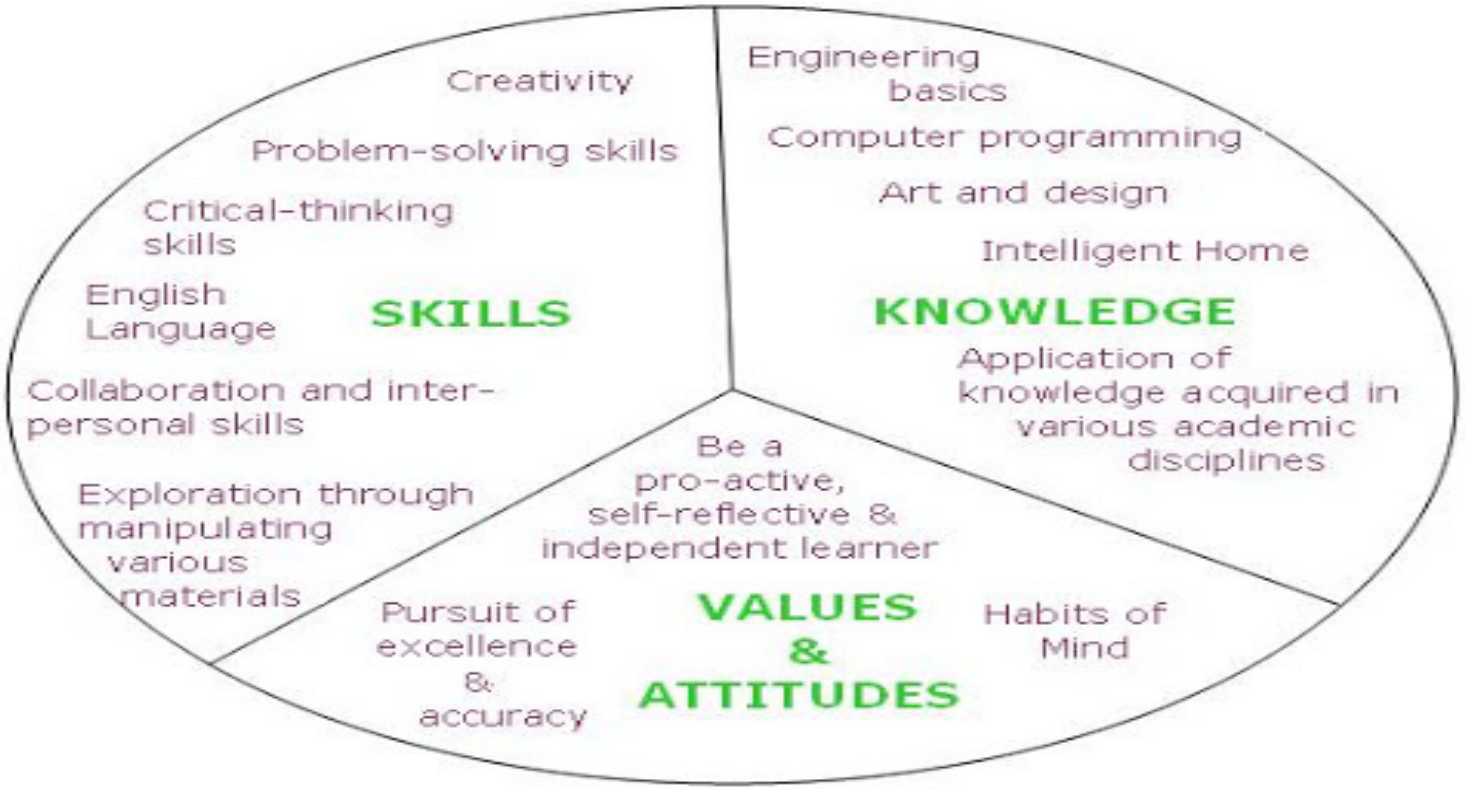
EWC 351 Transportation Engineering:

OBE

KSA	Description
Knowledge	Condition of being aware of something (facts or concepts)
Skills	Abilities based on performance measured in time and precision
Attitudes	Feelings, emotions, beliefs, or values about something



Course Out line (CO –PO)

Syllabus Introduction to transportation engineering, geometrical design of highways, element of design, cross-section elements, curves and sight distances. Introduction to intelligent transportation system. Transport planning, concepts, scope and hierarchy, process, goals and objectives, inventories, socio-economic activities, land use-transport interaction, travel demand forecasting. Introduction to pavement materials, **flexible and rigid pavement: pavement components and functions. Traffic engineering: fundamentals of traffic engineering, vehicle and traffic characteristics, traffic control devices and systems.**

Week	Lecture	Intended topics to be covered
1	1	Introduction to Course and OBE, Traffic parameter, congestion, safety
2	2	Traffic parameter, congestion, safety
3	3	Traffic Volume Study
4	4	Speed and Delay Study
5	5	Vehicle and traffic characteristics
6	6	Parking Study
7	7	Traffic Control Device
8	8	Traffic signal
9	9	Traffic signal
10	10	Pavement Types and Function
11	11	Pavement Types and Function
12	12	Wheel Load & Pavement design Requirement
13	13	AASHTO Method of Pavement Design
14	14	RHD Method of Pavement Design and Wrap UP

Reference

References

"Transportation Engineering and Transport Planning", 7th Edition, by – L.R. Kadiyali

Traffic Engineering Design" by - Mike Slin, Peter Guest and Paul Mathews

"Transportation and Traffic Engineering Handbook", Second Edition, Institute of Traffic Engineers,

"Highways and Traffic", Volume 1, Second Edition, 1983, O'Flaherty, C.A.,

"Highway Capacity Manual", Special Report 209, Third Edition, 1994, Transportation Research Board,

- Pavement Analysis and Design: Yang H. Huang 2nd edition
- "Highway Engineering" by – Paul H. Wright (7th Edition)

Lec 1-2 : Traffic parameter, congestion, safety

Lec Outline (Lec 1-2)

1. Definition
2. History
3. Objectives of TE
4. Traffic Parameters
5. Congestions
6. Safety Problems
7. TE Tools

Traffic Engineering

Definition

Traffic engineering is the science of

- Measuring traffic and travel , the study of basic laws relating to traffic flow and generation , and
- Application of this knowledge to the professional practice of planning, designing, and operating traffic systems to achieve safe, efficient and convenient movement of persons and goods.

History

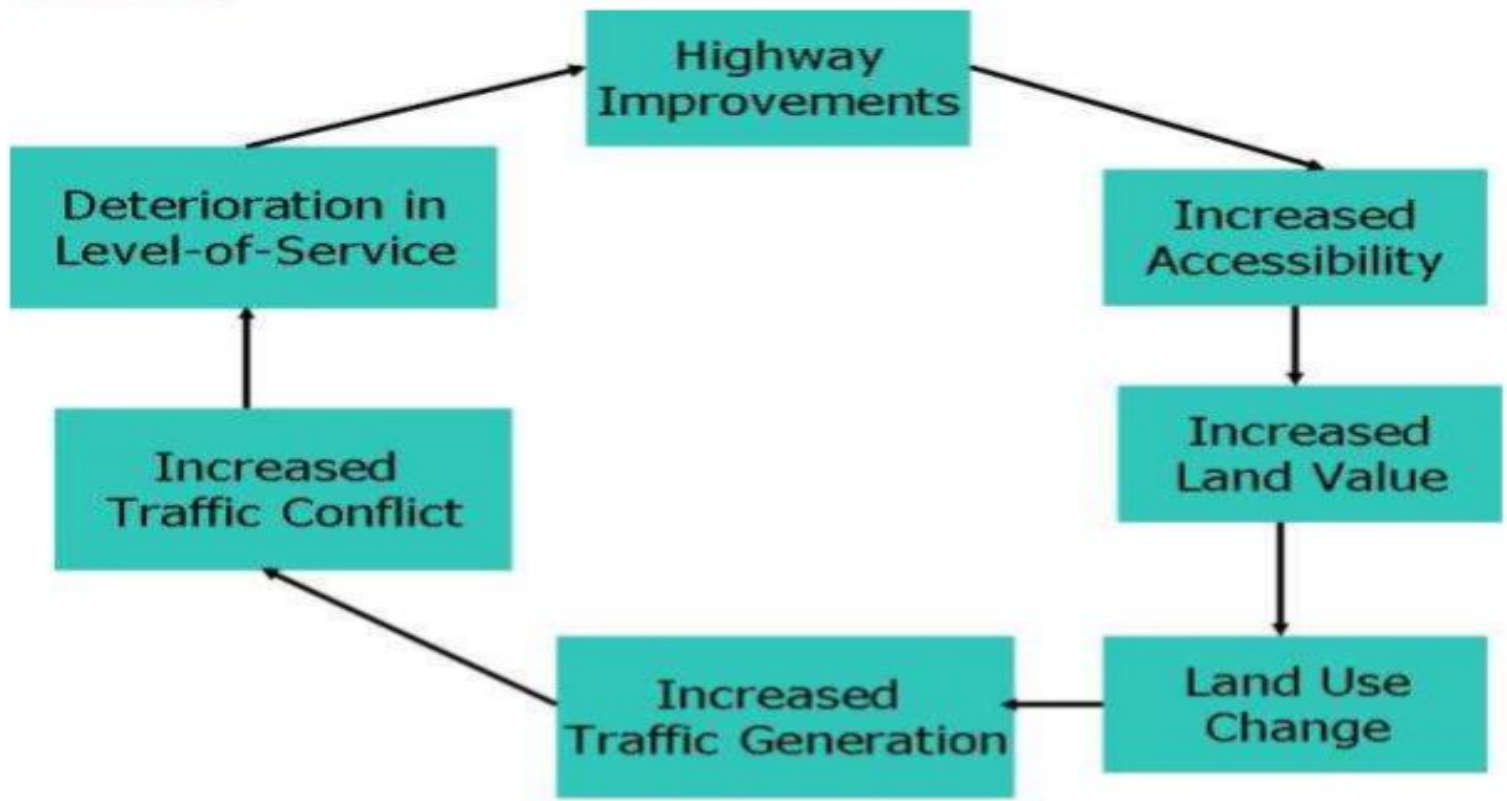
- Traffic Engineering has evolved gradually with increase in traffic
- Initially it was limited to application of simple rules and regulations such as left driving rule, road signs, marking and intersection control by flag etc.
- Subsequently, analysis of traffic and accidents led to the realization that traffic regulations and other methods of traffic control should be based on proper engineering studies.


