12-Congestion Studies

18 January 2022 09:37

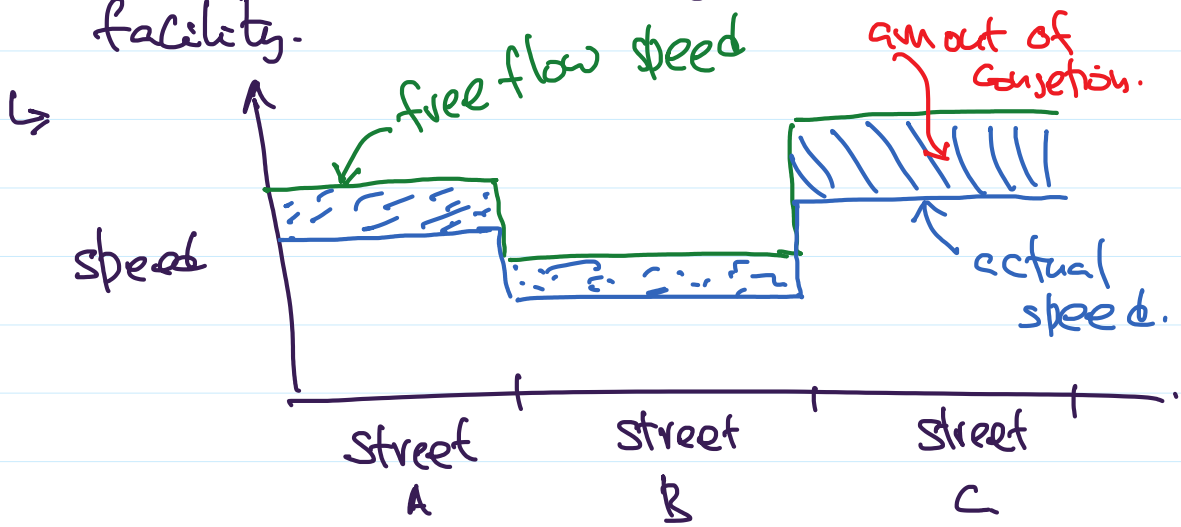
Introduction.

↳ When demand exceeds capacity

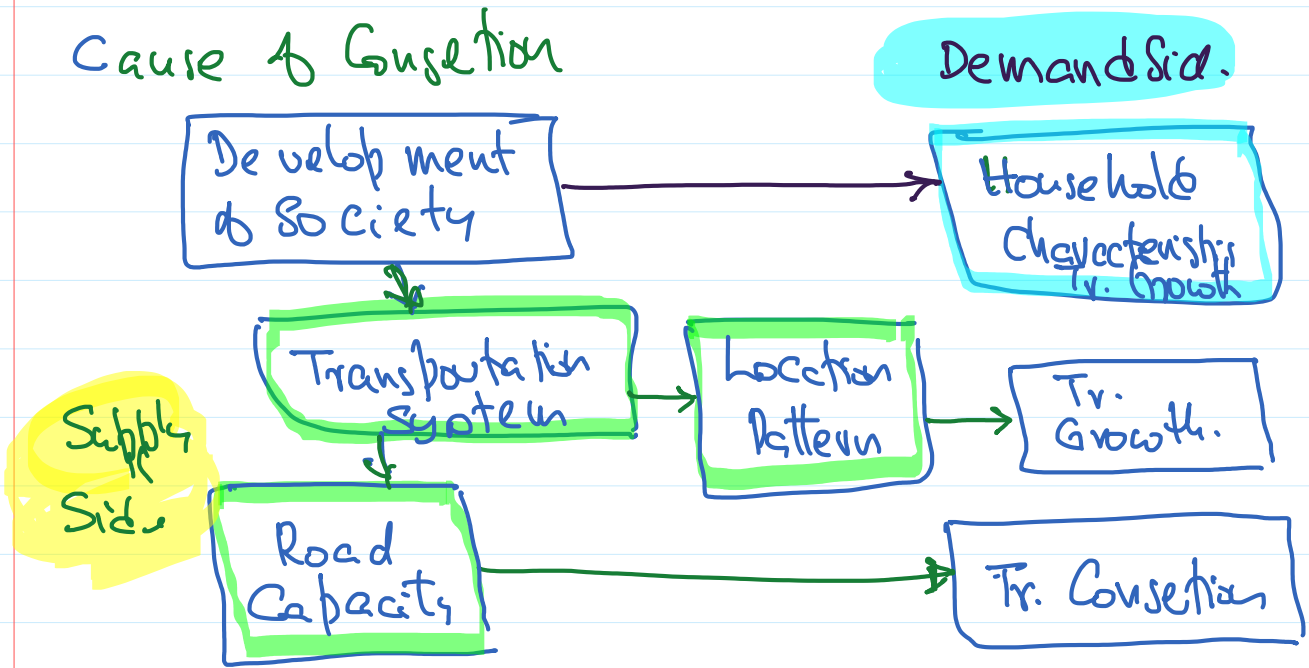
↳ Defined as when travel time or delay is in excess of normally incurred under light or free flow traffic condition.

