouraged
- Segregation of Long term and short term parking spatially

PERTH

- Less parking provision in Town centers The long term parking on the fringe areas of the town center
- The short term parking at the rate of one parking space per 50 Ha
- Parking provisions are to be guided as per the access from the arterial or subways.



PARKING POLICY IN INDIA

Comparison of various norms and standards formulated by different transport scientists; transport Agencies, Transport Authorities etc. for provision of parking spaces while constructing a new building.

COMPARISON OF VARIOUS PARKING NORMS					
Authority/Study Report	Parking Norms(in ECS per 100sqm of floor area)				
	Commercial Public	Retail	Banks	Govt offices public/s.public	Social Residential
Parking Demand for Different Landuses: a case study of Delhi-1971	0.37	1.85		1.11	2.77
New Delhi Area Development-1972		2.28			1.14
Master Plan for Delhi-1981		1.14			0.63
Master Plan for Delhi-2001			1.67		1.33
Recommendation for the provision of parking spcaes in urban areas-1988	1.4	1.25		1.4	1.25
Parking policy for a district:Nehru place-thesis report-1991	1.05	0.53		1.05	0.53
Parking study of selected areas in Delhi 1996-97 by CRRI		1.8		3.05	1.25



PARKING STUDIES IN DELHI

- School of Planning & Architecture, New Delhi (SPA), (from 1971-1991), (Including research work done in the school)
- Indian Roads Congress, New Delhi (IRC'), (1973);
- New Delhi Redevelopment Advisory Committee, NDARC, (1972);
- Delhi Development Authority, (First & Second Master Plan)
- New Delhi Municipal Corporation (NDMC) .
- Central Roads Research institute (CRRI), New Delhi,



FORMULATION OF POLICIES

- **PARKING POLICY** - package of Objectives, Strategies and Programs of action or a set of Measures for achieving desire objectives
- **INCREASING SUPPLY TO MEET DEMAND** - creation of additional off street parking lots by provision of the area to meet the surplus demand.
- **REDUCE DEMAND TO REACH SUPPLY**

Control of Vehicle Growth

Control of F.S.I., or F.A.R

By token Ride System

By Use of Meters

Pricing of a Road

Increasing Public Transport Share

By Car Pooling

Parking Fee

- At the registration time (High Taxes)
- High fuel price
- By control of spare parts and service by skilled men.

- Reduced hassle and fatigue from driving
- Reduced Commuting cost
- Reduced vehicle maintenance difficulties
- Reduced need to find parking
- Reduced Susceptibility to fuel shortage

PARKING STUDIES OF SELECTED LOCATIONS IN DELHI





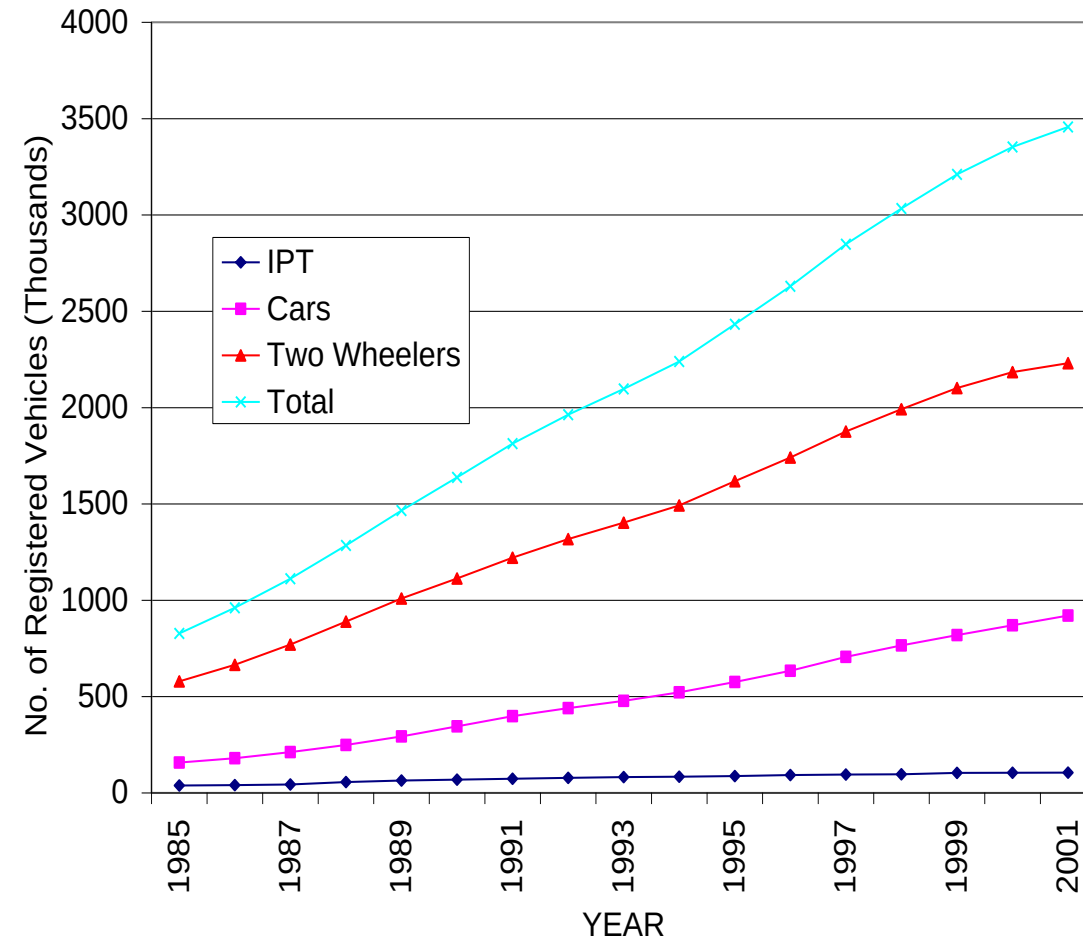
INTRODUCTION...

....GROWTH TRENDS OF DELHI POPULATION

....GROWTH TREND OF VEHICLES



GROWTH TRENDS



EFFECTS

- Higher travel demand
- More parking demand
- Declining ambient air quality
- Rising trend in road accidents
- Other traffic problems