SIMONDS
ALES
OLDFIELD PARK
52
BATH ELECTRIC TRAMWAYS

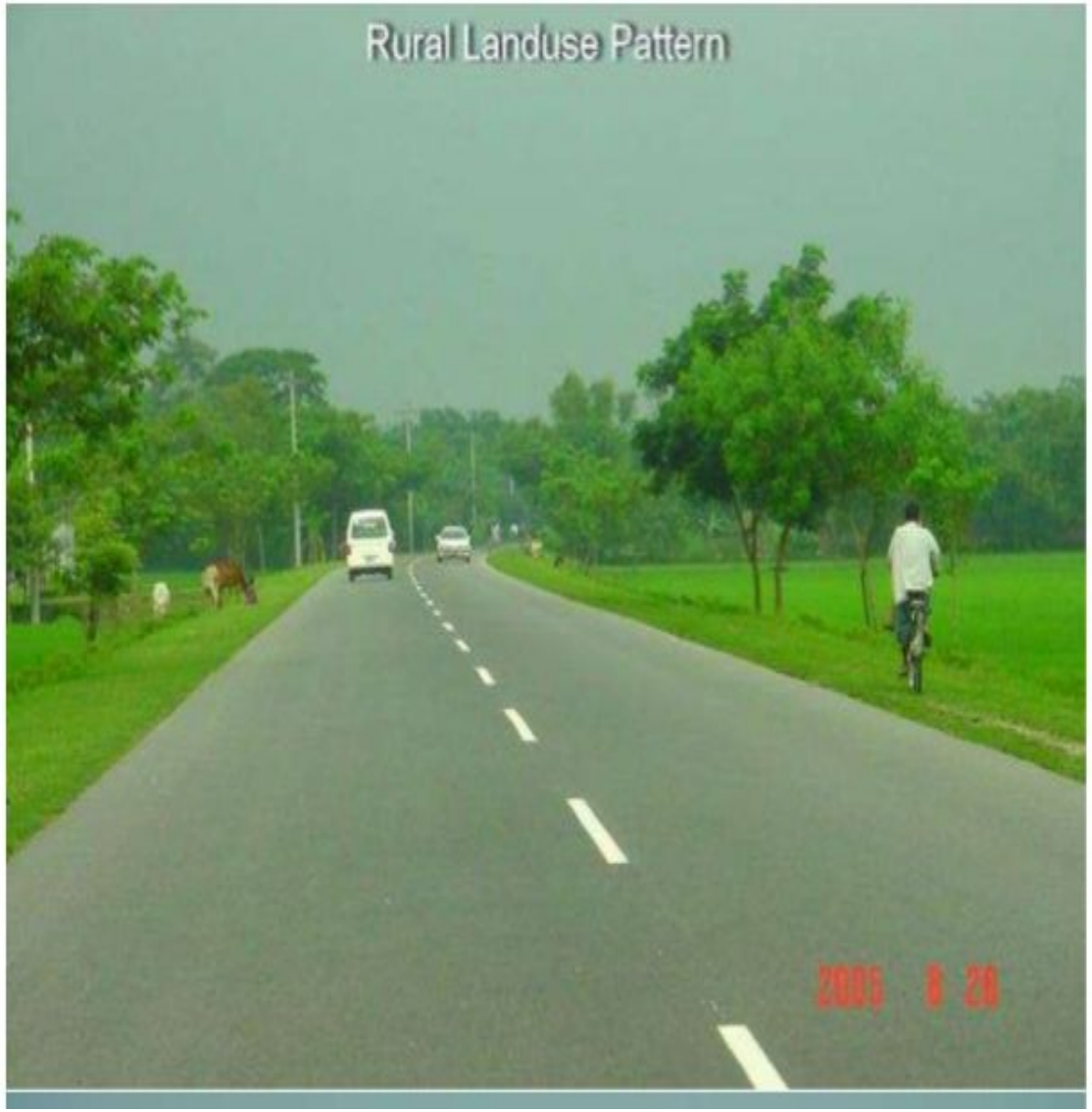

St. Pancras
Great Portland Street
Euston
Angel
Paddington
Edgware Road
Baker Street
Paddington
Edgware Road
Marylebone
Warren Street
Euston Square
Euston 200m
Farringdon
Barbican
Old Street
Bayswater
Regent's Park
Goodge Street
Russell Square
Moorgate
Holland Park
Queensway
Lancaster Gate
Bond Street
Oxford Circus
Holborn
Notting Hill Gate
Marble Arch
Tottenham Court Road
Chancery Lane
St. Paul's
Bank
Covent Garden
High Street Kensington
Hyde Park Corner
Green Park
Cannon Street
Leicester Square
Mansion House
Piccadilly Circus
Knightsbridge
Charing Cross
Monument
Blackfriars
Gloucester Road
Sloane Square
St. James's Park
Temple
Earl's Court
South Kensington
Victoria
Westminster
Embankment
Charing Cross 100m
London Bridge

History

- In consequence as extension of traffic regulations-many new traffic control and management techniques were devised viz. speed zoning, traffic signals, turn restrictions, parking restrictions, bus priorities, one-way street etc.
- Eventually it became evident that the planning and design of efficient road network largely depends upon the **integrated land-use and transport policies** and effective demand management (road pricing to control and distribution of peak hours).
- *Modern traffic engineering* measures largely depend on public transport facilities and information technology



Transportation-Land Use Cycle


Rural Landuse Pattern


Urban Landuse Pattern



CONGESTION CAUSED BY SMALLER SIZED VEHICLES





Modern City









Traffic Engineering

Objectives of Traffic Engineering

- To improve overall road capacity
- To ensure Safety
- Since both veh-veh and veh-pedestrian conflicts reduce roadway capacity and cause accident risk overall objective is to minimize these conflicts so as to make the most economic use of the existing roadway facilities

Traffic Engineering

Traffic Engineering (TE) includes

- Studies and analysis of traffic characteristics and flow parameters (Speed (v), Volume, Flow (q), Peak Hour Factor (PHF) , Density (k), Headway (h) , Spacing (s), Gap (g), Clearance (c)).
- Geometric design (mainly improvement)
- Planning of regulatory measures (speed, vehicle, driver, traffic, parking, enforcement)
- Design and application of control devices
- Functional planning of road network

Why Traffic Engineering is so essential now-a-days?

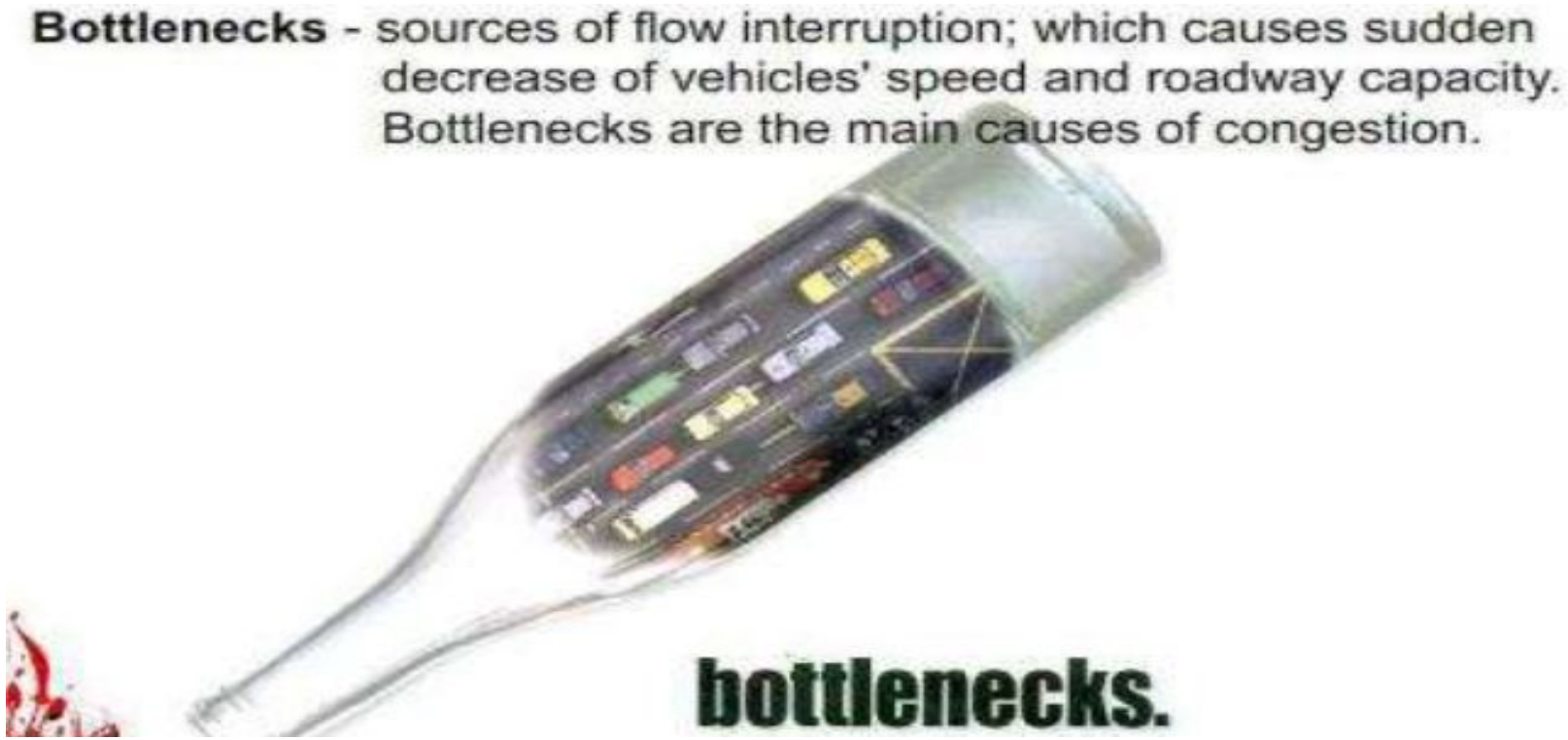
Because of-

- Increased urbanization process
- Increased traffic demand-(phenomenal growth in traffic specially within urban areas).
- Difficulties in expanding roadway facilities within built up areas.
- Congestion becomes chronic in everywhere.
- Increased air pollution.
- Increased accident numbers.
- Road network become larger.

