

Lecture 2.7

2.2 Traffic Volume Studies

Definition and Significance of Traffic Volume

Traffic volume represents the quantity of traffic moving along a road segment during a specified observation interval (e.g., 15 minutes, 1 hour, or 24 hours).

It serves as a primary measure of highway utilization and is crucial for evaluating whether an existing roadway meets current traffic demand.

- Quantifies vehicle throughput on road sections and intersections
- Expresses traffic intensity across different time periods
- Identifies peak traffic hours and congestion thresholds
- Essential input for structural pavement thickness calculations

Purpose and Applications of Traffic Volume Data

Traffic volume data is utilized across planning, design, regulatory, and management domains in civil engineering.

Engineers rely on volume statistics to justify road widening, allocate construction priorities, and evaluate the economic return on transportation infrastructure.

- Designing pavement structures based on cumulative standard axles
- Sizing geometric elements (number of lanes, turning lanes)
- Warrants for installing traffic signals, stop signs, or roundabouts
- Planning urban transport networks and bypass routes

Units of Traffic Volume

Depending on the duration and purpose of measurement, traffic volume is expressed in various standard units.

Short-term volume is expressed in vehicles per hour (veh/h), whereas long-term planning utilizes daily average metrics.

- Vehicles per Hour (veh/h): Used for operational analysis and signal design
- Passenger Car Units per Hour (PCU/h): Accounts for mixed vehicle types
- Average Daily Traffic (ADT): Average 24-hour volume over a test period (1 year)
- Annual Average Daily Traffic (AADT): Total annual volume divided by 365 days

Concept of Passenger Car Unit (PCU)

Indian traffic is characteristically heterogeneous, comprising two-wheelers, auto-rickshaws, cars, buses, trucks, and non-motorized vehicles sharing the same carriageway.

Because different vehicle classes occupy varying road space and exhibit different speeds and acceleration characteristics, traffic volume cannot be expressed by simple vehicle counts.

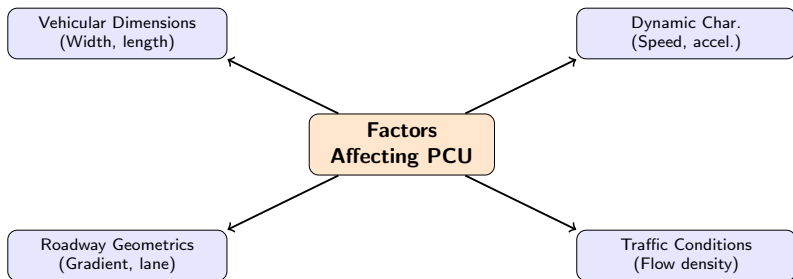
The Passenger Car Unit (PCU) converts all vehicle categories into an equivalent number of standard passenger cars.

- Standardizes mixed traffic streams into a uniform equivalent metric
- 1 PCU represents the impact of one standard passenger car
- Larger/slower vehicles have $PCU > 1$; smaller vehicles have $PCU < 1$
- Mandatory metric for highway capacity analysis under IRC standards

Factors Affecting PCU Values

PCU is not a constant value for a vehicle class; it dynamically varies depending on roadway characteristics, traffic stream composition, and environmental conditions.

Understanding these factors enables engineers to apply accurate PCU factors for urban streets versus rural highways.



Recommended IRC PCU Values (IRC:106 / IRC:64)

The Indian Roads Congress (IRC) provides standardized PCU conversion factors for rural highways (IRC:64) and urban roads (IRC:106).

Engineers multiply the count of each vehicle category by its designated PCU factor to determine total traffic flow in PCU/hour.

Vehicle Type	Urban (IRC:106)	Rural (IRC:64)
Passenger Car	1.0	1.0
Auto Rickshaw	0.5 - 0.75	-
Two-Wheelers	0.5	0.75
Bus / Heavy Truck	3.0	3.0
LCV	1.5	1.5
Bicycle	0.5	0.5

Average Daily Traffic (ADT) vs Annual Average Daily Traffic (AADT)

ADT is the total volume during a given time period (greater than 1 day and less than 1 year) divided by the number of days in that period.

AADT is the total volume passing a point in a full year divided by 365 days, accounting for all seasonal, monthly, and day-of-week fluctuations.

- ADT measured over 7-day or 14-day counts for routine design
- AADT accounts for holiday seasons, harvest periods, and weather impacts
- AADT used for economic feasibility, accident rate normalization, and revenue modeling
- Seasonal adjustment factors applied to convert ADT to estimated AADT

Temporal Variations in Traffic Volume

Traffic volume fluctuates continuously across different time scales: hourly variations during a day, daily variations across a week, and seasonal variations throughout the year.

Understanding these patterns allows engineers to schedule traffic counts during representative periods and design for true peak conditions.

- Hourly Variation: Morning peak (office/school) and evening peak hours
- Daily Variation: Higher commercial traffic on weekdays, leisure traffic on weekends
- Seasonal Variation: Harvest seasons, festival peaks, monsoon dips
- Volume trend curves used to identify design peak hours

Peak Hour Volume and Peak Hour Factor (PHF)

Peak Hour Volume (PHV) is the maximum number of vehicles passing a point during 60 consecutive minutes.

To measure traffic flow concentration within the peak hour, engineers calculate the Peak Hour Factor (PHF) using 15-minute sub-intervals.

$$PHF = \frac{V}{4 \times V_{15max}}$$

Where:

V = Total hourly volume (veh/h)

V_{15max} = Maximum 15-minute volume during the hour

Key Values:

- Ranges from 0.25 (congested burst) to 1.00 (uniform flow)
- Typical urban peak: 0.85 to 0.95

Directional Distribution and Lane Distribution

Traffic flow is rarely equal in both directions; during peak hours, directional split can reach 60:40 or 70:30 towards central business districts.

Lane distribution analysis measures how multi-lane highways distribute traffic across outer, middle, and shoulder lanes.

- Directional Split Ratio (D): Expressed as percentage of traffic in major direction
- Crucial for designing divided carriageways and tidal flow (reversible) lanes
- Lane utilization varies with heavy vehicle percentages and interchange ramps
- Informs placement of directional signage and overhead lane controls

Summary & Key Takeaways

Traffic volume is the fundamental measure of highway demand, expressed in veh/h, PCU/h, ADT, or AADT.

Passenger Car Units (PCU) convert heterogeneous mixed traffic into standard equivalent units according to IRC guidelines.

- Volume quantifies road utilization and pavement loading
- PCU standardizes mixed traffic streams (Cars=1, Buses/Trucks=3, 2-Wheelers=0.5)
- Peak Hour Factor (PHF) evaluates traffic flow uniformity within peak hours
- Temporal and directional variations dictate highway design capacity