Kabite Site

23.04.24

Lecture-01:

- Transportation is the movement of men, materials and goods. Also the movement of information.
- Time কমা → productivity বাড়ে → economy বাড়ে.
- Transportationsolution must be →
  - analytically based → max people carry করবে
  - economically sound → affordable
  - socially credible
  - environmentally sensitive
  - practically acceptable
  - sustainable.

Disciplines of transportation:

1. Transportation planning
2. Geometric design
3. Pavement "
4. Trafic engg.
5. Public transportation
6. financial and economic analysis
7. Environmental impact assessment
8. Accident analysis and reduction

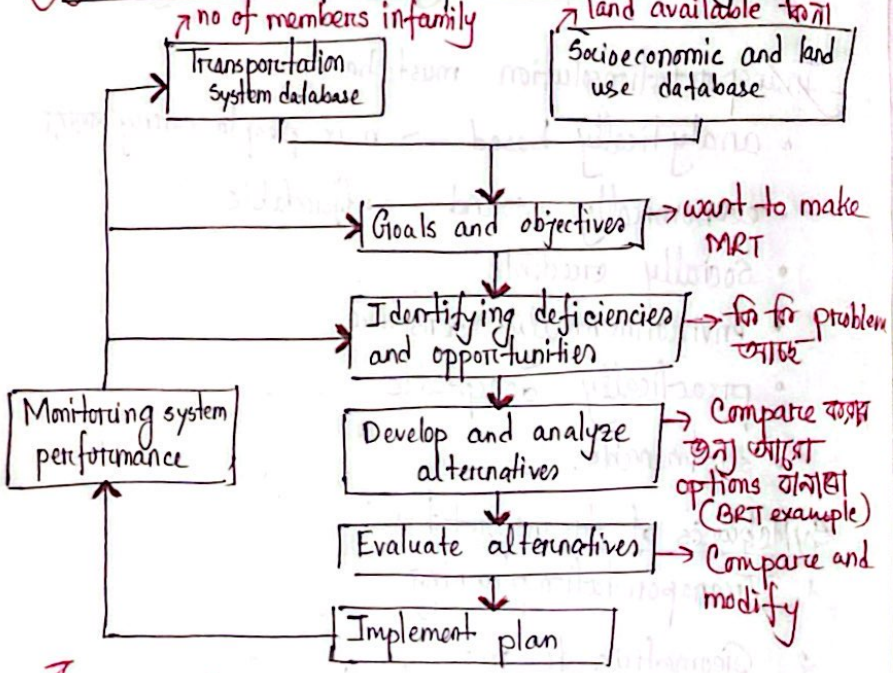
Scanned with CamScanner

factors affecting transportation:

- Road
- human
- vehicle

V.V.I

Basic elements of transportation Planning:



—Task নিজেরও আসতেপারে.

V.V.I

Transportation system Modeling:

- Recognized components of future travel demands are

1. Existing traffic → বর্তমানে traffic কত/কেমন
2. Normal traffic growth → future-এ কত শতাংশ কত % করে বাড়বে।
3. Diverted traffic → অনেক route থাকবে same জায়গায় যাওয়ার জন্য
4. Converted traffic → আগে হেটে গেলে এখন মোটর করে যায় মানে mode of transportation change হবে।
5. Change of destination traffic → A point-এ আগে hospital ছিলো কিন্তু Bpoint এ নতুন hospital হওয়ার কারণে অনেকে সেখানে যায়। নতুন road হওয়াতে new destination-এ traffic divide হয়ে new road use করা শুরু করবে
6. Development traffic → জায়গার development হওয়ার কারণে traffic develop হয়।
7. Induced traffic → similar like converted traffic। transport improve করে নতুন একটা জায়গায় যাওয়া যেখানে আগে কিছু ছিলোনা

road করার আগে আগে road এর surrounding-এ building, markets করা হয় which effects GDP

Social and environmental consequences of Highways:

1. Noise attenuation
2. Air pollution
3. Impacts on wetlands
4. General principle of Noise barrier design.

Highway evalution:

- purpose মূল্যায়ন করতে হবে।

Cost of highway transportation:

1. highway investment cost → রাস্তা তৈরির খরচ
2. " maintenance cost → " যত্ন রক্ষার খরচ
3. " user cost : VOC (Vehicle operating cost) [ব্যবহার খরচ, fuel cost], TTC (Travel time cost) [time-time লাগবে], accident cost
4. Transit capital cost → investment
5. " operating " → সব নিয়ম কিভাবে পালন হচ্ছে কিনা
6. " user " → parking cost

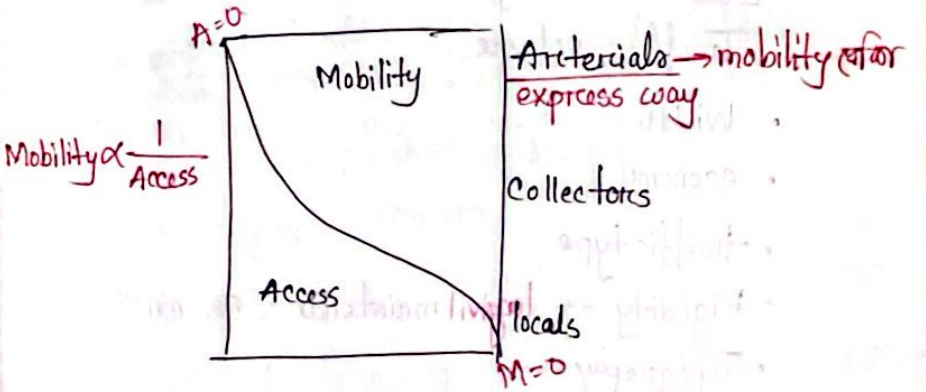
Benefits of highway transportation:

1. Direct benefits → less time, comfortable
2. Indirect " → নতুন transport network others facility বা modify করলে

Highway classification:

- function of highway → (i) movement/mobility
  (ii) access → access পাইলেই movement হবে।

access — সমান্য → movement — slow
access — limited → movement — fast



- main road কে Artery বলে।

V.V.I

The concept of functional classification:

- main road এবং sub road এর মাঝে transition দিতে হবে কারণ কম speed থেকে হঠাৎ speed এ যাবে।

→ Figure must

Types of roads:

- classified based on →
  - Materials
  - Location and function
  - Traffic volume
  - Width
  - economy
  - traffic type
  - Rigidity → maintenance কম লাগে।
  - Topography

Based on materials:

WBM → Water Bound Mecadam

Green transport → walking, cycling

- Rigid pavement → made of concrete, more durable, costly
- Flexible " → easily break হয়, bituminous roads

building design এর input → load
রাস্তার ক্ষেত্রে input → traffic

Lecture-02: 30.04.24

Design controls and criteria:

- functional classification — কোন কাজে use করবো
- Projected traffic volumes and composition highway দিয়ে কী কীসের men and material যাবে
- Design speed and design vehicle রাস্তা দিয়ে কত speed এ গাড়ি চলবে এবং কোন কোন রকম গাড়ি চলবে
- Topography → কোন জায়গা তে রাস্তা করবো
- Available funding → কোন alignment এ funding কত হবে
- Drivers performance factors → কেমন drivers গাড়ি চালাবে
- Safety
- Politics
- Social and environmental impacts
- Right of way (ROW) → কতটুকু জায়গা নিবো।
- Costs

Scanned with CamScanner

- highway এভাবে design করতে হবে যেন একটি minimum sight পাওয়া যায়

Cross-section elements: → figure must

- travel lane
- Divider
- Rickshaw lane
- Cycle lane
- footpath
- street light
- railing
- electric pole
- bus stop

Principal elements:

(i) Travel lane

(ii) Shoulder — main road এর পাশের যে travel lane এর extended part.

Marginal elements:

(i) Median and roadside barrier
(median = divider)

(ii) Curbs and gutters

(iii) Guard rails

(iv) Sidewalks

(v) Cross slopes

(vi) Side " (পানি যাতে side এ চলে যায়)

(vii) Right of way

Additional elements:

(i) Passing lane

(ii) Turnouts

(iii) Climbing lane

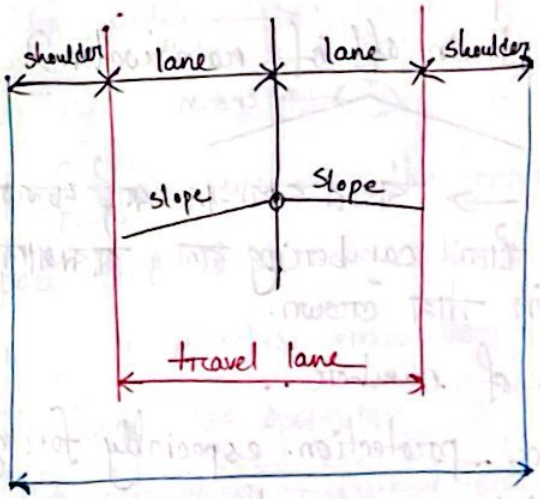
(iv) frontage road/ service road

(v) Bus layby

(vi) Noise barrier

(vii) street light

Roadway and travel way: figure must



Lane width:

- 12' হলে ভালো হয় কেননা lane
- ৪' এর নিচে lane হয়না

(*) lane width affect safety, comfort, speed and capacity → explain why?
speed এর capacity কমে যাবে
per unit time এ কম vehicle যাবে

Geometric Design standards for roads & Highway department, BD:

(i) National
(ii) Regional
(iii) feeder

PCU → passenger Car Unit

(*) How cross slopes are provided on roadway pavement? How to ensure surface drain off of rain water?