↳ Travel time or delay in excess of agreed norm, which may vary by the type of the facility.

↳



Cause of Congestion



Types of Congestion

↳ Recurrent

↳ non-recurrent.

Effect of Congestion.

Quantification of Congestion.

1. Duration
   Extend
   Intensity..
4. Reliability.

1 Duration

→ The amount of time the congestion affects the travel time.

→ Highway Capacity Manual.

→ Number of hours of congestion observed on a link.

→ If $\left(\frac{V}{C}\right)_i < 1 \Rightarrow$ no Congestion

$> 1 \Rightarrow$ Congestion.

$$H_i = \frac{T\left(\frac{V_i}{C_i}\right)(1-r)}{1 - r\left(\frac{V_i}{C_i}\right)}$$

$H_i \rightarrow$ Duration of congestion for link i

$r \rightarrow$ $\frac{\text{Off-peak demand rate}}{\text{peak demand rate}}$

$v_i \rightarrow$ vehicle demand on link i (veh/hr)

$C_i \rightarrow$ capacity of the link i (veh/hr)

$T \rightarrow$ Duration of analysis (hr).

2. Extent

→ No. of people or vehicles affected by Congestion.

→ Queue length for segment i

$$Q_{Li} = \frac{T\ (v_i - c_i)}{N_i\ d_s}$$

Q_{Li} → queue length for link/segment i (m)

v_i → veh. demand for link i (veh)

c_i → capacity of link i (veh)

N_i → No. of lanes.

d_s → storage density (veh/km/lane)

Free way → 75 veh/km/lane.

Two lane Street → 130 veh/km/lane.

3. Intensity.

→ Measure severity of Congestion.

→ Measured in terms of

(i) Delay in person hours (or vehicle...)

(ii) Average speed of the corridor.

(iii) Per Capita delay.

(iv) Relative delay...

→ $PHD = PHT - PHT_0$

PHD → Person Hours

PHT → Actual

PHT_0 → Free-flow Condition.

$$PHT = \frac{AUO_i * V_i * L_i}{S_i}$$

PHT → Person Hours of Travel.