ACTIONS TAKEN BY

- Traffic police
- Transport Dept
- NDMC
- DDA
- MCD

POPULATION GROWTH – 1.7 million in 1951 to 14 million in 2001

VEHICULAR POLLUTION - 4 lakhs in 1972 to 36 lakhs in 2001



SCOPE AND OBJECTIVE

SCOPE

- Study the parking characteristics in the commercial parking of

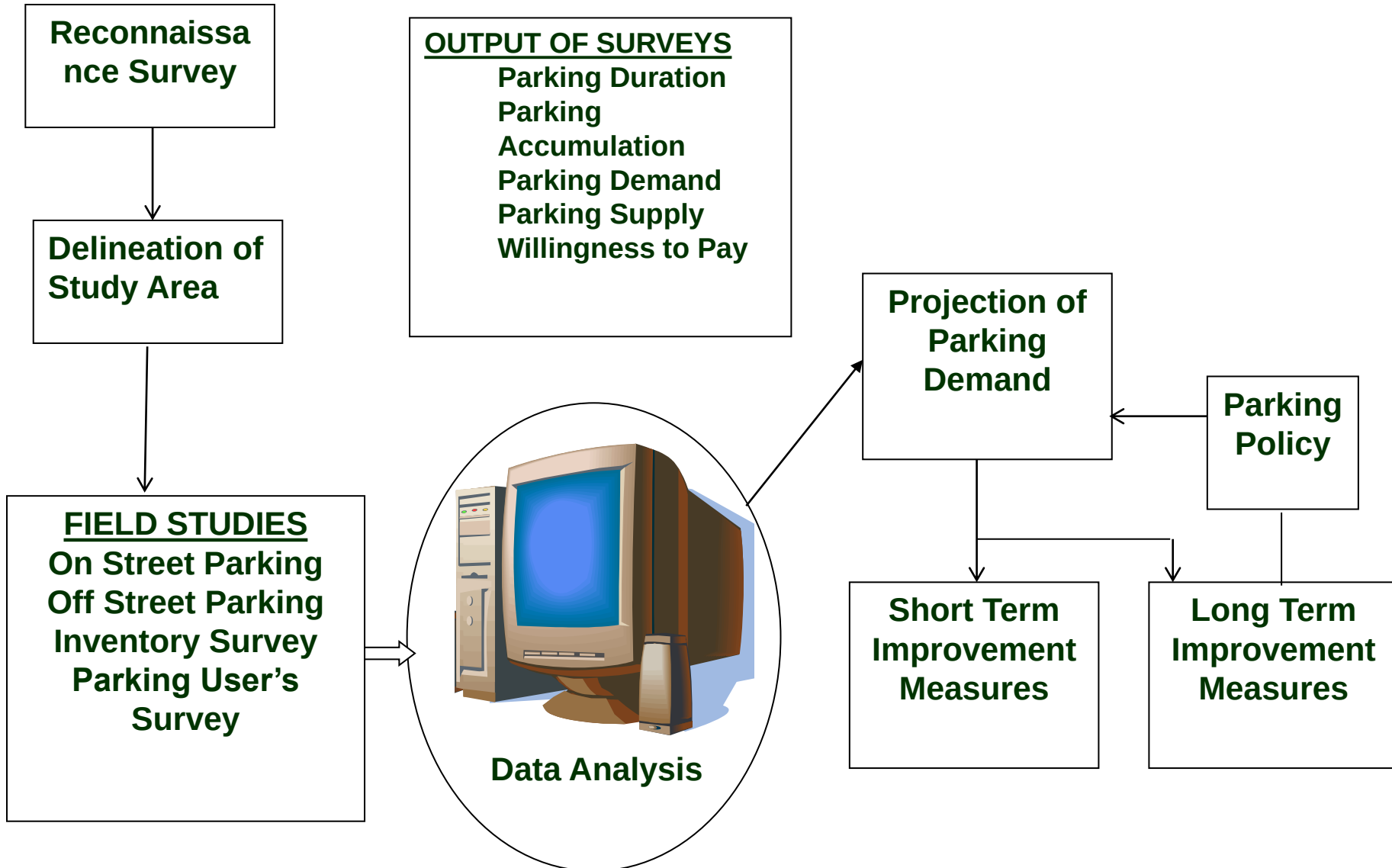
1. Nehru Place
2. Lajpat Nagar
3. Karol Bagh
4. Chandni Chowk
5. Sadar Bazaar
6. Kamla Nagar
7. Krishna Nagar
8. Ajmeri Gate
9. Darya Ganj

OBJECTIVE

- To quantify the parking demands
- To conduct necessary parking surveys to assess the parking characteristics
- To suggest suitable measures to reduce parking problems through controls, regulations and management.
- To assess future parking demand and suggest suitable policy and measures to manage it.

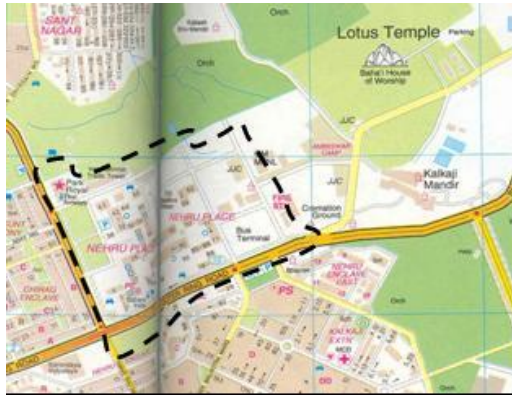


STUDY METHODOLOGY





Delineation of the study areas



Nehru Place



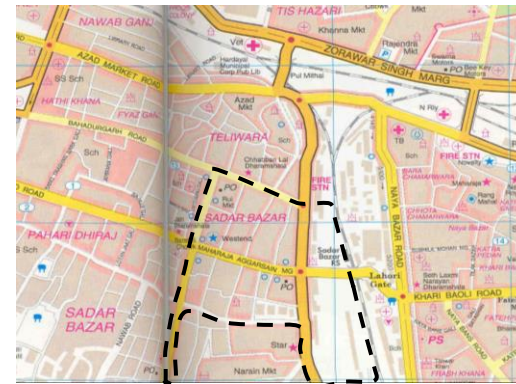
Lajpat Nagar



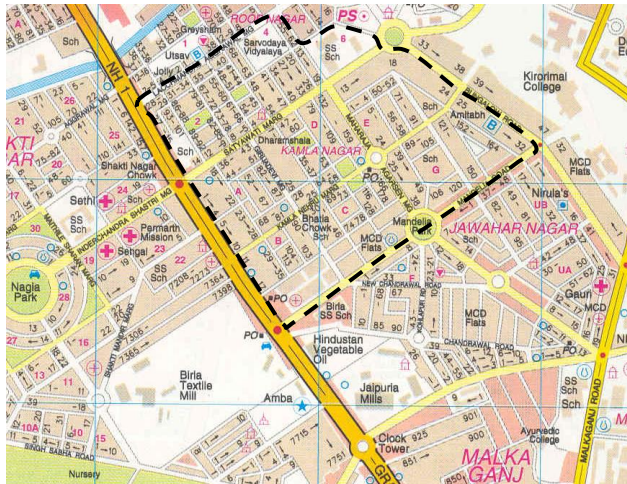
Karol Bagh



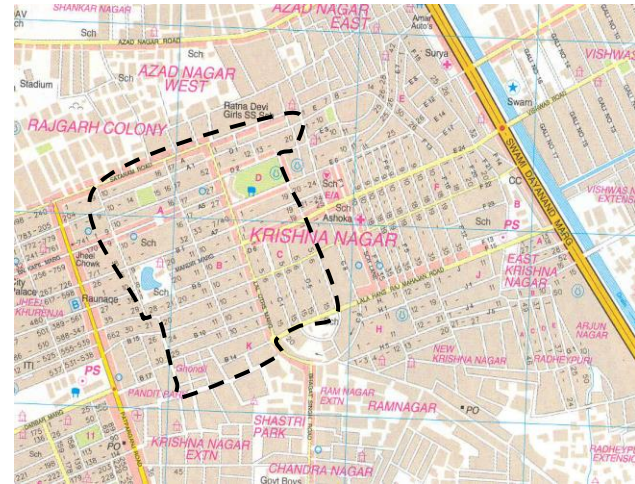
Chandani Chowk



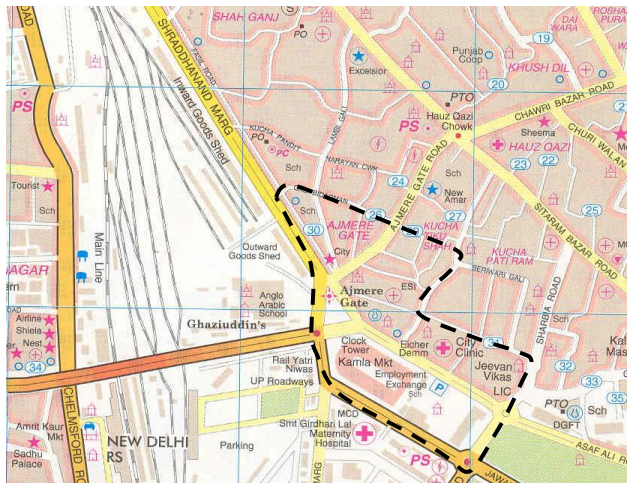
Sadar Bazaar



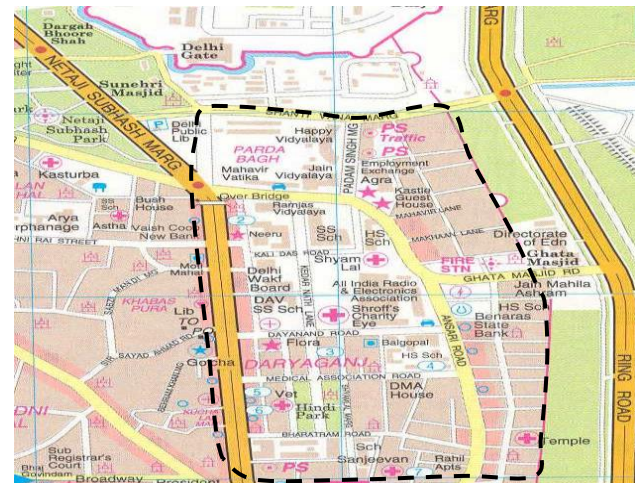
Kamla Nagar



Krishna Nagar



Ajmeri Gate



Darya Ganj



Study Methodology includes :