- Camber → রাস্তার মাঝখান বরাবর উঁচু করা. process টাকে cambering বলে, মাঝখানের উঁচু অংশের নাম crown.

(1) Objectives of camber.

- Surface protection especially for gravel and bituminous road
- Sub-grade protection by proper drainage
- Quick drying of pavement which in turn increases safety.

(2) alternative system of providing cross road with figure. → camber এর চিত্রগুলো

Shoulder:

- It is essential that shoulder be flush with the edge of the traveled lane and sloped to facilitate drainage.
- shoulder width → 10-12'

Importance of shoulders:

1. space for vehicles with problems to park
2. Space for drivers to stop and check maps.
3. " " evasive maneuvers to avoid collisions
4. The sense of openness
5. Help providing required sight distance
6. Increased aesthetics
7. Improved capacity
8. Space for maintenance operations (snow & storage)
9. Lateral clearance for signs and guardrails
10. Discharge storm water away from the edge of pavement
11. Structural support for the pavement
12. Space for pedestrians and bicycles

07.05.24

Lecture-03:

Sidewalks : — যেখানে pedestrian বেশি সেখানে এটা main element

- Sidewalks are generally provided when pedestrian traffic is high along main or high-speed roads in either rural or urban areas.

V.V.I

(A) Shoulder এর color, texture কেন different করা হয় main road থেকে ?

⇒ যাতে গাড়ির driver shoulder line এ দেখলেই road এবং shoulder differentiate করতে পারে।

V.V.I

(B) How to identify shoulder ?

Sidewalk :

- Min width → 4' (residential area)
- " " → (4-8)' (commercial areas)
- sidewalk যত চওড়া হবে তত main road এর জন্য ভালো

Median :

- it is the section of a divided highway that separates the lanes in opposing directions.
- two lane two way → দুটো lane দুটো direction (undivided) → many hall to mist — ২ লাইন।
- two lane two way divided → divider থাকে মাঝে করা। → mist to BUP
- similar like shoulder → drainage network হিসেবে কাজ করানো যায়

Median functions:

- provide recovery area for out-of-control vehicles.
- Separating opposing traffic
- Providing stopping areas during emergencies
- " storage areas for left-turning and U-turning vehicles
- Providing refuge for pedestrians.
- Reducing the effect of headlight glare.
- Providing temporary lanes and cross-overs during maintenance operations.

Scanned with CamScanner

Median Types :

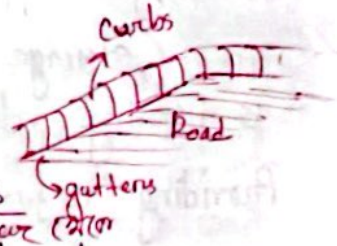
1. Raised → travel lane থেকে উঁচু
2. flush → travel lane এর সমান
3. Depressed → " " থেকে নিচু

- Median width →
  (4-80)' or more
  for 4 lane urban freeways min of 10'
  " 6 " " " " (22-26)'

Median Barriers :

- to prevent errant vehicle from crossing

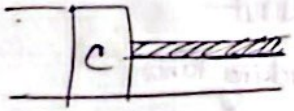
Drainage structures :



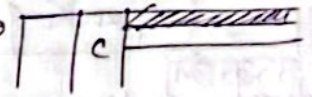
1. Ditches
2. Curbs and gutters Shoulder থেকে
3. Parallel drainage structures
4. Cross drainage structures

Curbs/Kerbs:

(i) Vertical curb →



(ii) Flush curb →



(iii) mountable curb →

Longitudinal barriers:

(i) Guard rail

Right of way :

- রাস্তার এপাশ থেকে ওপাশ পর্যন্ত।
- is the total land area acquired for the construction of the highway.

Marginal cross roads elements :

(i) footpath, bike way
(ii) Noise barriers
(iii) Bus bays
(iv) Service road/ frontage road
local slow moving transport এর জন্য।
(v) passing lane — কেন দরকার??

Scanned with CamScanner

CT-syllabus → 1st class থেকে এই পর্যন্ত

(VI) Turnout

(VII) Parking lanes

Types of parking facilities :

On-street parking → রাস্তার পাশে curb parking করার জন্য

- along curb

off-street parking → রাস্তার বাহিরে করার জন্য।

Street lighting :

- Arrangement / Layout →

(i) Single side

(ii) both side

(iii) Central

(iv) Key location where adequate street lighting is imp? CT-syllabus

Traffic Island :

19.05.23

Lecture-04 :

Intersection :

- is an area shared by two or more roads whose main function is to provide for the changes of route direction
- may be simple or complex depending on the no of roads crossing each other
- overall traffic flow on any highway depends to great extent on the performance of intersection

- Intersection কতটা efficient তার উপর রাস্তার capacity নির্ভর করে।
- যেই জায়গায় capacity কম সেই জায়গা দিয়ে vehicle এর জন্য road capacity কম করবো। যেমন → bridge, bottleneck area
- যেখানে capacity বেশি সেটা দিয়ে design করবো।

Scanned with CamScanner

Types of intersection :

3 type →

1. At Grade slope → same level এর রাস্তা meet করলে

→ বেশি জায়গায় লাগবে

2. Grade separated intersection with tramp that is interchange
→ উপরের intersection এর সাথে নিচের road এর connection থাকবে।

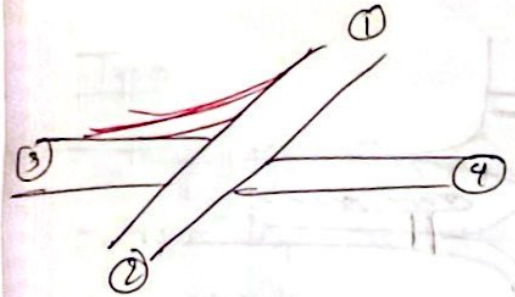
নিচের রাস্তা দিয়ে গাড়ি flyover-এর উপরে যাবে এটি tramp

metro trail উপর দিয়ে যায় রাস্তা নিচ দিয়ে গেছে। level of road অনেক আলাদা

3. Grade separated intersection without tramp.

Basic elements to be considered in intersection design :

1. Human factors
2. Traffic consideration
3. Physical elements
4. Economic factor
5. functional intersectin area



1 → 2 সরাসরি যাবে
3 → 4 " "
তাহলে tramp লাগবেনা।

যদি 1 এর মানুষ 3 -এ যেতে চায় তাহলে tramp লাগবে।

→ abutting property- road এর আশেপাশের জমি থাকবে।

Objectives of intersection :

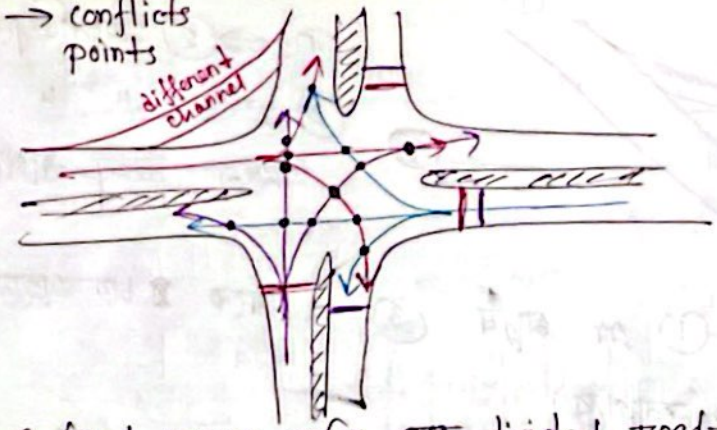
- main objective facilitate in convenience, ease, comfort.
  - enhance efficient movement

Need to meet two conflicting objectives →

- Minimize the severity of potential conflicts. conflicts কম হলে ভালো।
- Provide for the smooth flow of traffic across the intersection

Scanned with CamScanner

• → conflicts points

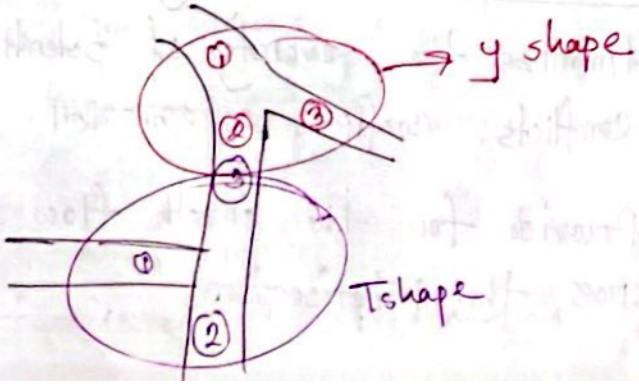


- Conflict অনেক কমে যায় কারণ divided road-এ আলাদা আলাদা channel দিয়ে flow smooth হয়।

① Conflict reduce
② Smooth flow

At grade intersection:

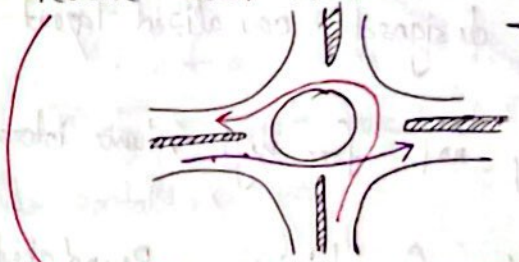
- All road joins or crosses at the same level



- Lecture note → 50%
- বই থেকে ques আসবে
- lecture note এর topic গুলোই পড়তে হবে বই থেকে।

Types:

- three legs (T or Y)
- four legs or crossing
- multileg
- round about intersection → 4/5 এর উপরে মূল ভাজে



→ গাড়িকে stop করতে হয়না। round-এ গিয়ে movement slow হয়ে যায়।

Round about or rotary intersection:

Advantages:

- Continuous traffic movement at reduced speed, at low volume
- Accidents are less serious (Crossing movement eliminated)
- Simplified design layout (for 5 more than 4 approaches)
- Cost less than grade separation

- aesthetically appealing
- function as a traffic calming measure

Disadvantage:

- Can't handle more traffic than an adequately designed canalized layout
- Definitely not for high volume intersec.

