05/07/2014

Dr. Shamsul Hoque Sir

Lecture:= 1

CE-351

Transportation Engineering-I

(Transportation & traffic Design)

Reff. Books:=

G.C. Singh ⟶ Highway Engineering

TEU → Twenty Equivalent Unit → (20′) → 1 unit

40′ → 2 TEU

BRT → Bus Rapid Transit

Planning, Design, Construction, Operation

↓

(Traffic Engineering)

Road safe, Economical, Convient (Operational system)

↙

(Traffic Engineers)

12/07/2014

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Lecture :- 2

Traffic stream → Vehicular flow & pedistrial flow
(যানবাহন এবং পথচারী)

Land use এর সাথে Road management করতে হবে।

Transportation Land-Use cycle :-
↳ (Classical)

| vicious cycle (দুষ্ট চক্র) |

For sustainable change:-

- # Land use change
- # Increased traffic generation

} We have to control these

★ Multimodal system:- শুধু ভূমির ব্যবহার নয় রাস্তার ও multipurpose use করতে হবে।

Modern philosophy of town planning

- Public transport
- Information technology

Transit oriented development (TOD)

↳ গণপরিবহন (Mass transportation)

15/07/2014

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Lecture:-1

CE-351

Transportation planning:-

Transportation as a system:-

Transportant Engineering

- Krishy & Lal

Principles of highway engineering

11/08/2014

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Lecture:=2

Basic elements of transportation planning:-

① Analysis phase

② Evaluation phase

① The survey phase (Inventory):-

Inventory → list তৈরি করা → কি আছে কি নাই;

→ Travel pattern

* Home interview survey
* Roadside interview

→ Exising transportation facilities & traffic characteristics

Origin → Destination (Derived demand)

→ Land use directly related with transport

② Analysis & Model Building Phase:-

Model → Series of equation

Travel pattern → Dependent variable

Socio economic status → Independent variable

Present → Analysis করলেই কাজ হয়ে যায়

Future → Model করতে হবে।

③ The Forecasting Phase:-

- Policies

④ The Evaluation Phase:-

- Operational Evaluation
- Economic Evaluation
- Financial Evaluation

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Lecture 2

System approach :-

Steps in system analysis :-

- Recognize community problems & values
- Establish goals
- Define Objectives
- Establish criteria
- Design alternative criteria

Transportation system model :-

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Lecture:-3

Road-Traffic system:-

হাতের বামদিক দিয়ে চলবে → Left Hand Driving Practice

পথচারীর উল্টা দিকে যেতে হবে,

Downstream → সামনের দিকে তাকালে

Upstream → উল্টা দিকে,

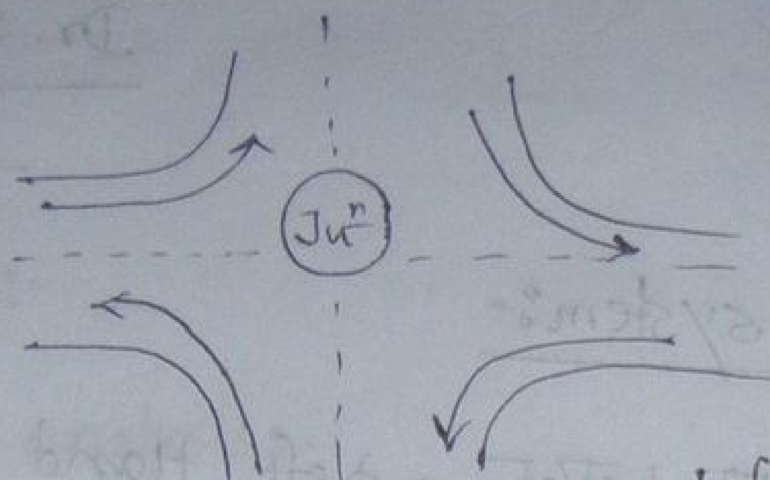
* Lane Based Traffic Operation:-

গাড়ি col^m wise যাবে, একটার পর একটা

(*) Diff^r bet^w traffic operation beh^r developed country & Ban?

Hetrogeniows & non-lane based traffic system in our country.

- ছোট ছোট গাড়ির অংশগ্রহণ বেশি,
- Line base এ চললে অনেক space নষ্ট হয়,
- Right turn বাধা নেই; Left Run বাধার মধ্যে না;
  একটা junction পাশেই থাকে।



Left Run

Road traffic system:-

Complex interaction of -

— Road —

— vehicle —

\# আসাকে বলে → approach

যাওয়াকে বলে → Exit [বেশি হতে হবে approach থেকে]

~~[illegible]~~ — Foothpath/ Shoulder

— Embankment (Flood এর জন্য করা হয়)