AUO_i → Average Veh Occupancy on link i

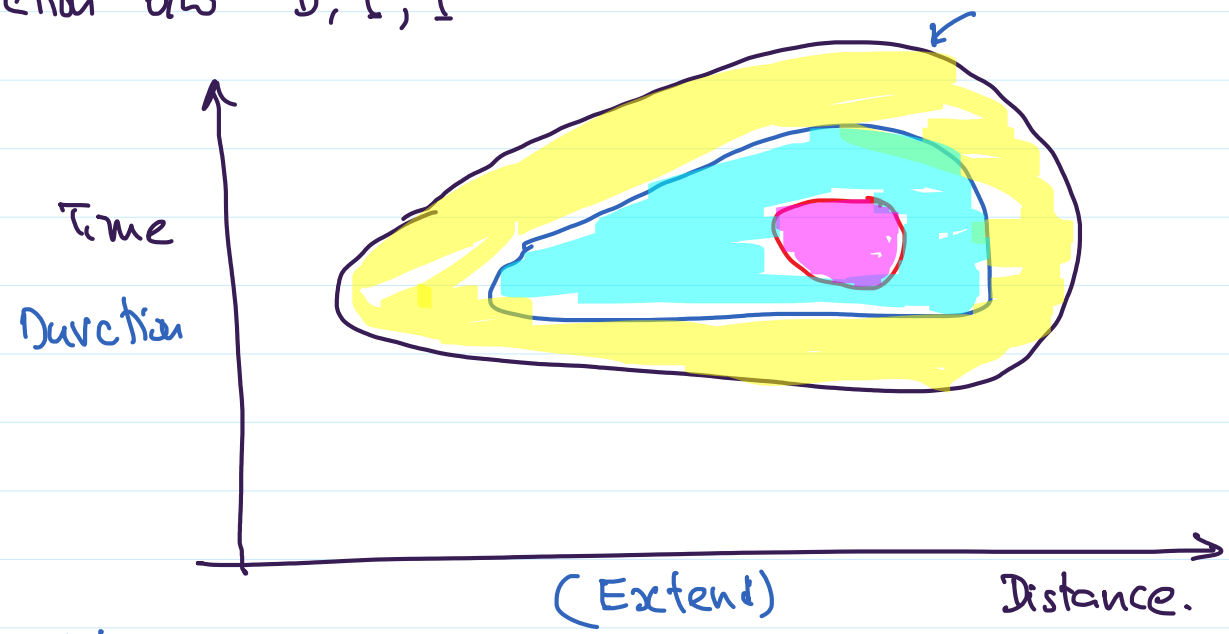
V_i → vehicle demand

L_i → Length of the link

S_i → Mean speed of the link i

$$PHT_o = \frac{AUO_i \cdot L_i V_i}{So_i}$$ → free flow Conditions.

Relation b/w D, F, I



Reliability

→ Measure of drivers ability to predict and plan for certain travel time.

→ variation of travel time / speed . . .

→ std. dev can be a very simple measure

velocity.

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Congestion Mitigation

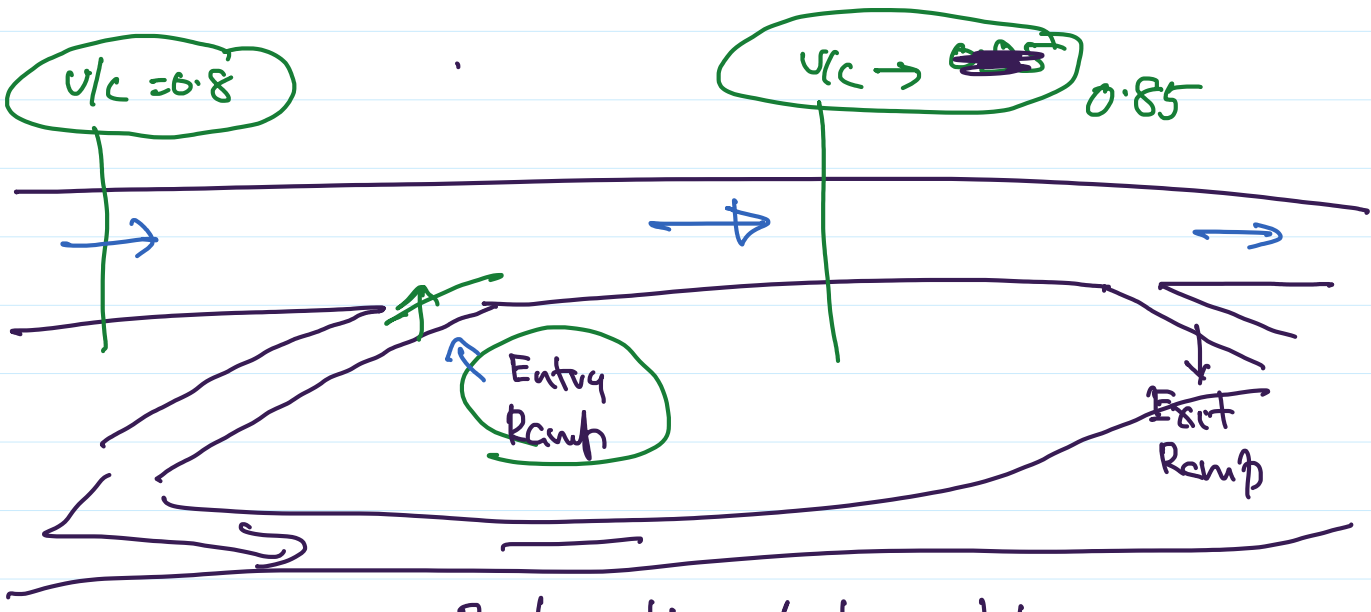
Demand.