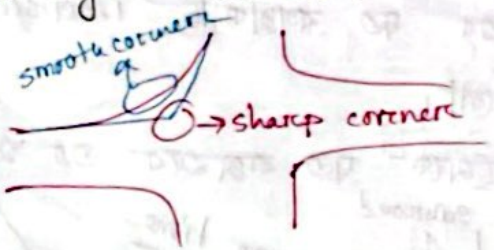
(*) General rules for driving a Roundabout?

Design principle of At Grade intersection:

- Design should incorporate the op characteristics of both vehicle and pedestrian using the intersection
- corner radius & either turning radius required by design vehicle or design speed of the road

veh size ↑ turning radius ↑

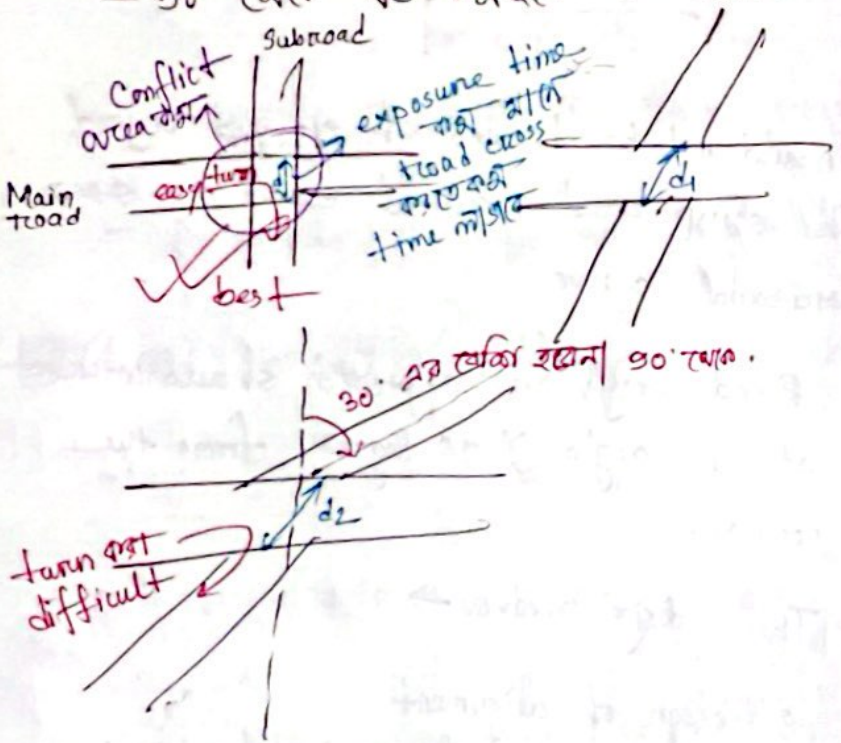
- pavement width should be adequate and approach sight distance.



- should not be located at or just beyond the sharp crest vertical curve or sharp horizontal curve.
- Road ways or approach should intersect at an angle ≯ 30 degree from the normal.
- The design involves →
  - Design of alignment
  - " " a suitable channeling system
  - Determination of min required roadway width for turning when veh move at > 15 mph

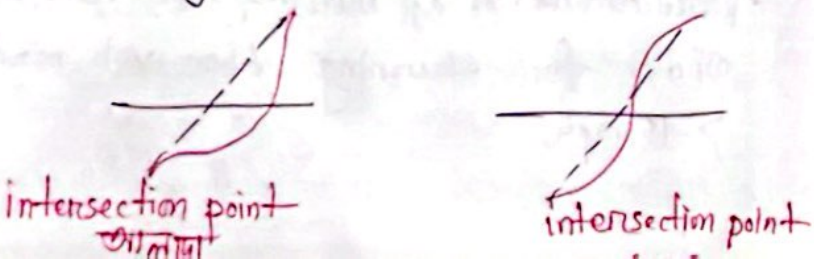
Alignment of At Grade intersection :

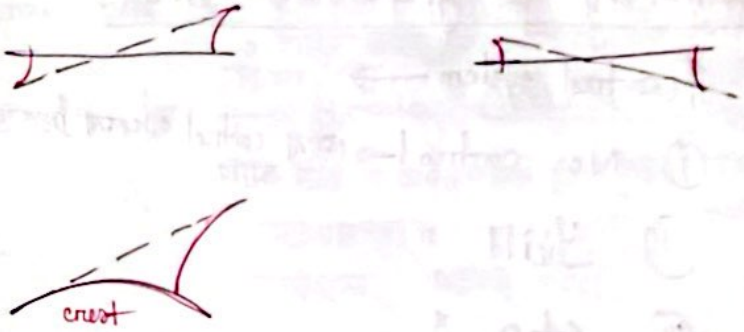
- 90° এর যত কাছাকাছি intersection হবে তত ভালো।
- 90° থেকে যত কম হবে তত খারাপ



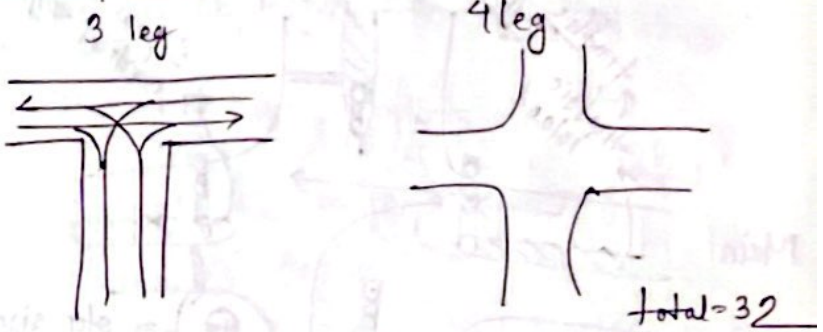
30° এর থেকে হলেন 90° থেকে.

existing intersections to improve :





Conflict points at unsignalized intersection :



Crossing = 3
Merging = 3
diverging = 3
total = 9

Control of at grade intersection :

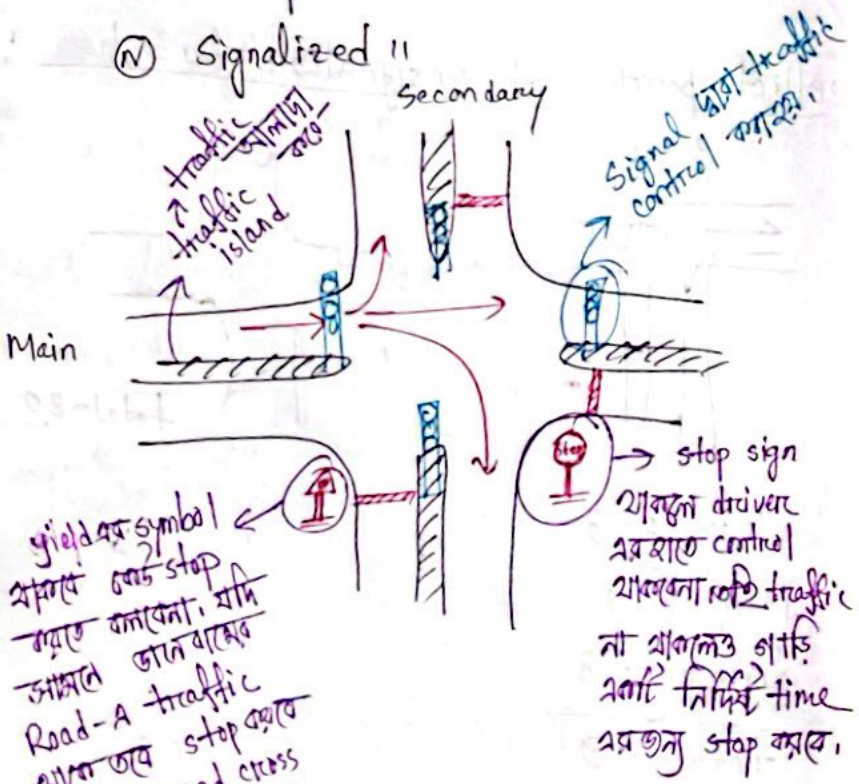
4 control system →

(i) No control → কোনো control থাকবেনা ছোটোগুলো থাকে

(ii) Yield "

(iii) stop "

(iv) Signalized "



yield এর symbol থাকলে তাকে stop করতে বলবেনা। যদি আসলে তাদের Road-A traffic থাকে তবে stop করতে হবে road cross করবে। এটি yield control (driver এর হাতে থাকে control)

stop sign থাকলে driver এর হাতে control থাকবেনা কোনো traffic না থাকলেও গাড়ি একটি নির্দিষ্ট time এর জন্য stop করবে।

amber color → precaution (green এর আগে)
↳ গাড়ি চলতে শুরু করার নির্দেশ দিতে প্রস্তুত হওয়ার জন্য।

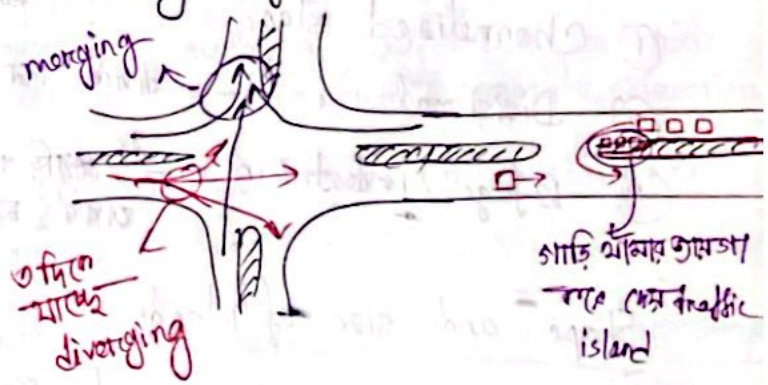
amber color → warning (red এর আগে)
↳ যদি road cross করতে পারে red হওয়ার আগে then cross করবে নাহলে থামতে হবে।

Traffic Island :

v.v.i.