= Floodplane

\# রাস্তা বানাতে Highest Flood Level জানতে হবে।

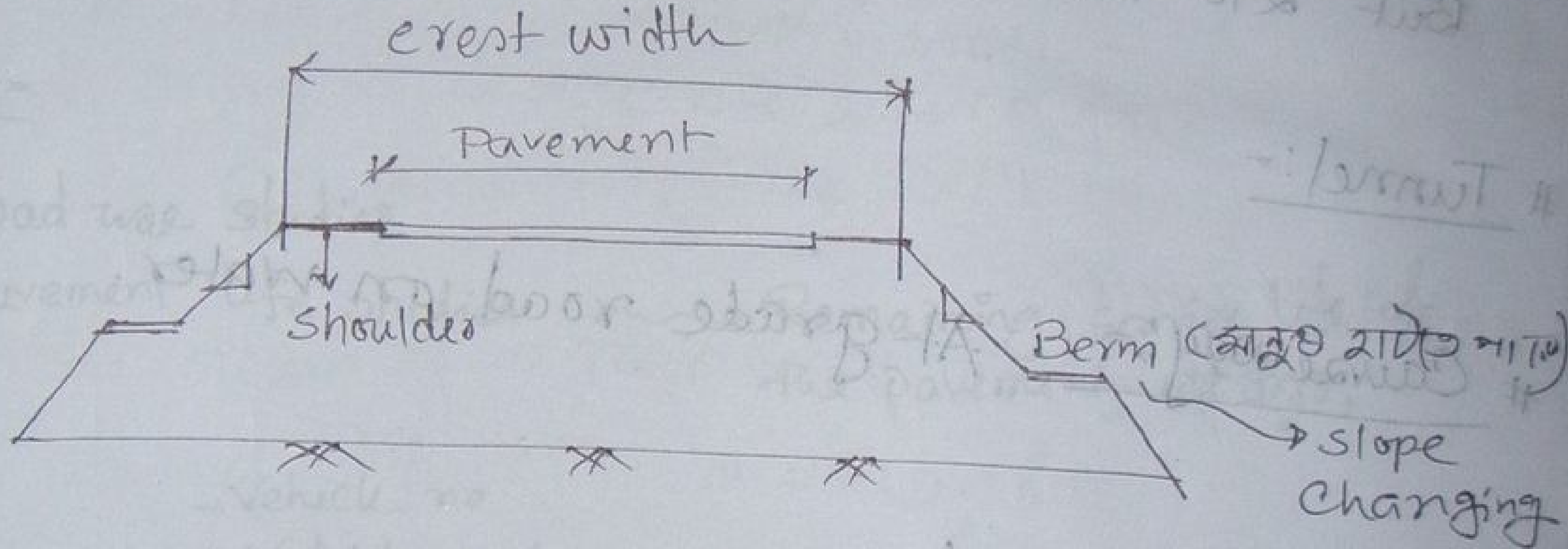
— 88 এর বন্যায় হয়েছিল।

— বাংলাদেশে রাস্তা বানাতে cost বেশি। Embankment বানাতে হয় এজন্য।

— cross drained structure দিতে হবে, পানি নিষ্কাশনের জন্য। Culvert / Bridge

Culvert → শুধু পানি যাবে (Launch/Boat যাবে না)

— slope দিতে হবে।



একটা slope হলে stability কম হয়, তাই Berm দেয়া হয়।

* Grade separated elements:-

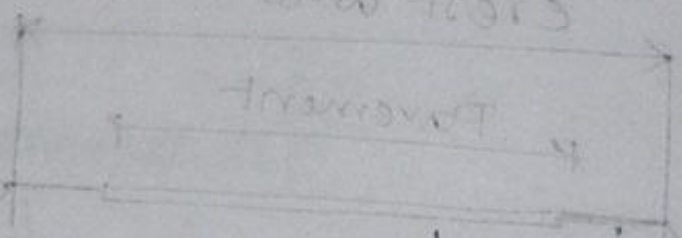
— Overpass
— Underpass

— col^m support পানির মধ্যে থাকলে → Bridge
— Viada → Bridge কিন্তু support মাটির মধ্যে থাকবে।

Interchange → আন্তঃ উপরে যাওয়া
Road seperate করা হয়।

Right turn → 90°
But 270° turn নিলেই left turn হয়ে যাবে।

Tunnel :-



Causeway :- At grade road on water.

For stationary traffic :-

- Bus lay / ~~bipoo~~ Pull out
- Parking areas

18/08/2014

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Lecture:- 3

Possible Data Sources for Desk Study of Highway Locations:-

① Engineering Data
② Environmental Data
③ Social Data
④ Economic Data.

Survey:-

— Road use studies
— Pavement life studies ~~ Remaining service life of the pavement বের করে,

- Vehicle no
- Vehicle volume

\# Daily traffic
\# Anual avg. traffic
↳ station use করি,

① Counting station
  - Coverage station (2-5 sites)
  - Control station (7 days counting) → AADT বের করে,

\# Automatic counter
- কখনো কখনো manual counting করতে হয়,
  ↓
  checking (machine ঠিকমত কাজ করছে কিনা)

Travel Survey:=

- Trip

(কি mode এ যাচ্ছে, কিভাবে যাচ্ছে)

Household travel survey

- Home interview
- Phone survey
- Mail survey

Roadside survey:=

- 20% sample এ করতে,

কত vehicle এ survey করতে,

Modal survey:=

কোন কোন mode দিয়ে কোথায় চলাচল হয়, Multimodal এ চলে,

Goods transportation survey:-

survey → studing area কে Define করা,

↓

Cordon line / Cordon Boundary

(কোন area কে)

