

University of Al-Maarif
College of Engineering
Department of Civil Engineering



TRAFFIC ENGINEERING

FOURTH LECTURE

Lecturer:

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Traffic Stream Parameters

Traffic stream parameters classified into two groups:

1- Macroscopic parameter: describe the traffic stream as a whole, includes the following:

- Volume
- Speed
- Density

2- Microscopic parameter: describe the behavior of individual or pair of vehicles, includes the following:

- Headway
- Spacing
- Speed of individual vehicle

Traffic Stream Parameters

Traffic Volume

Volume: The number of vehicles passing a given point or section of a lane or a roadway during a specified period of time. (day or hour).

Units: vpd (vehicle /day)

vph (vehicle /hour)

* Note: Daily volume is given for entire roadway (both directions), otherwise specified, for example, 5000 v/d in both directions.

Traffic Stream Parameters

Daily Volume is used for :

- 1- Establishment of traffic volume trend.
- 2- Computation of accident rates in term of 100 million vehicles kilometers.
- 3- Evaluation of the economical feasibility of highway project.
- 4- Development of maintenance program for highways.
- 5- Structural design of pavement.
- 6- Planning of highway.

Traffic Stream Parameters

Daily Volume Types:

1- Average Annual Daily Traffic (AADT) : The total yearly volume divided by the number of days in the year

$$AADT = \frac{\text{Total volume for one year}}{365 \text{ day}} = (vpd)$$

2- Annual Average Weekday Traffic (AAWT) : total weekday volume for one year divided by the number of weekdays (usually 260)

$$AAWT = \frac{\text{Total weekday volume for one year}}{260} = (vpd)$$

Traffic Stream Parameters

3- Average Daily Traffic (ADT) : The total volume during a given time period (greater than one day and less than one year) divided by the number of days in that time period.

$$ADT = \frac{\text{Total volume for a given period}}{\text{time period (days)}} = (vpd)$$

4- Average Weekday Traffic (AWT) : the total weekday volume for a given period divided by the number of weekdays in that time period.

$$AWT = \frac{\text{Total weekday volume for a given period}}{\text{no. of weekday on the time period}} = (vpd)$$

Traffic Stream Parameters

Traffic Projection Factor (T.P.F) عامل الإسقاط المروري :

Future volume = current volume \times T.P.F

$$\text{T.P.F} = (1 + r)^{x+n}$$

Where ;

r = annual rate of traffic increase (0-10%)

x = construction period (2-4 years)

n = design life (20- 50years)

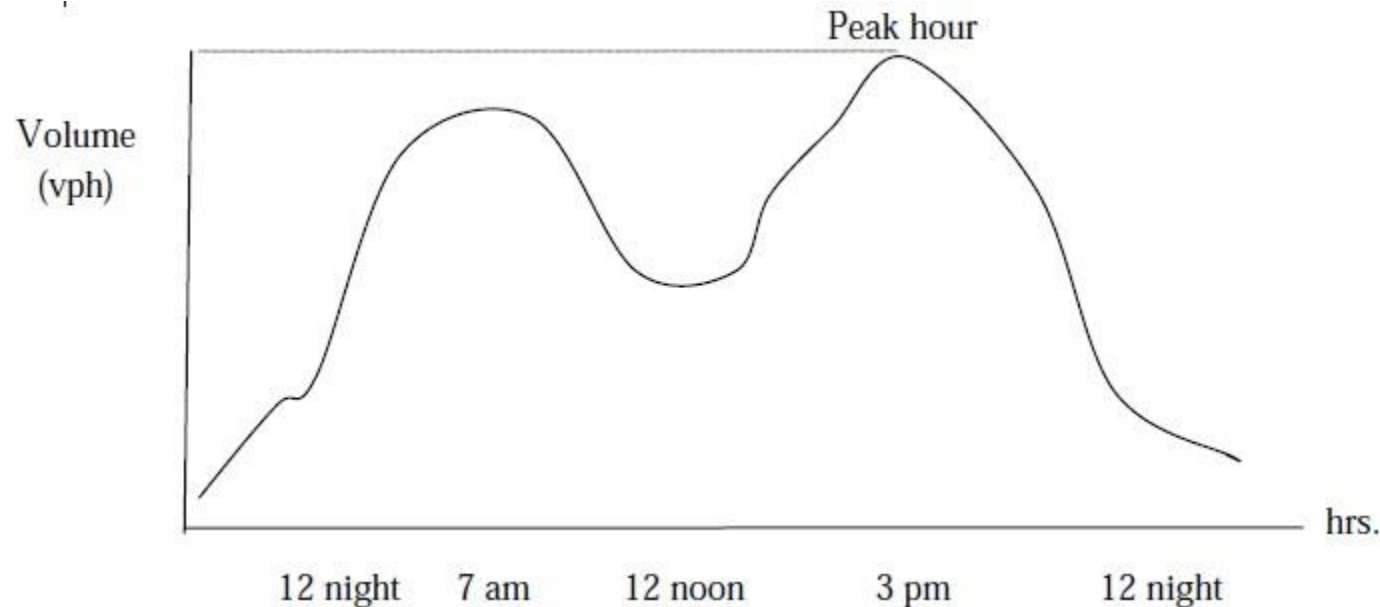
For example: $\text{T.P.F} = (1+0.05)_{2+20} = 2.9$