■ DELINEATION OF THE STUDY AREA

In consultation with Delhi Traffic Police and local authorities.
Considering **area of influence and the adjoining land use.**

INVENTORY SURVEY AND FIELD STUDY PLANNING

- Street parking lots area
- On-street parking lanes and length
- Road inventory
- Access to parking areas
- Land-use
- Inventory of buildings
- Commercial activities

■ PARKING SURVEYS

Parking accumulation and duration survey

To know the parking demand
& duration different vehicles

Parking User Survey

To know users perception of the
problems and aspirations
Origin and destination



■ DATA ANALYSIS AND INTERPRETATION

- Hourly variation of Parking demand
- Parking duration trend
- Perception of problem,
- Aspirations
- Catchment area of the study area

■ PARKING DEMAND FORECASTING based on

- Existing demand,
- Previous trend,
- Previous studies data,
- Population growth,
- Vehicle registration
- Commercial activities

■ PARKING MANAGEMENT PLAN - to reduce the parking problem and related traffic problems in the area

■ PARKING POLICY -appropriate parking regulations, control and management policies will be suggested for selected areas

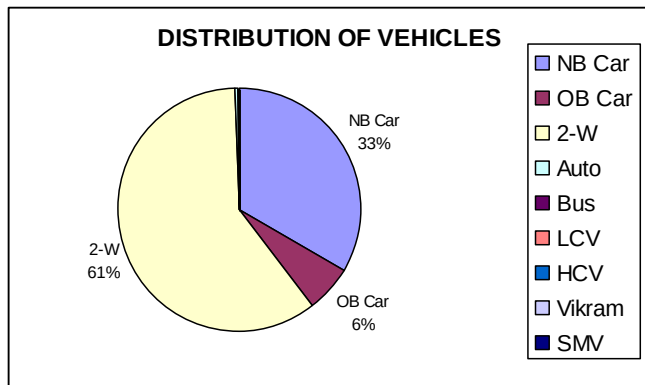


STUDY FINDINGS & ANALYSIS

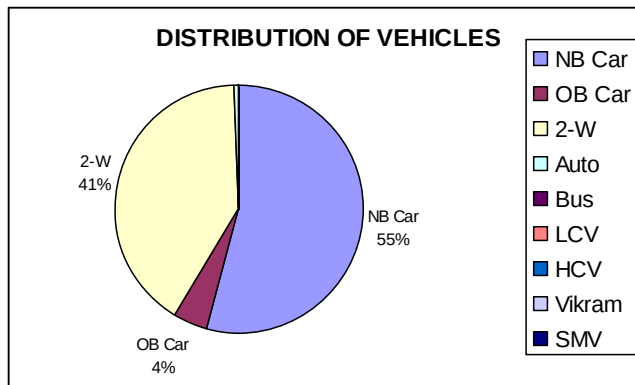
Parking user survey : O–D Survey
Parking Accumulation and Duration



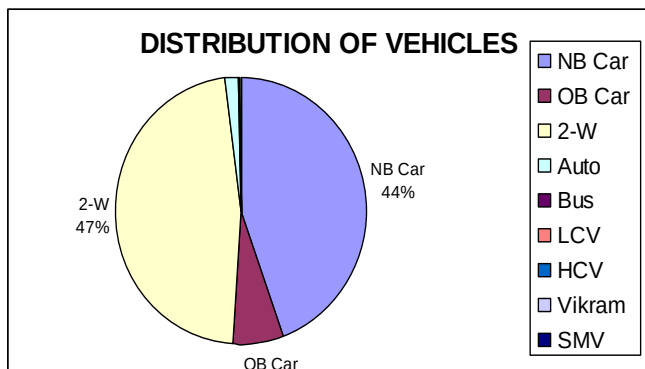
DISTRIBUTION OF VEHICLES AT ALL LOCATIONS



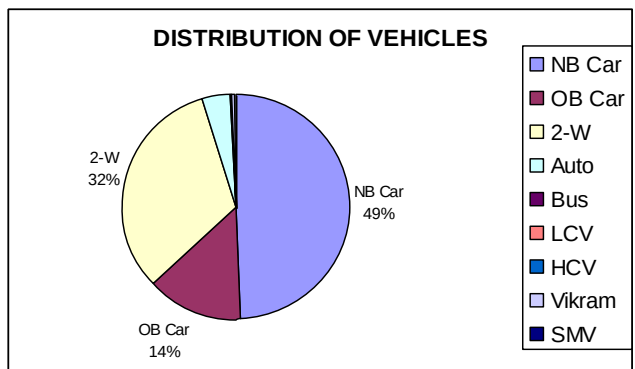
NEHRU PLACE



LAJPAT NAGAR



DARYA GANJ



AJMERI GATE

■ % of old cars is extremely low i.e. 5-10% of total cars.

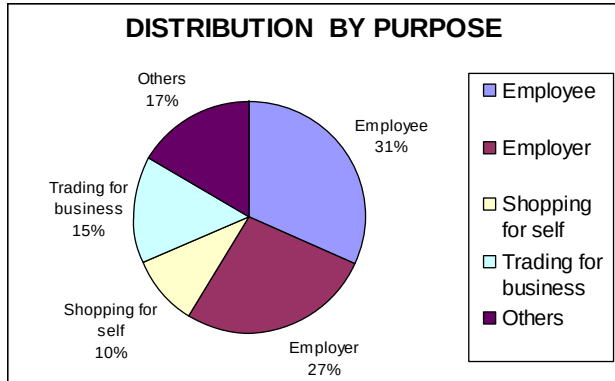
■ Old cars (15%) are mostly found in old Delhi area of Ajmeri gate.

■ % of heavy volume vehicles is very low and almost nil, and for short term parking only.

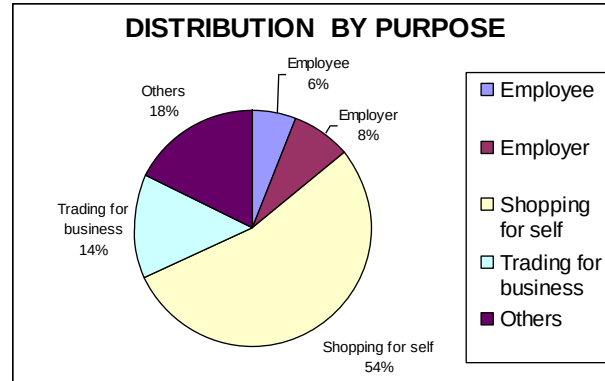
• Max. %age of 2-wheelers (61%) is found in Nehru Place which has a city level commercial activity and provision for cars and scooter parking separately.



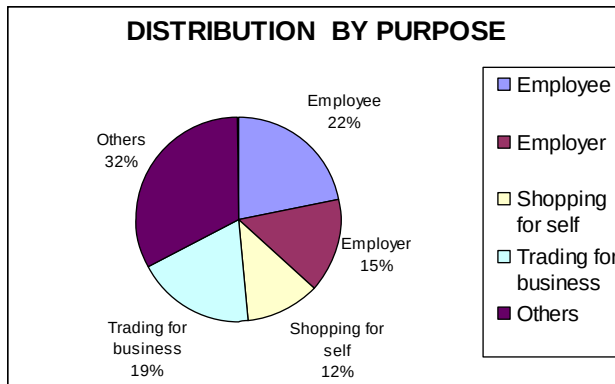
PURPOSE WISE DISTRIBUTION



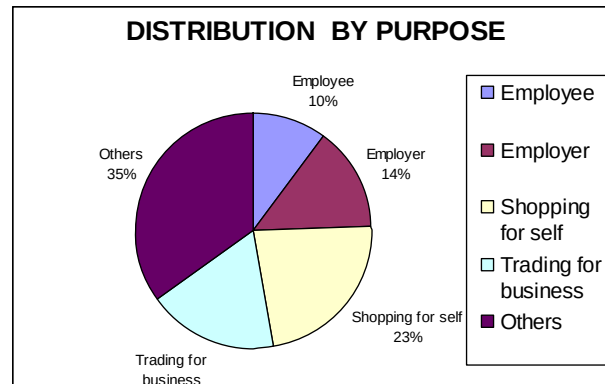
NEHRU PLACE



LAJPAT NAGAR



DARYA GANJ



AJMERI GATE

- Max. Parking space in Nehru place is taken by people working there for long term parking.