Supply Side

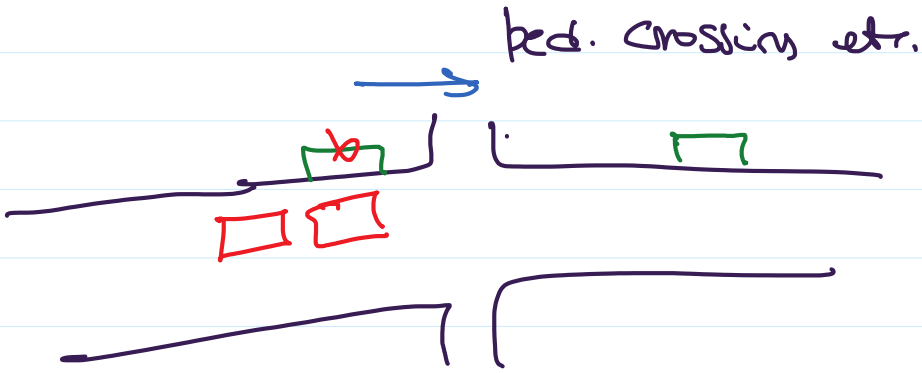
→ focus on transportation system
* Increasing the capacity of the sy.
* Operate more efficiently.

→ Large scale improvements
* Road widening / new roads
* Intersection improvements.
  ↳ Flyovers / Grade
* ITS technologies. (e.g. fastag)

→ Small scale improvement.
* Signal Control.
* Ramp metering. E.g. Freeway.