Traffic Engineering

Bottlenecks – Causes of Congestion

For better management of road network, traffic engineers **must know** the **common causes of congestion and accident.**



Traffic Engineering Bottlenecks









Traffic Engineering

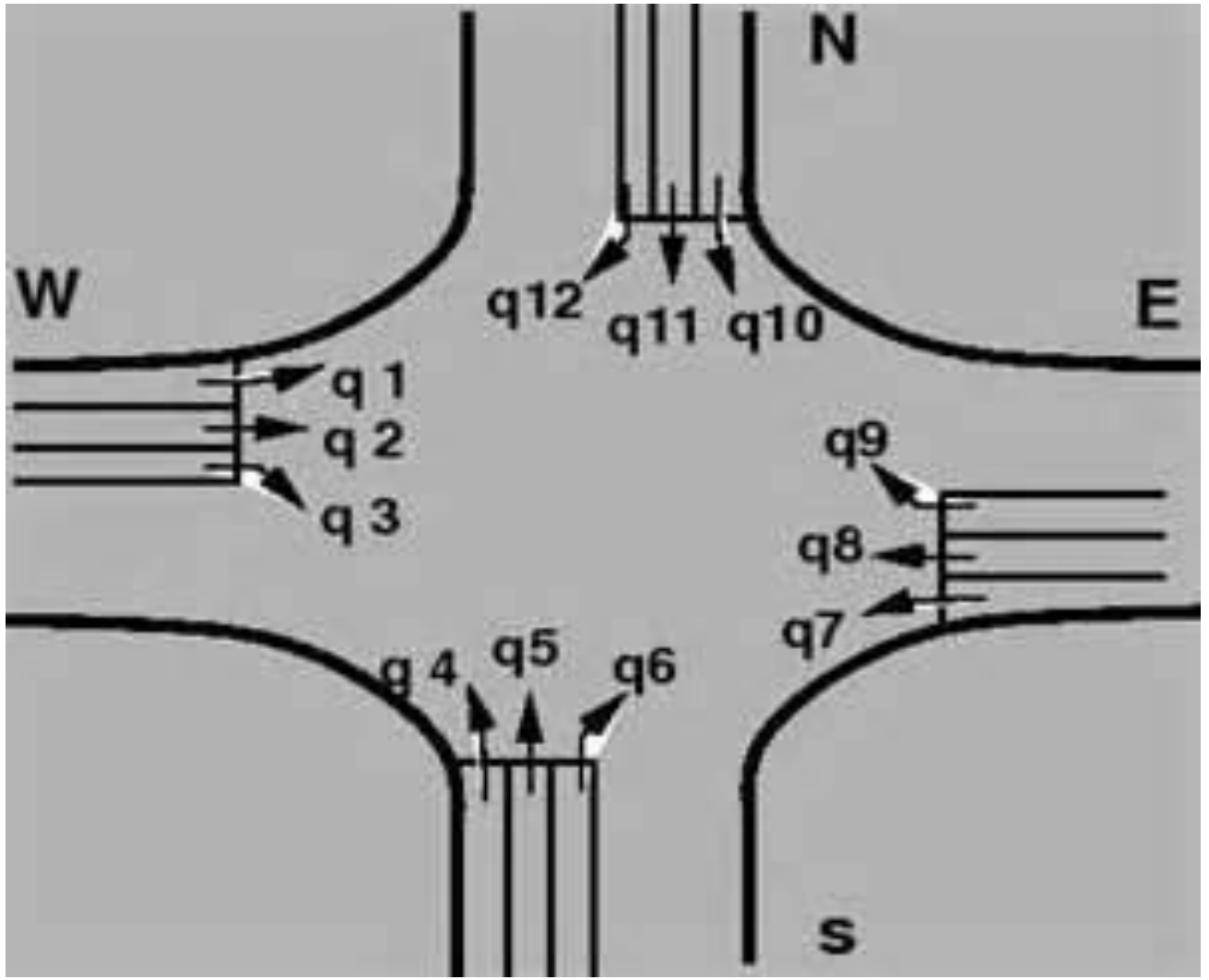
Causes of Congestion

a. External (Geometric) factors:

- Road intersections
- Railway crossings
- Narrow road/bridge/culverts
- Inconsistent roadway width
- Poor turning radius
- Side frictions
  - Scattered parking/non-motor activities along road
  - Frequent side roads entries
  - Bus stops/parking near junctions
  - Road side cut/unfinished repair of road side pavement