- Area কে আরও ছোট ছোট করা,

* TA2 → Traffic Analysis Zone

↳ Land use এর উপর Depend করে ছোট ছোট

~ BUET, DU → Educational হইবে

~ BUET, New Market → একই Purpose না,

① - Both origin & destination within the studing area.
(Internal trips)

② - Either origin of or destination outside the studing area.
(External Internal trips / Internal External trips)

③ - Both origin & destination outside the studing area.
(Bi-pass) ~ Ctg to Rajshashi যাবে,
But Dhaka দিয়ে যেতে হবে।

19/08/2014

Moazzem Hossain Si

Lecture:=3

Overview of Transportation Systems Characteristics:-

* Transportation systems can be evaluated in terms of three basic attributes:-

① Ubiquity ⟶ Accessibility

② Mobility ⟶ speed & capacity

③ Efficiency ⟶ Capital & cost
Energy consume
Safety

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Lecture no.=4

Road Furniture:-

- Divider ~ (1.5'-2')
- Median
  - ↳ Wider divider
    For multipurpose use
    - Physical seperate
    - Drainage facilities
    - Head light protection
    - Future expansion এর Provision রেখে দেয়া.
    - Right turner থেকে shelter দেয়া for safely turn.
    - Future এ Flyover/উপরে রাস্তা বানাতে use হয়।
- Channel
- Island

Traffic Control Devices :-

- Different signs, signals

Geometric Design of Highways :-

Roadway Classifications

(A) Geographical area
- Rural area
- Urban area
- Sub-urban area
  - ↳ Gradually land এর Density হবে।

(B) Terrain-wise
- Plain/Level
- Rolling
- Hilly/Mountain
  - ↳ আমার freedom নাই আমি কিভাবে বানাবো, terrain নিয়ন্ত্রণ।

(C) Functionwise

— Rural Road
— LGED

(a) National Highways → Total ৪টি রাস্তা (Eight) [N]

(b) Regional Highways → [R]

N1 → Dhaka to chittagong to teknaf.

N2 → Sylhet to Dhaka

N3 →

N4 → Jamuna কে connect করে যে Road.

N5 → Aricha Ghat, tetulia তে চলে গেছে।

N6 →

N7 →

N8 → Padma Bridge যেখানে চলেছে।

Urban Road

— Arteria Road → Bypass road → Origin & destination দুইটি কাছের নাহলে কিন্তু কাছের সর্বো দিয়ে Pass করে,
— Primary Road
— Secondary Road

Mobility Road
Accessibility Road

(D) Standard wise classification:=

- Full access control road (Freeway/motorway)
- Partial access control
- No access control
- Cal-de-sac

⊕ একটি অন্যতম arterial road হিসেবে হবে।

(E) Usagewise

- All purpose road
- Comuter Road → office going & school going যাত্রীদের জন্য।

(Tidal flow operation)

- Driveway → Road adjusting building এবং আরও connecting থাকবে।
- Service Road

25/08/2014
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Lecture - 4

- Traffic analysis zone (TAZ)
  ছোট ছোট Area কে ভাগ করে নিব,
  Uniform Land Use যাতে হয় সেভাবে TAZ

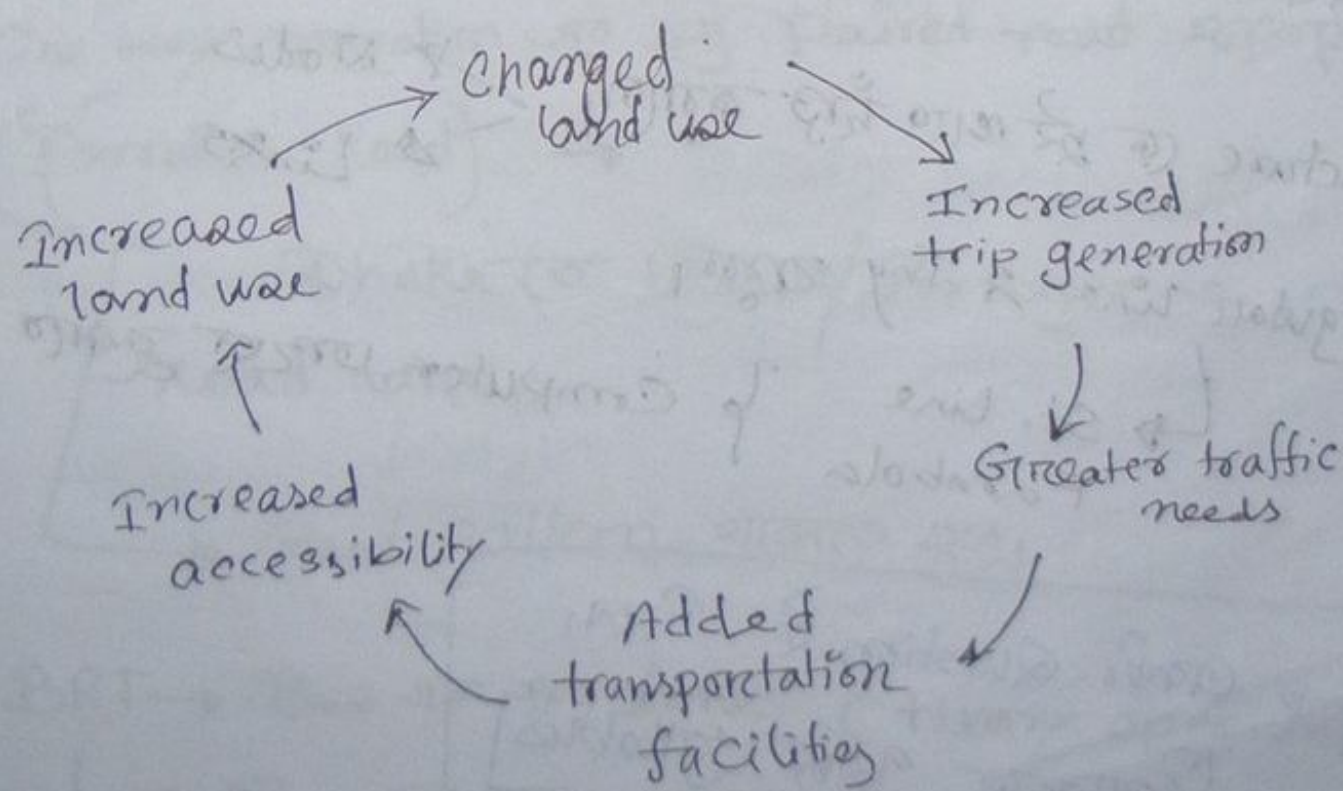
* Peak hour ও Off-peak hour survey থেকে বের করতে হবে,