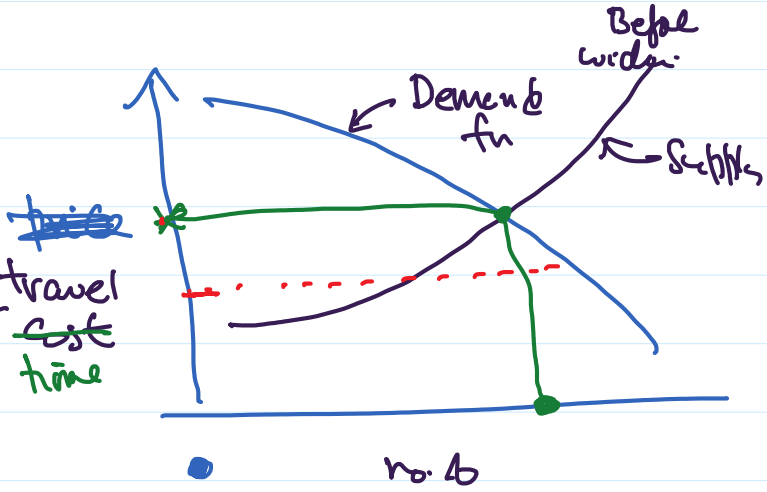
* Relocation of bus-stops

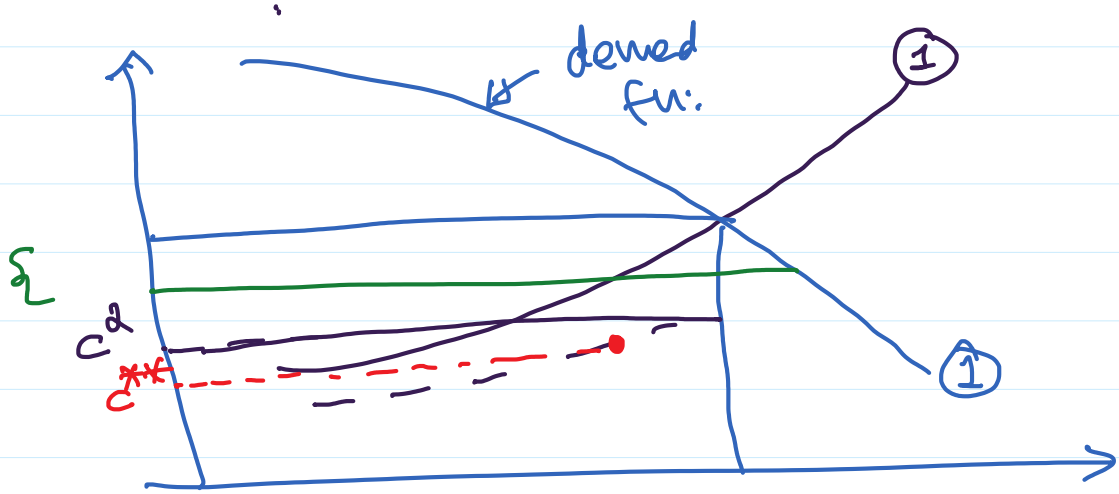


Demand Side

Generalized Travel

= f(d → distance
t → time
→ Comfort
→ Convenience)
:

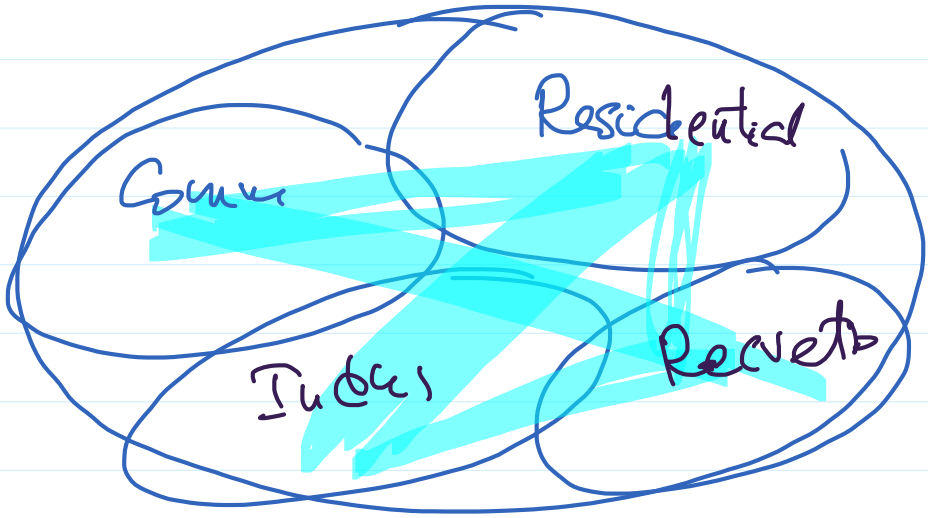


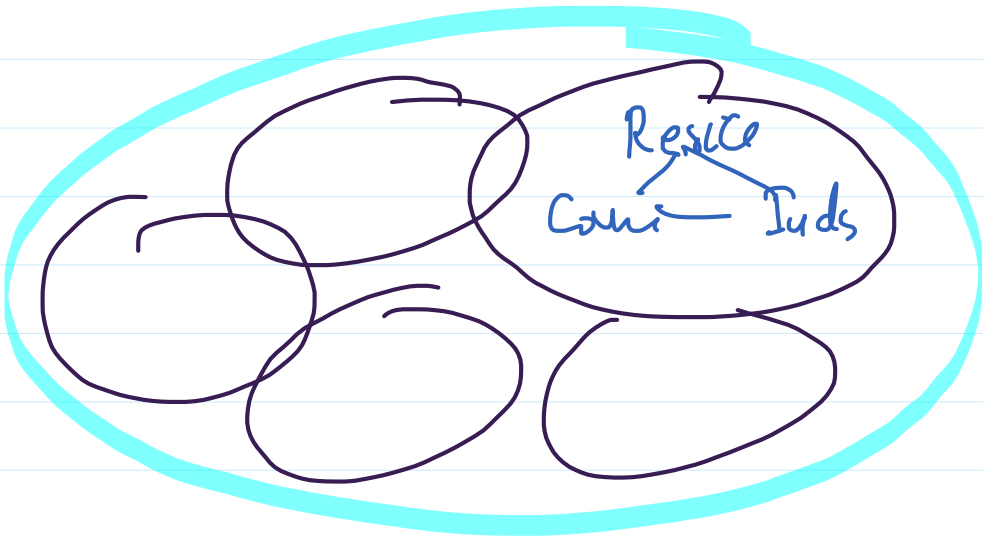


① Existing ② Proposed

E.g. ① Staggered working time.

② Land use management.





(3) Discourage use of put. vehicles.