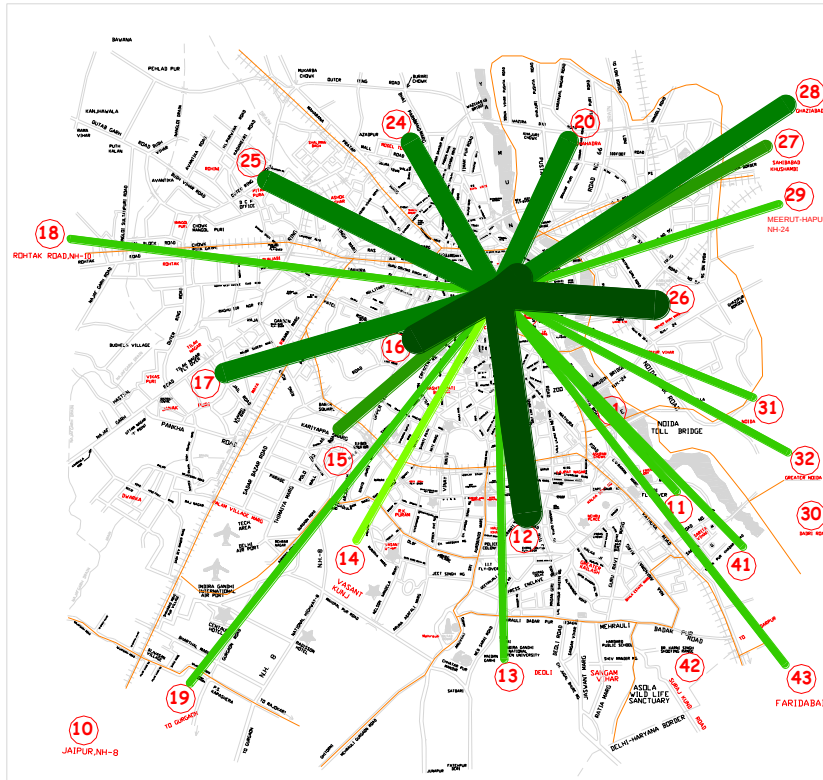
- People coming for shopping which is very less as 10%.

- Parking space occupied by shoppers mostly i.e.54% is found only in Lajpat Nagar

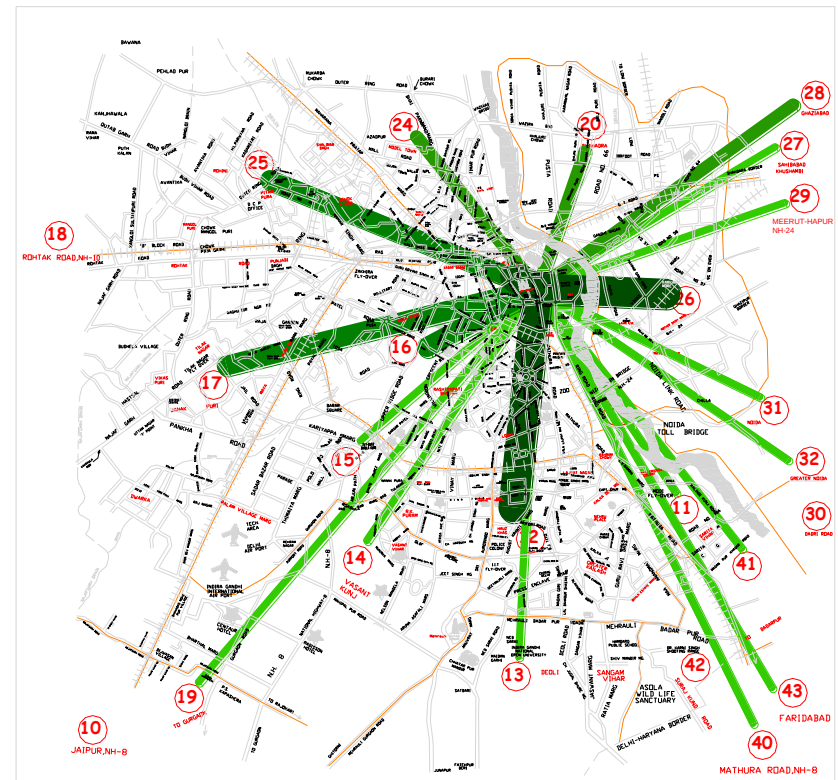
- People coming for business purpose are found almost same in all areas, about 15-20%



ORIGIN-DESTINATION DIAGRAM



NEHRU PLACE

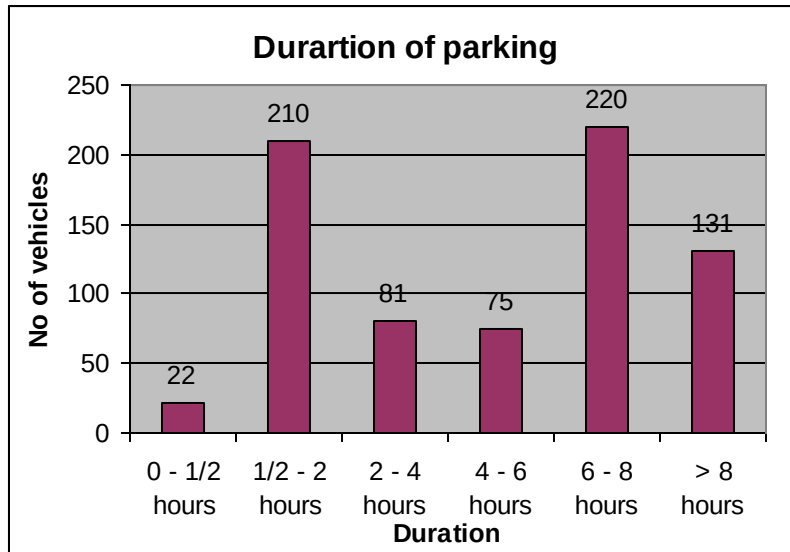


DARYA GANJ

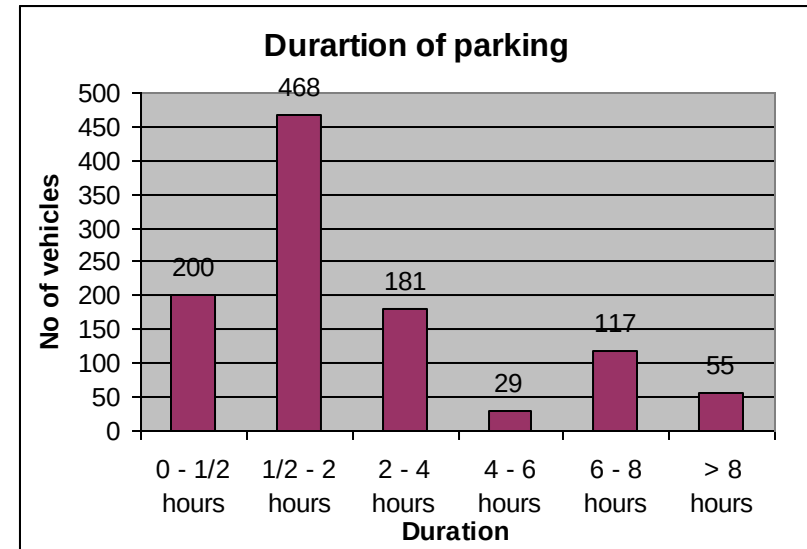
These diagrams represents the catchment areas of the different survey locations in Delhi