Purpose or objective →

- separation of conflicts
- control the merging, diverging and crossing angles



গাড়ি থামার জায়গা

Control of at grade intersection :

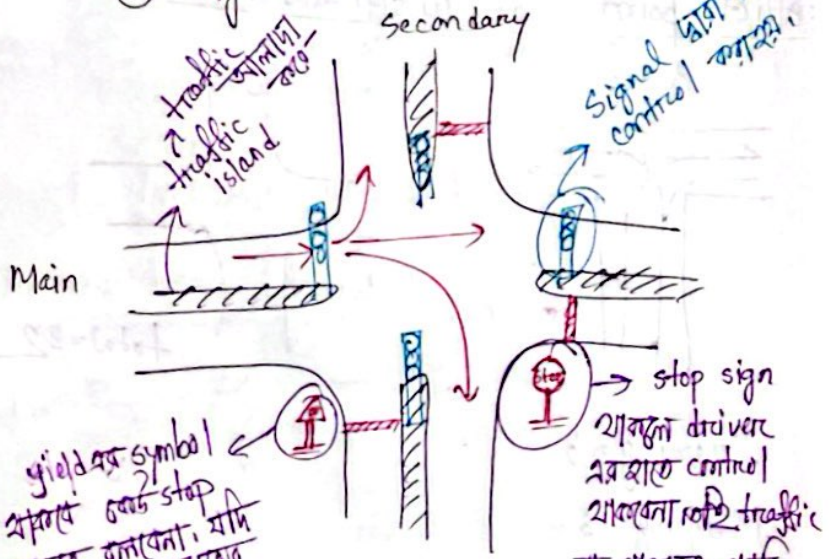
1 control system →

(i) No control → কোনো control থাকবেনা ছোটখাটো road এ থাকে

(ii) Yield "

(iii) stop "

(iv) Signalized "



যখনই road এ stop sign আসবে তখন driver Road-A traffic থাকে তবে stop করবে না road cross করবে, এটি yield control (driver এর হাতে থাকে control)

না থাকলেও গাড়ি একটি নির্দিষ্ট time এরজন্য stop করবে.

amber color → precaution (green এর আগে)
↳ গাড়ি চলতে শুরু করার নির্দেশ দিতে প্রস্তুত হওয়ার জন্য.

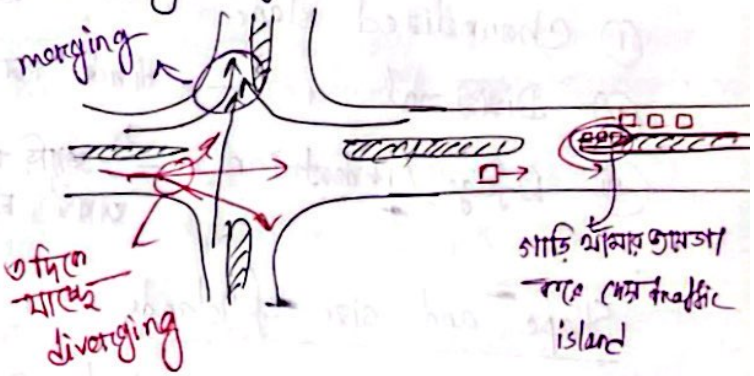
amber color → warning (red এর আগে)
↳ যদি road cross করতে পারে red হওয়ার আগে then cross করবে না পারলে থামতে হবে.

Traffic Island :

V.V.I

Purpose or objective →

- separation of conflicts
- control the merging, diverging and crossing angles



How formed/ Types of traffic island based on Formation:

(i) Curbed Island

(ii) Flushed "

(iii) Unpaved " → রাস্তার edge ⇒

- median → island

Types of traffic island based on functional classification:

(i) Channelized island

(ii) Divisional " → divide করে দেয়

(iii) Refuge / Pedestrian " → আমরা road দিয়ে আরাম চলাচল করে।

Shape and size of islands:

- should be large enough to command attention

Lecture - 05:

21.05.24

- Grade separation কখন করবে?

⇒ at grade intersection যখন required service দিতে পারবেনা, congestion হবে অনেক

PPP → Public- Private Partnership

- basic reason →

(i) at grade intersection requirement fulfill করতে

Grade separated intersection without ramp:

- based on mobility function
- designed such a way that no vehicle should face traffic from opposite direction

(i) Advantage over at grade intersection?

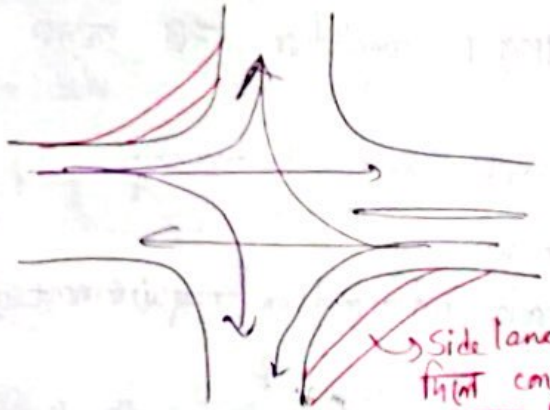
(ii) Disadvantages " " " " ?

Warrant for Grade separations and interchange:

- When sufficient discharge capacity of a junction cannot be achieved by the use of conventional treatments.

Scanned with CamScanner

At grade intersection required service দেয়ার পরও যদি extra lane improvement করার পর congestion না কমে।



- Where congestion and accident records are very high and expected cost savings in delay and accident is significant.
- To eliminate bottlenecks and to prevent accidents
- Where topography does not permit other types of design. → hilly area, restricted area কোথাও future এর জন্য রেখে দেয়া

- When traffic on intersecting roads is very high.
- When there is a need to construct express-way to provide high speed and uninterrupted flow.

- delay cost →
- accident cost → কোন আয়তনে accident-এ সুবিধে অসুবিধে govt. খরচ/লাভ।

V.V.I^ax. কোথাও থাকে? flow direction দিবে।

Common types of interchange:

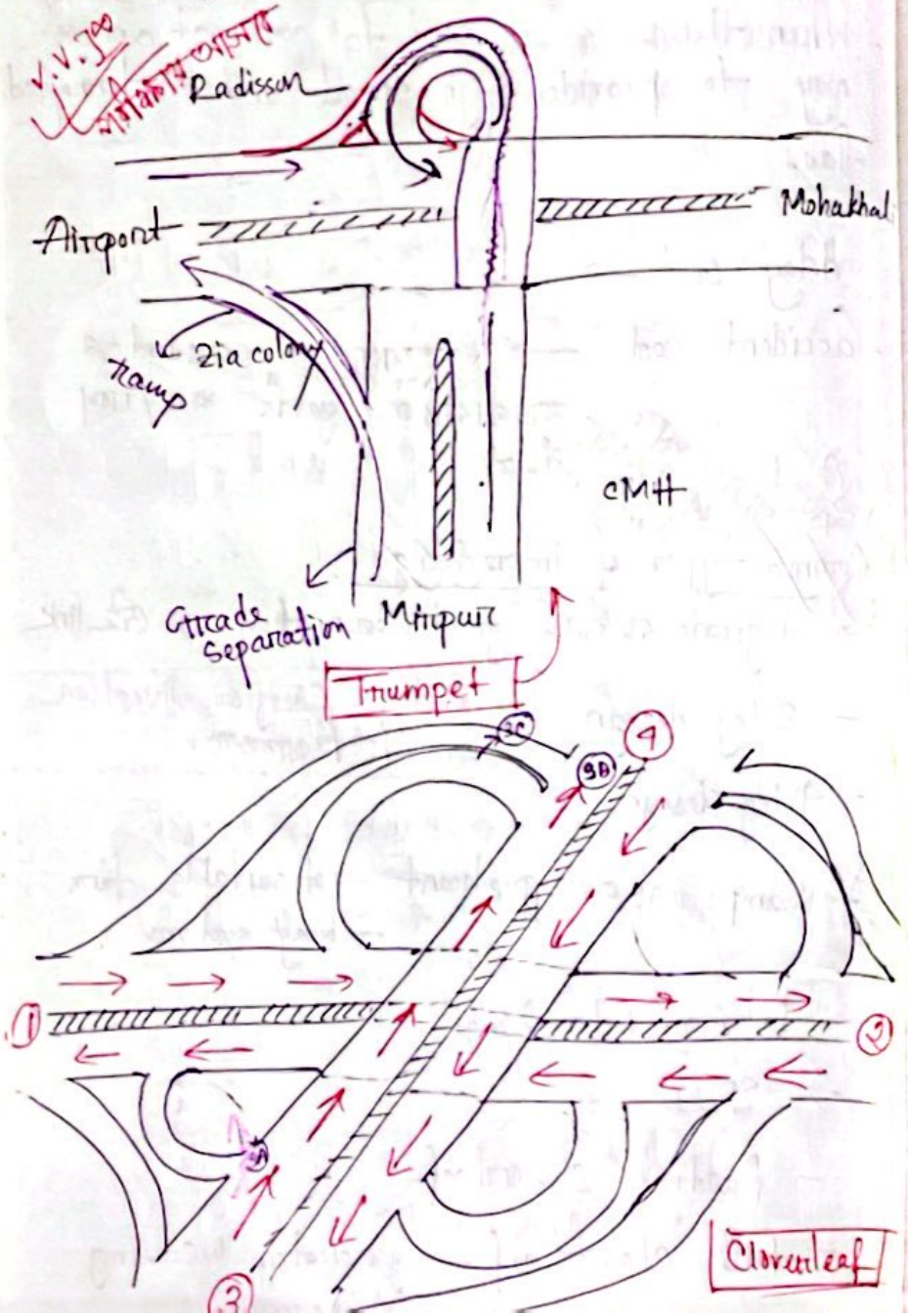
↳ at grade এবং সবচেয় grade separation এর মধ্যে link