Transport System Modeling :-

Simple Model
Complicated Model

- Land use এমন ভাবে করতে হবে যেন trip কম হয়,

* Land use Interaction :-



Land use cycle

- Accessibility
- Mobility

The recognized components of Future Travel Demand:-

1. Existing traffic
2. Normal traffic growth → growth in state & regional population → areawise change in land use
3. Diverted traffic → switched to a new facility from nearby road
4. Converted traffic → change of mood (Result of)
5. Change of destination traffic
6. Development traffic
7. Induced traffic → not made but now are because of improved transportation

Basic concepts of in Transportation System Modeling:-

- Purpose → কি উদ্দেশ্যে travel behaviour হবে।

একটি structure কে দুই ভাগে ভাগ করেন, → Nodes → Links

- Regular line এ Try করুন,
  - ↳ St. Line, Parabola } Computer অনেক বুঝতে,

[C/T] → একটি Question ই দিবে।
[আজকের পর্যন্ত Syllabus]

30/08/2014
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Lecture:-5

Even distribution of traffic:-

Load ক চারদিকে distribution করা গেলে road, Over loaded হবে না, Ring Road

(F) Operation-wise classification:-
- Single carriage way road
- Dual carriage way road
- One way → (More benifit)
- Two way
- Tidal flow operation
- Lane/Non-lane

One way operation এর জন্য Paired road থাকতে হবে।
(Parrallel Road) →
Dhaka তে Sikatuli/Farmgate এ one way road তৈরি।
→ Grid pattern থাকতে হবে।

BRT → Bus এর জন্য lane (tirany operation এ)
↳ Bus Rapid Transit

(G) Surface wise type classification :-

- Earthen road
- All weatherend road

(Flexible pavement)
Bituminus Road → Cost কম, light Deflection করে না।

Concrete Road → cost বেশি, Life time বেশি,
(Rigid pavement)
Light Deflection হলে, তবে অনেক দূরেও রাস্তা দেখা যায়।

Bituminus road এর Static load নেওয়ার ক্ষমতা কম। Pavement তখন ভেঙে যায়, তাই Rigid pavement করা হয়, (Toll-plaza, Bus stand ইত্যাদি)

(H) Investment wise classification :-

- Public road (Free)
- Private road — (BOT/BOOT)
↓
Tolled

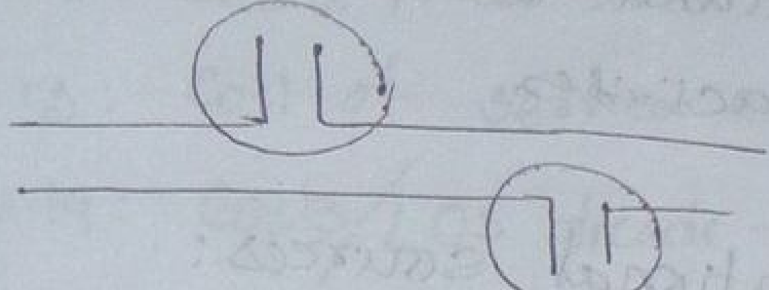
(Build own operate transfer)
BOOT

Road Intersection:-

— Basic form wise

Stagger junction:-

closely T-junction



closely T-junction

→ Stagger junⁿ করতে হয় safety এর জন্য।

Residential Building এর আবাসনে করতে হয়।

Round about:-

police-signal কিছুই থাকে না।

- Trumpet interchange → মাঝিতে থাকে না,
- Diamond interchange

— Operation wise classification

01/09/2014

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Lecture:- 5

Trip generation:-

(i) Intensity of land use

(ii) Characteristics of land use

(iii) Major economic activities

☐ Trip rates from National sources:

☐ Cross classification Analysis:

(*1)

— Home based trip

— Non home based trip

→ (1) Work trip
(2) Shop trip
(3) School trip
(4) Other trips

☐ Regression analysis:-

02/09/2014

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Lecture:-5

Transportation system:-

(Key points)

Key point 11:- Infrastructure shape

Key point 12: Costs, prices & LOS

Key point 13: Cost of service estimation

Key point 14: Costs/LOS trade-offs

Key point 15: Demand consolidation - may reduce costs for like demands.

key point 16: Peaking - design capacity trade off

Key point 17: Diff^{n} time scales - long short, medium & infrastructure plans.

Key point 18 : Equilibrium between demand & supply.

Key point 19: Transport development & land-use relation among transportation, economic development & location of activities.

Key point 20: Performance measures.

06/09/2014

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Lecture:=6

Road-Traffic system:-

Types of vehicles:-

(A) Propulsion force wise

(B) Service wise

└→ Paratransit (taxi)

└→ যে কোন জায়গায় যাও, (Fixed route না) ভাড়া ও fixed না,

(C) Carier wise

(D) Fuel type wise

(E) Maneuvers wise

Cross junction থেকে $4*3=12$ টি maneuvers হতে পারে।

4টা Right, 4টা Left, 4টা Straight

Lane Change:= অন্য গাড়ীকে পিছনে ফেলে নতুন Lane দিয়ে যাও,

Over take:= Lane change করে আবার নিজের Lane এ ফিরে আসলে,

Two successive lane changing maneuvers

⊞ Road Users :=

⊕ Roadway Environment :=

New Chapter

Traffic Characteristics

[এবার উপর থেকে Class Test হবে]

- # Vechicle traffic
- # Pedestrial traffic

Vehicle & human এর static & Dynamic অবস্থায় কতটুকু জায়গা লাগে তা দিয়ে traffic characteristic বোঝা যায়,

Design Vehicle → Virtual vehicle

⊞ Vehicular Characteristics

single axel → একটা wheel একটা shaft
Dual axel → দুইটা wheel একটা shaft
tridem axel

85% লোকের Use করে সেগুলো দিয়ে Design করব,
↳ 100% করব না (Economic না)

Dynamic Characteristics:-

- Speed

(Level of service)

Road width গাড়ীর width ও speed দুটোর উপর নির্ভর করে Design করতে হবে।

Level of service A → 100 , B → 80 , C → 60

Design speed:-

Road width, Curvature

Road users characteristics:-

- Drivers reactions/PIEV Time:-

Thinking time → 2.5 secs (0.5 ~ 4.0 sec)

08/09/2014

Nasib Sir

Lecture:- 6

Trip Distribution:-

A → Matter of attraction

D → Distance

$$T_{ij} = \frac{\frac{A}{D_{ij}^2}}{\frac{A_1}{D_1^2} + \frac{A_2}{D_2^2} + \cdots + \frac{A_n}{D_n^2}}$$

Distance এর চেয়ে Travel time বেশি Important.

K → Socio-economic factor.

Aij → Attaction factor

Fij → Distance factor

Mode Split Methods:-

- Gravity Model → Aggregate model (Group model)
- Non-aggregate model (Individual choice Model)

* Individual choice model এ main part utility fun.

Utily Model → Probability fu^n দিয়ে represent করি.