PARKING DURATION

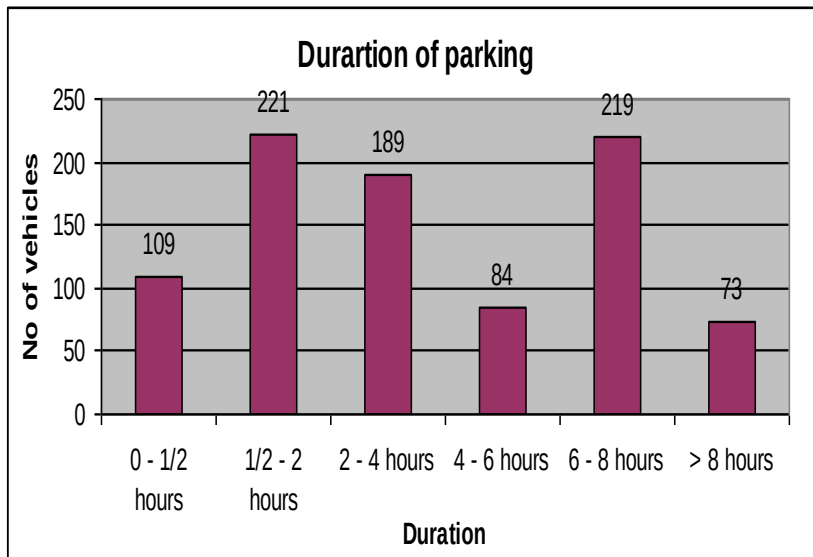


NEHRU PLACE

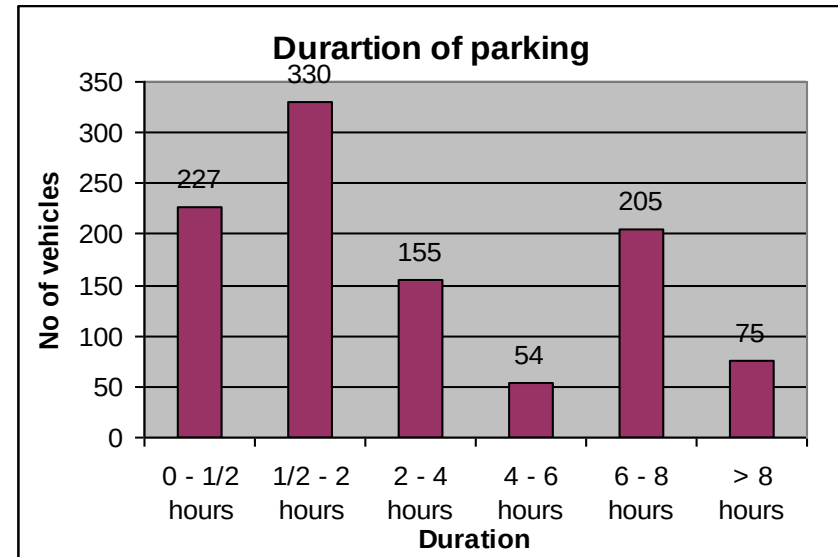


LAJPAT NAGAR

- Maximum percentage of vehicles for Long term parking (more than 6 hrs) is found out in Nehru Place, as it is taken by the people working there.
- Maximum percentage of vehicles for Short term parking, (up to 2 hrs) is found in Lajpat Nagar, major proportion which is taken by the shoppers.



DARYA GANJ



AJMERI GATE

• In old Delhi area of Ajmeri gate and Darya Ganj, vehicles are parked for short term, mid term as well as long term and not much remarkable difference can be seen. As the parking areas are equally taken by shoppers and shopkeepers



PARKING PROPOSALS

CONGESTION TAX - levied on vehicles entering specific areas ; for financing parking infrastructure projects and encouraging institutional finance for multi-level parking complex .

TAX ON SECOND CAR - imposition of an extra nationwide tax on those purchasing their second vehicle; be to discourage use of private vehicles

PARKING CHARGES - enable higher parking charges to be levied in particularly problematic areas

FINANCING PARKING INFRASTRUCTURE - collaboration with financing companies and developers to finance the parking infrastructure.

PLANNING & DEVELOPMENTAL CONTROLS - optimum utilization of land for enhancing parking spaces, eg-reducing the kerb heights of the pavements , Open areas used for underground parking.

PEOPLE'S CO-OPERATION - sense of discipline to obey traffic and parking regulations, eg-using parking meters, car free day.



CONTRIBUTIONS TO THE PROJECT

- Detailed literature search on parking
- Data collection & surveys for 4 locations
- Preliminary data analysis & O–D mapping
- Preparation of report of the work which was carried on the project during summer training

IMPACT OF CONGESTION ON FUEL CONSUMPTION & TRAVEL TIME





INTRODUCTION

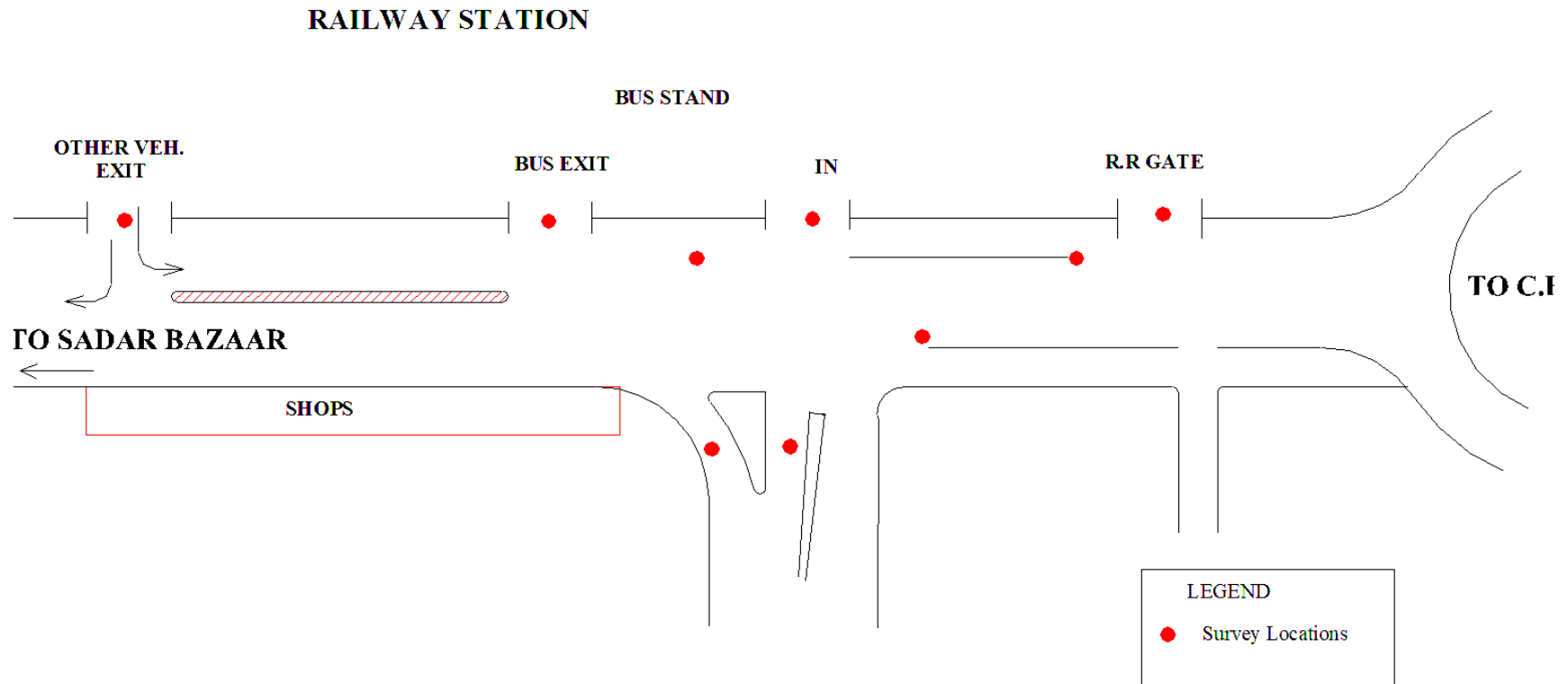
- Ill-effect of vehicular traffic movement & congestion
 - Pollution
 - Increased Fuel Consumption
- PCRA (Petroleum Conservation Research Association) has rightly decided to request CRRI to study this impact
- A study stretch of 1 km - Chelmsford road linking outer circle of Connaught Place to walled city was chosen .
- Problems faced
 - Heavy volume of vehicular traffic
 - Non-motorized traffic
 - Roadside encroachments
 - Haphazard on-street parking
- Need of
 - Traffic management measures
 - Mitigate the congestion & delay, fuel consumption & save travel time