- 3 leg design
- 4 leg design

এর type এর flow direction এর ছবি দিয়েছে।

- Ramps in one quadrant - not suitable for freeway systems
- Diamond interchange
- SPUI
- Partial cloverleaf
- full cloverleaf → generates weaving Maneuvers

- All directional four lege



Traffic management system : 2 types →

(1) Demand management
(2) Supply "

- যতটুকু road দেয়া হবে তা supply
- যতগুলো trip এরজন্য design করা তা demand

demand ↑ supply ↓ ⟶ congestion

এভাবে control করতে পারি →

(1) Demand ↓ supply যা আছে তাই
(2) Demand ↓ supply ↑
(3) Supply ↑ demand যা আছে তাই

Demand management : যেভাবে করবো →

(1) regulatory system → office time, school time
(2) Online education
(3) Online shopping
(4) Telemedicine

(*) How can you integrate internet service/ online facilities / ITS in road/Traffic management?
→ Intelligence Transport System

Lecture-06: 28.05.24

Roadway alignment:

Topo/terrain classification →

1. level terrain → সমতল ভূমি
2. Rolling " → like Mirpur area
3. Mountainous " → hilly area

Types of Alignment:

(i) Horizontal → একটা রাস্তা ডানবামে কতটুকু অগ্রসর।
(ii) Vertical → একটা রাস্তা কতটুকু উপরে বা নিচে যেতে পারবে।

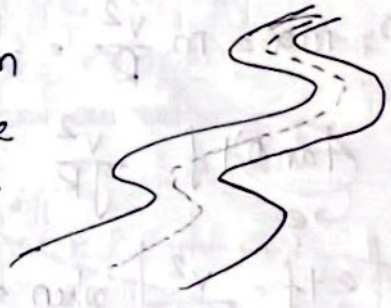
- রাস্তার ক্ষেত্রে slope কে grade বলে।
উপরে → rising grade
নিচে → falling "

Objectives:

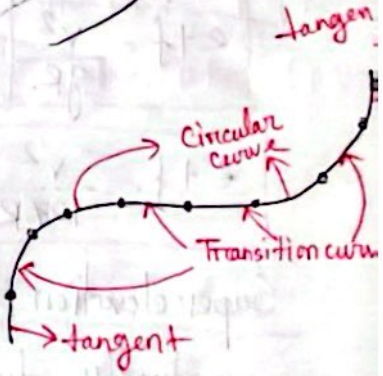
① Comfort
② Safety

- horizontal alignment: → turning radius কতটুকু দিতে পারবে।

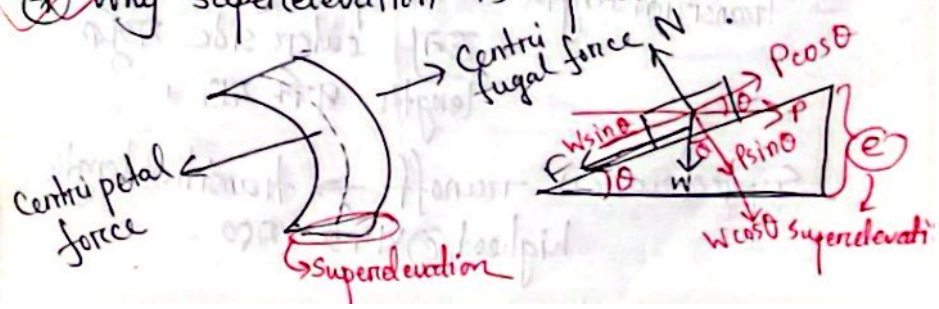
elements →
① Straight section
② Transition curve
③ Circular curve
④ Supercelevation



Circular curve →
① Simple curve
② Reverse "
③ Compound
④ Spiral



(*) Why supercelevation is provided?



$$\frac{P}{W} = \frac{\tan\theta + f}{(1 - f\tan\theta)}$$ → road friction

angular acceleration, $\alpha = \frac{v^2}{R}$

neglecting $(1 - f\tan\theta)$

$\therefore \tan\theta + f = \frac{P}{W}$

$P = m\alpha = m\frac{v^2}{R} = \frac{W}{g}\cdot\frac{v^2}{R} \therefore \frac{P}{W} = \frac{v^2}{gR}$

$\therefore \tan\theta + f = \frac{v^2}{gR}$ Since θ is very small

$\tan\theta \sim e$

$\tan\theta = e$

$$e + f = \frac{v^2}{gR}$$ when speed of vehicle in m/s

$$e + f = \frac{v^2}{127R}$$ " " " in kmph

$$e + f = \frac{v^2}{gR} = \frac{\left(\frac{v}{3.6}\right)^2}{9.81R} = \frac{v^2}{127R}$$

Supereleveation transition :

- gradually transition দিতে হয়।
- Transition length → Superelevation gain করার জন্য outer side সর্বনিম্ন length পর্যন্ত যায়।
- Superelevation runoff → transition length highest (e) পর্যন্ত যেতে
- tangent runoff → highest (e) থেকে (0) zero তে আসতে সর্বনিম্ন length দরকার।

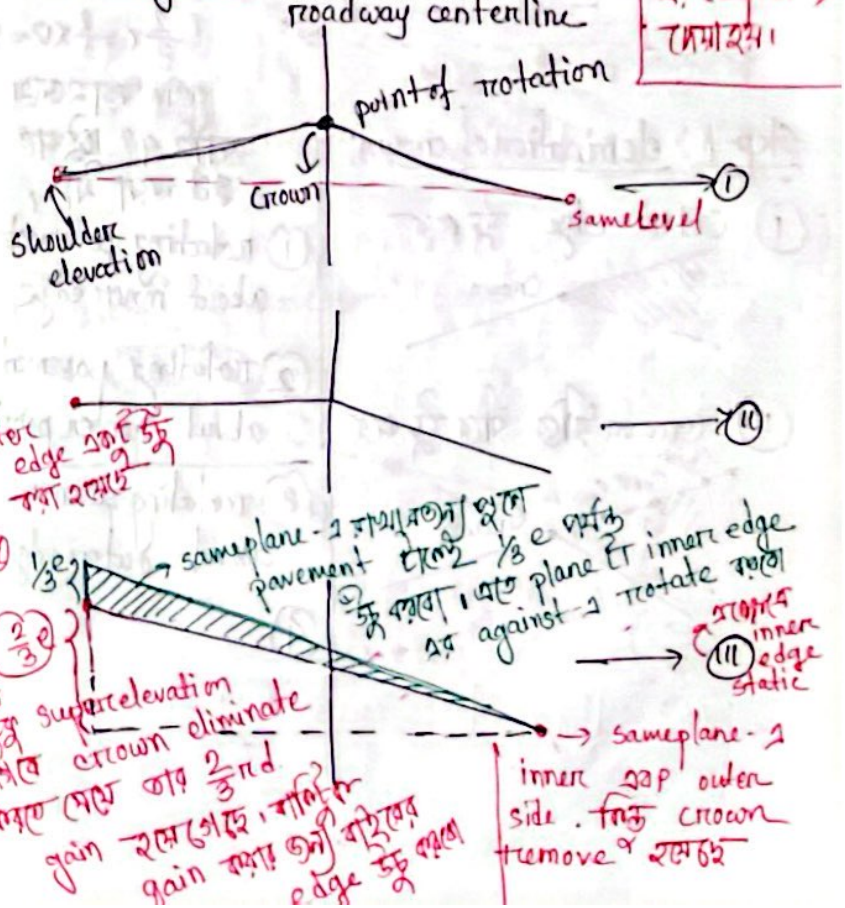
Method of attaining superelevation :

- Sup. eccleration is provided in two steps →

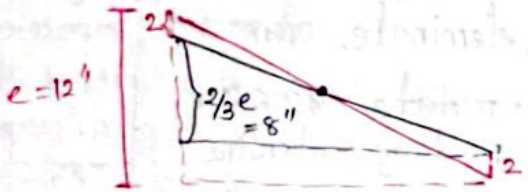
(i) Crown eleminate করতে হবে

(ii) Segment (pavement + shoulder) rotate করতে হবে।

Superelevation inner edge এর respect এ দেওয়া হয়।



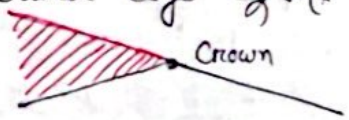
(ক) যদি center point কে static ধরে inner edge কে 2" নিচে এবং outer edge কে 2" উপরে উঠিয়ে তাহলে total 12" gain করা যাবে super elevation এতে inner এবং outer edge same plane এ আসবে।