current volume = 24000 vpd in 2021

future volume = $24000 \times 2.9 = 69600$ vpd in 2043

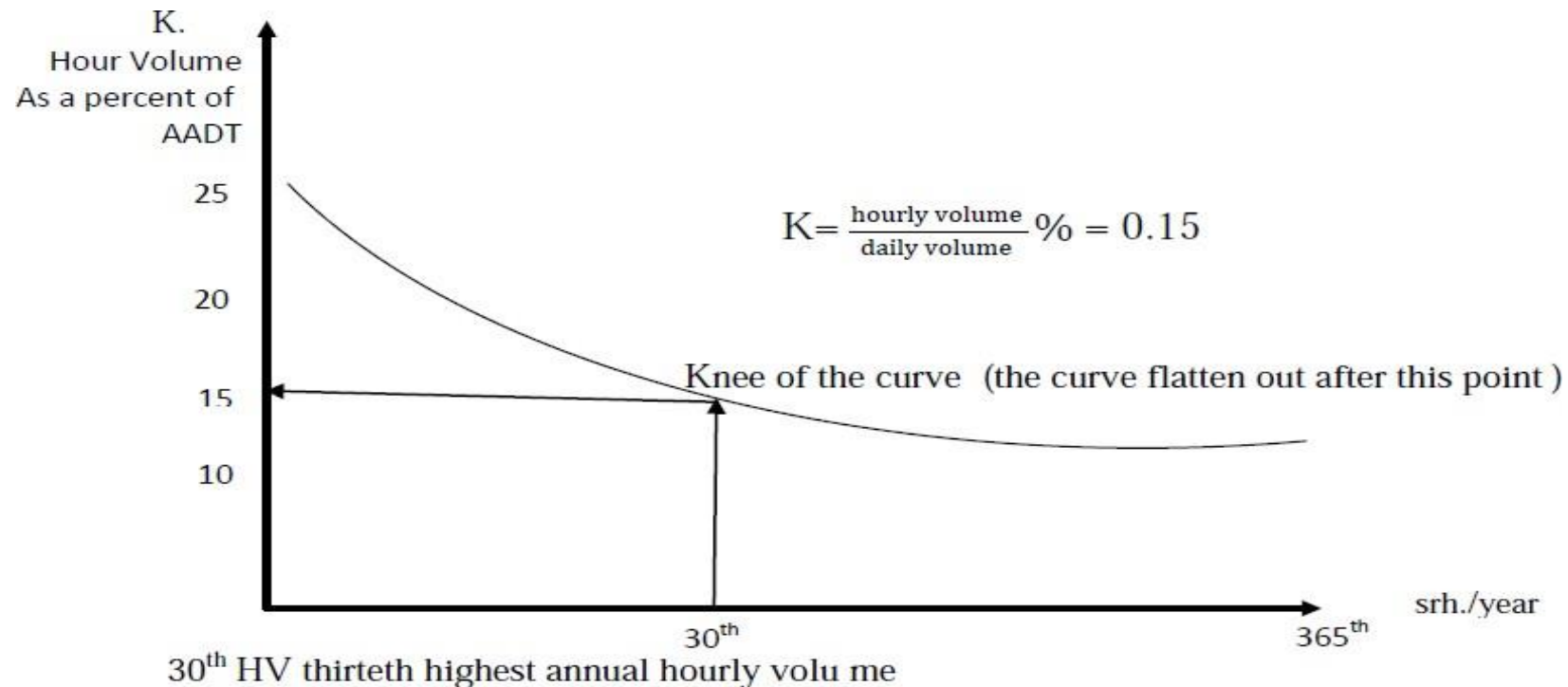
Traffic Stream Parameters

Hourly Volume : HV (veh/hr) : the single hour of the day that has the highest hourly volume is referred to as peak hour .the traffic volume within this hour is of great interest to traffic engineer for design and operational analysis for highway section.



Traffic Stream Parameters

DHV : Design Hourly Volume : the 30th highest hourly volume that is exceeded by 29 hourly volumes during the design year. This volume is usually taken as percentage of expected ADT or AADT on the highway.