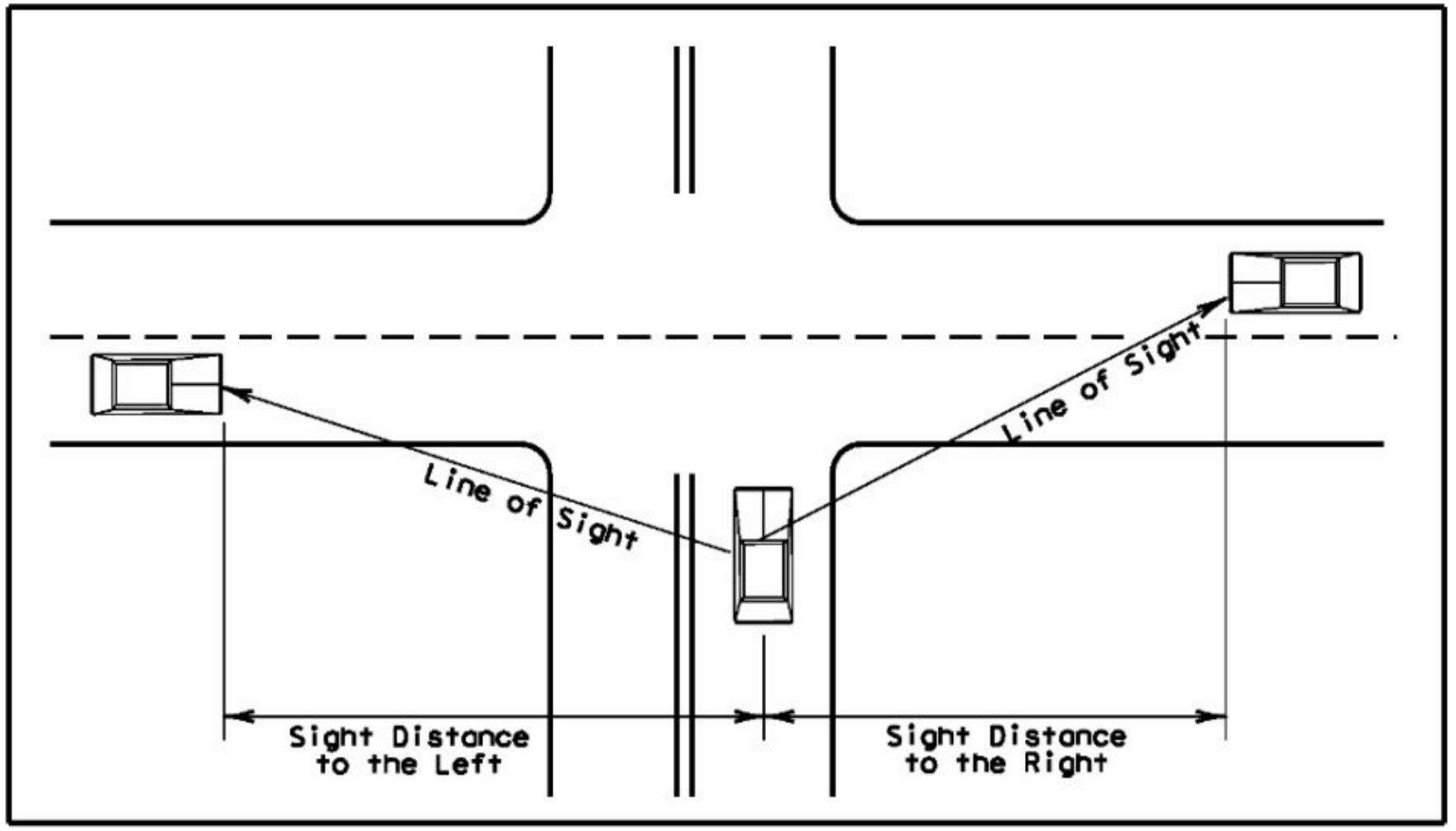
Causes of Congestion

a. External (Geometric) factors: Road intersections



Causes of Congestion

External (Geometric) factors: Road intersections



Entering Sight Distance Criteria

Causes of Congestion

External (Geometric) factors: Road intersections



Causes of Congestion

a. *External (Geometric) factors:* Railway crossings





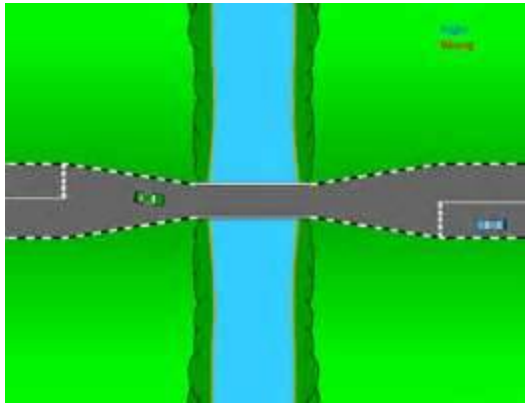
Causes of Congestion

a. *External (Geometric) factors:*

Narrow road/bridge/culverts







Causes of Congestion

a. *External (Geometric) factors:*

Inconsistent roadway width



Causes of Congestion

a. *External (Geometric) factors*: Poor turning radius



Causes of Congestion

a. *External (Geometric) factors:* Side frictions

- Scattered parking/non-motor activities along road





Causes of Congestion

a. *External (Geometric) factors:* Side frictions

- Frequent side roads entries



Causes of Congestion

a. *External (Geometric) factors:* Side frictions

- Bus stops/parking near junctions



Causes of Congestion

a. *External (Geometric) factors:* Side frictions

- Bus stops/parking near junctions



Traffic Engineering

Causes of Congestion

a. *External (Geometric) factors:*

- Side frictions
  - Road side cut/unfinished repair of road side pavement

Traffic Engineering

Causes of Congestion

- Poor roadway environment
  - Poor road discipline
  - Uncontrolled pedestrian crossing
  - Poor road surface condition
  - Speed breaker
  - Poor sight distance
  - Poor lighting
  - Poor drainage facilities

EXTERNAL (GEOMETRIC) FACTORS

POOR ROADWAY ENVIRONMENT

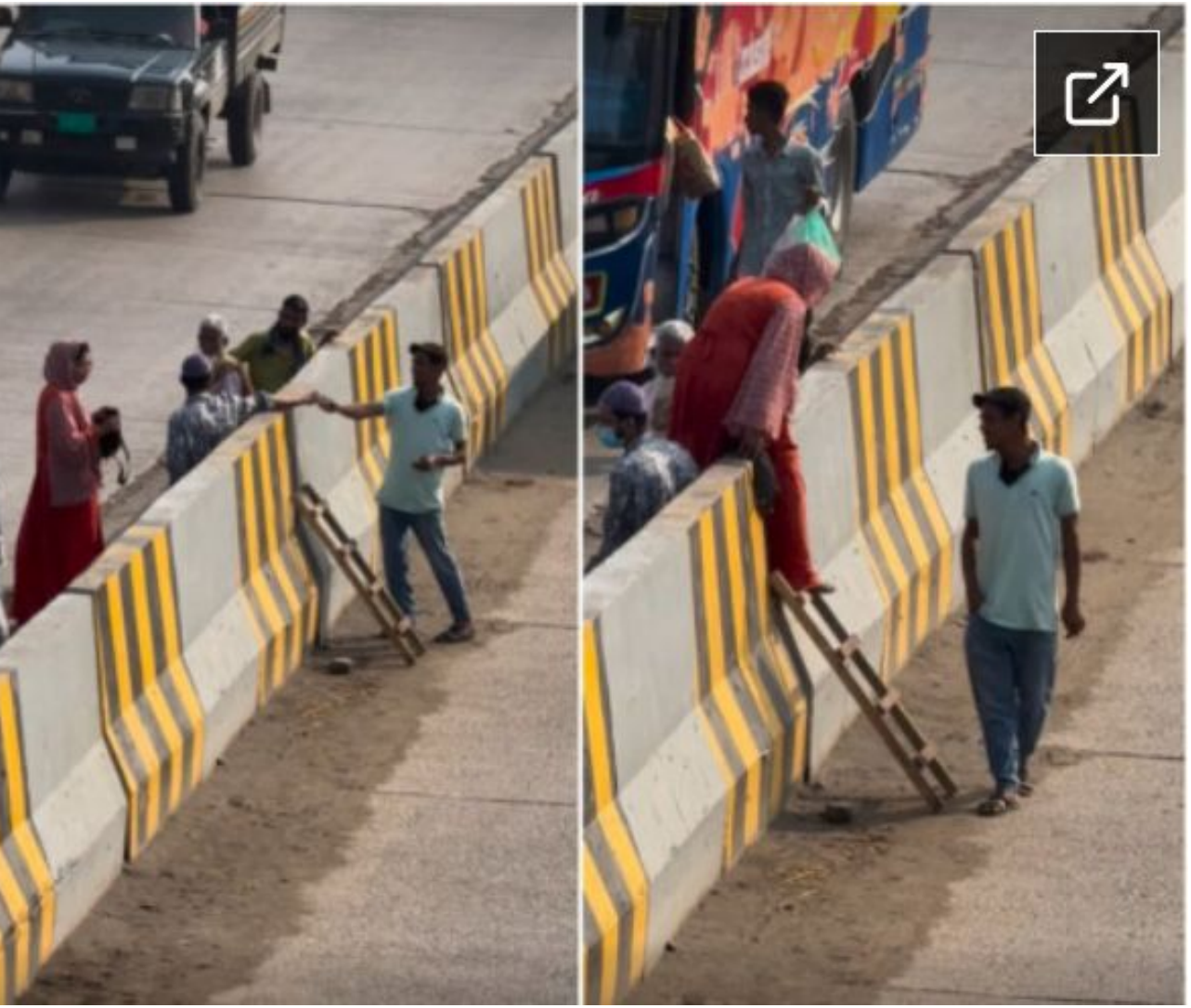
POOR ROAD DISCIPLINE



EXTERNAL (GEOMETRIC) FACTORS

POOR ROADWAY ENVIRONMENT

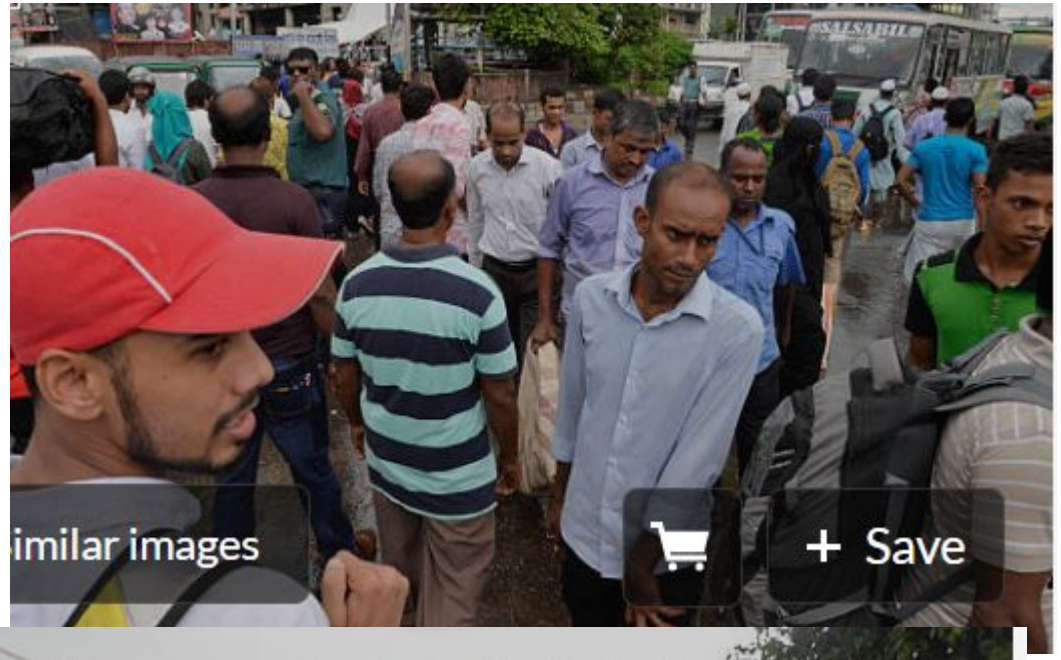
UNCONTROLLED PEDESTRIAN CROSSING



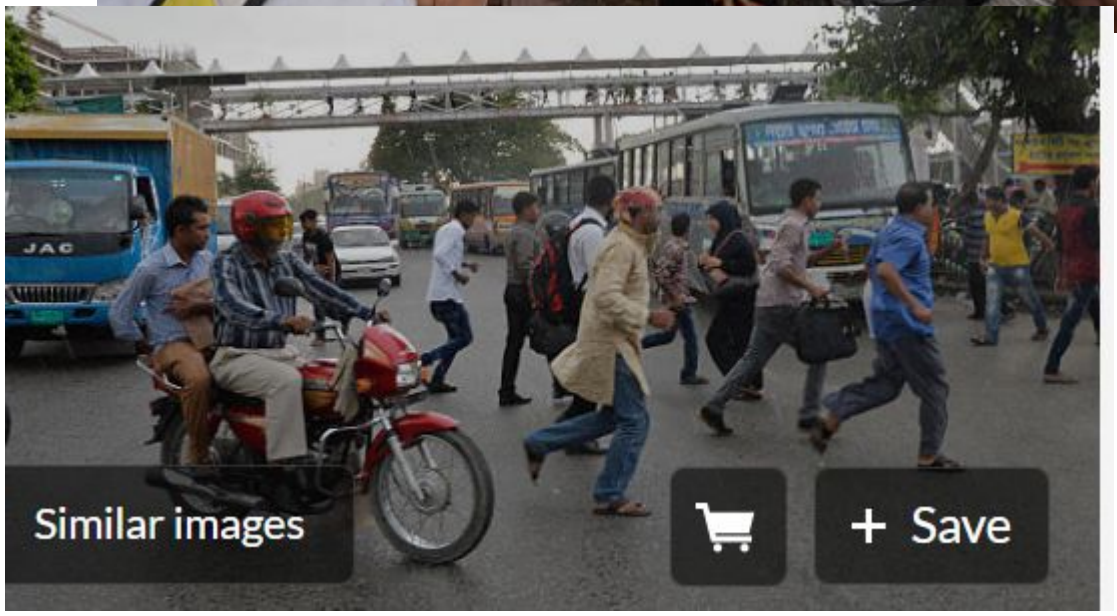





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EXTERNAL (GEOMETRIC) FACTORS