↓

** logit Model

$$U_{auto} = 1.0 - 0.1(TT_{auto}) - 0.05(TC_{auto})$$

TT = Travel time

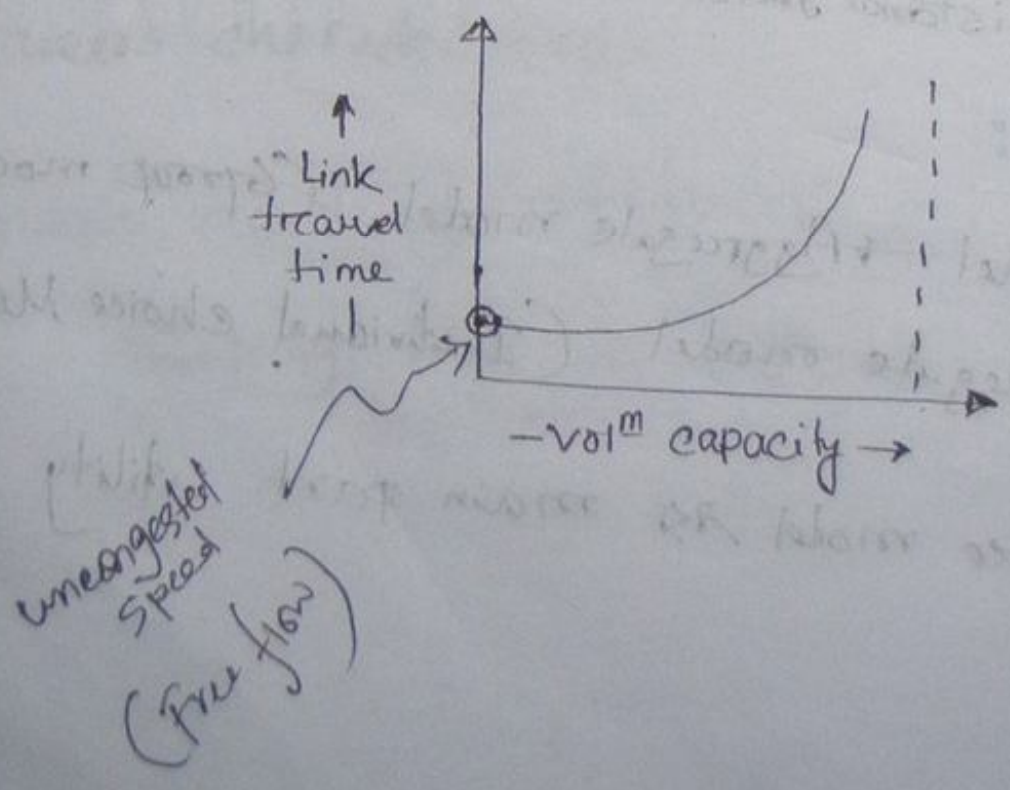
TC = Travel cost

Walk trip → (ছোট দূরত্ব) → সবাই walk trip করতে চায়,
কিন্তু কারো কাছাকাছি হলে walk trip হয়,

Trip assignment:-

Route হচ্ছে small component এর → Link

Travel time is the most important factor



① All-or nothing assignment:-

Short time এ যে Road দিয়ে যাওয়া যায় সেটিই সবাই use করতে থাকে, যতক্ষণ না vehicle congession না হয়,

আস্তে আস্তে সিদ্ধান্ত নেই কোন Route দিয়ে যাব (Stochastic Equilibrium assignment)

Data বেশি থাকলে → Stochastic Equilibrium

Data কম — Capacity restrain

Date খুবই কম — All or Nothing Method.

Date gradually change হয়, Simple Data দিয়ে Model করা যায় না,

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Lecture: 6

Emerging Transportation Technologies:-

* Intelligent Transportation systems (ITS)

(Six sub systems)

- ATMS

  ETC → Electronic toll collection

- ATIS

- AVCS

  AHS → Automated highway system

- CVO

  WIM → Weight in motion

- APTS

- ARTS

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Lecture:= 7

Traffic Studies:-

↳ Need for traffic study:-

TIA / EIA → Environmental impact assistance
↳ Traffic Impact assistance

Rehabitation → Profession change করতে হয়।

রাস্তার LOS কমে যায়, এ জন্য রাস্তার treatment করার হয়, → TIA.

Method of Data Collection & Analysis:-

15/09/2014

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Lecture:- 7

Geometric Designs of Highway:-

Geometric design → Visible

Structural design → রাস্তার নিচের অংশ (Invisible)

Design control & criteria:-

- Topograph → land use, land's pattern
  ↳ অনুযায়ী চলতে পারলে সবচেয়ে ভালো Drainage facility হবে

① Functional classification of roadway:-

- access function ← completely access control
- movement function ← without access control

there are six catagories of LOS

A – Free Flow

B, C, D → Stable Flow

E → Unstable flow

F → Forced flow condition

controlled access highway

PCE → Passenger Car Equivalent

PCU → Passenger Car Unit

Bottol neck → হঠাৎ করে সব গাড়ি এসে পড়লে কেউই বের ~~হবে~~ হতে পারবে না;
(Bottole এ পানির মত)

16/09/2014

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Lecture:-7

ITS subsystems & communications:-

- Travelers
- Centers
- Vehicles
- Roadside

Intellegent Trasport System (ITS) :- Encom passing Emerging Technologies.

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Lecture:-8

#ITS market package.

20/09/2014
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Lecture:-8

Traffic Volume Study:-

Volume/Flow:-

Given interval এ কতগুলো vechile move করছে,

ADT → Avg. Daily traffic
AADT → Annual avg. daily traffic

#DHV:-

Very important parameter.
— Geometric feature কে detect করে,
— Economical hour
(Design Hourly Volume)

Scope of traffic Volume Studies:-

Flow → Scaler value না; It's a vector.

