

Lecture 2.10

2.5 Parking Studies

Growing Parking Problems in Urban Areas

In modern cities, available road space is limited while vehicular ownership grows exponentially.

Uncontrolled parking encroaches on active carriageways, reduces effective traffic width, creates sight obstruction hazards, and causes severe traffic congestion.

- Reduction of effective carriageway width and road capacity
- Increased accident potential due to masked sight lines and curb maneuvers
- Environmental pollution from vehicles cruising for open spaces
- Economic loss in commercial districts due to lack of customer parking

Objectives and Need for Parking Studies

Parking studies evaluate the demand for and supply of parking spaces within a defined commercial or residential area.

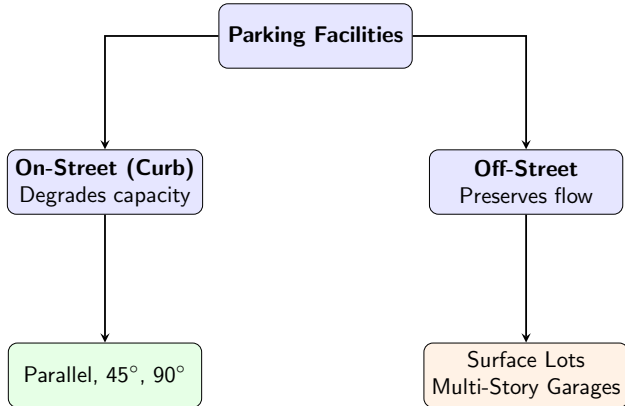
Data collected from parking surveys enables engineers to design new parking structures, formulate pricing policies, and enforce regulations.

- Quantifying peak parking demand and spatial distribution
- Determining parking duration and turnover rates
- Designing on-street curb layouts and off-street multi-story garages
- Evaluating economic fees and parking zone regulations

Classification of Parking Facilities: On-Street vs Off-Street

Parking facilities are categorized based on their location relative to the active roadway carriageway.

Engineers evaluate whether traffic volume permits on-street curb parking or necessitates dedicated off-street parking facilities.



On-Street (Curb) Parking Layout Patterns

On-street parking is designed at various angles relative to the curb line: Parallel, 30°, 45°, 60°, and 90° (Right-angle) parking.

The choice of parking angle depends on available street width, vehicle maneuverability, and desired parking capacity.

- Parallel Parking: Vehicles parked parallel to curb; safest for traffic flow
- 30° Angle Parking: Easy entry/exit; low parking capacity per length
- 45° Angle Parking: Popular compromise between ease of access and capacity
- 60° Angle Parking: Higher capacity; requires wider roadway width
- 90° (Perpendicular) Parking: Maximum capacity per length; highest crash risk

Comparison of On-Street Parking Angles

Engineers select parking layout angles based on quantitative trade-offs between space efficiency and road safety.

Angle parking allows easy head-in maneuvering but presents blind spots during reverse egress into active traffic lanes.

Parking Type	Curb Length / Car	Road Width Req.	Traffic Obstruction
Parallel	6.0 m – 6.7 m	~2.5 m	Low (Safest)
45° Angle	~3.5 m	~4.5 m	Medium
90° Angle	~2.5 m	~6.0 m	High (During reversing)

Off-Street Parking Facilities

Off-street parking facilities isolate parking maneuvers from active roadway corridors, protecting traffic capacity.

Modern off-street facilities incorporate automated access controls, pay-and-display systems, and intelligent guidance signs.

- Surface Parking Lots: Low capital cost; requires large urban land area
- Multi-Story Parking Garages: Stacked concrete structures maximizing vertical space
- Underground Basement Parking: Built beneath commercial complexes and malls
- Automated Mechanical Parking: Robotic elevator systems placing cars in slots

Key Parking Statistics and Parameters

Analyzing parking survey data requires standardized mathematical metrics to express facility performance.

Engineers compute accumulation, volume, duration, turnover, and index parameters to assess adequacy.

- **Parking Accumulation:** Total number of vehicles parked at a given time instant
- **Parking Volume:** Total count of vehicles parked over a specified observation period
- **Parking Load:** Cumulative vehicle-hours of parking stored (Area under accumulation curve)
- **Peak Accumulation:** Maximum count of parked vehicles recorded during survey

Parking Duration, Turnover, and Index Formulas

Parking Duration measures how long an individual vehicle remains parked.

Parking Turnover and Parking Index evaluate the efficiency and utilization intensity of available parking bays.

Metric	Formula	Significance
Average Duration	$\frac{\text{Total Parking Load (veh-hrs)}}{\text{Total Parking Volume (veh)}}$	How long a vehicle stays
Parking Turnover	$\frac{\text{Total Parking Volume (veh)}}{\text{Total Available Bays}}$	Efficiency/Utilization rate
Parking Index (%)	$\frac{\text{Parking Accumulation}}{\text{Total Available Bays}} \times 100$	≥ 100% means over-capacity

Methods of Parking Surveys

Engineers conduct parking surveys using fixed-period counting, registration plate monitoring, or interview methods.

The chosen survey technique depends on required data precision, budget, and facility size.

- License Plate Count Method: Patrolling observers record plate numbers at 15-30 min intervals
- Parking Space Inventory: Physical mapping of all available on-street and off-street bays
- Curb Count Method: Simple tally of total parked cars at periodic intervals
- User Interview Survey: Questionnaires gathering driver trip purpose and walking distance

Environmental & Economic Impacts of Parking Congestion

Improper parking management causes cascading environmental and economic costs in urban communities.

Traffic engineers design pricing mechanisms and time limits to discourage long-duration commuter parking in retail zones.

- Increased carbon emissions and fuel waste from vehicles hunting for parking
- Visual blight and obstruction of emergency vehicle response lanes
- Variable pricing structures (peak rates) promote short-stay retail turnover
- Park-and-Ride facilities at transit hubs encourage public transit usage

Summary & Key Takeaways

Parking studies quantify parking load, accumulation, turnover, and duration to guide urban parking design.

Selecting appropriate on-street parking angles or off-street structures balances traffic safety against bay capacity.

- On-street parking reduces road capacity; parallel parking is safest
- Angle parking (45°, 60°, 90°) increases capacity but adds reversing hazards
- Key metrics: Accumulation, Volume, Load (veh-hrs), Duration, Turnover, Index
- Parking Index $\geq 100\%$ signals facility overload and demand deficit