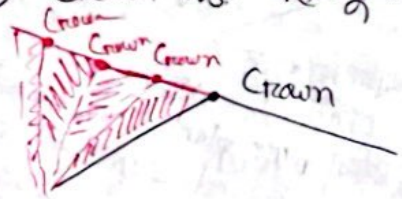
Suppose, e = 12"
Crown eliminate করতে মোট
$\frac{2}{3}e = \frac{2}{3} \times 12 = 8"$
gain করা হবে।
বাকি 4" ঘুরপথে তাহলেই করা যায়।

Step 1: elemination of crown:

(i) Outer edge টুকু কেটে



(ii) Crown থেকে ধীরে ধীরে টুকু কেটে



(i) rotating pavement about inner edge

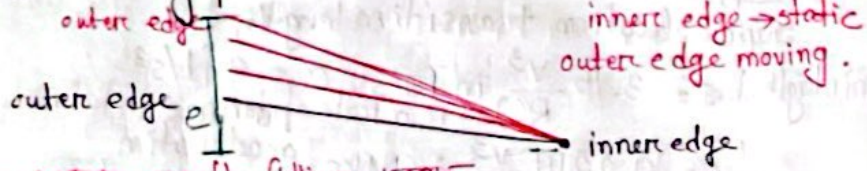
(ii) rotating pavement about center point

(iii) rotating pavement about outer edge

(iv)

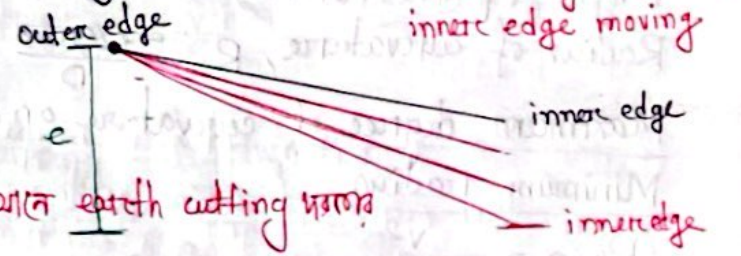
Step-2 : যেকোনো একটা দিতে পারে মোট-৩

(i) Revolving pavement about inner edge



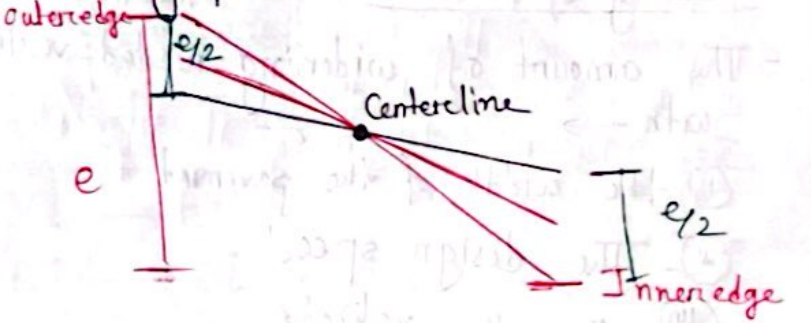
- এখানে earth filling করতে হবে

(ii) Revolving pavement about outer edge



- এখানে earth cutting করতে হবে

(iii) Revolving pavement about center line



- Super elevation transition formula:

- Superelevation transition length,

min length, $L_s = 3.15 \frac{V^3}{RC}$ in fps; $C = 4 ft/s^3$ → max rate of change in lateral acceleration

$L_s = 0.0214 \frac{V^3}{RC}$ in MKS; $C = 1.2 m/s^3$

Properties of simple circular curve:

Length of the curve, (PC to PT), $L = \frac{2\pi R\Delta}{360}$

Radius of curvature, $R = \frac{5729.58}{D}$

Maximum degree of curvature and Minimum radius:

$R_{min} = \frac{V^2}{15(0.01 e_{max} + f_{smax})}$

R → radius of curve; e_{max} → tan α; f_{smax} → coefficient of side friction

Widening of curves:

- The amount of widening needed varies with →

(i) the width of the pavement

(ii) The design speed

(iii) " " vehicle

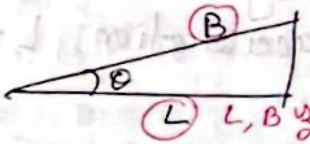
(iv) Horizontal curve radius

(*) Without providing superelevation turning করা কি possible?

⇒ possible যদি friction অনেক বাড়ানো যায়।

অথবা friction একদম zero থাকলে $\frac{V^2}{gR}$ superelevation এর সমান হতে হবে।

$\tan\theta + f = \frac{V^2}{gR}$



$\tan\theta = \frac{e}{B}$

for balancing fully by super elevation, $\tan\theta = \frac{V^2}{gR}$

for balancing fully by friction, $f = \frac{V^2}{gR}$

Again, from roadway geometry, $\tan\theta = \frac{e}{B}$

∴ for roadway, $\tan\theta = \frac{e}{B} = \frac{V^2}{gR}$ → R = radius of curvature

V↑ → e↑

R↑ → e↓

for railway, $\tan\theta = \frac{e}{G} = \frac{V^2}{gR}$

Length of transition curve:

1. By an arbitrary gradient, $L = ne$ — n varies from 300 to 1200 $= \frac{Bv^2}{gR}$
2. By the time rate, $L = e \cdot \frac{V}{rt}$
3. By the rate of change of radial acceleration, $L = \frac{V^3}{\alpha R}$ or $L = \frac{v^3}{14R}$

Problem: A transition curve is required for a circular curve of 200m radius, the gauge being 1.5m and max super elevation restricted to 15 cm. The transition is to be designed such that no lateral pressure is imposed on the trails and the rate of gain of radial acceleration is 30 cm/s³. Calc the required length of the transition curve and the design speed.

Soln:

$\tan\theta = \frac{e}{G} = \frac{v^2}{gR}$

(0 cm to super elevation gain rate to length)

$\Rightarrow \frac{15}{150} = \frac{v^2}{9.81 \times 200} \Rightarrow V = 14 \text{ m/s}$

$L = \frac{v^3}{\alpha R} = \frac{14^3}{0.3 \times 200}$

Problem: A road bend which deflects 80° is to be designed for a max speed of 100 km per hr, a max centrifugal ratio of 1/4 and max rate of change of acceleration of 30 cm/s³. the curve consisting of a circular arc combined with two cubic spirals. Calculate,

(a) Radius of circular arc
(b) The requisite length of transition
(c) The total length of composite curve
(d) The chainage of the beginning and the end of transition curve and of the junctions of the Transition curves with circular arc if the chainage of the P.I. is 42862m.

Problem: Calculate the super elevation required for load of 7m wide on a curve of 250m radius for permissible speed of 80 kmph. Let the coefficient of friction be 0.15.

Soln: $e + f = \frac{v^2}{127R}$

$\Rightarrow e + 0.15 = \frac{80^2}{127 \times 250} = 0.201$

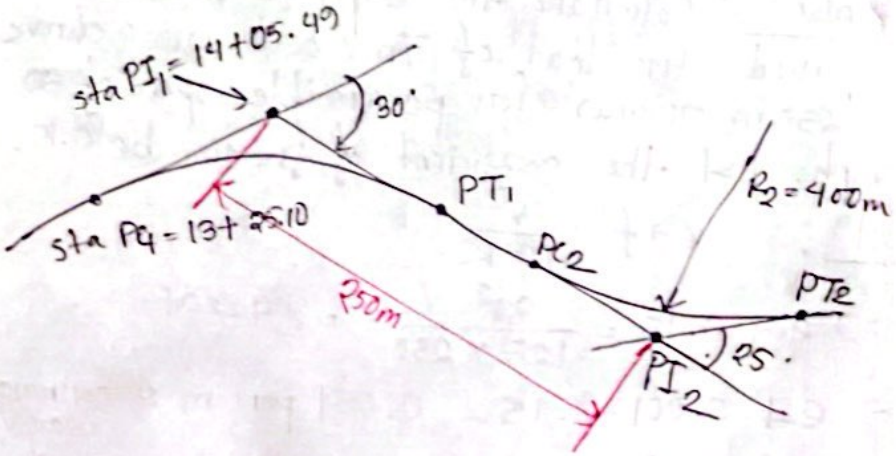
$\Rightarrow e = 0.201 - 0.15 = 0.051$ per m of carriage way

$\therefore$ Superelevation $= 0.051 \times 7 = 0.357 \text{ m} = 35.7 \text{ cm}$ above the inner edge of the roadway.

Scanned with CamScanner

Problem: (a) For the horizontal alignment shown below, compute the stations PT_1 and PC_2 and a point P that on curve 1 and is located 30.52 m before PT_1

(b) If the design speed is 80km/h and the road is designed so that the superelevation for curve 1 is 0.058 (5.8%). Determine the side friction demands on curve 1 for vehicles travelling at the design speed and at 10km/h.



Vertical alignment:

- Vertical plane-এ circular curve, transition curve নিয়ে আলোচনা।

Lecture-07: 04.06.24

Sight distance : (SD)

- is the length of the roadway ahead that is visible to the drivers at any time.
- Safe highways must be designed to give drivers a sufficient clear vision ahead so that they can →

1. avoid hitting unexpected obstacles in the road
2. Can pass slower vehicles without danger

Types of sight distance:

(1) Stopping sight distance (SSD)
(2) Passing " " (PSD) → 2 lane highway তে শুধু applicable
(3) Decision " " (DSD)
(4) Intersection " " (ISD) → clear intersection area

Stopping sight distance (SSD)

SSD = sum of perception reaction distance and breaking distance.