STUDY STRETCH CHELMSFORD ROAD



Key Map showing Survey Points





SCOPE AND OBJECTIVES

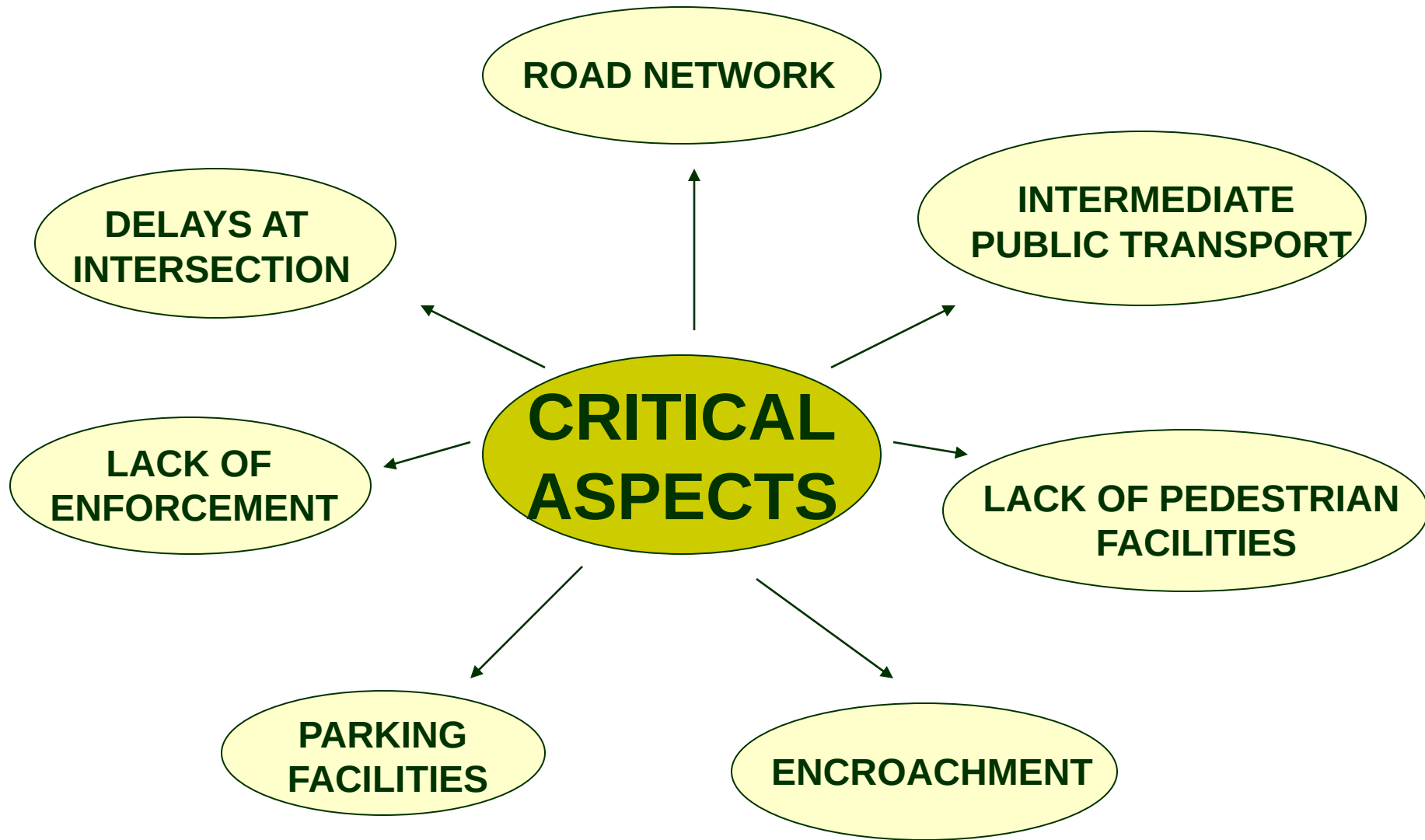
■ The objectives of the study are :

- To study the traffic characteristics of Chelmsford road
- Study the speed profile of traffic
- Monitor the fuel consumption of selected vehicles
- Evolve the relationship between operating characteristics and fuel consumption
- Suggest measures to improve the traffic operating condition and conserve fuel



STUDY AREA CHARACTERISTICS

- **Chelmsford road** - linking traditional (walled city area) with Modern Connaught Place area .
- **Caters to the needs of persons –**
 - Coming to New Delhi Railway Station & Railway Reservation Centre.
 - Commuting between Central Delhi & walled city
- **2 distinct stretches - on the basis of traffic composition, level of congestion and Infrastructure characteristics**
 - *Connaught place to the Basant lane intersection -*
 - Very little delays,
 - Service road on both sides
 - Less no. of non-motorized traffic
 - *Basant lane intersection to Deshbandhu Gupta flyover*
 - Frequent delays,
 - Heterogeneous mix of traffic.
 - Heavy movement of pedestrians





ROAD NETWORK

- Stretch of 150 meters the carriageway changes from 11.4m to 17.8m
- Service lanes on the sides & footpaths for pedestrians on basant lane(25m).
- The service lanes used for parking of buses & informal sector on footpaths.

❖ DELAYS AT INTERSECTION

- Due to turning movements with pedestrian traffic & non-motorized modes.

❖ PARKING FACILITIES

- IPT for tourists & other commuters in main bazar (basant lane)
- Absence of parking facilities outside the railway station premises.

❖ INTERMEDIATE PUBLIC TRANSPORT

- Don't follow any traffic rules and move on the carriageway even in the wrong direction, and cross the road even during red.

❖ ENCROACHMENT - Encroachment on footpath reduces the road capacity.

❖ LACK OF PEDESTRIAN FACILITIES

❖ LACK OF ENFORCEMENT



FIELD SURVEYS

- **TRAFFIC VOLUME COUNTS AND TURNING MOVEMENTS**
- **VEHICLE CLASSIFICATION-** classified into 19 categories
- **MEASUREMENT OF DELAYS** - for 24 hours. 2 runs per direction were made every hour
- **PEDESTRIAN VOLUME SURVEY** - counted at 4 locations, 2 across the road and 2 along the road
- **PARKING ACCUMULATION SURVEY** - done on both sides of the road at half an hour intervals



FUEL CONSUMPTION TEST

- In the present study fuel consumption tests at idling were performed by the use of flow detectors (FP Series) and flow meters CDF Project supplied by M/s. Ono Sokki, Japan
- Used to determine the fuel consumption of gasoline, light oil, Kerosene and general petroleum oils.
- FP 213S detectors DF 210A flow meters has been employed for two wheelers
- FP 214OH flow detector and DF 210 a flow meter has been employed for fuel consumption studies of four wheelers.
- For gaseous fuels like CNG and LPG (mostly CNG) separate studies were carried out for the vehicles.
- Mean values of average fuel consumption along with standard deviation values (i.e. mean + standard deviation value) was found out to give a fair idea of fuel consumed

