Lecture 2.13

2.2 Traffic Volume Studies

Manual Traffic Volume Counting Method

Manual counting involves trained human enumerators stationed at field stations recording passing vehicles on standardized tally sheets or mechanical hand counters.

Manual counting is uniquely suited for complex urban intersections where vehicle classification and turning movement directional counts are simultaneously required.

- Enumerators record vehicle counts by type and direction of movement
- Uses 5-minute or 15-minute sub-interval tally sheets
- Essential for turning movement counts (Left-turn, Through, Right-turn)
- Shift rotation required every 2 hours to maintain counter accuracy

Equipment and Tally Sheets for Manual Counts

To streamline manual counting, field observers utilize multi-tally mechanical counters, electronic hand-held tally boards, or specialized mobile tally apps.

Standardized tally sheets record location metadata, weather, observer ID, count interval, vehicle classification categories, and movement arrows.

- Mechanical Key Tally Counters: Multi-button banks for fast finger tapping
- Electronic Tally Boards: Digitally logs timestamps and vehicle categories
- Tally Sheet Layout: Organized by vehicle classes matching IRC guidelines
- Pre-survey calibration and synchronizing observer watches across stations

Automatic Traffic Counter and Classifier (ATCC)

Automatic Traffic Counter and Classifier (ATCC) systems utilize sensors to count and classify passing vehicles continuously without human intervention.

ATCC systems process vehicle wheelbases, axle counts, or electromagnetic signatures to categorize vehicles according to IRC classes.

- Deploys combination of inductive loops, piezoelectric axle sensors, or radar
- Calculates vehicle classification based on axle spacing and overall length
- Operates continuously for 7-day, 30-day, or permanent annual counting
- Transmits real-time volume data via cellular telemetry to central servers

Moving Observer Method for Volume & Speed Estimation

Developed by Wardrop and Charlesworth, the Moving Observer Method (Floating Car Technique) enables simultaneous measurement of traffic volume and travel speed along a corridor.

A test vehicle makes multiple round trips along a highway section, recording vehicle counts met, vehicles overtaking, and test vehicle travel times.

- Test vehicle travels against traffic stream (trip 1) and with stream (trip 2)
- Key Variables: m = Vehicles met; ny = Vehicles overtaking test car - test car overtaking others
- ta = Travel time against stream; tw = Travel time with stream
- Traffic Volume Formula: q = (m + ny) / (ta + tw)
- Average Journey Time Formula: t_bar = tw - (ny / q)

Presentation of Volume Data: Traffic Flow Maps (Band Maps)

Traffic Flow Maps (Band Maps) present volume data graphically by drawing band widths along highway alignments proportional to traffic flow magnitude.

Engineers use flow maps to instantly identify high-volume corridors, bottleneck sections, and traffic accumulation patterns across a regional road network.

- Band width drawn proportional to traffic volume in PCU/day or PCU/hour
- Thicker bands indicate heavy traffic demand; narrowing bands indicate flow constriction
- Directional flow maps show directional volume splits using divided bands
- Provides intuitive spatial communication for city planners and politicians

Presentation of Volume Data: Trend Charts & Hourly Variation Graphs

Traffic volume data is plotted on hourly, daily, and annual trend line charts to visualize temporal variations.

Bar charts and line graphs illustrate peak hour spikes, off-peak troughs, and multi-year traffic growth trends.

- Hourly Volume Profiles: 24-hour bar charts showing morning/evening peaks
- Daily Variation Charts: Monday through Sunday volume comparisons
- Monthly / Seasonal Charts: Highlights agricultural harvest or holiday spikes
- Historical Growth Trend Curves: Evaluates annual traffic compounding growth rates

Isochronal Maps and Travel Time Isochrones

An Isochronal Map features contour lines (isochrones) connecting points of equal travel time from a major central origin (e.g., city center).

Isochrones visualize urban accessibility and show how congestion delays distort spatial travel time radii.

- Isochrone line connects locations reachable within equal time (e.g., 15 min, 30 min)
- Closely spaced isochrones indicate congested corridors or low travel speed
- Widely spaced isochrones along expressways indicate high accessibility
- Used for evaluating public transit accessibility and emergency service coverage

Design Hourly Volume (DHV) Concept

Designing highways for the absolute maximum peak hour volume of the year is economically wasteful, as that capacity would sit idle for 99% of the year.

Conversely, designing for average hourly volume causes severe traffic congestion during peak periods.