POOR ROADWAY ENVIRONMENT



POOR ROAD SURFACE CONDITION

EXTERNAL (GEOMETRIC) FACTORS

POOR ROADWAY ENVIRONMENT



SPEED BREAKER



EXTERNAL (GEOMETRIC) FACTORS

POOR ROADWAY ENVIRONMENT

POOR SIGHT DISTANCE



EXTERNAL (GEOMETRIC) FACTORS

POOR ROADWAY ENVIRONMENT



POOR DRAINAGE FACILITIES

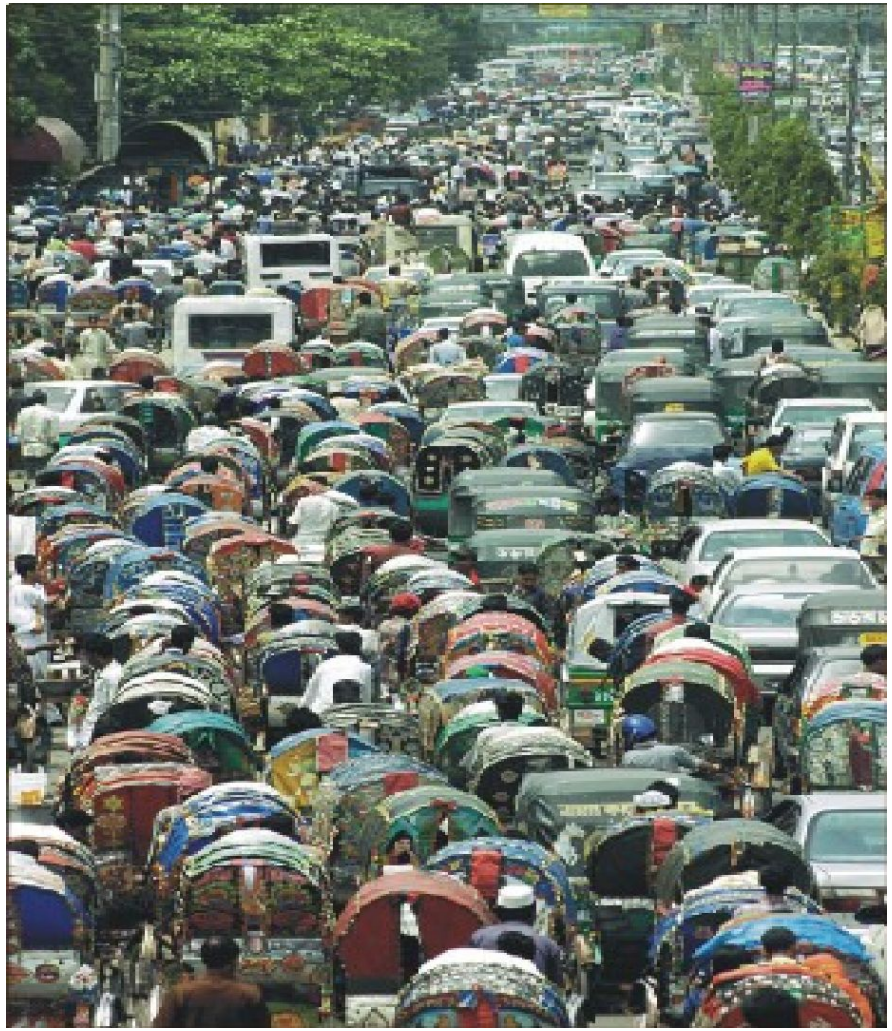


INTERNAL (TRAFFIC) FACTORS

b. Internal (Traffic) factors :

- Heterogeneous traffic stream
- High volume of traffic (demand > capacity)

HETEROGENEOUS TRAFFIC STREAM



INTERNAL (TRAFFIC) FACTORS:

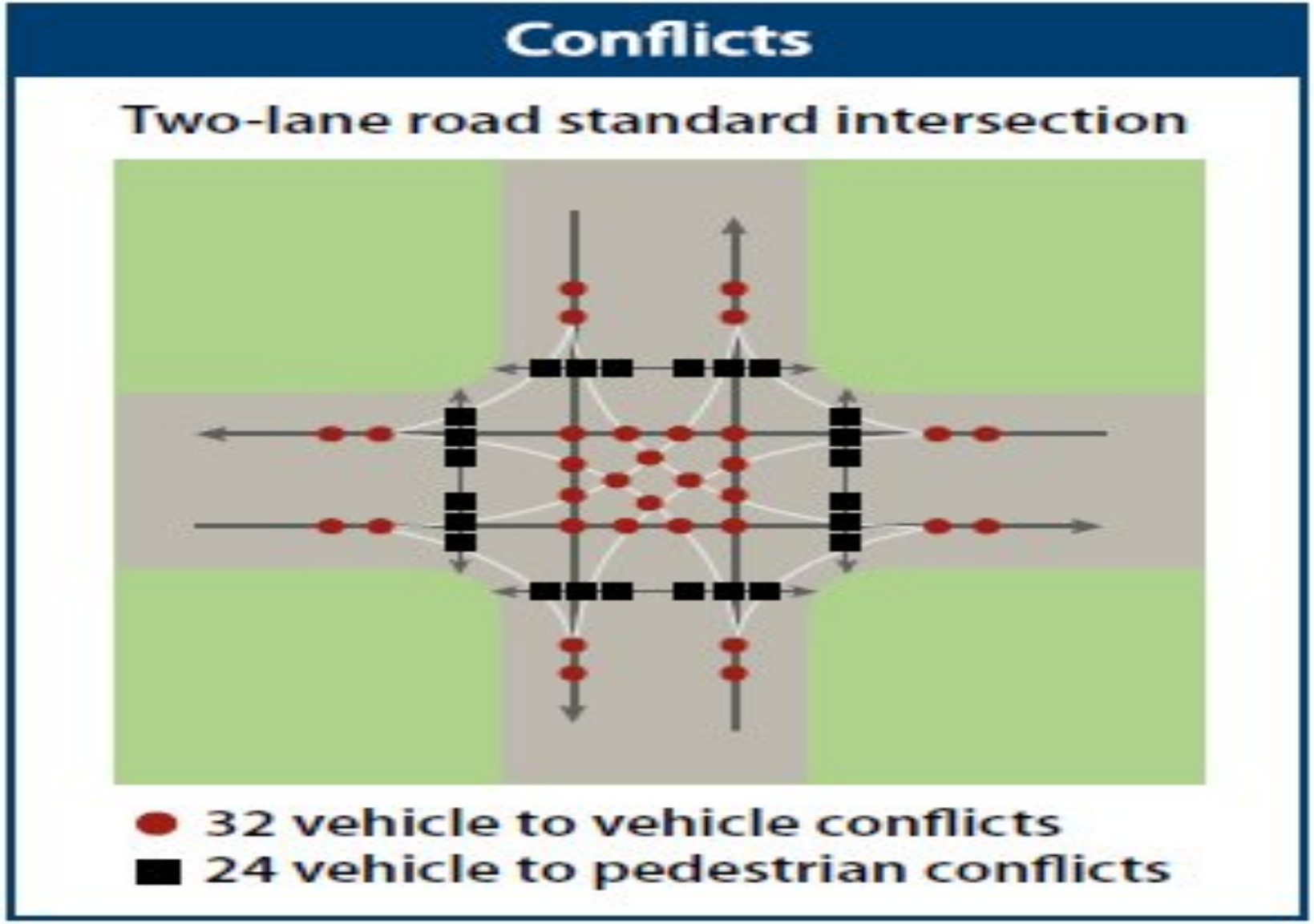
HIGH VOLUME OF TRAFFIC



SAFETY PROBLEMS

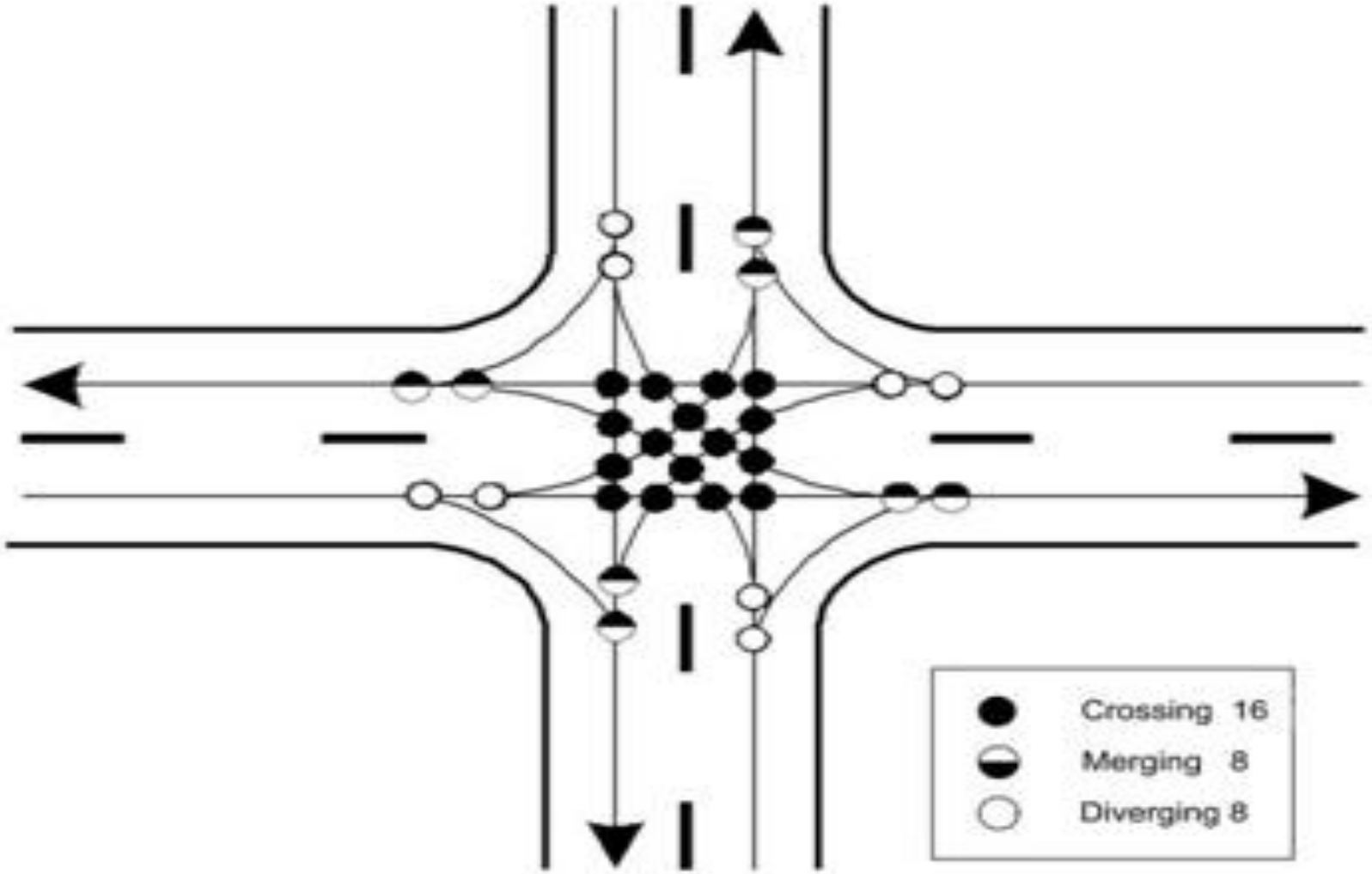
Safety Problems may arise mainly:

FROM CONFLICTS- AT INTERSECTIONS



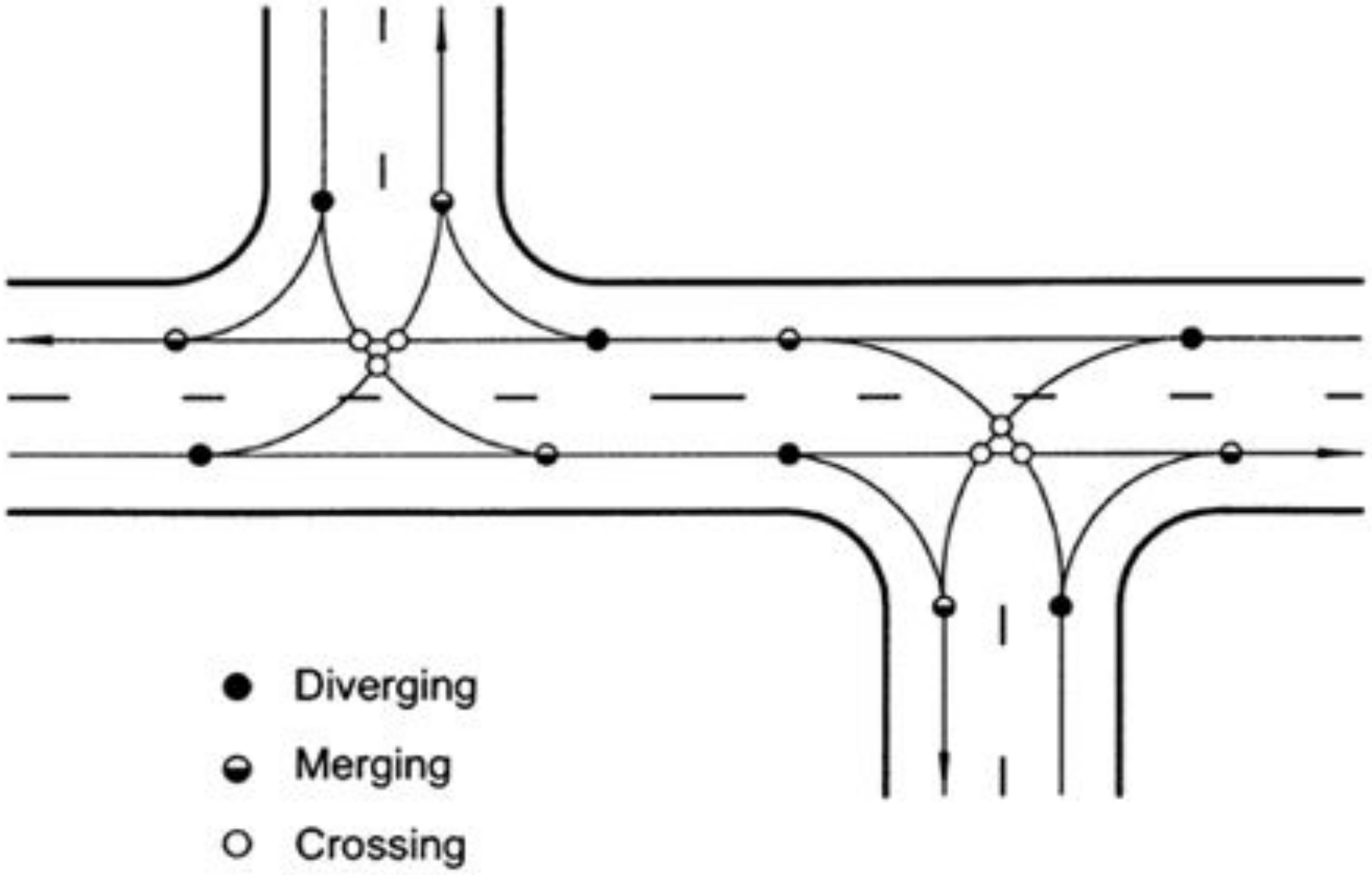
Safety Problems may arise mainly:

FROM CONFLICTS- AT INTERSECTIONS (32 at 4-Leg)



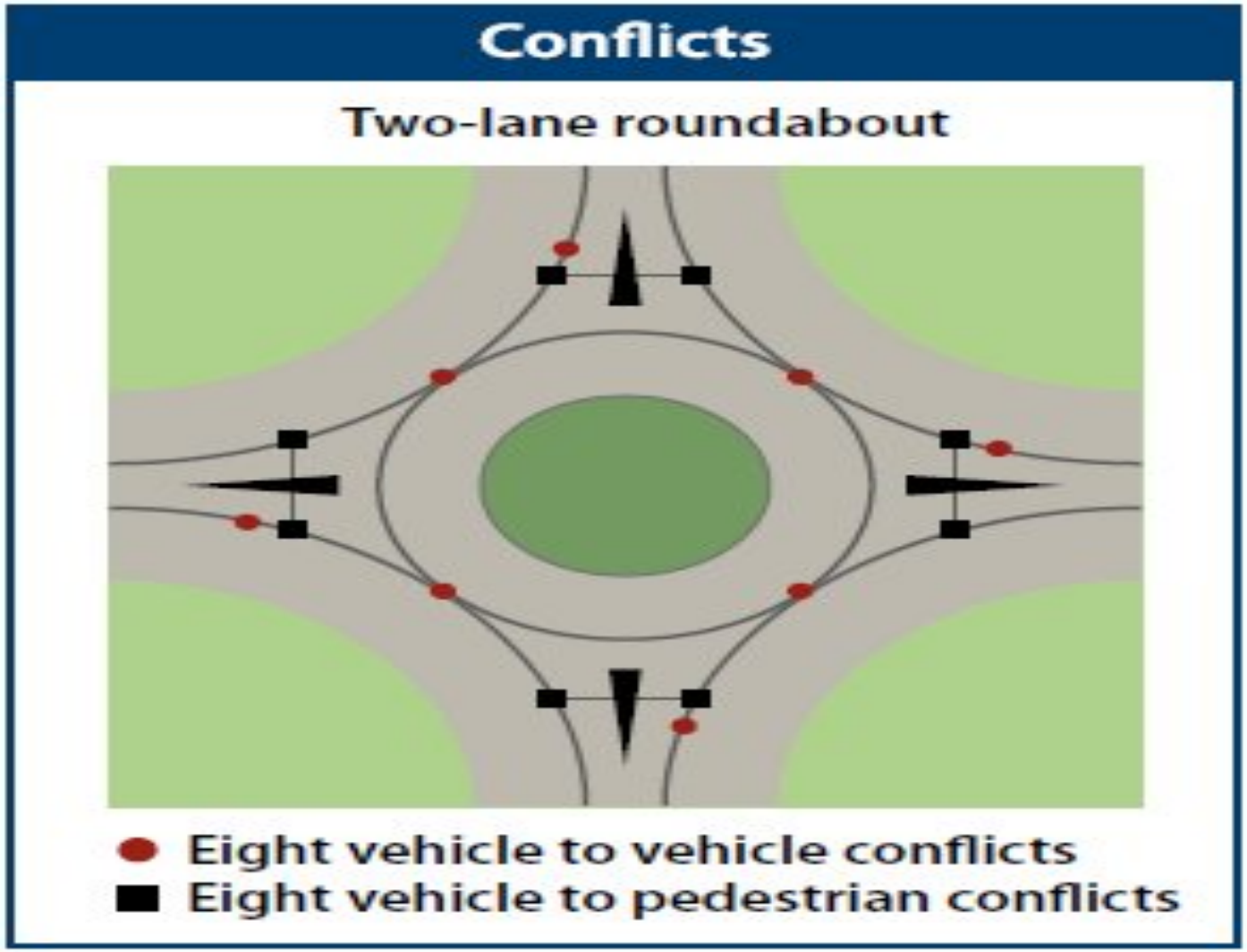
Safety Problems may arise mainly:

FROM CONFLICTS- AT INTERSECTIONS (9 at 3-Leg)



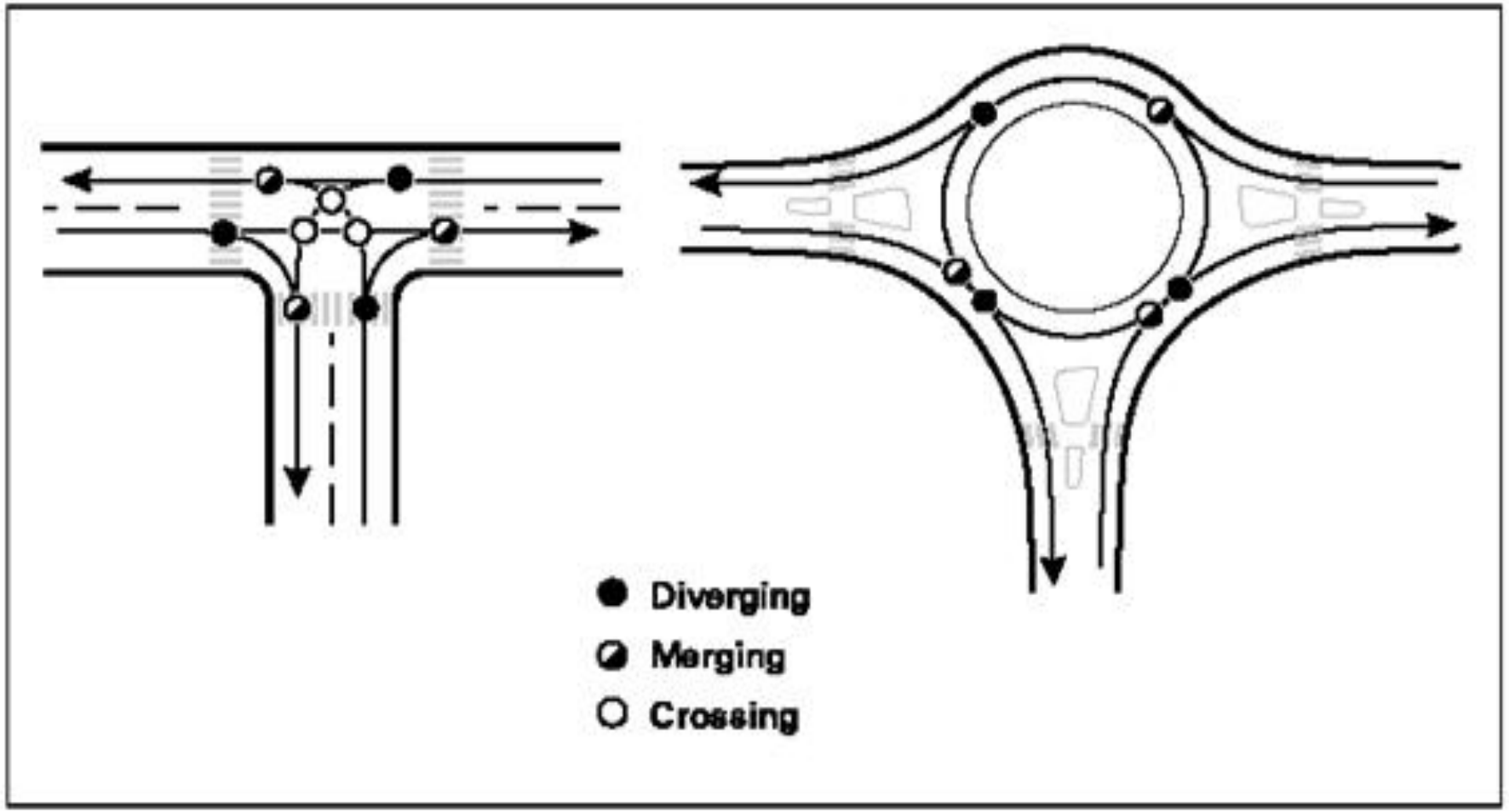
Safety Problems may arise mainly:

FROM CONFLICTS- AT INTERSECTIONS (8 x VV, 8 x VP)



Safety Problems may arise mainly:

FROM CONFLICTS- AT INTERSECTIONS (9 reduces to 6)



Safety Problems may arise mainly:

FROM CONFLICTS- ALONG ON-STREET PARKING





Safety Problems may arise mainly:

FROM CONFLICTS- WHERE PEDESTRIAN ACTIVITIES ARE HIGH





Safety Problems may arise mainly:

FROM CONFLICTS- At blind spots –bends, spots with poor sight distance/lighting facilities etc





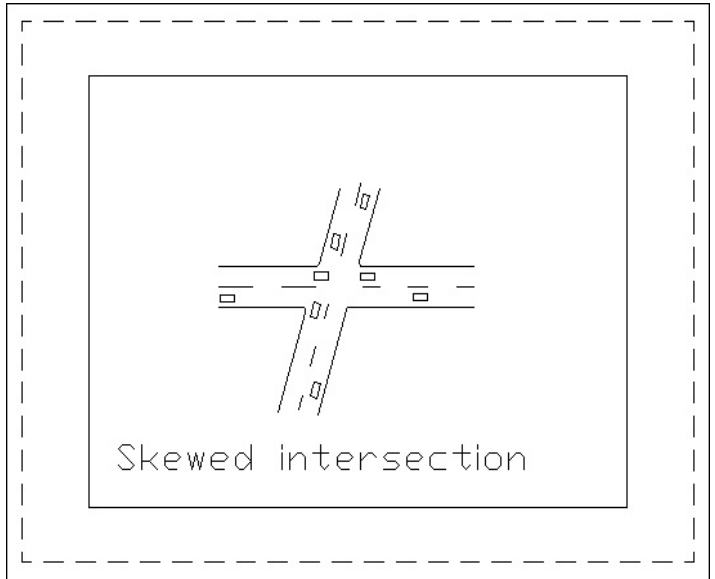
Safety Problems may arise mainly

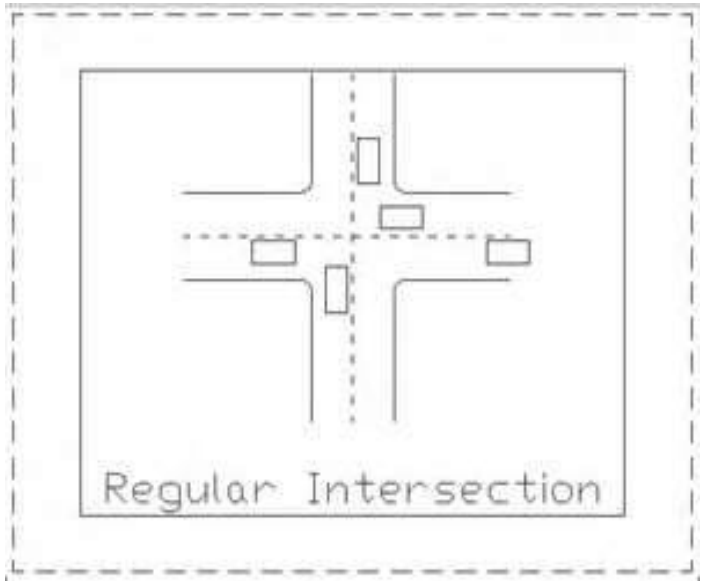
Due to

- Poor road surface condition
- Faulty road geometry
- Poor traffic operating condition – lack of traffic control devices
- Drivers' fault
- Mechanical failure

Safety Problems may arise mainly - Faulty road geometry







Safety Problems may arise mainly – Lack of traffic control devices



Road signs not visible



No restrictive marking at curve

Traffic Engineering Tools

1. Physical measures

2. Regulatory measures

Traffic Engineering Tools

Physical measures

- *i) To control vehicular movements*
- **Road signals/markings**
- **Road divider/Channelisation/islands**
- **Exclusive turning lane – flaring/widening of intersection**
- **Slip road**
- **Bus lay-by**
- **Speed breakers**
- **Segregated bus lane**
- **Grade separation etc.**
-
- *ii) To control standing vehicles*
- **On/off parking**
- **Off street loading/unloading for freight vehicles**
- **Terminals etc.**
-
- *iii) To control pedestrian movements*
- **Guard rail/median/pedestrian barriers**
- **Side walk**
- **Cross walk**
  - **Un-signalized – Zebra crossing**
  - **Signalized – (time separated/sharing)**
  - **Grade separated**
    - **Underpass**
    - **Overpass**

