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"A Study On Parking Characteristics And Comparative Analysis Of On-Street And Off-Street Parking".

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ABSTRACT:-
Parking is a critical element of urban transportation planning as it directly influences traffic flow, land use, and overall mobility within cities. A parking study provides systematic analysis of parking demand, supply, usage patterns, and management practices to ensure efficient utilization of space and smooth movement of vehicles. This paper highlights the significance of parking studies in addressing congestion, improving accessibility, and supporting sustainable transport systems. It reviews different types of parking facilities such as on-street and off-street parking, surface lots, multi-level parking structures, mechanical parking systems, and smart parking technologies while discussing their suitability in diverse urban contexts. Furthermore, the study examines the methodologies used in parking surveys, including inventory, accumulation, duration, turnover, and occupancy studies, to evaluate parking performance. The findings emphasize the role of effective parking management in reducing traffic congestion, enhancing safety, and optimizing land use planning.

KEYWORDS:- Parking study, Traffic flow, Urban transportation planning, On-street parking, Off-street parking, Parking surveys, Parking management, Land use planning, Congestion reduction, Sustainable transportation

1. INTRODUCTION:-

Parking is an essential component of urban transportation systems, serving as the critical interface between vehicles and land use. With the continuous growth of urban populations and vehicle ownership, the demand for parking has become a major concern for city planners and traffic engineers. Inadequate or poorly managed parking facilities often lead to traffic congestion, reduced road capacity, safety issues, and inefficient land utilization. Therefore, a systematic study of parking is necessary to analyze the patterns of parking demand and supply, identify existing challenges, and propose effective management strategies.

A parking study involves the collection and analysis of data related to parking characteristics, including inventory, accumulation, occupancy, turnover, and duration. Such studies help in evaluating the adequacy of existing parking infrastructure and in planning future facilities to meet increasing demand. Different types of parking systems, such as on-street, off-street, surface lots, multi-level structures, and smart parking technologies, provide varying levels of efficiency, accessibility, and cost-effectiveness.

Understanding the significance of parking studies is crucial for achieving sustainable urban mobility. Effective parking management not only reduces congestion but also improves accessibility, promotes economic activity, and supports environmentally friendly transport systems. This paper focuses on the importance of parking studies, explores different types of parking facilities, and highlights methodologies used in assessing parking performance for better urban traffic management

2. OBJECTIVES OF THE PARKING STUDY:-

- **To assess parking demand and supply** – Evaluate the adequacy of existing parking facilities in relation to present and future vehicle requirements.
- **To identify parking patterns and characteristics** – Analyze occupancy, duration, accumulation, turnover, and peak demand periods.
- **To study the impact on traffic flow and congestion** – Examine how parking practices influence road capacity, delays, and safety.
- **To classify and evaluate types of parking facilities** – Compare the effectiveness of on-street, off-street, multi-level, and smart parking systems.
- **To optimize land use and space utilization** – Ensure efficient allocation of urban space for parking without hampering pedestrian or vehicle movement.
- **To recommend suitable parking management strategies** – Propose solutions such as pricing, zoning, policy interventions, and advanced technologies.
- **To support sustainable urban mobility** – Encourage eco-friendly transport modes and reduce environmental impacts of excessive vehicle parking demand

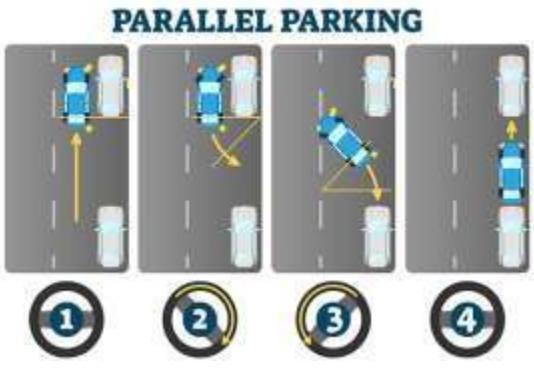
3. METHODOLOGY:-

3.1 On-Street Parking

On-street parking refers to the provision of parking spaces along the edges of public roads, usually parallel or at an angle to the curb. It is the most common and convenient form of parking, especially in central business districts, commercial streets, and residential areas where land for off-street facilities is limited. Since vehicles occupy part of the roadway, on- street parking directly affects traffic flow, road capacity, and safety.

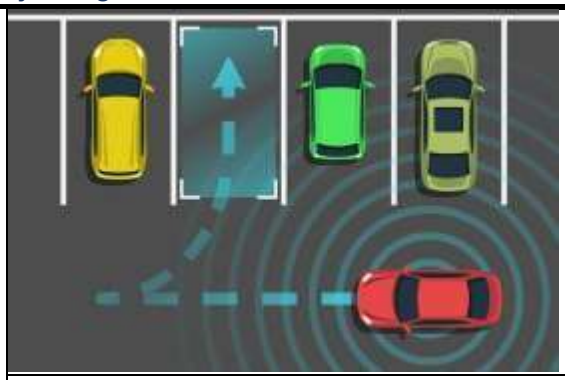
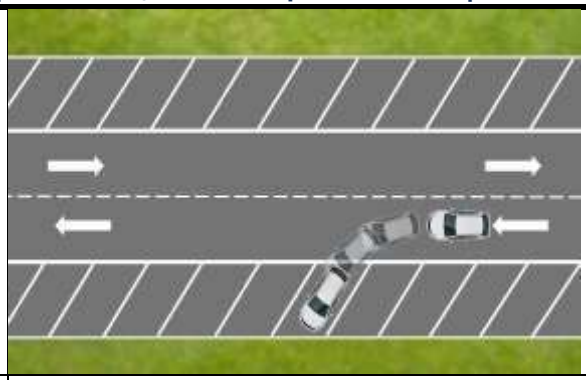
Types of On-Street Parking:

1. **Parallel Parking** – Vehicles are parked parallel to the road alignment. It requires minimal road width but offers low parking capacity.
2. **Angle Parking** – Vehicles are parked at an angle (generally 30°, 45°, or 60°) to the curb. It provides higher parking capacity than parallel parking but needs more manoeuvring space.
3. **Perpendicular Parking** – Vehicles are parked at 90° to the curb. It offers maximum capacity but requires significant road width and often disrupts traffic movement.
4. **Echelon Parking** – Similar to angle parking, but vehicles are parked in a staggered arrangement for easier entry and exit.



Parallel Parking

Angle Parking

	
Perpendicular Parking	**Echelon Parking**

Advantages:
- Convenient and easily accessible for short-term users.
- Requires minimal infrastructure investment.
- Suitable for areas with frequent parking turnover (e.g., shopping zones).

Disadvantages:
- Reduces effective road width and traffic-carrying capacity.
- Increases risk of accidents during entry and exit.
- Creates congestion, especially in high-volume traffic corridors.
- Difficult to enforce regulations and prevent illegal parking.

Applications:
On-street parking is generally recommended for low to medium traffic roads, residential streets, and areas with high short-term parking demand. For high-volume arterial roads and intersections, restrictions on on-street parking are often necessary to maintain smooth traffic flow.

3.2 Off-Street Parking

Off-street parking refers to parking facilities located away from the roadway, typically on separate plots of land or within designated structures. Unlike on-street parking, it does not occupy carriageway space and therefore has less impact on traffic flow. Off-street parking can be provided in open lots, basements, or multi-level structures depending on land availability, demand, and urban development requirements. It is generally managed either by municipalities, private operators, or institutions.

Types of Off-Street Parking:

1. **Surface Parking Lots**
- Open ground-level spaces designated for vehicle parking.
- Common in residential complexes, shopping centers, and public institutions.
- Easy to construct but requires large land areas.

2. **Basement Parking**
- Parking space provided below buildings, often in commercial complexes, malls, and offices.
- Utilizes underground space efficiently and preserves surface land for other uses.

3. **Multi-Level Parking Structures**
- Multi-storey buildings exclusively designed for vehicle parking.
- Can be above ground or a combination of basement and elevated levels.
- Suitable for dense urban areas where land is scarce.

4. **Mechanical / Automated Parking Systems**
- Use lifts, conveyors, or robotic systems to park and retrieve vehicles.
- Highly space-efficient and ideal for metropolitan areas with limited land availability.
- Reduces human effort and improves security.

Advantages:
- Reduces traffic congestion on roads.
- Provides safer and more organized parking.
- Can accommodate large volumes of vehicles.
- Enhances land use efficiency in urban planning.

Disadvantages:
- Requires significant investment in land and infrastructure.
- May be underutilized if poorly located.
- Maintenance costs can be high, especially for mechanical and multi-level systems.

Applications:

Off-street parking is ideal for city centers, shopping complexes, airports, railway stations, and areas with high parking demand but limited road space. It forms a crucial part of modern smart city planning

	
Surface Parking Lots	**Basement Parking**
	
Multi-Level Parking Structures	**Mechanical / Automated Parking Systems**

4. General Observation

Both on-street and off-street parking play important roles in meeting the parking demand of urban areas, but their characteristics and impacts differ significantly.

- **On-Street Parking** is more convenient and accessible for short-term users, especially in commercial and residential areas. However, it reduces effective roadway width, lowers traffic capacity, and often leads to congestion and safety issues. It is best suited for low to medium traffic streets where quick access is more important than traffic efficiency.
- **Off-Street Parking**, on the other hand, provides organized and larger capacity facilities without interfering with road traffic. It is more sustainable in the long term, especially in dense urban areas. While it requires higher investment and planning, it reduces congestion, improves traffic flow, and enhances overall urban mobility.

Observation Summary:

- On-street parking favours accessibility but compromises traffic efficiency.
- Off-street parking favours traffic efficiency and long-term sustainability but requires more space and investment.
- A balanced combination of both, supported by proper parking policies and management, is essential for effective urban transport planning.

5. CONCLUSION

1. Parking is an integral part of urban transport planning and directly influences traffic flow, safety, and land use efficiency. The study of parking helps in understanding demand and supply patterns, user behaviour, and the impacts of different parking systems on road networks.
2. From the analysis, it is observed that on-street parking provides easy accessibility and is convenient for short-term users, but it reduces roadway capacity, increases congestion, and compromises safety. In contrast, off-street parking offers organized facilities with higher capacity and better traffic efficiency, though it requires greater investment and proper location planning.
3. Therefore, neither system alone can fully meet the parking needs of growing urban areas. A balanced approach integrating both on-street and off-street facilities along with modern parking management strategies, pricing mechanisms, and smart technologies is essential for sustainable mobility. Proper planning and regulation of parking can significantly reduce congestion, improve accessibility, and optimize urban land use, thereby contributing to efficient and sustainable city development.

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