#Design Purpose:-

কত volume নিয়ে design করতে হবে

Methods of Counting :-

Economic feasibility → Cost benifit analysis
Without flow জানলেও economic analysis করা হয় না।

① Mannual counting
(Quality Data কখনোই ensure করা যায় না)

② Indirect Method

③ Automatic counting Method

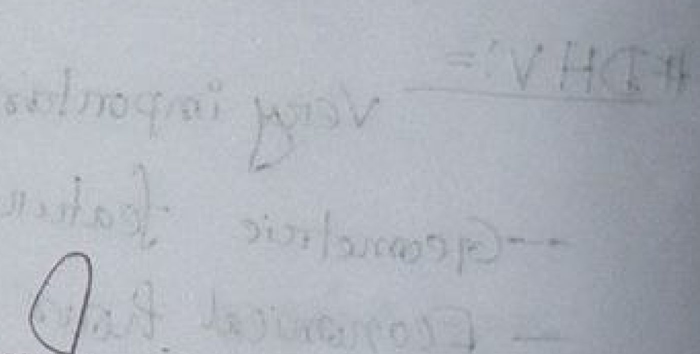
Flow Derivatives :-

LOS → A — Max^m speed এ চলতে পারবে।

LOS → F → worst speed

Free flow :-
Force flow :-
Stable flow :-
Unstable flow :-

Signature curve :-
যেকোনো world এর সব urban এ একই হবে।



Contra flow (Wrong Side এ গাড়ি চালালে)
↳ Question আসবে।
(বাসের জন্য করা হয়)

Road accident এর natural lane change আর wrong side দিয়ে হয়।

18/10/2014
Shamsul Haque Sir
Lecture :- 9

⊞ Traffic Volume Study :-

Flow stable হলে →

Minute → Hour → Day → Week → Month → Year

(Factor গুলা আলাদা হবে)

ϕ O-D survey :-

Bi-pass করার আগে কিনা তা জানার জন্য O-D survey করা লাগবে।

(Matching Regestration)

Tag / Steaker Method

Desire-line graph

ϕ Speed study survey :-

- Economic evaluation এ দরকার হয়,

- Time-mean speed → Arethmatic mean
- Space mean speed → Harmonic mean

↓

Total space কে Total time দিয়ে Divide

- Time mean speed > Space Mean speed

Question এর Data উনি দেবেন নাই

একটা graph paper এ দুইটি graph আঁকতে হবে।

20/10/2014

Hasib Sir

Lecture:- 8

Geometric Design of Highway:-

→ It is proposonic of visible elements
(geometric design)

রাস্তায় যত জিনিস দেখা যায় সব Geometric Design এর under.

Design Speed:-

- Max^m safe speed
- Design feautures govern

Design Designation:-

— Tabulation

Design Hour Volume → 85%.

Design Vehicle:-

- Largest vehicle in significant number.

The highway cross section:-

Limited acess highway:-

Pavement Crowns:-

(Highway এর মাঝখানে উঁচু)

↳ For drainage purpose.

Shoulder:- Lateral strength of pavement

21/10/2014

Muntazim Sir

Lecture - 8

Next week → C.T.

(Slide)

IT Market Package :-

— Transit security
— Transit surveillance

New Technology / Tools -

— GPS
— RFID

(2nd mid Class Test Syllabus)

URBAN Public Transport Technologies

25/10/2014

Shamsul Hoque Sir

Lecture:- 10

Speed study:-

- Spot speed
- Running speed

Methods of speed measurement:-

- Time mean speed
- Space mean speed

Z-test:-

statistically proof করতে হয়,

95% confidence level / 5% satisfiction level / level of significance → 5%

↳ Statistic বইয়ের last এ chart হতে দেখব

Delay study:-

Causes of delay

- Fixed/geometric delay
- Operational delay
- Non recurrent delay
- Recurrent delay

Parking study:-

Elements:-

- Supply ⟶ কতটি parking slot তৈরি হবে।
- Demand

Design vehicle → 85% ~~sto~~ satisfy করবে।

Actual Demand

Strategy charge:-
(Higher than parking charge)

On stream parking

রাস্তার উপরে parking

Off-stream parking

রাস্তা হতে দূরে parking

27/10/2014

Hasib Sir

Lecture:- 9

Curbs:-

- Barrier Curb
- Mountable Curb

Road Alignment:-

Horizontal & Vertical allignment—

Curves:-

(Xm-এ আসতে পারে)

Degree of curvature:-

unit- মনে রাখতে হবে।

Circular curve:-

Superelevation of curves:

f - side friction factor (Rough surface করা হয় ↓ এজন্য আওয়াজ হয়)

আমরা formulae মুখস্থ করব,
(Table/Graph এগুলো দিয়ে করব না)

Max^m value → উপরের দিকে যেতে পারবে না; Round up হতে [illegible] দিবে।

Transtion Run-off:-

Super elevation দেয়ার জন্য যে Distance.
↳ Length of transition Curve

Spirals or transition Curves:-

Transition ~~run~~ run-off ও length of transition curve যে
যেটা বড় সেটা আমরা use করব।

3 ভাগে Pavement কে super elevation দিতে পারি।

Widening of Curves:-

Effective width বেড়ে যায় → Curve ত

Vertical Curves:-

(formulae)

Sight Distance:-

Driver যতদূর পর্যন্ত দেখতে পায় তা।

① Stopping
② Passing
③ Horizontal

→ Perception, reaction distance
(2·5 secs)

→ Breaking distance

$$d = \frac{v^2}{2fg}$$

Grade থাকলে;

$$d = \frac{v^2}{30(f \pm g)}$$

উপরের উঠলে কমবে
নিচে নামলে বাড়বে

Measuring Stopping - Sight Distance:-

Minimum passing sight distance/overtaking distance:-

→ Bangladesh এঃ concept এ কাজে হবে,
(Diff^x image হবে)