Traffic Engineering Tools

Physical measures

To control vehicular movements

Road signals/markings













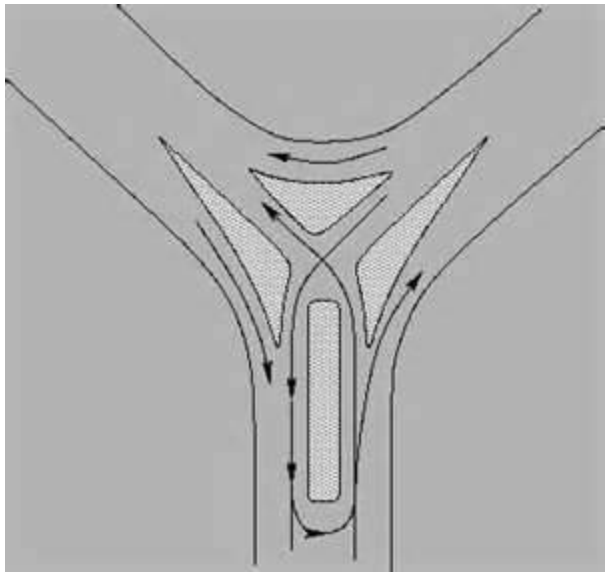
Traffic Engineering Tools

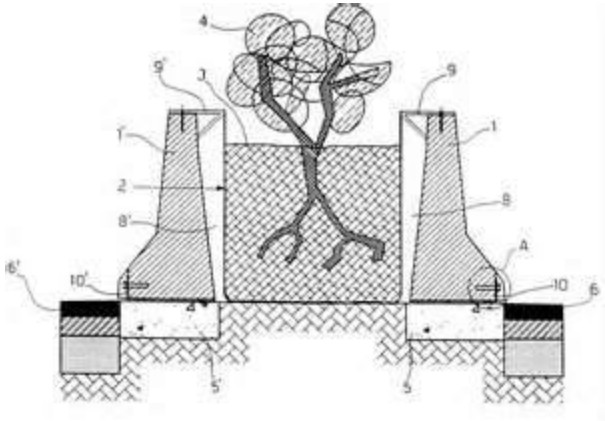
1.Physical measures

i) To control vehicular movements

- Road divider/Channelisation/islands
-









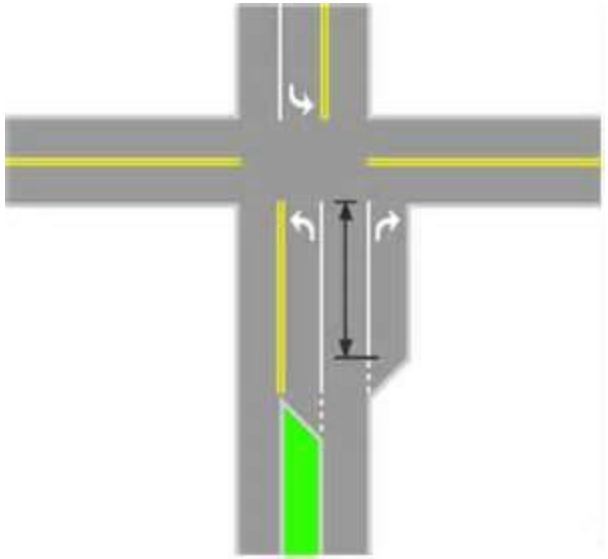
Traffic Engineering Tools

1.Physical measures

i) To control vehicular movements

•Exclusive turning lane – flaring/widening of intersection

•





Traffic Engineering Tools

1.Physical measures

i) To control vehicular movements

- Slip road
- Service Road



Slip Road

- It is a road traffic lane provided at an intersection to allow vehicles to turn at the intersection without actually entering it and interfering with through traffic. It therefore is not controlled by any traffic signals at that intersection.
- Sometimes it is also provided for entering or exiting a access controlled highway like Expressway.

Service Lane

- Is a local road running parallel to a higher-speed, limited-access road. A frontage road is often used to provide access to private driveways, shops, houses, industries or farms.

So basically a **slip road can be a service lane but a service lane can't be a slip road** as it gives access to the various properties or utility buildings located on a access controlled highway in order to prevent the interruption to the high speed traffic from the diverting traffic.

Traffic Engineering Tools

1.Physical measures

i) *To control vehicular movements*

Bus lay-by

- 



Traffic Engineering Tools

1.Physical measures

i) *To control vehicular movements*

Speed breakers/ Speed humps/







RUMBLE STRIPS



SPEED HUMPS

Traffic Engineering Tools

1.Physical measures

i) *To control vehicular movements*

Segregated bus lane





Traffic Engineering Tools

1.Physical measures

i) *To control vehicular movements*

Grade separation etc.





Traffic Engineering Tools

1.Physical measures

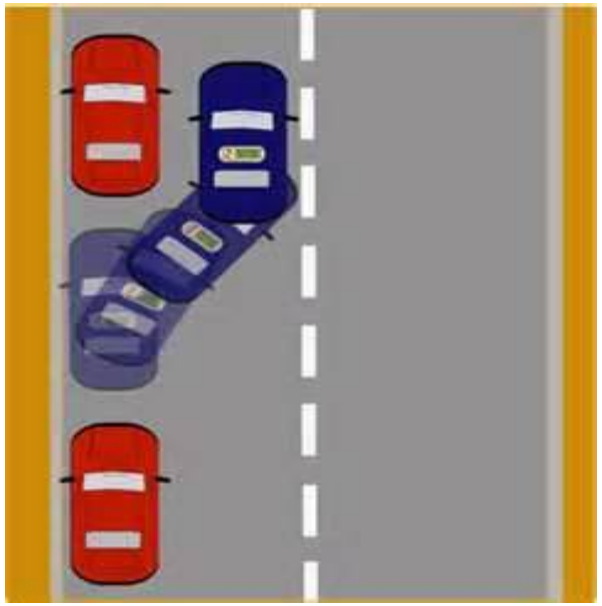
ii) To control standing vehicles

On/off parking









Traffic Engineering Tools

1.Physical measures

ii) To control standing vehicles

Off street loading/unloading for freight vehicles





1.Physical measures

ii) To control standing vehicles



BUS STATION



BUS TERMINAL



1.Physical measures

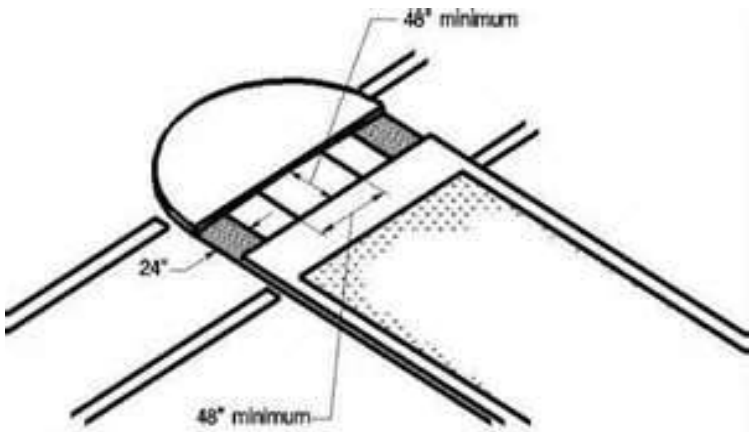
iii) To control pedestrian movements

Guard rail/median/pedestrian barriers









Ramped Median

1.Physical measures

iii) To control pedestrian movements

Side walk



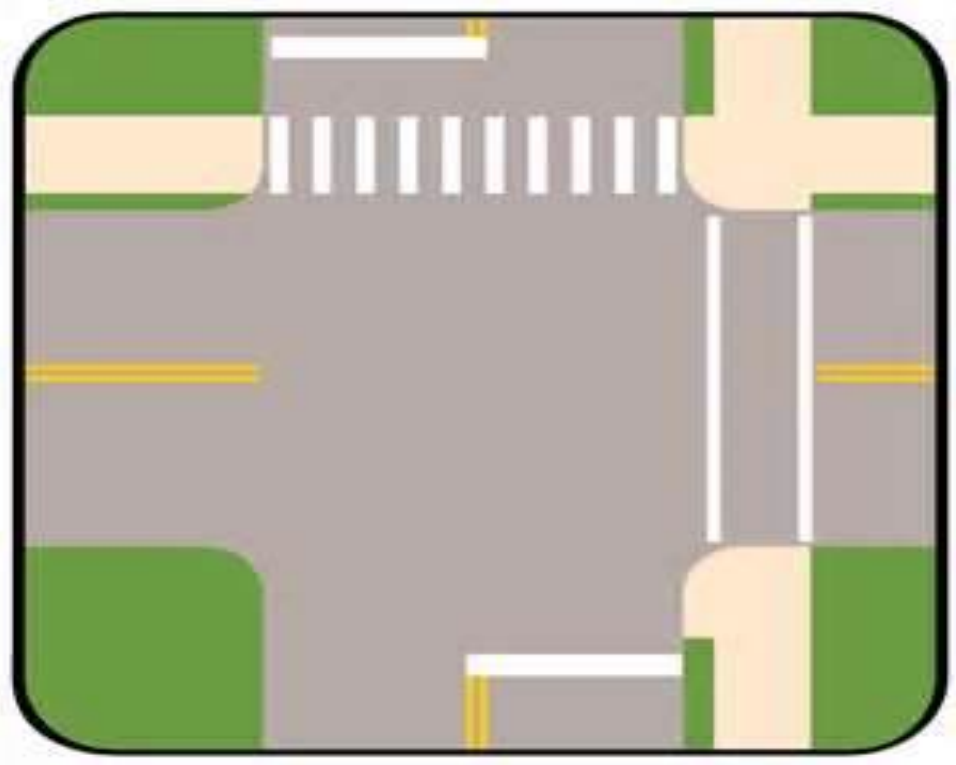


1.Physical measures

iii) To control pedestrian movements

Cross walk

-





1.Physical measures

iii) To control pedestrian movements

Cross walk





1.Physical measures

iii) To control pedestrian movements

Cross walk

•Grade separated



1.Physical measures

iii) To control pedestrian movements

Cross walk

•Overpass





Traffic Engineering Tools

Regulatory measures

- Banning right turn
- One-way operation
- Speed control
- Parking control
- Access control
- Road Pricing

Regulatory measures





Regulatory measures





Regulatory measures

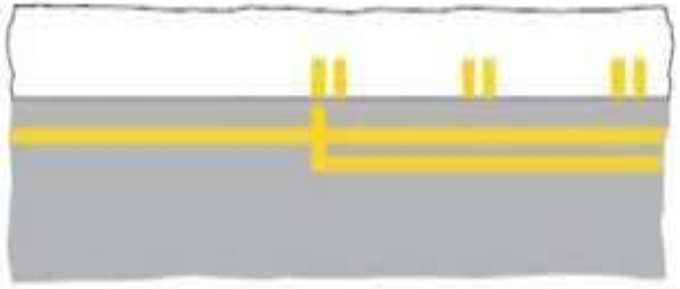




Regulatory measures











Regulatory measures





Regulatory measures





Discussion

1. Definition
2. History
3. Objectives of TE
4. Traffic Parameters
5. Congestions
6. Safety Problems
7. TE Tools