- যেকোন decision গ্রহণ করার →
  - (i) To continue riding
  - (ii) To stop or slow riding
- Object দেখার পর থেকে decision নেয়া পর্যন্ত যে distance cover করে → perception reaction distance
- decision নিয়ে break apply করে গাড়ি থামানো পর্যন্ত যে distance cover করে → breaking distance

- perception reaction dist, $s = vt$ (depend on efficiency of driver)
- breaking dist, $s = \frac{v^2}{2g(f \pm G)}$ (f = roadway friction; G = Grade of road; level ground এর জন্য G এর মান 0; কোনটি উপরে থাকলে G এর মান +)

$s = ut - \frac{1}{2}at^2$

The computation of sight distance depends on;

- perception reaction (PR) time of the driver
- break
  - Speed of veh.
  - efficiency of breaker type, road surface
  - frictional resistance between the tyre and the road
  - Gradient of the road, road alignment
  - Size, type of object → (যেকোন বড় গাড়ি সামনে থাকলে সেটা driver কে রাস্তার কিছু দেখতে দেয় না। কিন্তু ছোট গাড়ি সামনে থাকলে সেটা দেখা যায় তাই এক্ষেত্রে driver height এর গুরুত্ব)
  - Climate condition

Driver, Vehicle, road, Climate

$$SSD = vt + \frac{v^2}{2g(f \pm G)}$$
$$= 1.47vt + \frac{v^2}{32(f \pm G)}$$

(xx) Explain the effects of above factors and how they effect?

(effect explain করতে হবে)

উপরে উল্লেখিত G যেকোন → SSD কম
" " v কম → SSD কম

effect of friction:

wet condition → friction কম → SSD বেশি

effect of speed:

V বেশি → SSD বেশি

Suppose 80 km/h - এ চলতে SSD 1000 ft হতে হবে।

effect of grade:

- shorter along upgrade

Will you design SSD for cars or buses/ trucks?

→ for cars

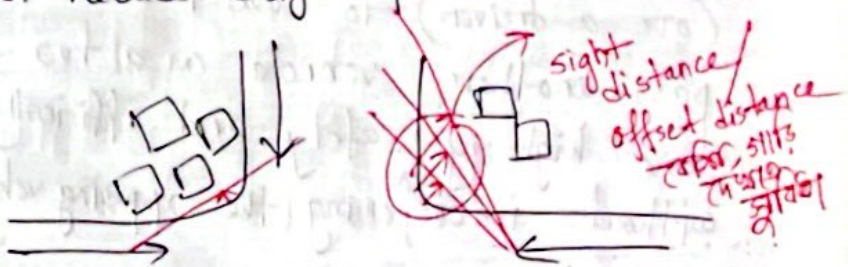
Low cost improvements for locations with inadequate sight distances:

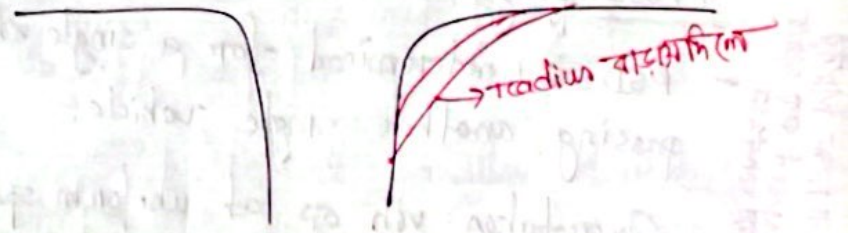
(আঁকাবাঁকা রাস্তা, turning point)

1. Installing reduced speed warning signs
2. " Limited sight distance warnings
3. " sight distance mirrors.

Alternatives designs when SSD is not available due to object alongside of roadway:

1. Increase offset to obstruction
2. " the radius
3. Reduce design speed.





SSD for crest vertical curve:

$S < L$, $L = \frac{AS^2}{100\left(\sqrt{2h_1} + \sqrt{2h_2}\right)^2}$

S → sight distance

A → Upgrade - downgrade

h_1 → driver height

h_2 → Object height

L → distance between PVC and PVT (road এর lane বরাবর) curve

$S > L$, $L = 2S - \frac{200\left(\sqrt{2h_1} + \sqrt{2h_2}\right)^2}{A}$

downgrade = −3

- downgrade-এর value (−) হবে বসানো minus সহ formula তে।

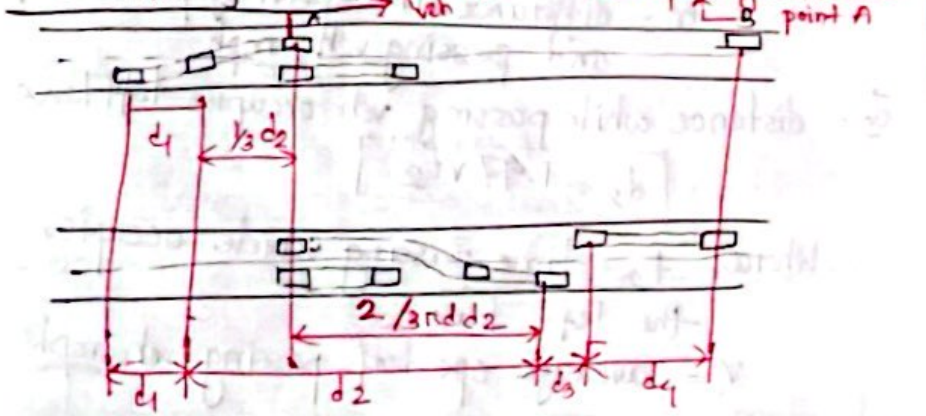
Passing Sight distance (PSD):

- min distance which enable a veh (or a driver) to overtake and pass another vehicle on a two lane highway safely and efficiently without interfering the opposing veh.

Assumption:

- PSD is determined for a single vehicle passing another single vehicle.
- Overtaken veh op at uniform speed.
- Overtaking veh has reduced speed and trails the overtaken vehicle as it enters a passing section.
- When passing sec is reached, driver required a short period of time to perceive the clear passing section and to react to start his maneuver.
- passing is accomplished under delayed start and hurried return in the face of opposing veh.
- Passing veh accelerates during maneuver and its average speed during the occupancy of opposing lane is 10 mph higher than overtaken veh.
- When return to own lane there is sufficient clearance dist between it and opposing veh.

Elements of PSD:



d_1 = initial maneuver distance (own lane)

d_2 = distance while passing vehicle occupies left lane (Opposite lane)

d_3 = clearance length = 110 – 300 ft (design এর জন্য নিলে)

d_4 = distance traversed by a opposite vehicle = ⅔ of d_2

$$PSD = d_1 + d_2 + d_3 + d_4$$

d_1 = initial maneuver distance

$$d_1 = 1.47 t_i \left(v - m + \frac{a t_i}{2}\right)$$

Where, t_i = time of initial maneuvers, s

a = average acceleration, mph/s

V = average speed of passing veh, mph

m = difference in speed of passed veh and passing veh, mph

d_2 = distance while passing veh occupies left lane

$$d_2 = 1.47 v t_2$$

Where, t_2 = time passing vehicle occupies the left lane, s

v = average speed of passing veh, mph

Problem: Estimate the total passing sight distance for a two-lane highway for average passing speed of 62 mph. The initial maneuver time is 4.5 sec and avg. acceleration is 1.50 mph/s. Consider the time of passing vehicle occupying right lane as 11.3 sec. and clearance length as 300ft.

Soln: d_1 = initial maneuver distance

$= 1.47 t_1 \left(v - m + \frac{a t_1}{2}\right)$

$= 1.47 \times 4.5 \left(62 - 10 + \frac{1.50 \times 4.5}{2}\right) = 366.91 ft = 367 ft$

d_2 = Distance while passing vehicle occupies left lane

$= 1.47 v t_2 = 1.47 \times 62 \times 11.3 = 1029.9 = 1030 ft$

d_3 = clearance length = 300 ft

d_4 = Distance traversed by opposing veh = $\frac{2}{3} d_2 = \frac{2}{3} \times 1030$

$= 686.6 = 687 ft$

$\therefore$ PSD = $d_1 + d_2 + d_3 + d_4 = 2384 ft$

PSD effect:

effect of grade →

up grade greater

Down grade shorter

- upgrade-2 d_2 কমে যায় (velocity will be less)

Problem-4.3: Determine the minimum length of a sag vertical curve between a -0.7% grade and a +0.5% grade for a road with a 110 km/h design speed. The vertical curve must provide 220m stopping sight distance and meet the California appearance criteria and the AASHTO comfort standard. Round up to the next greatest 20m interval.

Scanned with CamScanner

Soln:

Stopping sight distance criterion,

assume, $S \leq L$

$$L = \frac{AS^2}{120 + 3.5S} = \frac{[0.5-(-0.7)](220)^2}{120 + 3.5(220)}$$

$$= 65.3\,m < 220\,m$$

So, $S > L$

$$\therefore L = 2S - \frac{120 + 3.5S}{A}$$

$$= 2(220) - \frac{120 + 3.5(220)}{[0.5-(-0.7)]}$$

$$= 440 - 741.7 = -301.7\,m$$

Lecture-08

+Geometric design

02.07.24

footpath / sidewalk:

L-8,9 থেকে 1টা ques (conceptual আসতে পারে)

v.i.p ques আসতে পারে

(x) What is green transport? What is the importance of green transport?

(x) effect of right turn?

⇒ ডানের veh slow হয়ে যায়

(x) effect of pedestrian and NMV?