Horizontal sight Distance:-

01/11/2014

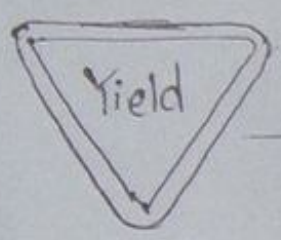
Shamsul Hoque Sir

Lecture:- 11

Traffic Signs:-

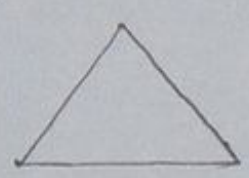
① Mandatory Signs :- (Shall follow / have to follow)

- Regularity
- Prohibitary



→ আগে যেতে দিন

② Warning Singsi- (Should follow)



→ Upper triangle
↓
Signs

③ Informatory Signsi-

Rectangular Signs

VMS

Road Markingi:-

- continuous message বোঝাতে ব্যবহৃত
- Thermo plastic cement paint দিয়ে painting করা

ডঃ → Very expensive

- # General requirements (Traffic Control Devices)
- # Road Sign
- # Road Marking

C.T. (Next week)

Yellow Marking → Restricted vehicle
White Marking → Moving vehicle
White & Black → Pedestrian

Traffic Signals:-

- Guard requirements (Traffic Control Devices)
- Road sign
- Road Marking

Yellow Marking → Restricted vehicle
White Marking → Moving vehicle
White & Black → Pedestrian

Traffic Signals

08/11/2014

Dr. [illegible] Hoque Sir

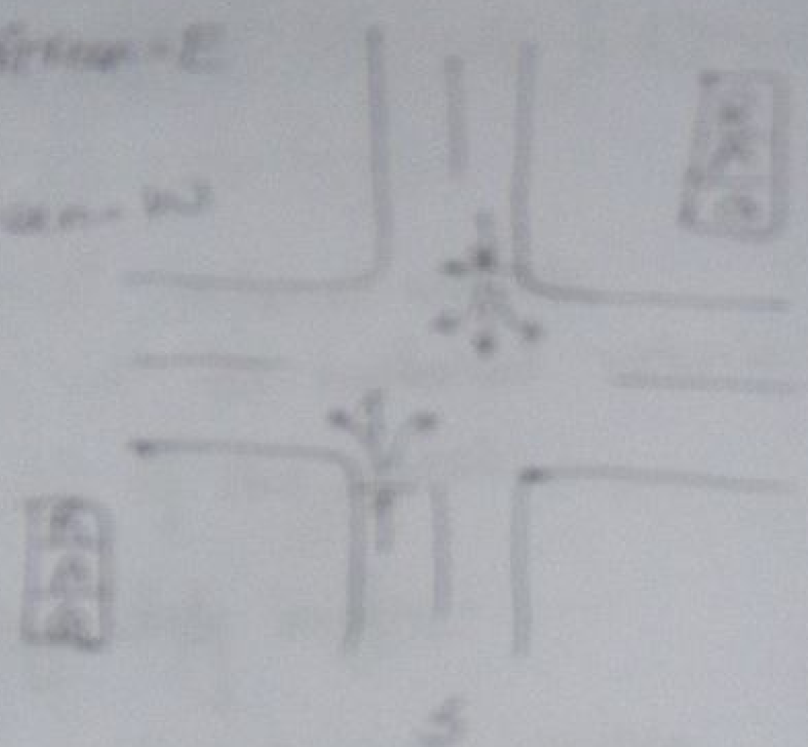
Results :-

Phase 1

N→S ; Green = E

Phase - 2

E - W ; Green - W



Amber time :- (3 secs)

Jam's specific parameter

Cycle time :-

All red :-

[illegible] [illegible]? → junction [illegible] wide [illegible]

[NMV] → Non motorized vehicle

junction clear [illegible] entire time [illegible]

Inter-green :-

Min^{m} 3 secs (For amber)

Green time + Amber time = Effective green time +
2 * lost time.

10/11/2014

Hasib Sir

Lecture:=

Planning & Design of Bicycle facilities:-

Bicycle facility planning:-

- Vol^m of motorized vehicle
- Vol^m of non-motorized vehicle
- Diff^r of the speed

ADT → Avg. daily traffic

facilities for non-motorized vehicle:-

Vurnable ~~rto~~ users → Pedestrians, bicycleist.

Pedestrian, rickshaw → 70% trip (নং,

Vehicle → 6 LOS

Pedestrian → 7 LOS

Intersections :-

যেখানে ২'টি রাস্তা meet করে;

Islands & channels :-

① Directional

② Divissional

③ Refusional

Size → Min^{m} 75ft^{2}

Triangle → Arm 12ft ~ 15ft

Rotatroy Intersections :-

(Circular flow) →

* Circular islands

→ ① Advantages

② Disadvantages

Grade separations :-

Interchange বানাতে হবে,

(Figure আঁকতে (দেয়) → flow directions দিতে হবে ঠিকভাবে,

~~রাস্তার~~ Number বসে

Volume বসে,