Traffic Stream Parameters

Directional design-hour volume (DDHV): The DDHV is the amount of traffic moving in the peak direction during the design hour. The formula for calculating the directional design hour volume is:

$$\mathbf{DDHV = K \times D \times ADT}$$

K = proportion of daily traffic occurs during the peak hour

$$= \frac{\text{Hourly Volume}}{\text{Daily Volume}} = \frac{DHV}{AADT}$$

D = Directional distribution factor reflecting the proportion of peak-hour traffic traveling in the peak direction.

$$= \frac{\text{Volume of one direction}}{\text{Volume of two direction}} * 100 = 50\% - 80\%$$

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Type of facility	K factor	D factor
Rural highway	0.15-0.25	0.65-0.8
Suburban highway	0.12-0.15	0.55-0.65
Urban highways	0.07-0.12	0.5-0.6

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Example: Rural highway has (20 years) forecast of AADT of (30000 vpd) what range of directional design hour volume might be expected for this situation?

Solution:

$$DDHV = AADT \times K \times D$$

$$DDHV \text{ low} = 30000 \times 0.15 \times 0.65 = 2925 \text{ vph/dir.}$$

$$DDHV \text{ high} = 30000 \times 0.25 \times 0.8 = 6000 \text{ vph/dir.}$$

Traffic Stream Parameters

Flow Rate and Peak Hourly Factor

Peak Flow Rate : volume observed for a period less than one hour (15 min. or 5 min) expressed as equivalent hourly rate of flow (**q**)

Example /

Time interval	Road A	Road B
8:00 – 8:15	1000	4000
8:15 – 8:30	1000	0
8:30 – 8:45	1000	0
8:45 – 9:00	100	0
	4000	4000

Traffic Stream Parameters

$$\text{Peak Flow Rate} = 4 * \max V_{15min}$$

$$\text{Peak Hour Factor (PHF)} = \frac{\text{Volume}}{\text{Peak Flow Rate}} = \frac{\text{Volume}}{4 * \max V_{15min}}$$

$$0.25 \leq \text{PHF} \leq 1$$

Normally, between 0.7- 0.98 , lower PHF indicates a greater degree of variation in flow during the peak hour.

$$\therefore \text{Peak flow rate} = \frac{\text{Volume (DDHV)}}{\text{PHF}}$$

Traffic Stream Parameters

Example:

Time interval	Volume (vehicles)
5:00-5:15 pm	950
5:15-5:30 pm	1150
5:30-5:45 pm	1250
5:45-6:00 pm	1000
For 5:00-6:00 pm	4350 veh/h

Solution:

$$\text{Peak Flow Rate} = 4 * 1250 = 5000 \text{ veh/hr}$$

$$PHF = \frac{4350 \text{ (veh/hr)}}{5000 \text{ (veh/hr)}} = 0.87$$

Traffic Stream Parameters

Passenger Car Equivalency Factor (E_{pc})

To convert different distribution of vehicle, (truck, bus) to one standard type (passenger car P.C)

Terrain	Flat	Rolling	Mountain
E_{pc}	1.5	2.5	4.5

Example:

volume = 3000 vph , truck = 10% , mountain terrain.

Solution

Volume (p.c per hour) = volume (vph) [($P_{pc} \times 1$) + ($P_{HV} \times E_{pc}$)]

Volume = 3000 [(0.9 \times 1) + (0.1 \times 4.5)] = 4050 p.c per hour.

Traffic Stream Parameters

Summary

ADT

↓ × TPF = traffic projection factor = $(1 + r)^{x+n}$

Future ADT

↓ × K (0.15 rural - 0.12 urban)

DHV

↓ × D (directional distribution factor 0.5-0.8)

DDHV

↓ / (design service flow rate for one lane)

No of lanes

Traffic Stream Parameters

Capacity: it represents the maximum number of vehicles that can pass a given point or section during a period of time under ideal condition, commonly expressed as (pcphpl).

$$\text{No. of lanes/ one direction} = \frac{\text{Volume of one direction}}{\text{design service flow rate for one lane}}$$

Example: A multilane minor arterial highway is being designed through a rolling rural area. The current daily volume is 7100 vpd with 20% truck . 90% peak hour factor and 60% directional distribution factor . how many lanes are required for this highway if this highway located in an urban area with level terrain.

Traffic Stream Parameters

Solution:

Minor arterial rolling area = design level of service is B

So, design service flow for one lane = 1080 pc ph pl

Assume T.P.F = 3.6

Future volume = current volume \times T.P.F = $7100 \times 3.6 = 25560$ vpd

DHV(30_{th}) = $0.15 \times$ Future ADT = $0.15 \times 25560 = 3834$ vph

$$\text{Peak flow rate} = \frac{\text{Volume}}{\text{PHF}} = \frac{3834}{0.9} = 4260 \text{ vph}$$

Volume (pc ph) = $4260 [0.2 \times 2.5 + 0.8 \times 1] = 5538$ pc ph

Volume of one direction = $5538 \times 0.6 = 3323$ pc ph /dir

No of lanes in one dir. = $3323/1080 = 4$ lanes/ dir .

No of lanes in both dir = $4 \times 2 = 8$ lanes / two dir

THANK YOU