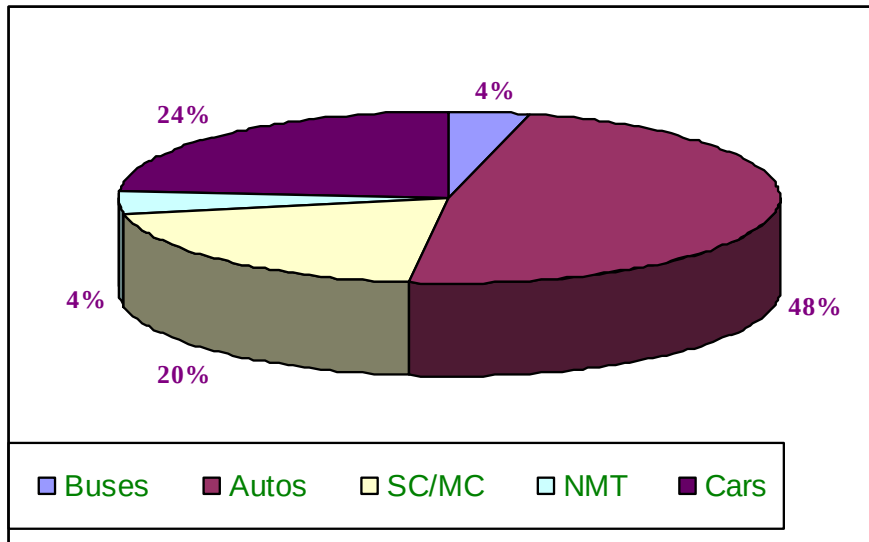
DATA ANALYSIS





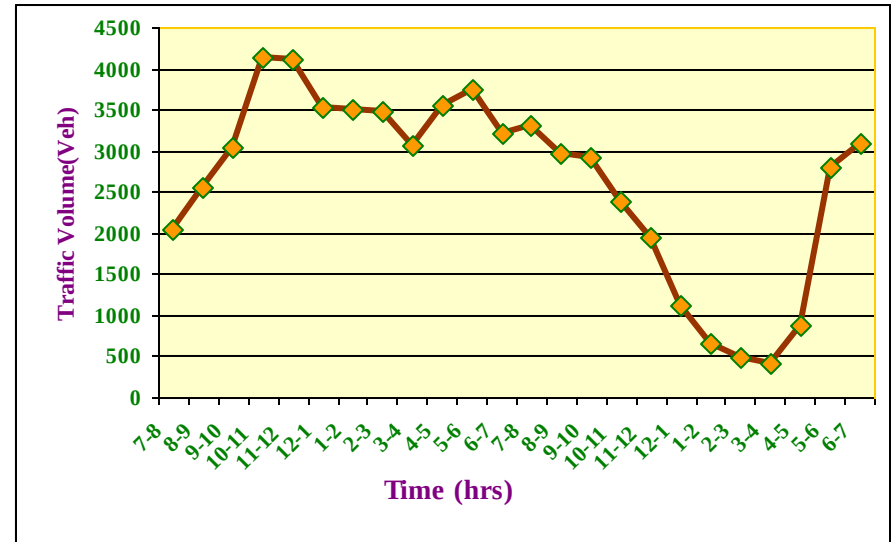
TRAFFIC VOLUME STUDY

■ Composition of traffic



**MAXIMUM %AGE -AUTOS 29692 (48%)
& BUSES AND CYCLE RICKSHAWS 4% EACH.**

■ Hourly variation of total traffic



**PEAK HOURS - 6 AM - 7AM , 10 AM -12 PM
4 PM - 6 PM**

■ Traffic Volume Distribution

Total Flow	Sadar Bazar-CP	CP-Sadar Bazar	Pahrganj to Railway Stn.	% Motorised veh	% Non M. vehicles
66365	35451	27441	3473	95	5



SPEED DELAY STUDY

Average Running Speed & Journey Speed

Direction	Avg Running Speed(km/h)	Avg Journey Speed(km/h)
CP-Paharganj	21.79	20.62
Paharganj- Sadar Bazar	14.29	13.60
Sadar Bazar - Paharganj	10.51	9.77
Paharganj - CP	27.98	27.50

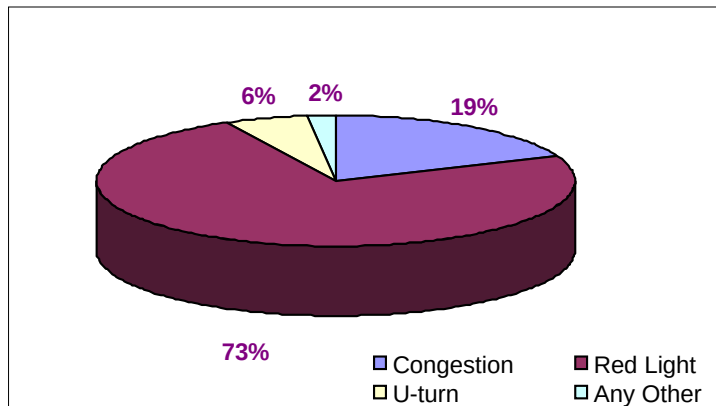
Average Delay

Direction	Average Delay (s/veh)
CP – Paharganj	40.169
Paharganj- Sadar Bazaar	11.909
Sadar Bazar – Paharganj	76.91
Paharganj – CP	10.42
Paharganj – Railway Station Entry Gate	69.704

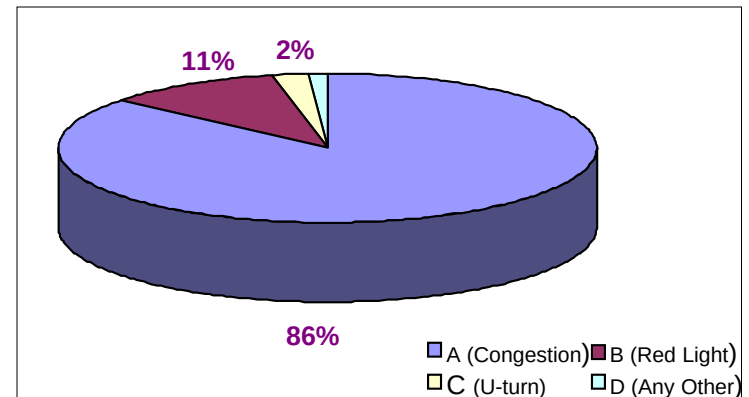


REASON FOR VARIOUS DELAYS

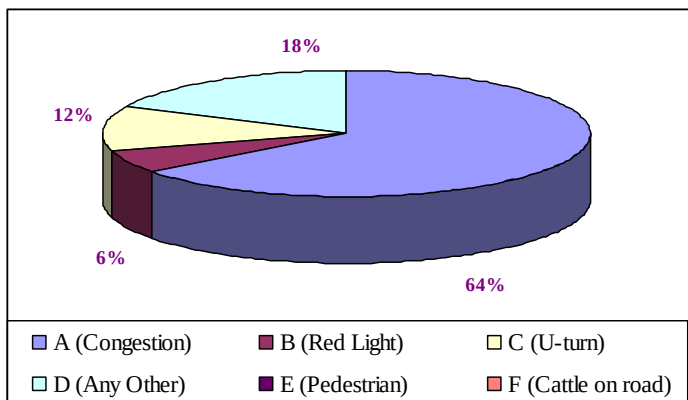
(Connaught Place to Paharganj)



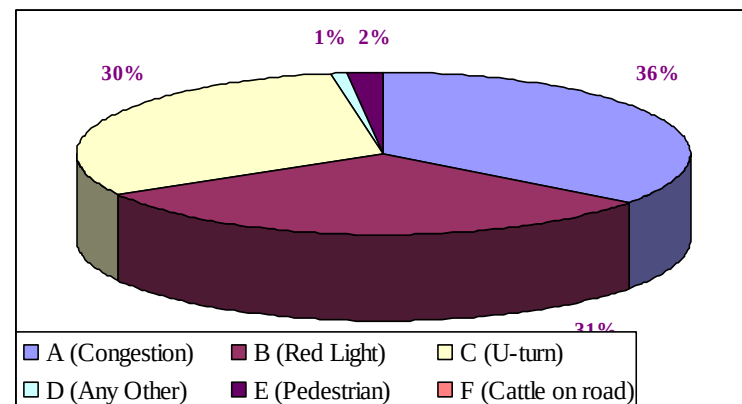
(Paharganj to Sadar Bazaar)



Paharganj to Connaught Place



(Sadar Bazaar to Paharganj)