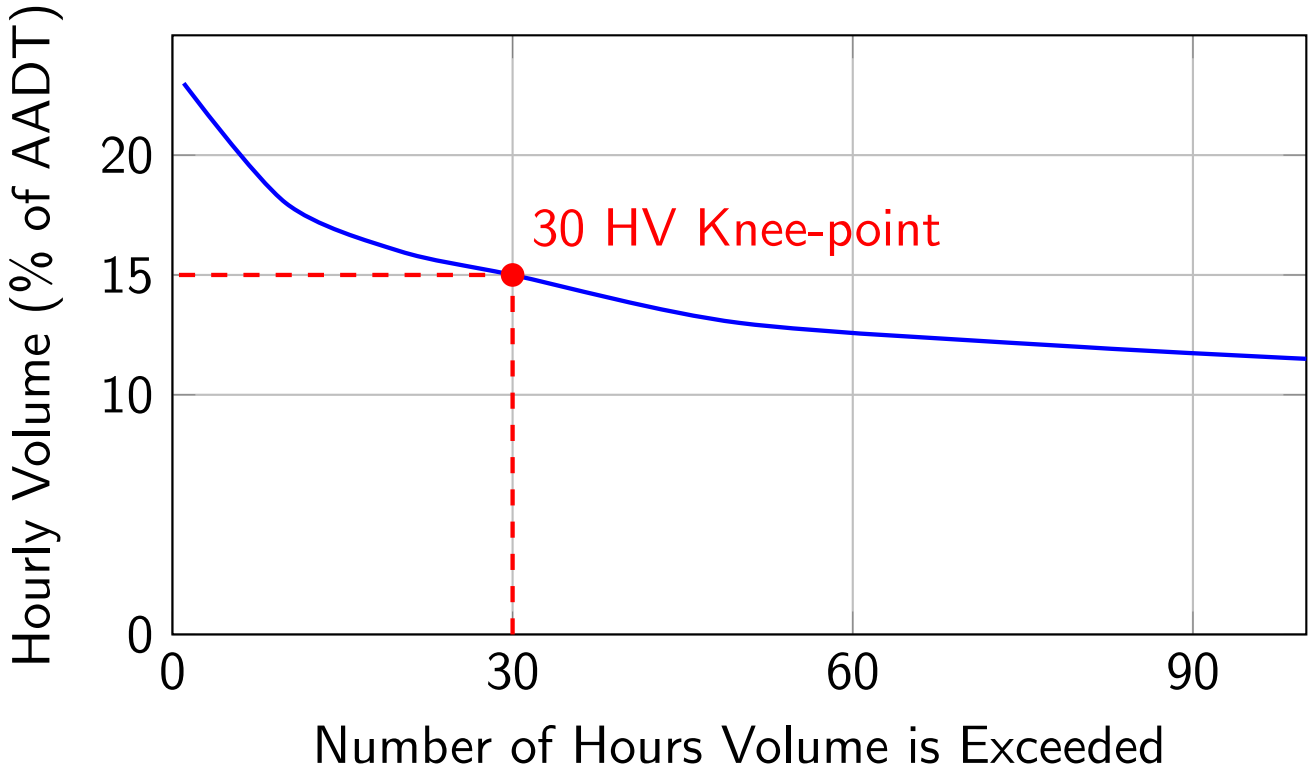
Engineers select the Design Hourly Volume (DHV) as an economically balanced capacity threshold.

- DHV is a representative high peak hour volume used for geometric design
- Typically ranges between 8% and 15% of Annual Average Daily Traffic (AADT)
- Balances structural investment cost against traffic congestion delays
- Determined from annual hourly volume ranking curves

30th Highest Hourly Volume (30 HV)

When all 8,760 hourly volumes of a year are arranged in descending order, the 30th Highest Hourly Volume (30 HV) is selected by IRC as the standard DHV for road design.

The slope of the hourly volume ranking curve changes knee-point sharply at the 30th hour mark, offering maximum economic efficiency.



Capacity Analysis and Level of Service (LOS) Basics

Highway Capacity is the maximum sustainable flow rate of vehicles passing a point under prevailing roadway, traffic, and control conditions.

Level of Service (LOS) is a qualitative measure describing operational conditions within a traffic stream, categorized from LOS A (free flow) to LOS F (forced breakdown congestion).

LOS	Condition	Description
A	Free Flow	Complete freedom to maneuver
B	Reasonably Free Flow	Minor maneuvering restrictions
C	Stable Flow	Restricted lane changing (Urban Design Target)
D	Approaching Unstable	High density, restricted speed
E	Capacity Limit	Operating at maximum volume
F	Breakdown Flow	Stop-and-go gridlock congestion

Summary & Key Takeaways

Traffic volume survey methods range from manual counting and ATCC systems to the Moving Observer technique.

Presenting volume data via Traffic Flow Maps, Isochrones, 30 HV, and LOS analysis enables civil engineers to design adequate highway capacity.

- Manual counts ideal for turning movements; ATCC for continuous 24/7 data
- Moving observer method computes volume q and travel time t_bar simultaneously
- Traffic flow band width represents volume magnitude spatially
- 30th Highest Hourly Volume (30 HV) is the standard IRC design hourly volume
- Level of Service ranges from LOS A (free flow) to LOS F (gridlock)