(x) effective width of road.

Road/Traffic system:

- Road
- Traffic
- environment
- Road user.

Scanned with CamScanner

Problems (traffic related):

- pollution (i)
- congestion (ii)
- Time
- accident (iii)

} 3 major problems of traffic.

General causes of traffic related prob:

External factors (Geometric) →

road intersection
railway crossing
narrow road
inconsistent roadway width
poor turning radius

Side friction: scattered parking, rd side NM activities, frequent access, illegal or improper bus stop, uncoordinated public work

Poor roadway environment: poor rd,

Internal factors →

- Heterogeneous traffic stream
- high volume of traffic

Possible approaches to solve prob:

- রাস্তা বাড়াও হে

(1) Invetment on new highway projects

- রাস্তা বাড়াতে না পারলে management টিম করতে হবে। (demand restrict করতে হবে আমরা না পারলে)

(2) Traffic system Management (TSM) which include supply and demand management

Traffic system management:

(1) **Supply management** → traffic system এ যেসব supply আছে, includes →

- physical measure
  - Low cost → Can widen here
  - expensive → channelized

traffic आउटपुट/समय.

1. regulatory measures → no right turn
   → समय और manage गर्ने no parking
- technological measures

traffic capacity बढ़ाने उपाय:

Low cost physical supply management:

- correcting / improving roadway geometry and surface condition
- channelization
- flaring
- exclusive lane marking
- provision of improved skill
- Bus lay by
- Street lighting

expensive:

- widening of intersection
- grade separation at junction
- pedestrianisation
- construction of new links
- " " off street parking lots
- " " terminals etc.

Regulatory: (supply smoothening)

- provision of clear ways
- banning right or U turn
- entry restriction for particular veh to city center.
- access control from side roads
- banning veh
- ~~one~~ way operation
- ~~tidal~~ flow "
- parking control
- use of terminal facilities
- restriction over speed, weight, overtaking
- provision of auto free zone.
  → pedestrian mall

Scanned with CamScanner

Technological:

- Intelligence/automated highway/veh
- Advance traffic info system
  - Driver route guidance
  - Users up to date travel info
- Advance traffic control and management
  - (i) sign
  - (ii) marking
  - (iii) signal
  - Use of VMS or dynamic sign
    Variable message sign
  - Auto surveillance system
    দূর থেকে বোঝা যায় কোথায় jam কোথায় কেন jam হচ্ছে।
  - Active marking/headlight
  - Adaptive traffic signal control
    গাড়ির সংখ্যা দেখে auto signal change হয়।

veh actuated design: অ্যাম্বুলেন্স- ambulance এর জন্য red green হয়ে যাবে।

Transportation Demand Management (TDM)

(I) Restrictive measure (demand cut off করে)
- road pricing, parking pricing (fiscal measures)
- parking control
- control over veh ownership

(II) Strategic measure
- increasing veh occupancy
  fine rule দিয়ে গাড়িতে passenger বাড়ানো or private car কমানো।
- providing improved alternatives modes.
- introducing staggered/flexible office hours.
  office-time, school-time আলাদা হয়ে হবে।
- Strict land use planning and control
  যেখানে সেখানে shopping mall/school/college
- introducing one stop services.
  একটা জায়গায় অনেক building/complex - এ থাকলে আলাদা আলাদা যাতে হবে।
- using improved telecommunication and IT facilities
- Introducing IT enabled services etc

(*) কীভাবে 4-lane intersection improve করা যায়?

→ একদিক থেকে গাড়ি যায়' → সোজা যাওয়ার জন্য ... flyover
left turn এর জন্য channelization

Lecture-09: 09.07.24

Access management/Control:

- Access management includes several techniques that are designed to increase the capacity of the roads, manage congestion

Access management/control measure:

- Introducing signal
- use of exclusive turning lanes.

Warrant of access control:

- When there are no. of lightly traveled cross road along an important route.
- When density of various accesses are higher than the standard density of the road
- control ribbon development → রাস্তার দুপাশের development এর জন্য রাস্তায় প্রত্যেকটা building এর সামনে গাড়ি থামবে. প্রত্যেকটা point থেকে গাড়ি বাহির through the road ribbon এ মিলে যায়।
- Access control করলে ribbon development হবেনা। একটা particular point থেকে গাড়িতে উঠা নিয়ন্ত্রণ করলে ribbon development হবেনা।

Speed restriction:

(*) Why lower speed is also required?

Tidal flow operation:

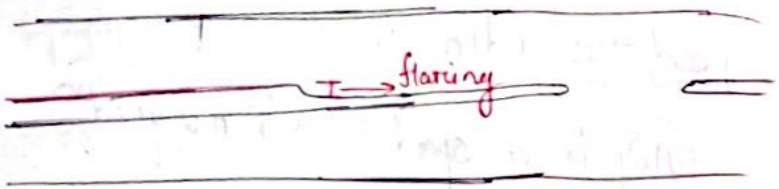
$$\frac{W_1}{W_2} = \frac{q_1}{q_2}$$

- অনেকগুলো lane এর flow একত্রিত, বিপরীতমুখী আরেক lane-এর flow একত্রিত, এদের মধ্যে median barrier use করতে হবে যেটা একপাশের lane width বাড়াবে (barrier side-এর অপাশে), বিপরীতমুখী আরেকপাশের lane width বাড়বে।
- HOV – high Occupancy Vehicle
  ↳ passenger car এর পরিবর্তে bus use করা;

Restriction of Turning movement:

- Turning movement → Right turn
  Left "
  U - turn

Flaring for right turn →



Parking management:

Parking to be prohibited at →

① Intersection
② Narrow street
③ Driveway
④ Ped crossing
⑤ Horizontal curvature and Vertical grade
⑥ Bridge and tunnels
⑦ Priority locations etc.

Parking control and management:

- Obj:

Park and Ride facility:

- It is a traffic control system in which motorists are encouraged / sometimes forced to park their cars at selected locations usually at the periphery of the central area and then use the public transport to travel to their destination and come back again.
- effective for large city
- একটা গাড়িতে করে জিনি park করে আরেকটা

- Service road

(1) Joint intersection - এ অনেক jam হচ্ছে, তা নিয়ে improve করা যায় diagram দিয়ে দেখাও.

→ low cost / expensive cost এর ভিত্তিতে answer করতে হবে.

- Transportation related problem in BD and how to manage it?

- 10slide - max, একজনকে একটা করে করা হবে.

- slide-এ point explain করতে হবেনা, new picture add করলেই হবে এবং point লিখতে হবে.

- Transportation management system.

16.07.24

Lecture-10:

Highway materials:

- 4 types of materials used →

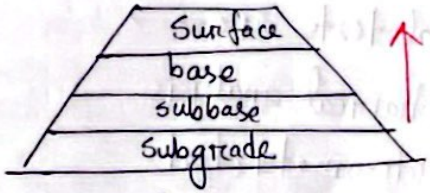
(I) Soil → subgrade-এ use হয়.

(II) fine agg., coarse agg. → base/subbase

(III) Bitumen → binding material → surface-এ

(IV) MS Bar → Reinforcing material

- যত উপরে উঠবে stone chips এর পরিমাণ তত বাড়বে.



Basic soil properties:

1. Moisture content
2. Specific gravity
3. Unit weight
4. Shearing resistance → $\tau = c + \sigma \tan\phi$
   - is attributed to the existance of internal friction and cohesion

5. Other properties →
   • permeability

Soil gradation :

(i) Well-graded
(ii) Poorly "
(iii) Uniformly "
(iv) Gap "

Soil classification for highway purposes :

- Principal tests are →
  (1) Mechanical analysis
  (2) Hydrometer test

1. AASHTO
2. USCS

→ classified by this two methods

- Atterberg test

Bituminous material :

Asphalt :

- binding material
- naturally occuring substance

- Tare is not asphalt
(iv) Comparison between bitumen and Tare
- tare এর মাত্র কম → filler material হিসাবে use করি, harder than bitumen

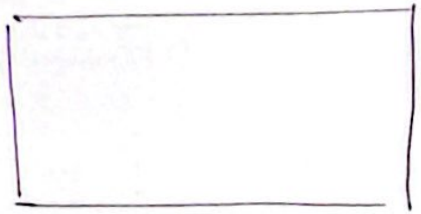
Classification of Asphalt :

(i) Asphalt cement
(ii) emulsified asphalt
(iii)

Scanned with CamScanner

Emulsified asphalt :

- mixture of asphalt cement, water and emulsifying agent



Specifications for emulsified asphalt :

Bituminous emulsion →

important
Criteria for asphaltic material

V.V.2nd
Test for asphaltic material

V.V.2nd
Viscosity test :

- bitumen কোন কোন heat এ কোথায় কত আছে এবং কোনটা কেন।

(*) Why optimum bitumen is important?

Marshall Mix design → xm-এ quer আছে

V.V.2nd
- Curve xm-এ আছে

Aggregates : types

(i) Coarse agg. → retained on #4 sieve
(ii) fine agg
(iii) filler

Properties of agg :

- particle size, Gradation
- Hardness or resistance to weare
- Durability or resistance to weathering

Aggregate tests :

- Crushing test
- Abrasion test
- Impact test

Scanned with CamScanner

- hardness → ~~শক্ত~~ শক্ত
- durability → ~~স্থায়ী~~ sustain করে।

- ~~specific~~ specific gravity and adsorption
- ~~Chemical~~ Chemical stability
- ~~particle~~ particle shape and surface texture.
- chemical stability of agg.

Brick agg :

- Source → crushed brick

Scanned with CamScanner