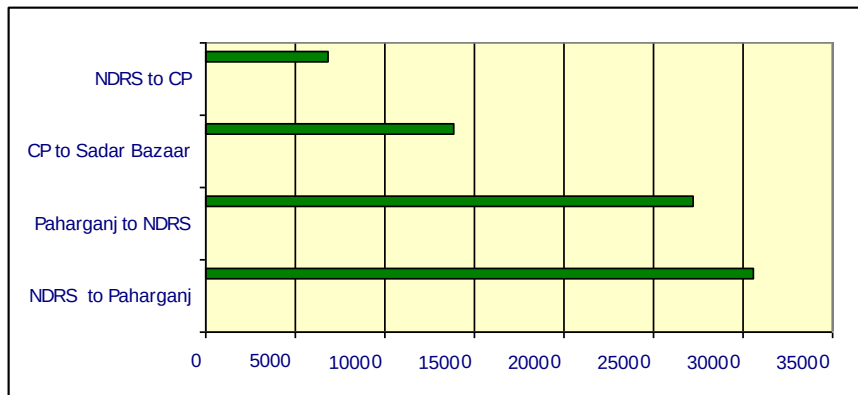




PEDESTRIAN & PARKING STUDY

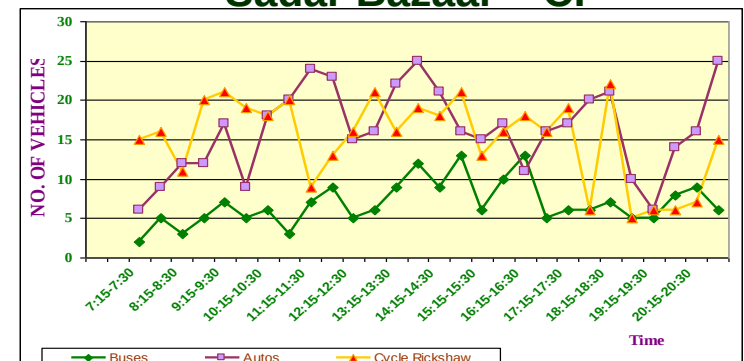
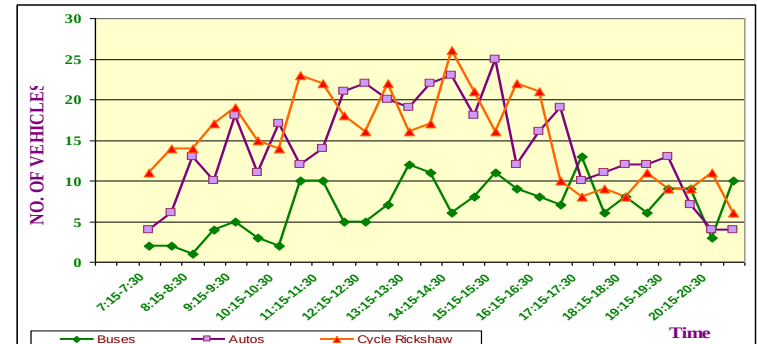
Pedestrian traffic

NDRS to CP	CP to Sadar Bazaar	Paharganj to NDRS	NDRS to Paharganj
6841	13832	27256	30574



- Absence of proper pedestrian facilities.
- Improper designing of pavements
- Encroachment of sidewalks

Parking Accumulation



- The parking area comprises mainly of the buses, autos and the cycle rickshaws
- Buses don't wait for more than 10 to 15 mins.
- Autos and cycle rickshaws wait up to an hour



STUDY OF VEHICLE FUEL CONSUMPTION DUE TO IDLING

■ Idle fuel Consumption

S No.	Vehicle Type	Idle Consumption (ml/hr)	Fuel	Remark
1	Maruti Gypsy	1045		Carburetter
2	Maruti Van	692		Carburetter
4	LML Freedom (Motor Cycle)	129		4-stroke
5	Enfield (Motor Cycle)	260		4-stroke
6	Pulsar (Motor Cycle)	166		4-stroke
7	Bajaj (2-wheeler)	216		2-stroke
8	Bajaj Chetak (2- wheeler)	500		2-stroke
9	Ambassador Car (petrol)	957		Carburetter
10	LML Select (2-wheeler)	763		Carburetter
11	Diesel Jeep	1052		
12	Maruti Van (MPFI)	563		MPF 1
13	Fiat Car	657		Carburetter
14	Tata Sumo	717		Diesel
15	Indica (Diesel)	547		Turbo change
16	RTV	800 g/kg @16.83/kg =13.5Rs/hr		
17	Esteem	740 ml/hr		
18	CNG bus	3.61 kg/hr		
19	Auotrickshaw	700gm/hr		2-stroke
20	CNG Taxi	1010 gm/hr		

Annual fuel loss

Cannaught Place to Sadar Bazaar -Rs. 19,62,820
Sadar Bazaar to Cannaught lace Rs.45,11,691.
Paharganj to railway station Rs.2,85,372.

Total annual fuel loss of Rs.67,59,883.

The annual per capita income has been found to be Rs.38,864. The fuel loss has also been obtained in terms of annual time loss

Fuel Loss (Existing)

Direction	CP-Sadar Bazar	Sadar Bazar-CP	Paharganj to Rly stn.	Total
T.Monetary loss	4696710	9782467	18970	14498147
Annual fuel loss(Rs.)	1962820	4511691	285372	6759883
Total Delay (hrs)	343	796	121	1260



FUEL , TIME & MONETARY LOSSES

- FROM THE SURVEY DATA WE GOT THE AVERAGE TIME LOSS/VEHICLE & TOTAL TIME LOSS IN ALL DIRECTIONS
- TO GET TOTAL MONETARY LOSS WE MULTIPLIED THE TIME LOSS BY PER CAPITA INCOME OF DELHI

$$\text{TOTAL MONETARY LOSS} = \text{TIME LOSS (sec)} * \text{PER CAPITA INCOME (Rs / month)}$$

- TO GET TOTAL FUEL LOSS WE MULTIPLY AVERAGE FUEL CONSUMPTION BY TIME LOSS

$$\text{TOTAL FUEL LOSS} = \text{TIME LOSS (sec)} * \text{AVERAGE FUEL CONSUMPTION (ml/hour)}$$



RECOMMENDATIONS

- **TRAFFIC CONTROL DEVICES** - road signs including regulatory, warning, road markings, channelisers & reflectors reduce accidents.
- **TURNING MOVEMENTS RESTRICTIONS** - reducing the number of turning movements at this intersection.
- **PEDESTRIAN FACILITIES AND PEDESTRIAN GRADE SEPARATION** - providing walkways clear of any encroachment, foot over bridge inside the railway station, A suitable location for ticketing facilities at railway st.
- **PARKING RESTRICTIONS** - parking of auto rickshaws and cycle rickshaws be prohibited
- **MEDIAN RAILINGS** - reduces the conflict between the vehicles coming from opposite direction & pedestrians do not cross road erratically.
- **SIGNAL SYNCHRONIZATION** - will help in avoiding jams in front of the station gate, thus resulting smooth movement of traffic.
- **FREE STRAIGHT MOVEMENT** – will help in reduction in delays and thus savings in fuel loss.



CONTRIBUTION

Our Scope of work in the project was mainly :

- **INVOLVED IN SURVEYS FOR THEIR PROPER COMMENCEMENT & TRAINING OF SURVEY ENUMERATORS**
- **ANALYSIS OF DATA COLLECTED FROM FIELD SURVEY**
- **PRELIMINARY INTERPRETATION FROM THE ANALYSED DATA**



TRANSPORT PLANNING AS A DEMAND FUNCTION....

- TRANSPORT IS A FUNCTION OF LAND USE.
- PROVIDES MOBILITY & ACCESSIBILITY WHICH EFFECTS THE LAND USE ,WHICH INTURN EFFECT THE LAND VALUES
- PARKING POLICY IN ABROAD CANT BE APPLIED IN INDIA DUE TO DIFFERENT URBAN FORM, & TRANSITION OF LAND USES.



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- THESIS REPORT-Parking Policy in Urban Villages
- NEUFERT'S ARCHITECT'S DATA
- INTERNET



THANK YOU